PROCEEDINGS

SCIENTIFIC RESEARCH RESULTS

FOR TRAINING

KIEN GIANG UNIVERSITY

PROCEEDINGS
SCIENTIFIC RESEARCH RESULTS
FOR TRAINING

SCIENCE AND TECHNICS PUBLISHING HOUSE

PREFACE

Implementing The Party and The State's policies on comprehensive and fundamental Vietnam's educational system reformation, including education at university level, Kien Giang University organizes The International Scientific Workshop on "*Scientific Research for Training Assignment*" in Kien Giang Province, Vietnam on December, 22nd 2017.

The Workshop aims to facilitate exchanging and sharing experience of scientific research assignment and to publish the results of typical research in a variety of fields in order to create a relationship between scientists and enterprises or organizations whose needs are the application of scientific achievements.

This workshop will serve, directly or indirectly, for training assignment, the development, and the supply of high-quality human resources in the future for Kien Giang Province, Mekong Delta Area as well as the whole country in general. This workshop also confirms the significant role and position of the scientific and technological activities in universiies.

The workshop is a multi-branch forum with the participation of leading experts and academic administrators. More than 90 discussion articles, scientific reports specialized in the fields of Engineering - Technology, Natural Sciences and Economics – Human Society have been attracted. In those, 53 articles have been selected to be published. With knowledge, practical experience and dedication to science, the authors provide their readers with highly valuable insights, and abundant material resources in scientific fields for training assignment in universities.

From the sense above, the proceedings "Scientific Research Results For Training" was compiled and published with the aim of reference material provision in scientific research activities to the readers, which supports to improve the quality of teaching at university in Vietnam in the future.

Due to the shortly time for editing, mistakes are ineluctable. Readers' sincere comments are welcomed by the Editorial Board.

On behalf of the editorial board

Assoc. Prof. Dr. Thai Thanh Luom

INDEX

PART 1

ENGINEERING AND TECHNOLOGY

ECOSYSTEM SERVICES VALUATION AND ECONOMIC APPROACHES FOR INTENSIVE SHRIMP ASSESSMENT IN KIEN LUONG DISTRICT, KIEN GIANG PROVINCE

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ABSTRACT

In the context of strong conflicts among rice farming and brackish aquaculture in the coastal zones, managers ought to make optimal decisions after carefully considering many aspects including economy, environment, society and even potential hazards when land use type will be changed. This research supplies a support tool to consider what issuitable agriculture model basing on economy, opportunity choices and ecosystem services value. Social economy surveys are the major data source that performed at intensive shrimp house holds via designed questionnaires in Kien Luong district; after that ecosystem services were quantified using the values of Fixed Costs (FC), Variable Costs (VC), Opportunity Cost (OC), productivity and selling price of shrimp. As a result, some characteristics of the intensive system in the research area are detected that the model has just transformed from extensive system for 10 years, so majority farmers' experience from 5 to 10 years and that is accumulated by their own experiences or neighbor sharing each other. While Duong Hoa and Hoa Dien common with Litopenaeusvannameiin intensive, Hoa Dien have a large number area of Penauesmonodon. For intensive farming, VC accounts a considerable part in total costs in which the majority investments are aqua-feed, medicine and energy for water-fan engines. Although EVP ofPenaeus monodon in BinhAnis about 8,057.8 USD/ha/year, which is smaller than this value for Litopenaeusvannamei in Duong Hoa and Hoa Dien about 8 times, farmers can earn profits basing on this model. Moreover, the research also detects that comparing to hireout farmers' land to others, intensive shrimp is still an effective model for the local shrimp farmers, although intensive shrimp implies much risks and challenges.

Keywords: aquaculture, ecosystem services, economicefficiency assessment, intensive culture, Litopenaeusvannamei

1. INTRODUCTION

1.1. Background

Aquaculture: In the Lower Mekong Delta (LMD), aquaculture plays a vital role andcontributesthe largest volume and value to Vietnam's aquaculture production (Ministry of Fisheries & The World Bank, 2005). That is a reason why aquaculture area in the LMD has been increased continuously since the year of 2000 by the Government's decision number of 09/2000/NQ-CP. Due to this decision, the area ofineffective agriculture land can be converted tobrackish aquaculture in the coastal zones, in which Ca Mau, Kien Giang and Bac Lieu are the provinces with the most converted area. In these regions, the traditional aquaculture systemsare generally extensive-improved shrimp and rice-shrimp rotationfarming to rear Penaeus monodon; butnowadays some innovative models (i.e., intensive, semi-intensivefarming and rice-shrimp rotation) are beingcommon trendsin SocTrang, Ben Tre, Bac Lieu, Ca Mau and Kien Giang province. Ca Mau and Kien Giang are the two provinces with the most brackish aquaculture area,

thus the export value of brackish aquaculture is also higher than these values in other provinces. However, aquaculture sector in general is facing to many problems, especially the farmers are not profitable due to the low selling price of raw materials and high production costs on intensive shrimp (Viet, 2013). In Kien Luong district (Kien Giang province), the area of brackish aquaculture land is approximately 13,069 hectares in 2014, that increasesby 3,626 hectares comparing to the year of 2010(Fig.1-[3]). These brackish aquaculture regions were converted from triple or double rice crops in the context of the low rice's selling price while the price of shrimp is extremely higher than rice'smany times. In addition, irrigation systems were plannedcompletely that effectively serve to intensive shrimp and semi-intensive shrimp in Duong Hoa, Binh An, Binh Tri, Hoa Dien and Kien Binh communes (People's Committee of Kien Luong district, 2015).

Ecosystem services (ES): ES are defined the benefits obtained by ecosystems (UN Global Compact and IUCN, 2012). In general, each ecological system supplies numerous ES that exist in complicated relations. Therefore, the inappropriate decisions related to ecosystem that can lead to unpredictable consequences, thus the demand to strengthen the ability to integrate ES in decision-making, that is really essential for managers and decision makers (Thang & Trung, 2012). Additionally, the ES quantification is not only the tool for potential assessment of ancertain ecological system in the decision supports (Loc, Diep, Can, Irvine, & Shimizu, 2017), but it is alsoa novel approach for land price valuation, which shouldbe a powerful reference to evaluate land if the actual transaction price of land on the real estate market is not available (Loc et al., 2016).

This researchaims to describe theses general features of intensive farming about society and economy in Kien Luong district. Especially, integrated approach of economic assessment and ES quantification is a key tool to evaluate the efficiency of intensive culture comparing to another opportunity when farmers decide to rent out their lands to others, instead of cultivating by themselves. The research is really necessaryin the context of agricultural land (e.g., rice fields) and extensive shrimp areas in Kien Luong district, which incessantly converted to intensive shrimp but does not follows the district's planning.

1.2. Research area

Kien Luong district is located in North-West of Kien Giang province, and it belongs to Tu Giac Long Xuyen zone. It is bounded in the North by Giang Thanh district, in the South by Vietnam's sea of Kien Hai district, in the East by Hon Dat district, and the West-Southwest borders on the sea of Kien Hai and Phu Quoc district (Fig. 1-1). The district lies approximately 47,329.12 hectareswith 8 communesincluding 5 inland communes (Duong Hoa, Hoa Dien, Kien Binh, Binh An and Binh Tri) and 2 archipelagoes communes (Son Hai and Hon Nghe), and the district's coastal line is about 30 kilometers (Fig. 1-2). These natural geographic features importantly contribute the development of marine economy, agriculture and brackish aquaculture especially, that are the foundation of economic development in zone level. The total aquaculture area in Kien Luong district is 13,069 hectares (2014) in the communes of Kien Binh (64.3 ha), Binh An (986.63 ha), Kien Luong town (1392.28 ha), Duong Hoa (3046.39 ha), Hoa Dien (3524.46 ha) and Binh Tri is about 4055.52 ha. This research was performed in Binh An, Duong Hoa and Hoa Dien commune where intensive system is a typical model (People's Committee of Kien Luong district, 2015).

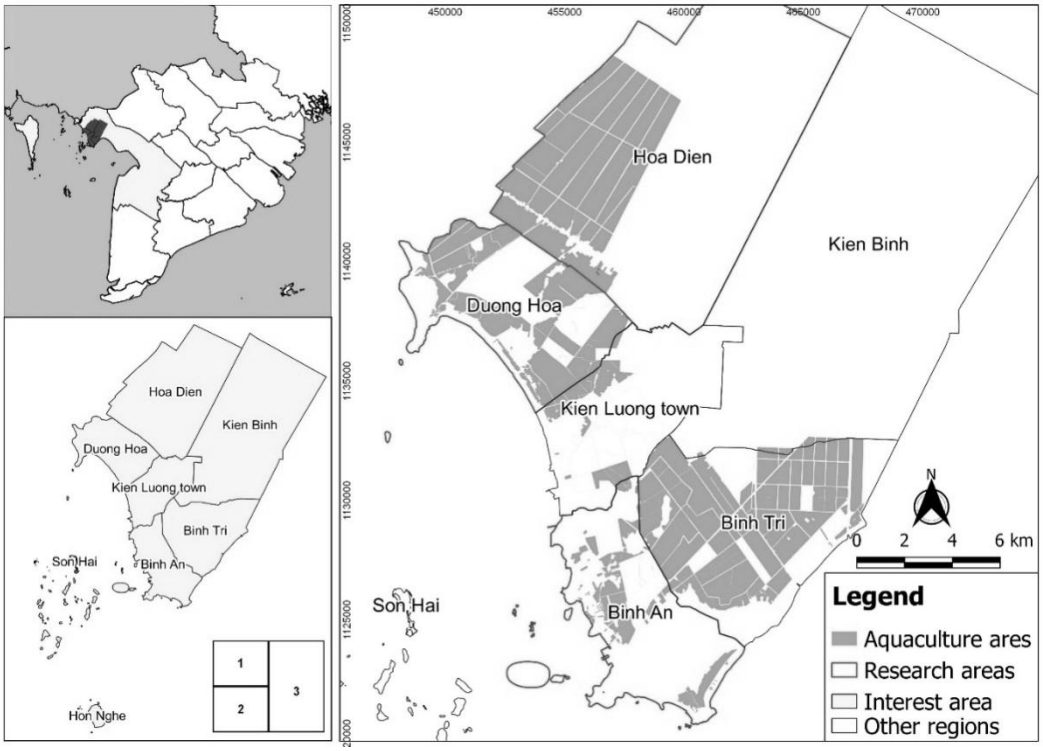

Fig 1. [1] [2] Kien Luong district location and [3] Aquaculture area in Kien Luong district

(Source: Land Registration Office of Kien Luong district, 2016)

2. METHODOLOGY

2.1. Household interview

Interviews were performed at households where they are cultivating intensive shrimp farming (e.g., Penaeusmonodon and Litopenaeusvannamei). The quick interview follows designed questionnaires with four main information categories including (1) general information (name, age, genders, job, education, and experience of the shrimp model), (2) technique in shrimp cultivation (number of pond, water-surface area, density, species and shrimp cultivation calendar), (3) Initial investment costs (digging pond, and investment for machines, electric motor and so on), and (4) season costs/ annual costs and income (pond renovation, energy/electricity, fingerling, food, medical products and yield, selling price of shrimp). For this research, datasetwas analyzed by social-economy survey in the year of 2015 in Kien Luong district, KienGiang province with 44 scatter household interviews.

2.2. Economic value of ES

Similar to researchof Can et al., (2016), the ES from intensive shrimp can be defined in three values consist of (1) provision value: shrimp – the main product; (2) regulation value: nutritional supply toaquatic plants and plankton (or mollusk) in the neighboring ecosystems via mud in bottom pond and organic residue; as well as (3) support value (e.g., the place where the scientific experiments are concerned).

The value of these ES is estimated in a hypothesis that all non-independent services are in a cycle to produce the final product (Thang & Trung, 2012).

$$EVP = \sum (P * Y - (FC + VC + OC)) \qquad [1] \qquad \text{(Sumarga, Hein, Edens, \& Suwarno, 2015)}$$

With: EVP = Ecosystem services Value Provision

P = Price

Y = Yields

FC = Fixed Costs (The initial investments)

VC = Variable Costs (Season costs or Annual cost)

OC = Opportunity Cost

Fixed costs relates to the concepts of "Time value of money" and "Compound interest rate". Therefore, FC can beconverted from the initial investment in N years to annual value (FC) using the bellow formula:

$$FV = PV * (1+r)^N \qquad [2] \qquad \text{(Ladue, 1993)}$$

With: FC = Fixed Costs yearly

FV = Future value in hypothesis that saving money in the bank in N year

PV = Present value (initial investment costs)

r = Bank interest rate (assuming interest rate of one year (12 months) of the Vietnam Bank for Agriculture and Rural Development is 6.0% per annum and the bank interest rate remains unchanged throughout the term).

The opportunity cost of an action is what people must give up when they make that choice(Nielsen, 2004), or this is the value of the next best opportunity (Mankiw, 2001). In this research, the OC is defined the second decision if farmersdid not cultivate shrimp, they couldrent outtheir lands to other famers. Therefore, the OC is equal to the leasing price of land in the interviewed site.

In this research, we did not focus on the negative impacts of intensive shrimp on ecological environment (e.g., soil degradation and water pollution), that we have to probably cost more thanbenefits to renovate them returning to the originalvalues. Actually, water pollution from aquaculture production can lead to reduce natural fish resource and the risk of spreading out shrimp diseases (Ngan, Trang, & Trai, 2013).

3. RESULTS AND DISCUSSIONS

Social and technology characteristics of intensive farming

Social information

Genders and Age: Most of interviewees are male (97.7%), because in the Southern LMD's agriculture and aquaculture, males contribute in creating income and improving household livelihood in poor and isolated communities where women's roles are still underestimated (Duc, 2008). Therefore, in our interviews men usually are the respondents while women often refuse the interview with the reason that they do not know clearly about the technique aspects and they are not the directly labors (Fig. 2-a). In terms of age, there are twomain groups which include (1) 30-40 years old (43.2%) and (2) 40-60 years old (56.8%). In general, with these ages, they have enough experienced in shrimp cultivation about techniques, fingerling selection and also diseases control in their shrimp ponds (Fig. 2-b).

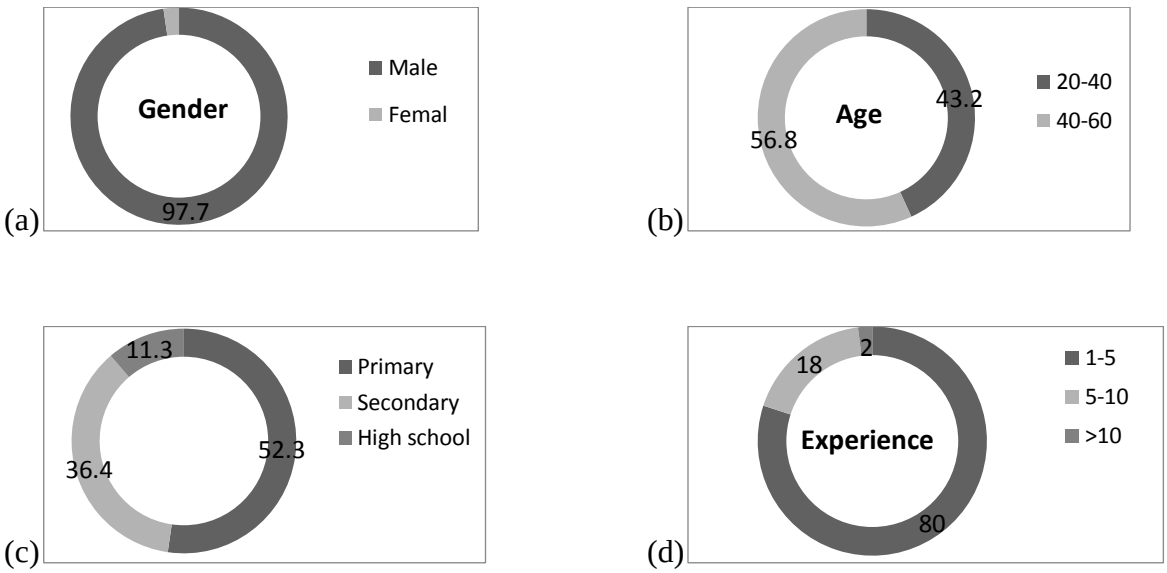

Fig 2. Social information in intensive shrimp

Education: For intensive shrimp, technologyhighly influence on the productivity and efficiency. Education is one of the criteria to evaluate the accessibility of science and technology application during cultivation period. According to survey data, the lowest education level is literacy and highest level is high school graduation (class 12 per total of 12 classes). Most of farmers have education level between primary and secondary school with 52.3% and 36.4% respectively, and minority amount of high school about 11.3% (Fig. 2-c). No farmer has studied in aquaculture course orattended short-term training in aquaculture. This is a main obstacle for farmers rearing in intensive system because it is necessary to applyan advanced techniques or update new technologies, but most of the education level of operators in aquaculture sector in LMD very low, even illiteracy (Luat & Thuy, 2016).

Experience: The same as other shrimp cultivation areas in LMD, cultivation experience of farmers in Kien Luong district is mostly learned from their friends, neighbors, experienced adults, parents or personal experience accumulation (Long, 2016). Kien Luong is the district have just converted from extensive culture system to intensive culture system for a few years, thus the farmers have from 1 to 5-year experience, about 80%. The restshave more than 5-year experience (18% from 5to10 years) and only 2% with more than 10-year experience who have cultivated intensive culture for a long time (Fig. 2-d).

Technique information

Grow-out pond: The amount of ponds basing on the survey data in Kien Luong district is from 1 to 12 ponds, and the available water surface area for shrimp cultivation is average from 0.2 to 1 ha per pond.

Fingerling and stocking density: Fingerlings are reared by two types shrimp that Penaeus monodon and Litopenaeus vannamei. For Penaeus monodon, the stocking density fluctuates from 20 to 70 fingerlings per square meter and they feed from 4 to 5 months until harvest, while the density of Litopenaeus vannameiis double amount of fingerlings comparing to Penaeus monodon (about 70-150 fingerlings per square meter), however, the growing time isearlier than from 1 to 2 months.Based on field survey, Penaeus monodon is a dominant fingerling (about 72,7%) in study area,because farmers can stock with high density and grow shorter time.However, growing time mainly depends on size of shrimp which farmers would like to harvest, if farmers' purpose is bigger size collection, the growing time may be longer.

Cropping calendar: There are 3 main types of crop calendar that are one crop per year and the stocking time is not fixed. For double crops, the first crop begins at January and May for the second one,

each crop is reared in 3 months. When raising period is shortened to only 2 months, farmers can increase to 3 crops per year; the first crop is from January to February, the second one is from May to June and the last one is from September to October. In general, the stocking time of shrimp is in the dry season (Preston & Clayton, 2003), when salinity is stable and easily control, because salinity in pond easily fluctuates during rainy season that is harmful to young shrimp.

Economic informationof intensive shrimp

Fixed costs: The FC include an expense of digging pond and theinvestment of machine/devices which account for more than 70% of total FC. In addition, fixed costs in Binh An commune is 3,576.8 USD/ ha/ year that is lower than FC in Duong Hoa (7,882.7 USD/ha/year) and Hoa Dien communes (10,369.1 USD/ha/year). These costs depend on not only local prices of machines and labor costs but also be determined by model type (e.g., intensive or semi-intensive shrimp). Specifically, Binh An commune is dominant to rear Penaeus monodon which stocks raisingwith low density, thus the expense for electric fan is lowand it does not requires high capacity fan engines. In contract, Litopenaeus vannamei is stocked with higher density than Penaeus monodon and requires to supply more oxygen in culture pondthus farmers keep more electric fan system to supply more oxygen and improve water quality.

Variable costs: Similar to VC, Binh An isa commune with the lowest season costs (about 37,567.6 USD/ ha/ year), and two communes of Duong Hoa and Hoa Dien are two continuous communes with 76,958.7 and 93,126.4 USD/ha/year respectively. The expense of pond preparation, fingerlings, food feeding, electricity, medical products for shrimp and labor costsare total of season cost in which food feeding cost contributes more than 55% of total VC. Besides, the investment of aqua-medicine and power also highly occupy the total expense.

Opportunity cost: The leasing price of land in Binh An commune is about 909.1 USD/ ha/ year that is lower than the prices in Duong Hoa and Hoa Dien communes (about 1,136.4 USD/ ha/ year). Duong Hoa and Hoa Dien is located in the coastal and there is a national road going through the center areas, that benefits for transportation both materials (aqua-feed, devices) and product distribution. Moreover, extensive system is majority culture in Binh An commune so the leasing price of land is also not good as price in the rest communes where a large number of aquaculture areasare intensive ponds.

Income and Profit:

Generally, intensive system supplies high income to farmers with an average productivity of Penaeus Monodon in Binh An commune about 7,733.3 kg/ ha/ year, which is lower than the productivity of Litopenaeusvannamei about 26,536.4 and 32,714.3 kg/ ha/ year in Duong Hoa and Hoa Dien respectively. However, the average selling price of Penaeus monodon is higher than selling price ofPenaeusvannamei (6.5 USD/kg comparing to 4.4-4.5 USD/ kg). An income from Penaeus monodon in Binh An is the lowest with only 50,961.6 USD/ ha/ year while the income from Litopenaeus vannamei in Duong Hoa and Hoa Dien are higher with 118,293.0 USD/ ha/ year and 146,597.1 USD/ ha/ year, respectively. The ordinal of profit is similar to income's ordinal, while profit in Hoa Dien is the highest (43,401.6 USD/ ha/ year), the next commune is Duong Hoa with 33,451.5 USD/ ha/ year and the lowest profit commune is Binh An just 9,817.2 USD/ ha/ year.

Table 1. An average of economic value of intensive culture

Communes	**FC**	**VC**	**OC**	**Price**	**Yields**	**Income**	**Profit**
	USD/ ha/ year			*USD/kg*	*Kg/ ha/ year*	*USD/ ha/ year*	
Binh An	3,576.8	37,567.6	909.1	6.5	7,733.3	50,961.6	9,817.2
Duong Hoa	7,882.7	76,958.7	1,136.4	4.5	26,536.4	118,293.0	33,451.5
Hoa Dien	10,369.1	93,126.4	1,136.4	4.4	32,714.3	146,597.1	43,101.6

**Note: Exchanged rate: 1 USD ~ 22,000 VND*

EVP value

The economic quantification of ecological services for a certain ecosystem not only helps to assess the natural potential of this ecosystem, but also proposes land conversion or land-use decision in the future (Sumarga et al., 2015). In this study, farmers cultivate intensive system in Kien Luong district can get profits and there is not any negative value of EVP, these values meansthatmodelis still an effective aquaculture system in the present background of market, productivity and cultivated techniques. Moreover, current farmers' decision in intensive cultivation is suitable and efficient instead of hiring out theirlands to other farmers. Comparing to the EVP value of rice-shrimp rotationalcrop in An Minh (Kien Giang) that is from 900 to 2,000 USD/ ha/ year (Loc et al., 2017), the EVP value of intensive culture is enormously higher than rice-shrimp rotational crop from 10 to 20 times. This EVP value is about 8,901.1 USD/ ha/ year in Binh An, and 32,315.1 and 41,965.2 USD/ ha/ year in Duong Hoa and Hoa Dien, respectively (Table 2).

Table 2. Ecosystem services value of intensive culture

Unit: USD/ ha/ year

Communes	Min	Max	Mean	Standard deviation
Binh An	599.5	23,540.4	8,908.1	8,057.8
Duong Hoa	8,632.3	103,447.0	32,315.1	25,185.3
Hoa Dien	8,632.3	97,997.6	41,965.2	24,300.5

**Note: Exchangedrate:1 USD ~ 22,000 VND*

Although the potential of intensive culture in economic aspect is detected better than other shrimp model, it also implies various risks regarding to lose incomes. Actually, in the shrimp industry, shrimp farmers are vulnerable respondents because there is no policy relating to the output of shrimp products and farmers have to totally rely on the network of middlemen (i.e., trader) who always try to make use of shrimp farmers in the whole process of shrimp production (Lan, 2013). Additionally, shrimp farmingis also anextremely vulnerable fields and even crop failure that commonly comes from shrimp diseases (Clayton & Brennan, 1999). As a result, the social problems can be occurred in many shrimp cultivation regions, for example, shrimp farmers lose their initial capitals and they become immigrant labors in big cities as another strategy of local inhabitants for securing their livelihoods and risk mitigation (Lan, 2013). That state clearly shows in the Standard deviation of EVP in the study area, the Standard deviations in both Binh An, Duong Hoa and Hoa Dien commune account for over 50% of mean value, about 90.5%, 77.9% and 57.9% respectively, these values illustrate the risk of loss in Binh An commune is higher the risk in Duong Hoa and Hoa Dien. Besides, the value of ΔEVP (i.e., $\Delta EVP = EVP_{\max} - EVP_{\min}$) is always higher than 200% to nearly 300% comparing to the mean value of EVP in per hectare each year, it displaysthe fluctuation of EVP in each communeis extremely big, and that might depends on farmers' techniques and their season costs.

4. CONCLUSION

This researchhas been illustrated insocial economy aspects and ES valuation of intensive culturein specific area, Kien Luong district. In terms of society, this is an intensive zone with majority farmers in low education level (primary and secondary school), and it has just converted to intensive from extensive for 10 years,thus their experience is from 5 to 10 years and mainly learning from own themselves or their neighbors' experience. In Duong Hoa and Hoa Dien commune, the popular fingerling isLitopenaeus vannamei, while Penaeus monodon is widely accepted in Binh An commune. In economy aspects, VC occupies a considerable part in total costs beside FC and OC; And in VC, sub-variable-cost comprise aqua-feed, medical products and energy account for over a half VC's percentage due to the narrow rearing density. The incomes and profits of intensive system are positive and effective; Moreover, these values are even extremely higher than rice-shrimprotation's. The EVP is about 8,057.8 USD/ ha/ year in

Penaeus monodon, and this is actually smaller than the EVP in Litopenaeus vannamei about 8 times (24,000-25,000 USD/ ha/ year). Generally, the economic potential of intensive shrimp is enormously high and it is still efficient in the current background, but this farming model also faces many risks that come from the fluctuated market, unusual weather phenomenon, shrimp diseases and the increase intensive cultivation while lacking of techniques.

5. ACKNOWLEDGEMENTS

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A MACHINE VISION BASED METHOD FOR SHRIMP WEIGHT ESTIMATION

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ABSTRACT

Weight measurement plays an important role in shrimp grading process. In this paper, a machine vision based estimation of shrimp weight using contour area was proposed. A shrimp image capture system was designed which employs back lighting technology using a LED panel. A polynomial fitting was applied to calculate the relationship between the number of pixels inside the boundary contour of shrimp image and the weight of shrimp. The experimental results show that the weight estimation system archives high accuracy and it is feasible to use machine vision technology to measure the weight of shrimps. The proposed method is more accurate and faster than experienced shrimp grading workers.

Keywords: Contour area, Machine vision, Number of pixels, Polynomial fitting,Shrimp weight estimation.

1. INTRODUCTION

Shrimp is very popular seafood in the world. Grading process is very important for increasing the value of this kind of seafood. Traditionally, grading process is conducted manually, which may cause problem such as low efficiency and even bacterial and chemical contamination.

Machine vision has been widely applied for size and weight evaluation because it is nondestructive and highly efficient. In agriculture and food industries, this technology has been used to determine the size of seeds (Granitto *et al.*, 2005), and beans (Boyaci *et al.*, 2005), and to grade apples (Menesatti *et al.*, 2009). Through image analysis and machine vision technology, key sizes orback area of pig could be obtained (Zhuo *et al.*, 2013). Fish features were recognized based on image analysis, including fish length (Dunbrack, 2006). The weights of different forms of whiteshrimp and visual quality were determined by machinevision (Luzuriaga *et al.*, 1997). Image analysis was also utilized to evaluate carapace length of shrimp (Harbitz, 2007).

The goal of this paper is to demonstrate that the pixel areas of shrimp can be measured automatically using machine vision technology and they can provide a precise estimation of weight.In particular, the number of pixelsinsidethe body shape of shrimp image was obtained using contour detection algorithm. The relationship between the weight of shrimp and the pixel area of shrimp image was estimated by polynomial fitting method. The weight of shrimp was predicted from the number of pixel inside the boundary of shrimp image by employing this relationship.

2. PROPOSED SHRIMP WEIGHT ESTIMATION METHOD

The proposed method for weight prediction is based on the body area of shrimp. In particular, the number of pixels of the shape of shrimp image is acquired using image processing algorithms. Then the weight of shrimp is estimated from thisbody area of shrimp.

a. Machine vision system

A structure of a shrimp image capture system is shown as Fig.1. The system consisted of a LED (light emitting diode) panel and CCD (charge coupled device) camera. The area of LED panel is 200 mm x 200 mm. The weighted shrimp is placed on the top of the LED panel. The camera is installed at the center of the system, about 30 cm above the LED panel. Images is acquired by the camera and transmitted into a computer. In there, these images are processed by image processing algorithms to get the area of the boundary of the weighted shrimp. The resolution of captured images are 2500 x 2000 pixels.

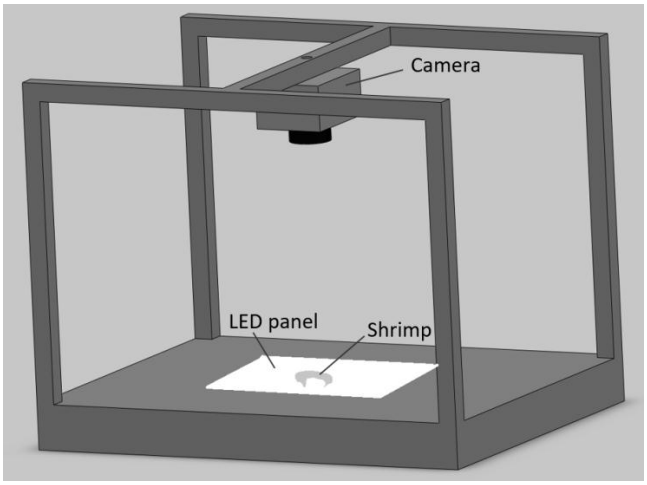

Fig 1. Machine-vision-based weight estimation system

b) Boundary detection algorithm

Boundary detection algorithm is employed to yield the body shape of shrimp in captured image. To obtain the area of the body shape of shrimpimage a few image processing steps are used. The origin RGB format of a captured image (Fig. 2) is converted to a grayscale format (Fig. 3). In order to remove the noise around the shrimp body, a closing and a Gaussian blurring operations are conducted for image smoothing (Fig. 4). Then, a threshold is applied to transform the smooth image into a binary image (Fig. 5). Next, a contour detection is used to obtain the boundary of the body shape of shrimp (Fig. 6). Finally, the area of the body shape are estimated by counting the number of pixels inside the detected boundary.

Fig 2. Original image

Fig 3. Grayscale image

Fig 4. Smooth image

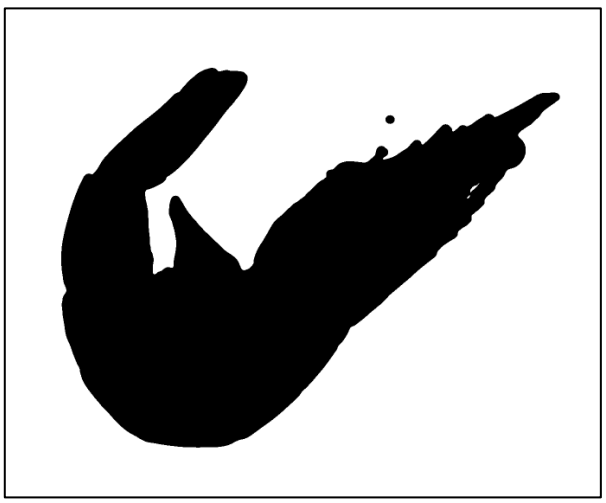

Fig 5. Binary image

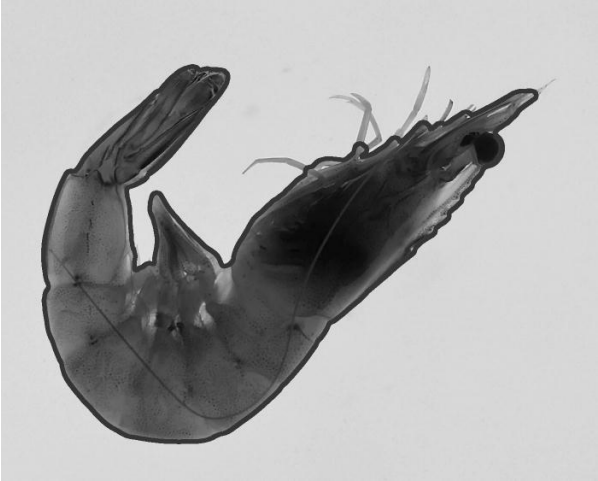

Fig 6. Boundary contour detection

c) Weight estimation

The weight of shrimp is estimated based on the relationship between the weight of shrimp and the area of the body shape of shrimp image. In order to yield this relationship, the precise weight of shrimp is acquired, and the number of pixels inside the body shape of shrimp image is collected, respectively. From these data, the relationship between real weight of shrimp and the area of shrimp image is calculated by curve fitting method for the follow polynomial function.

$$w = p_0.a^2 + p_1.a - p_2 \quad (1)$$

Where w is the real weight if shrimp and a is the number of pixels inside the boundary of shrimp image.

3. EXPERIMENTAL RESULTS

Fig 7. Precise weight of shrimp

All experiments of the proposed weight estimation system used shrimp samples which have the weight being in the 2 – 20 g range. The wet weight of shrimp was determined using an electronic scale (to an accuracy of 0.0001 g - Fig. 7). The number of pixels of the body shape of shrimp image was calculated

from the detected boundary contour in the shrimp image.

Table 1. Collected data of the weight of shrimp and the boundary area of shrimp image

Exp. No.	1	2	3	4	5	6	7	8	9	10
Weight [g]	2.2413	2.6672	3.0022	4.4864	5.3621	10.6923	12.2077	12.5795	19.9401	20.5073
Boundary area [No. of pixel]	97901	116752	127755	177782	201887	316455	344614	350202	477588	504952

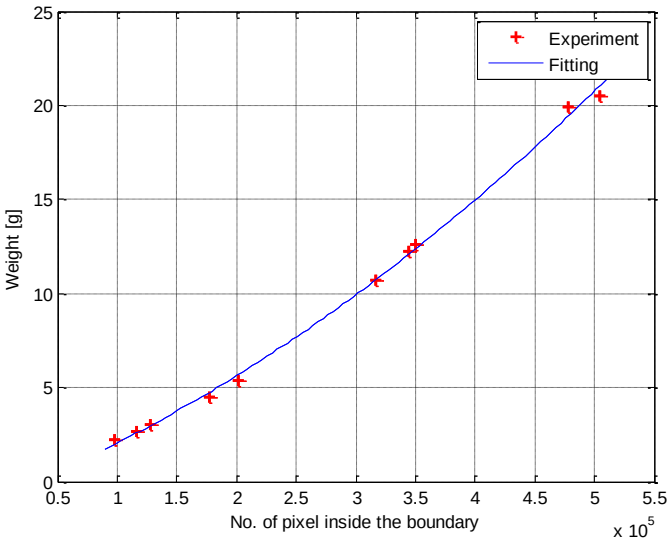

Fig 8. Polynomial fitting result

In order to obtain the coefficients of the polynomial function which describes the relationship between the weight of shrimp and the area of shrimp image, in this study, we selected 10 data samples as listed in Table 1. Using polynomial fitting method based on the collected data, the coefficients of the polynomial function are obtained: p_0 = 3.687e-11; p_1 = 2.4621e-05; p_2 = -0.7712. The result of polynomial fitting is shown in Fig. 8.

Table 2. Experimental results

Exp. No.	1	2	3	4	5	6	7	8	9	10
Real weight [g]	2.1653	2.4652	2.7556	5.1786	6.4622	10.1984	12.6529	13.4683	19.9227	20.7814
Boundary area [No. of pixel]	102451	111657	122341	187542	219883	306447	354762	372341	485663	501121
Estimated weight [g]	2.1383	2.4376	2.7928	5.1431	6.4252	10.2364	12.6038	13.5079	19.8830	20.8260
Error [g (%)]	0.0270 (1.25%)	0.0276 (1.12%)	0.0372 (1.35%)	0.0355 (0.69%)	0.0370 (0.57%)	0.0380 (0.37%)	0.0491 (0.39%)	0.0396 (0.29%)	0.0397 (0.20%)	0.0446 (0.21%)

The proposed weight estimation method was evaluated by performingvarious experimental samples. Table 2 shows results obtained from 10 experiments. The experiment results show that the maximal error of the proposed weight estimation method is 0.05 g and the accuracy archives 98.75%.

4. CONCLUSION

A weight prediction method for shrimp was designed, which includes image segmentation and polynomial fitting approaches. This system was tested to have an accuracy rate of greater than 98%. In this system, the contour detection algorithm plays an important role in the accuracy of the estimated weight. The experimental results demonstrate that it is feasible to use machine vision technology to measure the weight of shrimps. It is more accurate and faster than experienced shrimp grading workers.

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EFFECTS OF GELATIN, SORBITOL, MODIFIED STARCH ON THE GEL STRENGTH OF HAIRTAIL SURIMI *(TRICHIURUS HAUMENLA)*

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ABSTRACT

The results obtained indicate that the folding grade of hairtail surimi were rather stable at different additive concentrations. At the optimal concentration of additives (3.0% modified starch, 4.2% sorbitol, 0.74% gelatin), the gel strength value were increased from 332 g.cm to 867 g.cm, *higher than 2.61 times with control sample.*

Keywords: surimi, hairtail, Trichiurus haumenla, imitative products, gel strength

1. OVERVIEW OF RESEARCH PROBLEMS

In recent years, surimi industry has made remarkable achievements in our country, has expanded scale and production capacity, domestic consumption and export market continously increased. In the coming years, one of the main research goals is to enhance the scientific and practical application in order to improve the quality of surimi and imitative products for major export markets such as Europe and Japan.

In our country, hairtail fish is one of the main raw material for surimi production because of high harvest and common use in surimi and imitative products. Due to softening and gapping texture of muscle protein of the hairtail fish, gel strength, toughness of surimi fish and imitative shrimp were low, there is a need to study on washing, mixing additives to improve the elasticity, toughness, gel strength of surimi and surimi shrimp product.

Modified starch technology is quite new technology, that continue developing. Application of modified starch in surimi and imitative shrimp is at the beginning and has achieved success in improving elasticity, toughness, gel strength of surimi and surimi-based products. However, in our country and over the world, the use of modified starch in surimi and surimi-based products is uncommon. In addition, there are insufficient scientific data about using modified starches (cross-linked phosphate) in surimi production and imitative shrimp from hairtail and the effect of modified starch (phosphate cross-linked) was not investigated on product quality of surimi shrimp during frozen and heating. The aim of the research is to provide new technology solutions in manufacturing surimi and imitative shrimp in Vietnam.

2. MATERIAL AND METHOD

2.1. Material

The object of the research is hairtail fish: Order: Perciformes; Family: Trichiuridae; Genus Trichiurus; Species T. haumenla. Hair-tail fish is caught in Khanh Hoa with the body length from 50 - 60 cm, 350 - 400 g/piece, raw fish meets in accordance with Vietnam standard TCVN 3215:1988.

Fig 1. Trichiurus haumenla (PorssKal, 1775)

2.2. Method

In this study the traditional and modern methods such as measuring food rheology, slicing frozen cells, stereoscopic microscope were used. Besides, experimental planning and Design Expert 6.0 software were used, Unscrambler version 9.1 used to establish the mathematical model and optimize the parameters in data processing.

2.3. Equipment, chemicals, additives for research

- Rheometer, frozen cell slice machine; distillation equipment for protein, stereoscopic microscopes, handle equipment, laboratory instruments;

- The additives used in the study are highly purified, ensuring reliable for analyzing.

3. RESEARCH RESULTS

3.1. Mass and chemical composition of hair-tail fish

Table 1. Mass composition of hair-tail fish

N^o	Target	Ratio (%)
1	meat	40,8 ± 3,8
3	Head	13,2 ± 2,5
4	skin, cartilage, bones, fins	39,6 ± 1,9
5	organs	6,4 ± 2,1

Table 2. Chemical composition of hair-tail fish

N^o	Target	Ratio (%)
1	water	77,98 ± 0,02
2	protein	16,82 ± 0,03
3	Lipid	1,35 ± 0,02

The results showed that hairtail fish consists meat 40.8%, head 13.2%, skin, cartilage, bones, fins 39.6%, organs 6.4%. Chemical composition consists water 77.98%, protein 16.82%, lipid 1.35%. Hairtail is low-fat fish, the flesh is white, so suitable as raw materials for producing surimi. However, fish flesh accounted for only 40.8% of the total weight, lower than that of sardines, horsehead fish. Hairtail fish has the specific structure. Its muscle fibers is quite short and loose that negatively affect on surimi quality, especially elasticity and gel strength.

3.2. Effects of ratio of additives on the gel strength of hairtail surimi

3.2.1. Determination of optimal additive concentration

In order to study the optimum ratio of additives, the thesis utilized Design Expert 6.0 software to analyze many factors to understand the relationship between additives such as modified starch, gelatine, sorbitol with the gel strength of surimi. The optimization results to determine the percentage of additives added to gel strength of surimi are shown in Table 3.

Table 3. The effect of additive concentration mixing ratio on the strength of the surimi

Number of exp		I_1	I_2	I_3	X_1	X_2	X_3	X_{12}	X_{13}	X_{23}	X_{123}	Y_2
Number of exp in 2k	1	2,6	0,6	3,8	-	-	-	+	+	+	-	806
	2	3,0	0,6	3,8	+	-	-	-	-	+	+	852
	3	2,6	1,0	3,8	-	+	-	-	+	-	+	837
	4	3,0	1,0	3,8	+	+	-	+	-	-	-	874
	5	2,6	0,6	4,2	-	-	+	+	-	-	+	842
	6	3,0	0,6	4,2	+	-	+	-	+	-	-	867
	7	2,6	1,0	4,2	-	+	+	-	+	+	-	845
	8	3,0	1,0	4,2	+	+	+	+	+	+	+	859
Number of exp in center	9	2,8	0,8	4,0	0	0	0	0	0	0	0	863
	10	2,8	0,8	4,0	0	0	0	0	0	0	0	860
	11	2,8	0,8	4,0	0	0	0	0	0	0	0	868

Y_2 Gel strength (g.cm)

X_1 ratio of modified starch concentration on gel strength of surimi

X_2 ratio of gelatin concentration on gel strength of surimi

X_3 ratio of sorbitol concentration the gel strength of surimi

The effects of additive concentration on the gel strength of surimi are shown in regression equation:

$$Y_2 = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_{12}X_1X_2 + b_{13}X_1X_3 + b_{23}X_2X_3$$

Solving the experimental planning problem using Design expert 6.0 software for the results shown in Table 4 and Figure 2.

Table 4. Results of ANOVA analysis on gel strength of surimi in accordance with the rate of mixing of selected additives

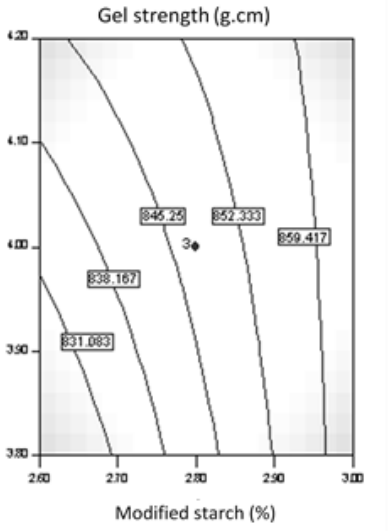
Gel strength	Coefficient	Prob>F
Modern		0,005 (significant)
Constant	+847,75	
X_1	+15,25	0,001
X_2	+6,00	0,015
X_3	+5,50	0,018
X_1*X_2	-2,50	0,123
X_1*X_3	-5,50	0,018
X_2*X_3	-7,25	0,008
R^2	0,989	
R^2 adjust	0,968	
Lack of fit		Not significant

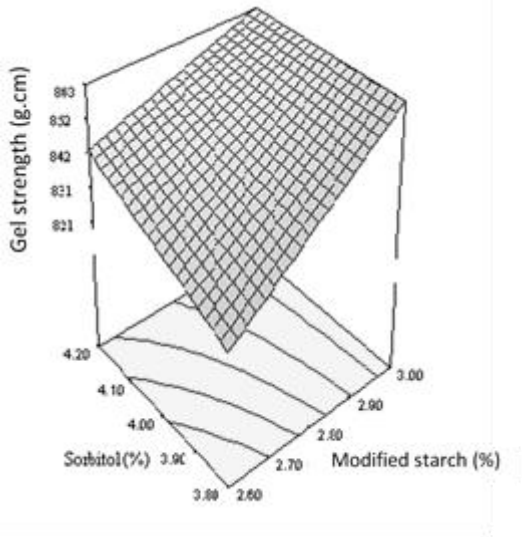
The results obtained in Table 4 are based on the Prob > F value of the model with a value less than 0.05 and the incompatibility of the model is greater than 0.05, retaining the coefficients with the values of Prob > F of the variables less than 0.05, eliminating the coefficients with Prob > F values greater than 0.05, obtained the gel strength of surimi as follows:

The effects of additive concentration on the gel strength of surimi are shown in regression equation:

$$Y_2 = 847.75 + 15.25X_1 + 6.00X_2 + 5.50X_3 - 5.5X_1X_3 - 7.25X_2X_3$$

The regression equation indicated that the gel strength of surimi increased with increasing the additive concentration. The surimi added with modified starch had the strongest effect on the gel strength followed by surimi treated with gelatin and sorbitol.





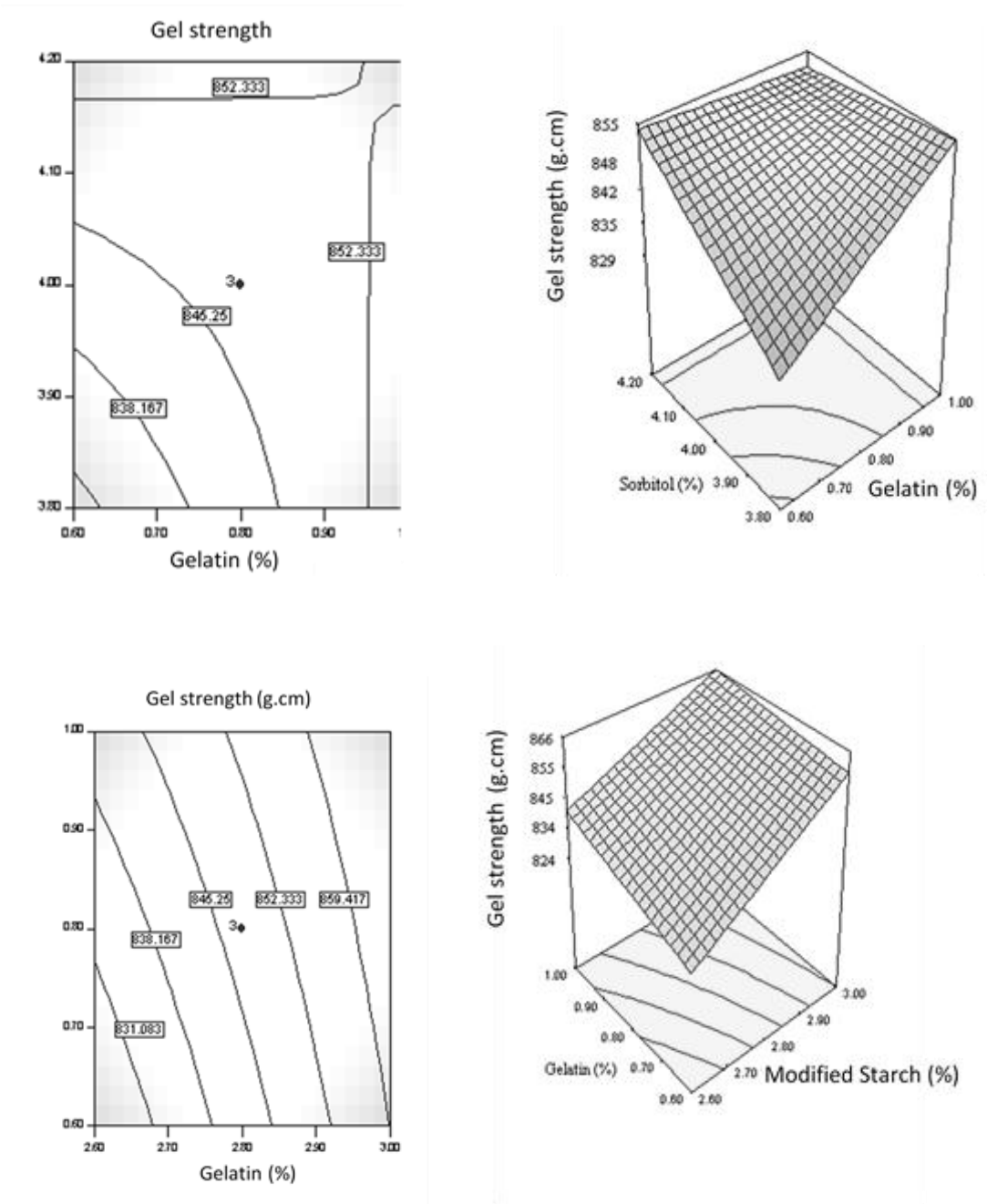


Fig 2. Changes in gel strength of hairtail surimi as functions of modified starch, sorbitol and gelatin concentrations

Based on the results presented in Figures 2, it can be seen that when the percentage of additives added to surimi is reduced, especially the reduction in starch denaturation, Concentration of fish surimi decreased. This result may be explained by the fact that in the structure of denatured starches there are many hydroxy groups and contain phosphate groups which themselves participate in forming hydrogen bonds and linking the polypeptide with the polypeptide chains. As well as polypeptide chain linkage with starch vessels.

Table 5. Results of optimizing percentage of additives added to surimi by regression and experiment

No	Factors			Gel strength (g.cm)	
	X_1	X_2	X_3	Data from equation	Experimental data
1	2,62	0,87	3,88	832,79	831,00
2	2,72	0,70	4,06	339,88	339,00
3	2,99	0,85	3,99	863,27	860,00
4	3,00	0,74	4,20	864,01	866,00

Results of evaluating gel strength of the frozen surimi were shown in Table 5. There is a compatibility between the gel strength of surimi samples calculated by regression equation and experimental results.

3.2.2. Effects of modified starch of the folding grade of hairtail surimi

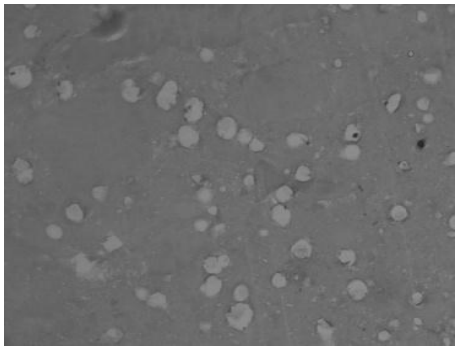


Fig 3. The microstructure of surimi treated with 3% modified starch

The microstructure of surimi was examined by microscope OLYMPUS IX70. Figure 3 shows transverse sections of surimi that has been added with 3% modified starch. It is clearly seen that the added modified starch reacted with water, resulting in removal spaces where the free water was stored in. This led to increase the gel strength, elasticity and folding grade of surimi.

It could be concluded that the optimal additive concentrations in hairtail surimi processing were of 3.0% modified starch, 0.74% gelatin and 4.2% sorbitol.

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AIR POLLUTION IN HOCHIMINH CITY, MODELING AND SCENARIOS TO REDUCE

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ABSTRACT

Modeling air quality is needed to manage and predict air pollution levels in an area. Study results have prepared emission inventory of air pollutants from three main sources (road traffic, industry and domestic) in Hochiminh City. Besides, TAPOM and FVM models were used to simulate the meteorological conditions and air quality in Hochiminh City. Emission inventory results from road traffic show that emission from motorcycles account for a significant amount of total load of pollutant emissions from that source. Simulation results of air quality give better results when using emission inventory with traffic emission factors were estimated in Hochiminh City. In addition, some scenarios to reduce pollution levels in general, especially air pollution from road traffic in particular show that, if reduce 50% of motorcycle volume (private transportation) and increase 10 times of bus volume (public transportation), air quality will more improve and can reduce traffic jam.

Keywords: Road traffic, emission inventory, models, scenarios, Hochiminh City.

1. INTRODUCTION

Air quality model is an important tool to manage air pollution in urban areas. We can use models to predict impacts in the process of urbanization, such as development of traffic network, the location or expansion of residential and industrial areas, etc. Air pollution in Hochiminh City (HCMC) is in alarming environmental issue. In our country in general and HCMC in particular, the studies aim to simulate air quality was initially implemented and achieved some initial results [1,4,5,7]. Typically, there were several research projects at all levels and master thesis. However, one major limitation in almost studies of data on the emission factors (EF) of air pollutants from road traffic was used from neighbor countries. In addition, due to traffic is one of the main sources of air pollution generated in HCMC. So the simulation results of air quality in that studies had more or less limited accuracy. Therefore, in this study, the authors used results of the study estimated air pollutants EF in real conditions of transportation activities in HCMC, so the simulation results of air quality will get more precise.

2. MATERIAL AND METHOD

2.1. Emission inventory for air pollutants

2.1.1. Emission inventory data

The general methodology for preparation of the emission inventory includes three main steps; identify sources, classify sources and calculate emissions. A temporal resolution of 1h is used, and calculations are done for given working day Jan. 19, 2006. As for the spatial resolution, the EI is calculated inside grid used for modeling 35 km by 35 km with 1 km square cells. Three main sources are considered for the emission calculation includes: road traffic, industry and domestic activities. Emission estimations are done for air pollutants includes NO_x, CO, VOCs and SO_2. In particular, the emissions from road traffic activities using two kind EFs data, EFs from China (used before) and EFs determined in HCMC.

2.1.2. Methodology and input data

a. Road traffic source: Traffic emissions are calculated using three main data groups: the georeferenced street network, the fleet composition, and temporal and spatial variations of circulation of this fleet. In this study, we use EFs of air pollutants were developed in real conditions in HCMC by authors [6].

Table 1. Road traffic emission factors in Hochiminh City

No.	Pollutants	MC (g/km.veh.)		LDVs (g/km.veh.)		HDVs (g/km.veh.)	
		In HCMC	China (*)	In HCMC	China (*)	In HCMC	China (*)
1	NO_x	0.05 ± 0.02	0.23	1.9 ± 0.9	3.3	19.7 ± 5.2	6.1
2	VOCs	2.34 ± 1.17	11.8	15.02 ± 7.36	0.5	89.92 ± 33.01	6.69
3	CO	21.85 ± 8.67	17	34.8 ± 15.5	16.1	11.1 ± 5.3	14.96

Note: MC (Motorcycle); LDVs (Light duty vehicles); HDVs (Heavy duty vehicles).

(*): EFs from China (DOSTE, 2001) [5].

b. Industry source: At present, HCMC has about 1,000 plants, factories and more than 33,000 small-scale production facilities handicrafts. In HCMC, the emission calculation of air pollution load based on the emission factors and the production process of industries that can be applied:

$$G_{in} = \Sigma K_{in}. N_{jn} \text{ (g/year)} \quad (1)$$

Which, Gin is emission of pollutant i for sector n (g/year); Kin is emission factors of pollutant i for sector n (g/tons of raw materials or products); Njn is amount material or fuel of factory j for sector n (tons/year).

c. Domestic source: Some main activities generate pollutants such as burning fuel (DO, FO, LPG, coal, etc), building homes, offices (paint and other organic solvents, etc).

2.1.3. Evaluation of the EIs over a specific case study in HCMC

For evaluate two emission inventory results, local scale air quality model was used with purpose to compare the concentration of CO, NO_x and Ozon between results model and measurement. The models TAPOM (Transport and Air Pollution Model) and FVM (Finite Volume Model) developed at LPAS-EPFL, are used for this study. They are three dimensional Eulerian models using terrain following grid and finite volume discretization. Meteorological input data for TAPOM is obtains from the model FVM, whose borders can be forced using wind and temperature fields from large scale model results. FVM includes an urban turbulence model which specifically simulates the effects of urban areas on the meteorology [3,8,10,11,12].

2.1.4. Distribution of emissions by source and region

Emission inventory and distribution of air pollutants emission from pollution sources in HCMC for spatial and temporal by using GIS method. Domain with dimension of each cell $1km^2$ and have 35 cells for x and y direction is used in this study. Distribution the emission for temporal estimated as equation:

$$E_h = E_a * f_a * f_w * f_d /8760 \quad (2)$$

Which, E_h, E_a are emission load per hour and year, respectively; f_a, f_w, f_d are coefficient of emission distribution for each month, hour in day, respectively; and 8760 is total hours of a year.

2.2. Simulation of meteorology and air quality

2.2.1. Select simulation episode

Episode selected for simulation based on several criteria: In the dry season because during that time cloudy sky, appropriate for FVM model; Concentration of primary air pollutants are high and stable in the monitoring stations; Ozone concentration is high in the monitoring stations and often exceed standards. Based on the criteria above, the period chosen for simulation is Jan. 19 - 20, 2006.

2.2.2. Settings in the model

a. Simulation area: To simulate air quality in mesoscale requires precision and resolution of meteorological input data. To get the requirements, FVM model is run by using one way nesting method with 5 domains. Dimension and resolution of domains are selected to simulate meteorology conditions in the study area as follows: Domain1: Dimension 20 x 20 cells, spatial resolution 150km x 150km (covers an area of Southeast Asia and a part of South China Sea); Domain D2: Dimension 20 x 20 cells, 75km x 75km (covers an area of South of Vietnam, Cambodia, Thailand and a part of the South China Sea); Domain D3: Dimension 33 x 33 cells, 16km x 16km (covers an area of the Southern provinces and parts of Central Southern provinces and South China Sea); Domain D4: Dimension 35 x 35 cells, 7km x 7km (covers an area of South Western provinces and HCMC); Domain D5: Dimension 38 x 38 cells, 1km x 1km (Central of this domain coincides with the center of HCMC).

b. Boundary and initial conditions: This simulation uses 6-hourly data from the NCEP/NCAR (2006) reanalysis dataset for its initial and boundary conditions. Data have 2.5 x 2.5 degree global resolution with 17 pressure levels at times 0Z, 6Z, 12Z and 18Z.

c. Topography and land use data: Input data for FVM model also includes topography, land use, characteristics of the soil, roughness, humidity and thermal. All databases are took from USGS with 1km resolution.

2.3. Scenarios to reduce air pollution levels

2.3.1. Emission scenarios

Due to the road traffic is play important source role to air pollution in HCMC in general, so the proposed scenarios to reduce pollution levels from this source is necessary. Two types of transportation special interested are motorcycle and bus. Scenarios to reduce air pollution levels are based on two major criteria: (a) change the number of transportation types and (b) change the type of fuel used.

HCMC has 3.584 streets with total road length about 3.670 km, the area of pavement is 36 million m^2, so the ratio of road area density and city area only about 1.8% (km/ km^2). Area for a motorcycle travel is 7 - 10 m^2, while area of a seat on the bus only 2m^2 area of road. With about 4 million motorbikes will account for approximately 40 million m^2 travel. But, HCMC build a new or adding about 1% of road surface every year. In addition, fuel consumption indicator for a passenger is 0.015 liters/ km when using motorcycles and 0.0044 liters/ km when using the bus. Thus, when used as a means of transportation, motorcycles have fuel consumption higher than 3.4 times of the bus. Therefore, only increase the bus and reduce the motorcycle volumes can solve traffic congestion in the status of the current tight line, save fuel and reduce pollution.

(a). Change the number of transportation types

Some scenarios to reduce air pollution levels from road traffic were proposed as follows:

- Scenario 1 (Scen.1): Reduce 50% of motorcycle volume travel throughout the city at the same time

so the load of pollutants emission from motorcycles will decrease 50%.

- Scenario 2 (Scen.2): Reduce 50% of the motorcycle volume, at that time to fill the demand for travel ½ rest of the people to increase the volume of bus 10 times of the current number. Besides, change small size buses (35-40 seats: B35-B40) for the types are commonly used (55-80 seats: B55-B80). The new size means in accordance with the existing road traffic in HCMC where the whole city has only 14% of the road 12 meters width (convenient for the buses B55-B80), 51% of the road from 7-12m width and 35% of the road width less than 7m. In addition, efficiency buses must be from 80-100% (currently 40-45% for the large buses).

- Scenario 3 (Scen.3): Reduce 50% of the motorcycle volume, at that time to fill the demand for travel ½ rest of the people to increase the volume of bus 5 times higher than the current number. Efficiency buses have at least 80% (currently 40-45%).

(b). Change the type of fuel

Using CNG (Compressed Natural Gas) costs only about 50-60% of the transport than gasoline, oil, but reducing to 35% of CxHy, 60% CO and 10% NOx,... emitted into the environment. With some other benefits such as anti-abrasion, increased engine life, reduced maintenance costs. Comparison with gasoline, motorcycle run on 40% LPG saving fuel costs and environmental pollution levels reduced over 70%.

2.3.2. Support method

Some support methods: Propose to do inspection and control emissions periodically; Encourage, extensive propaganda and strongly in the people about the consequences of the motorcycle explosion; Implement solutions "2 needs" that need a strong method in the general planning, transportation planning and need quick investment for public transportation network;

3. RESULTS AND DISCUSSION

3.1. Emission inventory results

Table 2. Total emission of air pollutants by sources in HCMC

No.	Pollutants	Road traffic (tons/year) [(1)]		Industry (tons/year)[(2)]	Domestic (tons/year)[(3)]
		EI-1	EI-2		
1	NO_x	30,161	33,822	41,310	3,878
2	CO	2,903,064	2.197,008	38,400	358,950
3	VOCs	405,062	931,188	30,900	44,213
4	SO_2	6,422		80,370	7,110

Note: [(1)] EMISENS [2]; [(2,3)] INTEX-B [14].

Table 2 is the emission inventory results from sources in HCMC, which in road traffic source were divided to two columns, EI-1 is used emission factors in HCMC and EI-2 is used emission factors from China. Results of emission inventory show that, when we used EFs from HCMC, emission load of NO_x and VOCs are lower (89.2% and 43.5%, respectively) but emission load of CO is higher (factor 1.32) value when using EFs from China.

3.1.1. Evaluation of the EIs over a specific case study in HCMC

Comparison of simulated and observed concentrations show that ([(CEI-Cob.)/Cob.]%) simulation

results by EI-1 have value is closer to the measurements, especially for CO, presenting an average percentage difference of 20%, whereas for the simulation results by EI-2, the percentage difference presents 35%. For NOx, the percentage difference with respect to observations is smaller for EI-1, although not so different from EI-2 results. This indicates a clear underestimation of CO emissions in EI-2, whereas for NOx both EI-1 and EI-2 generate similar results. The average concentration of Ozone in the simulation episode and the measurement values at HB station show that for EI-1, the percentage difference is about 10%, whereas for EI-2, the percentage difference is about 30%. Therefore, we can conclude that the simulation for EI-1 will get reasonable levels of Ozone.

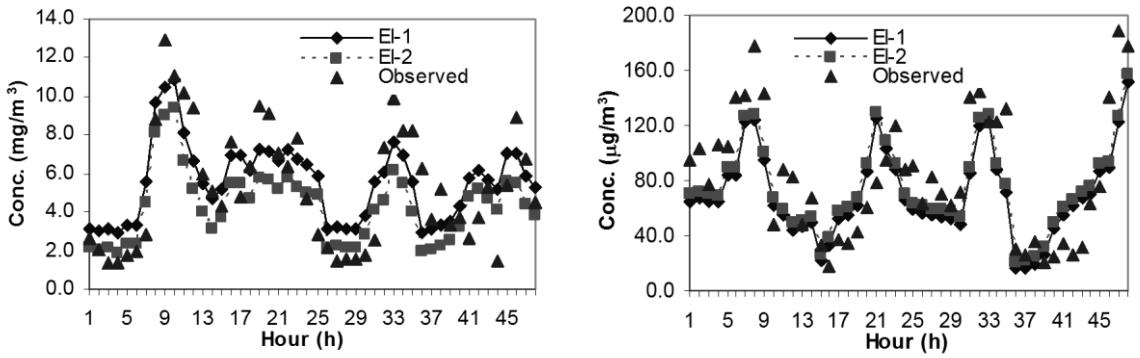


Fig 1. Comparison CO conc. at HB station (left) and NOx conc. at BC (right) on Jan. 19&20, 2006

3.1.2. Distribution of emissions by source and region

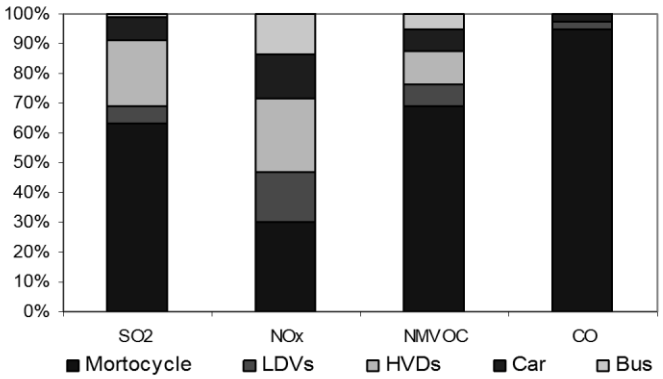


Fig 2. Distribution of the on-road vehicle emissions in HCMC by type of vehicle and by pollutants

The most important contribution of CO, VOCs and NO_x in HCMC is attributed from road traffic.

For SO_2, NOx, CO and VOCs, the 63, 30, 94 and 69%, of the total road traffic emission, respectively, correspond to motorcycles. This result is entirely reasonable that 95% of the total volume of motor vehicles in HCMC is motorcycles.

3.2. Meteorological simulations

3.2.1. Boundary and initial conditions

The model is first applied to a 3.000 km x 3.000 km grid, aiming to generate adequate boundary and initial conditions for our mesocale domain. A very similar behavior of the wind patterns between the two days of the episode in simulated by the model (in range NE to SE direction). From 5h to 12h, the mainly wind direction often between SE and NE directions, similar behavior of the sea wind. From 12h to 14h, as influenced by sea-continental wind so the mainly wind direction is SE.

3.2.2. Mesoscale simulation

Distribution of land use in urban areas in meteorological model is quite complex because they need many information such as density and height building, area of trees and many others information. However, their classification more detailed will get the simulation results closer the measurements. Because the resolution of small domain is 1km x1km to simulate meteorological in mesoscale so they need some corrections for surface data. Databases for the correction is took from USGS and land use in HCMC. Domain D5 is chosen for simulate meteorological as mesoscale in episode of study. Measurement data from Tan Son Nhat (TSN) station was used to compare with the simulation values.

3.2.3. Compare simulation result and observed

+ Wind direction and wind speed: Simulation results from FVM show wind speed depend on the type of surface. On the sea, the wind vector is stable on direction and value, wind speed in lower when come to the continent. Wind direction and wind speed in continent is change a lot and depend on the distribution of the surface thermal. In urban area, wind speed is lower but not clear. Compare with the measurements show wind direction consistent relatively. Comparison between the simulation with measurement values in episode study have correlation coefficient R=0.68 and 0.81 for wind direction and wind speed, respectively.

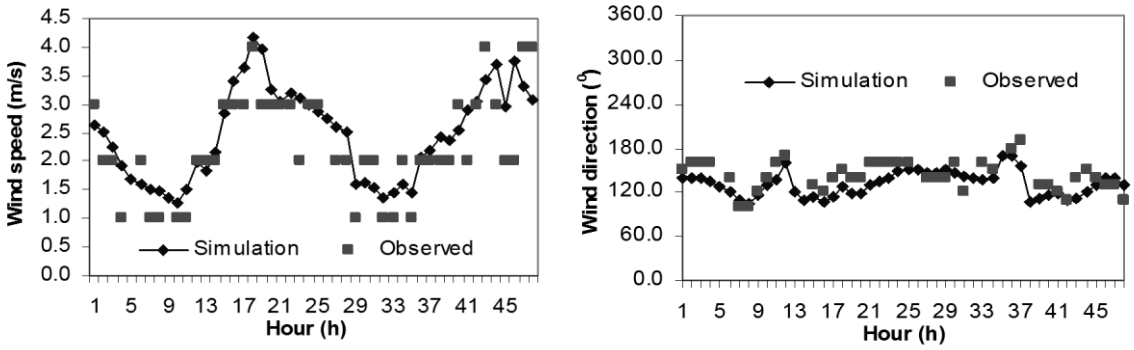


Fig 3. Comparison wind speed and wind direction between simulation and observed on Jan. 19 & 20, 2006

+ *Temperature:* Simulation results show the effects of sea to the surface temperature distribution, coastal areas have low an average temperature and temperature variations. When going into the continent, temperature variations and average temperature tends to increase. The highest temperature in domain D5 appear in the center of HCMC, the region have trees and water surface area is low. The model predicts well the time of the day when temperature start increasing due to the sunrise (around 6h-7h), as well as the time of the maximum value (between 12h-13h). Comparison between simulation and measurement values in episode study have correlation coefficient R=0.92.

3.3. Air quality modeling

3.3.1. Primary air pollutants

The process of transportation and dispersion of primary pollutants in the central of HCMC through have change dispersion toward at times during the day but the trend is moving toward the SE direction in generally, the same with the mainly wind direction in episode of meteorological simulation. Depend on times of day, the distribution of air pollutant concentrations is difference, the peak is in the morning (7-9h) and at night (20-21h).

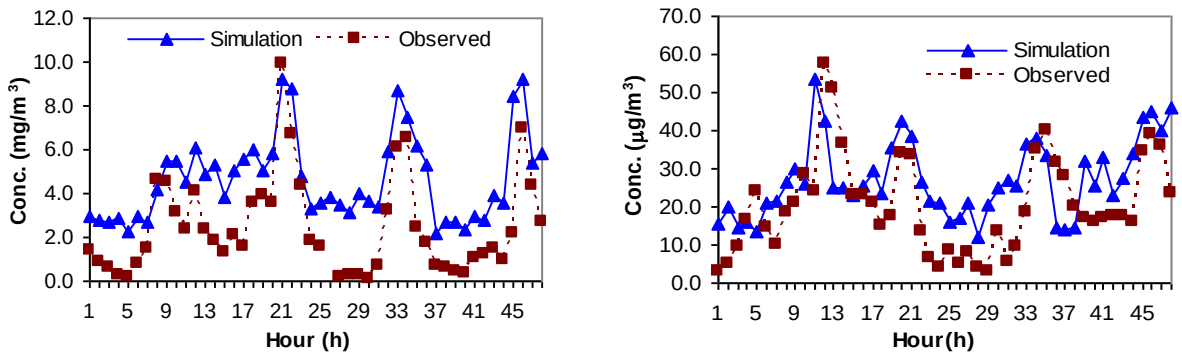
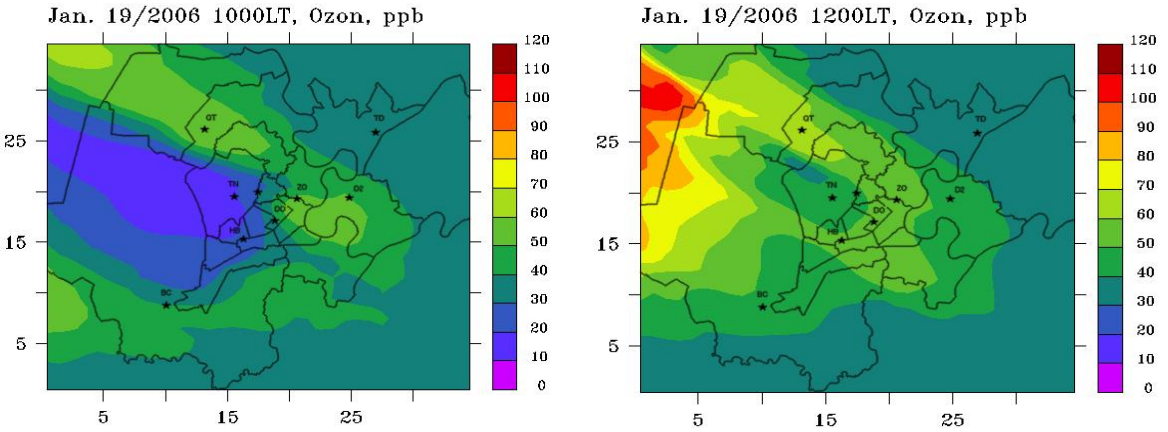


Fig 4. Comparison CO conc. at DO station (left) and SO_2 conc. at TN station on Jan. 19&20, 2006

Both simulated and measured concentrations of CO and NO_x show important morning peak. This peak is related to high emissions from road traffic in the morning rush hour and low mixing height. The intensities of the peaks of both CO and NO_x are good agreement with observations at air quality monitoring station HB and DO. Important nightly peaks of CO and NO_x (around 21h), appear both in the simulation and measurements. This peak is also related to the road traffic and it is sometimes overestimated by the model. With SO_2 value, the comparison between simulation and measurement show the same pattern.

3.3.2. Secondary pollutant - Ozone

The spatial distribution of Ozone is generated depending on the primary pollutant (NO_x & VOCs) concentrations and the meteorological conditions. For this episode, pollutants are pushed by wind coming from SE direction, while Ozone is being formed with maximum values at midday. After midday, wind direction move a little to E direction. At 16h, the maximum Ozone values have dropped and the plume move to E-SE direction. The simulation results show that, the plume of air pollutants is pushed to SE direction in the morning. When the thermal wind is developed, pollutants are then transported eastwards, crossing again the central part of the city. This happens at the same time of maximal solar radiations, thus important peaks of Ozone are generated in town.



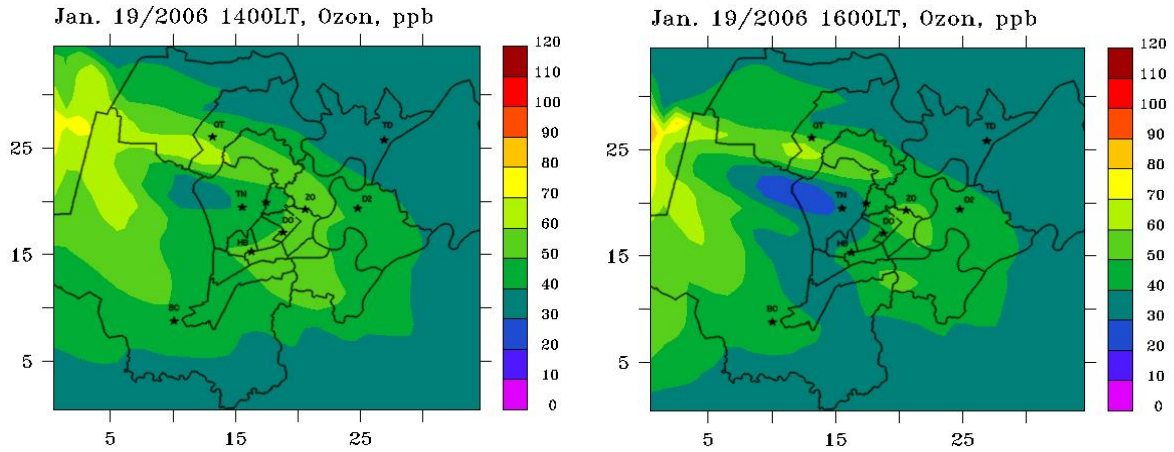


Fig 5. Map of Ozone concentration (ppb) in domain D5 at at 10h, 12h, 14h &16h on Jan. 19, 2006

The Ozone measurements corroborate the presence of the plume over the city, with high concentration in Jan. 19, 2006 at DO & HB stations (152.3 µg/ m^3, 84.8µg/ m^3, respectively) and lover values in Jan. 20, 2006. This might imply that the city plume remains mainly in the city center on 19 Jan. But is slightly moved towards SE on 20 January. The simulation shows high Ozone levels at the same stations as the measurement values on 19 January, indicating a good reproduction of the plume position.

3.4. Simulation results air quality in the scenarios

Depending on the pollutants and scenarios, the emission of air pollutants will be increased or decreased. Simulation comment results of air quality in 3 scenarios above as follows:

- NO_x concentration: In scenario 1, light decrease with the initial concentration (base case). However, in scenarios 2 and 3, concentrations of NO_x increase with the base case value simulation (1.2 times and 1.1 times higher for Scen.2 and Scen.3, respectively) because of NO_x emissions load in scenarios 2&3 increase with the value calculated emissions load initially.

- CO concentrations significantly reduced in 3 scenarios with base case simulation value, this completely reasonable when the load emissions calculated of CO in the 3 scenarios are lower (only 53-54%) emissions load in the base case.

- SO_2 concentration from simulation results in 03 scenarios are light decrease with results simulation by the base case because SO_2 emissions load calculated in 3 scenarios are reduced by 69-74%.

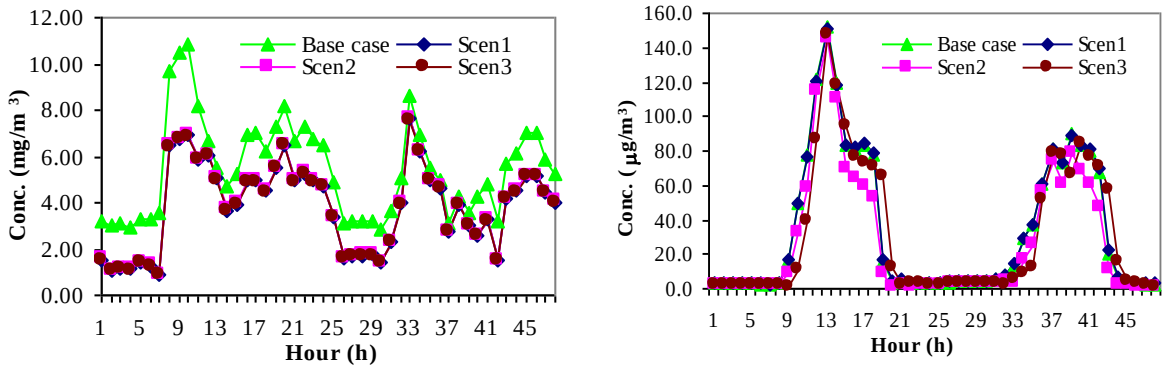


Fig 6. Comparison CO conc. at HB station (left) and Ozone conc. at DO station on Jan. 19&20, 2006

- Concentrations of Ozone from 3 scenarios simulation are lower with the simulation results of the

base case. Comparison of Ozone concentrations simulated from 03 scenarios and base case simulation were implemented at air quality monitoring stations DO and HB.

3.5. Support method

Besides on the propose of scenarios to reduce air pollution levels from road traffic by changing the number and type of vehicles and fuel used, the support method to reduce air pollution from road traffic should be also of interest:

Propose to do inspection and control emissions periodically for other means of transportation 1 times per year. For motorcycles, due to for the high volumes so in initially can be required for category of motorcycle with capacity engine ≤ 50 cm^3. These motorcycles have high pollution emission levels will be required to upgrade, maintenance or replacement of spare parts, the engine or forbidden travel.

Encourage, extensive propaganda and strongly in the people about the consequences of the motorcycle explosion, the long-term risk to the development of the city and next living generations.

Implement solutions "2 needs" that need a strong method in the general planning, transportation planning and need quick investment for transport projects especially public transportation network.

Restriction of cars travel into the central city during the morning rush hours (7 – 9h) and evening (20 - 21h). These are times with high concentration of air pollutants in simulation and measurement.

4. CONCLUSION

Study results obtained in this study is to develop the emissions data of air pollutants from major of air pollution sources in HCMC, especial for transportation source. Besides, TAPOM and FVM models were used to simulate the meteorological conditions and air quality in HCMC. Episode was chose for simulation on January 19&20, 2006, in the dry season of year. Emission inventory of air pollutants from road traffic show that emission load of motorcycles account for a significant amount of total emission of that source. Air quality simulation get better results when using emission inventory calculated from the emission factors developed in HCMC compared with case using the emission factors from China.

FVM and TAPOM models are chose to simulate meteorology and air quality in HCMC. The simulation episode for research results show that, there is not so difference between simulation and measurement values. Particular, at air quality monitoring station HB, CO conc. Is 5% difference between simulation and measurement. For others pollutants NO_x, SO_2 and Ozone comparison results between simulation and measurement have similar results. Besides, based on the simulation results and current statue of air pollution in HCMC with air pollution from road traffic plays an important role in air pollution in general, the authors proposed some scenarios to reduce air pollution levels in general and air pollution from road traffic in particular. The simulation results from scenarios show that, if reduce 50% number of motorcycles and increase 10 times number of buses, concurrently, change all the present buses (B55-B80) to small size buses (35-40 seats), air quality will be improve and can be reduce traffic jam in rush hour.

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TREATMENT OF SWINE SLAUGHTERHOUSE WASTEWATER BY ELECTROCOAGULATION

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ABSTRACT

The effects of electrocoagulation on COD removal of Nam Phong swine slaughterhouse wastewater (Binh Thanh District, Ho Chi Minh City, Vietnam) were investigated in this paper. For this purpose, the response surface methodology (RSM) was employed to investigate the effects of three operating conditions on COD removal by Electrocoagulation (EC) with iron electrodes. A central composite design (CCD) was used to optimize the EC process and to evaluate the individual and interaction effects of current density, electrolysis time and initial pH. The results based upon statistical analysis showed that the quadratic models for COD removal efficiency were significant at very low probability value (<0.0001) and high coefficient of determination (R^2 = 0.9754) value. Optimal conditions for COD removal were established at 130 A/m^2 current density, 9.5 min electrolysis time, and initial pH 8.5, in which a removal of 97.3% was achieved. Operating costs and sludge production at the optimum operating conditions were also calculated for the treatment process.

Keywords: Electrocoagulation; optimization; surface response method; swine slaughterhouse wastewater.

1. INTRODUCTION

With the rapid socio-economic development in Vietnam, lots of slaughterhouses were established to meet the meat consumption demand of people (Nhat, 2006). However, a large amount of slaughterhouse wastewater was discharged into the environment annually. Most of the wastewater includes blood, fat, fur as well as detergents, preservatives and pathogenic microbes, etc., which contain large amount of Biochemical oxygen demand (BOD_5) or Chemical oxygen demand (COD) values (Ikehata *et al.*, 2006). Therefore, it is necessary to treat or purify the wastewater to some degree before disposal.

Due to the high organic in wastewater characteristic, most of BOD_5 and some of COD in swine slaughterhouse process were normally eliminated by biological treatment such as upflow anaerobic sludge blanket reactor (Nacheva *et al.* , 2011), upflow anaerobic filter reactor (Rajakumar *et al.* , 2011), anaerobic fixed-film reactor (Del Pozo *et al.* , 2006), *etc.*, However, some research (Qiao *et al.* , 2013) indicated that biological process required both a long treatment time for acclimation and a huge space to set up a biological unit. The removal efficiency also greatly depends on the types of organisms in the biological systems. Moreover, in some cases, the organic values (COD or BOD) after the biological process do not meet the current water quality standards (Nhat, 2006). Some oxidation processes such as ozonation (Millamena, 1992; Wu and Doan, 2005), UV radiation (Luiz *et al.* , 2009), photo-degradation (Bustillo-Lecompte *et al.* , 2016), etc. were reported to be not completely effective. Hence, the approach for the rapid and effective removal of contaminants from swine slaughterhouse wastewater is necessary to be further developed.

Recently, a number of investigations have reported that application of electrocoagulation (a kind of physical-chemical method) had been successful to remove pollutants from different kinds of wastewater

including hospital (Ha and Xuyen, 2017), dairy (Aitbara *et al.* , 2016), textile (Ha, 2016; Ha *et al.* , 2017), pesticide (Abdel *et al.* , 2012), herbicide (Benincá *et al.* , 2016), etc. In electrocoagulation process, a direct electrical current is used to dissolve metal electrode (mostly iron and aluminium) forming a range of coagulant species and metal hydroxides in that precipitation and adsorption efficiencies are greater than pre-precipitated hydroxides of conventional coagulant like coagulation process (Mollah *et al.* , 2004). As compared with mentioned methods, Electrocoagulation have many advantages such as low investment cost, low space requirement, absence or less of additional chemicals, less retention time, less sludge production, simple equipment and easy operation (Aitbara *et al.* , 2016; Abdel *et al.* , 2012; Benincá *et al.* , 2016). Hence, the application of EC to alleviate the contamination of swine slaughterhouse wastewater offers the promise of an effective process.

The objective of this study was to investigate the pollutant removal capacity of electrocoagulation process with iron electrode on Vietnamese swine slaughterhouse wastewater by monitoring the decrease in COD. Response surface methodology (RSM) was used to experiment design, to analyse the effect of three variables (current density, electrolysis time and initial pH) and determine the optimum conditions. The sludge production and operation cost were also examined.

2. EXPERIMENTAL

2.1. Reagents and apparatus

Raw swine slaughterhouse wastewater was obtained from Nam Phong Food Processing Enterprise (Ho Chi Minh City, Vietnam). The wastewater samples were kept in polyethylene containers and cooled to room temperature before preserving it at 5◦C to reduce biodegradation due to biological activity. pH, conductivity, total suspended solids, color and chemical oxygen demand (COD) of the raw wastewater were 6.53 ± 0.15, 5.78 ± 0.15 mS/cm, 176 ± 23 mg/L, 1,363 ± 20 and 4,150 ± 30 mg/L, respectively.

The experimental set up and used for the electrocoagulation (EC) study could be found in the previous study of Ha (2016). Briefly, the Plexiglas reactor with the maximum capacity of 5 liters was used for EC experiment. Four iron electrodes grouped in paralleled were placed in the reactor with the active area of 19.6 cm^2. The electrodes were connected to an adjustable DC power supply (220V, 30A) whose polarity automatically switches every 30 seconds to reduce the passivation films on the electrodes.

2.2. Procedure and analysis

For a typical run, 4 litters of the wastewater were put into the reactor. The initial pH was adjusted using H_2SO_4 (0.1 M) and NaOH (0.1 M) solutions to reach the desired values and a constant current density at regular electrolysis time was applied according to the experiment design (*Table 1*). After 30 min settling at the end of each run, 50 mL of the treated samples were withdrawn and determined pH, COD or other parameters by Standard Methods for the Examination of Water and Wastewater (APHA, 1998). All the experiments were performed at room temperature of 30 ± 2°C.

Table 1. Experimental range and levels of independent parameters

Parameters		Levels				
		-2	-1	0	+1	+2
Electrolysis time (min)	X_1	4	6	8	10	12
Current density (A m^{-2})	X_2	65.0	86.6	108.3	130.0	151.6
Initial pH	X_3	4	5.5	7	8.5	10

2.3. CCD response surface design

In the current study, the central composite design (CCD), a standard RSM, was used to find out the individual and interactive effects of process parameters on COD removal capacity of swine slaughterhouse wastewater via Minitab statistical software (version 16.2.0). Electrolysis time (X_1), current density (X_2), and initial pH (X_3) were chosen as independent factors, while COD removal efficiency (Y) was selected as response function. The variable range was divided into five levels (-2, -1, 0, +1, +2) as shown in Table 1. The removal efficiencies were fitted to a general function indicating the interaction between dependent and independent variables by following quadratic (second degree) polynomial equation.

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_{11}X_1^2 + b_{22}X_2^2 + b_{33}X_3^2 + b_{12}X_1X_2 + b_{23}X_2X_3 + b_{13}X_1X_3 \quad (1)$$

Where X_1, X_2, X_3 are the input factors which influence predicted response Y; b_0 is the intercept; b_1, b_2 and b_3 are the linear coefficients; b_{11}, b_{22} and b_{33} are the quadratic coefficients; and b_{12}, b_{23} and b_{13} are the interaction coefficients.

Twenty experiments were conducted including six repeated runs at the central point. The analysis of variance (ANOVA) was used for statistical analysis. The adequacy of the model was evaluated by calculating the determination coefficient (R^2) in addition to testing it for the lack of fit by the *P* value (probability) with 95% confidence level. Three-dimensional plots were obtained from the results of the experiments.

3. RESULTS AND DISCUSSION

3.1. Model fitting and validation

The significance and adequacy of the predicted model are normally determined by ANOVA. While the F-value describes the variation in the mean of data, the probability F-value (Prob.>F) - p value below 0.05 is considered as a significant term. Table 2 presents the ANOVA of regression parameters of the predicted response surface quadratic model and other statistical parameters for COD removal efficiency. The model F-ratio of 44.12 and the p value of 0.000 indicating the employed model is significant. The high of P values 0.113, 0.510, and 0.434 for X_1X_2, X_1X_3, and X_2X_3, respectively also indicates that all interactions should be eliminated in order to improve the quality of the regression model. Furthermore, the lack of fit F-value of 3.43 is not significantly relative to the pure error to demonstrate that the model is successfully predicted the effect of the factors on the treatment process. Therefore, the model for predicting COD removal using EC process includes a set of coefficients and uncoded factors described as follows:

$$Y_{COD} = 28.59X_1 + 2.087X_2 + 54.936X_3 - 1.031X_1^2 - 0.007X_2^2 - 3.402X_3^2 - 395.515 \quad (2)$$

Table 2. Analysis of variance (ANOVA) for COD removal efficiency (%)

Source	DF	Seq SS	Adj SS	Adj MS	F- value	P
Model	9	6124.07	6124.07	680.45	44.12	0.000
X_1	1	949.41	387.22	387.22	25.11	0.000
X_2	1	799.62	234.58	234.58	15.21	0.003
X_3	1	2628.36	785.87	785.87	50.96	0.000
X_1^2	1	427.89	427.89	427.89	27.75	0.000
X_2^2	1	46.88	289.22	289.22	18.75	0.001

Source	DF	Seq SS	Adj SS	Adj MS	F- value	P
X_3^2	1	1207.86	1473.00	1473.00	95.51	0.000
$X_1 X_2$	1	46.61	46.61	46.61	3.02	**0.113**
$X_1 X_3$	1	7.20	7.20	7.20	0.47	**0.510**
$X_2 X_3$	1	10.24	10.24	10.24	0.66	**0.434**
Residual error	10	154.22	154.22	15.42		
Lack of fit	5	119.43	119.43	23.89	3.43	0.101
Pure error	5	34.79	34.79	6.96		
Total	19	6278.29				

$R^2 = 0.9754$ and $R^2_{adj} = 0.9533$

The accuracy of an achieved quadratic model could be also checked by the residual plots. If the trend of the residual plot is approximately a straight line, then the residuals are normally distributed or the accuracy of the model is satisfied (Isa, 2015). Figure 1a displays the normal probability plot of the residual for COD removal on EC process which is approximately a straight line. The determination coefficient (R^2) and adjusted determination coefficient (R^2_{adj}) for the quadratic model were found to be, 97.54% and 95.33%, respectively. The amount of R^2 suggested that less than 2.46% of the variations in the response variable of COD removal could not be explained by this model. This relation between the experimental and predicted values could be confirmed by the good agreement described on Figure 1b (Montgomery, 2013).

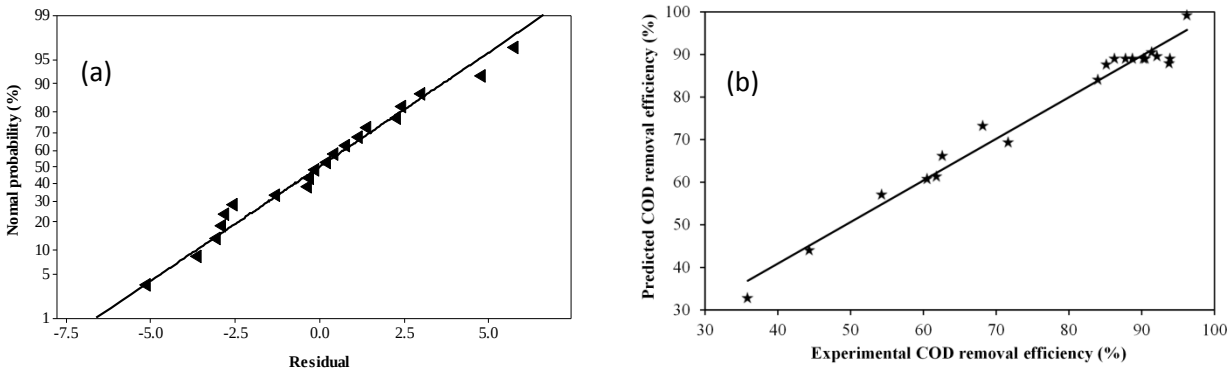

Fig 1. The diagnostic plots for COD removal efficiency: a) Probability plot and b) Actual vs. predicted plot

3.2. Effects of operating parameters

The design matrix with experimental and predicted COD removal efficiencies are listed in Table 3**.**

Table 3. Central composite design and experimental results

Run	Experimental design			COD removal efficiency (%)	
	Electrolysis time (X_1)	Current density (X_2)	Initial pH (X_3)	Experimental	Predicted
1	-1	-1	-1	44.34	44.12
2	+1	-1	-1	62.63	66.25
3	-1	+1	-1	60.53	60.82
4	+1	+1	-1	68.17	73.30

Run	Experimental design			COD removal efficiency (%)	
	Electrolysis time (X_1)	Current density (X_2)	Initial pH (X_3)	Experimental	Predicted
5	-1	-1	+1	71.67	63.39
6	+1	-1	+1	85.17	87.72
7	-1	+1	+1	91.39	90.62
8	+1	+1	+1	96.23	99.30
9	–2	0	0	54.29	57.20
10	+2	0	0	93.78	88.02
11	0	–2	0	61.82	61.41
12	0	+2	0	92.12	89.68
13	0	0	–2	35.85	32.86
14	0	0	+2	83.99	84.13
15	0	0	0	86.29	89.11
16	0	0	0	88.74	89.11
17	0	0	0	93.91	89.11
18	0	0	0	90.27	89.11
19	0	0	0	90.51	89.11
20	0	0	0	87.80	89.11

The best percentage removal efficiency of COD was reached 96.2% which is significantly higher than 76.5% COD removal case using ferrous sulfate combined ferric chloride coagulation process of Mahtab *et al.* (2009). The Response surface plot (Figure 2) was carried out to check the influence of three operating parameters on COD removal. It could be ascertained from the Figure 2a that at first the COD removal percentage increases with increase in electrolysis time and current density. However, as the current density or electrolysis time reached "suitable" values, the COD removal efficiency was no longer improved. These results should be explained because the iron coagulant was saturated in the solution and could not react efficiently. This observation is in agreement with the state of Abdel *et al.* (2012) as they eliminated pesticides from simulated wastewater using electrocoagulation. Similar trend was recorded as changing electrolysis time vs. initial pH (Figure 2b), the percentage COD increases with increasing in the initial pH from acidic condition to slightly alkaline (around 8) for given electrolysis time. Further increase in the initial pH (to 10) at long reaction time did not show any significant improvement in the percentage COD removal, which may be due to the fact that the activities of coagulants (ferric iron ion) are suitable at slightly alkaline condition as described in the research of Barrera-Díaz *et al.* (2003). Figure 2c shows the combined effect of current density and initial pH. It can be observed that the COD removal efficiency increase together with the increasing of current density as initial pH slightly alkaline medium. Gengec *et al.* (2012) suggested that with suitable pH range (neutral to slightly alkaline condition), the formed floc. had a large specific surface area that can absorb soluble organic compounds. Therefore, the maximum COD removal efficiency at high current density was achieved in relatively neutral medium.

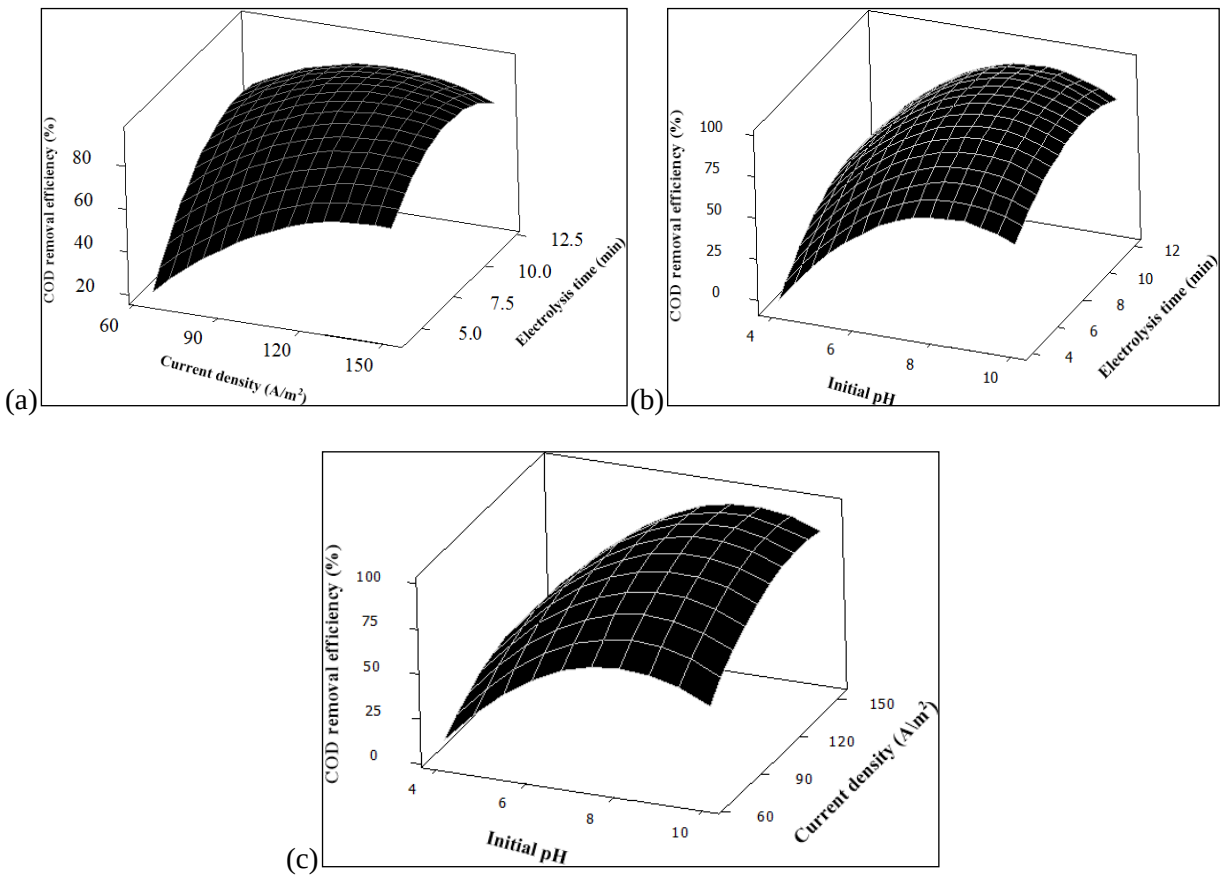

Fig. 2. Three dimensional surfaces for COD removal efficiency: a) Current density vs electrolysis time at pH 7); b) Initial pH vs electrolysis time at current denisty 108.3 A/m^2, and c) Initial pH vs current density at electrolysis time 8 min

3.3. Optimization of treatment process

The optimum conditions are obtained by taking the top summit point of the response surface plots (Figure 3). The EC process gives a maximum COD removal of 99.9% at an optimum initial pH 8.36 and current density 126.2 A/m^2 during 9.7 min electrolysis. The predicted value is very close to the experimentally observed value of 97.3% (two additional tests at initial pH 8.5, current density 130 A/m^2 during 9.5 min). Increasing current density and electrolysis time beyond their optimal values might decrease the removal slightly. This behaviour is due to the scavenging effect of iron coagulants, and the restabilisation of the iron (III) hydroxide flocs. appeared when excess iron ion was produced. These reasons could also contribute to the decrease in removal (Gengec et al. , 2012; Akyol, 2012).

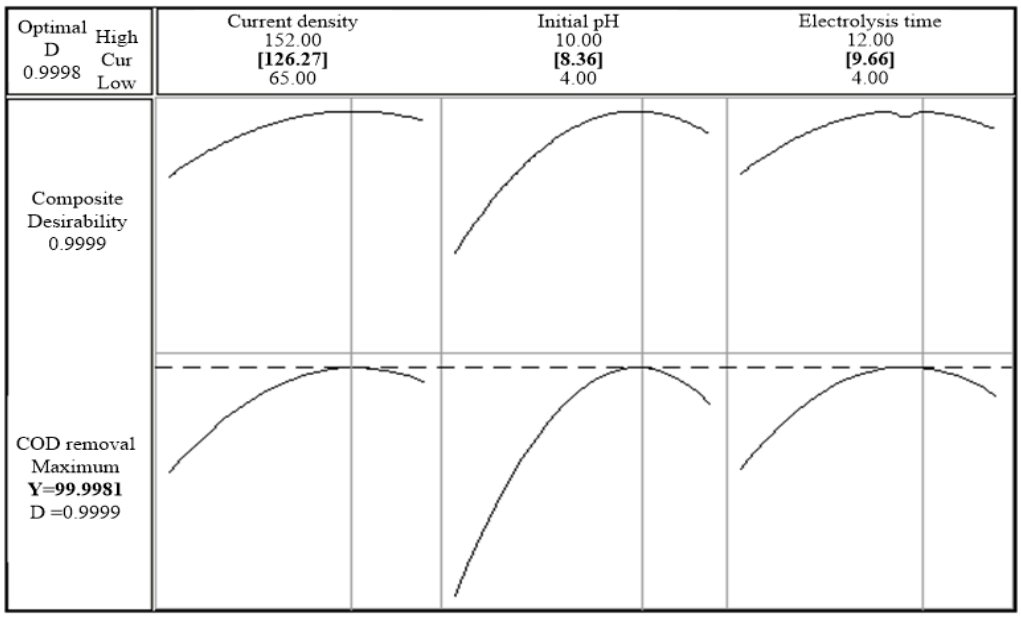

Fig 3. Response optimization plot of maximum COD removal efficiency

3.4. Sludge production and operation cost

EC technology is widely known to be producing less sludge as compared with coagulation process. The production of EC easily determines using Faraday's law.

$$C\ (g_{Fe}/m^3) = \frac{ItM}{ZFV} x10^3 \quad (3)$$

Where I is applied current (A), t is the operating time (s), M is the atomic weight of the iron 56 (g/mol), Z is the iron valance (in the case is 3 for Fe^{3+}), F is the Faraday constant 96485 C/mol and V is the volume (4 liters) of wastewater.

The electrical energy consumption and operational cost are important economical parameters in EC process that were calculated by Equations (4) to (5) respectively.

$$E_{consumption}\ (kWh/\ m^3) = \frac{UIt}{3.6\ x\ 10^3 V} \quad (4)$$

$$\text{Operation cost} = \alpha * E_{consumption} + \beta * C \quad (5)$$

Where "α" and "β" are electricity price 0.0492 US$/KWh and electrode material price 0.67 USD/kg Fe (CT_3), respectively according to the Vietnam market in March 2017 and U represents cell voltage (V).

Based on the calculations, the energy consumption and theory cost are 7.13 kWh/m^3 and 0.667 US$/$m^3$, respectively while the actual operating cost reaches 0.724 US$/ m^3 swine slaughterhouse wastewater at the optimal condition. Comparing with other reports of iron EC for organic wastewater treatment (Ozyonar and Karagozoglu, 2011; Daneshvar *et al.* , 2006), the actual operating cost for COD removal from the wastewater was economical effect. However, the total material consumption was higher than theoretical value. Actual consumption of the dried electrodes was 0.210 g/L at suitable EC process as compared with 0.165 g/L of theoretical. These results could be accounted by the fact that practical production of Fe was influenced by Fe oxidation and wastewater characteristic such as: pH, conductivity, and gas soluble as the state of Moussa *et al.* (2017).

4. CONCLUSIONS

The results obtained indicate that EC process can be used for COD removal from swine slaughterhouse wastewater. The central composite design was successfully used to develop a mathematical model for predicting COD removal. The value of R^2 = 0.975 for the obtained quadratic model indicates high correlation between observed and predicted values by the mathematical model. The optimization using RSM led to the optimum operating conditions as 130 A/ m^2 current density, initial pH 8.5, and 9.5 electrolysis time for the treatment of swine slaughterhouse wastewater yielding COD removal with 97.3% efficiency. The actual operating cost and sludge production were found 0.724 US$/ m^3 and 0.210 g/ L at the condition.

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EFFECT OF SUPPLEMENTING MIMOSA PIGRA ON THE IN VITRO METHANE PRODUCTION

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ABSTRACT

The experiment was carried out in complete randomized design with 6 treatments and 4 repetitions to determine effects of supplementation of tannin levels in *Mimosa pigra* on methane production based on Para grass and Water spinach diets. Six treatments were 0, 10, 20, 30, 40 and 50 g of tannin in *Mimosa pigra* for every kg of Para grass and Water spinach basal diets.

Results showed that methane production decreased respectively from 21.2, 18.4, 15.8, 15.0, 12.1 and 10.9 ml/g DM with increasing of levels of tannin supplementation of 0, 10, 20, 30, 40 and 50 g/kg DM in Water spinach diets. In Water spinach diets, methane production also decreases with increasing of levels of tannin supplementation from 21.5 to 8.9 ml/g DM. Inclusion of Para grass and Water spinach diets resulted that tannin supplemented levels of *Mimosa pigra* reduced methane production from 13.2 to 58.6%.

Keywords: tannin, methane emission, gas production

1. INTRODUCTION

Climate change seriously affects ecological balance, human health and sustainable development, particularly in developed and developing countries (Najeh Dali, 2008). The causes of climate change is manufacturing operations create large amounts of methane, including livestock and crops have contributed significantly to this process (Watson, 2008). The amount of methane emitted from livestock for about 16% of global methane emissions and about 74% of methane emissions from ruminant livestock. Therefore, research into reducing methane emissions from ruminant livestock achieve two objectives is to reduce greenhouse gases and improve feed efficiency (Martin *et al*., 2008).

Mimosa tree is *Mimosa pigra* L, belongs to the Fabaceae family. Mimosa is considered as one of the most dangerous weed species in tropical wetlands. The extent of their spread is at alarming threshold. Mimosa is dangerous invasive exotic speacy that threatens biodiversity, damage the environment in many countries around the world. Mimosa pigra has become one of the most dangerous weed species with environment and biodiversity.

Mimosa trees are legumes so its crude protein content is quite high . The crude protein content of Mimosa leaves varied from 17.9 to 21.21% calculated on dry matter. This result shows that Mimosa tree is a source of protein for ruminants. Therefore, using Mimosa trees in the diet of goats is not only help overcome the shortage of food but also enrich food sources. When Mimosa is widely used to feed the goat, this contribute positively to limit the invasive power of this speacy. The experiments that use Mimosa in goat meat diet showed Mimosa is protein supplement food or a basic food. However, there are no studies showing the positive effects of Mimosa to the methane production and the growth of ruminants, especially goats (Nguyen Thi Thu Hong *et al.*, 2008).

2. MATERIAL AND METHODS

Location

This experiment was be carried out on Laboratory of Department of Animal Sciences, College of Agriculture and Applied Biology, Can Tho University.

Design and treatments

The experiment was carried out in complete randomized design with 6 treatments and 4 repetitions to determine effects of supplementation of tannin levels in Mimosa pigra on methane production based on Para grass and Water spinach diets. Six treatments were 0, 10, 20, 30, 40 and 50 g of tannin in *Mimosa pigra* for every kg of Para grass and Water spinach basal diets. The procedure herein described is that of Tilley and Terry (1963). The evaluation included for 24h with measurements of total gas production; proportions of CH_4, and CO_2); for 48h with pH, NH_3 and Protozoa.

Table 1. Ingredients compositionof the experimental diets 2a (%DM)

Ingredients	Treatments					
	RMD 00	**RMD 10**	**RMD 20**	**RMD 30**	**RMD 40**	**RMD 50**
Mimosa	0	11.2	22.5	33.8	45.0	56.4
Water spinach	74.6	63.4	52.1	40.8	29.6	18.2
Concentrate	25.4	25.4	25.4	25.4	25.4	25.4

RMD control; RMD 10; RMD 20; RMD 30; RMD 40 và RMD 50 supplement Mimosa with tannin levels were 10; 20; 30; 40 và 50 g/kg DM.

Table 2. Ingredients compositionof the experimental diets 2b (%DM)

Ingredients	Treatments					
	RMD 00	**RMD 10**	**RMD 20**	**RMD 30**	**RMD 40**	**RMD 50**
Mimosa	0	11.2	22.5	33.8	45.0	56.4
Para grass	74.6	63.4	52.1	40.8	29.6	18.2
Concentrate	25.4	25.4	25.4	25.4	25.4	25.4

LMD control; LMD 10; LMD 20; LMD 30; LMD 40 và LMD 50 supplement Mimosa with tannin levels were 10; 20; 30; 40 và 50 g/kg DM.

Table 3. Ingredients in the buffer solution (adapted from Tilly and Terry 1964)

Ingredients	**$CaCl_2$**	**$NaHPO_4.12H_2O$**	**NaCl**	**KCl**	**$MgSO_4.7H_2O$**	**$NaHCO_3$**	**Cysteine**
(g/liter)	0.04	9.3	0.47	0.57	0.12	9.8	0.25

Fig 1. Bottles are placed in water - bath temperature controlled 38^{o}C

Measurements and Chemical analysis

The feed offered, refused and faeces were be analysed for dry matter (DM) by drying at 105^{0}C for 24hrs, organic matter (OM) by ashing at 550^{0}C for 4hrs and crude protein (CP) by Kjeldahl technique (AOAC-1990) was be also observed.

Statistical analysis

All the data was be calculated with MS Excel software and used for subsequent statistical analysis, using the general linear model in the Minitab software (release16.1). Sources of variation in the model are treatments and error.

3. RESULTS AND DISCUSSION

Chemical composition of the experimental feeds

The chemical composition of the feedstuffin the experiment is given in Table 3. The CP and tannin content of *Mimosa pigra* 19.8% and 8.8% respectively.

Table 3. Chemical composition of the feedstuffin the experiment

Items	Mimosa	Concentrate	Water spinach	Para grass
Dry matter g/kg	348	947	72	175
(g/kgof DM)				
CP	198	183	187	103
OM	939	922	853	879
ADF	386	75	427	372
NDF	501	234	558	487
Tannin	88	-	30	-

Effect of Mimosa pigra in diets on the *in vitro* methane production with basal diets of water spinach

Methane production decreased respectively from 21.2; 18.4; 15.8; 15.0; 12.1 and 10.9 ml/g DM with increasing of levels of Mimosa pigra tannin supplementation of 0, 10, 20, 30, 40 and 50 g/kg DM in Water spinach diets (P<0.05).

Table 3. Mean values of gas production, percent of methane and CO_2 in the gas

Items	**Treatments**						**P**
	RMD 00	**RMD 10**	**RMD 20**	**RMD 30**	**RMD 40**	**RMD 50**	
Total gas, (ml/500 mg DM)	62.4^{a}	59.4^{a}	58.7^{a}	57.7^{a}	48.2^{b}	45.6^{b}	0.01
CH_4 (%)	17.0^{a}	15.5^{b}	13.4^{c}	13.0^{cd}	12.6^{d}	11.9^{e}	0.01
CH_4 (ml/g DM)	21.2^{a}	18.4^{b}	15.8^{c}	15.0^{c}	12.1^{d}	10.9^{d}	0.01
CO_2 (%)	60.6^{a}	59.2^{b}	570^{c}	56.3^{d}	54.9^{e}	53.5^{f}	0.01

RMD control; RMD 10; RMD 20; RMD 30; RMD 40 và RMD 50 supplement Mimosa with tannin levels were 10; 20; 30; 40 và 50 g/kg DM. ^{abcd} *Means within rows with different superscripts are different at P<0.05.*

These was closely related between the levels tannin of Mimosa in the diet and methane production (Figure 3.1) with regression equation y = -0,203x + 20,651, R^2 = 0,9293 and high correlation (r = 0,964; P = 0,000).

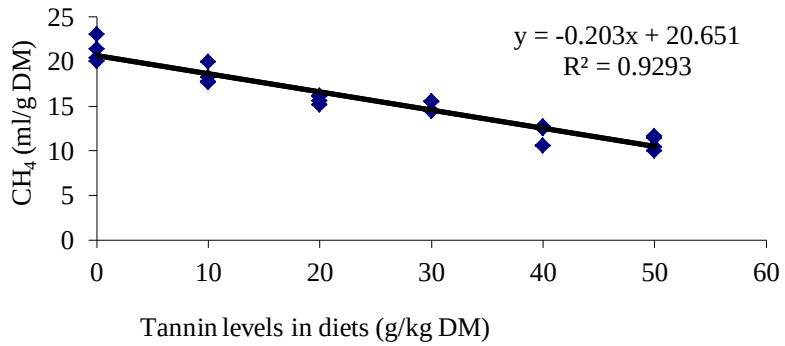

Fig 2. Relationship between methane production and levels of Mimosa tannin supplementation in Water spinach diet

Effect of Mimosa pigra in diets on the in vitro methane production with basal diets of Para grass

The different rates of CH_4 production was statistically significant between treatments (P < 0,05) with value 18,5; 16,7; 15,0; 13,4; 13,0 và 11,8% respectively tannin levels 0; 10; 20; 30; 40 và 50 g/kg DM.

Table 4. Mean values of gas production, percent of methane and CO_2 in the gas

Items	Treatments						P
	LMD 00	LMD 10	LMD 20	LMD 30	LMD 40	LMD 50	
Total gas(ml/500mg DM	58.0^{a}	48.5^{b}	43.7^{bc}	41.6^{c}	39.6^{c}	37.5^{c}	0.01
CH_4 (%)	18.5^{a}	16.7^{b}	15.0^{c}	13.4^{d}	13.0^{d}	11.8^{e}	0.01
CH_4 (ml/g DM)	21.5^{a}	16.1^{b}	13.1^{c}	11.2^{cd}	10.3^{de}	8.9^{e}	0.01
CO_2 (%)	62.7^{a}	59.9^{b}	57.0^{c}	54.9^{d}	52.1^{e}	50.6^{f}	0.01

LMD control; LMD 10; LMD 20; LMD 30; LMD 40 và LMD 50 supplement Mimosa with tannin levels were 10; 20; 30; 40 và 50 g/kg DM^{abcd} *Means within rows with different superscripts are different at P < 0.05.*

Methane production also decreases with increasing of levels of tannin supplementation from 21.5 to 8.9 ml/ g DM. These was closely related between the levels tannin of Mimosa in the diet and methane production (Figure 3) with regression equation y = -0.2359x + 19.413, R^2 = 0.8693 and high correlation (r = 0.932 and P = 0.000).

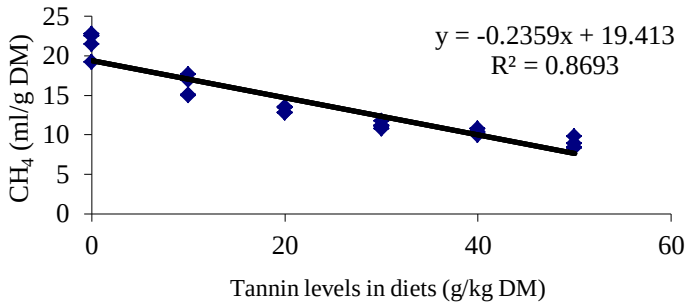

Fig 3. Relationship between methane production and levels of Mimosa tannin supplementation in Para grass diet

4. CONCLUSIONS

Inclusion of Para grass and Water spinach diets resulted that tannin supplemented levels of Mimosa pigra reduced methane production from 13.2 to 58.6%.

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DESIGN AND ORGANIZATION OF TEACHING ONLINE MODULE COMPUTER ARCHITECTURE

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ABSTRACT

Design and teaching institutions is an important factor in training to accelerate the learning process and improve the quality of teaching and learning. Weakness in online training is learner not communicate directly with the instructor and their classmates. So designing courses like? what teaching organization? in online training that is the problems posed. In this paper, the author designed a model of teaching module type computer architecture to capacity development and creative thinking as well as chemical active learners.

Keywords: Design online courses, Organization of online learning, online training assessment, computer architecture

1. INTRODUCTION

From the 90s to the present, E-learning has been implemented by the leading universities in the world [1] such as Harvard, MIT, Stanford, Phoenix... and have obtained some encouraging results. Besides these advantages, e-learning are facing major obstacles 03 [2]:

- No environmental and psychological interaction with peers as traditional classroom, it is difficult to attract and retain students in front of the computer for a long time.

- There is no way to encourage students to actively participate in the classroom.

- There is no feasible method to validate the results of student learning.

Therefore the quality of training E-learning is not commensurate with the potential, the university opened the E-learning has licensed but their qualifications are not social appreciation, career opportunities for those who are this is a very low degree [3.4].

Solve 03 obstacles on the problem of large, macro, requires the collaboration of scientists in the professional field of technology and didactics. In this article we are only limited content E-learning research for specific subjects to minimize these obstacles. Specifically, the design and organization of online teaching model courses "Computer Architecture".

2. CONTENTS OF THE STUDY

2.1. Design online course module "Computer Architecture"

2.1.1. These differences of online course design and traditional courses.

The view that "Just convert documents available of traditional classroom into digital form is

completed online classes" is misleading because the instructor can provide a program and document holistic to students at the beginning of training courses online.

So differences of online course design:

- Firstly, Trainers need to turn these principles into learning materials and plans for activities and training materials.

- Secondly, online training is the process of providing information and building activities to promote the course participants, aims to study.

- Thirdly: Design is the process of planning a whole system before the development or implementation. When designers need to pay attention to three questions: What are the objectives of the training strategy and media ?, what ?, The test is designed to look like, evaluate and edit the copy, how to know we have arrived?

2.1.2. Using ADDIE design model

According to [10] ADDIE model is applied in designing online courses are as follows:

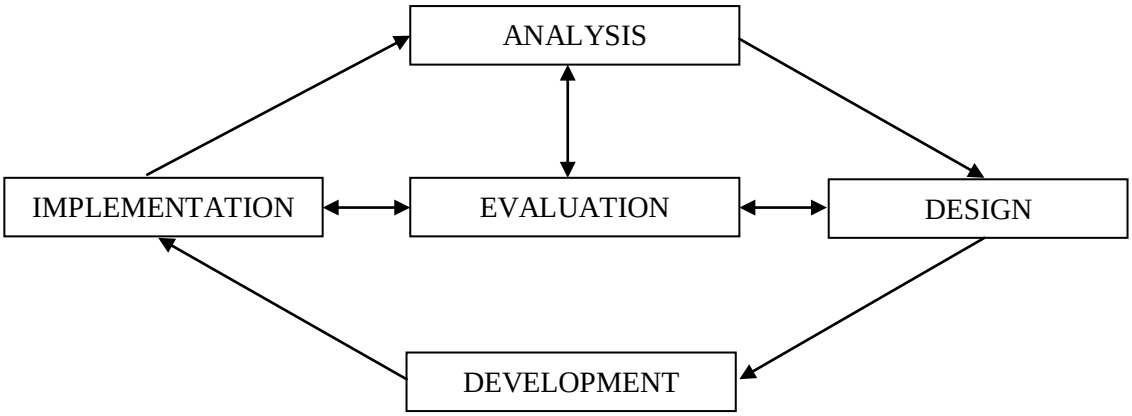


Fig 1. Design Model ADDIE

*** A: Analysis**

- Aims and objectives: The purpose and objectives of the course?

-Learning outcomes: Students can achieve your goals? Observing and measuring work, knowledge, attitudes and skills of students like?

- Characteristics of the students: Students know anything before school? The purpose and their motivation in this course.

- Learning Environment: What obstacles of traditional classroom can affect the design of online courses.

- Project Management: Time, resources, staff, how to affect the successful implementation of this project.

*** D: Design**

- Design course materials include:

+ Design works: Students need to take steps to complete the work?

+ Design content: content providers should do and where to put the focus on

+ Using the graphical interface design: Documents, web pages, e-lectures are designed like? Students will be easy to use and can attract and inspire them to study or not?

- Overall design structure an online course include:

+ Greetings

+ Course description

+ Technical Support

+ Aims and objectives

+ Course Structure

+ Request Course

+ Communicate in courses

+ The activities in the course

+ Score: The scores, scoring criteria

+ Other policies

*** D: Development**

- Construction products such as web pages, documents, electronic lecture or online activities for students. When building Notes 4 questions: How Content classified documents? Designing these types of activities and exercises? How Evaluate the results of students learning ? The course is to convey to the students like?

- The experts, technical staff and the medium (media) is responsible for development of infrastructure for content design.

***I: Implementation**

Faculty and students use materials and implement courses

*** E: Evaluation**

- Collect feedback evaluation of the design effectiveness courses to meet our goals and objectives of the course early. If reached expectations, can see this as the end step.

- You can rely on this feedback to modify and supplement designed courses if necessary.

Here we present design course content structure and design assessment modules "Computer Architecture".

2.1.3. Structural design online course content modules "Computer Architecture"

Computer architecture courses are designed to teach the six themes corresponding to the six chapters, duration of the 15-week courses are as follows:

Topic 1: Chapter 1. Overview of the computer: is taking place within 2 weeks.

Topic 2: Chapter 2. Central Processing Division: is taking place within 2 weeks.

Topic 3: Chapter 3. Script computers: be held within three weeks.

Topic 4: Chapter 4. Memory: is taking place within 2 weeks.

Topic 5: Chapter 5. External Memory: be held within 3 weeks.

Topic 6: Chapter 6. System bus and peripheral devices: take place within three weeks.

Each topic is designed an online lecture SCORM standard format. Lecture with information-rich content, vivid visual recordings with the teaching faculty, the full content transmission of knowledge to students.

Learning lessons and read references is mandatory activities of the course. Through this section the students acquire basic knowledge of the course since then have the knowledge to do a multiple choice exercise, personal training, group exercises, participation in forums and meetings.

2.1.4. Design assessment in online learning module Computer Architecture

a. Overview assessment in online learning

- The student evaluation criteria:

According to [10] to assess effective practitioners must rely on the 9 following basic principles:

A: Assess what and how?

Two: Review what students know and apply the knowledge into practice like.

Three: Assessment will promote the most efficient course with clear objectives.

Four: Assessment of the results end of the course, the efforts, the progress during the process.

Five: The process of regular evaluation and continuous.

Six: Assessing needs the participation of all parts of the room management/training center.

Seven: Use the appropriate questions to determine the result of effort and substantial academic achievement.

Eight: Evaluate towards improving quality and encouraging innovation.

Nine: Through the evaluation process, managers are trained to understand their responsibilities to students.

- Solutions to limit the student's dishonesty.

This is very important in online education, it is critical to the accuracy of the assessment results as well as attracting students active learning. The specific measures are as follows:

+ Reduced pressure on students by creating opportunities for students to achieve the course objectives.

+ Conduct evaluation in small groups where students know each other, in order to improve accountability.

+ Design the evaluation form meaningful and not too long

+ Check random.

- Assessment tools for faculty students

To assess students in online classes, teachers can use the following tools:

*** Multiple choice questions:** Check the level of comprehension, memory cards and the ability to apply in practice. Provide the basis for discussions after checking, clarifying why true why wrong. Reduce guesswork. Easy Grading software construction but hard to build the different options and take time to build.

*** Question true/false:** Check memory and comprehension level of the students. Conjectures can reach 50% the right plan. Easily design and easy software to create scoring but hard to pinpoint the strengths and weaknesses of students.

*** Question suitable option:** Check to be aware not just remember all. Ease dot and dot design fast but difficult because it requires the same information, difficult to identify the strengths and weaknesses of students.

*** Complete the sentence**: Fit to assess the level of mastering the difficult scoring events but because there may be many alternatives right. All used to assess memory and awareness, assessment of high level thinking, but it is difficult to build grading software.

*** Short Answer/Essay:** Presentation by group: Shows the full picture of the ability of students. This section is no grading software.

- Assessment tools for students other students:

*** Ranking**: Each member's contribution ranking members from the best or less.

*** Indication:** The members were evaluated for growth characteristics.

*** Scoring:** Same as specified but grading is done with a set of characteristics.

b. Assessment requirements for computer architecture modules.

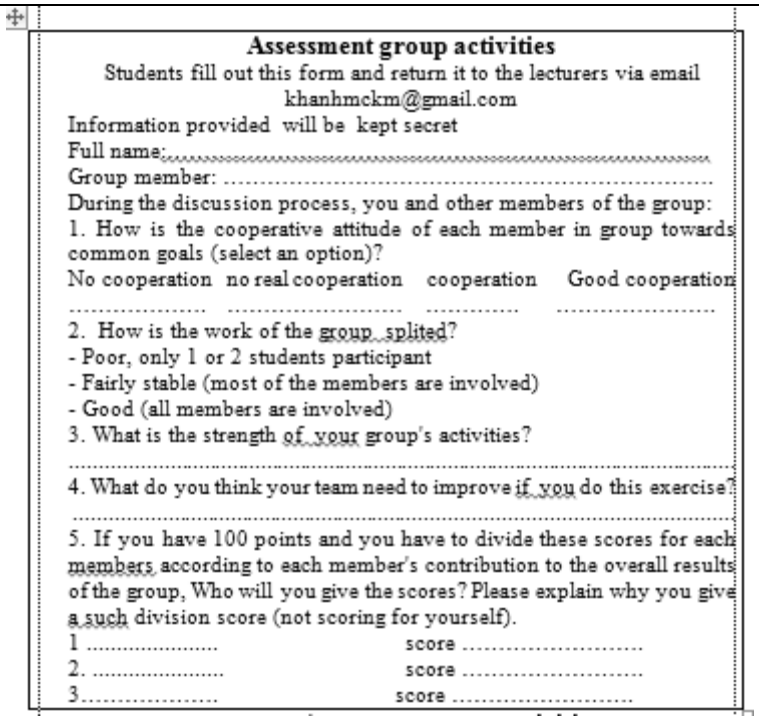
This subject has had particular taking into abstraction, the subject is appreciated in the ability to apply in practice. Therefore the criteria for evaluating students in online learning are: The ability to remember and understand, the ability to identify, analyze, evaluate possibilities

c. Design course assessments

Table 1. The evaluation activities in online learning courses Computer architecture

Assessment activities	Request	Mark
Probing questions before the course	This is the objective tests multiple choice format. Content is the basic knowledge in practical computer users need to know. The result marked by the system itself and records the students. Post time will end when the course began to take place.	Mark

Assessment activities	Request	Mark
Assessment test results online learning lecture	This is the objective multiple choice quiz multiple choice format to help students assess their knowledge comprehend after school lessons. Made several times, after each self-assessment system and the results have implications for the right time to do the following answers will help students gain knowledge through training. If the score is too low self-knowledge students need to learn the lessons for the next time as all have higher scores. Scores by self dot system and student records. The last point is the average of the times to do. Time to pay all the duration prescribed for the school lectures.	Mark
Discussion forums/individual assignments	Forum participants and exchanges to answer, respond to discussion questions or individual assignments. Students analyze problems in the forum discussion on each topic of the course to solve real-life situations and make their individual assignments. Each student must respond to at least 2 answers other students. There are criteria for evaluating students: Excellent, Good, satisfactory, unsatisfactory. - Export Identity: Actively participate in the discussion. The comments are more new ideas, analysis and closely argued anonymous contributions and build all. Remarks at least 2 or more for each topic discussion or individual assignments. Score 100%. - Good: Actively participate in the discussion. The comments have analyzed and closely argued anonymous contributions and constructive discussion. Remarks at least 2 articles for each topic discussion or individual assignments. 70% points. - Satisfactory: Participate in the discussion. The comments have argued anonymous contributions and constructive discussion. Remarks at least one post for each topic of discussion or individual assignments. 50% points. - Unsatisfactory: Participate in the discussion, but the feedback is only "Agree with your opinion" there is no argument anonymous contributions and constructive discussion. Or do not participate in the discussion and not submission. Points reaches 0%.	Mark
Group homework	Each group consists of 5 to 6 members and the exercise group and submitted to the faculty through course management system. Each team member must perform reviews of other members in the group and submitted to the faculty email the following form:	Mark

Assessment activities	Request	Mark
	 **Assessment group activities** Students fill out this form and return it to the lecturers via email khanhmckm@gmail.com Information provided will be kept secret Full name:..... Group member: ..... During the discussion process, you and other members of the group: 1. How is the cooperative attitude of each member in group towards common goals (select an option)? No cooperation no real cooperation cooperation Good cooperation .... 2. How is the work of the group splited? - Poor, only 1 or 2 students participant - Fairly stable (most of the members are involved) - Good (all members are involved) 3. What is the strength of your group's activities? ..... 4. What do you think your team need to improve if you do this exercise? ..... 5. If you have 100 points and you have to divide these scores for each members according to each member's contribution to the overall results of the group, Who will you give the scores? Please explain why you give a such division score (not scoring for yourself). 1 ..... score ..... 2. ..... score ..... 3..... score ..... **Fig 2.** Sample evaluation activities for student groups Lecturer marking based on the content of the group assignments and assessments of the operations team members. There are specific provisions on deadlines, if the late payment of less than 24 hours will be charged 20% of the total score, if more than 24 hours late payment will not be paid by all and get 0 points.	
Test the end of the topic	This is a multiple choice test exercises aggregate multiple choice format and types coupled. Check assess general knowledge of the program. Was made on Sunday last week at the end of the chapter. Students are made once in a specific time by notification system and homework. Scores by self dot system and student records.	Mark
Test the between courses	This is a multiple choice test exercises aggregate multiple choice format and types coupled. Check assess general knowledge of topic 1, topic 2 and topic 3. To be done on Sunday the 7th week of the online exam room. Scores by the system and student records.	Mark
Test the end of courses	This is a multiple choice test exercises aggregate multiple choice format and types coupled. Check assess general knowledge of full courses. To be done on specific days after the end of the course at the online exam room. Scores by the system and student records.	Mark
Conclude	Learners to summarize and draw lessons for themselves at the end of each module through answering questions: "What is the most important lesson you learned from this?", "The	Mark

Assessment activities	Request	Mark
	most important question you can not answer." "Where does / did you point unclear, even in the most confusing ... ..?".	
Course Evaluation	Students evaluate the effectiveness of the course and method of guidance of trainers online after the course.	No Mark

d. Evaluation Criteria Course results

Each student will be evaluated according to the actual completion of the works on online classes under the following specific criteria:

- The level of active participation in discussions, with positive feedback to the problems mentioned in the discussion.

- The degree of completion of the quality of the assignments.

- Results participate in online quizzes online at home and at the university's online exam room.

Specifically the following scale:

- From 85% to 100% = A

- From 70% to 84% = B

- From 55% to 69% = C

- From 40% to 54% = D

- Less than 40% = F

Scores for the following topics:

	Scores
Probing questions before the course:	50
Topics 1. Introduction to computers:	
- Assessment test results online learning lecture:	10
- Discussion forums/individual assignments: Answer discussion questions, reading and contributing at least 2 post reviews of other students:	20
- DoGroup homework:	40
- Test the end of the topic:	20
- Conclude:	10
Total points:	*100*

Topic 2.central processing blocks: place within 2 weeks

- Assessment test results online learning lecture: 10

- Discussion forums/individual assignments: Answer discussion questions, reading and contributing at least 2 post reviews of other students: 20

- Do Group homework: 40

- Test the end of the topic: 20

- Conclude: 10

Total points: *100*

Topic 3. Scripts computer: is taking place within 3 weeks

- Assessment test results online learning lecture: 10

- Discussion forums/individual assignments: Answer discussion questions, reading and contributing at least 2 post reviews of other students: 20

- Do Group homework: 40

- Test the end of the topic: 20

- Conclude: 10

Total points: *100*

Test between courses: **150**

Topic 4. Memory: place within 2 weeks

- Assessment test results online learning lecture: 10

- Discussion forums/individual assignments: Answer discussion questions, reading and contributing at least 2 post reviews of other students: 20

- Do Group homework: 40

- Test the end of the topic: 20

- Conclude: 10

Total points: *100*

Topic 5. External Memory: be held within 3 weeks

- Assessment test results online learning lecture: 10

- Discussion forums/individual assignments: Answer discussion questions, reading and contributing at least 2 post reviews of other students: 20

- Do Group homework: 40

- Test the end of the topic:	20
- Conclude:	10
Total points:	*100*
Topic 6. The system bus and peripherals: is taking place within 3 weeks	
- Assessment test results online learning lecture:	10
- Discussion forums/individual assignments: Answer discussion questions, reading and contributing at least 2 post reviews of other students:	20
- Do group homework:	40
- Test the end of the topic:	20
- Conclude:	10
Total points:	*100*
Test the end of courses:	**200**
Final grade:	**1000**

2.2. Building and organizing online teaching module "computer architecture"

2.2.1. Online learning system

Meeting online file system [5,6,7,8,9] is the system is built in the form of a website. Here teachers can give lectures to electronic self-learning students. Use these tests to test assessment or recurring regular home schooling of students; examine and evaluate the classroom of students with quiz with highly interactive; test results evaluation system is automatically processed and saved to the position of the subject scores. The system allows organizations to do individual assignments, group projects, students submit online all at the request of teachers, can exchange information online and discuss regularly with teachers through forums and meeting online. In addition the system also can be used to organize and expiry of term exam in the form of quizzes online.

2.2.2. Organize online training module computer architecture

Online course module computer architecture areorganized by topic at http://khanhmckm.com.

Fig 3. The system of online learning courses Computer Architecture

Each topic corresponds to a chapter and place time as analyzed above, the theme of the time will be closed. Each topic includes those items:

- Online Lecture

- Assessment test results online learning lecture

- Online Meetings

- Discussion forums/individual assignments

- Group homework

- Test the end of the topic

- Conclude

a. Online Lecture

As electronic Lectures SCORM standard are packed 6 topics of the modules. Built as an electronic lecture (slides, video, simulation) Convey the core fully closed content knowledge of the discipline (structure, Principles of operation of the computer equipment as well as technical mathematics, algorithm goes on inside the computer) to Students.

This lecture is open regularly to help Students understand the basic content of the lesson. Students can attend anytime, anywhere using Your Computer with an internet or phone connection.

b. Assessment test results online learning lecture

Exercise is a test subject includes 50 questions presented cover the entire content selected types of the unit to Assess the ability to remember and understanding of Students. This exercise can set the start time and duration of the play (the before the assembly online) the individual exercises, group exercises.

After carefully Studied Online Lectures, Students used this exercise to test knowledge. Exercise time is set all 50 minutes and always open mode, Students can go to work again and again, results evaluation

system, and the points (the average of the times to do) and save to the scores of student records. Calculated using the average of the times make the final assessment point will push as many times as the Students the previous times lower results. Due to the time limit set ended up forcing to do this part Students Joining Online Meetings is before considering the results online discussion is raised.

Through this exercise Students Will Be Remembered help and understood the lesson content.

The system stores the results of the test-taking beyond making course Students am also help teachers discover Evaluations Students who do not participate in active learning than Timely reminders and shocks adjust the learning of Students.

c. Online meeting

Teachers Students used to Organize discussions with fixed time appointment system to elucidate the problems of Students do not study with participating in Lectures, while over here for orientation for students to apply knowledge Learned Into Practice. Time 2h sessions are taking place and cleverly place. Examination and assessment Organizations of all topics. Discuss many to mention Content accused the teachers intend to test problems soon to Attract broad Participation of Students.

d. Discussion forums/individual assignments

Teachers give n the question (n > the number of students in the class) fitted with corresponding actual topic. Students choose a favorite question to answer their questions but no one to pick it and comment at the same time at least two answers to other students. Review Score 60% for answers questions and 40% for the comments section your answers another.

The selected questions will help answer students interested in doing homework and choosing the questions that no one has chosen to promote all students pay as soon as possible to be able to select the question in my reviews. Also over the comments made by all other students will help students develop the ability to analyze, evaluate and creativity in learning.

Teachers evaluate students scoring evaluation criteria stated above.

With the introduction of a large number of practical questions for students to discuss teacher helped students to apply knowledge learned into practice is the key element is in place in special training is learning online. On the other hand these questions are content inspection of all topics test (20 questions apply practical section, 10 sentences extensions knowledge).

Furthermore, teachers through forums to answer questions from students online meeting and now can not afford. This is a place for teachers to capture the students' difficulties in learning to take timely support to students. Teachers can use the forum to fill the feedback from students about the organization of their teaching thus adjusted accordingly.

e. Group homework

Teachers divide students appropriate group (a group of 5 people), division leader (the members will take turns as leader in each subject), content delivery and create a forum exercises for each group. Ask groups to organize themselves and discuss homework online, pay online results for teachers under the allotted time. Provisions on group exercises as follows:

In the subgroup with two types of objects are: The leader and members

+ *The job of the leader to do:*

(first). 3 hours after the starting time to complete all distention group task: assigning tasks to each member of the group (who do somewhat, maybe more people doing the same content) and post to the forum of the group (response)), notice must set out the term of a member must submit to the board team.

(2). In 2 hours after the deadline for submission team members head to sum up the results of all completed and sent to the board members of the group to participate in the discussion, attention must set deadline discussion (at 3 hours before the deadline for submission most group exercise teachers)

(3). In 1 hours since expiry discussion leader to sum up the results and editing of group exercises and submitted to the trainers.

+ *The work of the members*

(first). The group must submit all assignments on time as the leader

(2). Must proceed to complete group assignments

* Review score: total = 10 points

+ The results of group projects submitted: 5 points

+ The group participation exercises: 5 points

(- Leader (1): 1point, (2): 2 point, (3): 3 point;

- Members (1): 2 point, (2): 3 point)

Note: If the leader does not complete the task, after the time specified for each task to do (1), (2), (3), the other members of the group can snatch the right and stands out as this time the leader and the leader became a member

The group of students doing homework at the request of the teacher and then as a teacher send files via the online assignments for the specified time. Also each student must send an email ballot teacher assessment of student group activities with students in the form.

- Through group exercises will help students develop the ability to organize and teamwork thinking while using the rubric group activities will help teachers accurately assess the results and to minimize is the dependence of student complaints of participation as a group exercise.

Teachers receive graded assignments and sending feedback to the student group.

f. Test the end of the topic

Organized as a test consisting of 50 questions presented with a duration of 50 minutes to by all, content includes QUESTIONS:

+ 20 Questions of self-examination questions section reviews the results of the self-study online lectures.

+ The question of section 20 apply in practice.

+ 10 questions of the extension of knowledge.

- Time for assessment by teachers and are held immediately after the time online meeting place.

Students can participate only one time test results are saved system, teachers use the results to assess the learning outcomes of students.

g. Conclude

Through this section to help students find their key knowledge needed thanks.

h. Test between courses and test the end of courses

Each theme has 70 multiple choice questions, so with banks 420 questions used to the test subject's exam room online at the school mid-term exam and test their end.

2.3. The result assessment of the online courses

2.3.1. Qualitative assessment:

For students: Due to regular participation in class activities through the Internet, students actively in learning, no complaints ideological dependence on friends and learn new exam time. The use of electronic lectures quality, personality test systems, discussion boards / individual assignments and group exercises stimulate thinking ability and creativity of learners.

For teachers: The suitable assessment of study result has estimated the right ability of learners. Especially, it can reduce the cheating of students when using the online learning system.

2.3.2. Quantitative results:

In order to confirm the quality of pedagogical experimental phase, we conduct processing mathematical statistics on the results of 2 classes, Experimental class and Control class. Processing results obtained statistics as follows:

Table 2. Table frequency of exams after graduation

Group	Number of student	A (8.5-10)	B (7.0-8.4)	C (5.5-6.9)	D (4.0-5.4)	F (< 4.0)	$\overline{X}$	S^2	S
Control (C)	37	0	17	13	1	6	4.71	0.94	0,82
Experimental (E)	48	5	23	10	3	7	6.48	0.68	0.97

Next, we use t-student tests to see and check the effectiveness of the pedagogical experiment, results $t = \sqrt{\frac{X_E}{S_E}}$ = 2.58. Investigation distribution table t-student with degrees of freedom N = 48 and at α =0.05 excipients t_α=1.67. So t = 2.58 > t_α = 1.67. This demonstrates pedagogical experiment with tangible results.

Next we test the variance of the experimental class and the control class with the assumption class H_0: "the difference between group variance in the experimental class and the control class is not significant". We have the results of testing the following quantities: $F = \frac{S_E^2}{S_C^2} = 0.52$. Critical value F_α in the table distributed F investigations to the extent α=0.05. And with the degrees of freedom f_E = 48, f_C = 37, is 1.69. We see F< F_α. Accept H_0, mean that the difference between variance of the experimental class and

the control class is not significant.

To compare experimental results, we performed our testing hypothesis H_0: "the difference between the average score in 2 sample is not significant with the same variance. The level of significant $\alpha = 0.05$, check table t-student distribution with degrees of freedom is $N_E + N_C - 2 = 48 + 37 - 2 = 83$ that we have $t_\alpha = 1.66$. Value test is calculated by the following formula:

$$t = \frac{\overline{X_E} - \overline{X_C}}{S\sqrt{\frac{1}{N_E} + \frac{1}{N_C}}} \quad \text{with } S = \sqrt{\frac{(N_E - 1)S_E^2 + (N_C - 1)S_C^2}{N_E + N_C - 2}}$$

Result: $t = 1.69 > t_\alpha = 1.66$. Confirm the hypothesis Ho is rejected, provided that the difference between the average score at 2 sample are significant. The test results demonstrate the learning outcomes of the experimental class higher than the control class. From the above analysis demonstrates knowledge as well as learning quality of the experimental class ahigher than the control class. This demonstrates that the organization form of our teaching is effective for students learning.

3. CONCLUSION

Contents of the paper offers design and organization online courses teaching computer architecture. This system is currently being used for online training modules for Computer Architecture Faculty of Information Technology - Viet Tri University ofIndustry, Vietnam. The results of our research will contribute to improving the quality of online education.

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BLOCKCHAIN – TECHNOLOGY FOR CHANGES OF FUTURE EDUCATION

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ABSTRACT

Blockchain, the underlying technology behind the cryptocurrency Bitcoin, is becoming a prominent topic for application in various fields, including education. However, comparing to other fields, the interest of educators remain low, reluctant is still the dominant attitude of the majority of researchers and administrators. Therefore, if educators want to explore the possibilities of blockchain, what should they know? This paper is based on the results and opinions of numerous researchers, to motivate and evaluate the potential of blockchain to be implemented into the field of education.

Key words: Blockchain, decentralized ledger, crypto currency, new education, decentralized database

1. INTRODUCTION

In 2001, researchers had designed and implemented a system to Napster, but did not a central control center to distribute educational content to other non-competing people to share. However, Napster had not achieved that because public education institutions did not like change or commitment. The consequences of this are that education continued with obsoleted methods, overlapping in contents and inability to share the achievement of students. Theories are slow to satisfy the new requirements from empirical practices. Will history repeat itself and blockchain suffer the same fate as its predecessor?

However, with recent development, Sony is planning to launch an experimental system, powered by Blockchain. A group of Mozilla employee has published new development on SXSWedu about the potential of blockchain in the field of education, forcing people to rethink their approach on education, as well as realizing that further research need to be done. The goal of this group is to create a clear conclusion on blockchain, a technology that is not too complicated but also not too simple to say that (LakshvaNarula, 2017) "Blockchain is the most important creation of our time." Through that introduces people in the field of education, making them more interested to student about blockchain and its application in education. So, what is blockchain? Can blockchain be used in education? And if we accept blockchain in education then what do we need to focus on?

2. THE ARGUMENT FOR IMPLEMENTING BLOCKCHAIN IN EDUCATION

Education is the tools to develop skill and provide knowledge. An effective educational foundation need to have trustworthy evidence on the ability of students, creating opportunities for students to share knowledge, experience and collaborate in research, contributing to the development of society. In order to ensure that information is useful, is has to be examined and proven. However, up until now, this process has been time consuming, usually require documentation and close up examination of each individual case. A development based on blockchain technology can help solve these problems on distribution and trust, but in the current stage, it might not be fair to accept a leveled technology, if it has to go through a centralized system. Therefore, the problem of why we need to use blockchain?

2.1. What is Blockchain?

On a technical level, blockchain is a decentralized database, spread among numerous computes and do not subject to control from centralized agencies. Blockchain is predicted to change the very basis of management technology, the flow of the economy, as well as the definition of business and function of

organization. And with this methods, blockchain has not only exist in the digital world as Bitcoin, Ethereum but also in numerous other services and goods like study results, research, contributions, creation, certification and personal development.

Each “block”is the prove for transparency with a time stamp to record and provide proof of all unchangeable transactions, instead of relying on confirmation of a third party. This method does not allow a similar transaction to be replicate with a different person.

In every day live, even when communicating with other, people still prefer to be able to cut out the intermediary. Using blockchain will not require a central data center as everything is publicly distributed, digitized, and synced. All transactions are recorded with date and time, and other details, and then it is digitized with very smart compilation system.

About the confirmation of all transaction based on the principal of common and public agreement, this ensure that blockchain will be the most effective tools for processing transactions, safer and more transparent, saving huge amount of time and work. With the development of the internet of thing, the world is hoping for the development of the potential blockchain technology.

2.2. Who can use blockchain?

Blockchain can be used in personal, common, public and international education institutions. In reality, everyone that demand safekeeping of proof of their work, study, and certification and create meaningful educational data can use blockchain technology.

2.3. Why is blockchain important?

When education becomes more varied, more democratic, leveled and decentralized, everyone still needs to retain their identity, trust in certification and proof of education. The focus on work that require specialization and usinglabor will also push it toward this trend as everyone desire more transparency. With an open database, online, safe, blockchain will provide such a system.

2.4. How does one use blockchain?

+ For individual small scale-education institutes

Blockchain is a ledger technology for financial application but when applied into other fields, blockchain can still be used to record other types of transactions. In education, this application can be to acknowledge the completion of homework or a course, recording publication of research, blogs, or books; it can also be result of exchange, agreement, or more simply expressing agreement, retweeting, etc. The question is what does the user gain and loss when educator record and valuate these transactions or actions?

+ Group of education institutes

When many institutes cooperate, the creation of databases to share certifications and achievements is necessary. Recently, group of universities Delft, EPFL, Boston, ANU and UBC have entered into an agreement similar to that to create a common databases for digitalization of certification. Blockchain can also be used by these institutes to organize a global database of international university. In short, any organization, education institutes, using blockchain can ensure they can share information at very low rate.

+ National blockchain database

Educators always want to explore information about ethnicity and countries. Even in the EU, this need

is still exist as an unsolved problem. However, in a country, this need requires an approach that incorporates multiple standards, building on all levels in the system: middle schools, colleges, universities, academies, valuation committees, economic consortiums, employers, etc. There is a real need for a database above all these organizations, and that is the blockchain technology.

+ Global evaluation:

Our current certification system is not adequate for the goal of the field of education. A system relies on documentation cannot avoid loss or even frauds. With the number of students and employees increase drastically and the need of changing study become more frequent, the establishment of a centralized database on certification and academic achievement would be a disruptive development. No matter if students transfer to any other institutes, work, or other country, they do not need to carry around their certifications. Forms of safe, online database like blockchain will be extremely useful.

The validation of student capacity will be the first implication of blockchain. However, this topic remains convoluted, waiting talented management to resolve. Sony Global Education is research into creating a blockchain use to validating students' scores. This group is hoping that schools can use this service, so that individual can share their information with other third parties, like employers, LinkedIn etc. with further implication for global coverage.

3. NOTEWORTHY RESEARCH OF BLOCKCHAIN APPLICATION IN EDUCATION

There are now numerous research group focusing on exploring the potential of blockchain in education. For example:

- Blockchain can be used to better manage tests, certification and grades like OTLW or BadgeChain. Blockchain will be used to manage recognition and "smart contract", implement and evaluate "standards", confirming "Certifications and Degrees".

- Ideas for signing up with different university certification on the same database will result in a blockchain solution that transform it into a Diploma shop in certification.

- View blockchain as the most focused technology by using ethereum with a smart contract to allow for determine deadline for copies, announcing results and publishing within minutes.

- Creating a database that allows the validation of name, birthday of students on their score cards and their characteristics such as their academic orientation. All of these data will never be erase from the system.

- Using conditioned smart contract of Ethereum to help educators finish class on time and ensure course end according to established timelines. By using working condition based on "if-then-else" program, school can remind or force educators to finished course according to timelines.

- Connecting students' arrival time with their parent's accounts, by register information transaction on the blockchain. Students will always have proof for their appearance in class and the time that they have used for study and research. This will help establish trust with parents.

- Using Blockchain to effectively manage the process of paying tuition, reducing the work of school accountants. This is especially meaningful for large schools or school with numerous branches around the world.

- Better assistance to employers when there is an education platform based on blockchain. Because everything related to documentation will be recorded in the blockchain, as well as provide a chain of event for future review.

- A public blockchain can become a public database for all educational purposes, recording achievement and work experience. University and other training facilities like vocational school, military can use suitable smart contracts to connect with public blockchain to permanently record information, achievement in education.

- Create opportunity for students who seek further education, or help working professional to achieve further education. On the other hand, help people who desire to teach but not as a full-time job. Schools can use blockchain to create a platform to connect these people and ensure money is paid through crypto code.

- Leveled "knowledge sharing boundary" allowing a new type of education. A platform can create new certifications and degrees according to new standards, abolishing the traditional education system, heavily focus on program dictated by the government. By using blockchain to connect with SMEs, creating courses that have practical application in a corporate setting.

- Students that took online courses that have not download all their course materials unusually discover that the course materials have been delete for some reasons. If these course was on the blockchain then this situation will not occur.

- Assist project workers, where teachers are paid to create courses with situation content for their clients. Nowadays, students need a lot of effort to learn new things, and everyone is expecting to learn and apply into work and their careers/ aneLearning blockchain project will helps solve these problems and students can work and have income from earlier days of work.

- Continuous Career Development is always a hard problems to distribute, it is usually fragmented and low quality. If there is a blockchain system that focus on this, we can easily get information from courses that were announce at meetings, training courses and other types of education. Teachers and experts can received investment from trusted providers. If all knowledge and experience for education is stored in a safe and trustworthy system, there will be incentive for people to focus on career development.

- Create room for study in company. Companies provide a large amount of need for education for their employees but recording achievement is not an easy task. Technology that deal with education and talent management like SCORM is old and obsolete. Using Blockchain is necessary to have a safe and open system to not only for internal but can also be used when employees have left the company.

- Pushing vocational study, vocational education nowadays is a large business, government around the world has admit their shortcomings of focus too much on pure academic training to provide graduated education. In England, a three-million vocation education opportunities is supported through wages. This a complicated system because when employers have to take part in management and distribution, the question raised is that how will they manage the entire system effectively? Blockchain has real potential because it can provide a central nationwide database to transparently validate the entire certification process.

- Knowledge center like Wikipedia or Khan Academy, science journals, OER, or even research institutes can create certification from their own systems. John Helmer (Donald Clark, 2016) has provide an idea to validate identification to access to educational materials through library administrators. Replacing some current systems like Open Athens, Shibboleth that use centralized ledgers that have serious problems, Blockchain can ensure a stronger platform for validation.

- In addition, blockchain can be used for numerous study experience from various sources to collect macro experience, benefiting from micro transaction models. Instead of using traditional transactional system that rely on expensive third parties, using blockchain allow for free transaction between the parties. This will open up new opportunities for payment to use educational sources, courses, etc. All in

all, using blockchain allows liberation of the system, making education become more open and flexible. These reasons have proven that blockchain is surely a positive development for the future of education.

4. CHALLENGES IN USING BLOCKCHAIN TECHNOLOGY

Using blockchain can cheaply record students' achievement safely and cannot be forged as well as public through ledgers, recording information on a global network, reducing cost and time for documentation and validation of students' certification. However, there are still a large gap from theory to practice. The potential to implement blockchain into education can only be shorten if the perception of educators, researchers, students, and administrators are changes. Currently, some education institutes have changed to use blockchain, however, they are also encounter various difficulties. Most noticeable:

- Princeton University has created MOOC on Bitcoin and blockchain based on Coursera. This has brought real change in education methods, forcing other university to change their perspectives. However, the validation is still no solid as all MOOC separate providers give certifications. MOOCs organizers have hope that by using blockchain, their problems concerning wider reach with their certification will be resolved.

- When asked about building a validation of education platform based on blockchain, Chairman of Global Educational Corporation Sony Masaaki Isozu told Education Week (Noelle Acheson, 2017): "We want to record documentation on study on the cloud forever, students and educators can share their information validation safely." Blockchain will create a permanent records, usable for all facets of education, especially if we view education of a changing and growing process.

- Open inicjatywand Open Badges is collecting proof of certifications, to build a database that can fight against forgery to serve educational purposes. According to Doug Belshaw (David Matthews, 2017) if using blockchain is a perfect solution to the pure validation problems, we will solve the complexity about open source, scale and cost for the validation of identity, achievement of students. MIT is currently using blockchain Bitcoin to certify and provide open source codes.

Holburton in San Francisco, a programing school that specialized in providing education program for projects to replace university cources, has announced that they will use blockchain to store and distribute their certifications to prevent forgery. Digitize and validate is two basic elements to create, sign and input certifications in the blockchain database. The school will still provide student with paper copies of their diploma, but a distribution system will help employers validate the students' information. Sylvain Kalache, cofounder of Holberton (Luke Graham 2016), told CNBC through email "Using blockchain also mean that the school will save money from building and maintaining its own database. Because of decentralized nature of blockchain, it is unchangeable, permanent, and always available and safe."

- University of Nicosia in Cyprus also using blockchain technology to record their students' achievement and proving its popularity. George Papaeorgiou, lecturer in cryptocurrency said (Luke Graham 2016) "We will receive attention when we use it in practices, students will be happy when they can validate their knowledge because blockchain has validate that their certifications are real and cannot be replicate." He believes that this will create trust for both the students and potential employers, helping them to check by themselves to see if the certifications are real or not.

Recently, Sony Global Education has announced their plan for a service to help students share information safely; they can share their test results with other potential employers. In a public announcement, Sony Global Education said (Don Tapscott and Alex Tapscott, 2017) "This technology has the potential to realize a new foundation system to share document safely in any form possible, opening new opportunities for student records and how we evaluate them."

- Ed Featherston, CTO of Collaborative Consulting (Luke Graham 2016) review that he is working

with some university to implement blockchain technology. Other than using it to monitor and record students' work, they are also considering provide small courses and other certification over blockchain. He said "Its low fee from a system point of view and transaction has provided a more possible implementation". Featherston also reviewed that by having a record of students on the blockchain will mean that can more easily control who seem it and will benefit people who want to chance the education environment.

- Some schools have begun to experiment with blockchain, primarily to validate passwords. Including MIT with Media Lab, Nicosia University and Holberton in San Francisco, King College in New York and University of Simon Fraser in British Columbia have announced that they will accept tuition payment through blockchain.

5. CONCLUSION

Blockchain is a technology that can be readily implement into the field of education on a personal, systematic, group, country and global levels. It can connect all types of education institutes from university, college, MOOC, CPD, corporates, vocational and knowledge facilities. Using blockchain technology with its decentralized characteristics will change the traditional fragmented system, based on the brand value of institutions to create trust. Even though in the financial world, where blockchain is a popular topic, with banks creating new services base on blockchain, fostering an environment where blockchain has a clear advantage. Still in the field of education, in order to achieve trust beyond technology, the world need to look for a hybrid model, not managing blockchain only as a transactional platform. Identity will continue to be a problem that depend on quality of teaching, teachers, research, etc. Blockchain will play a role as a web platform for teachers and students without the need for administrative agencies. However, it has to be recognize that blockchain does have its shortcomings. In recent time the management of cloud data on the blockchain platform has lost 500 million Bitcoins. Or that the USA will have to prohibit the use of Bitcoin in order to minimize the trading of narcotics on the infamous "Silk Road", which rely on Bitcoin.

Yet, the largest obstacles to wider implementation of blockchain is culture. Education has always been the slowest to adapt and accept new development. Despite its superior advantages, the educational world will still be slowly to adapt blockchain, because the majority of financial and cultural aspects still revolve around the individual. As history has proven, Bologna was dead when it was signed, because no one want to lose students and suffer financial losses, but it has become the standard for education in Europe. This showed us that the stimulus for changes must come from somewhere else. Besides, there is one thing for sure that is students are always open-minded and want to explore other alternative choices. Therefore, we can say that a blockchain based education system has to be an organized changes from the students, such as with Bitcoin, the blockchain evolution will also spark from the left side of education. In conclusion, knowledge and wealth of the worlds are in the hands of the technologically inclined, in which blockchain will be at the forefront of technology.

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FABRICATION OF INORGANIC CALCIUM SILICATE HYDRATE FROM MEKONG-DELTA RICE HUSH FOR THERMAL INSULATOR MATERIALS

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ABSTRACT

Vietnam is an agriculture country, in which produce lot of rice and its by product is rice husk ash (RHA). The RHA in Mekong Delta is consider as waste of agriculture industry, and treated by burn in the open air. This process cause air pollution, thus attracted Vietnamese researcher to find alternative method to reduce the impact of rice husk ash to environment. The research group in Department of Ceramic Materials aim to reuse rice husk ash as source of Silica (SiO_2). It need to emphasized that the main content of rice husk ash is silica. This research report new technology to mixing RHA and CaO with the Ca/Si molar ratio of 1.0, in order to synthesize calcium silicate hydrate (CSH) such as Tobermorite (C5S6H5) and Xonotlite (C6S6H) as environmental materials. The advantage of our study is utilize the Vietnam RHA in Mekong Delta and reduce the impact on environment by using hydrothermal treatment technique.

Key words: calcium silicate hydrate, rice hush ash, hydrothermal treatment, ceramic.

1. INTRODUCTION

Vietnam is an agriculture country, in which produce lot of rice and its by product is rice husk ash (RHA). The RHA in Mekong Delta is consider as waste of agriculture industry, and treated by burn in the open air. This process cause air pollution, thus attracted researcher to find alternative method to reduce the impact of rice husk ash to environment [1-3]. The research group in Department of Ceramic Materials aim to reuse rice husk ash as source of Silica (SiO_2) [4-8]. The obtained silica can be used as stating materials to reaction with calcium source to form calcium silicate hydrate (CSH). By this chemical reaction, we can utilize the Vietnam rice hush for sustainable development.

2. MATERIALS AND METHODS

2.1 Preparation of Vietnam Rice Husk Ash (VRH)

Rice husk was burn at 600^{o}C with the heating rate of 10^{o}C/min (Naberthem 1400, Nabertherm, Germany), then soaking at 4 hours for complete burning. The phase composition of obtained VRHA was characterized using X-ray Diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). The chemical composition of VRHA was analyzed using X-Ray Fluorescent (XRF) method.

2.2 Preparation of CaO

CaO was used from the commercial without purified (Xilong Chemical, China). The phase composition of commercialized CaO using XRD.

2.3 Hydrothermal treatment the mixture of VRHA and CaO

The mixture of VRHA and CaO was mixed with the Ca/P molar ratio of 1.0 with the moisture of 10% (weight percent) then pressing at 30 MPa to form the compact disk with diameter of 9 mm. The compacted cylinder is hydrothermal treated at different temperature for 24 hours to obtain calcium silicate hydrate such as tobermorite and xonotlite.

2.4 Phase analysis

The powder Xray Diffraction (XRD) patterns of disk samples were recorded with a vertically mounted diffractometer system (Bruker-AXS: D8 ADVANCE, Germany) using Ni filtered CuKa generated at 40 Kv, 20mA.

2.5 The chemical composition of samples

Were characterized by XRF (ZSX, Rigaku, Japan) operated at 40 kV and 40 mA.

2.6 The bonding chemical of samples

Were characterized by FTIR analysis: the sample were ground into fine powder, mixed with KBr powder at the ratio 1:200. Infrared spectra were measure at a resolution of 2cm-1 using a Fourier transform infrared (FTIR) spectrometer (PerkinElmer 2000, USA).

3. RESULT AND DISCUSSION

3.1. Characterization of starting materials RHA and CaO

The chemical composition of RHA is shown in Table 1:

Table 1. The chemical composition of RHA (weight percent)

SiO_2	K_2O	CaO	P_2O_5	MgO	Al_2O_3	MnO	Fe_2O_3	SO_3	other	LOI	Total
92.7	3.16	1.33	0.596	0.466	0.306	0.291	0.242	0.126	0.153	0.63	100

The phase analysis of VRHA is given in Figure 1, indicating that VRHA is composed of crystaballite, which the peak of crystabalite at 22^o (PDF# 01-082-0512).

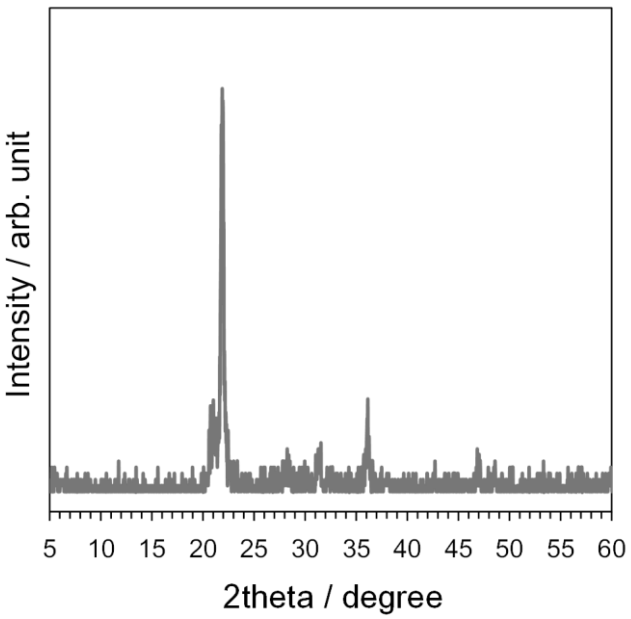

Fig 1. XRD pattern of VRHA

The FTIR of VRHA is given in Figure 2, indicating that the main chemical bonding of VRHA is O-Si-O, go well with XRD data given in Figure 1.

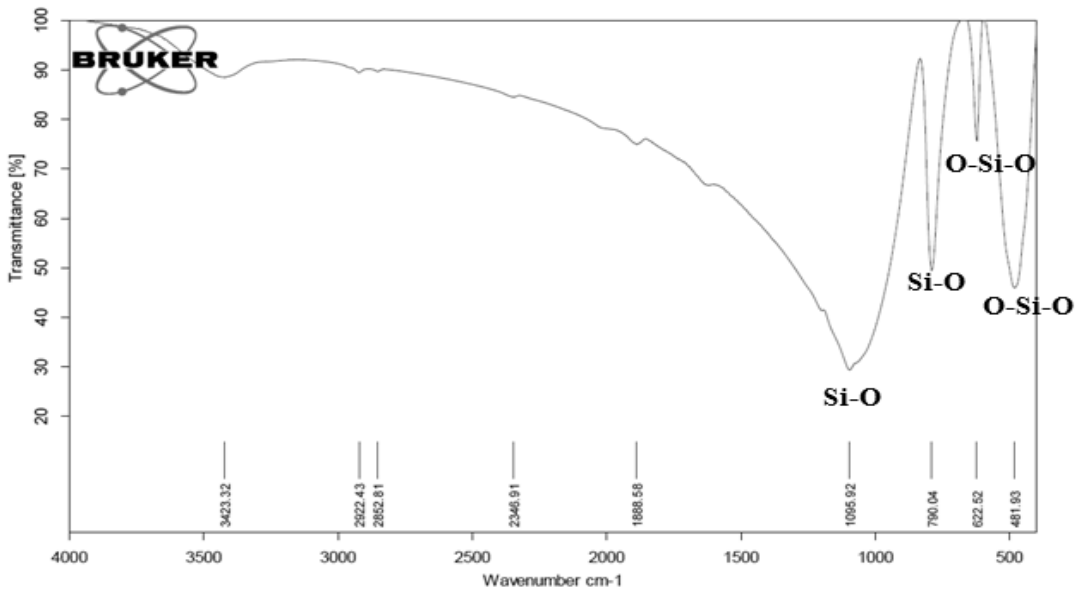

Fig 2. FTIR spectrum of VRHA

The phase analysis of CaO is given in Figure 3, indicating that commercialized CaO is puried (which the peak of CaO at 32^o, 37^o and 54^o corresponding to PDF# 01-077-2376) and can be used for further reaction.

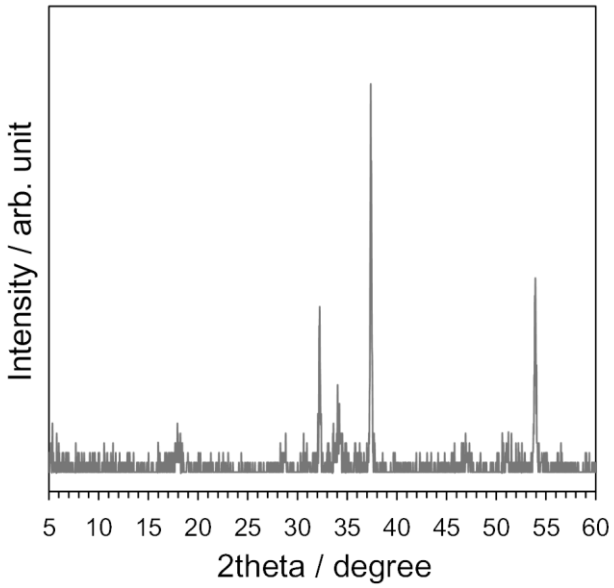

Fig 3. XRD pattern of CaO

3.2. Characterization of hydrothermal sample at 110°C and 200°C for 24 hours

The phase analysis of mixture of VRHA/CaO before and after hydrothermal treatment at 110°C, and 200°C for 24 hours.

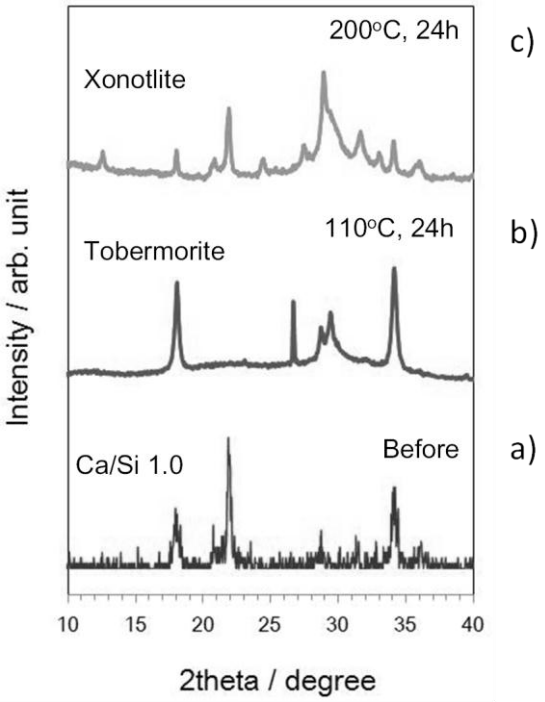

Fig 4. XRD pattern of mixture of VRHA/CaO before and after hydrothermal treatment at different temperature: (a) before; (b) 110°C to obtain Tobermorite; and (c) 200°C to obtain Xonotlite

Before hydrothermal treatment, the phase composition of sample is crystobalite and $Ca(OH)_2$. The present of $Ca(OH)_2$ is given by hydration of CaO and water during the mixing process. After hydrothermal treatment, we can observed the new phase of Calcium Silicate Hydrate (CSH), Tobermorite (at 110°C for 24 hours) and Xonotlite (at 200°C for 24 hour). The morphology of sample before and after hydrothermal treatment at 110°C and 200°C for 24 hours also were given at Figure 5.

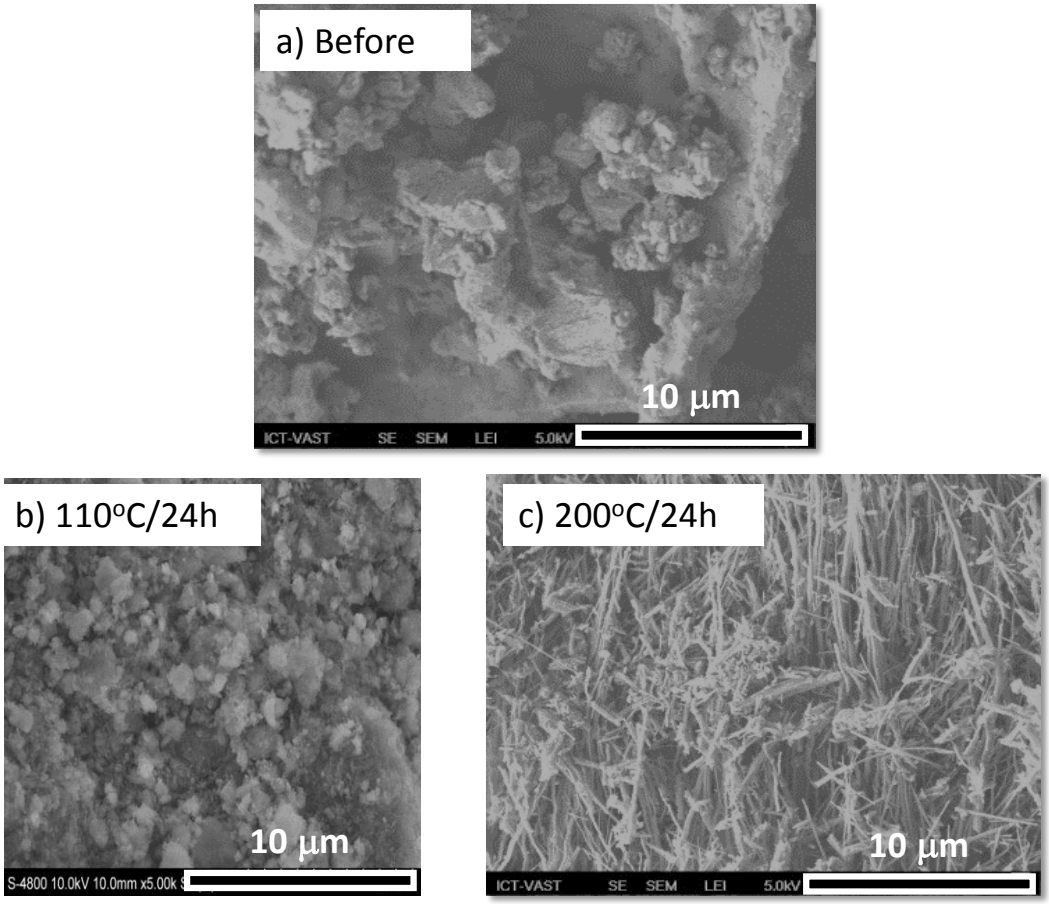

Fig 5. SEM images of sample before and after hydrothermal treatment at different temperature: (a) before; (b) 110°C; and (e) 200°C

We can observed the morphology changed of sample before and after hydrothermal treatment with the increasing of hydrothermal treatment temperature. At 110°C and 200°C, we can observed the new pore, while the morphology transitionally changing from polyonal-like shape to needle-like shape and these needle-like shape crystals are interlocked together (Figure 5c). The size of new needle-like shape also increased with the increasing of hydrothermal treatment temperature (Figure 5b, 5c).

4. CONCLUSIONS

By using hydrothermal treatment of the compacted of VRA and CaO with the molar ratio of Ca/Si 1.0, we can synthesize Tobermorite (C5S6H5) at 110oC and Xonotlite (C6S6H) at 200oC. Both Tobermorite and Xonotlite are calcium silicate hydrate, and can be used as thermal insulator materials. Thus, this research can contribute to the sustainable of Vietnam rice hush industry, especially in Mekong Delta area. Further research on using different kind of rice hush is awaiting for publication.

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SOLUTIONS IN DRYING TECHNOLOGY BY CONVECTIVE VACUUM METHOD FOR IRONWOOD (XYLIA XYLOCARPA) AT KIEN GIANG PROVINCE

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ABSTRACT

The drying time varies from 7 to 35 days depending on the thickness of wood. To reduce drying time, saving energy and improve quality wood should be changed the method. So the convective vacuum drying was one of the best method which applied the experimental at our laboratory. To set up the the drying regime for Ironwood (*Xylia xylocarpa*) follow the temperature and heating time and pump time. The result showed that the temperature and heating time and pump time effected to rate of evaporation. This relation was showed to pass correlate equation as follows: (code form) Y_{ta2}= 1.89441 + 0.347742.x_1 + 0.16119.x_2 –0.0398733.x_3 - 0.05875.x_1.x_2 - 0.06875.x_1.x_3 – 0.0374926.x_2^2 – 0.0392603.x_3^2. when Y_{ta} = 2.6557(%/h), with x_1 = 1.682, x_2 = 0.8318, x_3 = -1.682. Ironwood has been max rate of evaporation when the temperature T = 58.41^{0}C, when heating time 3.41 (h), pump time 1.16 (h) obtained drying time: 93 hours, defect of wood: 3.5%, MC of wood: 8-10%.

Keywords: convective-vacuum drying, technological solutions to drying wood

1. INTRODUCTION

The process of drying wood using the conventional air-drying method is both time-consuming and inefficient. Using a high temperature for drying can cause both the destruction of the wood structure and warping from increased moisture stress. The economics of vacuum drying have become more favorable, especially for drying thick, refractory, high-value species. The most attractive advantage of vacuum drying is the lowered boiling temperature of water in a partial vacuum which allows free water to be vaporized and removed at temperatures below 100°C almost as fast as it can at high-temperature drying at above 100°C. At a lower drying temperature, wood is stronger and can withstand a greater internal stresses without defects occurring [2-4].

During the phase of vacuum, there are two regimes of mass transfer between wood and the environment: the first called active regime in which the vacuum pump is working, the second one is called passive regime in which the vacuum pump is stopped.

2. MATERIALS AND METHODS

2.1. Materials

Specimens of green Ironwood (*Xylia Xylocarpa*) 50 mm by 50 mm by 500mm in length, were dried in a series of experimental runs were taken from Kien Giang province, Vietnam. Each piece of green timber came at about 500 mm in length from the sawmill and provided end initial moisture content samples was approximately 70% dry basis.

2.2. Methods

The Ironwood board is placed on rack support inside the chamber. After entering the chamber, the temperature inside the chamber was controlled using a temperature controller and heating coils. the air inside the chamber was removed using a vacuum pump The evaporated vapor was condensed using a condenser and collected in a liquid trap.

Wood samples were obtained from Ironwood. The samples were drying by vacuum drying method. Experimental design is summarized in Tab. 1.

The rate of evaporation for each vacuum drying was calculated following formula (Eq. 1)[3-4]:

$$Y_1 = \frac{W_1 - W_2}{T_s} \quad (1)$$

Where: W_1: MC of wood before (%) W_2: MC of wood after (%)

T_s: time of drying (h) Y: rate of evaporation (%)

3. EXPERIMENTAL RESEARCH

It was employed an experimental design, consisting of 20 experiments with three replications at the central point, with three independent variables: temperature (x_1), heating time (x_2), vacuum time (x_3), these were transformed into coded variables (x_1, x_2, x_3) respectively. Dependent variable (Y_1) was the rate of evaporation. The study of the effect of the different factors on the response was carried out using Statistics for Experimenters –Box, Hunter & Hunter complete factorial design (20). The experiments were performed in a random order to minimize the effect of the uncontrolled variables [3-8].

Number experimental : 20

$$N = N_1 + N_\alpha + N_0 = 2^3 + 2 \text{ x } 3 + 6 = 20$$

To rely on result of exploratory research to determine the value of input factor

Mathematical model

$$y = b_o + \sum_{i=1}^{n} b_i x_i + \sum_{i\#j=1}^{n} b_{ij} x_i x_j + \sum_{i=1}^{n} b_{ii} x_i^2 \quad (2)$$

Where:

Y_i: Output factor

x_i , x_j: Input factor

b_o, b_i, b_{ij}: Recurrent coefficient

Table 1. Level and range of input factor

No.	Level and range of input factor			
	Factor	***Temperature*** $T(^0C)$ x_1	***Heating time*** G_n (h) x_2	***Vacuum time*** H_k (h) x_3
1	$+\alpha = +1{,}682$	58.41 58.41	3.84	2.84
2	+1	55	3.5	2.5
3	0	50	3	2
4	-1	45	2.5	1.5
5	$-\alpha = -1{,}682$	41.59	2.16	1.16
6	Δl	5	0.5	0.5

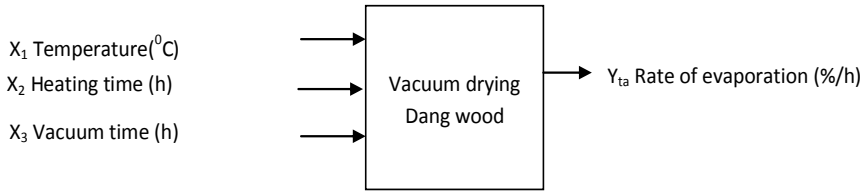

Fig 1. Process of vacuum drying wood

Fig 2. Ironwood (Xylia Xylocarpa)

Fig 3. Experiment of vacuum drying wood

Fig 4. Test the MC of wood

Caculation and data processing

Using the statgraphics Vers 7.0 program for determine coefficient and variance analysis. Using the Matlab software to slove a optimal problem.

4. RESULTS

After Fig 3 showed the actual equipment constructed. The Ironwood board is placed inside the chamber. After entering the chamber, the temperature inside the chamber was increased 40-58^{0}C (follow the tab.1) for 2.1-3.8 hours the air inside the chamber was removed using a vacuum pump. The evaporated vapor was condensed using a condenser and collected in a liquid trap

Pieces of Ironwood boards were dried for simultaneously for each of the conditions indicated in Table 2. The drying rate for each condition was obtained by measuring the weight of the wood board after each period of drying. The initial moisture content of the wood was determined by cutting a small piece of the board and drying it in a 100°C oven for 48 hours (modified from AOAC, 1990). The result show the figure and table 2,3 below

Table 2. Rate of evaporation water in wood during vacuum drying

No.	Rate of evaporation water in wood during vacuum drying			
	X1	**X2**	**X3**	**Y_{ta2}**
1	1	-1	-1	2.17
2	0	0	-1.682	1.79
3	0	0	0	1.93
4	-1	1	-1	1.65
5	-1.682	0	0	1.21
6	0	1.682	0	2.02
7	1	1	-1	2.41
8	-1	1	1	1.82
9	0	0	0	1.95
10	0	0	1.682	1.71
11	0	0	0	1.89
12	0	-1.682	0	1.49
13	0	0	0	1.85

No.	Rate of evaporation water in wood during vacuum drying			
	X1	X2	X3	Y_{ta2}
14	1	-1	1	1.96
15	-1	-1	1	1.24
16	1	1	1	2.14
17	-1	-1	-1	1.34
18	0	0	0	1.84
19	0	0	0	1.96
20	1.682	0	0	2.47

The mathematical statistical model, which represents the response function, is equivalent to Equation (2). In the canonical equation fitted to the experimental data, the dependent variable Y_{ta2} is rate of evaporation (%), in which significant terms at the 5% level are shown with an asterisk.

$$Y_{ta2}= 1.89441 + 0.347742.X_1 + 0.16119.X_2 - 0.0398733.X_3 - 0.05875.X_1.X_2 - 0.06875.X_1.X_3 - \\ - 0.0374926.X_2^2 - 0.0392603.X_3^2 \quad (3)$$

It was found that only (x_1), (x_2), (x_1x_3), (x_1x_2), (x_2^2) and (x_3^2)) were significant at the 5% level, with *p* values lower at 5%. All terms significance, except for the (x_1x_2) had positive coefficients, indicating that they positively influence the rate of evaporation

After checked the equation (3) following Fisher standard with $\alpha = 0.05$. and $F= 2.39 < F_{1-p} = 4.8759$ => suitable model so the equation compatible experimental.

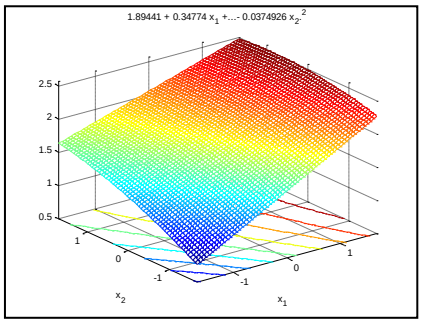

Fig 5. Effects of (X_1) and (X_2) in the rate of evaporation (%) at their optimum values during vacuum drying

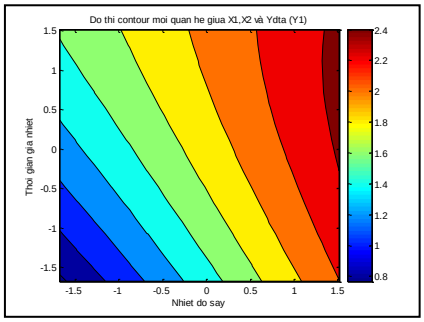

Fig 6. Effects of (X_1) and (X_2) in the rate of evaporation (%) at their optimum values during vacuum drying by contour chart

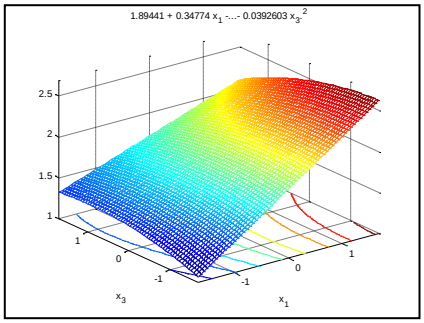

Fig 7. Effects of (X_1) and (X_3) in the rate of evaporation (%) at their optimum values during vacuum drying

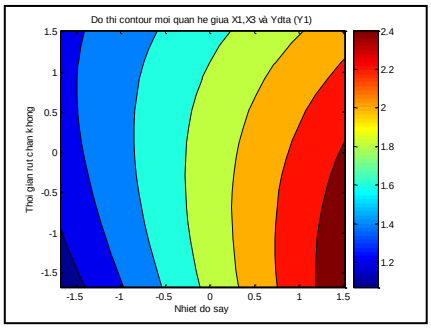

Fig 8. Effects of (X_1) and (X_2) in the rate of evaporation (%) at their optimum values during vacuum drying by contour chart

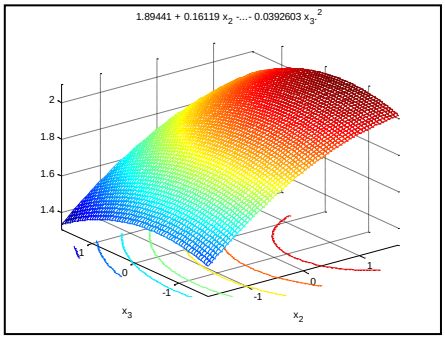

Fig 9. Effects of (X_2) and (X_3) in the rate of evaporation (%) at their optimum values during vacuum drying

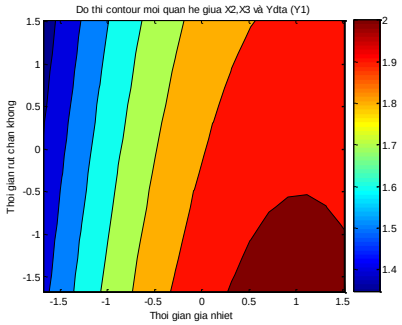

Fig 10. Effects of (X_2) and (X_3) in the rate of evaporation (%) at their optimum values during vacuum drying by contour chart

Considering that the model was validated, it was used to generate the response surfaces, with the objective to optmize the process. Figure 5,6,7,8,9,10 shows the effects of the main variables (x_1) and (x_2), (x_3), at their optimum.

Table 3. Optimal values of Y_{ta2} (%/h)

In put		Values		Output		Optimal values
Code	Real	Code	Real	Code	Real	
X_1	T_n	1.682	58.41 (^oC)	Y_{ta2}	D_{ta2}	2.6557 (%/h)
X_2	G_n	0.8318	3.41 (h)			
X_3	H_k	-1.682	1.16 (h)			

The changes in moisture content for samples of dang boards were shown for the drying of Ironwood and expressed figure 11.

The results indicated a simlar drying trend with a nearly constant rate of drying occuring during the first 27 hours when the moisture content was reduced to 30%. After that, the drying mechanism entered the falling period in which the bound water was gradually removed for the next 66 hours until the average moisure content reached 10%.The effect of temperature on vacuum drying operation is presented. As expected, the high the drying temperature, the faster was the drying rate.

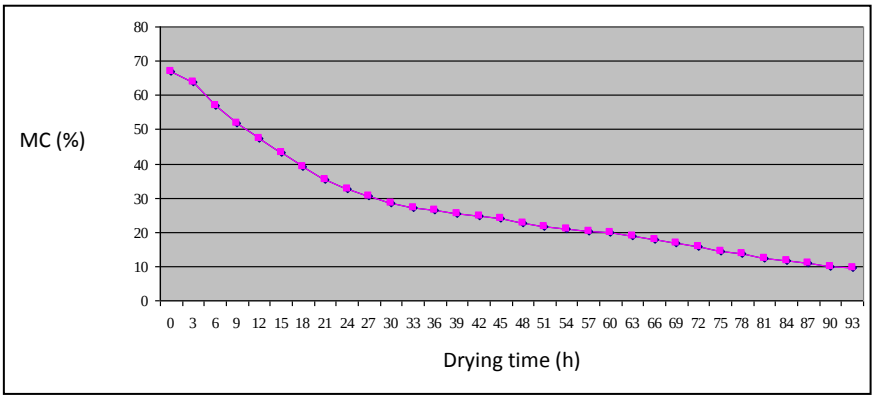

Fig 11. Moisture contents reduced curve during vacuum drying for Ironwood

There were no internal checks. There were small end checks in some samples, generally less than 5mm deep in the longitudinal direction. Surface checks were found in four samples out of 200 samples dried.The surface checks were less than 30mm in the length and extended less than 3mm deep. Warp was measured for each sample. The average amount of crook, bow, twist, and cup is 3.5%

5. CONCLUSION

A vacuum drying system was designed and fabricated and that system was used to dry green rough Ironwood dimension. It was simple and easy to construct, operate, and maintain. The experimental results supported the theory that during vacuum drying the water is removed from the end grain. Total pressure difference is the primary drying force. Ironwood can be dried from green 70% to 10% MC within 93 h at the optimal valuse with: temperature of 58^0C and pressure of 65cmHg, heating time 3.41h, vacuum time 1.16h. Drying is fast, reduce many defects of wood. It was found that drying stresses including both longitudinal and transverse were small. There were moisture gradients along the length with MC near the end grain lower than the MC at the center. There were small moisture gradients across the thickness. Drying quality was good with no color change. There were no internal checks. However, there were small end checks of approximately 5mm in length during drying. Only 3.5% percentage of samples developed these end checks. This study can apply the technology for many wood at Kien Giang province and contribute to improve quality of wood for using.

About technologycal solutions vacuum drying has 4 qualities which differentiate it from traditional kiln drying such as:

1. It dryes 3 to 5 times faster than conventional kilns and at a lower energy consumption. The drying speeds of these kilns are very fast as opposed to conventional kilns. Vacuum drying is especially competitive for drying difficult hardwoods such as Ironwood and is primarily marketed in the hardwood industry where high and uniform quality is important, e.g. in furniture, flooring, kitchen, musical instruments etc. and construction.

2. It does not darken the wood as traditional drying. reduction in drying defects

3. Vacuum drying is a closed system; a sawmill using traditional drying typically emit between 1.000 and 5.000 metric tons of VOC annually; in the vacuum drying most of the turpentine is captured in the condensate. As environmental regulation increases in the future, vacuum drying will become more competitive.

4. Kien Giang province located in the Mekong Delta, Kien Giang has a convenient location and a great economic potential. This study can apply for another species of wood in order to improve the quality of wood material.

6. ACKNOWLEDGMENT

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PRODUCTION STATE AND ECONOMIC EFFICIENCY OF AGRICULTURAL LAND USE AT THE U MINH THUONG & U MINH HA ZONE

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ABSTRACT

The household interview method was used to collect data about the production status and then calculate the economic efficiency of agricultural land use of the U Minh Ha in Ca Mau province and U Minh Thuong in Kien Giang province. The result of the study showed that the land use types in the study zone were various such as Rice crop, Upland crops included: Sugarcane, Pineapple, Ginger, Vegetable, Bananas, *Derris elliptica* crop and natural fishes. Most of the production lands were very variously from 0.75ha to 2.58 ha, except upland crops for Vegetables was less than 0.28 ha due to it is not enough labors. However, the cultivation models have brought in low economic efficiency, Rice – Ginger crop and Rice – Sugarcane – Ginger have high economic efficiency but benefit cost was low; *Derris elliptica* crop and Bananas crop have high economic efficiency but they were not popular in there yet. About the production status, most of the farmers who are major labors had low education level was ranging from primary school to secondary school, the farmer in the study area have long-term production experience, but they lack capital and equipment for production. The market of agricultural products in the area was advantages and information market also got from many reliable sources.

Keyword: economic efficiency, agricultural production, land use, U Minh

1. INTRODUCTION

The Mekong Delta is known as one of the largest agricultural centers in Vietnam and is globally influenced by diverse farming systems. Soil factors, resources water, and climate... have a great influence on agricultural production in the Mekong Delta (Trung N. H. et al, 2012).

Ca Mau and Kien Giang are the last coastal provinces of the Mekong Delta region with low terrain which region with diversified water resources and good conditions for agricultural development with diversified farming models. Inside, the U Minh region is in the extreme south of the Mekong Delta, before it had been located between Ca Mau and Rach Gia town, after reorganization and renaming of provinces, the provinces are Kien Giang and Ca Mau (R.J.Safford et al, 1998), this area includes U Minh Thuong national part and U Minh Ha national part, in addition to the conservation and development of forest resources, the development of agricultural economy for farmers in the area should be concerned about now. Before, there was the change land use in here, but this change has not brought economic benefits for the population because of limited technical knowledge, low economic, high risk and bad effect to the soil and water (Tan. Q. A., 2007).

In fact, there are many reasons leading to the unsuccessful in agricultural production such as the farmers have not choose the right cropping systems for their land, have not improved quality production and they also have a weak to call supporters for their products (Loi. L. T. et al, 2013), according to Duy, V.Q. (2017) the income of poor households in Ca Mau province of Vietnam is significantly affected by

various variables from the poor households' characteristics as well as economic issues. Such factors are the age of households' head, cultivated land area, and learning activities and the mean of productions.

On assessing the real situation of production, cases reviewed to support the conclusion that neither population nor poverty alone constitutes the sole and major underlying causes of land-cover change worldwide. Rather, peoples' responses to economic opportunities, as mediated by institutional factors, drive land-cover changes. Opportunities and constraints for new land uses are created by local as well as national markets and policies. Global forces become the main determinants of land-use change, as they amplify or attenuate local factors (E.F. Lambin et al., 2001).

The re-determination of the production status of the household as well as the economic efficiency of the agricultural models of cultivation that U Minh people are making from which proposed solver of development, improve household life is a necessary. So the topic "Production state and economic efficiency of agricultural land use at the U Minh Thuong and U Minh Ha zone" need to carry out.

2. THE METHODOLOGY

The study was done at buffer zone of U Minh Thuong National Park which is located in U Minh Thuong district, Kien Giang province and Buffer zone of U Minh Ha National Park which is located in U Minh district, Tran Van Thoi district, Ca Mau province.

The standard questionnaire was used to interview households.

- At U Minh Ha, Ca Mau province: The interview was done to households with popular cropping systems such as Rice, Bananas, Fish and *Derris elliptica* with total was 120 households.

- At U Minh Thuong, Kien Giang province: The 100 standard questionnaires were used to interview the households who have cropping systems such as Rice, Sugarcane, Pineapple, Ginger.

The information want to collect focus on the basic household situation, production activities and household incomes, inputs and outputs of agricultural production, investment in production, productivity, income and profitability of production, education level, access to scientific and technical, market and price, aspirations of the people, the advantages and disadvantages in production agriculture…

3. RESULTS AND DISCUSSION

3.1. The situation of land use

In the study area, the land area was allocated to farmers for cultivation included to planting the forest, agricultural production, and housing construction. According to Peter Mackay (2009), the livelihood system in the buffer zone is primarily based on agricultural production and is characteristic of the humid Mekong Delta coastal area in general. The farming system is predominantly rice-based, with one to three harvests per annum depending on soil fertility and the availability of supplementary irrigation.

The household would choose land use types to match capital and natural resource, according to Duy, V. Q. (2017), production land areas is significant and the poor household income have the positively correlated with because the production land can create a single significant source of income in rural farm production.

Land use types in the study area were very different, in the U Minh Thuong has been Rice, Sugarcane, Pineapple, Ginger, Vegetable…but in the U Minh Ha, the crops were less diversity than U Minh Thuong such as Rice, Banana, natural Fish and *Derris elliptica* crop.

In U Minh Thuong, the land area of the rice crop was the largest at 2.58 ha per household. However, it

is decreasing recently because of the low economic efficiency, the rice crop was changed to Pineapple or Sugarcane. While at U Minh Ha, the cropping systems like Rice – Banana – Fish crop was largest at 2.77 ha per household. The following were Sugarcane – Pineapple crop, Rice - Sugarcane – Pineapple crop Rice crop and *Derris elliptica* crop (Table 1 and 2). In general, the average cultivated area per farm household within U Minh Thuong & U Minh Ha around 4.0 ha (Peter Mackay, 2009) which is generally higher than other areas in the Mekong Delta.

Table 1. The average area of land use types per household at U Minh Thuong

Land use types	Average area (ha)
(1) Mono Rice crop	2.58
(2) Rice – Sugarcane- Pineapple	1.08
(3) Double Rice - Ginger	0.89
(4) Rice – Sugarcane - Ginger	0.94
(5) Sugarcane- Pineapple	1.48
(6) Sugarcane - Ginger	0.75
(7) Vegetable	0.28

Table 2. The average area of land use types per household at U Minh Ha

Land use types	Average area (ha)
(1) Mono Rice crop	1.68
(2) Double Rice crop	0.53
(3) Banana	0.68
(4) Rice – Banana	0.48
(5) Rice – Banana - Fish	2.77
(6) *Derris elliptica* crop	1.14

In U Minh Thuong, the vegetable crop was the smallest area which was 0.28 hectares per household because of the fact that they did not enough labor to do, they need more time than others, and does not popular in this study area. In U Minh Ha, Rice – Banana crop had the smallest land area which was 0.48 hectares per household, because, the Banana crop was only planted on the bank of fields and do not invest more capital or technology yet.

3.2. The situation of household production

Education level of Headed households and Major laborer

The members of the household, the headed household is usually major labor but another the son plays the main role in their family if the headed household is old, in U Minh Thuong the household size of female-headed households is substantially lower than male-headed households (Peter Mackay, 2009).

The education level of the labor may affect to production because they would not do the best for applying technical sciences and accounting economic, which is also part of the reason for the development the economy of the household. According to Duy, V. Q. (2013), the headed household determine to invest more for production agricultural such as fertilizers, plant protection products, and agricultural pieces of equipment… if they were higher education level than others.

The result in Table 3 was showed that education level of headed households and major laborer in the study area were low, around 90% their education level was ranging from primary school to secondary

school, and there were not very different between U Minh Thuong and U Minh Ha. The secondary school level at U Minh Ha was lower than U Minh Thuong, but the high school level was inverse.

Table 3. Educational level

Educational level	U Minh Thuong (%)		U Minh Ha (%)	
	Headed households	Major labor	Headed households	Major labor
Illiteracy	5.15	3.07	14.05	6.97
Primary school	52.58	49.12	53.72	48.43
Secondary school	40.20	42.11	27.27	36.59
High school	2.07	5.70	4.96	8.01
Total	***100***	***100***	***100***	***100***

Experience of agricultural production

The age of household head is inverse affecting the income of the poor households (Duy, V. Q., 2017). The results showed that farmers have experience in production. In particular, production experience from 6 to over 15 years accounted for a significant proportion (U Minh Thuong 78.35% and U Minh Ha 89.36%). While the experience less than 6 years was 21.65% & 10.74% for U Minh Thuong & U Minh Ha respectively.

Generally, the experience play an important role in agricultural production, when they have the best experience they can predict for the weather cycle, they can recognize crop diseases, and they can get more advantage for cultivation. However, for the agricultural production, the farmers did not only need experience but also high education level, this is the context of scientific and technological development in production.

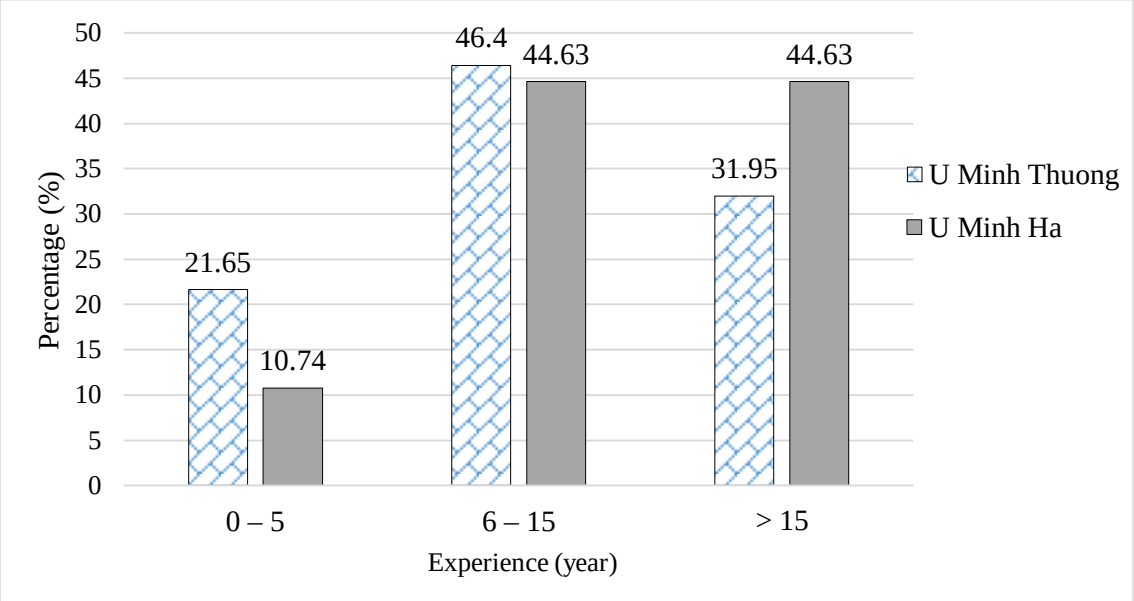


Fig 1. Experience of agricultural production

Agricultural equipment

In the study area, most of the households were lack facilities for production, they have only essential services such as atomizer, motorcycles, boats. The others were low proportion such as water pumps, plowing machine, rice grinder… The households have they not only use for their but also for others. The

limited production facilities are usually rented from neighboring areas or a manual laborer so resulting in high production costs.

Table 5. Agricultural equipment

Type of equipment	U Minh Thuong (%)	U Minh Ha (%)
Plowing machine	2.40	3.85
Atomizer	32.90	34.32
Concrete yard	2.40	2.36
Boats	29.94	8.88
Water pumps	10.78	6.21
Rice grinder	1.20	0
Motorcycle	20.38	44.38
Total	**100**	**100**

Capital for production

In general, the socio-economic conditions in the study area are limited, there were only 14.44% households at U Minh Thuong, and 22.45% households at U Minh Ha are sufficient capital for their production, while the most of the households are lack capital shortages with was 85.56% in U Minh Thuong and 77.55% in U Minh Ha. Normally, farmers will use fewer seeds and fertilizer if their families have limited access to credit (Duy, V. Q., 2013).

However, the household said that they could be not to enough capital for production if they had grubbed and opened more area, they must borrow it from the others. Currently, they do not want to hire money because they were a worry to repay when farming is at risk or difficult markets.

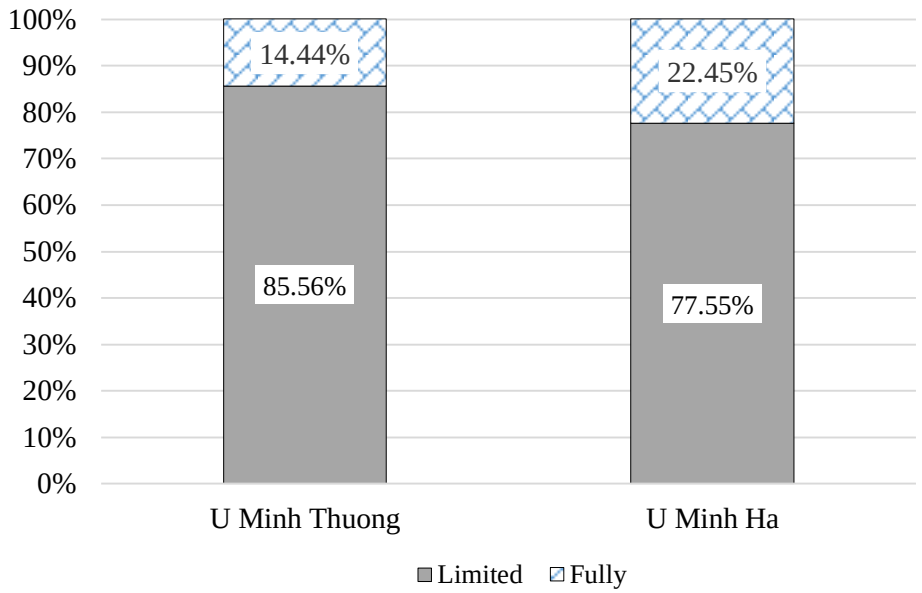


Fig 2. Capital for production

The result also showed that the farmers could look for capital from a variety of sources, in which they chose to borrow money from banks with low rates which accounted for the most significant (33.02% in U Minh Thuong and 28.23% in U Minh Ha) but the amount of loan was a little and collateral.

Accessibility to credit by rural households could be improved by establishing more branches of

agricultural and community banks in the rural areas, providing innovative credit schemes that overcome problems of smallholder farmers who lack collateral and by reducing the currently long processing times of loan applications and other requirements (Duy, V. Q., 2013).

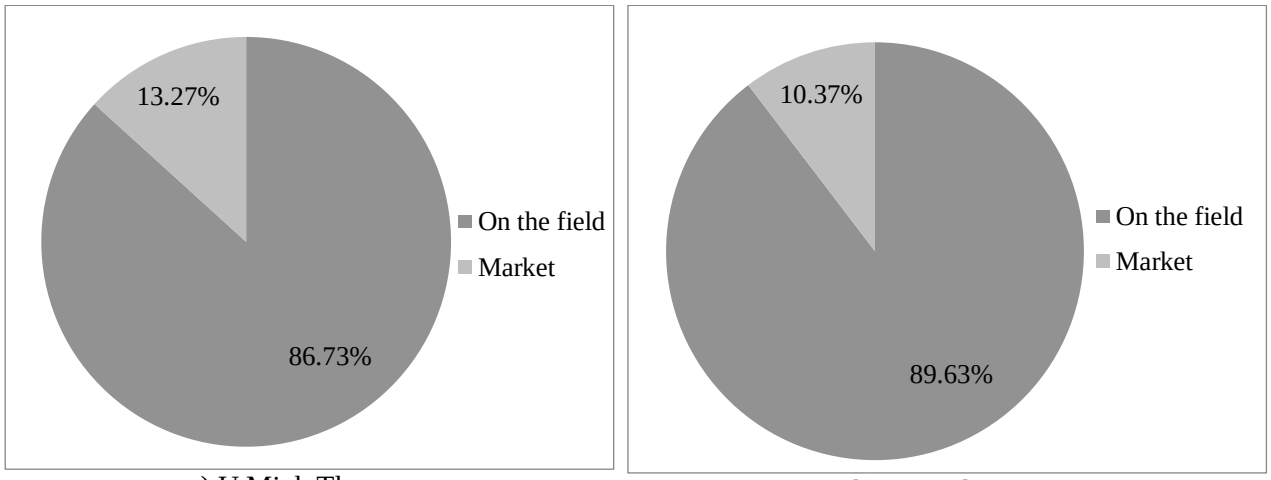
Table 7. The information about capital

Capital sources	U Minh Thuong (%)	U Minh Ha (%)
Bank	33.02	28.23
Company	27.36	23.39
Neighbor	12.26	20.96
Agricutural store	27.36	27.42
Total	***100***	***100***

Consumption market

The sensitivity of the timing between harvesting and processing is crucial. Easily stored products such as wheat or rice can be bought at harvest time in the open market and stored for milling throughout the year (Hans P. Binswanger et al, 1995).

Almost all products were directly purchased on the field at 86.73% and 89.63% in U Minh Thuong & U Minh Ha respectively because of the large production household. Only a few farmers sold their products in the local market that was low productivity and easy to transport to the market (Figure 3).



a) U Minh Thuong b) U Minh Ha

Fig 3. Consumption market

To know prices of agricultural products, people often get information form markets, neighbors or newspapers and televisions. In which, information from neighbors or traders were a higher proportion than others (32.44% in neighbors and 32.44% in trader). A large number of people have for long time farming, they and traders have become friends for many years, so they have trust traders.

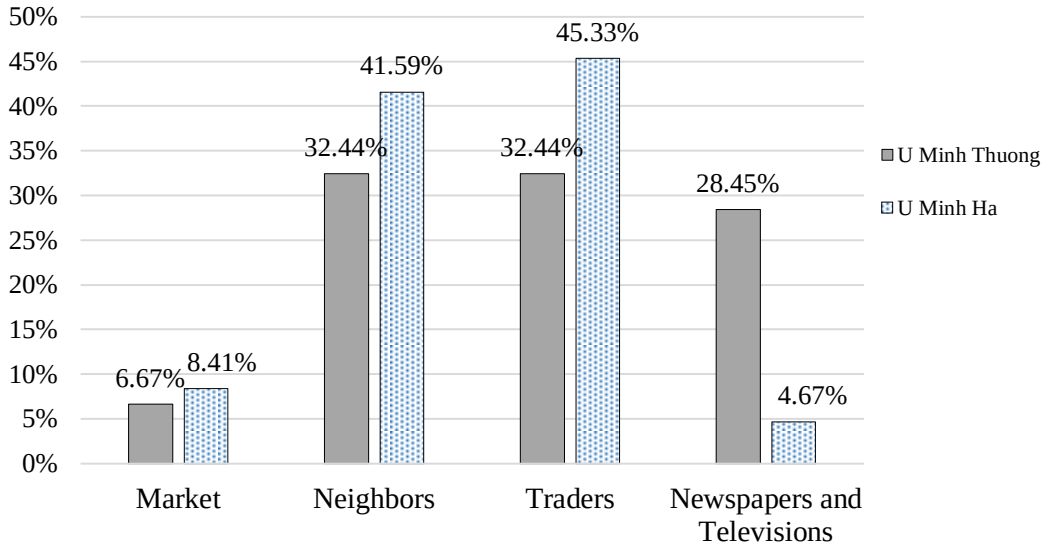


Fig 4. The information about price

In general, there were the advantages for agricultural production in zone such as the large area of land, abundant human resources with long-term production experience, stabilize markets. However, the household lack capital and education level to access technology are not high.

3.3. Economic efficiency of land use types

In the U Minh buffer zone, adding the land area was allocated to farmers not only for cultivation included to planting the forest (*Melaleuca*) but also for agricultural. There were land use types such as Rice crop, Double rice crop, Rice – Banana, Rice – Banana – Fish, *Derris elliptica* crop, Rice – Sugarcane – Pineapple, Sugarcane – Pineapple, Sugarcane – Ginger and vegetable. According to Peter Mackay (2009), in the many years the demand for Melaleuca decreased, and hence the sale price has declined to the point where growing Melaleuca is not economically attractive. Many of the households within the zone are not producing *Melaleuca* anymore, primarily because it is no longer profitable and the increased availability of suitable alternatives such as sugarcane and bananas.

At U Minh Thuong, the land use type for the highest profit was the Double Rice - Ginger crop with an average annual profit was 172.586 million VND/ ha/ year, and cost-benefit was 2.12. In fact that, the main of this land use was Ginger which was a high price in the harvest time. However, in this study area, Ginger often diseased and they were usually failure (Loi. L. T. et al., 2013). The following, Rice – Sugarcane – Ginger also has high profit 142.838 million VND/ha/year and cost-benefit 1.56. These were highly benefited, but they have been higher income production than others (Table 8).

Vegetable in U Minh Thuong included leaf vegetables, gourd, cucumber, taro… the production time was short, the farmer can cultivate 2 to 3 crops per year. The Table 8 showed that Sugarcane- Ginger, Vegetable, Sugarcane – Pineapple…have huge benefit, but the cost was also high.

Table 8. Economic efficiency of land use types at U Minh Thuong

Unit: VND/ ha/ year

Land use	Outcome	Income	Benefit	Cost-benefit (B/C)
Mono Rice crop	8,753,000	12,843,000	4,089,000	0.47
Rice – Sugarcane –Pineapple	68,801,000	117,478,000	48,677,000	0.71
Double Rice crop - Ginger	81,234,000	253,820,000	172,586,000	2.12
Rice - Sugarcane - Ginger	91,819,000	234,657,000	142,838,000	1.56
Sugarcane –Pineapple	52,132,000	96,497,000	44,365,000	0.85
Sugarcane –Ginger	105,731,000	151,187,000	45,456,000	0.43
Vegetable*	107,883,000	180,000,000	72,117,000	0.67

** Unit: VND/ ha/ season*

Table 9. Economic efficiency of land use types at U Minh Ha

Unit: VND/ ha/ year

Land use	Outcome	Income	Benefit	Cost-benefit (B/C)
Mono Rice crop	11,001,000	18,119,000	7,118,000	0.67
Double Rice crop	28,722,000	53,000,000	24,277,000	0.85
Banana	12,193,000	47,246,000	35,052,000	2.87
Rice – Banana	23,185,000	62,554,000	39,368,000	1.69
Rice – Banana - Fish	21,077,000	58,874,000	37,797,000	1.79
Derris elliptica crop	31,780,000	118,720,000	86,940,000	2.70

Mono Rice crop, the average cost was from 8.753 million VND/ha/year to 11.00 million VND/ha/year. In particular, in the U Minh Thuong, the cost and efficiency are lower than U Minh Ha. The other models, farmer mainly cultivated plant which was in the acid soil.

At U Minh Ha, *Derris elliptica* crop and Banana crop have outcome lower than income leads to high cost-benefit respectively 2.87 and 2.70. These two land use types have low cost, in that fact *Derris elliptica* crop was 31.780 million VND/ ha/ year and Banana crop was 12.193 million VND/ ha/ year, but their profit was high (*Derris elliptica* crop was 118.720 million VND/ ha/ year and Banana crop was 47.246 million VND/ ha/ year (Table 9). However, *Derris elliptica* crop was a new model and not popular yet which cultivated time was so long from 18 to 24 month.

In general, the mono rice crop is one of the worst. However, farmers still cultivate because the soil conditions can only be grown with rice and they want to get enough rice for the whole family, besides they want to use the labors by themselves.

Besides, natural fish production is an important source of food, and fish are also cultivated in the pond which associates with rice fields. The food for fish production is considered to be low-input based on the sources of fish feed. Predominantly fish are fed with crop residues from the farm, farm manure only. Fish has eaten just about every day and is the primary protein source for most households. Harvesting occurs at a relatively small scale and is primarily for home consumption (Peter Mackay, 2009).

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

The status of land use types area was different and most of the land area was ranged from 0.75 to 2.58 hectares, except vegetable crops was less than 0.28 ha.

Most of the head - household and major labor had low educational level that was ranging from primary school to secondary school and they have long-term production experience, but they were lack capital and equipment of production. The market in the area was advantages and price information of agricultural also have many reliable sources.

There were many land use types in the study area. However, the land use type in the U Minh Thuong was the same in U Minh Ha. In which, the land use type for the highest profit was the Double Rice - Ginger crop (172.586 million VND/ ha/ year), following Rice – Sugarcane – Ginger (142.838 million VND/ ha/ year) but the cost-benefit was low. *Derris elliptica* crop, Banana have cost-benefit was high. However, Rice crop was low profit, but it still was popular crop in study area, because rice is an important food for their family.

4.2. Recommendations

The local government should support more in education and science technology for the farmers.

In addition, the government should provide the capital policies to make more advantages for production.

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EFFICIENCY IMPROVEMENT SOLUTIONS OF THE E-LEARNING SYSTEM

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ABSTRACT

Today, e-learning is a new education trend in the world as well as means to improve the quality of education in the age of the industrial revolution 4.0. Many tools are available used to support e-learning such as Moodle, Blackboard, Edmodo. Moodle is one of the most tools widely used to support online learning system. However, when applying online learning on Moodle system at Nha Trang University, it has revealed some limitations. In this paper, we show some limitations and propose some solutions to improve the efficiency of the e-learning. The our solutions is to develop new e-learning system use new technologies such as React, Redux, Apollo, MongoDB, Nodejs, Meteor as well as to add some additional features in our system. The added features are suitable and effectivefor teaching environment in Vietnam.These features consist of the ability to automatically notify to the learner via a personal email, support for online examinations monitored by camera, microphone system, tracking mail check of students, statistics and evaluationthe question bank, classification the difficulty level of each question based on result of testsand automatically notify student'sparents.

Key terms: E-learning; Moodle; Online learning system.

1. INTRODUCTION

Nowadays, the development of information technology is spreading and covering all areas of human life from economics, politics, science, culture, health, entertainment, research and education. With the development of information technology, many new approaches and methods of teaching and testing are developed. Among methods, e-learning is themost interested method. E-learning is a method that uses computers and smartphones connected to internet network for learning purposes. Using teaching and learning methods via e-learning, learners are not only students butalso workers who are not enough time to attend tradition classes. With using online learning and testing system, learners can attend anycourses held at anywhere, study any time and any program thatthey want. Thanks to the support of information technology, the internet development, multimedia data processing technologies, lecturescan be integrated multimedia data such as text, images, sound, and virtual reality models. As a result, lessonsare enriched the information to increase the attractiveness of the learner. Students can actively and easily exchange information with other members in class and instructors via online or offline channels such as email, forum, chat, live webcasting, facebook. In addition, learners can easily express and give their point of views, increase interaction between learners and teachers. The online teaching and testing method also helps the instructor to easily manage the learner as well as to count the number of interaction of the learner on the system to to evaluate diligencepoint.

E-learning is the educationtrend in the future, the indispensable part of the knowledge economy. This method is developing rapidly in universities of developed and developingcountries. According to Cyber Universities [1], nearly 90% of universities in Singapore use online training methods and in the America is more than 80%. Tools for teaching and learning are increasingly and varied as Moodle, Blackboard, Edmodo. Comparison of technologies used in online learning systems is shown in Table 1.

Table 1. Comparison of technologies used in some e-learning system [8]

	TUIE-LEARNING (Our proposed system)	MOODLES	EDMONDO	BLACKBOARD
Platform	Node.js(Meteor.js)	PHP	Unknown	ASP.Net
Web Server	Nginx	Nginx	Apache	Unknown

The limitations and challenges in the implementation of online teaching methods can shows such as limit opportunities to communicate directly with classmates, lack of motivation for the instructor and pressure on learners, loss of their own learning culture, not support for who do not use computers well, good network infrastructure, increasing the workload of lecturers, arising copyright and intellectual property issues, the highly interactivelectures, the examination fraud and security [2,7].

Nha Trang University is implementing a model of e-learningusing Moodleand has achieved remarkable results [5]. However, the number of attendingteachers to usee-learningmethods is not much. There are many reasons, but the main reason is that the response of the network system is slow during peak hours, when the trainers give assignments, tests, the system does not automatically send email to students, usinge-learning is not as fast as email, student can see the teachers at their class every week so they do not need e-learning helps, the online exam supervision is not tight, increasing the workload of lecturers [6].

In this paper, we present some solutions to develop a efficient tool supporting for learning and testing. Our proposed tool need to have the features of Moodle as well as the new proposed features. We use new technologies applied on large data models such as React, Redux, Apollo, MongoDB, Nodejs, Meteor. We hope that the tool is suitable for teaching environment in Vietnam. The newfeatures consist of the ability to automatically notify to the learner via a personal email, support for online examinations monitored by camera, microphone system, tracking mail check of students, statistics and assessment the question bank, classification the difficulty level of each question based on result of testsand automatically notify parents.

2. METHODOLOGY

In order to supporting and managing for online learning and testing, our tool focus on supporting three main objects including teachers, students andparents.

For teachers, the system supportsto create courses, make exams,managestudent and assigment, automaticnotify system via mail, schedule specific lessons for each week, online chat,support for online examinations monitored by camera, microphone system, track mail check of students, assess the questions bank, classify the difficulty level of each question. Some main functions of teachers are shown in Figure 1.

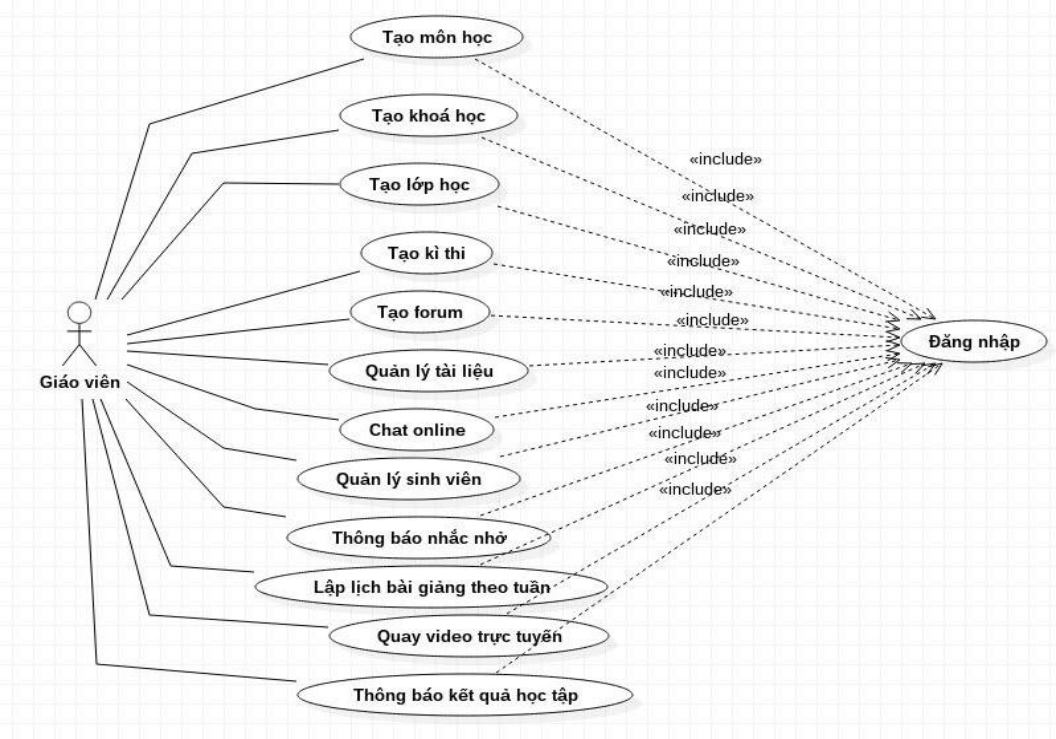

Fig 1. Some functions of teachers in the system

For students, the system supports to make the plan for studying such as list of courses, classes, subjects; register the course or search subjects; create a learning group; take online tests; receive reminders of teacher examinations. Some main functions of learners are shown in Figure 2.

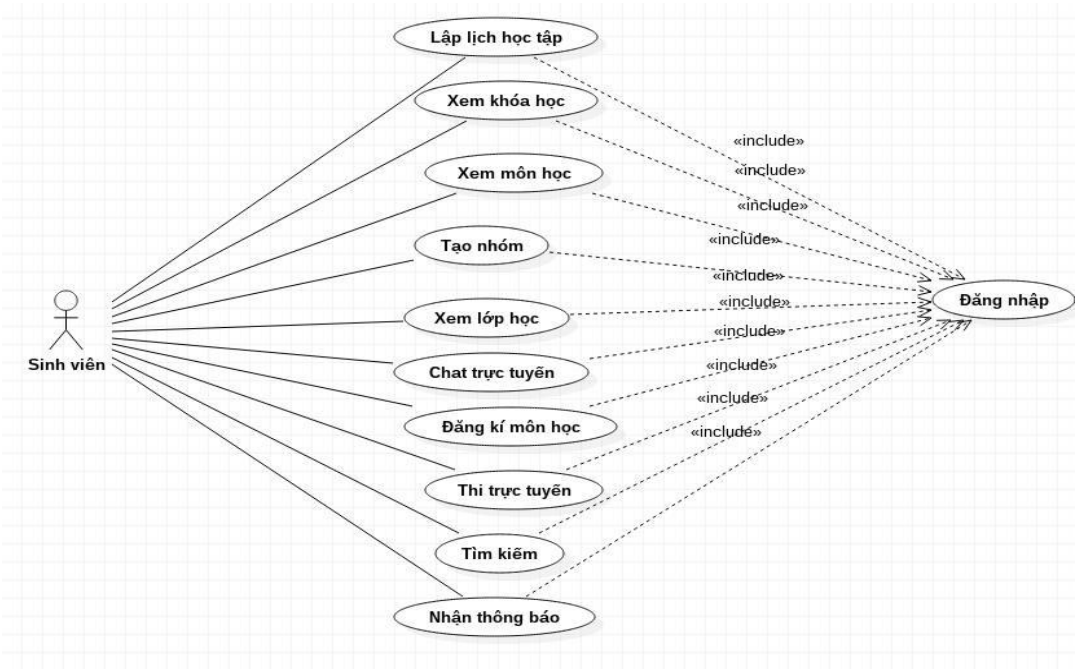

Fig 2. Some functions of student in the system

For parents of students, they can see the results of their students as well as receive the information from the teachers and the schools. Some main functions of parents are shown in Figure 3.

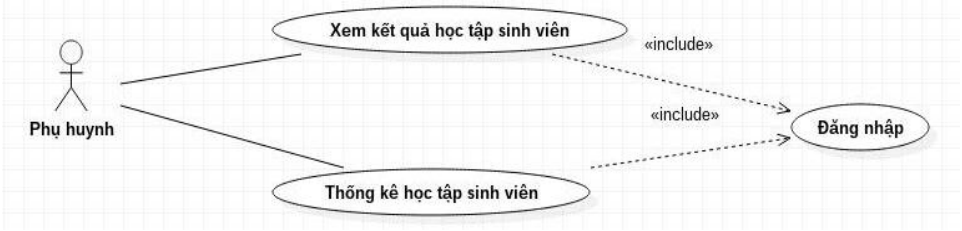

Fig 3. Functions of the system for students's parents

3. EXPERIMENT

In this paper, we have just finished a system analysis and design named Tuielearning and some demostrations as shown in figure below.

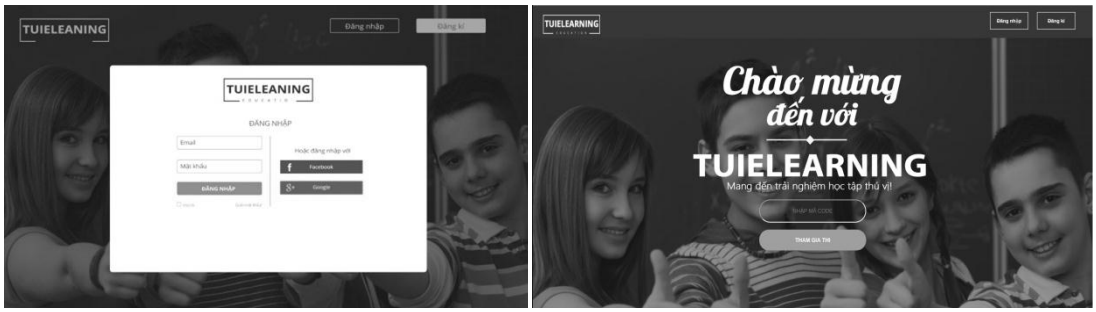

Fig 4. Main (left) and login (right) Interfaces

First of all, to log in the system, after registering your account and confirming success, you can log in enter by registered name, email address, facebook or google account.

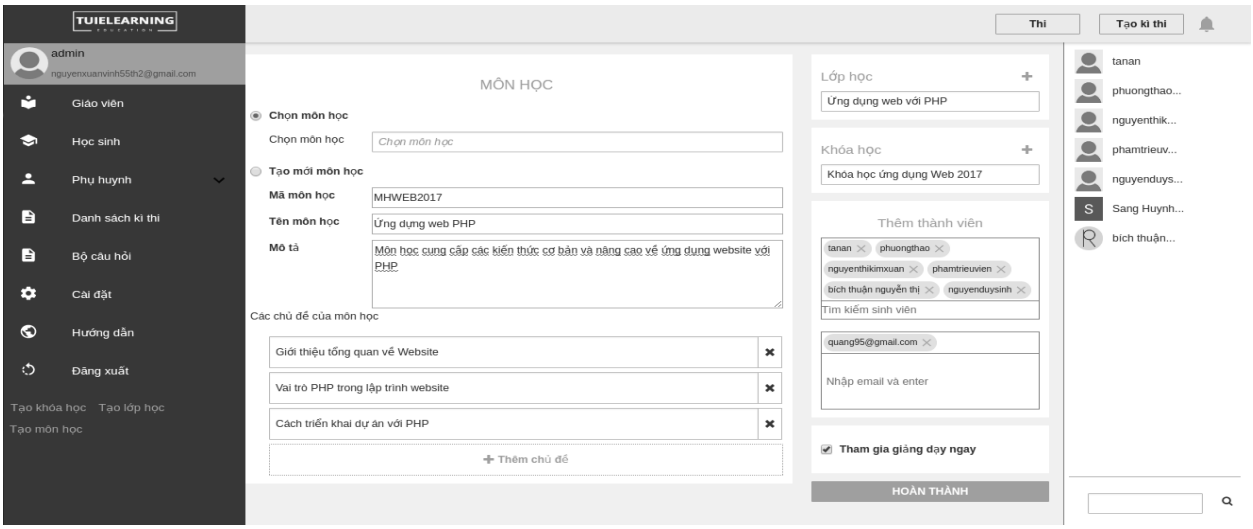

Fig 5. Main interface of Tuielearning demostration

In order to avoid cheating, we use the audio and visual acquisition system to track the duration of the student's examination. Figure 6 is shown the screenshot of the online sign-up and examination interface.

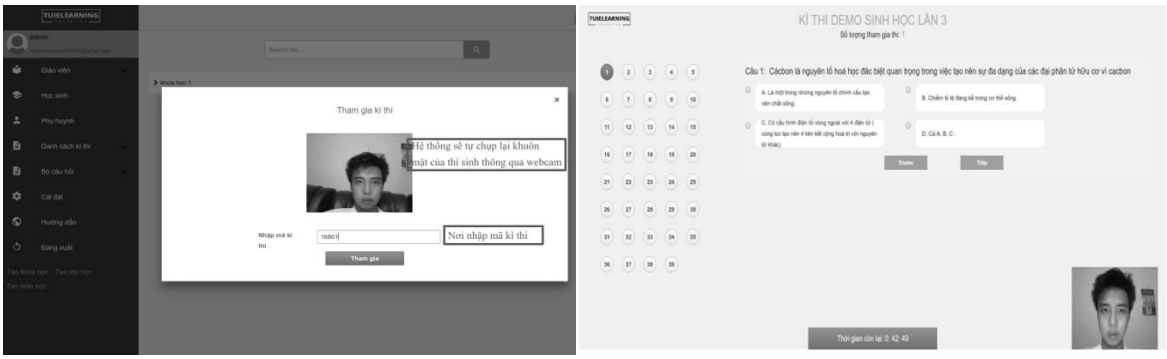

Fig 6. The screenshot of the online sign-up (left) and examination (right) interface

The system also supports for education managers, teacher in activity statistics with e-learning system as presented in Figure 7.

Forum | Bài giảng | Bài Tập | Thành viên | Hoạt động | Phân quyền

Tên	Email	Chức vụ	Số lượng tương tác Forum
VinhNguyen	Nguyenxuanvinh55th2@gmail.com	Giáo viên	70
tanan	nguyentanan@gmail.com	Sinh viên	3
phuongthao	tranphuongthao@gmail.com	Sinh viên	18
nguyenthikimxuan	nguyenthikimxuan@gmail.com	Sinh viên	26
phamtrieuvien	phamtrieuvien@gmail.com	Sinh viên	18
nguyenduysinh	nguyenduysinh@gmail.com	Sinh viên	8
bích thuận nguyễn thị	bichthuan55th2@gmail.com	Sinh viên	1
Thuận Ròm	notgoalone@yahoo.com.vn	Sinh viên	16

Fig 7. Illustrations of teacher's and student's interactions on forum

To support students' parent, the system provides all subjects, subject information, teacher information, from which parents can easily interact with teachers to see their child's progress. The system also provides a list of terms, from which to track and motivate your child to learn better. Parents can view all student assignments for grades and current status as shown Figures 8,9.

Fig 8. The interface for tracking students

#	Tên bài tập	Hạn nộp	Điểm số / trạng thái
1	Bài tập tự ôn trước khi thi	03/2/2017	7.5
2	Bài tập chương 2 tổng quan PHP	09/3/2017	Chưa nộp
3	Bài tập tổng hợp kiến thức	10/04/2017	9
4	Bài tập kiểm tra giữa kì	1/5/2017	4.5
5	Bài tập luyện tập	9/7/2017	Chưa nộp
6	Kiểm tra kết thúc môn học	03/8/2017	Chưa nộp

Fig 9. The interface for tracking status in each subject

In statistical function of the system, the system will report to the teacher the difficulty level of the questionnaire through the number of students answer correctly, the system will classify the questions and help the teacher know what needs to be supplemented in your lecture. Figure 10 shows statistical function based on right answers in each test suite.

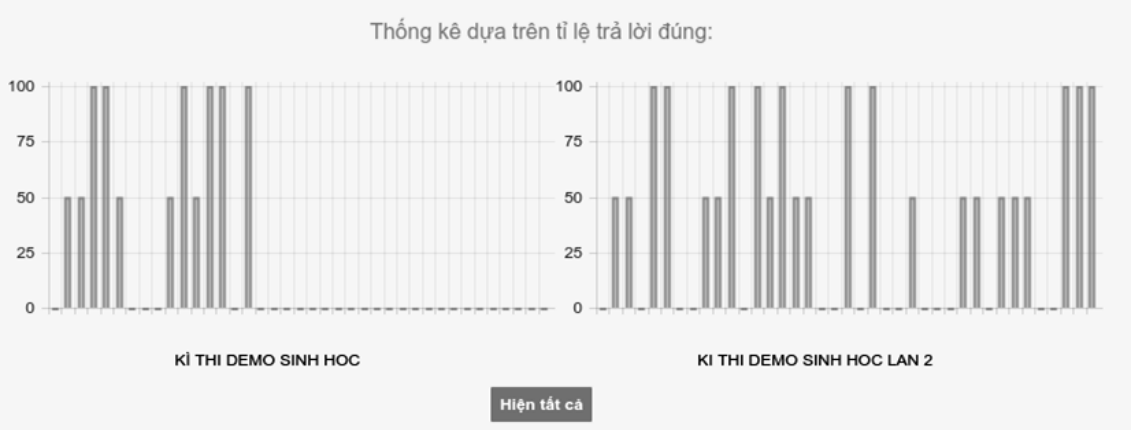

Fig 10. Demonstration of the system statistical function

4. CONCLUSION

Our paper presentsthe solutions to develop a efficient tool that supports for learning and testing. Our proposed system has the features like Moodle as well as some new solutions such as tracking automaticannouncement via mail, monitoring student during testing by camera and micro system, functions for support learner's parents, classificationand assessment forquestionsbank. These features are added to improve efficiently for teaching and learning in Vietnam education environment. We used new technologies such as React, Redux, Apollo, MongoDB, Nodejs, Meteor to applied on system. In this paper, we just, However, have completed a system analysis and design for Tuielearning system and some main function demonstrations. In future work, we hope that the tool will be finished and it will be widely applied to supportlearning and testing in Vietnam.

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http://www.apollodata.com/

http://dev.apollodata.com/core/

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http://graphql.org/

http://redux.js.org/

https://facebook.github.io/react/

https://www.mongodb.com/e-learning

https://www.edmodo.com/

http://anz.blackboard.com/

http://demo.moodle.com/

STUDY OF IMPLEMENTING A FACE RECOGNITION BASED AUTOMATED STUDENT ATTENDANCE SYSTEM

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ABSTRACT

As results of the challenges of the manual method of taking student attendance in colleges and universities, an automated attendance system requires to be applied. The challenges consist of effort in keeping the attendance list over a long period of time, unnecessary time waste during calling and checking student's name, students forgetting to sign the attendance list, lecturers forgetting the attendance list in the classroom, students passing illegally for an absentee among others. There are many automatic methods available for this purpose i.e. a biometric attendance system. All these methods, however, also waste time because students have to make a queue to touch their thumb on a scanning device. In this paper, we propose an efficient method that automatically marks the attendance without human interference. This attending is recorded by using a camera attached in front of classroom that is continuously capturing images of students, detect the faces in images and compare the detected faces with the database and mark the appearance.

Keywords: Automated Attendance System; Face Detection; Face Recognition; Local Binary Patterns; Viola and Jones; Verification

1. INTRODUCTION

It is necessary for checking the performance of students in the classroom to enhance their academic performance. Students are expected to attend 75 percent of the class time before they are allowed to the course examination. Traditional method of marking attendance students require to call student's names and then mark in the attending list. The problems related to this method vary from unnecessary time wastage to incorrect attendance, students forgetting to put their hand up during attendance time or students signing on behalf of other students who are absent from the class.

For saving manual labor and increasing the accuracy, an automated attendance system has replaced traditional attendance marking activity. Automated attendance systems are mostly biometric based, smartcard based and web based. These systems are widely used in different educational institutions. It has advantage over traditional method as not only saving time but also can be used for security purposes.The next sections in this paper are related works, detailed descriptions of proposed system, results and conclusions and future works.

2. RELATED WORKS

In [1] the authors have proposed a finger print based attendance system. A portable fingerprint device has been developed which can be passed among the students to place their finger on the sensor during the lecture time without the instructor's intervention. The problem with this approach in marking the attendance is that passing of the device during the lecture time may disturb the attention of the students.

Amount of works related to Radio Frequency Identification (RFID) based attendance systems exist in the literature. In [2] the author have proposed a RFID based system in which students carry a RFID tag type ID card and they need to place that on the card reader to record their attendance. There is a problem

that an unauthorized person may make use of authorized ID card and enter into the organization.

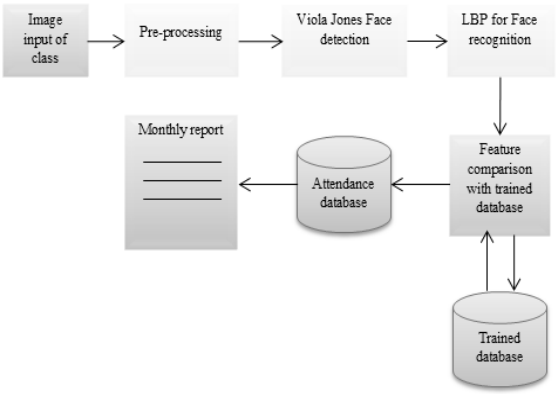

Fig.3. System architecture

Iris is another biometric that can be used for attendance systems. In [3] the authors have proposed attendance system based on Iris recognition. This system uses iris recognition management system that does capturing the image of iris recognition, extraction, storing and matching. But one of the disadvantages is that the equipment is very expensive and the iris is a small target and a scan not be performed properly if the person is more than a few meters way.

In [4] authors have proposed a system based on real time face recognition which is reliable, secure and fast which needs improvement in different lighting conditions. Face recognition consists of two steps that are detection and recognition. An amount of methods have been proposed for face detection i.e. Voila and Jones [5] and AdaBoost algorithm [6]. Face recognition techniques can be divided into two types, appearance based which use texture features as Linear Discriminant Analysis (LDA) [7], and Local Binary Pattern (LBP) [8] and feature based which uses geometric features like mouth, nose, eyes, eye brows etc. and relation between them. Table 1 is shown the disadvantages of various attendance systems.

Table 3. Disadvantages of various attendance systems

Types of system	Disadvantages
RFID-based	Fraudulent usage
Fingerprint-based	Time consuming for students to wait and give their attendance
Iris-based	Invades the privacy of the user

3. PROPOSED METHOD

Detailed system architecture is shown in Figure 1, basic steps of our proposed method are: Image input, Face detection using Viola Jones, Face recognition using Local Binary Pattern, Feature comparison, Attendance database and Monthly report.

3.1. Image Input

Image is acquired from a high definition camera that is connected above the white board. This camera is connected to the computer. Image input of class will be taken from camera. This image will consist of all the students present in class for that particular lecture. Figure 2 shows a captured input image of classroom.

Fig 4. The captured classroom image

3.2. Pre-processing

This preprocessing step involves with histogram equalization and noise filtering of input image. Histogram normalization is good technique for contrast enhancement in the spatial domain. Because captured image sometimes have brightness or darkness in it which should be removed for good results. After histogram equalization stage, we apply low pass filtering technique for removal noise in the input image.

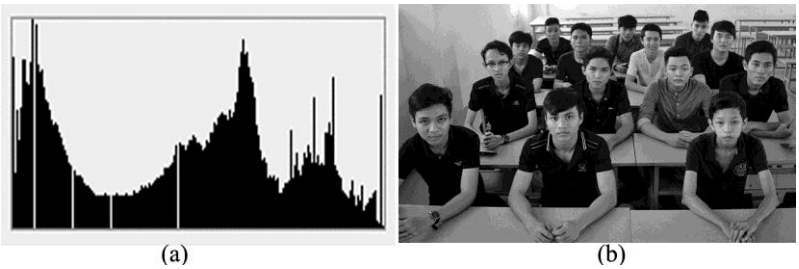

Fig 5. (a) Histogram of input image (b) Histogram equalized class image

3.3. Face Detection

In this section faces are detected and shown in the Figure 4 by marking rectangle on the faces of students. This step based Viola Jones algorithm which consists of four phase's integral image, Haar-like Features, AdaBoost, and Cascading Classifier. In integral image we assign each pixel a value. And these values are converted by summing up all the pixel values present above and at the left side.

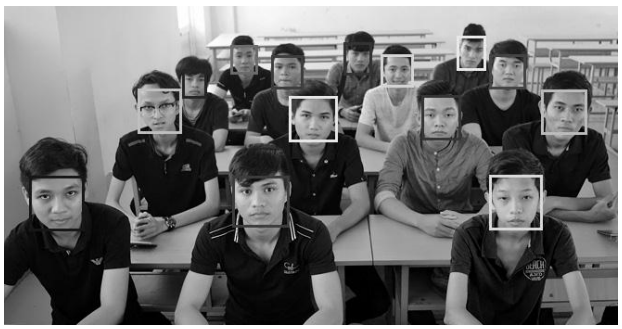

Fig 6. Face detection

Haar-like features consists of special pattern which is compared with image pixels and accordingly 1 or 0 is assigned. In AdaBoost only some necessary features are selected removing redundant ones. In Cascading classifiers wear classifiers are cascaded to make a strong classifier.

Algorithm is trained for the images of faces, and then applied on the class room image or detection of multiple faces in the image. Figure 4 shows the detection face.

3.4. Face Recognition

After the face detection step the next is face recognition. This can be achieved by cropping the first detected face from the image and compare it with the database. We developed a fast and reliable algorithm for face recognition based on histograms of Local Binary Pattern (LBP)algorithm. Image is divided into several parts and on each part LBP is applied. Initially 3x3 top left corner window is taken and each pixel is converted into equivalent gray level.

After this center pixel value is compared with all the neighborhood values and if center pixel value is greater than surrounding pixel then it is 1 else 0. After this, the 8-bit code is converted into decimal equivalent and this procedure is repeated for the whole image. After this all the decimal values are plotted on histogram. Figure 5 shows the histogram feature extraction from LBP algorithm.

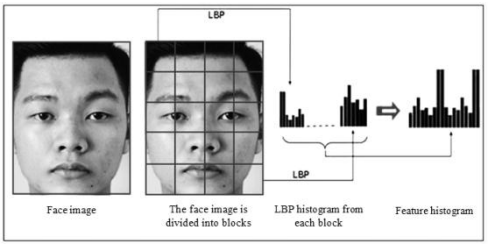

Fig 7. LBP histogram feature extraction

3.5. Feature Comparison

To compare two face images, a sample and a model, the difference between the feature vectors has to measure. In this step the calculated features are compared with stored features by Log-likelihood statistic [9].

3.6. Attendance Registering

If features match in comparison phase, then attendance for particular student is registered in the database. This database is stored in the backend of the system and the results drawn are all entered in the same.

3.7. Monthly Report

At the end of each month, monthly report will be generated and will be mailed to department. The report can be generated as per the institute norms. This reduces or finishes off the entire work of the faculties of the institute. Any alterations required to be done in the final report can be done by the respective authorities.

4. RESULTS

Face detection and recognition has been a challenging task due to unconstrained condition. In our project using Viola Jones face detection method; LBP and CIT UDN database are being used which will give us an overall efficiency of 83.21%.

Table 4. Performance evaluation of proposed system

No. of faces	No. of successfully detected faces	No. of successfully recognized faces	% of correct recognition	No. of false rejections	% false rejection
10	10	9	90.33	0	0
20	19	17	87.76	1	5.00
30	29	26	85.52	1	3.33
40	38	33	83.21	2	5.00

5. CONCLUSION

This paper introduces the efficient and accurate method of attendance in the classroom environment that can replace the old manual methods. This method is secure enough, reliable and available for use. No need for specialized hardware for installing the system in the classroom. It can be constructed using a camera and computer. The future work is to improve the recognition rate of algorithms when there are unintentional changes in a person like tonsuring head, using scarf and beard.

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THE INFLUENCE OF WASTE MOLASSES AND RICE HUSK ASH (RHA) TO CHARACTERISTICS OF UNBAKED BRICKS

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ABSTRACT

Rice husk ash (RHA) is the waste from incinetors fired by rice husk and waste molasses from the manufacturing of sugar, alcohol. These wastes cause environmental pollution affecting human health. In order to minimize the harmful effects of RHA and molasses, the wastes were reused to make unbaked bricks. The unbaked bricks were made by mixing the powder of RHA with an average size of 19.62 μm, waste molasses and the PCB40 cement binder, then were pressed at high presure.

The results showed that molasses (8% wt.) increased cement retention time and reduced mechanical strength (Bending and compression strength of the samples at 7 days of age, molasses samples were 1.12 MPa and 5.51 MPa, while water samples were 4.29 MPa and 18.79 MPa). When adding RHA from 10 – 40 (% wt.) the intensity of the samples was significantly improved. At an age of 7, 14 and 28 days, the compression strength and bending strength of the samples were increased with added RHA content. But at the age of 56 days, the intensity of the samples with high content of RHA 30 – 40 % was decreased.

Some unbaked bricks were prepared according to content of the samples denoted A2 (with 20% RHA and 8% molasses). The compressive strength of bricks was 35.58 MPa and the compresive strength of floor was 15 MPa, that reaching to Vietnamese Standars TCVN 6477: 2011.

Key words: rice husk ash (RHA), unbaked brick, molasses.

1. INTRODUCTION

Molasses is a by-product of the sugar manufacturing process, accounting about 3 – 5 % weight of sugarcane. The content of nitrogen in molasses is about 0.5 – 1 %. Additional resources of nitrogen such as urea or ammonium nitrogen sulfate have been used for the fermentation of molasses. After fermentation, molasses can not be changed into sugars. In addition, ethanol production plant using rice husk as fuel, provide heat for the distillation of alcohol. This RHA can not use as an additive for concrete because of lost on ignition (L.O.I) is very high (about 15 – 25 % weight). Therefore, the study of waste disposal from RHA and waste molasses from ethanol production plants is necessary to reduce the environmental pollution. In this study, two types of this waste were mixed with PCB40 cement binder to make unbaked bricks. The results showed mechanical strength of samples reached Vietnamese standards TCVN 6477: 2011 and nature of the binds formed in the samples explained by modern scientific methods as IR, SEM.

2. RAW MATERIALS AND EXPERIMENTAL METHODS

2.1. Raw materials

The chemical compositions of RHA were analyzed by XRF method as follow (% wt.): 69.03 SiO_2, 2.71 CaO, 0.34 MgO, 0.32 P_2O_5, 9.72 K_2O, 1.30 MnO, 0.67 Fe_2O_3, 0.16 ZnO, 0.16 Rb_2O_3, 0.17 SO_3 and 15.51 L.O.I.

The calcium absorption of RHA was determined by method of TCVN 3735:1982 as 88.2 mg CaO/1gr RHA (the average level).

Molasses had 11.8% protein, Brix concentration 1.44 and pH 1.66, volume density 1.08 g/cm3. Moduls of sand and powder of lime stone were 1.06 and 2.28 respectively.

Cement PCB40 was used as binder in these experiments.

2.2. The experimental methods

The samples denoted by letters A – A4 with the mixed fomulars are shown in the table 1. The mortar was mixed according to these formulars in the vibratory agitator for 90 secunds, then was formed in the former with sizes 4x4x16 (cm). The samples were cured in a humid environment and then tested for compressive and bending strength at different ages.

The chemical compositions of RHA were analysed by XRF, crystalline phases were studied by scanning electron microscopy (SEM) and infrared radiation (IR). The purpose of these studies was to know the effects of RHA and molasses into microstructure and mechanical characteristics (TCVN 6355-2: 2009 and TCVN 6355-3:2009) of the samples.

Table 1. The mixed fomulars of the samples

Symbol	The mixed formulars of the samples (% wt.)					
	RHA	Sand	Lime stone	Cement	molasses	water
A	0	60	15	25	0	8
A0	0	60	15	25	8.64	-
A1	10	50	15	25	8.64	-
A2	20	40	15	25	8.64	2
A3	30	30	15	25	8.64	3
A4	40	20	15	25	8.64	9

2.3. Process description of experimentals

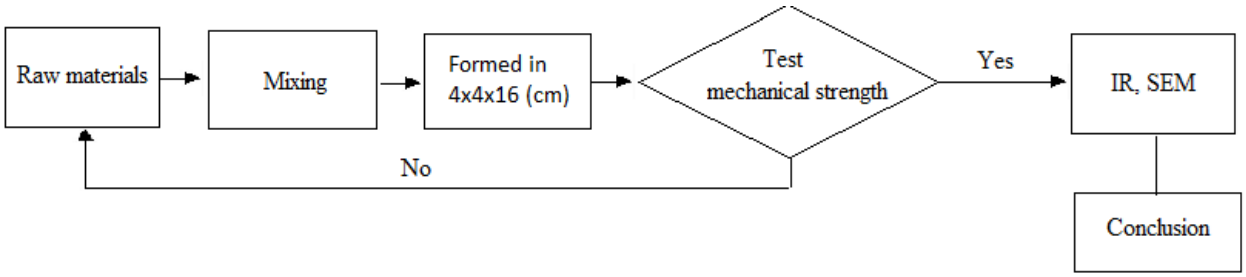


Fig 1. The process of experimettals

3. THE RESULTS OF EXPERIMENTS

3.1. The bending and compressive strength

The samples were maintained in a humid environment at different ages 7, 14, 28 and 56 days. The results of compressive and bending strength are shown in the table 2. Each result was an average of 3 tested samples.

Table 1. The Bending and Compresive Strength of the Samples

	Age (days)	A0’	A0	A1	A2	A3	A4
Bending Strength (MPa)	7	4.29	1.12	3.01	3.30	3.47	3.60
	14	4.59	1.21	4,10	4.46	4.90	5.60
	28	5.81	1.20	4.46	4.69	5.00	5.83
	56	7.22	3.03	6.86	8.20	7.20	6.28
Compresive Strength (MPa)	7	18.79	5.51	13.53	15.32	16.83	18.95
	14	26.76	7.09	28.20	30.02	31.20	33.27
	28	32.38	8.92	28.87	30.28	33.43	35.64
	56	34.62	29.96	39.12	33.70	32.21	32.46

Compared with the standard of TCVN 6477: 2011, the strength of the samples are suitable. Arcording this standard the compresive strength of the sample at 28 days is 5 MPa, when the lowest compressive strength of samples at 28 days was 8.92 MPa.

3.2. Effects of molasses to strength of cement mortar

During the hydration process of cement mortar, the hydroxyl calcium (Ca(OH)2) have been produced. The hydrophilic protein in molasses will react with $Ca(OH)_2$ to form complex compounds. The outside part of cement particles is hydrophobic so that the contact of cement particles with water will be impeded [1] and the strength of the samples will be decreased. This is confirmed when comparing the strength of the samples A0' (only water) and A0 (only molasses) (Figure 2).

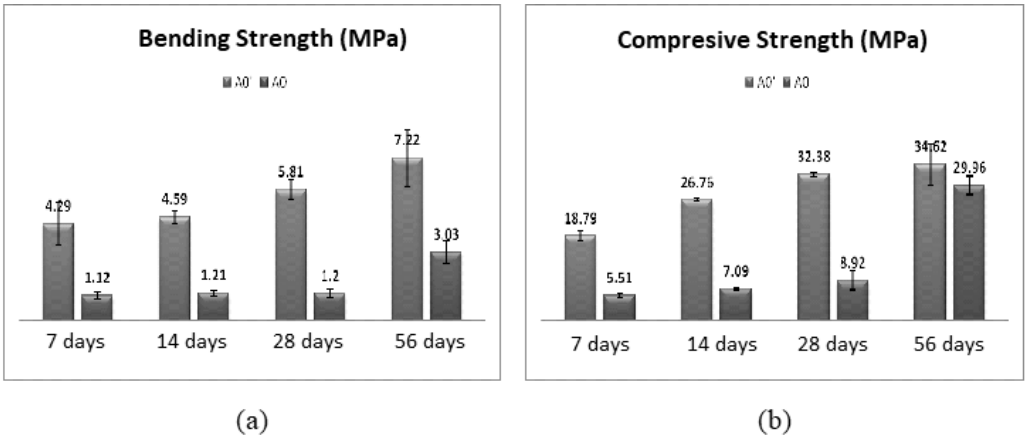


Fig 1. Bending Strength (a) and Compresive Strength; (b) of the samples A0' and A0

The results in Fig.2a show that at the age of 7 days, the bending strength of the sample A0' is 4.29 MPa, while the sample A0 is only 1.12 MPa (26.1% as compared to sample A0). The bending strength of the sample A0 remained unchanged for 56 days to reach 41.97 % of the A0'. When comparing the compressive strength of the samples A0 and A0’ (Fig.2b) we have the same results. Intensity of samples A0’ is increased faster and intensity of the samples A0 increased much slower. At 56 days of age, the strength of the samples A0 is closed to A0' (86.54 % compared to A0').

The bending and compresive strength of the samples was indicated the significant effect of molasses on mortar, which reduced the hydration of cement mortar.

3.3. The effect of RHA on the strength development

RHA is known as an active puzolanic mineral additive for cement mortar, because strength of mortar will be improved with additive RHA. In this case, the effect of RHA on strength development of mortar was demonstrated by the intensity measurements of the samples at age 7, 14, 28, 56 days (Fig.3).

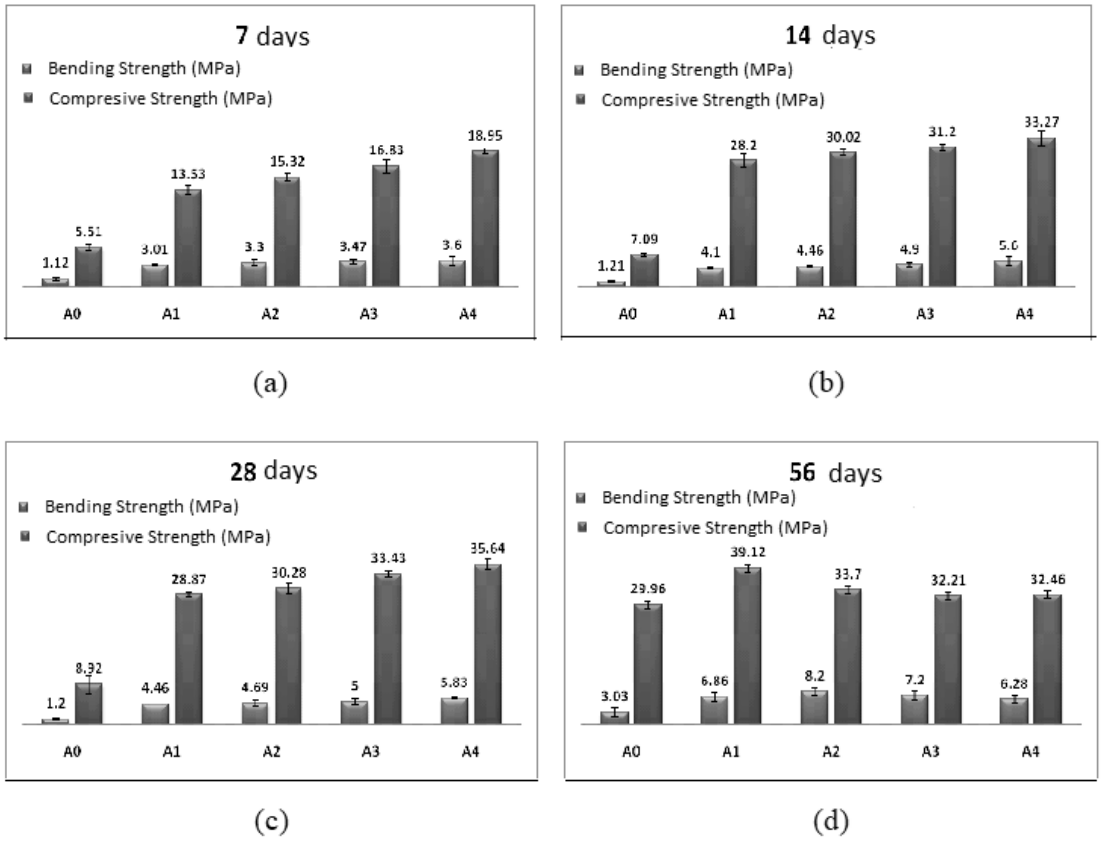


Fig 2. Bending Strength and Compresive Strength of the Samples

At 7 days of age, when adding 10% RHA, the intensity of the samples of molasses was changed very well (Figure 3a). The bending strength of the samples A1 was 3.01 MPa, increased by 1.89 MPa against A0. The compressive strength of the samples was 13.53 MPa higher than the A0 of 5.51 MPa. The sample intensities increased proportionally with the content of RHA, increasing from 10 to 40%. Similarly, at the age of 14, 28 days, the intensity increased when the content of RHA increased.

However, at the age of 56 days the intensity was decreased when the content of RHA increased. The reduction in bending strength was started with the samples having the content of RHA ranged 30 – 40 %, corresponding to the samples A3 and A4. At the same time, the reduction of compressive strength was started from 20 – 40 % RHA (the samples A2 to A4). High L.O.I. of RHA (15.51 % wt.) can be the cause of this phenomenon.

At the age of 56 days (Fig. 3d), the compresive strength of A1 is indicated highest (39.12 MPa) while the compresive strength of A2, A3, A4 was decreased. The lowest compresive strength of A4 was 32.46 MPa. For the bending strength, the A2 has the highest values as 8.2 MPa. Comparing of the samples at 28 and 56 days (Fig. 4a), we see that the compressive strengths of the samples A3 and A4 are decreased. Because of the content pf RHA in the samples in A3 and A4 was be high, that will be affected to the intensity of the sample for a long time.

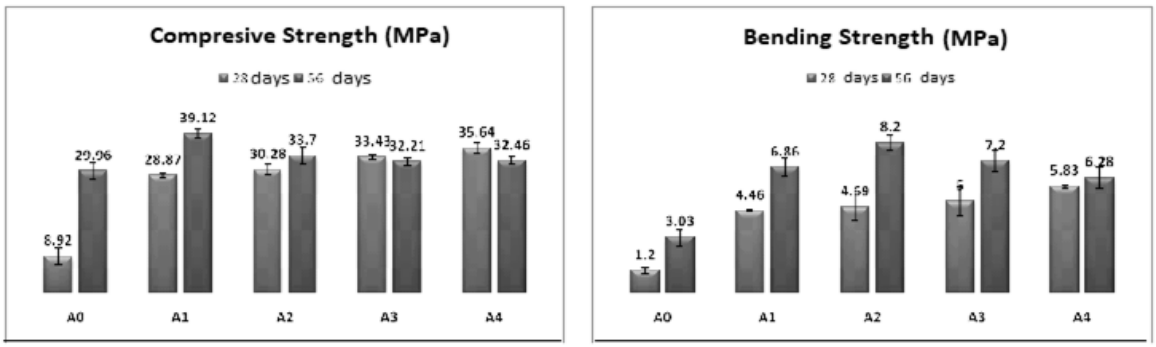


Fig 3. Compresive Strength and Bending Strength of the Samples at age 28 and 56 days

3.4. Study the puzzolanic reaction

Hydroxyl calcium ($Ca(OH)_2$) has been produced during hydration process of cement (due to reactions of C3S and free lime CaO with water H_2O). $Ca(OH)_2$ is easily solubled in water, reducing the strength of concrete and cement.

$Ca(OH)_2$ is characteristic by absorption wavelength at 3641 cm-1 in the IR spectrum [1,2]. We don't see this absorption peak in the IR spectrum of the sample A4 when it apears clearly in the IR spectra of the samples A0' and A0 (do not contain RHA) (Fig.5).

Similarly, the IR spectra of the RHA – containing samples (A1, A2, A3 and A4) did not apear the absorption peak at 3641 cm^{-1} (Figure 6). The results from anlysis of IR spectra confirmed that the puzolanic reaction between SiO_2 of RHA and $Ca(OH)_2$.

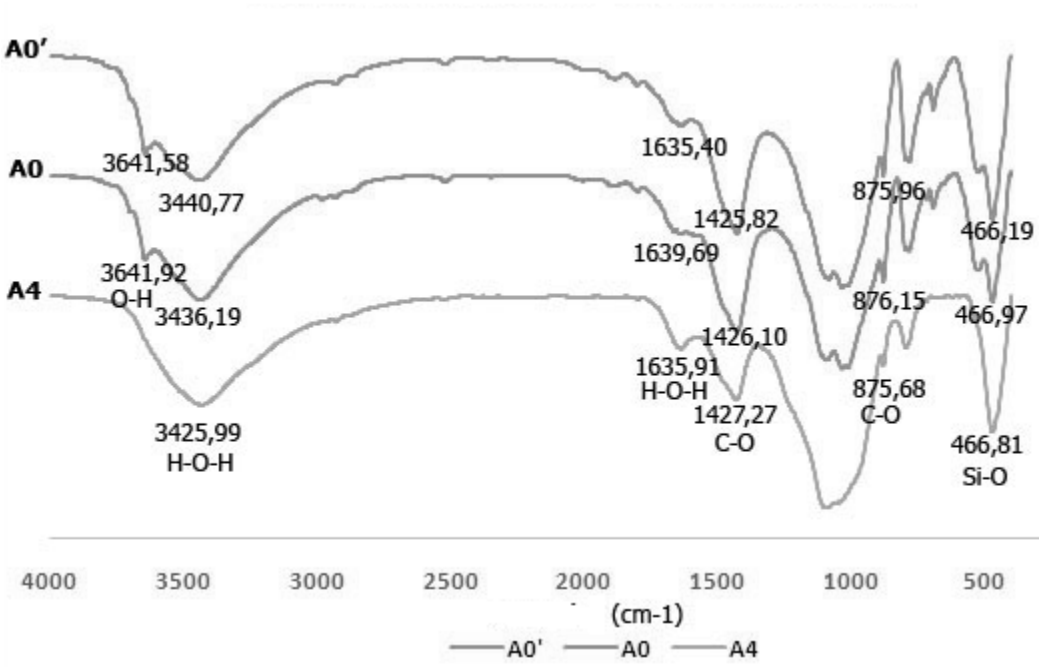


Fig 4. The IR spectra of A0' and A0 (do not contain RHA) and A4 (contaning RHA)

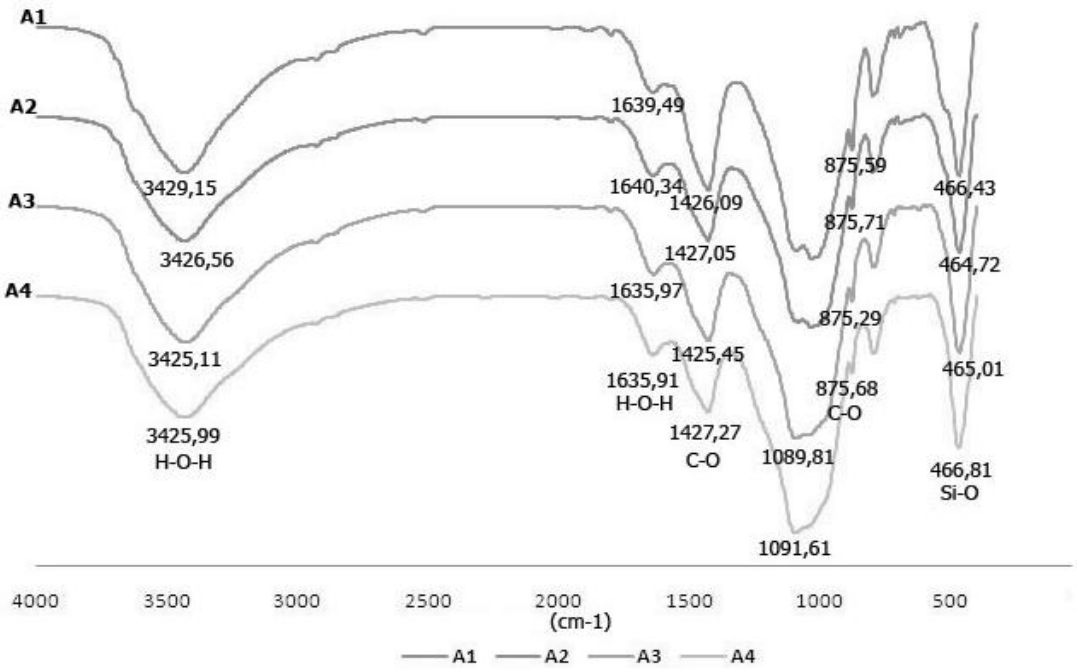
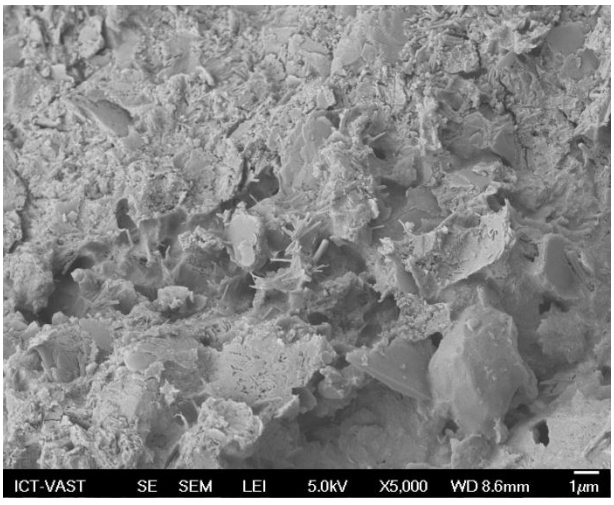


Fig 5. The IR spectra of the RHA – containing samples A1, A2, A3 and A4

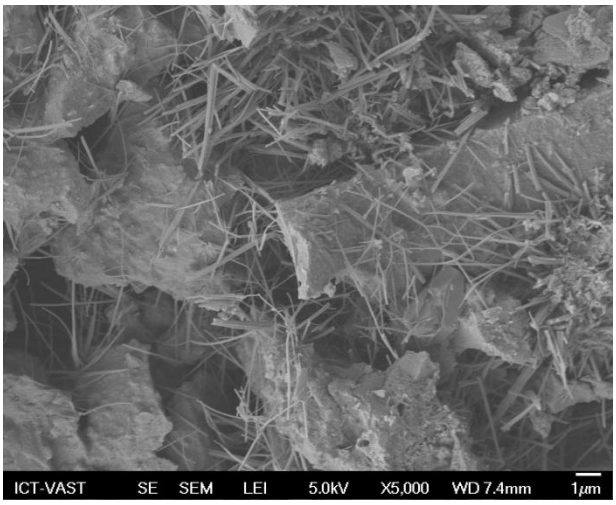
The puzzolanic reaction between SiO_2 in RHA will produce mineral CSH (hydro calcium silicate) which increases the strength of the concrete.

$$SiO_2 + Ca(OH)_2 + H_2O \rightarrow C\text{-}S\text{-}H$$

The product CSH from the puzzolanic reaction can be seen more clearly on the microstructure analysis from the scanning electron microscope (SEM). On the Fig.6b (the sample A4) the the fiber form of CSH is very clear, while not clearly seen on the Fig.6a (the sample A0).



a) The sample A0



b) The sample A4

Fig 6. The SEM images of the samples A0 and A4

3.5. Study the reaction between molasses and $Ca(OH)_2$

Molasses reduces the curing time of cement mortar because of reactions of the protein with $Ca(OH)_2$ from the hydration process. The two protein-specific groups are amine ($-NH_2$) and carboxylate ion

(-COO-) with the absorption peaks in the IR spectrum at 1660 – 1610 cm^{-1} and 1600 – 1590 cm^{-1}, respectively. Ion Ca^{2+} will be linked to the protein via the –COO-) group. This link has an absorption peak at 1580 cm^{-1} [1].

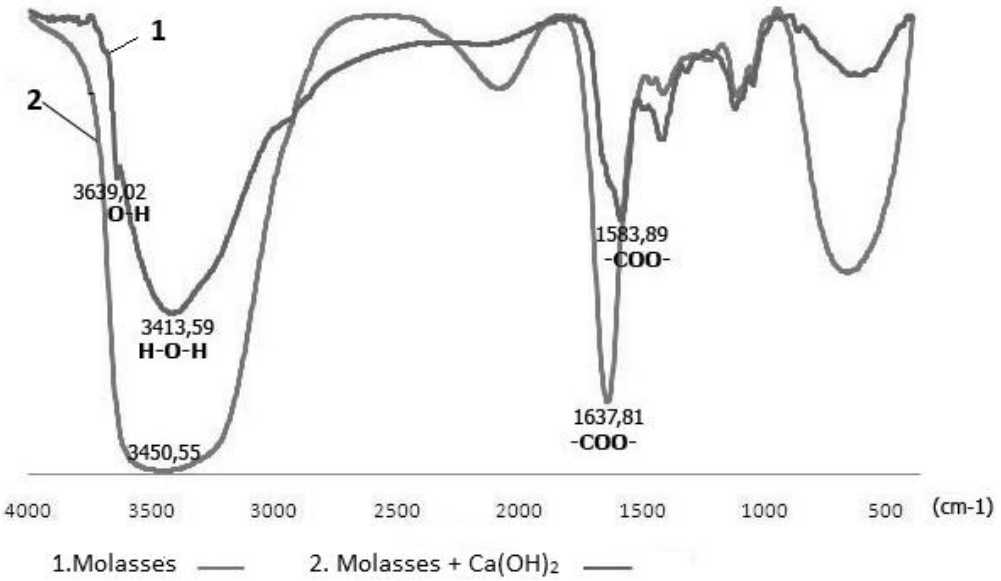
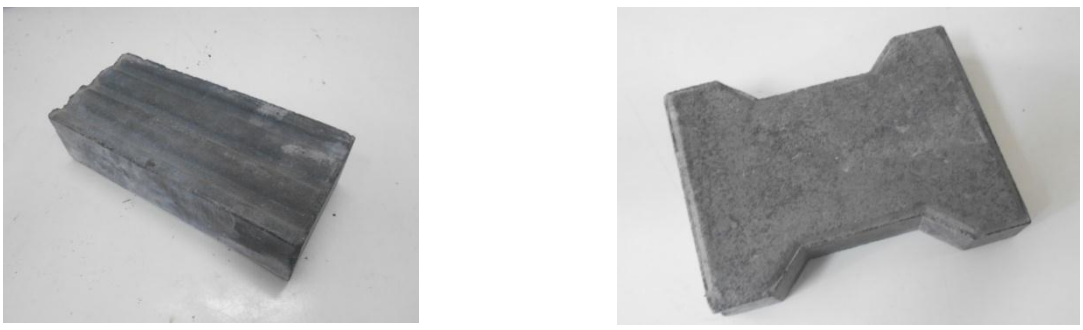


Fig 7. The IR spectrum of molasses (1) and a mixture of the molasses + $Ca(OH)_2$ (2)

Figure 8 is the IR spectrum of molasses (denoted 1) and of the mixture of molasses and $Ca(OH)_2$ (denoted 2). There is an absorption peak at 1637.81 cm^{-1} in the curve 1, which is the absorption peak of the –COO- group, due to the overlap of the absorption peak of the amino group [1]. When $Ca(OH)_2$ was reacted with molasses, the peak of the –COO- was shifted from 1637.81 cm^{-1} to 1583.89 cm^{-1}. This change was confirmed the link between the group -COO- and ion Ca^{2+}.

3.6. Made unbaked bricks from RHA and molasses

To indicate the practical application, some unbaked brick products have been made. The fabrication was selected according to the composition of the sample A2 because of the large amount of used RHA (20 % wt.).



(a) (b)

Fig 8. The unbaked bricks from RHA and molasses

In Figure 9, the unbaked brick is 45 x 80 x 180 mm (Figure 9a) and the I-type brick with a size of 165 x 205 x 50 mm (Figure 9b). The unbaked bricks were formed at presure 10 MPa. The compresive strength after 28 days was 35.58 MPa, water absorption was 12.12%. The compressive strength of the I – type brick after 28 days was 15 MPa.

4. CONCLUSIONA

RHA with the high content L.O.I. (up to 15.51% wt.) can be used to produce unbaked bricks. When using RHA, the puzzolanic reaction between $Ca(OH)_2$ and SiO_2 of RHA will be produced more CSH, so that the intensity of the bricks will be increased. The puzzolanic reaction was confirmed by IR and SEM analysis.

RHA can be reacted with proteins of molasses, so that intensity of the sample was significantly improved with the presence of RHA (10 - 40 %).

Some of unbaked brick samples using RHA (20% wt.) and molasses was made by pressed at 10 MPa. Unbaked bricks with a compressive strength of 35.58 MPa, water absorption 12.12% to achieve TCVN 6477: 2011.

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ANALYSIS AND ALTERNATIVE TREATMENT OF TRIMETHOPRIM RESIDUES IN WATER BY γ-IRRADIATION

Nam D. Le, Thang M. Ngo

ABSTRACT

Trimethoprim (TMP) is widely applied in veterinary and also frequently prescribed together with sulfamethoxazole (SMX) for human medicine. Therefore TMP residues accumulated in agricultural as well as municipal wastewater and further contaminate surface water. In this contribution, the capability of HPLC/UV to detect and quantify TMP residues in water is thoroughly investigated, yielding LOD = 0.06 µM, LOQ = 0.2 µM and very good reproducible calibration line in the concentration range 2 µM ÷ 100 µM. The resulting procedure was applied to evaluate the capability to treat TMP residues in water (init. 20 µM ÷ 140 µM) by gamma irradiation. Removal yields greater than 99 % were obtained using absorbed doses 0.3 ÷ 3.0 kGy, respectively. Based on the HPLC/UV chromatograms obtained, some aspects of the TMP radiolytic products in the investigated samples are briefly discussed.

Keywords: analysis, antibiotic residues, gamma-irradiation, trimethoprim, water treatment & -reuse.

1. INTRODUCTION

Residues of pharmaceutical products, especially those of antibiotics in natural aquifers have been detected worldwide (Sui et al., 2013; Schaefer et al., 2015; Dinh et al., 2017a, 2017b). A joint research project showed that residues of sulfamethoxazole (SMX) in surface waters in Vietnam are higher comparing to other countries (Shimizu et al., 2013). As SMX is frequently applied together with trimethoprim (TMP), residues of the later one in Vietnam's surface water were supposed at elevated levels, too.

Trimethoprim (TMP) with molecule formula $C_{14}H_{18}N_4O_3$ and structure shown in Fig. 1 is an antibiotic against a broad spectrum of bacterial species and applied both in veterinary as well as in human medicine (mostly in combination with SMX).

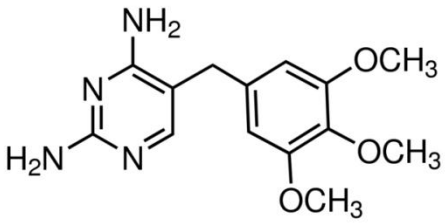

Fig 1. Molecular structure of TMP

At ambient conditions (1 atm, 20°C), TMP's solubility in water is about 400 mg/L, which increased with temperature and/or concentration of another organic solvents in the order ethyl acetate, 2-propanol, acetonitrile, ethanol (Yin et al., 2016). Moreover, TMP is known to be persistent in conventional wastewater treatment facilities. Therefore, TMP could be involved, accumulated and transported in the environment alongside the water streams.

Attention of several research groups has been focused to treatment of TMP residues in water by diverse methods. E.g. Electro-catalytic degradation of TMP on surfaces of carbon electrodes doped by porphyrin manganese was investigated and theoretically validated by means of computational chemistry (Rajith et al., 2011). Sorption of TMP onto some agricultural soil samples and its desorption by $CaCl_2$ solutions or outflow from an wastewater treatment facility was reported, demonstrating that the local soil- and aquifer compositions play an important role in transport of TMP (Zhang et al., 2014). Recently, peroxydisulphate initiated by heating to temperatures 50 ÷ 65°C was applied to activate TMP removal, depending on the sample matrices – while natural organic matters and bicarbonate ions suppressed this process, chloride ions accelerated it (Ji et al., 2016).

By means of photolysis and photo-catalysis, TMP in both distilled water and sea water matrices is relatively stable under natural light illumination. Although an intermediate photolytic product was photosensitive and acted as autocatalyst, the sample DOC decreased very slowly. Using TiO_2 increased the mineralization degrees of TMP in both matrices, but the rates in sea water were substantially lower because the inorganic components acted as hydroxyl radical scavengers (Sirtori et al., 2010). Under similar illuminating conditions by UV-A, UV-C and VUV, hydroxyl radicals play an important role in the samples investigated, enabling up to ~ 73% the total removal yields, while direct photolysis accounted for about ~ 27% (Kim et al., 2015). A somewhat more complicated situation is TMP and SMS treatment in urine matrices due to diverse effects of the matrix components (Zhang et al, 2015, 2016).

Gamma irradiation using ^{60}Co sources is classified among the advanced oxidation methods as it produced hydroxyl radicals, too. It was applied mainly to discuss the mechanism and intermediate products of TMP (init. 1 mM) transformation by hydroxyl radicals (Luo et al., 2012). In a more recent paper, the TMP (init. 20 mg/l ~ 69 µM) removal was reported but focused on the effects of persulfate concentration 0.5 ÷ 2.0 mM and matrix pH 6,5 ÷ 8,5 (Zhang et al., 2016). The effect of initial concentration of TMP was not reported in both these 2 publications. Moreover, the HPLC/UV procedures seem very complicated and differed from each other, causing confusion about the reported TMP removal yields. Our paper first focuses on the HPLC/UV procedure for TMP analysis and then on the TMP removal yields depending on its initial concentration and the applied doses.

2. MATERIALS AND METHODS

TMP 99.0% purchased from Sigma-Adrich, formic acid p.a. from Merck, Acetonitrile HPLC grade from J. Baker and other chemicals of analytical grade were used without further purification. Bi-distilled water was used for preparing solutions.

A 1000 µM TMP stock solution was prepared by dissolving 0.0726 g TMP in 250 ml bi-distilled water, stored in dark at ~ 4°C and diluted accordingly to actual samples (TMP conc. In µM: 140, 100, 70, 50, 30, 20, 10, 5, 2, 1, 0.5, and 0.2 µM, respectively) before use.

TMP concentrations were analysed using an HPLC equipment typed Agilent 1290 infinity series, equipped with an Agilent Eclipse Plus C18 guard column (1.8 µm x 2.1 mm x 50 mm), an Agilent Poroshell 120 EC–C18 analytical column (2.7 µm x 4.6 mm x 100 mm) and a diode array detector (DAD). The column was let at room temperature, the injection volume fixed at 10 µl, wavelength set at 254, 265, 270 and 275 nm. First, various compositions of the mobile phase were tested, then the mobile phase flowrate, and finally the calibration line was constructed as function of peak volume vs. sample concentration.

Gamma irradiation experiments were conducted at Dalat Nuclear Research Institute as described in previous paper (Le et al, 2016) , using a Gamma chamber 5000 (India) ^{60}Co source with dose rate ~ 46.6 Gy/min. Briefly, 8 ml sample (TMP init. conc. 20 µM ÷ 140 µM) was filled in 12 ml glass tube (Hach, USA), tightly closed and irradiated to the pre-determined absorbed dose (0.3 kGy ÷ 3.0 kGy). TMP concentrations before and after irradiation were analyzed using the established procedure and constructed calibration line. Each experiment was conducted in triplicate to validate the experimental errors.

3. RESULTS AND DISCUSSION

3.1. HPLC/UV procedure

In order to avoid the pressure change, the isocratic mode of mobile phase was applied throughout this work. Fixing the flowrate at 1 ml/min., various mixing ratios of bi-distilled water / acetonitrile (90% ÷ 10%), 10 mM phosphate buffer pH 3.5 / acetonitrile (10% ÷ 30%) did not result any peaks of TMP even at prolonged measuring time, despite of its success using gradient mode (e.g. Lue et al, 2012; Zhang et

al., 2016). However, mixtures of 0.1% formic acid / acetonitrile (70% ÷ 90%) worked relatively well. Taking into account effects of the mobile phase flowrate (1.0 ml/min ÷ 0.25 ml/min) onto the retention time, peak area and – symmetry, the mobile phase composition was chosen 0.1% formic acide / acetonitrile = 82% / 18% (v/v) and its flowrate 0.5 ml/min. TMP signals were the highest at wavelength 270 nm instead of 275 nm as stated in Zhang et al. (2016). Fig. 2 and Fig.3 shows chromatograms of the most dilute TMP samples which were measured in this work, and the constructed calibration line using the HPLC parameters mentioned above. One can see a linear relationship between the TMP peak areas and the corresponding TMP concentrations up to 100 µM with confidence coefficient 0.9999.

The reproducibility of TMP retention times is pretty well, e.g. $t_r = (3.42 \pm 0.02)$ min resulted from 12 measurements presented in Fig.2 (triplicate measurement each sample). Certainly, this retention time increased with increasing the 0.1% formic acid / acetonitrile in the mobile phase, e.g. to ~ 90/10. However, the peak shape and symmetry suffered a lot. The TMP peak areas were well reproducible, too. The estimated relative errors are within 3%, even for the most dilute sample (0.2 µM TMP). For the sake of our further application, 0.2 µM TMP is considered the real limit of quantitation (LOQ) and therefore 0.067 µM TMP comes out as the corresponding limit of detection (LOD) of this analytical procedure.

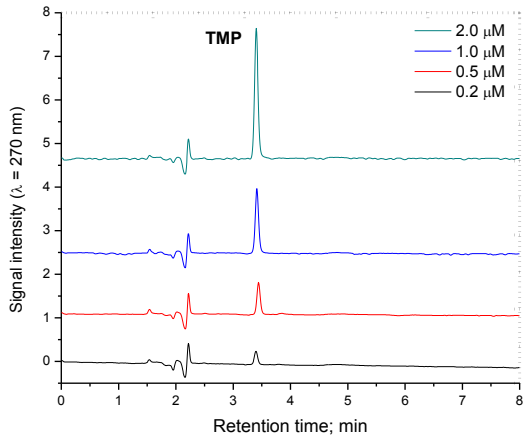

Fig 2. Chromatograms of dilute TMP samples

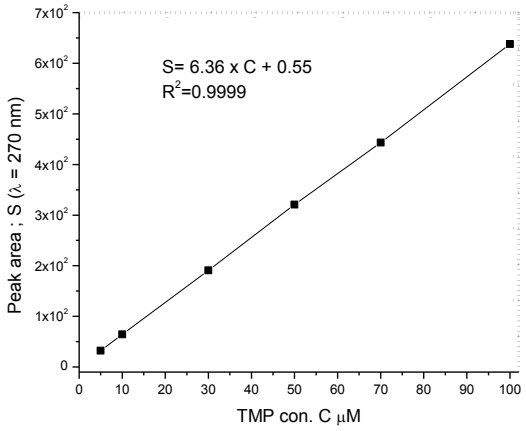

Fig 3. Calibration line for TMP analysis

Mobile phase: 0.1% formic acid / acetonitrile = 82 / 18 (v/v), 0.5 ml/min.

Detector wavelength 270 nm, injection volume 10 µl

It is worth to note this analytical procedure does not aim to analyzing TMP concentration in surface water samples, which are at least about 100x lower than 0.2 µM (Lue et al., 2012; Zhang et al., 2016). In such cases, an additional pre-concentration step, e.g. by solid phase extraction (SPE), is necessary. However, it confirms that the calculated removal yields up to 99% even from the initial concentration 20 µM TMP (see below) are reliably determined.

3.2. TMP removal yields, -rates, and radiolytic products

Based on the constructed calibration line in Fig 3, TMP removal yields R_D% were calculated according to the formula:

$$R_D\,\% = \frac{C_0 - C_D}{C_0} = \frac{S_0 - S_D}{S_0}$$

Where symbols C and S refer to TMP concentrations and peak areas, indexes 0 and D refer to samples before and after dose D, respectively. The sample with initial TMP concentration 140 µM was diluted before analyzing and the measured peak area re-calculated.

Fig 4. shows the TMP removal yields and –rates due to the absorbed doses. Almost quantitative removal of the initial TMP concentrations 20 µM, 50 µM, 70 µM, 100 µM, 140 µM was achieved at absorbed doses 0.3 kGy, 1.0 kGy, 1.5 kGy and 3.0 kGy, respectively. As C_0 = 70 µM is comparable with 20 mg/l (~ 69 µM) in the literature (Zhang et al. 2016), our determined dose for a practically quantitative TMP removal is slightly higher (1.5 vs. 1 kGy). The origins of this difference might be, but not limited to the difference in dose rates of the ^{60}Co sources. Except for the lowest conc. C_0 = 20 µM, the TMP removal rates fitted well to kinetic equations of pseudo-first order reaction, with the reaction rate depending on the initial TMP concentration. This finding is frequently reported in the literatures (e.g. Le et al., 2016; Ngo et al., 2010). In fact, reactions between substrate molecules – in this case TMP molecules – and hydroxyl radicals in irradiated samples are of second order (e.g. Luo et al. 2012). Anyways, these results demonstrate the potential of γ-irradiation as an alternative treatment method for TMP contaminating water. Even for such a high level of contamination as ~ 140 µM, an absorbed dose just about 3.0 kGy is needed for its almost quantitative removal.

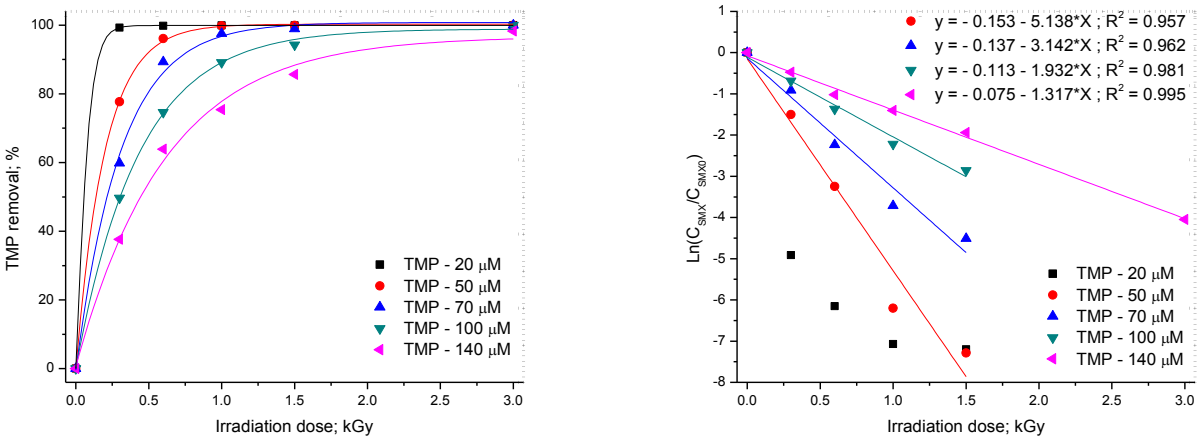

Fig 4. TMP removal yields (left) and –rates (right) depending on its init. conc. and doses

Beside the removal yields, the toxicity or even identity of the treatment products has recently become important factors from both theoretical and practical points of view. Normally, sophisticated equipments such as liquid chromatography – time of flight mass spectrometry (LC-TOF-MS) or conventional LC-MS are required (e.g. Luo et al., 2012; Zhang et al., 2016; Le et al., 2016). However, the HPLC-UV chromatograms reveal some characteristics of the treatment products which absorb UV lights (e.g. Ngo et al 2010). Fig 5 shows up to 6 peaks of TMP radiolytic products which have retention times shorter than TMP itself. According to the principle of reverse-phase chromatography all these detected UV-absorbing products have higher polarity than TMP. These peaks gradually diminished with increasing the absorbed dose, except for two with the shortest retention times, suggesting only the corresponding products were stable under γ-irradiation. In addition, comparing chromatograms on Fig 5 and Fig 2 would suggest these remaining 2 peaks represent the inorganic products. It is in good accordance with ~ 20% TMP mineralized under comparable conditions (Zhang et al. 2016). However, nothing more could be stated and, moreover, the number of detected peaks are far below the number of TMP radiolytic products reported in the literature (Luo et al, 2012; Zhang et al, 2016).

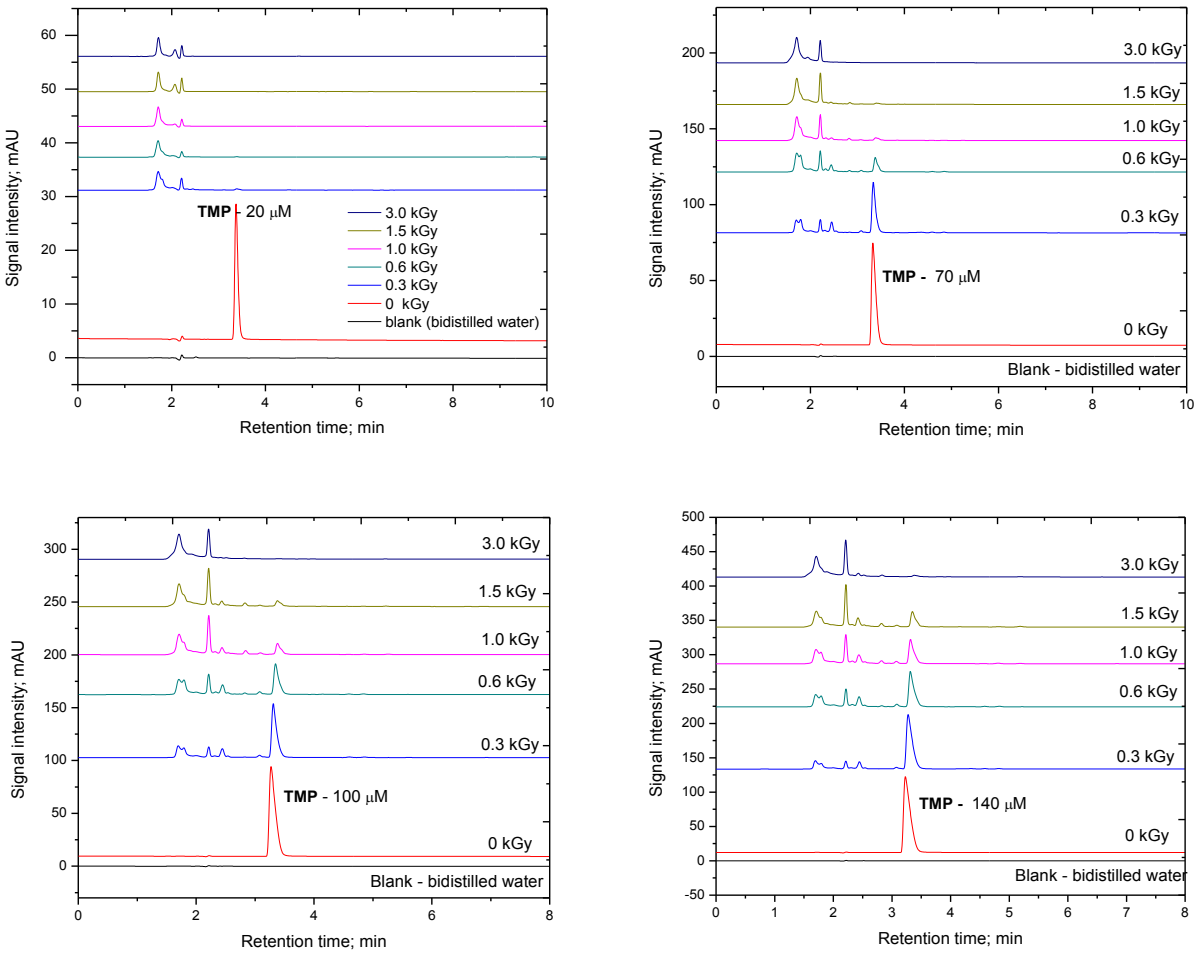

Fig 5. Chromatograms of TMP samples depending on its init. conc. and doses

It is well known from the literature that in irradiated aqueous samples, water is first radiolysed to produce many chemically active species including hydroxyl radical $\cdot OH$ – strong oxidant and $\cdot H, e^-_{aqua}$ – strong reductants, which further attack the substrate molecules (e.g. Luo et al, 2012; Zhang et al, 2016; Wojnarowitz and Takacs, 2017).

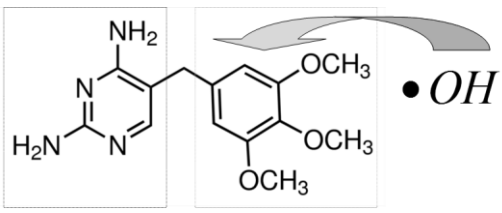

Fig 6. Preferential attack of $\cdot OH$ to TMP

Under the experimental conditions prevailing in this work, mainly hydroxyl radical is responsible for TMP radiolysis and it is believed to preferentially attack to the trimethoxybenzene moiety (TMB), as illustrated in Fig.6, resulting up to 5 products. They all contains aromatic rings (Luo et al., 2012; Zhang et al., 2016), and therefore should be able to absorb UV radiations, too.

It is questionable whether some of the TMP radiolytic products detected by LC-MS in the literature could be ascribed to the peaks mentioned above in the HPLC/UV chromatograms. As an indirect evidence, the octanol / water distribution coefficients of the detected products and their precursor – trimethropim – could be accessed by means of computational chemistry and compared with each other (Le et al. 2016).

4. CONCLUSIONS AND OUTLOOKS

A suitable HPLC/UV procedure for rapid TMP analysis in aqueous samples is described in details, which enables to analyze samples in the concentration range 0.2 μM ÷ 100 μM TMP. γ-irradiation proved to be an efficient alternative method for treatment of TMP residues in water, as an absorbed dose about 0.3 kGy should be sufficient to quantitatively remove TMP residues at all contamination levels typically found in wastewater effluents and natural aquifers. Further investigation is required to identify/quantify the radiolytic products of TMP and/or to compare the toxicity of samples before and after irradiation.

Acknowledgement

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USING COMBINED NEURAL NETWORKS AND GENETIC ALGORITHMS FOR PREDICTION OF THE DAMAGE OF RICE DISEASES IN AN GIANG PROVINCE

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ABSTRACT

Information technology applications to serve high-tech agriculturehave been consideredby many researchers in recent years. There are many solutions, information technology systems have been implemented and bring positive effects to the farmers such as e-commerce website for exchangingagricultural products, agricultural information system, livestock information management system, agricultural environment monitoring system, ... In this paper, we will present a combination ofback-propagationneural networksand genetic algorithms for prediction of the damage of ricediseasesin An Giang province. With input parameters are the factors of climate conditions and the damage of ricediseases in the past, the system will predict the damage of rice diseasesin the next weeks in 11 districts in An Giang. Our method has been tested on a dataset collected during 22 years by Plant protection department of An Giang. Ourrice diseasesforecasting system has achieved promising results and received good evaluations from the specialists of forecast department, with a total average RMSE on test dataset is 19.31 (ha).

Keywords: Artificial neural network, Back-propagation algorithms, Genetic algorithms, Information technology applications for agriculture.

1. INTRODUCTION

Appeared since 1943, artificial neural networks (ANNs) have always been the focus of many researchers who is finding out the operating mechanism of artificial neurons and biological neural networks. In recent years, ANNs have been more and more popular and successfully applied in many different fields such as finance, health, geology, physics, etc. Indeed, if anywhere there are problems with forecasting, classifying and controlling, artificial neural networks will be applicable and reliable in results.

In industrialization and modernization of the country, information technology plays a very important role. Many achievements of information technology are applied in all aspects of life such as state management, health, education, etc. An Giang is one of the top provinces of Mekong Delta about producing rice. Theagricutural land occupies a grade for area of 79% and over of the total natural land and rice is the main crop with over 74% of area. In the developing trend of agricultural production, the number of crops have been increased,aiming to increase the number of crops and income, land has been used to the max. Besides, environmental pollution and climate changesfacilitated the advanced conditions forseveral viruses to develop more and more on a large scale. Specially, the rate of harmful pests in rice is quite high.

In plant protection field, geographic information system (GIS) and remote sensing (RS) are widely applied to agricultural forecasting in some provinces such as: Dong Thap (2010), Quang Ninh (2011), Bac Ninh (2014), An Giang (2014). The software, which is used by agricuture for forecasting in An Giang is provided byTechnical Science Service Consultant Joint Stock Company(Scitec Company).Numerous statistical algorithms are integrated in this software which was developedas a supporting tool for forecasting. Prediction methods are used in these kind of softwares are based mainly

on tradition statistical models which must know beforehand the mathematical models. Therefrom, the forecast is made based on the linear regression model.But in fact, most forecastings problems are very complex and nonlinear. Applying a linear form to the mapping can limit the accuracy of the forecast models. Thus, to solve this disadvantage, people often perform some transformations on the independent and dependent variables before constructing the model. This process is called data linearization. So, the difficulty of constructing a linear regression model is not the determination of coefficients of linear mapping but it is the data linearization. However, this difficulty can be solved by building a direct nonlinear model on the data set and artificial neural network is a solution.These challanges encourage us to study an appropriate model of artificial neural network for forecasting the situation of rice deseases in An Giang province.

The next parts of this article are presented as follows: Section 2 provides a brief introduction to artificial neural networks; Back-propagation and genetic algorithms are presented in sections 3 and 4; An artificial neural network model for forecasting the status of rice diseases in An Giang will be covered in detail in section 5.

2. ARTIFICIAL NEURAL NETWORK

The artificial neural networks (ANNs) (McCulloch, Warren, Walter Pitts, 1943) is a computing system simulated the processing of biological neural network's information. It is made from a large number of elements (called artificial neurons or processing elements)connected through links (each link has a weight values called link weight)that work as an unity to solve a specific issue. In practice, many artificial neural networks are good tools for modelling nonlinear statistical data.They can be used to model complex relationships between input and output data.An artificial neural network is configured for a specific application (pattern recognition, data classification, etc.) through a learning process from a set of training samples. Learning is in substance the process of calibrating the link weights between neurons.There are three common machine learning methods including: supervised learning, unsupervised learning and reinforcement learning.Supervised learning is the most popular method, which is typically the back-propagation algorithm.

3. BACK-PROPAGACTION ALGORITHM

The back-propagation (BP) algorithm (Stuart Dreyfus, 1990) is often applied to multi-layer feed-forward neural networks consisting of processing elements with activated and continuous functions.Given the training set consisting of *p* samples, the input-output pairs are as follows:

$$\{x^{(k)}, d^{(k)}\}, k = 1, 2, \ldots, p. \quad (1)$$

The back-propagation algorithm provides procedures for altering the weight values in back-propagation neural networks to properly classify given input samples. The basis of this algorithm is reduced gradient method (Elijah Polak, 1997).For a given input-output pair, the back-propagation algorithm performs two phases of the data stream. Firstly,the input pattern$x^{(k)}$is propagated from*input*layer to*output*layer and it generates the actual *output* signal as the forward output.Next, the error, the differenceof$d^{(k)}$and$y^{(k)}$, will be back propagated from*output*layer to the *input* layers in order to help them to adjust their weight values.For example, consider a three layers network as shown in Figure 1 with *n* nodes in the input layer, *n* node in the hidden layer and *m* nodes in the output layer. Straight lines indicate the forward spread of the signals, the dashed lines indicate the backward propagation of the errors.

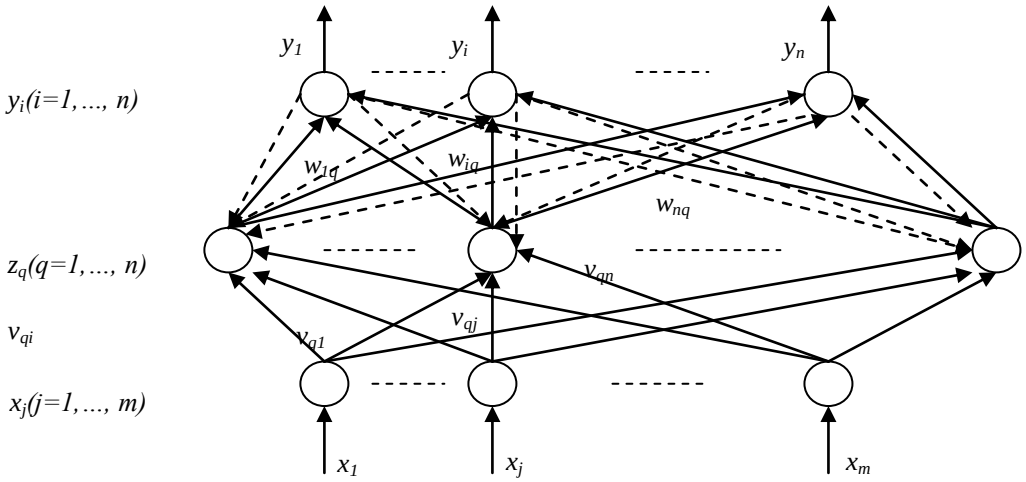

Fig 1. Back-propagation neural network with three layers

Consider a pair of training data *(x, d)*. With the given *input*pattern*x*, the node *q* in the hidden layer receives the network's*input*:

$$net_q = \sum_{j=1}^{m} v_{qj} x_j \tag{2}$$

And generates*output*

$$Z_q = a(net_q) = a\left(\sum_{j=1}^{m} v_{qj} x_j\right) \tag{3}$$

The network's *input* for thei^{th} node of *output* layer is as follows:

$$net_i = \sum_{q=1}^{l} w_{iq} z_q = \sum_{q=1}^{l} w_{iq}\, a\left(\sum_{j=1}^{l} w_{qj} x_j\right) \tag{4}$$

And generates*output*

$$y_i = a(net_i) = a\left(\sum_{q=1}^{l} w_{iq} z_q\right) = a\left(\sum_{q=1}^{l} w_{iq} a\left(\sum_{j=1}^{m} v_{qj} x_j\right)\right) \tag{5}$$

The above equations determine the forward spread of *input* signals through the layers.

Cost function is defined by equation

$$E(w) = \frac{1}{2}\sum_{i=1}^{n}(d_i - y_i)^2 = \frac{1}{2}\sum_{i=1}^{n}[d_i - a(net_i)]^2 = \frac{1}{2}\sum_{i=1}^{n}\left[d_i - a\left(\sum w_{iq} z_q\right)\right]^2 \tag{6}$$

By the reduced gradient method, the weights are updated as follows:

$$\Delta w_{iq} = -\eta \frac{\partial E}{\partial w_{iq}} \tag{7}$$

We have

$$\Delta w_{iq} = -\eta \left[\frac{dE}{\partial y_i}\right]\left[\frac{\partial y_i}{\partial net_i}\right]\left[\frac{\partial net_i}{\partial w_{iq}}\right] = \eta[d_i - y_i][a'(net)]\left[z_q\right] = \eta \delta_{oi} z_q \tag{8}$$

Here, δ_{oi} is the error signal anddouble index*oi*determines thei^{th}node in the*output* layer. The error signal is defined as:

$$\partial_{oi} = -\frac{\partial E}{\partial net_i} = -\left[\frac{\partial E}{\partial y_i}\right]\left[\frac{\partial net_q}{\partial net_i}\right] = [d_i - y_i][a'(net_i)] \quad (9)$$

The net_i is the i^{th}node's *input* in *output* layer

Anda'(net_i) = $\delta a(net_i)/\delta net_i$

The weights on *input* connections and hidden classes are updated as follows:

$$\Delta v_{qj} = -\eta\left[\frac{\partial E}{\partial v_{qj}}\right] = -\eta\left[\frac{\partial E}{\partial net_q}\right]\left[\frac{\partial net_q}{\partial v_{qj}}\right] = -\eta\left[\frac{\partial E}{\partial z_q}\right]\left[\frac{\partial z_q}{\partial net_q}\right]\left[\frac{\partial}{\partial v_{qj}}\right] \quad (10)$$

Thus

$$\Delta v_{qj} = \eta\sum\left[(d_i - y_i)a'(net_i)w_{iq}\right]a'(net_q)x_j \quad (11)$$

Deducing that

$$\Delta v_{qj} = \eta\sum\left[\delta_{oi}w_{iq}\right]a'\left(net_q\right)x_j = \eta\delta_{lq}x_j \quad (12)$$

Here, $\delta_{lq}$is theerror signal ofq^{th}node in hidden layerandis defined as:

$$\delta_{lq} \equiv -\frac{\partial E}{\partial net_q} = -\left[\frac{\partial E}{\partial z_q}\right]\left[\frac{\partial z_q}{\partial net_q}\right] = a'(net_q)\sum_{i=1}^{n}\delta_{oi}w_{iq} \quad (13)$$

The net_q is the q^{th} node's hidden *input*.

In the case of general networks with arbitrary classes, back-propagation has the form as:

$$\Delta w_{ij} = \eta\delta_i x_j = \eta\delta_{output-i}x_{input-j} \quad (14)$$

Here, the*'output-i'*and*'input-j'*determine two connections from j^{th} node to i^{th} node, $x_j$is the appropriate input, active point from hidden node or from external input,$\delta_i$is learning signal.

When the activated functionis a *sigmoid* function, we have:

$$\delta_{oi} = \frac{1}{2}\left(l - y_i^2\right)[d_i - y_i] \quad (15)$$

And
$$\delta_{hq} = \frac{1}{2}\left(l - z_q^2\right)\sum\delta_{oi}w_{iq} \quad (16)$$

4. GENETIC ALGORITHM

The Genetic Algorithm (GA) (Turing, Alan M., 1950) is a technique of computer science that is capable of solving problems by imitation of human or animal evolution under specified available conditions of the environment.The means to solve this problem is a computer program consisting of a number of steps,since selecting a representative solution to a problem,choosing adaptive functions as well as transformational methods to create more appropriate solutions (Thomas Back, 1996). So GA does not focus on the unique or accurate solution as classical approach, but it considers all possible solutions and chooses the best or optimal one.

5. ARTIFICIAL NEURAL NETWORK MODEL FOR PREDICTING RICE DISEASES

Based on national technical regulations on methods of detecting plant pests (Ministry of Agriculture & Rural Development, 2010) and agricultural professionals' experience(Vietnamese Agriculture Directory, 2000; Handbook of rice farmers need to know, 2000), the predicting of rice diseases can be based on the

following factors: climate, area of rice tea stages and the situation of rice diseaseslast week.In particularly, the environmental and climatic factors include the average temperature(^oC), the hightest temperature (^oC), the lowest temperature (^oC), the lowest humidity (*%*),the amount of evaporation (*mm*), the amount of rain (*mm*), the total hours of sunshine (*hour*); The growth stages of rice include plating, tillering, flowering and blooming (*ha*).

5.1. Data mining techniques

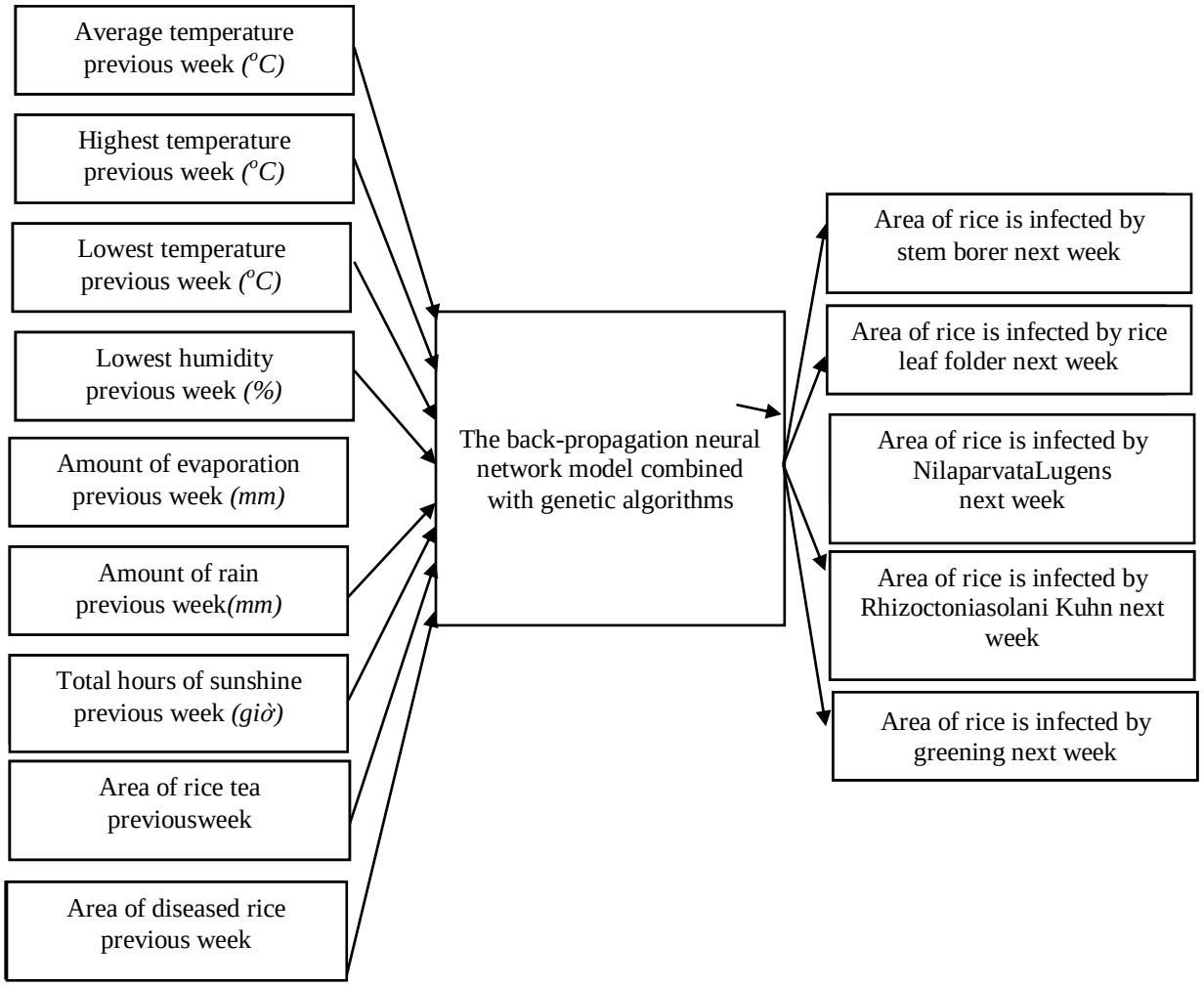

Fig 2. Artificial neural network model for predicting rice diseases

To solve the problem of rice diseases, the data mining technique we use here that is the back-propagation neural network combined with genetic algorithms. This model is generally depicted in Figure 2.Artificial neural network is a new computational approach that involves the development of learnable mathematical structures. One of the most important advantages of artificial neural networks is the ability to create highly accurate prediction models that meet the requirements of data mining about prediction of time-dependentevents. The method used in back-propagation neural networks is supervised learning method.Its operation is to analyze past data to generate a prediction rule for data in the future.Samples extracted by artificial neural network are expressed at the outputs of the network. In back-propagation neural networks, each node is associated with a threshold, so the patterns (or rules) of a concept are the combinations of weights that are greater than the threshold.

5.2. Back-propagation neural network with delay and shift window

The using input sample data of prediction problem is usually real-time data and output data is also real-time data.Real-time inference refers to the data at the present time and at earlier times. The *before-after* relationship is the centrepiece to learning real-time data.Actually, the hardest part in learning these patterns is how to recognize, describe and preserve those relationships. To solve that issue, we can improve the back-propagation neural networkto time-delay neural network and incorporate the shift window concept as shown in Figure 3.

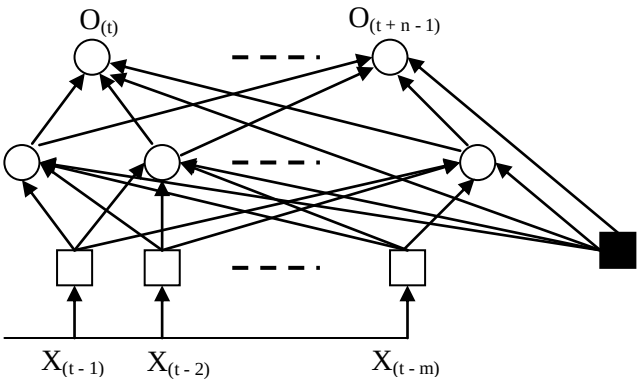

Fig 3. Back-propagation neural network with shift window on real-time data

If the input data has *x* bits and is delayed with *m* shift windows, there will be *m*x* input units to encode the input sample. When new data is inserted, it will be placed at the input node at a certain end of the network, the older data will be shifted by one unit on the network's entry nodes the same as the shift register.Prediction based on the data of how many times, the lookback windows will shift a corresponding amount.Likewise, the farther the prediction need is, the farther the look ahead windows will be. An example of a network's *input-output* relation that performs prediction with real-time data can be expressed as follows:

$$Y_{(t)} = f_{nn}(X_{(t-1)}, X_{(t-2)}, \ldots, X_{(t-m)}) \quad (17)$$

Where, *m* is the input shift windows and also the number of network's nodes, the output shift window is equal to 1 and also the network's output nodes.The relationship shows that the network will predict *Y* at the next time *t*, with the present time is*t-1*, knowing that its values and its dependent values are in the past and present time.

5.3. Applied genetic algorithms in finding the optimal set of weights for back-propagation neural networks

Using a local search method to minimize errors, back-propagation neural network encounter the following difficulties: (1) It is not possible to find the optimal set of weights for a given network's structure but only to find an acceptable set of weights; (2) The network may not converge or converge very slowly, this will affect data mining speed as well as the data mining results will notbe as expected.

Whereas genetic algorithms can easily find areas ofinterested extreme.But it is very difficult to find extreme values in that area (D. Montana and L. Davis, 1989; Whitley, T. Starkweather et C. Bogart, 1990).Actually, this is an optimization algorithm. Thus, in this paper we use genetic algorithms to support the optimization process of the weights set on neural networks.Firstly, the hybridization process begins by initializing the first population of chromosomes (It is the network's weights encoding set) as the input for genetic algorithms.Then, genetic algorithms will produce a new generation.This generation is decoded and send back to the neural network to evaluate the adaptability of each individual, here is the weight set. Before continuing evolution based on assessed adaptability, the system will retain some of the most

adaptable individuals of the present generation. The process will be repeated until the system finds out an optimal weights set. After neural network is optimized, it will use back-propagation algorithm to find local extremes in this optimized space.Finally, the network will be used to exploit the data and extract the prediction patterns.

5.4. Experiments and results

The rice diseases prediction model using back-propagation neural network and genetic algorithm was codedin C++ programming language.All of our experiments were implemented on a computer Intel Core i5 CPU, 4GB RAM, Microsoft Windows 7operating system.

Data: Our method was tested on a data ofrice diseasesin winter-spring crop, provided by An Giang Plant protection department. Winter-spring crops are now usually from January to the end of March, so this department usually collects data from districts for 15 weeks.In order to synchronize with the neural network's input data, we collected data of the climatic environment for 15 weeks (provided byAn Giang National Centre for Hydro - Meteorological Forecasting).To ensure adequate data for the training set and to enhance the reliability of the forecasting model, we have used the collected data for 22 years (from 1994 to 2015). So we have total collected samples in winter-spring crop is 15 (weeks) * 22 (years) = 330 (samples).We then used 300 samples for model training and the remaining 30 samples were used to test the model.

Measurement of forecasting accuracy: Predictions always have errors because rice diseases situation depends on many factors and develops complexly.Forecasting error will be a measure of how predicted value will be close to actual value.In fact, this error is the difference between the actual value (d_t) and the predicted value (y_t) and is calculated as follow: $e_t = d_t - y_t$.

A forecasting model is considered good if the forecasting error is quite small on testing data.In fact, if we build the model properly, the fluctuations of the prediction error will not go in any direction.The fluctuations in the prediction errors are often due to external phenomena that we can not foresee.This means that the random oscillations of e_t in each period are purely random oscillations around the predicted value y_t, so the total prediction error will be zero.At present, the two most popular method of calculating forecasting errors are absolute predictionerror relative prediction error.In fact, the calculation of forecasting errors is quite good in cases that the problem is complex and the forecasting model has a large error.Therefore, to measure the prediction accuracy of the rice diseases prediction model, we use the relative error, namely the Root Mean Square Error (RMSE).

$$RMSE = \sqrt{\frac{\sum_{t=1}^{n} e_t^2}{n}} \tag{3.6}$$

Where e_t is the prediction error in t stage, n is the number of forecasting observations.

Neural network training: To build the forecasting system, we train 11 neural networks for11 districts in An Giang respectively. The training of these networks is the same. Therefore, we only presentthetraining process of a neural network model of Long Xuyen City, in winter-spring crop, with the stem borer.This process is divided into two main steps as follows:

Step 1: Find global optimization weights: In this step, the network will be trained by genetic algorithms using randomly generated weights and configured as in Table 1.

Table 1. Configuring neural network when training by genetic algorithm

Population size= 40	Hybrid probability = 0.6
Chromosome length = 8	Mutation probability= 1.0 / population_size
Generationnumber=500	Fault tolerance = 0.01
pick_fittest = TRUE	Learning type: Genetic algorithm

Table 2. The results of training neural networks on testing data set (usingGA)

Sample index	**Reality (d_t)**	**Network(y_t)**	**Error ($e_t=d_t-y_t$)**
1	3.166,76	2.778,59	388,17
2	3.701,11	4.166,59	-465,48
3	4.813,15	4.599,67	213,48
4	5.345,51	5.660,28	-314,77
5	5.568,52	5.696,74	-128,22
6	6.123,95	6.422,10	-298,15
7	5.868,32	6.418,35	-550,03
8	3.688,47	3.547,33	141,14
9	1.328,50	1.603,20	-274,70
10	483,61	890,50	-406,88
11	468,52	404,57	63,95
12	533,26	386,01	147,25
13	505,61	466,27	39,35
14	505,69	3.229,32	-2.723,63
15	241,23	396,87	-155,64
16	3.075,18	3.232,77	-157,59
17	4.895,85	4.279,30	616,55
18	5.820,24	6.087,87	-267,63
19	6.398,39	6.411,60	-13,21
20	6.980,67	6.518,75	461,92
21	6.186,07	6.434,48	-248,41
22	4.656,38	4.975,58	-319,20
23	2.204,87	3.552,44	-1.347,57
24	834,76	1.226,75	-391,99
25	520,33	607,16	-86,84
26	494,24	530,86	-36,62
27	416,22	443,33	-27,11
28	394,52	274,21	120,32
29	205,83	314,01	-108,17
30	0,00	8,37	-8,37
	RMSE	**619,40**	

After 500 generations of network training using genetic algorithms, the RMSE error on the testing data set was 619.40. In particular, the error of each sample in the testingdata set is still quite large (as shown in Table 2). The error is quite large because in this phase the network is looking for a global optimization weights space. To reach the local extremity in weightsspace, we continue to step 2 for training with time-delay back-propagation network and shift window.

Step 2: Locate the local extremes in the global optimization weights space: After completing step 1, we have a global optimization weights space. However, the network model has not yet really reached its extreme value. So in this step, we continue to train the network with the weights set we already have, but using the learning modelis back-propagation algorithm. The specific configuration for the training in step 2 is shown in Table 3.

Table 3. Configuring neural network when training by back-propagation algorithm

Learning type: Back-propagation algorithm	Learing speed: 1.0
Lowest error: 0.00001	Iterations number: 1.000.000
Alpha: 0.9	Sigmoid Output Layer: No

Table 4. The results of training neural networks on testing data set (using BP)

Sample index	Reality (d_t)	Network(y_t)	Error ($e_t=d_t-y_t$)
1	3.166,76	3.163,96	2,80
2	3.701,11	3.695,08	6,04
3	4.813,15	4.797,84	15,31
4	5.345,51	5.320,79	24,72
5	5.568,52	5.558,66	9,86
6	6.123,95	6.113,42	10,53
7	5.868,32	5.842,22	26,10
8	3.688,47	3.660,90	27,57
9	1.328,50	1.329,58	-1,08
10	483,61	485,76	-2,15
11	468,52	468,40	0,11
12	533,26	530,54	2,72
13	505,61	503,50	2,11
14	505,69	539,97	-34,28
15	241,23	236,07	5,16
16	3.075,18	3.069,63	5,55
17	4.895,85	4.884,60	11,25
18	5.820,24	5.815,61	4,63
19	6.398,39	6.394,77	3,62
20	6.980,67	6.901,74	78,93
21	6.186,07	6.180,59	5,48
22	4.656,38	4.653,31	3,07
23	2.204,87	2.219,66	-14,79
24	834,76	840,70	-5,94
25	520,33	522,87	-2,54
26	494,24	494,55	-0,31
27	416,22	414,45	1,77
28	394,52	392,57	1,95
29	205,83	200,71	5,12
30	0,00	25,89	-25,89
	Error RMSE	**19,31**	

After 1,000,000 generations of training time-delay back-propagation neural network with shift window, we have the following results:

- With the training data set (300 samples): As shown in Figure 4, the network's output (blue color) almost coincides with the actual output (red color). This shows that the network has modelled the entire set of rice diseasessituation.

- With the testing data set (30 samples), we can see that the network was able to predict unlearned data, the neural network's output line is nearly closest to the actual output line, the RMSE prediction error on the testing data set is 19.31 (Table 4). This shows that the network has generalized quite well the data that was not learned during the training.

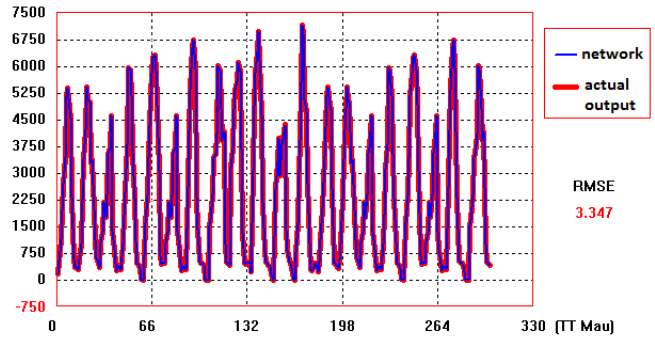

Fig 4. The comparion the results of neural network and actual output on training data set (using BP)

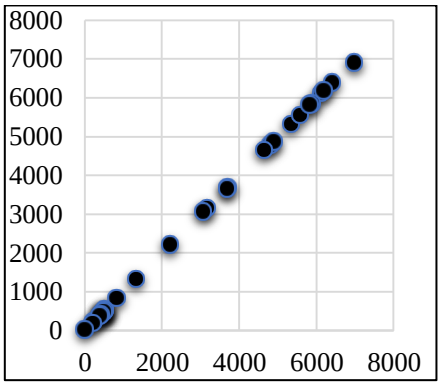

Fig 5. Verify the correctness of the model

The correctness of the network model is verified through Figure 5 where each circular dot represents a sample in the testing pattern. These samples are not randomly distributed around the diagonal; They tend to be on the slant in some areas and below in another. Deviation from the diagonal of the samples is not too large, indicating thatthe network is highly effective.

6. CONCLUSION AND DEVELOPMENT ORIENTATION

With the vigoruos support of the department of Plant protection in An Giang province andthe faculty of Agriculture and natural resources in An Giang university, our forecasting method has achieved certain results and it will perspectively bring many benefits to farmers. Our system has been tested in the rice fields of 11 districts in An Giang province.Experimental results show that our system is currently producing promising results. However, because rice diseases' situation has become increasingly complex, this system needs more time to research and improve. In this paper, we have presenteda combination of an artificial neural network model and genetic algorithm to predict rice diseases' situation in An Giang province.By applying this prediction model, it is found that the prediction has achieved better advantages compared to other traditional statistical methods. Our next task is to perfect this system and research other influencial factors that can helpmodel to predict rice yields, diagnose rice diseases and propose appropriate preventions and treatments.

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RESEARCH ON FACTORS AFFECTING THE COVERSION OF CROP COMPOSITION ON RICE-LAND IN HAU GIANG PROVINCE 2017

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ABSTRACT

Research on factors affecting the conversion of crop composition on rice-land was carried out from April to September 2017 to study the outcomes of the conversion of crop composition on rice-land as well as to identify the reasons why farmers decided to change their crop compostion. The reseach studied on farmers who had done crop composition conversion on rice-land in Hau Giang province to identify factors affecting the conversion as well as to understand difficulties facing these farming households by using sociological surveys. Results by using Binary Logistic Regression show that the likelihood is 90.6%, in which variables including household's financial resources (X_5), impacts from training courses (X_7), support from the Government and Local authorities (X_8), internal irrigation schemes (X_{11}) and irrigation water (X_{14}) have statistical meanings to conversion of crop composition by farming households. The unstable selling price of products after crop conversion is most concerned by farmers. One of the new approachs of the research is that the research used Binary Logistic Regression to analyze data then to identify factors affecting the outcomes of the crop composition conversion. Results also show that climate change variable has no statistical meaning within the scope of the research.

Key words: conversion, crop composition, farming household, impact, rice-land

1. INTRODUCTION

Crop diversification instead of rice monoculture is the key solution to the current situation of the Mekong Delta which is the bowl rice of Vietnam. This is considered an effective solution to rice farmers with the fact that the increase in rice yield year over year doesn't mean more profits for farmers. Moreover, bad impacts of climate change, more yield loss caused by pests, bad impacts from saline intrusion, droughts ect are some among many reasons that lead to the need of effective and suitable conversion of crop composition on rice-land. However, in order to have effective and stable crop composition conversion on rice-land there is a need of researches to identify suitable crop compositions as well as to find out factors that affect the conversion for higher profits.

2. MEANS AND RESEARCH METHODS

2.1. Data collection methods

The research collected information from farmers through surveys with prepared questions. Research areas are 3 communes in 3 districts of Hau Giang province with different ecosystems, including: (1) Truong Long commune, Chau Thanh A district which represents for alluvial soil areas with ample water all year round; (2) Vi Tan commune, Vi Thanh Town which represents for areas intruded by salt water; (3) Hoa An commune, Phung Hiep district which represents for aluminous areas. Subjects surveyed in the research are farmers who grow rice and other crops on rice-land.

Secondary data were collected from relevant published papers such as journals of science, books and Hau Giang annual statistics and other documents including Social-economic reports from People Committees of communes, districts, Hau Giang province and from Department of Agriculture and Rural development of Hau Giang province, Plant Protection Department of Hau Giang province.

Primary data to analyze the effectiveness of the conversed crop composition on rice-land were collected by convenience sampling and the law of large number to ensure the acuracy of the research. As mentioned earlier, samples were collected in 3 districts including Chau Thanh A district (n=60), Phung Hiep district (n=60) and Vi Thanh town (n=60) with the total of 180 samples. Farmers participated in the research were divided into 2 groups, including a group of farmers who cultivate rice only (3 cropping intensity/year) and the other group of farmers who converted crop compostion into 2 cropping intensity/year into growing rice and other crops on rice-land.

2.2. Data analysis methods

Data were analyzed by Excel and SPSS software. Descriptive statistic was used to analyze characteristics of researched farmers individually and farming households. Factors affecting the conversion of crop composition were identified by Binary Logistic Regression. In which, dependant variable was considered binary variable, independent variables could be quantitative variables, qualitative variables or categorical variables.

3. RESULTS AND DISCUSSION

3.1. Characteristic of samples

3.1.1. Age

In the research, age of farmers was divided into 4 groups, including: under 30 (group 1) accounted for 4.4%, age from 30- 45 (group 2) accounted for 32.8%, age from 46 - 60 (group 3) made up 38.9% and above 60 year-old (group 4) made of 23.9%. In which, group 3 was the biggest group (Fig. 1).

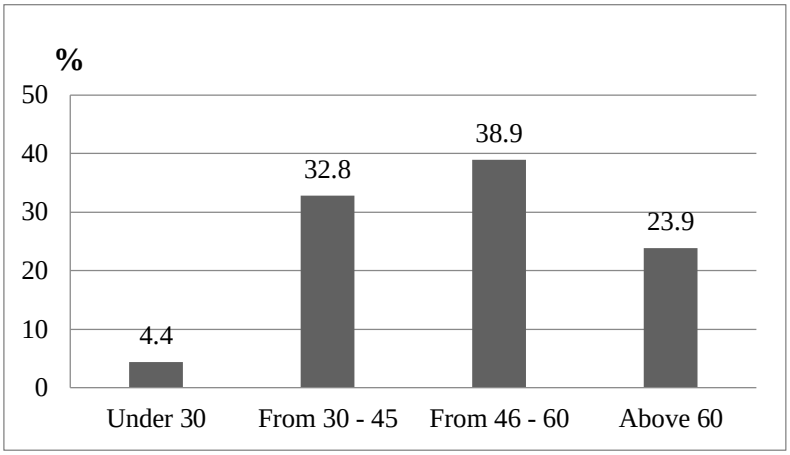

Fig 1. Age ratio of samples

Source: Survey on 180 farmers in Hau Giang province, 2017

Research shows that, farmers aged 45 and above are the main labors in the family and they also are the decision makers who are willing to converse to crop diversification as compared to other groups (Truong Thi Ngoc Chi and Duong Ngoc Thanh, 2012). According to Fig. 1, group of under 30 farmers is the smallest group, accounted for 4.4% only. It means that, young people are not interested in working in agricultural production.

3.1.2. Education background

About education background, 46.6% of surveyed farmers attended primary school while 33.3% of them completed secondary education and 17.2% went to high school. Besides, farmers who are illiterate make up 3.9% (Fig 2). In the researched areas, it is a fact that labors in the agricultural production don't

have sufficient education. This can lead to difficulties in acquire new knowledge or in applying new technologies in production.

It is a fact that lack of basic education acts as the biggest barrier for farmers to acquire new knowledge, to apply science in agricultural production. The reason is without eduction farmers may not know how to maximize profits from the money they invested in agriculture. Another consequence is that they would face difficulties in applying new technologies. However, according to research by Truong Thi Ngoc Chi and Duong Ngoc Thanh (2012), farmers who completed elementary and secondary education are best suitable for technology transfer training courses in agricultural production.

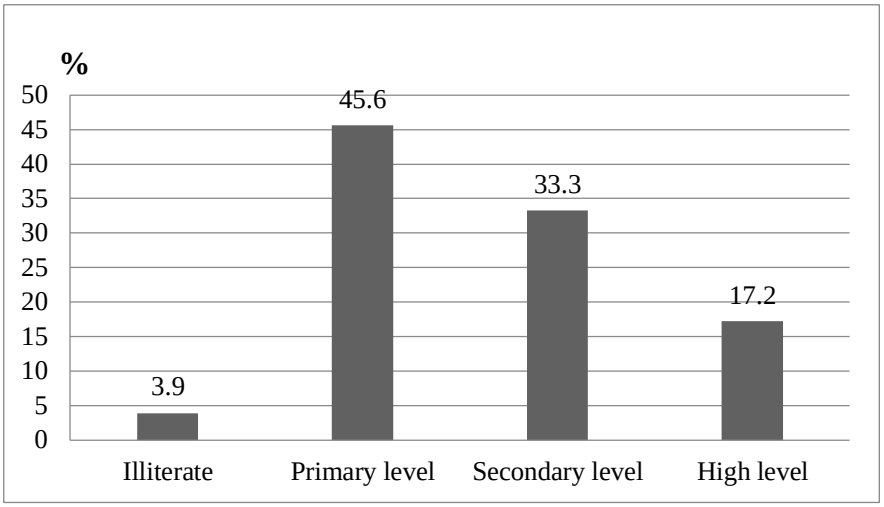

Fig 2. Education backgrouds of farmers

Source: Survey on 180 farmers in Hau Giang province, 2017

3.1.3. Size of agricultural land

Research found out that there are 69.3% of farming households who converted less than 0.5 hectare of their land from growing rice only to mix with other crops and only 5% of households who use more then 1 hectare of land to grow rice and other crops. In rural areas, land is the most precious asset, however the majority of farming households own less than 0.5 hectare of land and they are poor and average families. Without resources the main labors of these families couldn't find a long-term job. As the result, these families couldn't escape from poverty.

3.1.4. Agricultureal production experience

According to collected data, the number of farmers who have more than 20 years experience of growing rice are 112, accounted for the highest ratio of 62.2%, farmers with 11 from 20 years experience make up 29.4%, 7.8% of farmers have 5 to 10 years experience and only 0.6% of them have less 5 years experience. About farmers who grow other crops, farmers who have less than 5 years experience make up the biggest part of 57.8% while 25.6% of farmers who have 5 to 10 years experience and only 1.1% of farmers have more than 20 years experience of growing other crops.

These numbers show that farmers' experience in cultivating rice is rather high. They have experience in weed and pests control as well as apply techniques in growing rice. However, as the farmers have much experience in growing rice they tend to be rather conservative and less willing to change or to apply new techniques in production. Therefore, to start growing other crops on rice-land is a challenge for farmers as they don't have adequate knowledge of relevant techniques or don't have experience in pests control for other crops which is different from pests control for rice.

3.1.5. Reasons for conversion of crop composition on rice-land

Results of survey on the reasons of changing from growing rice only into crop rotation between rice and other crops show that higher profit is the main reason. In this research, the option higher profit was most selected by farmers as the reason why they converted their crop composition, accounted for 57.3% while 17.4% of them said that they followed their neighbors as they saw good results from the conversion by their neighbors.

According to Fig 3, bad impacts from plant diseases on yields of 3 crops of rice per year were also the reason why farmers had to change to crop diversification, accounted for 14%. Besides, climate change was also one of the reasons, but accounted for 10% only. Also according to the farmers, they have yet seen any impacts from the Government's policies to decide whether to coverse crop composition. Research also found out that, local Agriculture Extension Departments haven't played any role as well as local Authorities haven't had much support for farmers in the conversion of padding production to other crops.

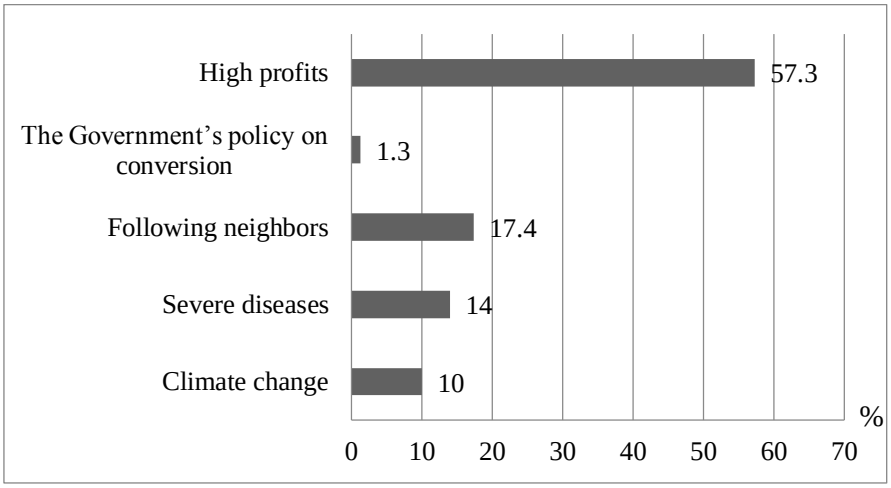

Fig 3. Reasons for farming method transformation

Source: Survey on 180 farmers in Hau Giang province, 2017

3.1.6. Factors help enhance the outcomets of crop composition conversion on rice-land

As Fig 4, according to the farmers, quality of crop varieties was the most important factor in the conversion of crop composition, this helpe enhance the outcomes of the conversion, accounted for 27.7% as the highest ratio. The second important factor was applying new technologies in production, accounted for 24.3%. Besides, in order to enhance the conversion outcomes, according to the farmers, the type of crops selected should be suitable to each cropping in a year and also should be suitable to the natural conditions of the area, especially water resource, accounted for 19.9%. About supply chain, farmers didn't have adequate awareness. In the research, only 13% of farmers understood the important of the linkage with the market for their products.

Research found out that, lack of knowledge about supply chain, farmers couldn't build up connection with trading companies then they couldn't understand the market's needs. As the result, their output products' price was unstable. Another consequence that keep happening year is that when the crop yield is high, price would go down dramatically and vice versa. Research found our that, the farmers suggested that the Governement have to play their parts in connecting farmers and the market. And farrmers should only concentrate on producing high quality products.

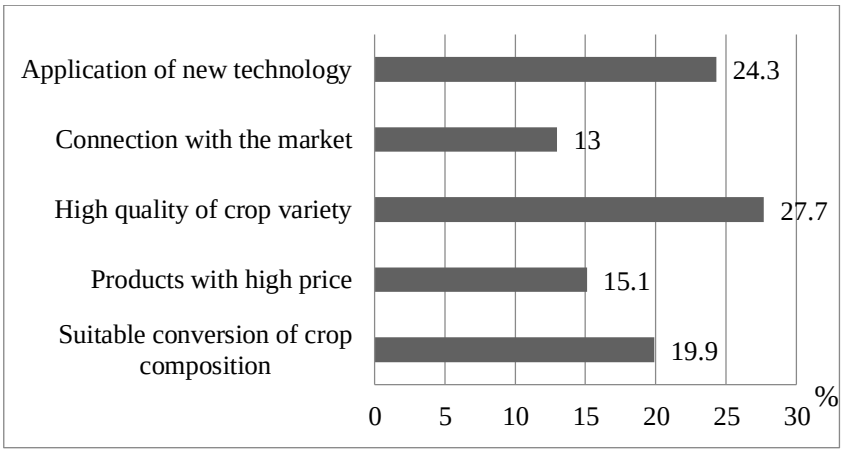

Fig 4. Factors that help enhance the outcomes of crop conversion om rice-land

Source: Survey on 180 farmers in Hau Giang province, 2017

3.2. Factors affecting the conversion into crop conversion between rice and other crops

The research uses Binary Logistic Regression to analyze the impact of Xi to probality of I when X occurred. Binary Logistics Regression is one of the methods often used in models that have dependant binary variables by David R. Cox. In Logistics Regression model, outcomes are analyzed by binary variables while independant variables are analyzed by continuous variables, binary variables or categorical variables, inverse of probability distribution function or linear association of explanatory variable.

In this model, the Logistic equation has dependant variables on the left that have two outputs: 0 (if farmers convert their crop conversion) and 1 (if farmers don't). On the right, there are 5 groups of variables including individual characteristics, farming household's characteristics and Government's and Local authorities' policies about crop composition conversion, connection between producers and the market and fators of climate, land and water environment.

The equation is as following:

$$\text{Log}_e\ P(Y=1)/P(Y=0) = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8 + a_9X_9 + a_{10}X_{10} + a_{11}X_{11} + a_{12}X_{12} + a_{13}X_{13} + a_{14}X_{14} + a_{15}X_{15}$$

Each variable indicates whether or not the farmers convert their crop composition in the regression model. The model has 5 groups of variables: (1) Personal information of farmers (age and education background), (2) Characteristics of farming households (labor force, farm size, financial resources), (3) Government's and local authorities' policies on the conversion of crop composition (role of agricultural incentive activities, impacts of training activities on conversion, impacts of policies for capital support), (4) Connection with the market and products sale and (5) Group of varieties including climate, land and water (internal irritation system, characteristics of land and water and impacts of climate on production).

Table 1. Description of variables in the model

Group of variables	Variable	Meaning/Unit	Expected value
Characteristics of farmers	X_1	Age (Year)	-
	X_2	Education background (Grade)	+/-

Group of variables	Variable	Meaning/Unit	Expected value
Characteristics of farming households	X_3	Labor force (Number)	+
	X_4	Farm size (Hectare)	+/-
	X_5	Fanancial resources (Yes/No)	+/-
Government's policies	X_6	Role of agricultural incentive activities (Yes/No)	+
	X_7	Impacts of training activities on conversion (Yes/No)	+
	X_8	Support from the Government and local authorities (Yes/No)	+
Market connection	X_9	Impacts from the market (Scale from 1-5)	+
	X_{10}	Connection with the market (Scale from 1-5)	+
Climante, land and water	X_{11}	Internal irritation system for the conversion (Scale from 1-5)	+/-
	X_{12}	Irritation water management (Scale from 1-5)	+
	X_{13}	Land condition (Yes/No)	+
	X_{14}	Water suitable for crop (Scale from 1-5)	+
	X_{15}	Impacts from climate (Scale from 1-5)	+/-

SPSS was used to analysed the collected data, results shown in Table 2

Table 2. Results by Binary Logistic Regression model

Factors	B index	S.E.	Wald	Sig.	Exp
X_1 Age	-0,026	0,023	1,217	0,270	0,975
X_2 Education background	0,051	0,081	0,395	0,529	1,052
X_3 Labor force	0,296	0,285	1,084	0,298	1,345
X_4 Farm size	-0,386	0,353	1,197	0,274	0,680
X_5 Financial resources	5,414	1,472	13,522	0,000	224,516
X_6 Role of agricultural incentive activities	-0,124	0,318	0,152	0,697	0,883
X_7 Impacts of training activities on conversion	1,254	0,316	15,773	0,000	0,285
X_8 Support from the Government and local authorities	1,995	0,475	17,608	0,000	7,354
X_9 Impacts from the market	-0,335	0,333	1,012	0,315	0,715

Factors	B index	S.E.	Wald	Sig.	Exp
X_{10} Connection with the market	0,494	0,304	2,639	0,104	1,638
X_{11} Internal irritation system	-1,052	0,455	5,349	0,021	0,349
X_{12} Irritation water management	0,215	0,476	0,204	0,651	1,240
X_{13} Land	23,438	8,903E3	0,000	0,998	1,511E10
X_{14} Water quality	2,264	0,597	14,410	0,000	9,626
X_{15} Impacts of climate	0,886	0,555	2,546	0,111	2,426
Constant	**-35,135**	**8,903E3**	**0,000**	**0,997**	**0,000**

Source: Survey on 180 farmers in Hau Giang province, 2017

Table 2 shows that, the independent variables X_5; X_7; X_8; X_{11}; X_{14} have statistical meanings while X_1, X_2, X_3, X_4, X_6, X_9, X_{10}, X_{12}, X_{13}, X_{15} have no statistical meaning in the model.

Table 2 can be explained as following:

- Variable of farming household's financial resources (X_5) has impact on the decision of conversion into crop diversification. Results show that, crop composition conversion requires a specific amount of financial investment, especially for farming households who convert in a large area. Therefore, households who have adequate financial resources will find it easier to change to crop diversification. In the model, the variable has $\alpha<0.05$ ($\alpha=0.000$).

- Variable of impacts from training activities (X_7) has Sig. = 0.000 ($\alpha<0.05$) and B = 1.254. It means that for farmers who had chance to join training activities on coversion of crop composition are more likely to apply what they had learned in order to earn more income.

- Variable of support from the Government and local authorities (X_8) has có giá trị Sig. = 0.000 and B = -1.995, a direct proportion with the conversion of crop composition. This means if the farmers receive more support from the Government they are more likely to convert their crop composition, especially for financial as well as technical support for more effective conversion.

- Variable of internal irritation system (X_{11}) has Sig. = 0.021 ($\alpha < 0,05$) and B = -1.052. There are two ways of explaination here: on one hand it create favorable conditions for conversion but on the other hand it can aslo act as a barrier. It means that in areas that have suitable canal system for irration or suitable internal irritation system, rice is the main crop. On the other hand, in areas without enough water for irritation, especially in summer-autumn crop, conversion into other crops that requires less water is a good solution for farmers. In the model, B of variable X_{11} is negative (-), this means lack of irritation water is a factor that make farmers convert into other suitable crops, for more efficient use of their gricultural land.

- Variable of water quality (X_{14}) has Sig. = 0.000 ($\alpha < 0,05$) and B = 2.264. This means that for areas with good and suitable irritation water and for other crops, the farmers will change agricultural land-use to other crops for higher income.

In the model, variables of characteristics of farmers including age and education background have no statistical meaning (Sig. are 0.270 và 0.529 respectively). For age variable, it is assumed that older farmers are less likely to change their crop composition. As for them, it's not easy to acquire new

knowledge or adapt to changes. Besides, they already have rich experience in cultivating rice then they are not willing to change to other crops. However, within the scope of the research, in our opinion it's a macro issue and it depends on other objective factors as well on each farmer's determination.

Table 3. Quantitative results of the model

Obervation		**Crop composition conversion on rice-land**		**Likelihood of the model (%)**
		Households converted their crop composition	Household didn't convert their crop composition	
Convesion	Households converted their crop composition	7	83	92,2
	Households didn't convert their crop composition	80	10	88,9
Binary logistic regression 2-log likelihood				**90,6**

By Binary Logistic Regression model, 2-log likelihood is 103.081 and Cox & Snell R Square is 0.557 while Nagelkerke R Square reaches 0.742. It means that about 74.2% factors of the model can be explained by the model and this is rather high value. Via Homer và Lemeshow test, Chi-square is 19.245 with Sig. = 0.014 ($\alpha < 0.05$). According to Table 3, the 2-log likelihood is rather high 90.6% it means that the use of binary logistic regression in the research is suitable.

4. CONCLUSION

According to the research, farming households who converted the crop composition own less land than those who still grow 3 crops of rice per year. Farming households who did crop rotation between rice and other crops think that the conversion can bring higher profits as compared to grow 3 crops of rice a year. Besides, right selection of crop variety and applying new technologies into agricultural production are two most effective ways suggested by the farmers.

Results by using Binary Logistic Regression show that the likelihood is 90.6%, in which variables including household's financial resources (X_5), impacts of training activities (X_7), support from the Government and Local authorities (X_8), internal irritation system (X_{11}) and irrigation water (X_{14}) have statistical meaning to the conversion of crop composition while other variables have no statistical meaning.

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SYNTHESIS AND CHARACTERIZATION OF TYPE-A ZEOLITE BY HYDROTHERMAL TRANSFORMATION OF LAM DONG RAW KAOLIN FOR WASTE WATER TREATMENT APPLICATION

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ABSTRACT

The synthesis and characterization of type-A zeolite materials by hydrothermal transformation of metakaolin in NaOH solutions was investigated at 80^0C and 100^0C for 4h and 8h. The Lam Dong raw kaolin is dehydrated to transform to metakaolin at 650oC, then follw by hydrothermal treatment. The obtain type-A zeolite were the main product when hydrothermal treated with NaOH 4M for 100^oC, later were confirmed by XRD, IR and SEM.

Key words: type-A zeolite, Lam Dong kaolin, ketakaolin, Hydrothermal reaction, Waste water treatment.

1. INTRODUCTION

Zeolites are important industrial minerals which has widely engineering applications. Zeolites are crystalline, microporous, hydrated aluminosilicates of alkaline or alkaline earth metals. The frameworks of zeolite are composed of tetra silicate oxide $[SiO_4]^{4-}$ and aluminate oxide $[AlO_4]^{5-}$ tetrahedra, which corner-share to form different open structures. Negative charge of lattice is compensated by the positive charge of cations located at specific positions of zeolite framework [1-2]. Zeolites as microporous inorganic materials have different applications, such as membranes, catalysts, adsorbents, and ion-exchangers, in many chemical and petrochemical processes due to their superior properties including strength, size or shape selectivity, thermal stability, and large ion-exchange capacity. In most of zeolites the compensating cations are usually mono- and bi-valent metal ions and/or their combinations. At present, synthetic zeolites are used commercially more often than natural zeolites due to the purity of crystalline products and the uniformity of particle sizes. However, the preparation of synthetic zeolites from chemical sources of silica and alumina is expensive. Such costs may be reduced by the use of clay minerals, volcanic glasses (perlite and pumice), rice husks, diatoms, fly ash or paper sludge, kaolin as starting materials.

Kaolin has been applied to wide fields, such as ceramics, papermaking, agriculture, rubber manufacturing, plastics industry, refractory materials and sophisticated national defense technology. In recent years, many studies have reported the researches of kaolin as a raw material for zeolite synthesis. Kaolin, as the silicon source and aluminum source, is particularly suitable for the preparation of zeolite due to the high quality and low price. The kaolin source from Lam Dong kaolin mine is huge and ready to be used as industry source.

In addition, type-A zeolite or zeolite A is a synthetic sodium aluminosilicate, a low silica zeolite with Si/Al = 1 ~1.15 represented bythe formula: $Na_{12}[(AlO_2)_{12}(SiO_2)_{12}].27H_2O$. It has a cubic crystal structure with a lattice parameter of 12.32 Å as shown in Figure 1. Type-A zeolite is characterized by a 3-dimensional network consisting of cubic a-cages, placed in the centers of the edges of a cube in the truncated octahedral and b-cage (sodalite cage) linked by double 4-ring (D4R). These a-cages connect the

b-cages, creating a three-dimensional structure having pores of size 4.2 Å. Each corner of the cube (a-cage) is occupied by the truncated octahedral (b-cage) enclosing a cavity with a free diameter of 6.6 Å. The centre of the unit cell is a large cavity, which has a free diameter of 11.4 Å. It can be inferred that type-A zeolite can be synthesized by adding appropriate amounts of Na_2O into kaolin and changing the crystalline form. But the Si and Al sources in kaolin are in an inactive state, which makes it difficult for direct transformation into type-A zeolite. The current widespread method to solve this problem is to activate kaolin by calcination at a high temperature (above 650°C) to obtain metakaolin. Then the metakaolin is mixed with alkali and water to a certain proportion and type-A zeolite could be synthesized after aging and crystallization processes. Type-A zeolite is also widely used in waste water treatment, including the removal of radioactive ions.[4-9]. Thus, the research group propose the synthesis of type-A zeolite which can be used as water waste treatment at Mekong Delta area.

Fig 1. Structure of type-A zeolite [1]

No attempt has been made previously to produce type-A zeolite from natural Lam Dong kaolin. Thus, the research group at Department of Silicate Materials, Faculty of Materials Technology at Ho Chi Minh City University of Technology aim to synthesize type-A zeolite by hydrothermal reation. The effect of hydrothermal temperature and hydrothermal time on the synthesis of type-A zeolite was investigated in this paper. The obtained type-A zeolite were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and Fourier transform infrared (FT-IR) spectroscopy. This type-A zeolite can be used as waste-water-treatment material, especially in shrimp industry at Mekong Delta province.

2. MATERIALS AND METHODS

2.1. Transformation Lam Dong kaolin to metakaolin by calcination

Lam Dong kaolin was washed with 4M HCl solution so that the ratio of kaolin to HCl solution is 2g to 3mL in order to remove the impurity in kaolin such as quartz and iron oxide, following by calcined at 650^{o}C (Naberthame, Germany) then soaking for 2 hours to form metakaolin. The calcined temperature was identified based on thermal analysis data.

2.2. Hydrothermal reaction to form type-A zeolite

The obtained metakaolin were mixed with 4M NaOH (Xilong chemical, China) with the ratio of solid to liquid is 10g to 100mL, follow by hydrothermal treatment at 80 and 100^{o}C for 4 and 8 hours. After hydrothermal treatment, the reaction were wash with distilled water, pass sieve 90µm and do characterization by XRD, SEM and FTIR. The code of experiment were given in Table 1.

Table 1. The code of sample

Code	Sample	Hydrothermal temperature (^oC)	Hydrothermal time (hour)
Z1	Z80-4	80	4
Z2	Z80-8	80	8
Z3	Z100-4	100	4
Z4	Z100-8	100	8

2.3. Materials characterization

2.3.1. Thermal analysis

The raw kaolin were identified the calcination temperature to form meta kaolin by DSC/TG in the range of room temperature to 1050^{o}C (Labsys TG/DSC Rigaku). In brief, 2mg of sample and alumina reference were put into platinum crucible and heating up to desire temperature. The weight loss and heat flow were recorded by software (Thermal Rigaku).

2.3.2. Chemical compositions

The chemical composition of raw kaolin were identified by X-ray Flouresent (XRF) (ARL Advantx-2443 Thermo Scientific). The samples were compacted and irradiated by X-ray and measured the secondary beam to analyze the chemical composition of sample.

2.3.3. Phase analysis

The powder X-ray Diffraction (XRD) patterns of raw Lam Dong kaolin, obtained metakaolin and obtain type-A zeolite samples were recorded with a vertically mounted diffractometer system (Bruker-AXS: D8 ADVANCE, Germany) using Ni filtered CuKa generated at 15 kV.

2.3.4. The morphology of samples using Scanning Electron Microscope (SEM)

The surface of samples were observed using a scanning electron microscope (SEM) (Hitachi S-4800 JEOL Co. Ltd., Japan) under an accelerating voltage of 10 kV after being coated with gold.

2.3.5. Chemical bonding of sample is analyzed by Fourier Transformer Infrared (FTIR)

The sample is mixing with KBr with the ratio 1: 200 and put in the FTIR machine with the waveband vary from 400-4000 cm^{-1}.

3. RESULT AND DISCUSSION

3.1. Characterization of Lam Dong raw kaolin:

3.1.1. The XRD of Lam Dong raw kaolin

Was given on Fig 2, indicating that the main phase of Lam Dong kaolin is kaolinite with high quality. The peak at $2\theta = 12\text{-}13^0$ are special peak for kaolinite. The peak which is maximum intensity show the distance between layers d_{001}. The theory parameter of kaolinite d_{001}= 7.1348Å at $2\theta = 12.3^0$. As in fig 3.1,

the peaks at 2θ=21.9^{O},2θ=26.7^{O}exhibit the quartz parameter d=4.367Å and d=3.355Å, respectively. Peaks intensity of Quartz is lower than Kaolinite.

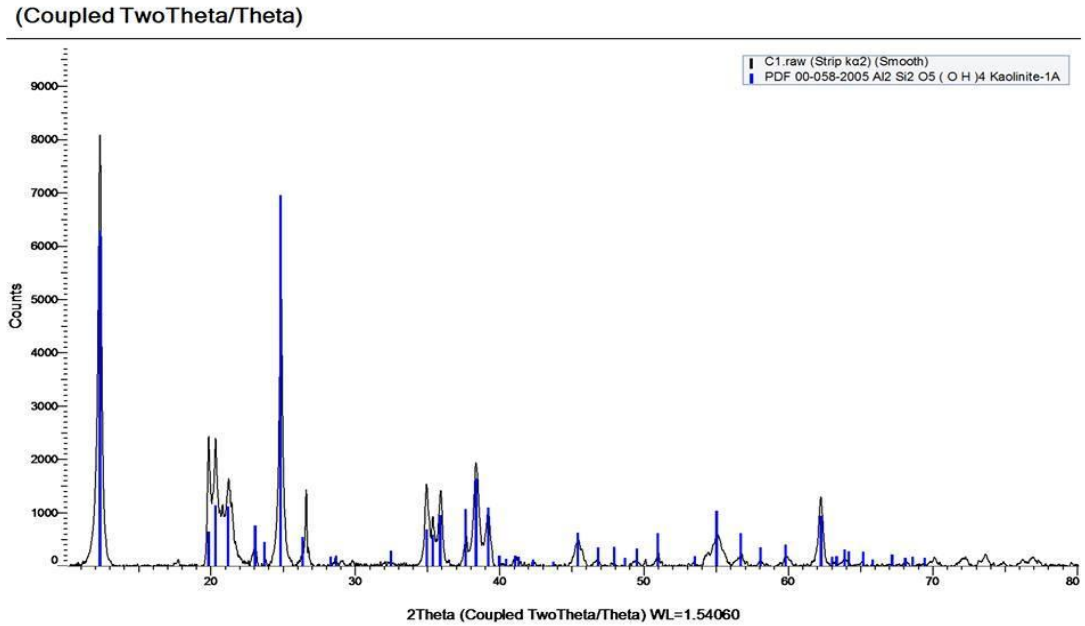

Fig 2. X-ray diffraction pattern of raw kaolin.

3.1.2. The chemical composition of Lam Dong raw kaolin

Was given in Table 2. Based on the chemical composition, the Si/Al ≈ 1 favorable for synthesis of the zeolite A, so we don't need to add alumina source to metakaolin. The rest were the impurities of Fe_2O_3, TiO_2 and K_2O.

Table 2. Chemical composition of Lam Dong raw kaolin (wt%)

SiO_2	Al_2O_3	Fe_2O_3	K_2O	TiO_2	LoI
44.64	37.46	2.28	1.18	0.95	11.92

3.1.3. The DSC-TG result of kaolin sample

Was shown in figure 3. The mass of sample was decrease 3.978% in the range of 180^{o}C – 400^{o}C because of the decomposition of organic impurities. From 507^{o}C to 588^{o}C, we can observed the endothermic peak due to the dehydration of kaolin to form metakaolin. Base on the DSC/TG analysis, the calcined temperature of 650^{o}C was decided to get the transformation of kaolinite to metakaolin.

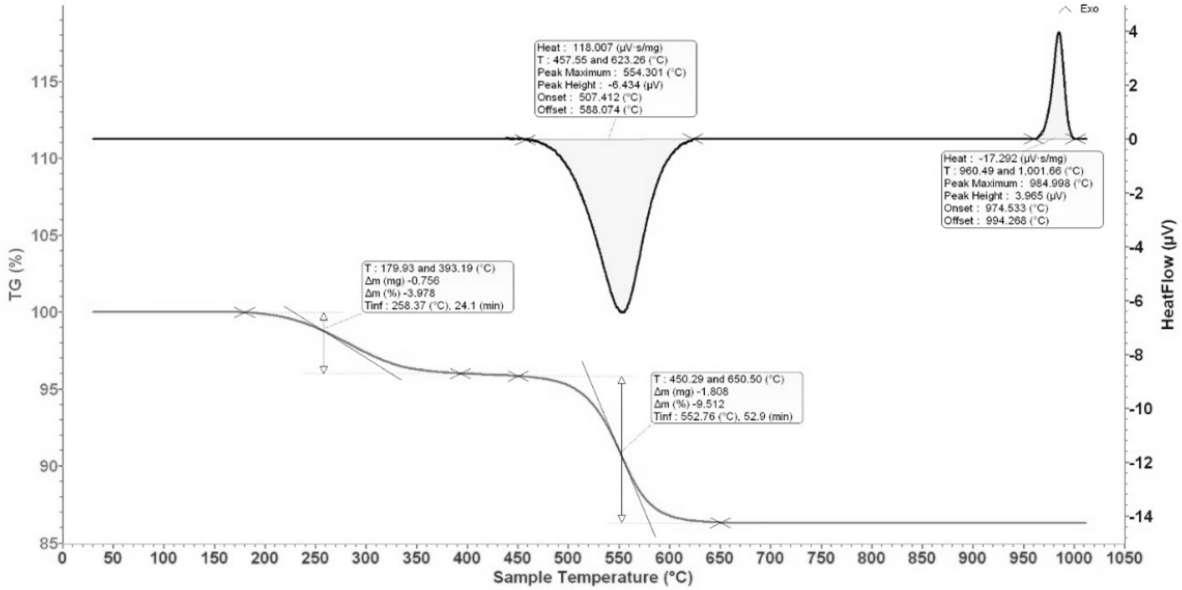

Fig 3. DSC-TG result of kaolin sample.

3.2. Characterization of type-A zeolite samples

3.2.1. The XRD of sample hydrothermal reacted

Fig 4 shows the XRD pattern of sample hydrothermal treated at different temperature and time. The characteristic peaks of zeolite A was shown at 2theta=6^{o} (ICDD 01-073-2340).

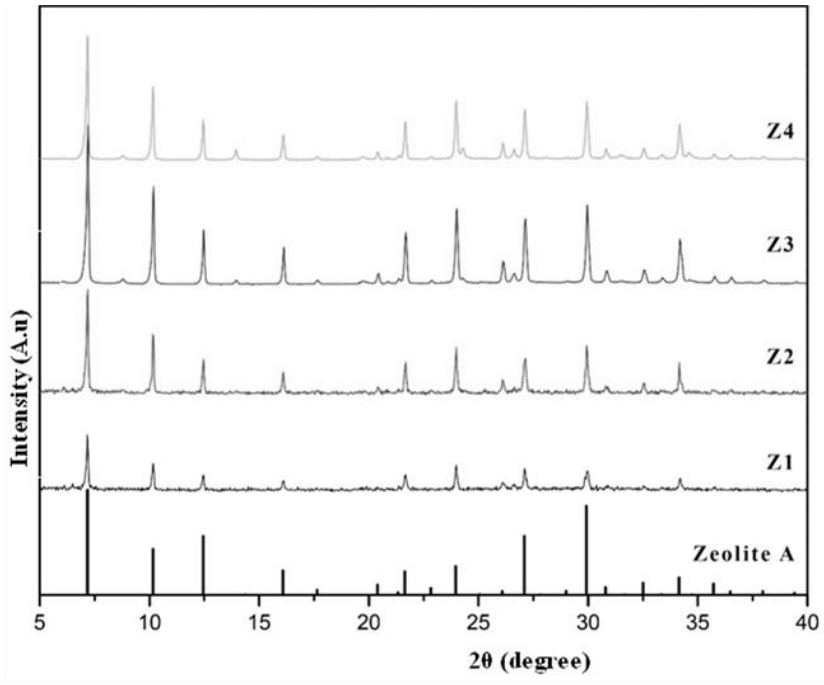

Figure 4. XRD pattern of mixture with different hydrothermal treatment temperature and hydrothermal time. Z1, Z2 (80^{o}C for 4 hours and 8 hours). Z3, Z4 (100^{o}C for 4 hours and 8 hours)

3.2.2. The SEM images of sample hydrothermal reacted

Fig 5 shows SEM images of the mixture with different hydrothermal treatment temperature and hydrothermal time. Z1, Z2 (80^{o}C for 4 hours and 8 hours). Z3, Z4 (100^{o}C for 4 hours and 8 hours).

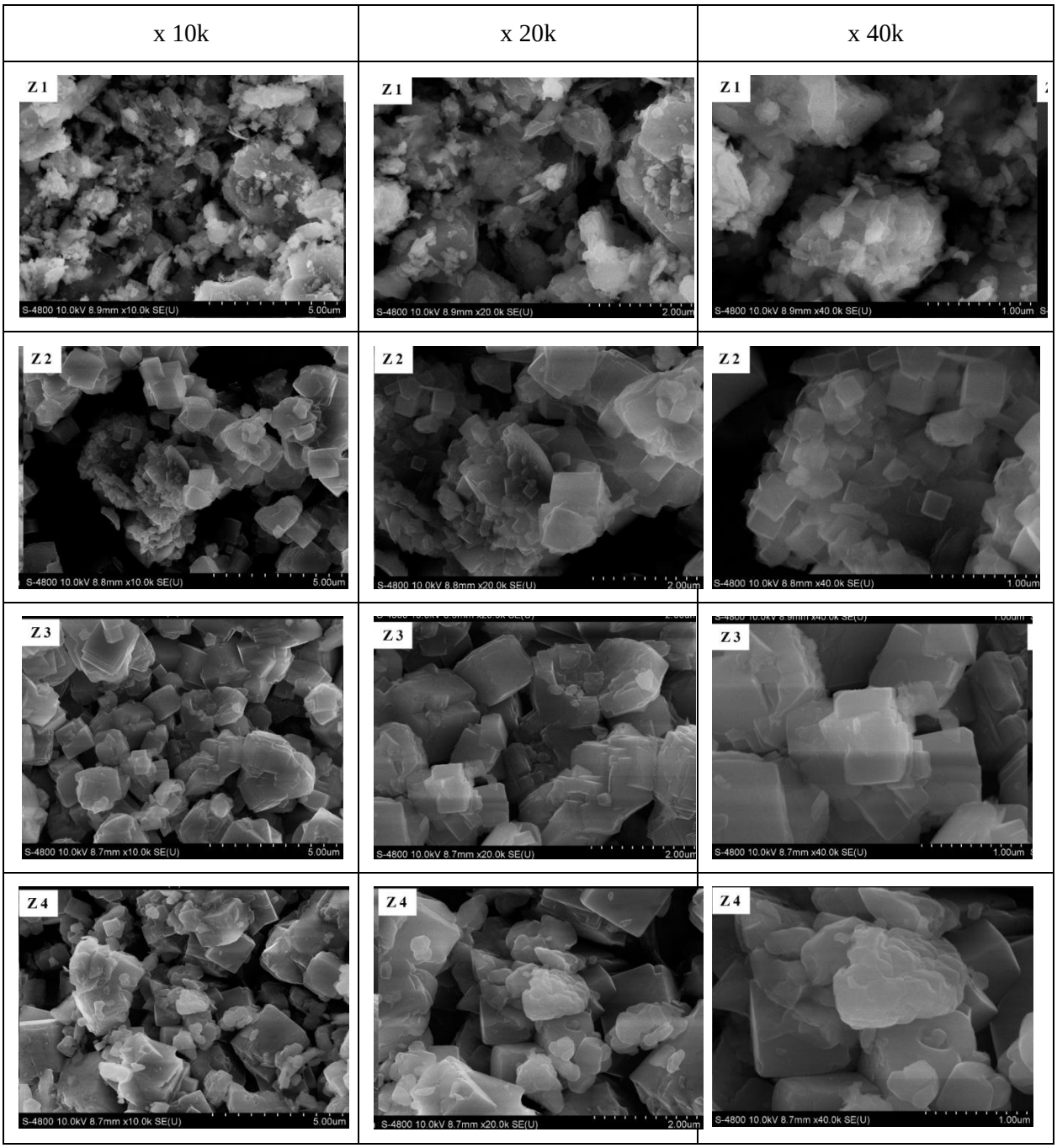

Fig 5. SEM micrograph of mixture with different hydrothermal treatment temperature and hydrothermal time with different magnification. Z1, Z2 (80^{o}C for 4hours and 8 hours). Z3, Z4 (100^{o}C for 4 hours and 8 hours)

We can not observe the evident of type-A zeolite in Z1 sample, due to low hydrothermal temperature. In contrast the samples Z2, 3, 4 have large amount of cubic particles which is suggested Zeolite A as shown in Figure 1. The topology of these samples is non-homogeneous with various particle sizes. The mean size of cubic type-A zeolite is approximately around 2µm.

3.2.3. The FTIR analysis of sample hydrothermal reacted

Figure 6 shown the FTIR of sample hydrothermal reacted at different hydrothermal conditions. The OH band were characterized by peak at 3634 cm^{-1} and 3433 cm^{-1} in zeolite structure. The H-O-H deformation band were characterized by peak at 1635 cm^{-1}. The bonding of (Si-O) and (Al-O) were characterized by peak at 1115, 1078, 1034 and 1005 cm^{-1}.

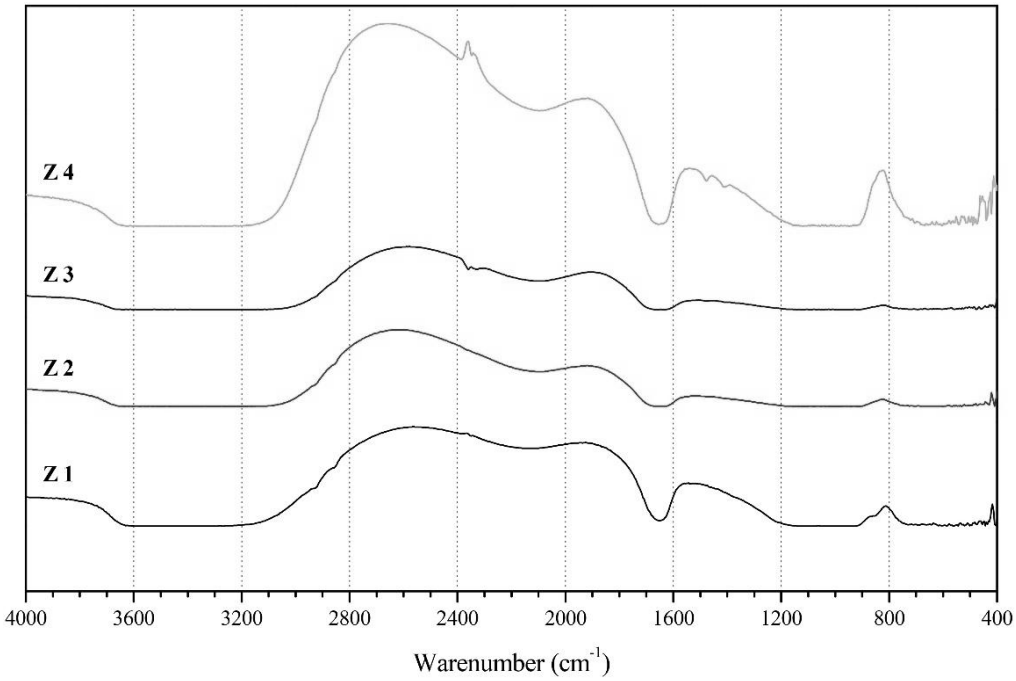

Fig 6. FTIR result of zeolite samples

4. CONCLUSIONS

The research group has successful to synthesize type-A zeolite from Lam Dong raw kaolin by 2 step: (1) dehydrate kaolin to metakaolin at 650^{o}C for 2 hours then (2) hydrothermal reaction of obtained metakaolin with 4M NaOH at 100^{o}C for 2 and 4 hours. The type-A zeolite can be used in wastewater treatment industry, especially on shrimp-feeding industry in Mekong Delta river. Further research on wastewater treatment application is awaiting to publish.

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EFFECT OF ZnO CONTENT ON PROPERTIES OF LOW- TEMPERATURE CERAMIC GLAZE OF Li_2O-Al_2O_3-SiO_2 SYSTEM

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ABSTRACT

In this study, we will investigate the effect of ZnO content on the melting point and the crystallinity of low melting temperature glaze of Li_2O-Al_2O_3-SiO_2 system. Then, we evaluate the phase composition of glaze by X-ray diffraction (XRD) and the melting temperature of each sample by thermal microscope Leitz. Finally, we afterwards apply preparing glaze on pre- engobed fired wall tile bodies in laboratory scale.

Keywords: glass ceramic; glazes, low melting temperature glaze, Li_2O-Al_2O_3-SiO_2 system.

1. INTRODUCTION

Glaze are essentially a thin layer of glass with a thickness of 0.15 to 0.4mm covering the surface of the material, protective effect as well as beautiful decoration. Use of glaze helps to increase the strength, protect the product from the penetration of corrosive agents, increase the durability, electrical strength and thanks to the combination with pigment to create aesthetic effect (smooth, crackle ...), fit the requirements of the user [1].

There are many types of glaze such as brilliance glaze, matt glaze, crackle glaze, enamel.... with different characteristics and properties. Among them, this study focused on low temperature melting glaze - a type of glaze is being paid special attention because of the economic benefits it brings such as reduced melting temperature of glaze, material saving, fuel saving... At the same time, low temperature melting glaze is suitable for coating metal, glass - materials with relatively low melting point.

The synthesis and study of the properties of low melting glaze have always been a matter of concern and research, many scientific studies have explored the effects of oxides on the structure and properties of glaze:

In 2016, Suvaci & Betul synthesized frit by preparing glaze batch with different CaO/ MgO ratios to investigate the change in glaze properties. The results showed that sintering and crystallization temperature of the glasses which have SiO_2/(CaO + MgO) ratios of 1.4 and 3.7 were determined 808–882.7°C and 818–891.3°C, respectively. [2]

In 2015, Bo Li *et al.*, also investigated the effect of CaO on microstructure, thermal properties, dielectric strength and mechanical properties of glaze. The sample LAS2 (2,1 wt% CaO) sintered at 800^{o}C for 0,5 h exhibits excellent properties: high density of 2,48 g/cm^3, low dielectric constant of 6,8 and loss of 3,79.10^{-3}, high three point bending strength of 154 MPa, and low CTE value of 1,99.10^{-6}/^{o}C. [3]

By the year 2015, Qing *et al.*, investigated the effects of ZnO content and sintering temperature on the microstructure, bending strength, coefficient of thermal expansion and dielectric properties of Li_2O–Al_2O_3–SiO_2 glass–ceramic are presente. Increasing ZnO content at the expense of SiO_2 was shown to not only promote the densification and lower the linear shrinkage, but also enhance the bending strength and

the coefficient of thermal expansion of the glass–ceramic. [4]

In 2005, Yektaet *et al.*, replaced CaO and MgO with ZnO and simultaneously increasing Al_2O_3. With attention to instability of β-quartz solid solution above 1000◦C, it seems that Li_2O bearing glaze can be used as a glaze with low thermal expansion coefficient in double fast firing programs in the wall tile industry. [5]

In addition, there are quite a few inventions related to the synthesis of low melting temperature glaze such as: Siebers et all synthesized lead-free glass frits for ceramics enamels, lead-free glass frit compositions [6], Singh et all, Low melting glass compositions, lead-free glass ceramic frits[7].

In the follow paragraph, we will investigate the effect of ZnO content on the melting point of low melting temperature glaze and evaluate quality of glaze.

2. MATERIALS AND METHODS

2.1. Raw materials

The raw materials used for preparation of the glazes were silica, nepheline, soda, acid boric, lithium carbonate and zinc oxide. The weighted batch materials, after thorough mixing were melted in an alumina crucible in electric furnace at 1200◦C for soaking 2h. The fluid melt was quenched by pouring it into water to obtain a glassy frit. The glaze slips were consisted of 100 parts by weight frit, 0.5 parts by weight cobalt oxides and 60 parts by weight water. The batches were fast milled for 30min in a planetary mill. After this procedure the glaze slip particle sizes were smaller than 45µm. The slips were then applied on 5cm×5cm dried ceramic bodies. The dried samples were heat-treated from room temperature up to 820^{o}C - 867^{o}C for 60min at a steps of 100^{o}C.

2.2. Chemical Compositions

The chemical composition of raw kaolin were identified by X-ray Flouresent (XRF) (ARL Advantx-2443 Thermo Scientific). The samples were compacted and irradiated by X-ray and measured the secondary beam to analyze the chemical composition of sample.

2.3. Phase analysis

The powder X-ray Diffraction (XRD) patterns of raw Lam Dong kaolin, obtained metakaolin and obtain type-A zeolite samples were recorded with a vertically mounted diffractometer system (Bruker-AXS: D8 ADVANCE, Germany) using Ni filtered CuKa generated at 15 kV.

2.4. Analysis of melting temperature by thermal microscope Leitz

For determination of viscosity, the shape of cubic sample with a side of 4 mm were observed in a heating microscope with heating rate of 10 C/min.

3. RESULT AND DISCUSSION

3.1. Chemical composition of raw material

Chemical composition of raw material by XRF analysis was given in Table 1.

Table 1. Chemical composition of raw materials (parts by weight).

Name of raw material	Content of oxites (wt%)									
	Li_2O	Al_2O_3	SiO_2	K_2O	Na_2O	Fe_2O_3	B_2O_3	ZnO	Others	L.O.I.
Silic dioxide	--	--	99	--	--	--	--	--	0.02	0.98
Li_2CO_3	39.3	--	--	--	--	--	--	--	0.63	59.8
H_3BO_3	--	--	--	--	--	--	56.3	--	--	42.9
Na_2CO_3	--	--	--	--	58.4	--	--	--	0.03	41.5
Nepheline	--	23.8	53	6.76	10.7	--	--	--	0.17	4.6
ZnO	--	--	--	--	--	--	--	99	0.09	0.8

3.2. Mixture and batch composition of samples

Mixture the materials into (03) samples corresponding to the figure M_1-M_2-M_3 according to the ratio given in Table 2.

Table 2. Parts by weight of the raw material on 03 samples (parts by weight)

Code	Raw material (wt%)					
	SiO_2	Li_2CO_3	H_3BO_3	Na_2CO_3	Nepheline	ZnO
M_1	25	15	12.3	2.5	45.2	0
M_2	25	15	12.3	2.5	45.2	5
M_3	25	15	12.3	2.5	45.2	15

3.3. The XRD of samples

Fig 1 shows the XRD pattern of sample containing 0%, 5% and 15% (M_1, M_2, M_3) were melted at 1200^{o}C in 2 hours.

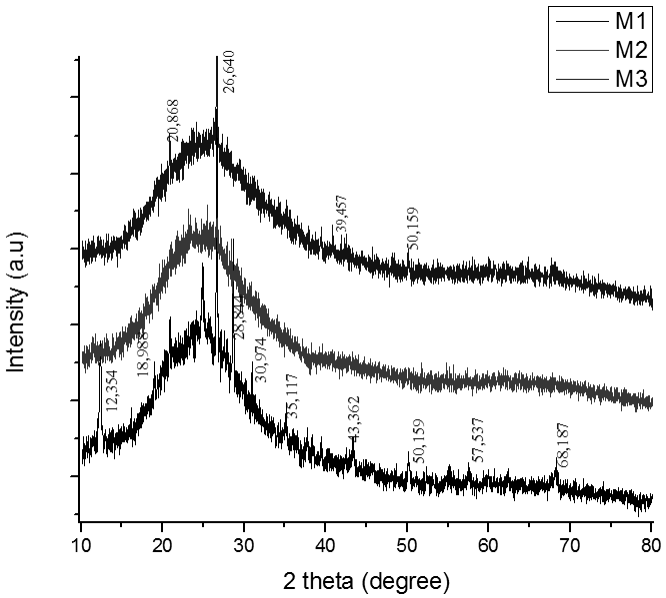


Fig 1. The results of the analysis by XRD

In the XRD spectrum of samples M_1 and M_3 still contain crystalline phase. Meanwhile, the main phase of frit M_2 is amourphous (6.6% of crystal phase).

Even though, frit M_1 and M_3' s main phase is also amourphous like M_2, but it still contain some crystal in it (Table 3). Namely, M_1 remain contains quartz, kaolinite, sodium nitrate and conrundum (a total of 11.1%). In the M_3 sample only contains quartz and conrundum (a total of 7.9%). It make increase the flow temperature and affect the quality of the glaze. Therefore, maybe the temperature or the time melting frit is not enough. Another reason can cause that is the uneven mixing batch or the effect of ZnO content.

Table 3. Ratio of crystal in samples

Sample	Crystal (%)
M_1	11.1
M_2	6.6
M_3	7.9

3.4. Result of effect of ZnO content on the melting temperature by thermal microscope Leitz

The results of the analysis by thermal microscope Leitz (Table 4) show that there are differences in the temperature ranges of the samples under the change in ZnO content in the batch.

Table 4. Deformation stages temperature of M_1, M_2, M_3

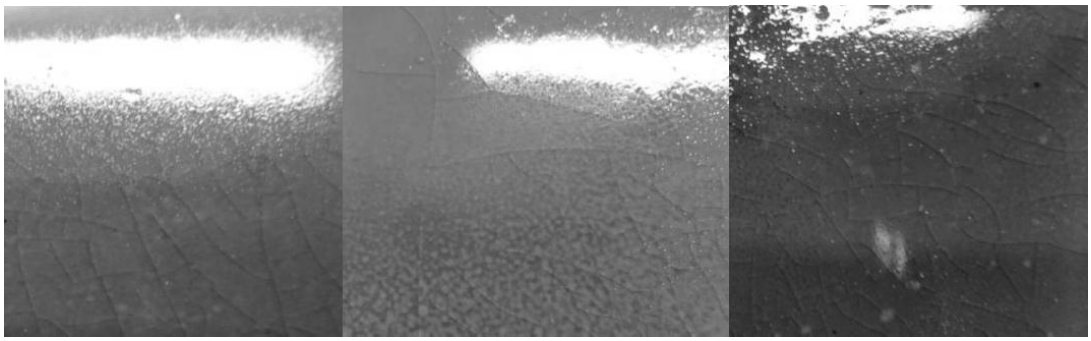
Deformation stages temperature (^oC)					
Sample	Sintering 	Deformation 	Sphere 	Hemisphere 	Flow 
M_1	505	679	752	813	867
M_2	480	678	724	780	820
M_3	475	709	768	830	863

As we have seen, when we increase the ZnO content from 0 to 5%, the overflow temperature of the sample will drop from 867^{o}C to 820^{o}C, (the difference is over 40°C). It is evident that, in the range of 0-5%, the higher the ZnO content, the lower the melting point temperature

However, for M_3 samples containing 15% ZnO, the melting temperature tended to increase (863°C). Demonstrating that in the survey range from 5 to 15%, the change in melting temperature of the glaze does not follow linear.

3.5. Result of effect of ZnO content on the firing tile

Fig 2 shows the results of M_1, M_2, M_3 after coating on ceramic and heated at 867°C, 820°C and 863°C for 1 hour.



a) b) c)

Fig 2. Result of M_1 (a), M_2 (b), M_3 (c) after firing at 867^{o}C, 820^{o}C, 863^{o}C in 1h

As we have seen, all three samples adherence to the tiles, smooth glossy surface. However, there are some cracks in the glaze, perhaps due to heat shock during the cooling phase in laboratory furnace.

3. CONCLUSIONS

In conclusion, we have investigated the influence of ZnO content on the melting temperature of the samples and concluded that in the range of 0 to 5% ZnO concentration, the melting temperature of the basic yeast decreased from 867^{o}C to 820^{o}C, in the range of 5-15% ZnO, the transformation is not linear.

In addition, the results of XRD analysis are consistent with the above conclusion, the sample M_2 has an amorphous phase component, the presence of the crystal phase is the least, then the M_3 and finally the M_2.

The test results on tiles indicate the low temperature melting glaze is suitable for use on ceramic tiles.

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HIGH-TEMPERATURE ETHANOL PRODUCTION FROM MOLASSES USING NEWLY ISOLATED THERMOTOLERANT *SACCHAROMYCES CEREVISIAE* Y81

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ABSTRACT

Molasses is a viscous by-product of refining sugarcane or sugar beets into sugar that has been considered as a cheap source of raw materials for industrial ethanol production. In this study, the ability of high-temperature ethanol production from molasses using thermotolerant yeast *Saccharomyces cerevisiae* Y81 was investigated at different temperatures (35, 37, and 40^{o}C) on the scales of 100 mL and 2 liters. The fermentation experiments were carried out in molasses with the initial sugar concentration of 26^{o}Brix, pH of 4.5 and cell concentration of 10^7 cells/mL for 6 days of fermentation. In the fermentation volume of 100 mL, ethanol concentrations of 6.13%, 6.10% and 4.50% (v/v) were achieved at 35, 37, and 40°C, respectively. The results of the ethanol production at 37°C from 2 liters of molasses showed that the ethanol concentration of 7.80% (v/v) and fermentation efficiency of 83.40%, these levels were the highest values in comparison to the other treatments at two different temperatures. Ethanol concentrations of 6.86% and 4.84% (v/v) with the fermentation efficiencies of 63.56% and 81.54% were obtained at 35°C and 40°C, respectively. From these results, 37^{o}C was selected as the best temperature to carry out the fermentation experiment on the scale of 50 L with the ethanol concentration of 8.10% and the fermentation efficiency of 85.98% were achieved.

Key words: Ethanol production, high-temperature fermentation, molasses, Saccharomyces cerevisiae, thermotolerant yeasts.

1. INTRODUCTION

Nowadays, the consumption of ethanol is increasing day by day since it plays several functions in human life. Ethanol is commonly used in beverages, it is also used in industrial solvents, cleansing agents, preservatives, etc. Besides, ethanol is considered as an important industrial chemical that can be used as biofuel to replace fossil fuels (Alfenore et al., 2002).

The application of thermotolerant yeasts to produce ethanol is an important potential, especially in the tropical countries. Fermentation process is affected by environmental condition such as temperature, pH, oxygen concentration, etc. Among them, temperature is the most important one. Besides, fermentation at high temperatures possesses a number of potential benefits including reducing cost of cooling (Roehr, 2001), enhancing saccharification and fermentation rates, reducing contamination (Abdel-Banat et al., 2009). Moreover, ethanol fermentation using microorganisms had characteristics for both thermotolerant and good ability fermenting bring high efficiency (Brooks, 2008).

Molasses is a viscous by product of sugar refining process from sugar cane or sugar beets, which has

been used as a common source of raw materials for industry bioethanol production. Sucrose is lost in sugarcane molasses which affect factory profit; therefore, transformation of molasses to ethanol is possible to alternative to maximize the use of molasses. Molasses is a budget material for low–cost bioethanol production to be able to substitute bioethanol for gasoline.

Recent studies have been carried out on isolation of thermotolerant yeasts (Nguyen Thi Mo, 2014), testing for ethanol fermentation ability of yeasts and optimum condition for ethanol fermentation using *S. cerevisiae* Y81 (Le Phan Dinh Qui, 2016; Ngo Thi Phuong Dung et al., 2017). This study is to follow up in term of applying thermotolerant *S. cerevisiae* Y81 to produce ethanol from molasses at high temperatures.

The aim of this study was to use thermotolerant *S. cerevisiae* Y81 in ethanol fermentation from molasses at different temperatures (35, 37, and 40^{o}C) on the scale of 100 mL and 2 liters and to select the appropriate temperature to carry out the fermentation on the scale of 50 liters.

2. MATERIALS AND METHODS

2.1. Materials

Molasses was purchased from Phung Hiep sugar factory, Hau Giang province, Vietnam. Thermotolerant yeast *S. cerevisiae* Y81 was kept at Food Biotechnology laboratory, Biotechnology Research and Development Institute, Can Tho University, Vietnam. YPD broth (yeast extract 0.5%, peptone 0.5%, D-glucose 2%), YPD agar (yeast extract 0.5%, peptone 0.5%, D-glucose 2%, agar 2%), Chistensen urea broth (yeast extract 1%, urea 2%, Na_2SO_4 0.95%, K_2HPO_4 0.91%, phenol red 0.001%), gelatin medium (yeast extract 0.3 %, gelatin 12%, peptone 0.5%).

2.2. Examination of the characteristics of *S. cerevisiae* Y81

***Morphological examination*:** *S. cerevisiae* Y81 was grown in YPD broth at 28–30^{o}C in 24 h. Then, yeast cells were spread on YPD agar plates and incubated at 30^{o}C for 24 h, characteristics of colonies and cells of yeast were recorded.

Ability to degrade urea: Five milliliters of Christensen urea broth in test tubes were sterilized at 115^{o}C in 15 minutes. *S. cerevisiae* Y81 was inoculated into the sterilized test tubes containing Christensen urea broth. Both the test and control (un-inoculated) tubes were incubated at 30^{o}C for 24 h. The experiment was carried out in triplicate. Positive reaction could be recognized by the changing to deep-pink color of the media.

Ability to hydrolyze gelatin: The test tubes containing 5 mL of gelatin were sterilized at 121^{o}C in 20 minutes. *S. cerevisiae* Y81 was inoculated into the sterilized test tubes containing gelatin media, and incubated at 30^{o}C in 48 hours. Then, the test and control (un-inoculated) tubes were placed in ice bath or refrigerator for at least 30 minutes. The experiment was triplicate carried out and the positive reaction could be recognized by the liquefying of the media.

2.3. Fermentation ability from molasses at different temperatures

S. cerevisiae Y81 was cultured in YPD at 30^{o}C under shaking condition to reach cell concentration of 10^9 cells/mL. Molasses solution was adjusted to 26^{o}Brix, pH 4.5 and pasteurized by $NaHSO_3$ (140 mg/L) in 2h. One milliliter of yeast culture was inoculated into an 250 mL-Erlenmeyer flask containing 99 mL of pasteurized molasses solution. The Erlenmeyer flask was capped by water-lock and incubate at 35, 37 or 40^{o}C in 6 days. Sugar concentration, pH, and ethanol concentration were determined and the experiment was performed in triplicate. Ethanol was determined by distillation method and sugar concentration was analyzed by dinitrosalicylic acid method (Ian et al., 2012).

2.4. Ethanol production from molasses at the scale of 2 liters

S. cerevisiae Y81 was cultured in YPD at 30°C under shaking condition to reach cell concentration of 10^9 cells/mL. Molasses solution was adjusted to 26°Brix, pH 4.5 and pasteurized by $NaHSO_3$ (140 mg/L) in 2 h. Inoculated 20 mL of the yeast culture into a container containing 1980 mL of pasteurized molasses solution and incubated at 35, 37 or 40°C in 6 days. Sugar concentration, pH, ethanol concentration after fermentation were determined.

2.5. Ethanol production from molasses at the scale of 50 liters

S. cerevisiae Y81 was cultured in YPD at 30°C to reach cell concentration of 10^9 cells/mL. Molasses solution was adjusted to 26°Brix, pH 4.5 and pasteurized by $NaHSO_3$ (140 mg/L) in 2 h. Inoculated 500 mL of yeast culture into a container containing 49.5 L of pasteurized molasses solution and incubated at the best temperature selected by the previous experiment in 6 days. The experiment was performed in duplicate. Sugar concentration, pH, ethanol concentration after fermentation were determined.

2.6. Data analysis

Data were analyzed using Microsoft Excel (Microsoft Inc., USA) and the statistical analysis was performed using Statgraphics Centurion XV (Statpoint Technologies, Inc., USA).

3. RESULTS AND DISCUSSION

3.1. Characteristics of *Saccharomyces cerevisiae* Y81

After 28h streaked on YPD agar plate, colonies of *S. cerevisiae* Y81 appeared as round shape with the size ranged from 1.5 to 1.8 mm in diameter (Fig 1). The colonies had entire margin, convex elevation, smooth surface, and opaque density without any pigment.

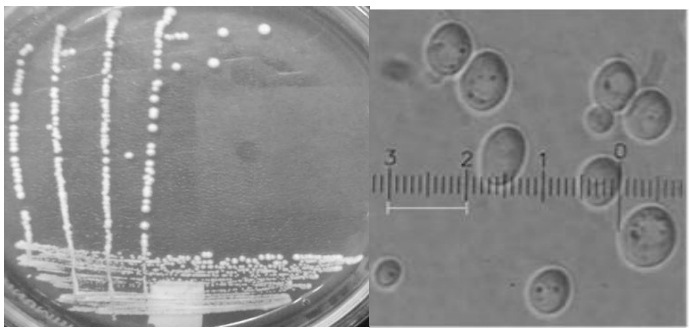

Fig 1. Colonies and cells of *S. cerevisiae* Y81

The cells of *S. cerevisiae* Y81 were ovoid with the size ranged from 4.0–8.5 µm in length and 3.0–7.5 µm in wide. The results showed that the morphological characteristics of *S. cerevisiae* Y81 were not different from these characteristics on the research of Nguyen Thi Mo (2014) who isolated this yeast from soil collected in sugarcane plantation.

After 24 hours incubation, the color of the test (inoculated) tubes were not different from the control (un-inoculated) tube in the degradation of urea test. The result showed that *S. cerevisiae* Y81 has no ability to degrade urea. For gelatin hydrolyzed test, after placing in refrigerator overnight, the solid state of the test (inoculated) tubes were not different from the control (un-inoculated) tubes. The result also showed that *S. cerevisiae* Y81 has no ability to hydrolyze gelatin. These results were exactly the same with the previous report by Nguyen Thi Mo (2014).

3.2. Fermentation ability from molasses using *S. cerevisiae* Y81

Molasses was prepared and adjusted to 26°Brix and pH 4.5. One milliliter of *S. cerevisiae* Y81 culture was inoculated into 99 mL of molasses solution. After 6 days of fermentation, samples were taken to measure pH, Brix, ethanol concentration, and sugar concentration. The results in Table 1 show that *S. cerevisiae* Y81 had a good ability to produce ethanol from molasses, especially at 37°C. The highest ethanol concentration of 6.13% was gotten at 35°C. However, the used sugar at this temperature was 178.44 g/L, so high to compare with the other ones. As a result, the fermentation efficiency at 35°C was not as good as at 37°C. The reason is at 35°C, most of the sugar was used for the growth of yeast instead of fermentation so the ethanol concentration was out of proportion to the used sugar (Ueno et al., 2001). At 40°C, both of the used sugar and ethanol concentration after fermentation were low so the fermentation efficiency was also low (59.65%). The reason is at high temperature, ethanol accumulation within yeast cells increases. Therefore, the growth and fermentation activity of the yeast cells were partly inhibited (Navarro and Durand, 1978; Sree et al., 1999).

Table 1. Ethanol fermentation using *S. cerevisiae* Y81 in 100 mL of molasses

Temperature (°C)	pH after fermentation	Used sugar (g/L)	Ethanol concentration (% v/v)	Fermentation efficiency (%)
35	4.16[b]	178.44[a]	6.13[a]	52.94[b]
37	4.46[a]	134.03[b]	6.10[a]	70.34[a]
40	4.49[a]	116.45[c]	4.50[b]	59.65[ab]
CV	3.67%	9.64%	8.92%	5.79%

Note: Data in the table is an average value of triplicate repeat

The pH after fermentation were smaller than the initial pH because of the forming of some acidic by-products in the fermentation process (Arshad et al., 2008). The higher the temperature, the smaller the decreasing of pH because at high temperature, the fermentation activity was partly inhibited lead to the decreasing of the by-products concentration (Navarro and Durand, 1978).

3.3. Ethanol production from molasses at the scale of 2 liters

Molasses was prepared and adjusted to 26°Brix and pH 4.5. Twenty milliliters of *S. cerevisiae* Y81 culture were inoculated into 1,980 mL of molasses. After 6 days of fermentation, samples were taken to measure pH, Brix, ethanol concentration, and sugar concentration. The results of the ethanol production at 37°C from 2 liters of molasses showed that the ethanol concentration of 7.80% (v/v) and fermentation efficiency of 83.4%, these levels were the highest values in comparison to the other treatments at two different temperatures (Table 2). Ethanol concentrations of 6.86% and 4.84% (v/v) with the fermentation efficiencies of 63.56% and 80.73% were obtained at 35°C and 40°C, respectively. From these results, 37°C was selected as the best temperature to carry out the fermentation experiment on the scale of 50 L.

Table 2. Ethanol production using *S. cerevisiae* Y81 in 2 L of molasses

Temperature (°C)	pH after fermentation	Used sugar (g/L)	Ethanol concentration (% v/v)	Fermentation efficiency (%)
35	4.41[a]	166.45 [a]	6.86[a]	63.54[b]
37	4.41[a]	144.18[b]	7.80[a]	83.40[a]
40	4.46[a]	93.24[c]	4.84[b]	81.54[a]
CV	1.31%	5.63%	2.09%	3.61%

Note: Data in the table is an average value of duplicate repeat

3.4. Ethanol production from molasses at 37°C on the scale of 50 liters

Molasses was prepared and adjusted to 26°Brix and pH 4.5. Five hundred milliliters of *S. cerevisiae* Y81 culture were inoculated into 49.5 L of molasses solution. After 6 days of fermentation, samples were taken to measure pH, Brix, ethanol concentration and sugar concentration. Similar with the previous results, the results on Table 3 shows that ethanol concentration increased by the increasing of the fermentation scale. Specifically, the highest ethanol concentration of 8.10% and the highest fermentation efficiency of 85.98% were gotten on the scale of 50 L.

Table 3. Ethanol production using *S. cerevisiae* Y81 at 37°C

Volume (L)	pH after fermentation	Used sugar (g/L)	Ethanol concentration (% v/v)	Fermentation efficiency (%)
50	4.31	145.29	8.10	85.98

Note: Data in the table is an average value of duplicate repeat

4. CONCLUSIONS

Ethanol fermentation using *S. cerevisiae* Y81 in 100 mL molasses, fermentation temperature of 37°C was selected as the optimum temperature for the fermentation process with the ethanol concentration of 6.10% and fermentation efficiency of 70.34%. Ethanol fermentation using *S. cerevisiae* Y81 in 2 L molasses demonstrated that fermentation temperature of 37°C was selected as the optimum temperature for the fermentation process with the ethanol concentration of 7.80% and fermentation efficiency of 83.40%. Ethanol concentration of 8.10% and the fermentation efficiency of 85.98% were achieved from the ethanol production at 37°C in the scale of 50 L molasses.

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STUDY ON TRANSPORT PHENOMENA AND KINETICS FOR THE CONVECTIVE DRYING OF SHRIMP

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ABSTRACT

In this paper, an experimental apparatus is carried out to make dried shrimp. Judging from the experiment with drying conditions of air velocity (1 -2 m/s) and temperature (50 – 60^{o}C) heat transfer coefficient, moisture transfer coefficient and moisture diffusivity are obtained by using *Bi-Di* correlation. An equation for determining the drying constant is established to determine the drying parameters at different drying conditions. Drying coefficient, moisture diffusivity, and moisture transfer coefficient were archived in the ranges of 0.09522×10^{-3}-0.15768×10^{-3} s^{-1}, 0.0434×10^{-7} - 0.2127×10^{-7} m^2/s, and 0.0981×10^{-6} - 0.4478×10^{-6} m/s, respectively. To obtain the final moisture the best drying condition (60^{o}C, 2m/s) consumed 3.6 hours, the worst drying condition (50^{o}C, 1m/s) needed up to 5.8 hours. The parameters are then used to simulate temperature and moisture content distribution inside the shrimp by ANSYS software. The results showed that the temperature in shrimp increased rapidly to dry air temperature after about 15 minutes. Moisture at the tail of the shrimp is quite low compared to the center at the thickest position in shrimp. The database from this study is expected to optimize energy consumption in technologies of convective drying for shrimp.

Keywords: Dincer number, Heat and mass transfer, Numerical simulation, Shrimp drying.

1. INTRODUCTION

Vietnam is a country with high catches of seafood in the world. Seafood export turnover also accounts for a high proportion of the national economy. Of which the shrimp are caught and raised in very large quantities. Shrimp is then stored by freezing or drying. Shrimp are commonly stored in coastal areas by sun drying and hot smoke drying from coal burning. This is handmade and seasonally. Howerver research on shrimp drying is professionally done in the world, especially in Thailand. Prachayawarakorn et al. [1] studied the characteristics of shrimp drying using steam and hot air. Erdoğdu et al. [2] constructed graphs to optimize the shrimp cooking process in the industry to keep shrimp quality. Drying in a jet-spouted bed was studied extensively [3-5]. In these studies, hydrodynamic behavior in the drying chamber, shrinkage of shrimps during drying, quality of dried shrimp is presented. Information technology has also been applied thoroughly during shrimp drying in recent years. Hosseinpour et al. [6, 7] applied computer vision to analyze color and shrinkage during shrimp drying. More recently, Akonor et al. [8] studied the comparison of different drying technologies affecting protein, fat and quality of dried shrimp.

In the present study, we carried out a forced convection drying experimental model to provide a database of shrimp drying properties. This data can be used for optimization, design of experiments in various drying technologies such as heat pump drying, solar energy, hot smoke etc. Mathematical model for calculation of heat and mass transfer coefficients, and moisture diffusivity is the *Bi-Di* correlation. This is a mathematical model widely used in food drying studies [9-11]. From the above-mentioned data, governing equations, initial and boundary conditions were established to simulate the distribution of temperature and moisture in dried shrimp.

2. EXPERIMENT

Experimental model of shrimp forced convection drying was constructed as Fig. 1. The model consists of a 38-watt fan, nine resistors, each with a 130-watt resistor. The fan speed and resistor power are controlled by the variable resistors. Shrimps done in the experiment were 130 shrimp kg^{-1}. Shrimp is boiled in salt solution and then preliminarily dehydrated before drying. Drying shrimps have initial moisture content M_i = 1.86 db. Weight of the dry matter in shrimp was determined in the laboratory at temperature of 105^{o}C in a Binder dryer. The drying air temperature is measured by the TESTO 735 thermometer. The air velocity is measured by the PCE-007. Shrimp weight is measured on an electronic balance.

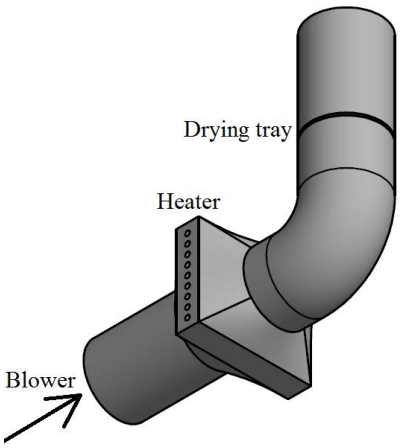

Fig 1. Experimental apparatus

3. DATA ANALYSIS

Moisture content was estimated using simplified equation of moisture ratio [11]:

$$Y = \frac{M}{M_i} \tag{1}$$

In order to determine the moisture transport mechanism, semi-logarithmic plots (ln*Y*-*t*) were constructed and described by linear function:

$$\ln Y = -St + \ln G \text{ or } Y = G\exp(-St) \tag{2}$$

where *t* is drying time, *S* drying coefficient and *G* lag factor.

The moisture diffusivity was calculated by using equation of Dincer và Hussain [12]:

$$D = \frac{SL^2}{\mu_1^2} \tag{3}$$

where *L* is the shrimp half-thickness and μ_1 is a root of the transcendental characteristic equation as follows:

$$\mu_1 = -419.24G^4 + 2013.8G^3 - 3615.8G^2 + 2880.3G - 858.94 \tag{4}$$

The moisture transfer coefficient can be obtained from Biot number definition as:

$$h_m = \frac{D.Bi}{L} \tag{5}$$

Biot number was calculated from relation between the Biot and Dincer numbers:

$$Bi = 24.848 Di^{-3/8} \tag{6}$$

where the Dincer number was developed as:

$$Di = \frac{v}{SL} \tag{7}$$

where v is flow velocity of drying air.

Fig 2a. presented the experimental result of moisture ratio with drying time at drying condition of 1.5 m/s and 50°C. A curve fitting was built from experimental data to determine the lag factor G and drying coefficient S (R^2 = 96.89%). As can be seen for the drying condition the values of G and S are 0.958087 and 0.12444×10^{-3} s^{-1}, respectively.

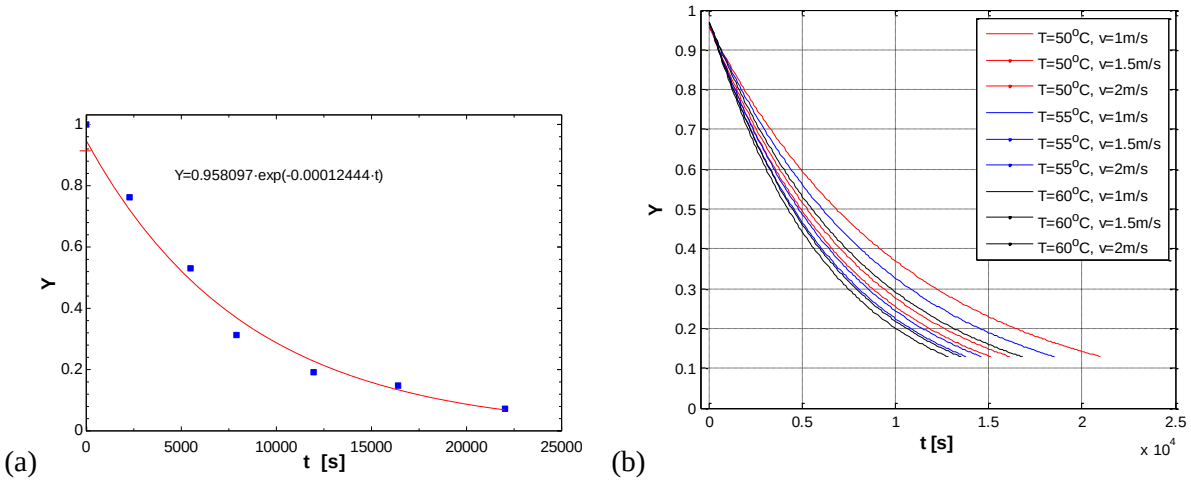

Fig 2. a) Moisture ratio with drying time at 1.5 m/s and 50°C; (b) Moisture ratio at various drying conditions

Moisture diffusivity, moisture transfer coefficient, and Biot number are then calculated by using Eqs. (3-7) as:

$$D = 0.0667 \times 10^{-7} \text{ m}^2/\text{s}$$

$$h_m = 0.1432 \times 10^{-6} \text{ m/s}$$

$$Bi = 0.0965$$

Similarly, experiments with different drying conditions were performed and tabulated in Table 1.

Table 1. Coefficients of regression model and calculated mass transfer parameters

Drying conditions		Model $Y = G\exp(-St)$		Mass transfer parameters		
T (^{O}C)	v (m/s)	G	$S\times10^3$ (s^{-1})	$D\times10^7$ (m^2/s)	$h_m\times10^6$ (m/s)	Bi
50	1.0	0.95582	0.09522	0.0434	0.0981	0.1016
50	**1.5**	**0.95809**	**0.12444**	**0.0667**	**0.1432**	**0.0965**
50	2.0	0.95788	0.13278	0.0701	0.1384	0.0888
55	1.0	0.96284	0.10842	0.0842	0.1999	0.1067
55	1.5	0.96511	0.13764	0.1301	0.2901	0.1002
55	2.0	0.96489	0.14598	0.1354	0.2771	0.0920
60	1.0	0.96677	0.12012	0.1323	0.3263	0.1109
60	1.5	0.96904	0.14934	0.2058	0.4731	0.1034
60	2.0	0.96883	0.15768	0.2127	0.4478	0.094

From Table 1 we find that the lag factor G is almost independent on the drying conditions and that the G value is approximately unity. The drying constant S denotes the drying capacity of a solid per unit of time. Compared to other types of food, the S of shrimp drying is relatively small, which indicates the drying time of the shrimp is longer than that of other foods in the same drying condition [9-11]. The parameters D and h_m play an important role in determination of moisture content distribution in a product. This study will be presented in next section. The obtained values were all in the range $0.1 \le Bi \le 100$ indicating that during drying of shrimp there were finite internal and surface resistances. Among the parameters, drying coefficient S is relative significance. Therefore an equation of S as a function of drying conditions T and v was developed as Eq. (8) with $R^2 = 99\%$.

$$S = -2.40374\times10^{-4}+5.79192\times10^{-6}T-3.00167\times10^{-8}T^2+1.62786\times10^{-4}v-4.17417\times10^{-5}v^2 \quad (8)$$

Fig 2b. shows nine drying curves from model $Y = G\exp(-St)$ at the drying conditions given in Table 1. The curves were reached to the final moisture content of 0.25 db [4, 5], i.e. moisture ratio $Y = 0.134$. Judging from the Fig 2b., to obtain the final moisture the best drying condition (60^{o}C, 2m/s) consumed 3.6 hours, the worst drying condition (50^{o}C, 1m/s) needed up to 5.8 hours.

4. NUMERICAL SIMULATION OF MOISTURE AND TEMPERATURE DISTRIBUTIONS

A mathematical model was developed to predict the temperature and moisture content inside shrimp during convective drying process. Heat transfer within shrimp is described by conduction equation and conditions as follows:

$$\frac{\partial \mathrm{T}}{\partial \mathrm{t}} = \frac{\mathrm{k}}{\mathrm{c_p}\rho_\mathrm{s}}\nabla^2\mathrm{T} \quad (9)$$

Initial condition and boundary condition:

$$t = 0;\ T = T_i$$

$$-k\nabla T = h_t(T_s - T_\infty)$$

Equation of Fick's second law was applied to simulate the moisture transfer:

$$\frac{\partial M}{\partial t} = D\nabla^2 M \tag{10}$$

Initial condition and boundary condition:

$$t = 0;\ M = M_i$$

$$-D\nabla M = h_m(M_s - M_e)$$

where M_e is equilibrium moisture content which can be evaluated by equation of Oswin as:

$$M_e = 0.103\left(\frac{RH}{1-RH}\right)^{0.645} \tag{11}$$

where RH is the relative humidity of drying air. Thermal conductivity k, specific heat capacity c_p and density ρ_s of shrimp were taken from Ref. [5]. Heat transfer coefficient h_t was calculated from equation of Pohllhausen [13, 14].

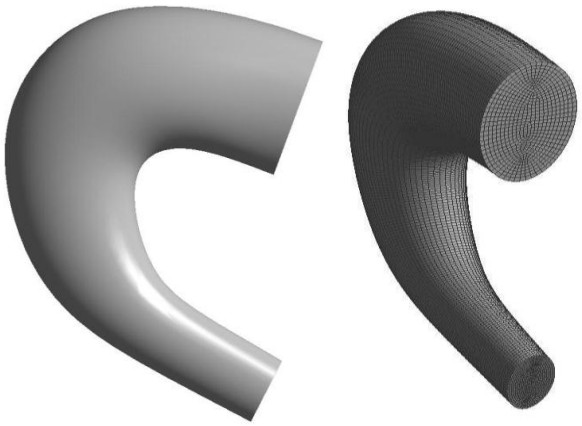

Fig 3. 3D model of shrimp and mesh

Moisture distribution and temperature in shrimp were simulated by using ANSYS software. The 3D model of shrimp and mesh were shown in Fig. 3. Input parameters for simulation are conditions corresponding to drying speed of 1.5 m/s and drying temperature of 50^{o}C. Figs. 4 and 5 show the temperature distribution after 1000s and the moisture content after 6.5 hours. It can be seen at this time that the temperature of shrimp is fairly uniform and approximately the temperature of the drying air, the humidity of the shrimp tail reaches about 0.37 while in the humid body is 0.8.

Fig. 6 presents moisture ratio at different positions in shrimp. It is possible to see the difference in moisture content in the thickest center in shrimp and shrimp tail. After about 6.5 hours, the moisture ratio at shrimp tail reaches 0.2. While at the thickest center is 0.46. Fig. 7 represents temperature distribution in shrimp. It is easy to see that after a short time of about 15 minutes the temperature of shrimp is approaching drying temperature due to the small size of shrimp.

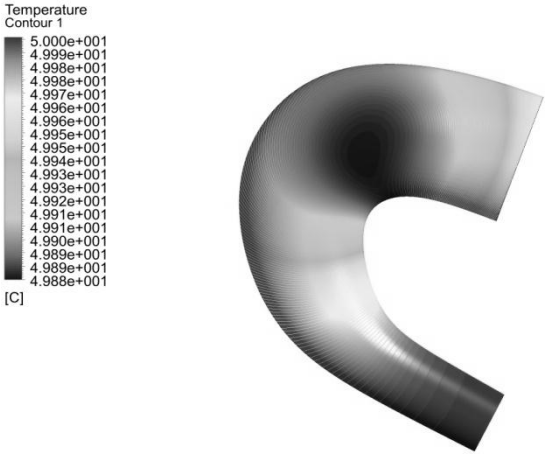

Fig 4. Temperature distribution after 1000s

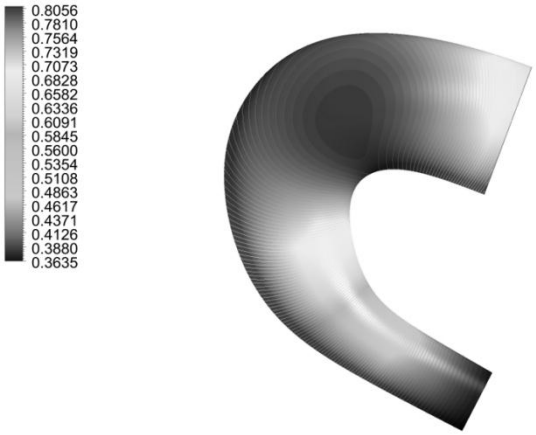

Fig 5. Moisture content distribution after 6.5h

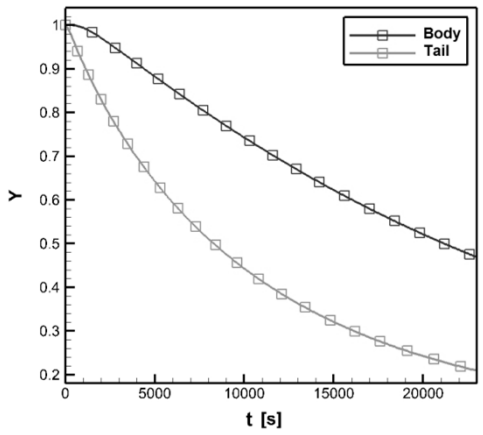

Fig 6. Moisture ratio at different positions.

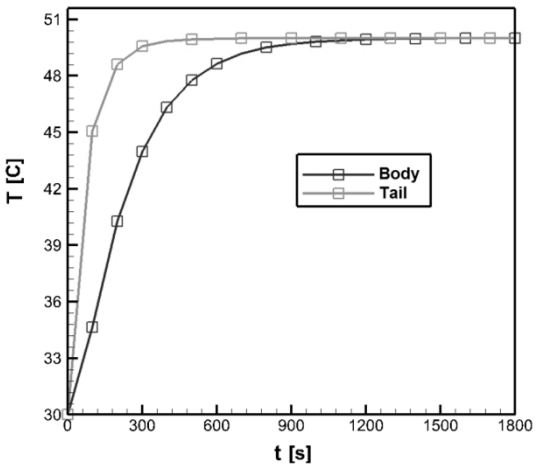

Fig 7. Temperature at different positions

From the simulation results, it can be observed a moderate deviation in comparison with the experiment results in the previous section. This can be explained by the difference in size of the simulated shrimp, errors of *Bi-Di* correlation, numerical solution and experimental process. The simulation does not take into account shrinkage of shrimps and latent heat of vaporization.

5. CONCLUSIONS

Experiments for convective drying with several drying conditions (50-60^{o}C; 1-2 m/s) were conducted to dry shrimp. Drying coefficient, moisture diffusivity, and moisture transfer coefficient were archived in the ranges of 0.09522×10^{-3}-0.15768×10^{-3} s^{-1}, 0.0434×10^{-7} - 0.2127×10^{-7} m^2/s, and 0.0981×10^{-6} - 0.4478×10^{-6} m/s, respectively. An equation for determining the drying constant is established to determine the drying parameters at different drying conditions. 3-dimensional numerical simulation was performed to determine moisture and temperature distributions in a shrimp. The results showed that the temperature in shrimp increased rapidly to dry air temperature after about 15 minutes. Moisture at the tail of the shrimp is quite low compared to the center at the thickest position in shrimp.

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CHEMICAL INVESTIGATION OF POLYSCIAS FRUTICOSA ROOT FOR QUALITY CONTROL OF THIS MEDICINAL PLANT

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ABSTRACT

Many valuable pharmacological effects of *polyscias fruticosa* (Dinh lang) were well known and applied to the prevention of diseases. Nowadays, Dinh Lang are widely used in the modern medicine. Therefore, the quality control of polyscias material and its product are required for improving the quality and effectiveness. So, which of the interest, active ingredient of polyscias root is still in progress.

Objective

In this study, extraction and isolation of main component in *polyscias fruticosa* root were presented.

Method

The fresh root of *polyscias fruticosa* was collected atTay Ninh province in March 2013.The raw material waspercolated with MeOH. The MeOH extract was evaporated under vacuum condition to get total extraction. After that, the extraction was liquid-liquid partitioned with chloroform, n-butanol respectively, evaporated of solvents to obtain $CHCl_3$, n-BuOH, water residues.The n-BuOH residue was continued separated by silica gel column chromatography and MPLC, furtherpurifications were separated by SPE C18 chromatography to get purified compounds. These compound structures were determined by MS and NMR techniques.

Result

Two new compounds PF1 (500 mg) and PFS1 (7.7 mg) were isolated from root of *polyscias fruticosa* by chromatographic techniques. The purity of PF1 and PFS1 was tested by HPLC and UPLC-PDA, indicated the purity of PF1 and PFS1 were 98.24% and 99.99% respectively. PF1 was determined as a new oligosaccharide with molecular $C_{30}H_{52}O_{26}$ namedβ-D-Glucopyranosyl-(1→4)-*O*-[α-D-Glucopyranosyl]-(6→2)-*O*-[3,6-di-*O*-β-Fructopyranosyl]-β-Fructofuranoside. Molecular formulation of PFS1 is $C_6H_6O_3$ and the structure was assigned as 2-(hydroxymethyl)-1,3-cyclobutadienylformate.

Conclusion

PF1 is anoligosaccharide, amount of this compound was in the extract of the root. It could be used as marker for developing quality control method for raw material and its products.

Key words: polyscias fruticosa, purification, pentose, oligosacchride, solid phase extraction

1. INTRODUCTION

Recently, many of the valuable pharmacological effects of*polyscias fruticosa*(Ding Lang) are well known and applied in the preventionof diseases [[1]-**Error! Reference source not found.**]. It was used as a tonic, anti-inflammatory, antitoxin, antibacterial herb and good for diuretic activity [[1]-[8], [14]]. Studiesshowed that leaf and root extract of *polyscias fruticosa*have adaptogenic activity[[1]] by

enhancing immunity against diseases, reduce mental stress and improve learning ability [[16],[17]].Nowadays, this medicinal herb and its products are widely used in modern medicine, so that the quality control of polyscias materials and its productare required for improving the quality and effectiveness.*Polyscias fruticosa*content many pharmacologicallycompounds such as polyacetylene, saponin, polysaccharide…[[9]-[11], 13, [15]]. Thisstudydescribes the isolation and structural elucidation of two new compounds named β-D-Glucopyranosyl-(1→4)-*O*-[α-D-Glucopyranosyl]-(6→2)-*O*-[3,6-di-*O*-β-Fructopyranosyl]-β-Fructofuranosideand 2-(hydroxymethyl)-1,3-cyclobutadienyl formatefrom root of *polyscias fruticosa*.

2. EXPERIMENT

2.1. General

MPLC Duoflow Pathfinder 80 System with Biologic Quadtec UV-Vis detector (Biorad) were used forfractionation of n-butanol extract. Testing the purification of compounds was performed by using HPLC Alliane 2695 with PDA 2996 detectors (Waters). Molecular mass of purified compounds was recorded by UHPLC Aquity Arc couped with QDa detector (Waters) and Quartro Micro Api mass spectrophotometry (MicroMass).

Silica gel 40-60 µm (Merck), Celite 545 (Merck),were used as stationary phase forcolumn chromatography. Further purification of compounds was performed by C18 SPE. Freeze dryer LD Alpha Plus (Martin Christ) was used for eliminating water from fractionations.Solvents for liquid chromatography analysis and extraction were choose HPLC grade and PA type. TLCSilica gel F254plates (Merck) were used for monitoring column progress and visualized by Vanillin sulfuric 1%/ethanol reagent.

NMR data was recorded on Bruker AVANCE 500 (Bruker Biospin Corporation, Swiss) spectrometer in MeOD (PF1), D_2O (PFS1) using TMS as internal standard at National Institute of Chemistry, Viet Nam.

2.2. Plant material

*Polyscias fruticosa*plant was harvested in Tay Ninh province.22 kg of fresh roots were rinsed, sliced, dried and ground to coarsely powder to get 5.5 kg raw herb.

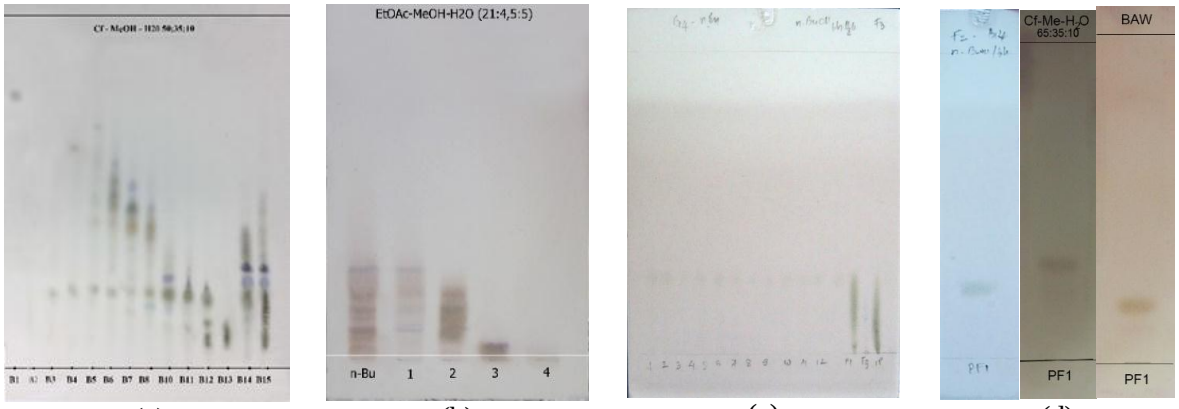
2.3. Extraction and Isolation

5,5 kg raw material was percolated withMeOH (60L). The MeOH extract was vacuum evaporated to get 902.3 g total extract. The former was liquid – liquid partitioned with $CHCl_3$ and n-BuOHrespectively, eliminated solvents by vacuum evaporation to get 91,8 g $CHCl_3$ and 119,5 g n-BuOH residues.

n-BuOH extract was loaded on Silica gel 40-60 column chromatography (Silica CC), eluted with $CHCl_3$:MeOH (1→100 % MeOH) to give 15 fractions. 4 simple fractions of this extract were collected from MPLC, which celite 545 was used as stationary phase and eluted withmobile phase EtOAc-MeOH-H_2O (21:4,5:5). Fraction 3 (0.278 g) from MPLC and Fraction 14 (4.2 g) from Silica CC were further separated into 5 simples fraction by SPE RP18, eluted with H_2O and MeOH. SPE fractions were eliminated organic solvent by vacuum evaporation and freeze dried to powder. In which, Fraction 2 (2.39 g) was purifiedseveral times by SPE technique to give pure PF1 (500 mg).

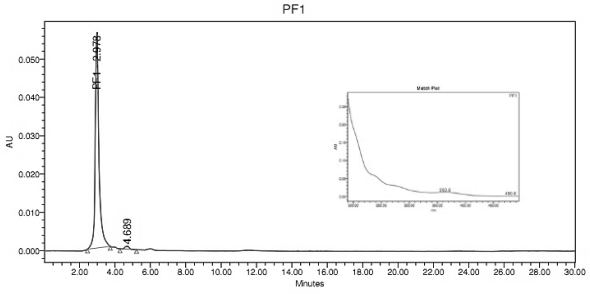
Fraction 5 (1,7 g) from SPE was continue separated by silica gel 40-60 column using n-BuOH to n-BuOH saturated water as mobile phase. 10 sub-fractions were obtained from this column. The first sub-fractionwas eliminated solvent and resolvedin MeOH, but it partially soluble in MeOH and the remainder dissolve in water. This water-soluble fraction was purified by SPE RP18 and freeze driedto

obtain 7.7 mg PFS1.



(a) (b) (c) (d)

Fig 1. TLC of fractions from silica gel column, MPLC and SPE purification
(a): Fractions of n-BuOH extract from Silicagel 40-60 column; (b) Fractions of n-BuOH extract from MPLC; (c) purification of PF1 by C18 SPE; (d) TLC test for purity of PF1

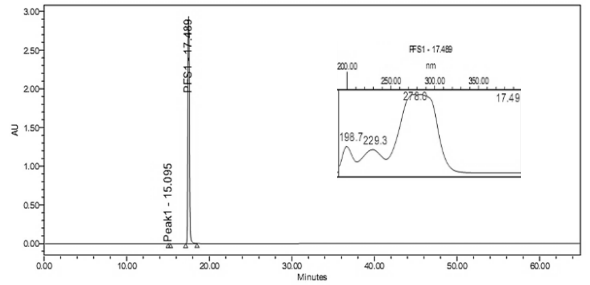


	Peak Name	RT	Area	% Area	Height	Purity1 Angle	Purity1 Threshold
1	PF1	2.978	821746	98.42	56246	15.718	70.351
2		4.689	13151	1.58	789	78.306	90.000

Purity test for PF1 by HPLC-PDA

- Column: Symmetry C_{18} (5µm, 4,6×150 mm)
- Mobile phase: H_2O-MeOH (95:5)
- Wave length scan: 190 – 400 nm
- Wave length detection: 205 nm
- Volume injection: 10 µl
- Flow rate: 0.5 ml/min
- Column temp: 40 ^oC

PF1 was at t_R 2.97, and its purity is 98.42 %



	Peak Name	RT	Area	% Area	Purity1 Angle	Purity1 Threshold	Selectivity	USP Plate Count	USP Tailing
1	Peak1	15.09	4917	0.01	32.74	69.38		9.58e+004	1.48e+000
2	PFS1	17.49	39411227	99.99	3.52	5.18	1.16e+000	5.38e+004	1.18e+000

Purity test for PFS1 by UPLC-PDA

- Column: Symmetry C_{18}(5µm 4,6×150 mm)
- Mobile phase:H_2O-MeOH (0 → 100% MeOH)
- Wave length scan: 200 – 400 nm
- Wave length detection: 278 nm
- Volume injection: 5 µl
- Flow rate: 0.35 ml/min

PFS1 was at t_R 17.49, and its purity is 99.99%

Fig 2. HPLC profiles of PF1 and PFS1

3. RESULTS

Compound PF1 was isolated as a yellowish gum and the ESI^+MSm/z = 851corresponding to $[M + Na]^+$ of molecular formula $C_{30}H_{52}O_{26}$.

^{13}C-NMR data of PF1exhibitedsugarcarbon signals in field region (δC 62-105 ppm). There are 4 signals δC93.94; 98,18; 99.19 (2C) and 103.14 ppm correspond to 5 anomeric carbons. The presence of two anomeric carbonshad the same chemical shift, which wasdemonstrated by the six peaks in the field region of the non-anomeric carbon(-CH_2-O-) (62.74; 62.84; 64.15; 64.52; 64.56; 65.86 ppm). This proves

that the structure of PF1 hassimilar chemical shift in 2 monosaccharides. The structure of PF1 was determined as a pentose oligosaccharide with five hexoses based on molecular formula $C_{30}H_{52}O_{26}$ and 5 anomeric carbons.

In the field region 93-105 ppm, there are 2 hydroxylated methine group(>CH-OH) belonging to 2 aldose hexose units (δC 93.94 and 98.18 ppm) and 3quaternary carbons (≡C-OH) of 3 ketose hexose moieties (δC 99.19 (2C) and 103.14 ppm).Furthermore, the ^{1}H-NMR spectrum indicated that there are only 2 anomeric protonsat δH 4.50 ppm (1H, *d*, J = 8 Hz) and 5.14 ppm (1H, *d*, J = 4 Hz). All of the remaining signalsδH 3.1 - 4.2 ppm characterized forprotons attached to oxygenated carbon. The resonance spectraproved thatPF1 was possibly determinedas a pentosewith 2 aldose hexoses and 3 ketose hexose moieties. Two aldosehexoses were defined as glucose by the chemical shifts of carbons and protons in comparision with NMR data reference [[12]]. There were a β-D-Glucopyranoside (Gβ) reducing end at equilibrium[δC 98,18 ppm; δH 4.50 ppm (1H, d, $^3J_{H-H}$= 8 Hz]andα-D-Glucopyranose (Gα)[δC 93.94 ppm; δH 5.14 ppm (1H, d, $^3J_{H-H}$= 4 Hz)]unit adjacent to Gβ.

The three ketose hexoseswere determined as fructose. Two of themhad similar chemical shift of C and H, identified as β-fructopyranose (Fp) with anomeric carbon at 99.19 ppm and 2 δC at 64,52and 65,86 ppm corresponding to C_1 and C_6 (-CH_2O-) of Fp. The remaining β-Fructofuranose (F_f) was identified by the anomericcarbon C_2(δC103.12 ppm), C_5 (δC 83,17 ppm) and these signal at64.15 and 64.56ppm could be assigned to C_1, C_6respectively.

The glycosidic linkagesinPF1 were elucidated by the 2D-NMR data (COSY, HMBC, NOESY, TOCSY). The proton and carbonchemical shifts of monosaccharide units were compared with NMR data reference. [[12]]

HMBC spectrum, Gβ's anomericproton (δH 4.5) showed only one interaction with carbon at 77.99 ppm, which is thought to be C_3/Gβ.While, the Gα'sanomeric proton (δH 5.15) showed 2 interactions with C_3, C_5 of Gα (δC 74.86; 72.97 ppm) and a long-range correlationwith C_4/Gβ (δC 73.83 ppm). Furthermore, NOE and TOCSYexperiments were observedcross peak betweenH_1/Gα (δH 5.15) and H_4/Gβ (δH 3.4). So, the linkage between two glucose moieties could be Gα1 → 4Gβ.

The proton of these-CH_2O- groups (δH 3.51; 3.64; 4.07 ppm)had long-range correlation with anomeric carbons of F_f and Fp. The appearance HMBC of proton H_6/Gα (δH 3,51 ppm) and anomeric carbon of F_f (C_2/Ff, δC 103,27 ppm) proved that α-Glucose was connected with FructofuranosethroughF$_f$C$_2$ → C$_6$Gα. The sugar F_f unit was continue linked with Fp1 and Fp2 residues through-bond F_fC$_6$ → C_2 Fp1; F_fC$_3$ → C_2 Fp2. These connectionswere elucidated by HMBC correlation of H_6/F_f (δH 4.07 ppm, 2H; δC 64.56 ppm), H_3/Ff (δH 4.05 ppm, 1H; δC 76.74 ppm) to anomeric carbon C_2 of Fp1 and Fp2 (δC 99.19 ppm). Furthermore, proton H_1/-CH_2OH Fp2 (δH 3.64 ppm, δC 64.52 ppm) displayed HMBC correlation with C_5/F_f (δC 83.17 ppm) and NOE, TOCSY correlation for H_1/Fp2 and H_4/F_f (δH 3.86 ppm, δC 71.21 ppm). Base on the experiments, the structure of PF1 was deduced as a new oligosaccharidenamedβ-D-Glucopyranosyl-(1→4)-*O*-[α-D-Glucopyranosyl]-(6→2)-*O*-[3,6-di-*O*-β-Fructopyranosyl]-β-Fructofuranoside.

PFS1 compound was isolated as yellowish powder, hadmolecular formula$C_6H_6O_3$by ESI$^+$MS spectrum [M+Na]$^+$m/z = 149.06. NMR spectra of PFS1show 6C, a carbonyl group -CH = O (δC 180.52 ppm, δH 9.39 ppm, 1H, S), 2C of methine -CH=HC-[δC 110.99 ppm, δH 6.61 ppm(1H, d, J = 4Hz) and δC 126.85 ppm, δH 7.47 ppm (1H, d, J = 4Hz)], anoxygenated methylene group -CH_2-OH (δC50.06 ppm, δH 4,63 ppm (2H, S); -OH (δH 4.7 ppm, 1H, S) and 2 quaternary carbon (161,38; 151,85 ppm). PFS1 had four carbons ring with 2 aromatic protons belonged to -CH=CH- groupand one double-bond of two quaternary carbon (C_{IV}) at low-field region. This proved that these twoC_{IV} must be attached to electronegative group, deshielded and moved themto downfield region. HMBC spectra exhibited

correlation of proton (δH 4.63)of -CH_2OH group with two carbon C_1 (161.38 ppm) and C_3 (110.99 ppm), while proton ofcarbonyl group (δH 9.39)displayed HMBC correlation with$C_1$of ring system.Therefore, structure of PFS1 wasassignedas 2-(hydroxymethyl)-1,3-cyclobutadienyl formate.

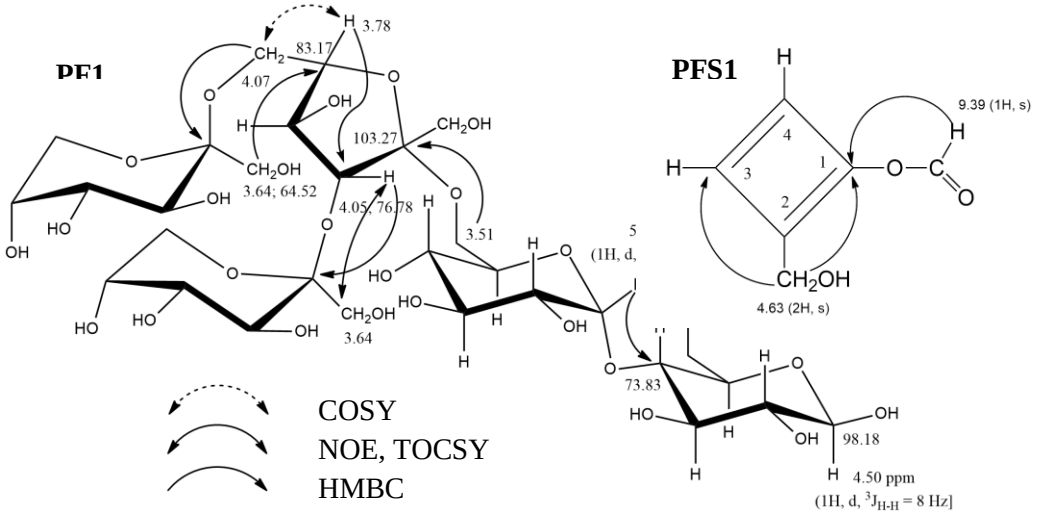


Fig 3. 2D-NMR correlation for PF1 and PFS1

4. CONCLUSION

From the root of *polyscias fruticosa*, 2 new compounds PF1 and PFS1 were isolated by chromatographic techniques. The purity of PF1 and PFS1 were 98.24% and 99.99% respectively,tested by LC-PDA. PF1 was determined as a new oligosaccharide with molecular $C_{30}H_{52}O_{26}$ named β-D-Glucopyranosyl-(1→4)-*O*-[α-D-Glucopyranosyl]-(6→2)-*O*-[3,6-di-*O*-β-Fructopyranosyl]-β-Fructofuranoside. Molecular formulation of PFS1 is $C_6H_6O_3$ and the structure was assigned as 2-(hydroxymethyl)-1,3-cyclobutadienylformate. High concentration of PF1 was in the extract of the root. Results proved that PF1 could be used as marker for developing quality control method for polyscias raw material and its products.

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THE EVALUATION OF THE EFFICIENCY OF WASTEWATER TREATMENT OF PIGS AFTER BIOGAS WITH WATER HYACINTH (*EICHORNIA CRASSIPESS*) AND BUFFALO SPINACH *(ENYDRA FLUCTUANS)*

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ABSTRACT

"The Evaluation of the efficiency of wastewater treatment of pigs after biogas with water hyacinth (Eichornia crassipess) **and Buffalo Spinach** (Enydra fluctuans)**"** were conducted to investigate the growth and treatment of animal wastewater of two aquatic plants. The results showed that after 6 weeks of cultivation, the growth of water hyacinth and Buffalo Spinachwere well developed, especially the best development at week 5. In addition, It was found that the water hyacinth was better than buffalo spinach and the P_{total}, COD, and N_{total} the water treatment efficiency were 42.6%, 65.82% and 63.31%

Key words: Wastewater treatment of pigs, Water Hyacinth (Eichornia crassipess), Buffalo Spinach (Enydra fluctuans), model, aquatic plants

1. INTRODUCTION

Husbandry pig is one of the most important areas of agricultural development. It provides daily life consumption of meat, and it is also an abundant organic fertilizers source for plants.In addition, the process of animal husbandry not only utilizes food but also attracts surplus labor in agriculture. With the characteristics of pigs such as fast growth and short life cycle, pigs are always concerned and become an essential animal in the daily life of the farmer family.

However, the control and the treatment of husbandry sewage has not been paid much attention in the households. As a result, there are a lot of rivers and canals are seriously polluted because of receiving sewage streams from these activities.

To solve this problem, the combination of animal wastewater treatment methods and aquatic ecosystems using aquatic plants is one of the engrossing technologies.

Aquatic plants are highly adaptable to submergence habitats and some of them are capable of treating pollutants in water with very high efficiency.

The role of aquatic plants in sewage treatment has been demonstrated in several domestic and foreign researches. Truong Thi Nga *et at* (2007) studied the ability of husbandry sewage treatment by Pistia stratiotes and Salvinia cucullata to conclude that the use of these two species to absorb nutrients in pollutted organic sewage is a effective measure.

Water Hyacinth *(Eichornia crassipess)* and reeds are two of the species aquatic plants used in sewage treatment in many countries around the world, such as *France, Brazil (Mangabeira et al 2004), Argentina, India, Egypt, China.* [5, 6, 7]. The experiment of using the combination of water hyacinth and coriander to process the P_{total}, COD, N_{total} of pig sewage after biogas technology was conducted to evaluate the efficiency of the parameters and generate the science background of applying the aquatic plants to treat the pollution at the laboratory scale.

2. MATERIALS AND RESEARCH METHODS

2.1. Study Materials

a. Researched Plants

Water hyacinth (*Pontederiaceae*) is a floating plant on the water with crossed roots. It has internodes which contains fasciculate roots. Their leaves grow on their roots, fold in lotus style or sprout. The stems are bloated and sponge to help them float on the water. Hyacinths widely distribute in Vietnam. They live in fresh water, ponds, canals, fields or rivers [1].

Buffalo Spinach*(Enydra fluctuans)* called "Ngo cong" in southern, also known as bitter, earthen scented, fragrant, incense or chrysanthemum is a medicinal plant which belongs to daisy family. They have rapid growth and fast development [1].

b. Livestock wastewater

Wastewater from pig raising after Biogas was collected Trang Bom district and Dong Nai province with the following parameters: pH ranged from 7,4 – 8,2, COD 927 mg/l – 987mg/l, SS 405 mg/l – 510 mg/l, N_{total} 446,7 mg/l - 750 mg/l, P_{total} 525,6 mg/l - 735 mg/l. The experiment was conducted at the Environmental Analysis of the Forestry University.

2.2. Experimental model

- Water hyacinth and turtles are kept in a tank of size L x B x H: 150 x 60 x 70 (cm) and the initial density is 120 grams/tank.

- Raising water hyacinth and spinach in wastewater of pigs after biogas with 2 treatments as follows:

(1) Water hyacinth.

(2) Buffalo Spinach.

- The activity of the experimental model: The input wastewater is pumped from the tank into the compartment via the metering pump into the water hyacinth and turmeric treatment tank. The post-treatment water will flow out through the drainage pipe according to the overflow mechanism.

2.3. Research Methods

- Inherited documents.

- Sample analysis.

Samples are taken and analyzed in the following table.

Table 1. Parameters and methods of analysis

Indicator Analysis	Method	Accuracy
pH	Use pH test	± 0.01
COD	Method of titration	± 2 mg/L
NO_3^-	Vietnamese National Standards 6498 : 1999	±0.01mg/L
PO_4^{3-}	Vietnamese National Standards 6202 : 1999	±0.01mg/L

- The experiment was conducted 3 times and the Microsoft Office Excel 2010 software is used to synthesis and calculate the experimental numbers and then analysis the statistical indicators.

3. RESEARCH RESULTS AND DISCUSSION

3.1. Evaluate the growth performance of TVTS in pig wastewater

Water hyacinth and banana are grown for 6 weeks to examine the survival ability and long-term development in the environment of biogas wastewater. The results are shown in the graph (Fig 1).

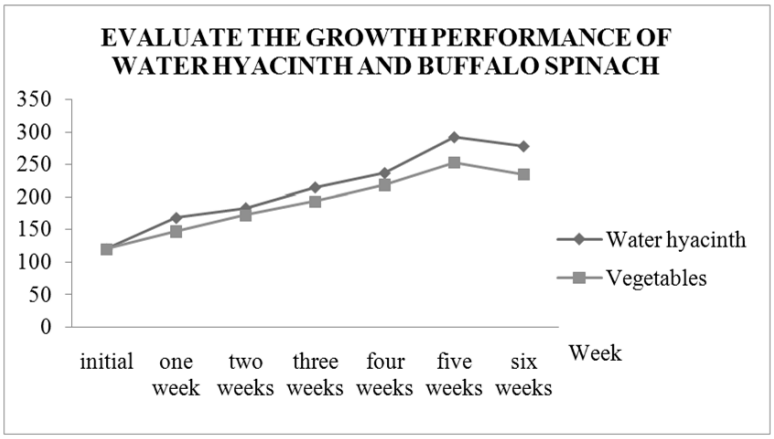

Fig 1. Evaluate the growth performance of Water hyacinth and Vegetables

Result of research shows that water hyacinth and turtles in wastewater of pigs after biogas developed well and increased the best weight at week 5. The process of monitoring and surveying of 2 wastewater tanks after 6 weeks of aquaculture are fresher than those of the first place. Suspended solids settle to the bottom and are enough for aquatic plants to absorb wastewater.

Fig 2. Water hyacinth and Buffalo Spinach after 5 weeks of cultivation

3.2. Evaluate the pH, COD, Nito, PO_4^{3-} of the model

3.2.1. pH

The experiments were arranged in two treatments: reservoirs of water hyacinth and *Buffalo Spinach* to investigate the ability of self-cleaning livestock wastewater after the biogas of the tank. Results of pH fluctuation of wastewater in the first week and after 6 weeks of the survey are presented in Fig 3.

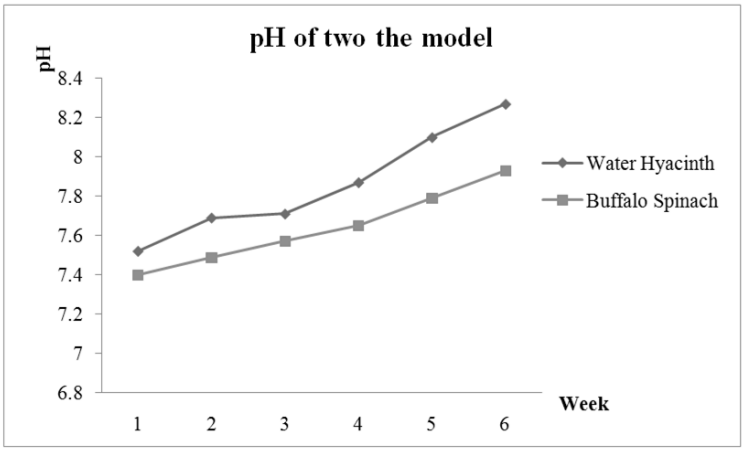

Fig 3. pH of two the model

As aquatic plants and photosynthetic algae absorb CO_2 faster than the CO_2 produced by the respiration of aquatic life and algae, they must extract CO_2 from the conversion of HCO_3^- ($2HCO_3^- \rightarrow CO_2 + CO_3^{2-} + H_2O$) increases pH.

The results of Figure 3 show that the pH of the tanks was slightly increased in all tanks. This is because water hyacinth, turtles and algae in water tanks absorb CO_2 for photosynthesis, which increases the pH of the water. At the aquaculture, the pH increased more than that of the basaltic tank due to the high algal density of hyacinth reservoirs

3.2.2. The effenciency of removal COD

The effenciency of removal COD of two aquatic plant models is shown in Fig 4.

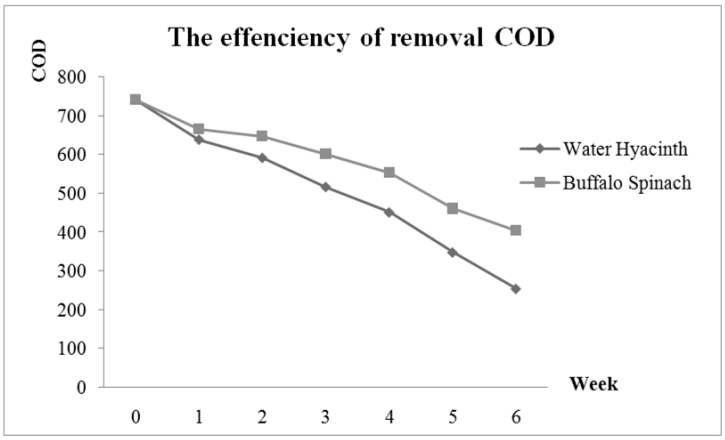

Fig 4. The effenciency of removal COD

The average COD level introduced into the treatment system was 741.74 mg/l. After 6 weeks of nourishment of water Hyacinth and *Buffalo Spinach* in 2 models showed that the treatment effect in the hyacinth was 65.82%, while the coriander model was only 45.57%. This suggests that the ability to process COD in water hyacinth model is very high. Results of the study are also consistent with the results of the authors of domestic and foreign authors such as Dang Xuyen Nhu et al (2005) studied the treatment of pig waste on a pilot scale by UASB system asscoiate with water Hyacinth reduces COD 80% when the input is about 3000mg/l [3]. Truong Thi Nga et al. (2009), using the reeds (Phragmites spp) to proces animal sewage, showed the efficiency of removal COD was 36.39% [2]. In Iron Bridge (U. S. EPA, 1988), the use of aquatic plants to process the urban sewage showed the efficiency of removal COD was 60% [7].

3.2.3. The eficiency of processing nitrogen

The eficiency of processing nitrogen of the two models is shown in Figure 5 with a nitrogen content of 357.24 mg/l. The results after 6 weeks showed that the efficiency of treating water Hyacinth in nitrogen tank was 63.31%. In addition, the efficiency of was treating *Buffalo Spinach* was 53.3% lower than water Hyacinth tank.

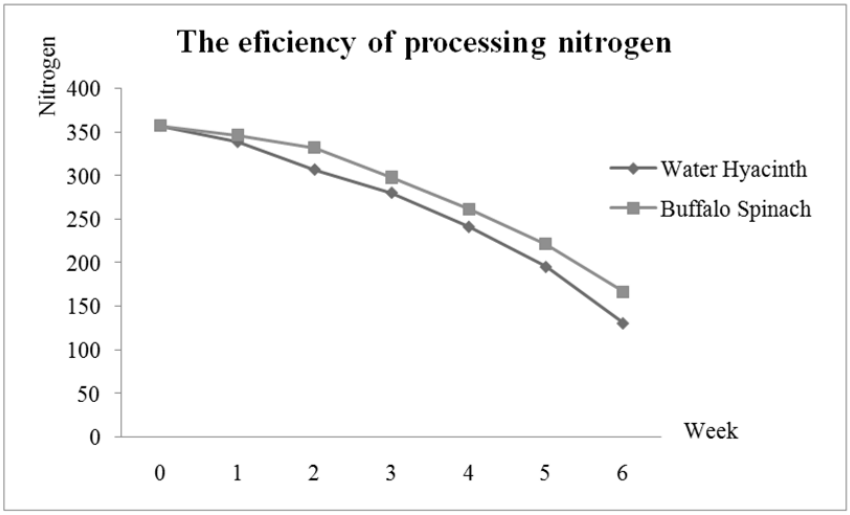

Fig 5. The eficiency of processing nitrogen

The results showed that the nitrogen content of both models decreased. This is due to the fact that some of the nitrogen in the sewage is absorbed by the water Hyacinth and *Buffalo Spinach*, which is used to increase biomass, a part of Nitrogen is the nutrient that provides the microorganisms exist in sewage.

In addition, nitrogen can be evaporated in the form of NH_3, especially in alkaline conditions. NH_4 is converted to NH_3, which also leads to a reduction in Nitrogen in sewage. The results of the researching are also consistent with the publication of R.D. Sooknah et al. (2004) to nourish Hyacinth in 31days experiment with cow's sewage through decompose anaerobic. With water dilution twice that has Nito total 164mg/l, Hyacinth removed 91.7% nitrogen , 99.6% ammonium[5]. Truong Thi Nga et al. (2009) used reeds (Phragmites spp) to treat animal sewage, suggesting an ammonium treatment efficiency of 64.08% [2].

3.2.4. The eficiency of processing phosphorus

Phosphorus is an important element in the development of plants and microorganisms. Discharging this nutrient with high concentrations into the natural environment increases algae growth and leads to eutrophication in lakes and rivers [4]. After the experiment, the content of phosphorus is shown in Fig 6.

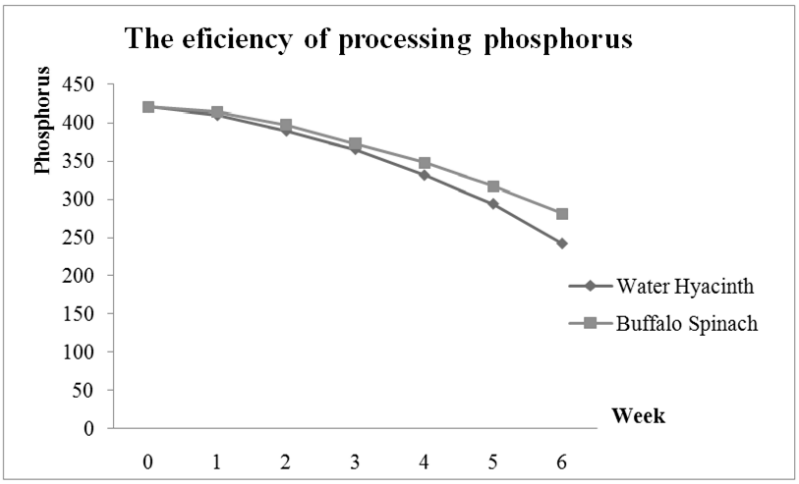

Fig 6. The eficiency of processing phosphorus

In sewage, phosphorus is reduced by the aquatic plants and microorganisms in absorb water to survive and grow because phosphorus is also an essential nutrient for their growth. Phosphorus compounds exist in water with $H_2PO_4^-$, HPO_4^{2-}, PO_4^{3-}polyphosphates such as $Na_3(PO_3)_6$ and organic phosphorus. Results of the researching showed that the efficiency of phosphorus treatment of the hyacinth model was 42.6%. Besides, the model of coriander was 33.2%.

The results of the researching that using system to combine floating plants with water hyacinth and coriander to treat pig husbandry wastewater after biogas that leads the eficiency of processing COD, nitrogen and phosphorus relatively high.This model contributes positively to the development of sustainable farming systems in which livestock is an important component.

4. CONCLUSION

The use of plants in the study of wastewater treatment in general and the wastewater of pigs after biogas, in particular, is necessary as they contribute to the reduction of pollutants in wastewater. Research results show that water hyacinth and *Buffalo Spinach* are able to live well in the wastewater environment. After 6 weeks of research, the efficiency of treatment of pollutants in wastewater of two plants is relatively high. Specifically, the efficiency of processing of COD, nitrogen, phosphorus of water hyacinth reached 65.82%, 63.31%, 42.6%. At the same time, COD removal efficiency was only 45.7%, Nitrogen was 53.2% and Phosphor 33.25%.

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WATER QUALITY ASSESSMENT MODELS OF SHRIMP CULTURE IN VINH THUAN DISTRICT, KIEN GIANG PROVINCE

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ABSTRACT

"Water Quality Assessment models of Shrimp Culture in Vinh Thuan district, Kien Giang province" was conducted to evaluate water quality indicators and pond bottom status in shrimp aquaculture. Samples are collected periodically twice a month. Method of collection and analysis are based on the Andrew standard method, 1995. Results over 4 rounds collecting and analyzing samples have shown that pond bottom quality, including the organic matter content, the total nitrogen and total phosphorous was generally suitable for shrimp development with N/P ranging from 1.12 to 1.77. Other indicators such as temperature, dissolved oxygen (DO), pH, salinity, clarity, alkalinity, NH_3 were monitored regularly. They showed little variation, which was suitable for shrimp growth and conformed with standards stated in the National Technical Standards of shrimp Culture (National Technical Regulation 02-19/2014 Ministry of Agriculture and Rural Development)

Key words: extensive shrimp farming, intensive, sediment, shrimp pond, water quality

1. INTRODUCTION

Ca Mau peninsula and Long Xuyen quadrangle are two key shrimp areas of Kien Giang province. Located in those zone, Vinh Thuan is one of the districts where aquaculture activities take place most popularly. According to the report of the General Department of Fisheries, in 2016, the entire shrimp farming area of Vinh Thuan covered 22.800 ha and the production reached over 10.500 tons. At present, the intensive and extensive shrimp farming models are high developing models in Vinh Thuan particularly and in Asian countries in general. The Shrimp farming not only contributes to the increase in seafood export turnover to other countries but also have positive effects on socio-economic issues and livelihoods of aquaculture farmers as well. However, the Intensive shrimp farming has caused many environmental problems such as self-pollution or the ecological imbalance in coastal areas (Macintosh and Phillip, 1992). Beside, Infection is the most damaging causes of shrimp farming (FAO, 2003). As a consequence, many areas of shrimp farming have been unsuccessful and abandoned, which causes serious socio-economic damages. To limit the infiltration of pathogens, scientists have proposed a less-water-intensive shrimp culture model - a popular farming model now. However, due to the less water changing, water quality decreases quickly and the more nutrients has accumulated.

In fact, the shrimp farming in Vinh Thuan has been facing many difficulties including diseases, the slow shrimp growth or the low survival rate especially. The understanding of farmers about the shrimp farming environment is very limited. When shrimps in the pond get diseases, the farmers only use drugs and chemicals for treatment and don't care about the effects of the pond environment on the species. For example, in some cases, diseases caused from the environment that directly affects the host or from the cumulative effect of the three components: the environment, the host and the pathogen in the environment. Therefore, for shrimp culture, it is very important to understand the environmental factors of ponds. From this fact, the study "***Water Quality Assessment models of Shrimp Culture in Vinh Thuan district, Kien Giang province***" was conducted to evaluate the water environment and bottom quality in the pond system at the key feeding areas of Vinh Thuan district.

2. MATERIALS AND RESEARCH METHODS

2.1. Time and place of sample collection

- Sample time is from January 2017 to April 2017. Regularly collect samples twice a month.

- Sampling locations are shown in Table 1.

Table 1. Location of sampling

Model	Location	Acreage	Density	Objects
Intensive	Vinh Phong commune (A1)	10.000 square meters	10 shrimp / square meters	Black tiger shrimp
	Tan Thuan commune (A2)	10.000 square meters	10 shrimp / square meters	Black tiger shrimp
	Binh Minh commune (A3)	6.000 square meters	10 shrimp / square meters	Black tiger shrimp
Extensive shrimp farming	Vinh Phong commune (A4)	10.000 square meters	10 shrimp / square meters	Black tiger shrimp
	Tan Thuan commune (A5)	10.000 square meters	10 shrimp / square meters	Black tiger shrimp
	Binh Minh commune (A6)	6.000 square meters	10 shrimp / square meters	Black tiger shrimp

2.2. Analytical methods

2.2.1. Sample collection method

Temperature, pH, salinity, alkalinity, dissolved oxygen (DO) and NH_3 levels in plastic bottles were collected at three different locations along the diagonal of the pond. Fishpond bottom was collected by bucket bottom sampling at 3 sites such as water sampling. All samples were carefully labeled and stored refrigerated ($<4^0$C) during transport and analysis.

2.2.2. Sample analysis

For alkaline and pH indicators, it is measured daily using the sera test-kit. The remaining indicators were transported to the laboratory and analyzed according to the methods of Andrew, 1995 as shown in Table 2

Table 2. Parameters and methods of analysis

Serial	Indicator Analysis	Method
1	Temperature	Use a mercury thermometer to measure
2	pH	Use pH test
3	Salinity	Use hydrometer to measure salinity
4	Alkalinity	Use alkaline test
5	DO	Use Winkler method
6	NH_3	colorimetric method
7	Total nitrogen (TN)	Vietnamese National Standards 6498 : 1999
8	Total phosphorus (TP)	Vietnamese National Standards 6202 : 1999
9	Organic substances (TOM)	Vietnamese National Standards 7377 : 2004

- Using Microsoft Office Excel 2010, SPSS, combining empirical and numerical data, analyzing statistical indicators.

3. RESEARCH RESULTS AND DISCUSSION

3.1. Water quality in shrimp ponds

3.1.1. Temperature changes

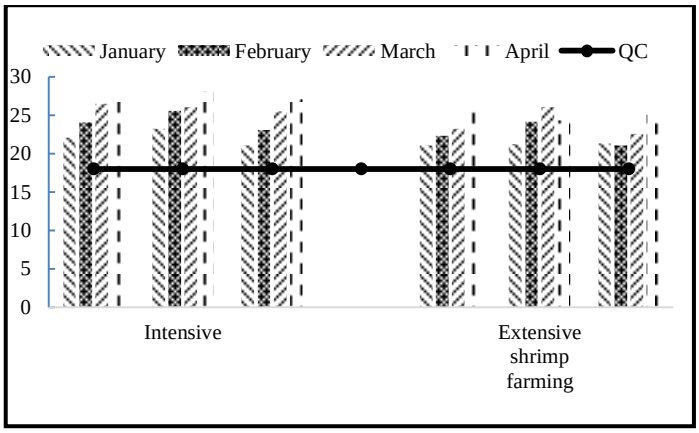

Fig 1. Temperature changes

Through the survey, the analysis showed that the temperature should be maintained at between 21.2^{0}C to 29.1^{0}C to create the ideal condition for shrimp growth in two aforementioned culture models . This is the adaptation, growth and development of shrimp farming. The sampling took place during the dry season and the beginning of the wet season, which caused temperature fluctuations. In the intensive model, the temperature was higher than that of the extensive shrimp farming model. This is due to the fact that the pond area, the large pond depth, the shrimp density, the amount of food and bio-products of the intensive model are more than those of the extensive shrimp farming model. However, the results of Fig.1 show that The temperature experienced a slight fluctuation bewteenn sampling times of the two models. According to Boyd (1998), The suitable temperature for shrimps to grow is about 25^{0}C to 30^{0}C. For Chanratchakool et al. (1995) When temperature is lower than 20^{0}C or higher than 33^{0}C, shrimps are more susceptible to pathogen due to the fact that the shrimp's ability of catch prey will decrease by 30-50%. In addition, the National Technical Standards of shrimp Culture (National Technical Regulation 02-19/2014 Ministry of Agriculture and Rural Development) stipulates that the temperature range of 18^{0}C – 33^{0}C is appropriate for shrimp to grow and develop. Therefore research results show that the temperature in shrimp ponds is suitable for the development of shrimp.

3.1.2. Dissolved Oxygen (DO)

DO is an important factor, depending on the wind speed, the width of the pond surface, algae density and the number of organisms in ponds. According to the research, the best levels of dissolved oxygen for shrimp are higher than 5 mg/l. In fact, shrimp can grow normally with the levels of DO above 4mg/l) while shrimp grows slowly in the range of 2-3 mg/l and can not grow up when the levels of DO are under 2 mg/l. (Truong Quoc Phu, 2009)

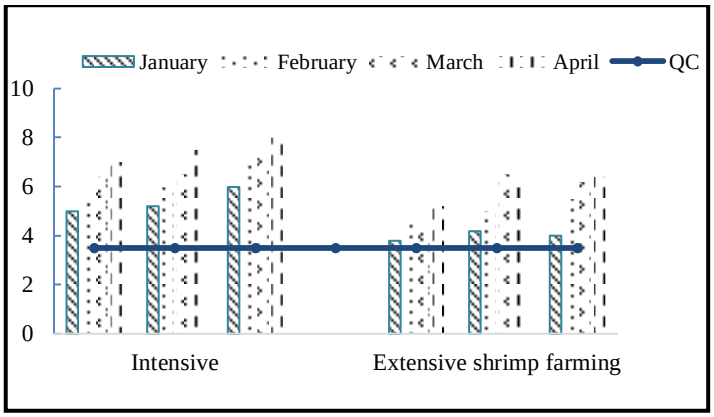

Fig 2. Dissolved Oxygen changes

The results of Fig.2 show that there was a significant variation in the level of dissolved oxygen between the two models. In the extensive shrimp farming model, the DO content ranged from 3.8 mg/l to 6.5 mg/l. Within this level, shrimp still developed normally but less slowly than the intensive model. There were some reasons behind this. Firstly, there was rain in this season, leading to the decrease in the temperature of the pond water. The low salinity also contributed to the decline in the level of DO.

In the intensive model, the DO content varied from 5 mg/l to 8 mg/l, which was suitable for shrimp to grow quickly and develop well. In general, the DO content in the intensive shrimp culture model was higher than that of the extensive shrimp farming model was due to the continuous supply of air blown throughout the day. According to Swingle, 1969 the ideal water-soluble oxygen content in shrimp ponds is above 5 mg/l and does not exceed 15 mg/l (Whetston et al., 2002). According to Wang et al. (2000) study about the oxygen distribution in ponds, 70% of oxygen is consumed by benthic organisms and oxidation of organic compounds and only 20% of oxygen is consumed for shrimp respiration. The best nitrification process will happen if the DO content is greater than 80% in saturation. The Nitrification will not occur when the DO content is 2 mg/l or less.

3.1.3. pH

The suitable pH for shrimp farming is from 7.8 to 8.5. If the pH > 9, then Anomium (NH_4^+) will turn to Ammonia (NH_3) which affects shrimp. At pH < 6.5, heavy metals (Fe, Cu, Hg, Pb ...) under the pond bottom will release into the shrimp toxic water. At the same time, low pH will reduce the accumulation of minerals in shrimp, which causes soft shell when molting. (Truong Quoc Phu, 2009)

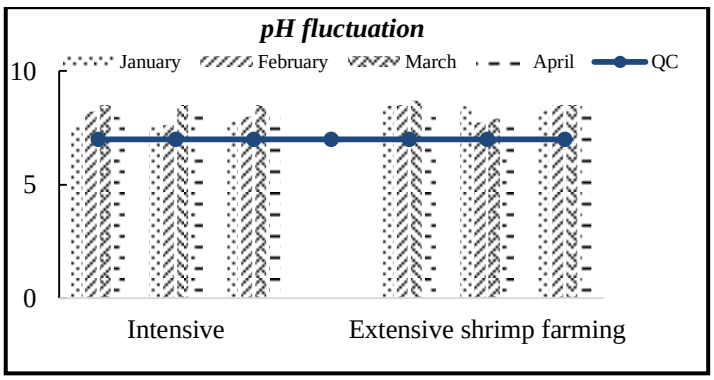

Fig 3. pH fluctuation

In general, the pH fluctuation of ponds in both extensive shrimp farming and intensive models were similar, both are with negligible variations. At two models, the pH ranged from 7.58 to 8.5. This is a suitable pH for the growth and development of shrimp. According to Chanratchakool et al. (1995), the pH

in the pond is very important because it will directly or indirectly affect shrimps. The suitable pH for shrimps is from 7.5 to 8.35 and the daily range does not exceed 0.5 pH units. According to Briggs et al. (1994), water sources with the pH from 7.5 to 8.5 are optimal conditions for the growth of nitrifying bacteria. For the National Technical Standards of shrimp Culture (National Technical Regulation 02-19/2014 Ministry of Agriculture and Rural Development), the appropriate pH for shrimp cultivating water is from 7 to 9. Therefore, the results of the study of pH in the culture ponds in the two models are suitable for shrimp culture.

3.1.4. Salinity fluctuations

Salinity is also an important indicator in shrimp aquaculture environment. Salinity directly affects the growth of shrimp. If the salinity is too high, shrimps will be susceptible to bacterial diseases and grow slowly. If the salinity is > 40 $^{o}/_{oo}$, shrimps will eat less, which affects shrimp gaining weight after 1.5 months and it will be difficult to shed the shrimp.

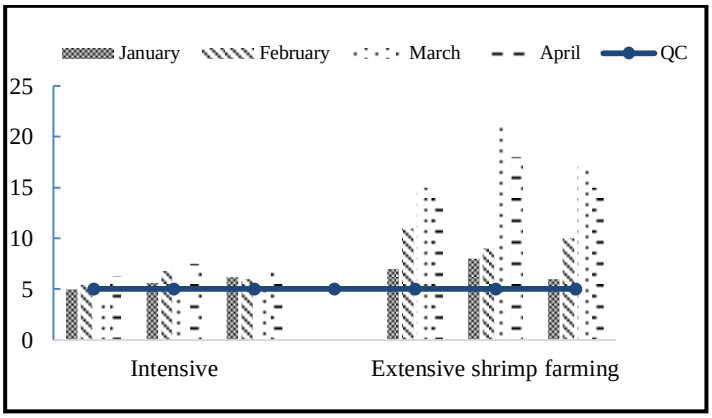

Fig 4. Salinity fluctuations

Analytical results show that salinity fluctuations in the range of 5$^{o}/_{oo}$ to 21$^{o}/_{oo}$ were in the values specified in Vietnamese standard 02-19/2014 Ministry of Agriculture and Rural Development. In the extensive shrimp farming model the salinity ranges from 6$^{o}/_{oo}$ to 21$^{o}/_{oo}$, which is suitable for shrimp to grow and develop rapidly. In March at extensive shrimp farming the salinity was twice as high as in January and February. It was due to the high water temperature and high alkalinity at this time. For the intensive model salinity fluctuations was in the range of 4$^{o}/_{oo}$ to 7.5$^{o}/_{oo}$, which is suitable for shrimp's development. However, in March, at the intensive, the salinity was 4$^{o}/_{oo}$, lower than the permitted standard. Consequently, vitamin and mineral supplements should be added to shrimp feed. In general, the salinity in the intensiveshrimp model is lower and more stable than those of the extensive shrimp farming model.

According to Wannina Yake et al. (2001) the optimal salinity for shrimp growth and development is from 15 to 25$^{o}/_{oo}$. Chanratchakool (2003) suggested that if cultivated shrimps have the salt concentration higher than 30$^{o}/_{oo}$, they often get diseases, especially white spot disease and yellow head. Shrimps can be raised in low salinity. In that case, the disease is less likely to occur but the salinity is not less than 7$^{o}/_{oo}$ because the lower salt concentration will cause shrimps to shrink and the the soft shell survival rate is low. However, when the shrimp weight is from 10g - 12g, they can be raised in low salt concentration but little influence on the growth. The results show that the salinity of shrimp culture models is relatively suitable for shrimp development.

3.1.5. Clarity of change

Clarity - turbidity is also one of the important factors need controlling in aquaculture ponds. In order to avoid its adverse effects on aquatic animal health, as well as the pond environment.

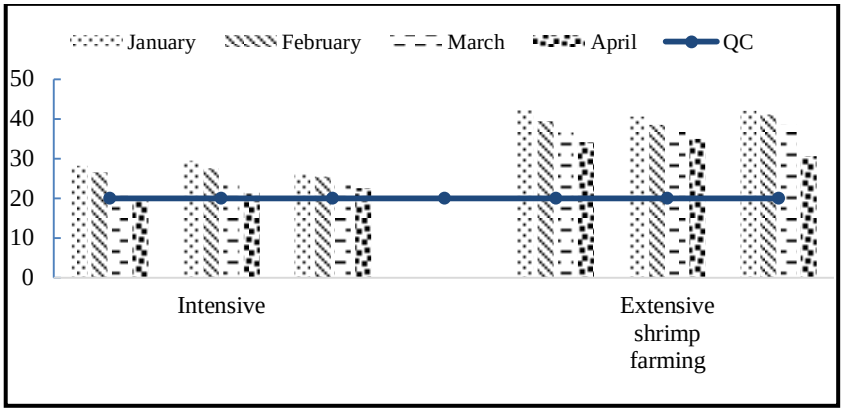

Fig 5. Clarity of change

The results of analysis in Figure 5 show that the degree in the range of 20 cm to 42 cm is within the allowable values of the National Technical Standards of shrimp Culture (National Technical Regulation 02-19/2014 Ministry of Agriculture and Rural Development) (20 cm to 50 cm). In general, the transparency value in the intensive shrimp culture model is lower than that of the extensive shrimp farming model. In the other words, the turbidity at the intensive model is higher than the extensive shrimp farming model. This is resulted from the culture density, the amount of food, the growth of algae of intensive model are higher than those of the extensive shrimp farming model.

3.1.6. NH_3 fluctuations

Ammonia (NH_3) in ponds is also an indicator that needs controlling. NH_3 is an important factor affecting the survival rate and growth of shrimp. NH_3 is the toxic gas for aquatic organisms but NH_4^+ is a non-toxic.

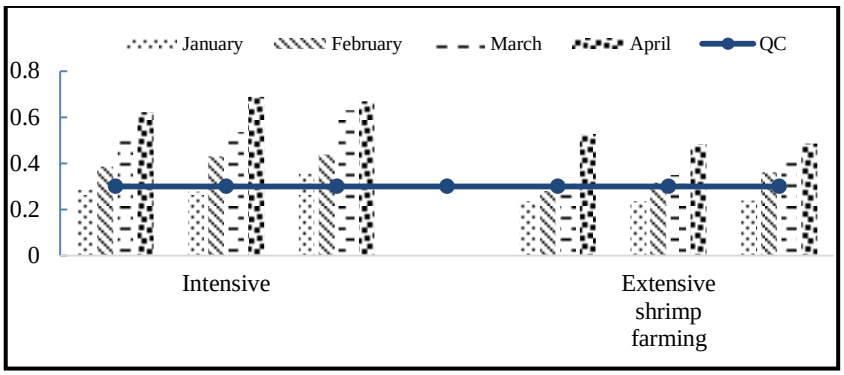

Fig 6. NH_3 fluctuations

The results showed that NH_3 contents ranged from 0.2 mg/l to 0.7 mg/l, increased from the beginning to the end of the crop.

In general, the NH_3 content in the intensive shrimp culture model is higher than that of the extensive shrimp farming model. Due to high density in the intensive model, farmers use a large amount of protein-rich diet which leads to the high nitrogen in the pond. Because of that, it was too much food in the pond for shrimp to eat. It is important to control the amount of feed in shrimp ponds to avoid NH_3 contamination which can affect shrimp health. According to Boyd (1998), Chanratchakool (2003), the appropriate TAN for shrimp culture ponds is from 0.2 mg/l to 2 mg/l and the NH_3 content is less than

0.1 mg/l. According to Chanratchakool et al. (1995), NH_3 is a gas that is easily released into the environment under the influence of a blower and the transformation into NH_4^+ form.

3.1.7. Alkalinity

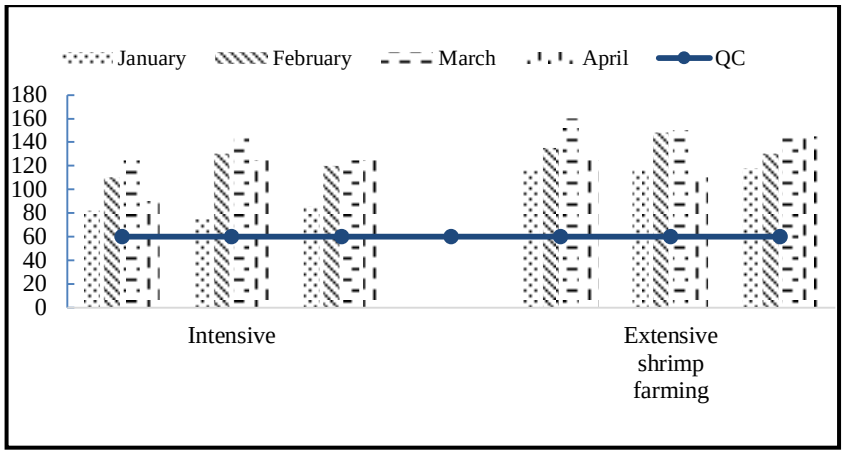

Fig 7. Alkalinity

Results of alkalinity analysis in two models ranged from 75 mg/l to 160 mg/l. This is the shrimp adaptation, growth and normal development.

In general, the alkalinity in the intensive shrimp culture model was lower and more stable than those of the extensive shrimp farming model. Low and stable alkalinity is due to the strict monitoring and adjustment of intensive model with densely density. In shrimp culture ponds, the alkalinity directly affects the pH fluctuation in the pond because it affects the shedding and hardening of shellfish. The suitable alkalinity for shrimps is from 120 mg/l to 180 mg/l $CaCO_3$ and for sugpo prawn is from 80 mg/l to 120 mg/l $CaCO_3$ (Nguyen Anh Tuan, 2003).

3.2. Quality of pond bottom

Bottom soil consist of original soil layer, sediment layer and liquid mud form excess food, organic matter and shrimp waste. The accumulated organic carbon accounted for 25% from shrimp feeds and, other related researched estimated 24% Nitrogen and 24 % phosphorus was accumulated (Avnimelech and Ritvo, 2003). The results of measuring total organic matter (TOM), total nitrogen (TN) and total phosphorus (TP) was showed in table 3.

Table 3. Quality of pond bottom

Model	Position	TOM (%)	TN (mg/l)	TP (mg/l)
Intensive	A1	5,49±0,21^a	6,75±0,025^a	3,81±0,2^a
	A2	4,85±0,2^a	7,1±0,02^a	4,17±0,25^a
	A3	5,26±0,25^a	6,24±0,02^a	3,75±0,2^a
Extensive shrimp farming	A4	4,48±0,31^a	3,98±0,01^b	2,51±0,19^a
	A5	4,05±0,3^a	3,4±0,01^b	3,02±0,15^a
	A6	4,12±0,3^a	3,02±0,01^b	2,47±0,15^a

Notes: Different characters on the same column have statistical difference (p>0,05)

The results indicates that total organic matter and total phosphorus between 2 models were not statistically significant (p> 0.05). For total nitrogen, significant differences were observed between the

two models between intensive and extensive shrimp farming models.

In the intensive shrimp pond, phosphorus was precipitated by combined with Ca^{2+} ions when liming periodically, and in saline water, brackish water with high water content also contributes to the accumulation of phosphorus in the bottom pond (Boyd, 1990). As a consequence, due to the high salinity, the phosphate content in the mud intensive is higher than that of the extensive shrimp farming model.

Protein content and organic matter in the intensive model was also higher. The reason were protein matter in bottom pond depended mainly on the amount of organic matter stored, the food waste, shrimp waste and the efficient of microbial activity. Despite using of bio-products periodically, the amount of food putting into the pond was high and using it was not efficient. Additionally, the ability of nitrogen degradation of bacteria was limited, so the protein accumulated at the bottom of the pond more and more over time.

Moreover, the pond improvement before each crop is one of the important factor to minimize organic accumulation in pond bottom. According to Boyd (1998) the decomposition of organic matter at the bottom pond was high when pH range from 7-8. Therefore, in acidic ponds unless using lime for improving pH, organic matter will accumulate more in pond bottom. In this study, the pond improvement was very well done, the pH was stable from 7.6 to 8 and the bacterial population in water and mud increased over culture time, then he decomposition process was rapid. In the study of Boyd (1998) indicated that the source of organic matter deposited at the bottom of ponds mainly was shrimp waste, food waste and dead phytoplankton. These matter occupied the bottom pond and reduced the living area of shrimp. Besides, the decomposition process consumed a lot of oxygen and produced toxic gases that damage shrimp. Therefore, the good management of water and food quality is an important task in industrial shrimp farming as well as in improved extensive shrimp farming.

4. CONCLUSION

The results show the water quality in the pond was suitable for growth and development of shrimp. Most of the water parameters in intensive and extensive shrimp farming models such as temperature, pH, salinity, transparency, dissolved oxygen, alkalinity are NH_3 were suitable for shrimp cultivation and within acceptable limits of the National Technical Standards of shrimp Culture (National Technical Regulation 02-19/2014 Ministry of Agriculture and Rural Development). However, the salinity in the intensive model was lower than standard but not harmful to shrimp.

Indicators on nutrient content of pond bottom (Total organic matter, total nitrogen and total phosphorus) were generally suitable for shrimp development.

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IMPROVING TREATMENT CAPACITY OF FISHY WASTEWATER USING A BIO-FLOCCULATION-ADSORPTION SEDIMENTATION PROCESS

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ABSTRACT

An experimental research for the Bio-Flocculation-Adsorption Sedimentation process which helps increase settling efficiency in period of mechanical treatment (secondary treatment) and creats beneficial and suitable conditions for period of follow-up biological treatment is the main content of this theme. The selected object of study is the wastewater of fishy process. The optimal parameters have studied for this following type of tank:Aeration time with air output 0.5m^3/hour/m^3(20 minutes), MLSS (4g/l), Settelment time (1,5 h).With the optimum surveyed conditions, depending on the front Bio-Flocculation-Adsorption Sedimentation tank, efficiency % removal of suspended solids at the settlement tank obtains 84.64%, suitable for biological treatment process.

Keywords: Bio-Flocculation; coagulation, Fishy wastewater; Sedimentation process…

1. INTRODUCTION

Water pollution abatement, combined with economical solutions for design and operation of Wastewater treatment plants, has been a crucial problem, especially in Viet Nam - a developing country.

Based on the traditional activated sludge process, a number of process technologies have been developed to cost-effectively reduce organic pollutants and nutrients with relatively low production of excess activated sludge, as well as address the deficiencies inherent in the conventional design and the imposed constraints (including minimizing waste sludge or tank age requirements). Some work has been done on the application of inorganic and organic flocculents in the advanced primary treatment of waste water. El-Gohary et al. (1991) introduced alum, ferric chloride and lime as a flocculent in wastewater treatment and obtained a turbidity removal of 83.5 to 98%, and a corresponding COD removal in the range of 77 to 86%.

Unfortunately, there are some drawbacks in the application of its in primary treatment. One obvious drawback is the disposal of sludge; most of the floccules used are refractory or non-biodegradable and secondary pollution occurs. The process also requires close monitoring and control of the dosage of the flocculent and flocculation time. Finally, the high cost associated with using floccules in large-scale wastewater treatment also makes it less attractive. These problems may possibly be overcome by using microbial flocs. as the flocculent. The objective of this study is to investigate the performance of advanced primary treatment of Fishy wastewater, using a bio-flocculation-adsorption. Sedimentation and stabilization process (*BSS*).

2. MATERIALS AND METHODS

2.1. Experimental Set-Up

The waste water used was raw fishy wastewater collected from a local sewage system (Binh Đong factory) with very low concentration of heavy metals and other industrial constituents listed in Tab. 1.

A schematic diagram of the apparatus is presented in Fig. 1. Three reactors were used in this BSS process: a bio-flocculation-adsorption tank (5 Liters), a sedimentation tank (5 L), a stabilization tank (5 L) and Sludge tank (15 L). In addition, a raw waste tank was used to contain waste water. All the tanks were made of transparent plastics. Two peristaltic pumps and one air pump were used in this system.

Table 1. Fishy wastewater used in this experiment

pH -	**Color** [*Pt –Co*]	**SS** [*mg /l*]	**COD** [mgO_2 /*l*]	**TKN** [*mg/l*]	**Total P** [*mg/l*]	**BOD_5** [*mgO /l*]	**Cu** [*mg/l*]	**Pb** [*mg/l*]	**Zn** [*mg/l*]	**Ni** [*mg/l*]	**Hg** [*mg/l*]
6.19- 6.48	692- 872	580- 628	2890- 3225	280-424	40-50.3	1800- 2080	0.204	< 0.05	0.322	<0.025	<0.005

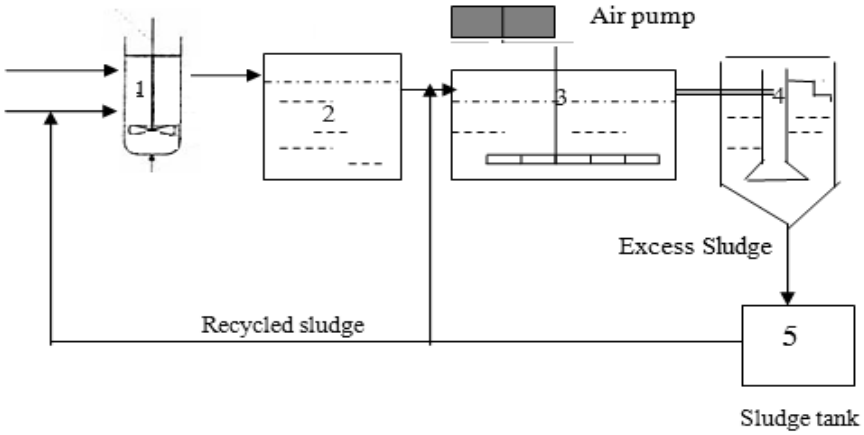

Fig 1. Schematic diagram of the experimental set-up: 1. Bio-flocculation-adsorption tank; 2. Primary Tank; 3. Aeroten tank; 4. Sedimentation tank; 5. Sludge tank

The influent was introduced into the bio-flocculation-adsorption tank using the peristaltic pump. An aerator was employed to maintain an aerobic environment for the activated sludge, together with a stirrer to ensure mixing of the influent and the activated sludge. After a hydraulic retention time of about 30 minutes, the mixed liquor was discharged into the sedimentation tank with a settling time of 1 or 1.5 hours.

The supernatant in the sedimentation tank was the final effluent of the system. Depending on the different return sludge ratio applied, a part of the sludge in the bottom of this tank was then fed to the stabilization tank, using a recycle pump. In the stabilization tank, activated sludge was aerated (with a DO of between 2 and 4 mg), and then recycled to the bio-flocculation-adsorption tank.

2.2. Chemical Analysis

The optimum operating parameters were determined by initially conducting batch and continuous experiments. Under these optimized conditions, the capability of the system in removing the pollutants, as well as the mechanisms of the process were investigated. The analysis of COD, SS, VSS, turbidity, NH; -N and phosphate were performed in accordance with the Standard Methods for the Examination of

Water and Wastewater (Clescerl et al. , 1998).

3. RESULTS AND DISCUSSION

3.1. Determining the Optimum Operating conditions at Flocculation tank

In order to determine the optimum MLSS in the bio-flocculation-adsorption tank, Raw wastewater (MLSS 3.2-3.8 g/l) and the activated sludge at various concentrations (2-8 g/l) were mixed in 5 liters plastics cylinder using a velocity gradient of 45 revs./min. for 30 min. After one-hour settling time, the supernatant was analyzed for COD, BOD and turbidity removal with the results shown in Fig. 2.

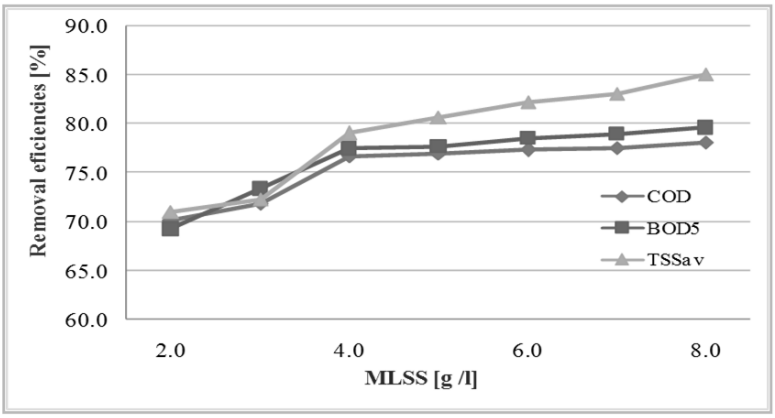

Fig 2. Effect of MLSS on COD, BOD_5 and TSS removal efficiencies

Considering the removal efficiency, an MLSS of 4 g/l was selected. In this study, different velocity gradients at 15, 25, 45, 60 and 80 revs. /min. were investigated.

Other operational conditions were fixed as follows: MISS of 4 mg/l, sedimentation time of 1 hour, flocculation time (HRT in the bio-flocculation-adsorption tank) of 0.5 hour. The results in Fig. 3 showed that the mixing intensity affected the removals of both COD and SS. Taking removal efficiency into account, a velocity gradient of 25 revs. /min. was hence selected as the optimum value.

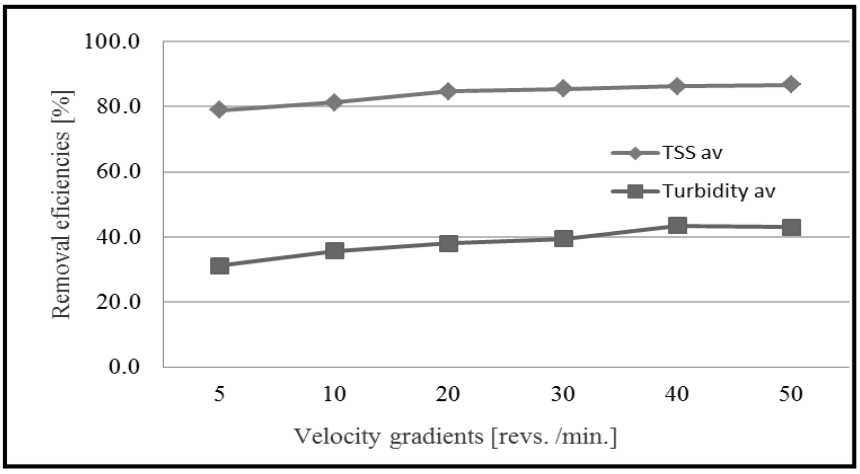

Fig 3. Effect of mixing intensity on the removal efficiencies of TSS and turbidity

Generally speaking, the sewage would stay in the contact phase for less than 30 min (Franklin, 1991; Gambrill et al. , 1992). In the bio-flocculation-adsorption tank, the mechanism for the removal of pollutants was similar to that within the contact tank, i.e. mainly by means of flocculation, coagulation and adsorption, instead of bio-oxidation. The results of the batch experiment were shown in Fig. 4, where

it can be seen that there was a rapid increase in COD removal efficiency up to 30 min, beyond which there was a gradual increase with time. An optimum flocculation time of 30 min was adopted. In summary, the system could be operated at an optimum condition with the concentration of activated sludge in the adsorption-bio-flocculation tank at 4 g/l, flocculation time at 30 min, velocity gradient of the mixer in the flocculation tank at 25 revs. /min.

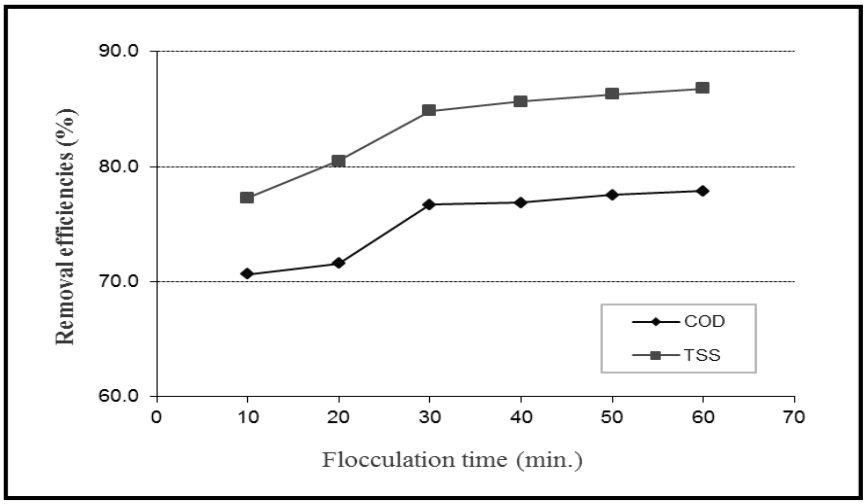

Fig 4. Effect of flocculation time on COD and TSS removal efficiencies

3.2. Determining the Removal efficiency in the process

The systems is linked total with aeration tank, the activated sludge stabilized for 1.5 h and the DO maintained at 2-4 mg/l. The results of this system are shown in ***Tab. 2*** and ***Fig. 5***.

With HRT is 8 hours, the removal efficiency of BOD5, COD reached over 90 %, Although SS at the beginning was low (Urbain et al. , 1993; Wahlberg et al. , 1994). The outlet can reach the Standard A in QCVN 15: 2015.

Table 2. Effect of aeration time on BOD_5, COD and TSS removal efficiencies

Time	pH	COD	BOD_5	MLSS
hour	-	(mg/l)		
0	6.82	579	385	3600
2	6.3	480	316	-
4	6.15	210	174	3670
6	5.8	130	90	-
8	**5.84**	**48**	**24**	**3755**
10	5.7	56	22	-
12	5.8	49	28	3700

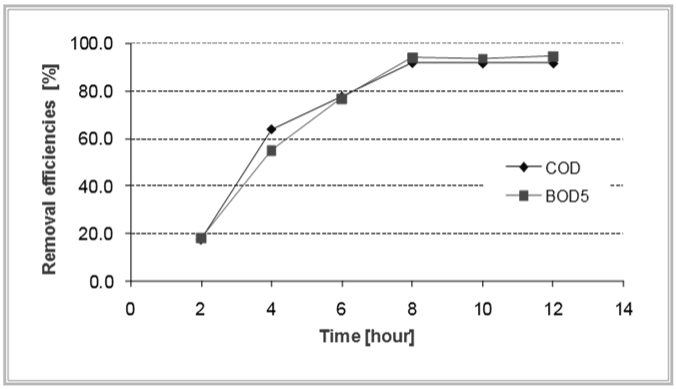

Fig 5. Effect of wastewater treatment on the system

3.3. Comparision with other Wastewater treatment Process

We have applied physicochemical (using Al2(SO4)3 detemined suitable conditions pH 6,5 dosing alum 1000 mg/l) combined with aerotank treatment and natural sedimentation combined with aerotank but the result is lower than the bio-flocculation-adsorption sedimentation and stabilization process (Zhao et al. , 2000).

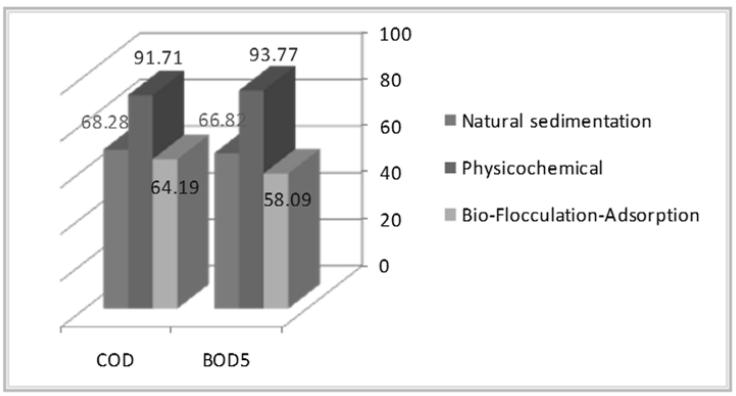

Fig 6. Effect of wastewater treatment on the system

4. CONCLUSIONS

The BSS process is an advanced primary treatment process. Unlike other advanced primary treatment processes, no additional chemicals are needed as the sludge itself can be used as a flocculent to enhance the treatment results. The additional cost of chemicals is therefore eliminated, and at the same time, secondary pollution is avoided.

Optimum parameters were found to be: MLSS (4 g/l), flocculation time (30 min), sedimentation time (1.5 h) and velocity gradient (25 revs. /min.). Under these conditions combined with aerotank treatment an approx. over 90% removal of COD, BOD_5 and SS was attained.

Because bio-flocculation and adsorption (and not bio-oxidation) are largely responsible for the removal of pollutant, the BSS process would be more effective when the raw waste water contains more suspended matter and colloidal materials.

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DEGRADATION OF WASTEWATER FROM AGRICULTURAL PROCESSING USING HETEROGENOUS FENTON LIKE – REACTION

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ABSTRACT

In this study, allergic fenton was applied to organic matter processing of agricultural production and processing. Solid Fe catalysts were carried on activated carbon (AC) carriers It prepared by wet impregnation. Images, structural materials were analyzed by X-ray diffraction. The XRD results showed that haematite were one main compositions of the synthesized catalyst. The test was examined by oxidation of blue methylen (50 ppm) with oxidation factor of 30% H_2O_2. Iron catalyst dispersed on activated carbon (AC) was prepared by wet impregnating $FeSO_4.7H_2O$ solution on AC. The mixed is stirred at 400 rpm at 90 degrees Celsius until completely dry and dried at 80°C for 2 hours. The mixture is heated at 500 degrees Celsius for 4 hours with nitrogen gas. In addition, the optimum conditions of the Fenton reaction such as initial pH, initial MO concentration hydrogen peroxide concentration and the amount of catalyst were also investigated. The investigation of optimum conditions suggested that initial pH at 3 provided the highest efficiency of MB removal. The optimum condition of amount of catalyst was 0.4 g/l. The efficiencies of MB removal reached > 95% at 60 min of reaction time at initial MB 58,4 mg/l with iron/AC catalyst. Additionally, after reuse the synthesized catalyst 3 times the MB removal efficiency still remained over 80%. In conclusion, the iron/AC and catalyst was successfully synthesized and applied to wastewater from agricultural processing treatment using heterogeneous Fenton reaction. The catalyst showed high efficiency of MB removal and could be reused many times.

Keywords: Fenton reaction; iron oxide; activated carbon; methylene blue, heterogenous fenton.

2. INTRODUCTION

At present, wastewater from agricultural processing is one of the most important issues in underdeveloped countries due to increasing contamination in water and the shortage of proper wastewater treatment technologies. There are several technologies that are widely used for wastewater treatment such as adsorption, filtration, chemical process and membrane technologies. Above-mentioned techniques are considered as effective technologies to remove toxic pollutants. However, these processes simply transfer pollutants to other phases that can not completely eliminate. Also, some chemical processes can generate secondary products or intermediate phases that are highly toxic than the primary pollutants. In order to over come the mentioned problems, advanced oxidation processes (AOPs) have been introduced. Briefly, mechanism of AOPs is the generation of hydroxyl radical OH• that is a highly reactive and nonselective oxidant. Thus, it can mineralize a variety of organic contaminants. Among the present AOPs**,** heterogeneous Fenton reaction is one of the most promising techniques because of its low cost and non-toxic. There were plenty of advantages in Fenton system, such as high efficiency, strong oxidation ability, simple operation, easy reaction, low-cost, environmental friendliness and so on, and had good prospects for degrading refractory organic pollutants in wastewater and reused several times. In this study, watsewater from agricultural processing was treated by heterogenous Fenton like – reaction. In thismethylene blue was choosen like a model compounds.

3. MATERIALS AND METHODS

Materials and reagents. $FeSO_4.7H_2O$, activated carbon (AC), 30% H_2O_2, methylene blue and other chemicals were of analytical grade and used without further purification. The pH of the experiment was adjusted by a diluted aqueous solution of NaOH or HNO_3.

Preparation of catalysts.

In this study, we prepared Fe/AC catalysts with 4 different levels of iron content of 5 10 15 and 20% wt Fe/AC. During the survey we found that at 20% wt Fe / AC catalyst was best treated.

Preparation 20%wt Fe/AC catalyst: The catalysts were prepared by impregnation method. The activated carbon was pretreated. The activated carbon of 40 g was in a small beaker, then to add 40 mL mixed solution of 49,6429g $FeSO_4.7H_2O$. The mixture was strirred for 6h at 90^o C and atmospheric pressure. After a complete evaporation of water under reduced pressure. The impregnated samples were dried at 80 ^{o} C for 2h. Finally the dried samples were calcined at 500^{o}C for 4h at the heating rate of 5 ^{o} C/min under flow to obtain the final from of supported catalysts nitrogen gas.

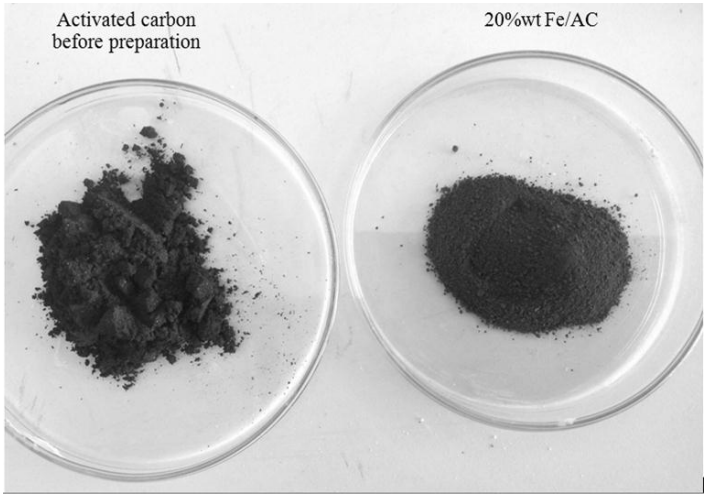

Fig 1. Catalyst before and after preparation

Procedures and analysis.

Take a certain concentration methylene blue of 500 mL with 50 ppm concentration at pH 3, 30% H_2O_2 2ml solution and 0,2 g 20%wt Fe/AC catalysts into the conical flask. The pH of the solution was adjusted by a diluted aqueous

solution HNO_3. Then the flask was capped and placed in a thermostated shaker at 400 rpm. Samples were with drawn to analyzed the residual concentration of MB at timed intervals. The concentration of MB was analyzed with by the single beam visible spectrophotometer (UV-1800) spectrophotometer at 664 nm. The pH value was monitored by a pHs-3C pH meter. Images, structural materials were analyzed by X-ray diffraction.

3. RESULTS AND DISCUSSION

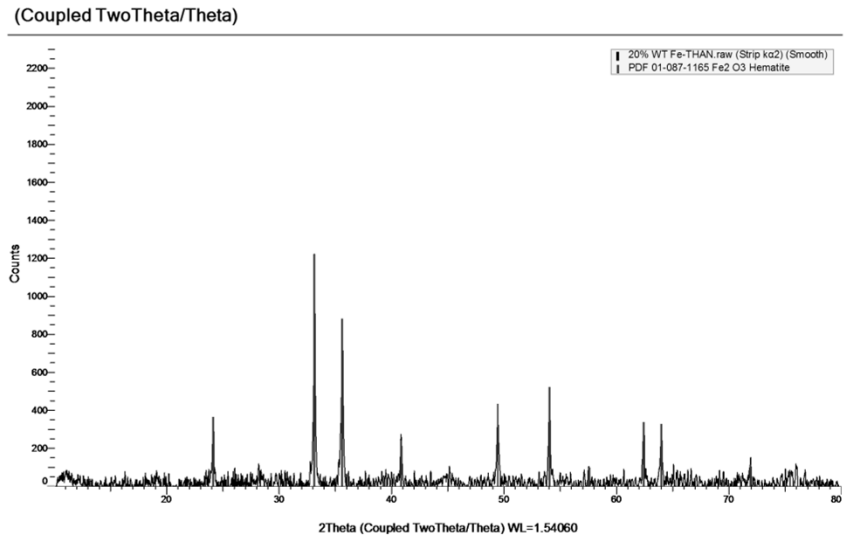

Fig 2. XRD pattern of the synthesized 20%wt Fe/AC catalyst

Figure 2 shows the XRD pattern of the synthesized 20%wt Fe/AC catalyst. The XRD result presents that the catalyst consisted of one phase of iron oxide: haematite (Fe_2O_3). The former is major phase and the latteris minor phase. The possible explanation of the presence of one phases of iron oxide is that the oxygen diffusion into particles isn't limited at the surface of particles. Although, the catalyst was synthesized under ambient condition, magnetite can occur because of the low rate of oxygen diffusion. It has to be noted that the catalyst particles were annealed in a crucible in a relatively long period (4 h of annealing time), oxygen could diffuse deep into the particles at the bottom of the crucible. This means the particles on the top and down of the crucible were exposed to enough oxygen to form haematite. The same in the colour of the particles can also prove this explanation. The particles all have reddish brown colour as haematite.

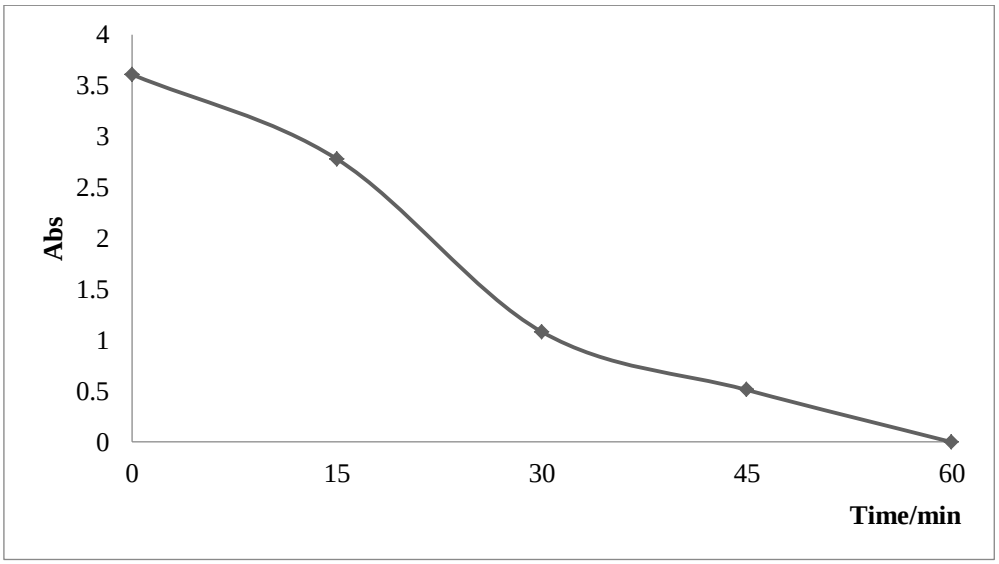

Fig 3. Color absorption of methylene blue is decomposed by time
Conditions: Methylene Blue 50 ppm 500 mL, H_2O_2 2mL; pH=3, 20%wt Fe/AC 0.4g/L, 30 ^oC

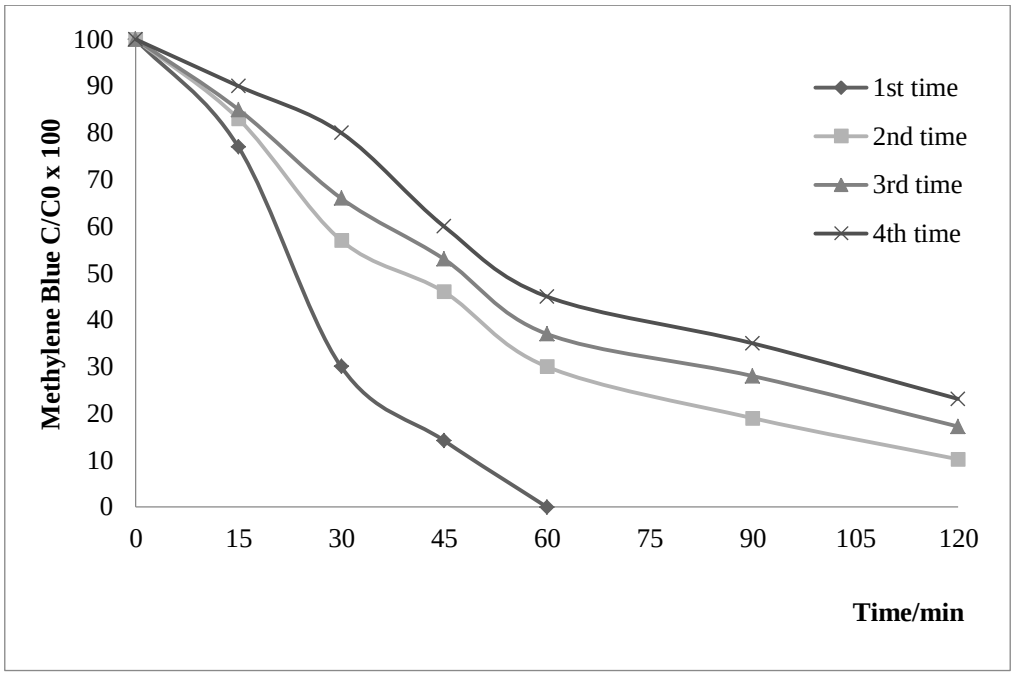

Fig 4. Effect of repeated use of catalytic on degradation of Methylene Blue.
Conditions: Methylene Blue 50 ppm 500 mL, H_2O_2 2mL; pH=3, 20%wt Fe/AC 0.4g/L, 30 ^oC

The effect of Fe/AC catalyst on the degradation of Methylene Blue was studied. The results are as shown in Fig.3. It can be found that the removal rate of Methylene Blue increased with time. The removal rate of Methylene Blue increased to 100% in 1 hours. The repeated use of catalyst was as shown in Fig.4. The results showed that the removal rate of Methylene Blue decreased with the increase of repeated use of thecatalyst. For the first time, Methylene Blue could be completely degraded in 1h. The degradation rate of Methylene Blue dropped to 76.1% after catalyst re-used 4 times. The reason for that maybe was that Fe^{3+} dropped off from the catalyst in the process. In this study we conducted experiments in the laboratory model. We have investigated the factors that affect the ability of the catalyst to break down at acidic decomposition conditions of > 95% better than neutral and bases. In addition, we find that the percentage of iron carries on AC also affect the decomposition of the catalyst. The results show that at 5 10 15 and 20% iron on AC, 20% wt Fe/AC the best decomposes and the stirring temperature of 50 to 80 degrees Celsius increases the decomposition time of MB.

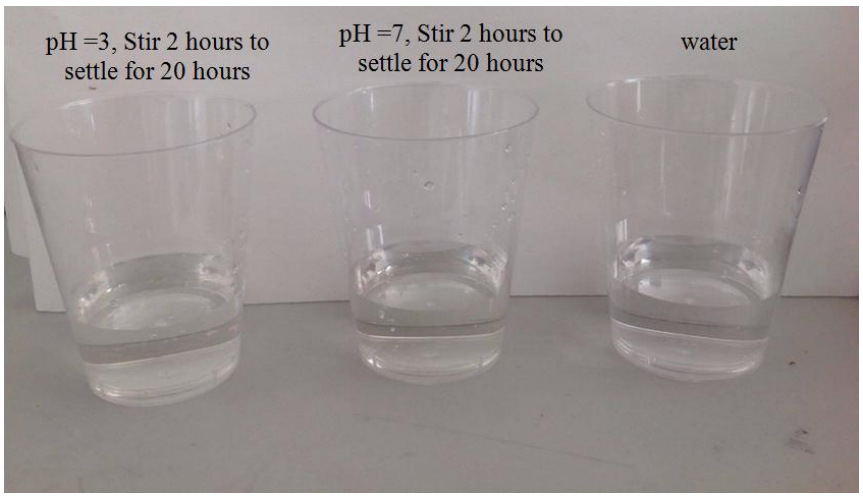

Fig 5. Color reduction of the solution after 20 hours of treatment in the original condition: Methylene Blue 50 ppm 500 mL, H_2O_2 2mL, pH=3 & 7, 20%wt Fe/AC 0.4g/L, 30^oC

Fig 5. shows the solution completely discolored for more than 20 hours at pH of 3 and 7. At pH 3 and 7 the MB treatment was good for 20 hours but at pH 3 the treatment time was faster than pH 7. This shows that the catalyst decomposes 100% MB into CO_2 and H_2O without turning into other substances, highly efficient catalysts do not create toxic substances so they are friendly to the environment.

4. CONCLUSIONS

The prepared catalysts have shown to be able to completely decolorize and partially oxidize the Methylene Blue

present in the model wastewater within 1 hours in the studied operating conditions.In this work, iron oxides dispersed on AC and catalyst was successfully synthesized by impregnating $FeSO_4.7H_2O$ solution on AC and then annealing the mixture at 500^oC for 4 h. The structural characteristics of the synthesized catalyst was examined using XRD. The catalyst's activity and lifetime were tested using 500 mL of MB 50 ppm solution. The XRD results showed that there were one iron oxides phases in the catalyst. This is haematite due to the limited oxygen diffusion in the catalyst during annealing process.The results of MB removal test suggested that the highest efficiency was achieved at initial pH of 3. Meanwhile, the optimum dosage of hydrogen peroxide and Fe/AC were found to be 2mL/L and 0.4 g/L, respectively . Furthermore, the catalyst reuse test proved that the synthesized catalyst could be reused for many times with a simple regenerationmethod that is to wash with water and then dry at 80◦C. In conclusion, the Fe/AC catalyst was found to be a promising material for wastewater treatment.

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PREPARATION AND MODIFICATION OF GAMMA-ALUMINA (γ-Al_2O_3) SPHERICAL FORM APPLY FOR ENVIROMENTAL TREATMENT

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ABTRACT

In this study, process of preparing spherical and γ-Al_2O_3-activated materials and heavy metal adsorption, environmental treatment. Using the $Al(OH)_3$ precursors and NaOH solution to form $NaAlO_2$ compound with surface active agent Sodium Lauryl Sulfate (SLS). Proceeding by Sol-gel to form a homogeneous mixture at pH = 7 for the synthesis ofγ-Al_2O_3, then use the spherical technique to create the product. Samples analyzed by X-ray diffraction (XRD) method showed the structure of the catalyst, chemical composition and purity of the product. In addition, research on denaturation on some metals (Pd, Cu, As, Co, ...) for application as adsorption and catalyst for environmental treatment.

Keywords:Gama alumina, sol-gel method, XRD, spheres,...

1. INTRODUCTION

Aluminum and aluminum compounds have been discovered for a long time and are used in many different fields to serve human life. Alumina minerals contain about of 15% the earth's crust. Therefore, it's an abundant material and inexhaustible for applied in the industry. Alumina oxide, which commonly referred to as alumina is the product of alumina minerals process by Bayer method, it can exist in several crystalline phases such as alpha, beta, delta, gamma that these phases depends on synthetic temperature. Alpha alumina is the strongest of the oxide ceramic, its high hardness, excellent dielectric properties, good thermal properties, which is the material of choice for a wide range of application. However, this crystalline phase rarely use to in the catalytic field because of low surface area and chemical activity.

Among them, aluminum oxide gamma with many advantages such as large surface, high activity, durable and heat resistant, has been applied in many important industries such as environmental technology, food technology , as carrier, adsorbent, and used as a catalyst or a support for catalyst as remove the highly polar compounds; remove the acids formed from the degradation of trans-former oils, lubricating oils, and refrigerant in process stream purification; treatment arsenic contaminated groundwater… However, this structure is difficult in fabricated alumina shapes such as ball, monolith, cylinder, rod,… The alpha and beta alpha forms should be prepared in conjunction with alumina for easy shaping.

Today there are many methods for preparing aluminum oxide gamma but the sol-gel method has many advantages. When using this method to produce alumina, the following points are possible: control of most of the modification processes, the product of purity, high homogeneity, uniform distribution of porosity... Therefore, in this study, we synthesized gamma alumina by sol-gel method as a catalyst in environmental treatment.

2. EXPERIMENTAL

2.1. Materials and methods

In this study we used the Al(OH)3 precursor of Tan Binh Chemical Factory, Sodium hydroxide (NaOH), surface active Sodium Lauryl Sulfate (SLS). The pH of the experiment was adjusted by a diluted aqueous solution of HNO_3.

2.2. Preparation of γ-Al_2O_3

Balance 40g of Al $(OH)_3$ dissolved in 100mL of water containing 45g of NaOH, heating until the mixture dissolves completely. Create a solution of $NaAlO_2$.

Continue to weigh 23g of surface active Sodium Lauryl Sulfate (SLS) into 500mL water, stirring the mixture to completely (about 2h).

Proceed:

Mix the $NaAlO_2$ solution still hot to the glass containing SLS solution, stir in homogeneous mixture, add concentrated HNO3 solution to neutralize to pH = 7 and continue stirring for 2 hours. will generate heat at about 70^oC). Then put the mixture into a crystallizer to overnight at 80^oC for 12 hours. Filter, rinse with distilled water. Continue drying in 2h and then bring the oven in the condition of passing air at 500^oC for 5h.

2.3. Spherical process

After successfully preparing the γ-Al_2O_3 powder, take a quantity of x (g) of γ-Al_2O_3 powder together with y (g) amount of adhesive polymer to proceed to the shaping process.

Then completely dried at 120^oC for 3 hours, then heated in the air at 500^oC for 5 hours.

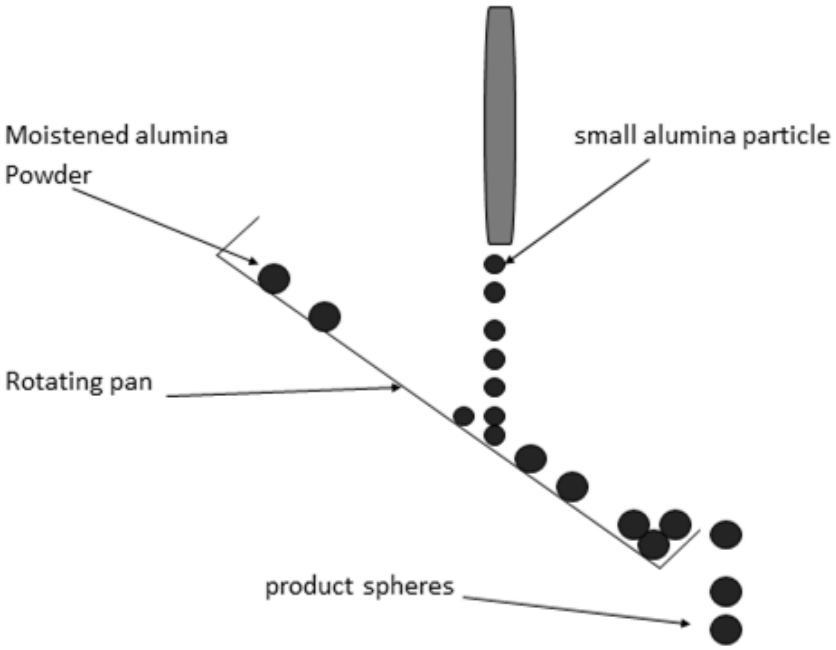

Fig 1. Spherical process

2.4. Catalysts characterization

The catalyst structure were analyzed by X-ray diffraction (XRD) on a Siemens D5000 using Cu Kα radiation operated (1.5406 A°) at 40kV and 40mA. The data were collected at 0.2°/min in the (2θ) range of 0-70°.The X-ray diffraction pattern will provide information such as the structure of the catalyst, the chemical composition, the purity of the sample.

2.5. Metabolism of γ-Al_2O_3 on metals

With high activity and absorptionof heavy metals, gamma aluminum is chosen as a carrier for metals such as Pd, Pt, Cu, etc. The alumina spheres loading to metals (0.5 or 1%wt) were prepared by impregnation method and alumina spheres is stirred in rotary evaporator at 50°C in 3h under atmospheric pressure and it was dried at 120°C in 12h then calcined at 500°C in 4 h in air with air flow 3°C/min to form the catalysts.

3. RESULTS AND DISCUSSION

3.1. Characterization of catalysis

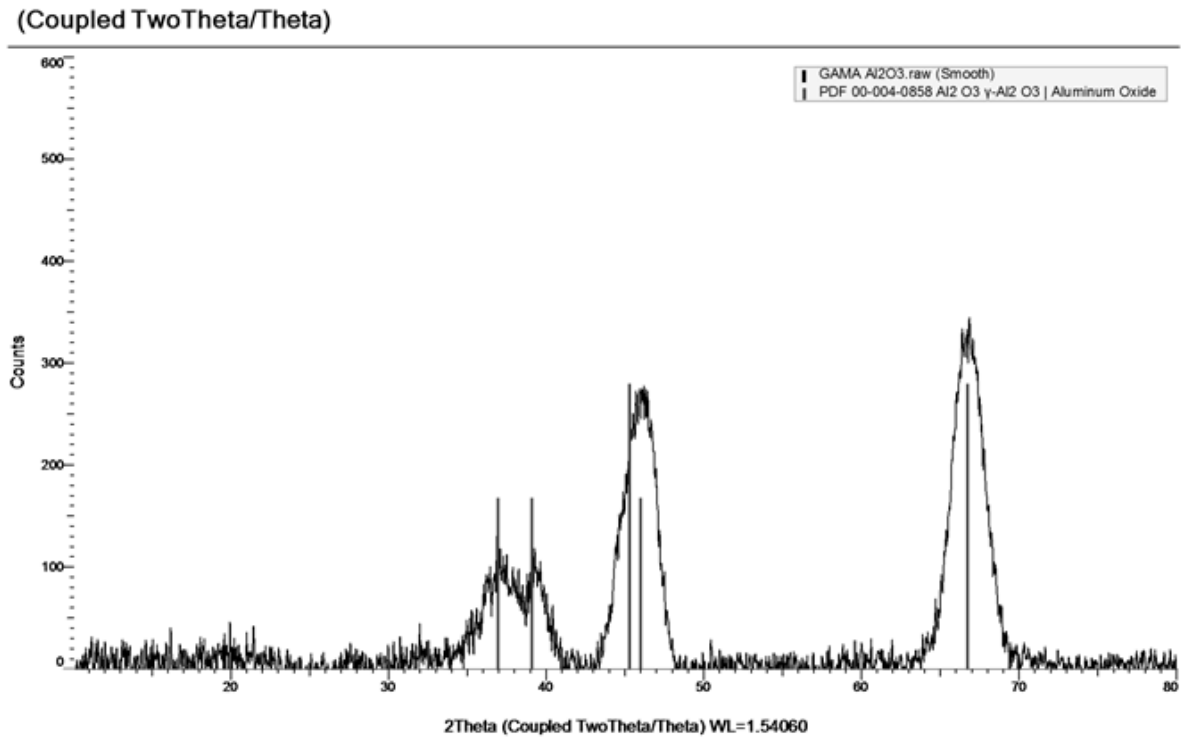

Fig 2. X-ray diffraction pattern of aluminum sample

The results of the X-ray diffraction measurements shown in Figure 2 show that the images of gamma-alumina occur at high intensity and no additional peaks appear. This proves that the product produced in this study is of high purity.

3.2. Characterization and denaturation

Table 1. The results obtained after modulation of the spherical alumina sample showed the following parameters

	γ-Al_2O_3(spheres)
Diameter (mm)	2.5
Crush Strength (N)	min.65
Packed Bulk Density (g/l)	500 - 600
Surface Area (m^2/g)	200 - 220
Pore Volume (ml/g)	min.0.75

Fig 3. Image of catalyst after modulation

From the modulation process, the configuration and size of the relatively uniform aluminum spheres, with a diameter of 1.8 mm (Fig 3).

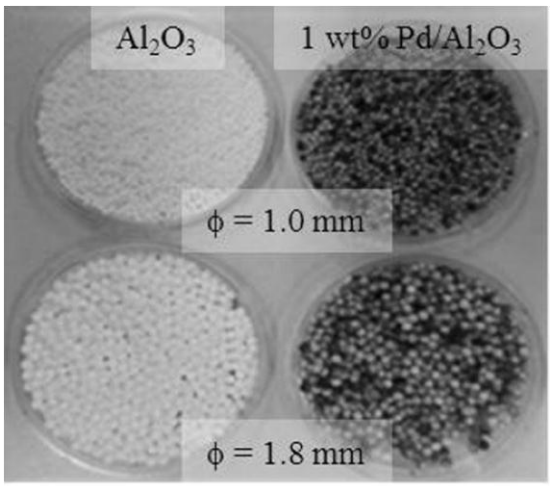

Fig 4. Alumina spheres loading to palladium

Figure 4 shows the results indicated that palladium impregnated on Al_2O_3 (1.0mm) is high activity than Al_2O_3 (1.8mm) in all reaction cases and the low concentration is easier oxidation than high concentration.

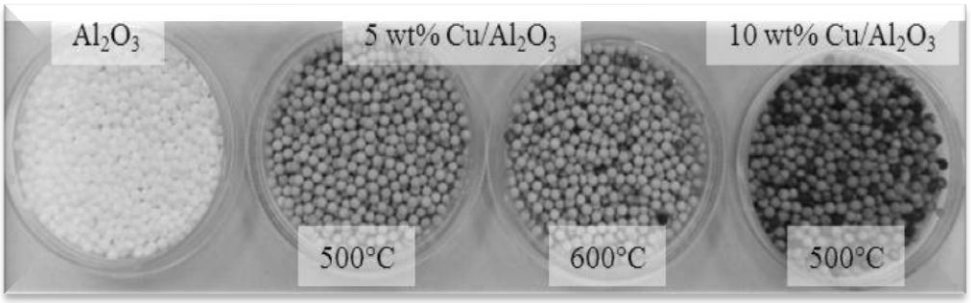

Fig 5. Alumina spheres loading to Copper

Figure 5 shows that when impregnated with copper at the same mass, at different temperatures the sample will have different colors. The higher the copper content, the higher the efficiency.

4. CONCLUSION

Results show that from the aluminum powder in the form of fine powder we have created the spheres and successfully processed on metal to apply for environmental treatment, bringing high efficiency and practical. It also shows the influence of factors such as the content of the metal, the size of the carrier (γ-Al2O3), the temperature of the furnace, etc., resulting in different results.

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SOLUBLE OF FERROUS PHOSPHATE AND ALUMINUM PHOSPHATE BY BACTERIA ISOLATED FROM FLOATING RICE

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ABSTRACT

A experiment of a selection strategy for phosphate-solubilizing bacteria based on phosphate solubilization ability was conducted. Of all the bacteria tested, they showed varying levels of phosphate solubilizing activity in both agar plate and broth assays using National Botanical Research Institute's phosphate medium that $Ca_3(PO_4)_2$ replaced by $FePO_4$ and $AlPO_4$. They grew rapidly in the liquid medium at pH 5. However, all the strains were able to mobilize significant amounts of phosphorus (P) depending on the phosphate type. They have ferrous phosphate solubilization ability in broth assays higher aluminum phosphate solubilization ability. The bacterial isolates were identified based on their phenotypic and 16S rRNA genes sequencing data B1 strain as *Enterobacter cloacae* and B2 strain as *Burkholderia cepacia.* Using these strain as possible inoculation for soils that have ferrous phosphate at greenhouse experiments and field trials.

Keywords: Phosphate solubilization, aluminium phosphate, ferric phosphate,

1. INTRODUCTION

Phosphorus is one of the major essential macronutrient for biological growth and development (Fernandez *et al.*, 2007). Phosphorus is typically in soluble or poorly soluble in soil. Although the average P content of soils is about 0,05%, only 0,1% of total phosphorus exists in plant accessible form (Illmer and Schimmer, 1995). As a result large amounts of soluble form of P fertilizers are applied to attain maximum crop production. However, the applied soluble forms such as tricalcium phosphate ($Ca_3(PO_4)_2$), $FePO_4$, $AlPO_4$ (Achal *et al.*, 2007). It has been found that approximately 75-90% of applied P fertilizer is precipitated by Ca, Fe and Al metal cations and these insoluble forms are not efficiently taken up by the plants. This again leads to an excess application of phosphate fertilizer to crop fields (Khan *et al.*, 2007). Some soil microorganisms are able to solubilize these insoluble phosphate forms through the process of organic acid production, chelation and ion exchange reactions and make them available to plants (Vessey, 2003). Improving the effciency of P uptake by plants through microbial associations would therefore be economically and environmentally beneficial. The existence of soil microorganisms capable of transforming unavailable P to available forms for plants is well documented (Rodriguez and Fraga, 1999).

2. MATERIALS AND METHODS

The characterisation of strains for their rock phosphate solubilising ability was assessed on plates filled with the National Botanical Research Institute's Phosphate growth medium (NBRIP) with some modifications and containing per litre of distilled water: 20g glucose, 5 g $MgCl_2 \cdot 6H_2O$, 0.25 g $MgSO_4 \cdot 7H_2O$, 0.2 g KCl, 0.1 g $(NH_4)_2SO_4$ and 5 g $FePO_4$ or Al PO_4, plus 0.5% bromocresol green, pH 7.0. A stock solution of 0.5% dye was prepared by dissolving a corresponding weight of bromocresol green into 70% ethanol and the final pH adjusted to 6.5 with 1M KOH. Five microliters of each bacterial suspension obtained as described above were transferred onto a single point of compartmented Petri dish. The plates were sealed and incubated at 28°C for 15 days and the phosphate solubilisation recorded through the halo/yellow zone surrounding the bacterial colony. The index of solubilisation (IS) was used as an indicator for the isolate efficiency:

IS = (Colony diameter + diameter of halo zone) / Colony diameter.

Mineral phosphate solubilization assays

The phosphate solubilizing (PS) activity of each of the isolates was determined by molybdenumblue method (Murphy and Riley, 1962). The isolates were grown in NBRIP liquid medium containing different insoluble forms of phosphate ($AlPO_4$ or $FePO_4$) for 20 days at 30°C on a IKA Incubator shaker at medium speed (150 cycles $min.^{-1}$). The solubilization efficiencies were determined by reaction with ammonium molybdate for phosphorus compounds as ammonium phosphomolybdate and reduced with a compound ascorbic acid to molybdenum blue. Then, the isolates were incubated for 30 min at room temperature for color development. And finally, the absorption of light in the wavelength range 880 nm was measured by Shimazu.

PCR amplification of 16S rRNA and sequencing

The gene-encoding 16S rRNA was amplified from selected strains by the polymerase chain reaction (PCR) using bacterial universal primers P515FPL và P13B (Zinnielet al.,2002) P515FPL: 5'-GTGCCAGCAGCCGCGGTA A -3';

P13B: 5'- AGGCCCGGG AACGTATTCAC -3'.

The PCR products were purified from agarose and sequenced. The nucleotide sequences were compared using the BlastN program and the closest match of known phylogenetic affiliation was used to assign the isolated strains to specific taxonomic groups.

3. RESULTS AND DISCUSSION

3.1. Activity of isolates on agar plates

The data in Table 1 indicate the values of colony diameter (n), that of the halo zone (z) and the z/n ratio of the different strains obtained on agar plates containing different phosphate types. The ratio z/n helps to evaluate the activity of strains; the higher the value of the ratio, the greater the activity of the tested strain. The activity was associated with a pH decrease of the medium, observable through the yellow zone surrounding bacterial colonies. All the two bacterial trains were able to show halo zone on agar plates containing Fe-P and Al-P (Fig. 1).

Table 1. The index of solubilisation by two bacterial strains

Strain	Nutrient agar with $FePO_4$			Nutrient agar with $AlPO_4$		
	Diameter of colony n(mm)	Diameter of halo zone z(mm)	The index of solubilisation (SI) z/n	Diameter of colony n(mm)	Diameter of halo zone z(mm)	The index of solubilisation (IS) z/n
B1	0.58	1.56	2.69	0.5	1.27	2.54
B2	0.54	1.49	2.75	0.48	1.21	2.52

3.2. Solubilization of ferric phosphate ($FePO_4$) and aluminum phosphate ($AlPO_4$)

All the two bacterial trains were able to produce soluble phosphate from ferric and aluminum phosphates (Fig.1). In case of insoluble form of phosphate source, B1 bacteria solubilized maximum amount of phosphorus from $FePO_4$ (28.63 mg P_2O_5) on 10^{th} day and $AlPO_4$ (26.71 mg P_2O_5) on 20^{th} day;

B2 bacteria solubilized maximum amount of phosphorus from $FePO_4$ (44.19 mg P_2O_5) and $AlPO_4$ (16.78 mg P_2O_5) on 20th day. In general, the amount of phosphate solubilized decreased in the order $FePO_4$ > $AlPO_4$. Two bacterial trains solubilizes the insoluble phosphate sources, such as $FePO_4$, and $AlPO_4$ which were slow initially, gradually increased in the middle period of incubation.

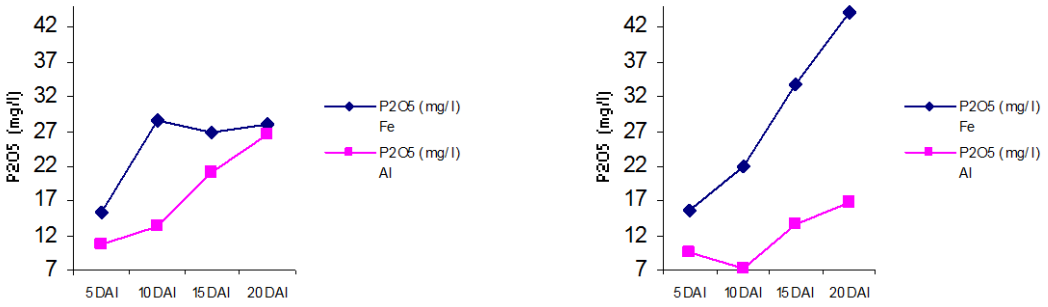
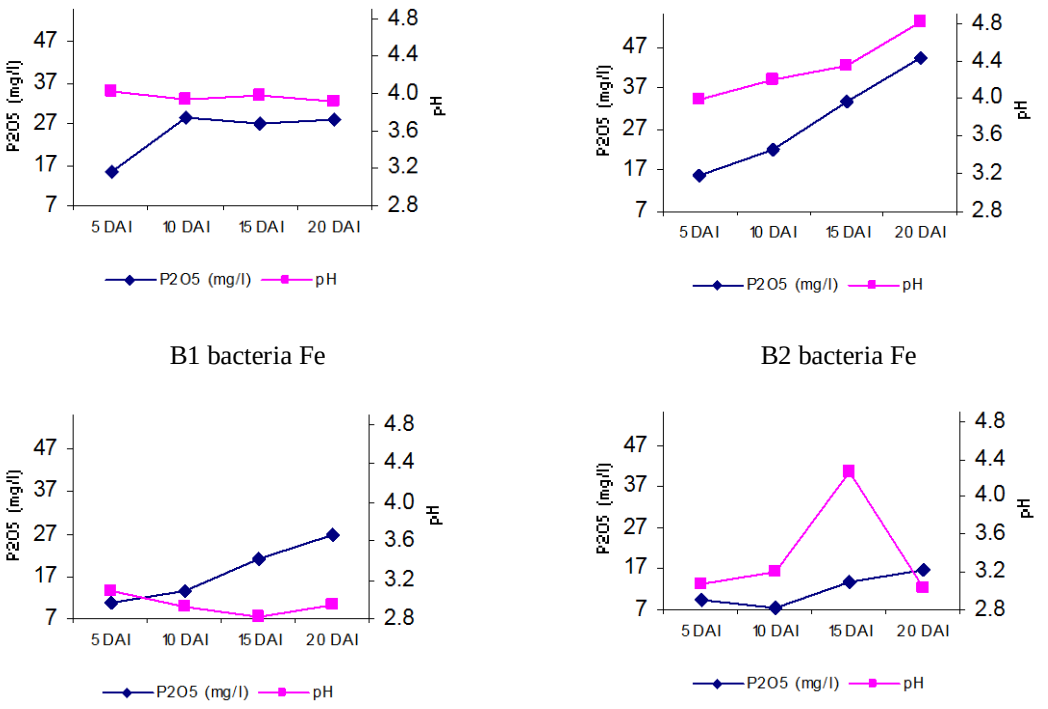


Fig 1. Changes in phosphorus concentration during the solubilization of $FePO_4$ and $AlPO_4$ by 2 bacterial strains

In case of $FePO_4$ source, the amount of phosphate solubilized increased with time of B1 bacteria. In case of $AlPO_4$ source, the amount of phosphate solubilized increased with time of B2 bacteria.

B1 bacteria, in case of $AlPO_4$ source, phosphate solubilization was associated with pH decrease of the media, but this pH decrease was not strictly proportional to the amount of the phosphate solved. However, acidification cannot be the explanation for phosphate mobilization in bacterial cultures in other cases (Fig.2).



B1 bacteria Fe

B2 bacteria Fe

B1 bacteria Al

B2 bacteria Al

Fig 2. Phosphorus concentration and pH were solubilised by 2 bacterial strains

All the strains that were solubilised phosphate in liquid media reduced the pH of the media compared to the initially, regardless of the source of phosphate. The strains that did not reduce the pH of the media were unable to solubilise phosphate (Marra *et al.,* 2011). P release is mainly based on acidification of the nutrient medium or the soil. It is generally accepted that the major mechanism of mineral phosphate solubilisation is the action of organic acids synthesised by soil microorganisms (Hariprasad and Niranjana, 2009). However, the decrease in pH is not always in the same correlation to the calcium phosphate solubilisation by microorganisms (Mehta and Nautiyal, 2001). Deubel *et al*. (2000) reported that only two of the eight strains showed clear zones on calcium phosphate agar and could be identified as P-solubilisers. However, seven of the eight strains mobilised significant amounts of tricalcium phosphate. Although some strains acidified the nutrient solution remarkably, found no correlation between pH and P in solution. Hence, acidification cannot be the single mechanism of phosphate mobilisation.

3.3. Identification of strains

All of them (02 isolates) were chosen to identify and the fragments of 900 bp 16S rRNA were obtained from PCR and sequencing, they are endophyte bacteria in rice.

The determination of nearest phylogenetic neighbor sequences for 16S rRNA gene sequence of the 02 isolates by the BLAST search program showed that they grouped into two groups: Gammaproteobacteria and Betaproteobacteria (Table 2).

Table 2. Closest species relative of two bacterial strains

Taxonomic group and strain	Closest species relative	Similarity (%)
Gammaproteobacteria		
B1	*Enterobacter cloacae*	99
Betaproteobacteria		
B2	*Burkholderia cepacia*	99

4. CONCLUSION

All the bacteria tested, they showed varying levels of phosphate solubilizing activity in both agar plate and broth assays using National Botanical Research Institute's phosphate medium that $Ca_3(PO_4)_2$ replaced by $FePO_4$ and $AlPO_4$. They grew rapidly in the liquid medium at pH 5. However, all the strains were able to mobilize significant amounts of phosphorus (P) depending on the phosphate type. They have ferrous phosphate solubilization ability in broth assays higher aluminum phosphate solubilization ability. The bacterial isolates were identified based on their phenotypic and 16S rRNA genes sequencing data B1 strain as *Enterobacter cloacae* and B2 strain as *Burkholderia cepacia*. Using these strain as possible inoculation for soils that have ferrous phosphate at greenhouse experiments and field trials.

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POTENTIAL OF ALGAE FOR ELIMINATING WASTEWATER POLLUTANTS FROM TRADITIONAL MARKET

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ABSTRACT

Traditional market plays a major role in socio-economic and constitutes a significant aspect of Vietnamese culture. However, wastewater streams discharged from the markets are generally characterized with a lot of inorganic nutrients and organic substances originated from the fresh food processing units. They will lead to serious water contamination if discharged without proper treatment. This study had applied microalgae *Chlorella sp.* for eliminating inorganic nutrient ($N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^{3-}$) and organic carbon (Chemical oxygen demand-COD) from wastewater of Binh Dien market. The removal efficiencies were reached $N\text{-}NH_4^+ > 86\%$, $N\text{-}NO_3^- > 72\%$, and $P\text{-}PO_4^{3-} > 69\%$, respectively at algae density 49×10^4 cell mL^{-1} and COD > 96% at algae density 35×10^4 cell mL^{-1} after five cultivating days. The effluence was also reached the Vietnamese standard column B of QCVN 40:2011/BTNMT. Results demonstrated that culture system composed of green alga *Chlorella sp.* can be a potential candidate for the removal of nutrients and organic carbon in wastewater treatment from Binh Dien market.

Keywords: Alga Chlorella sp.; Binh Dien market, Chemical oxygen demand; inorganic nutrient.

1. INTRODUCTION

Wastewater discharged from traditional markets has been considered as one of the major contributors to domestic pollution causing wide spread concerns (Yhdego, 1992; Danial *et al.*, 2016). Pollutants mostly contained nutrients and organic substances in the wastewater streams usually comes from wet section (where meat, fish, poultry, fruits, and vegetable are handle and sold), food preparation, and public toilets (Yhdego, 1992). If not properly treated, the pollutants can seriously harm the environment and human health. To comply with the problem, lot of techniques such as coagulation, electroflotation, filtration, etc. (Zulaikha *et al.* , 2014; Qin *et al.* , 2012) has been carried out prior to discharge or disposal. However, the processes are mostly uncost-effective, not environmentally friendly, and produce large quantities of toxic sludge.

Recently, microalgae based biological methods received great attention for the effective treatment of nutrients and organic pollutants. Microalgae has been successfully to treat slaughterhouse wastewater (Jayangoudar et al. , 1983), dairy wastewater (Woertz et al. , 2009), municipal wastewater (Wang et al. , 2010), textile wastewater (Devi et al. , 2016), and even wastewater containing heavy metal (Mehta and Gaur, 2005). However, to the best of our knowledge, there has been no research on the treatment of pollutants from traditional market wastewater by microalgae method reported so far.

The objective of this study is to test the ability of *Chlorellasp.* to remove inorganic nutrient ($N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^{3-}$) and organic pollutant (Chemical oxygen demand-COD) from wastewater of Binh Dien market.

2. MATERIALS AND METHODS

2.1. Culture medium

The green algae *Chlorellasp.*was supplied by Institute of Microbiology & Biotechnology, Vietnam national university, and cultivated in Department of Environmental Science, Sai Gon University. Wastewater effluent was collected from an equalization tank of the wastewater plant of Binh Dien market (Ho Chi Minh City, Vietnam) and was used as a culture medium. The wastewater characteristics were monitored and their annual average concentrations described in Table 1.

Table 1. Characterization of traditional market wastewater

Parameters	Mean values	*QCVN 40 (Column B)
pH	6.2	5.5 -9.0
COD (mg/L)	3200	150
NO_3^--N (mg/L)	82.69	40
NH_4^+-N (mg/L)	22.74	10
PO_4^{3-}-P (mg/L)	17.8	6
Salinity (‰)	3.0	-
** Vietnam national standard requirement.*		

A volume sample of *Chlorellasp.* suspended in BG-11 medium (Kuhl and Lorenzen, 1964) was added to the wastewater effluent. The cell density of *Chlorellasp.* in the wastewater were controlled.

2.2. Experimental setup

The experiments were conducted in batch by using 5000 mL flasks containing 4000 mL wastewater. At the beginning of each series of experiments, a volume of culture medium was inoculated to flasks with a suspension of pre-cultured cells. The initial *Chlorellasp.*concentration was varied between 0 – 70 $x10^4$ cell mL^{-1}. The flasks were aerated to provide CO_2 and for mixing via an air pump. The experiments were conducted atroom temperature (28±2 ◦C) for 5 days.

2.3. Analytical methods

The NO_3^-N, NH_4^+-N and PO_4^{3-}-P were determined according to Standard Methods for the Examination of Water and Wastewater (Clesceri *et al.* , 1998). While pH, DO and Salinity was measured by a portable multi-meter (2100P Portable Turbidimeter, Hach, USA). The cell density of *Chlorella sp.* was determined by direct microscopic count method using the Sedgewick Rafter chamber (Chorus and Bartram, 1999). All these measurements were done in triplicate and the mean value of the data are reported in this study.

3. RESULTS AND DISCUSSION

3.1. Growth study

Growth curves of *Chlorellasp.* in the growth stage is shown in Figure 1. The best cell density were reached 10.0 $x10^6$ cell mL^{-1} during six cultivated day with the normal physical water parameters (pH: 7.5 – 10, DO: 6.5 – 8 and Temperature: 28 – 31^0C). Further increasing cultivated day, the cell yields were dropped. This result was even higher than the previous finding in which maximum cell density of *Chlorellasp.* was around 6.5 $x10^6$ cell mL^{-1} (Paes *et al.* , 2016). The high cell density of algae result

reveals that *Chlorellasp.* appear to be promising and significant in pure culture through the cultivated process.

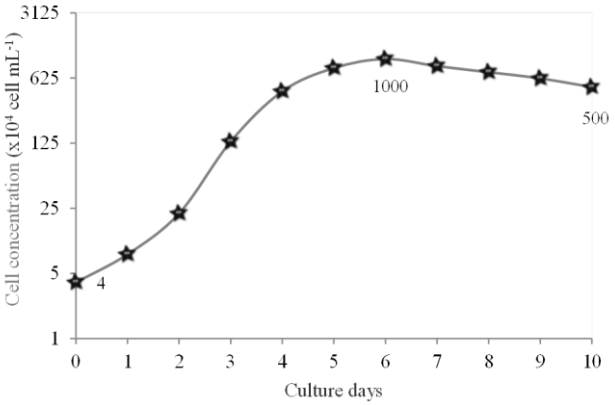

Fig 1. The growth curves of *Chlorellasp.* under aerobic culture condition for ten days

3.2. Nutrient and chemical oxygen demand removal

The variation of pollutants from wastewater of Binh Dien public market with time at the different initial concentration for 5 days operation is depicted in Figure 2. All effluent parameters are reached the Vietnam national standard requirement column B (QCVN 40:2011/BTNMT).

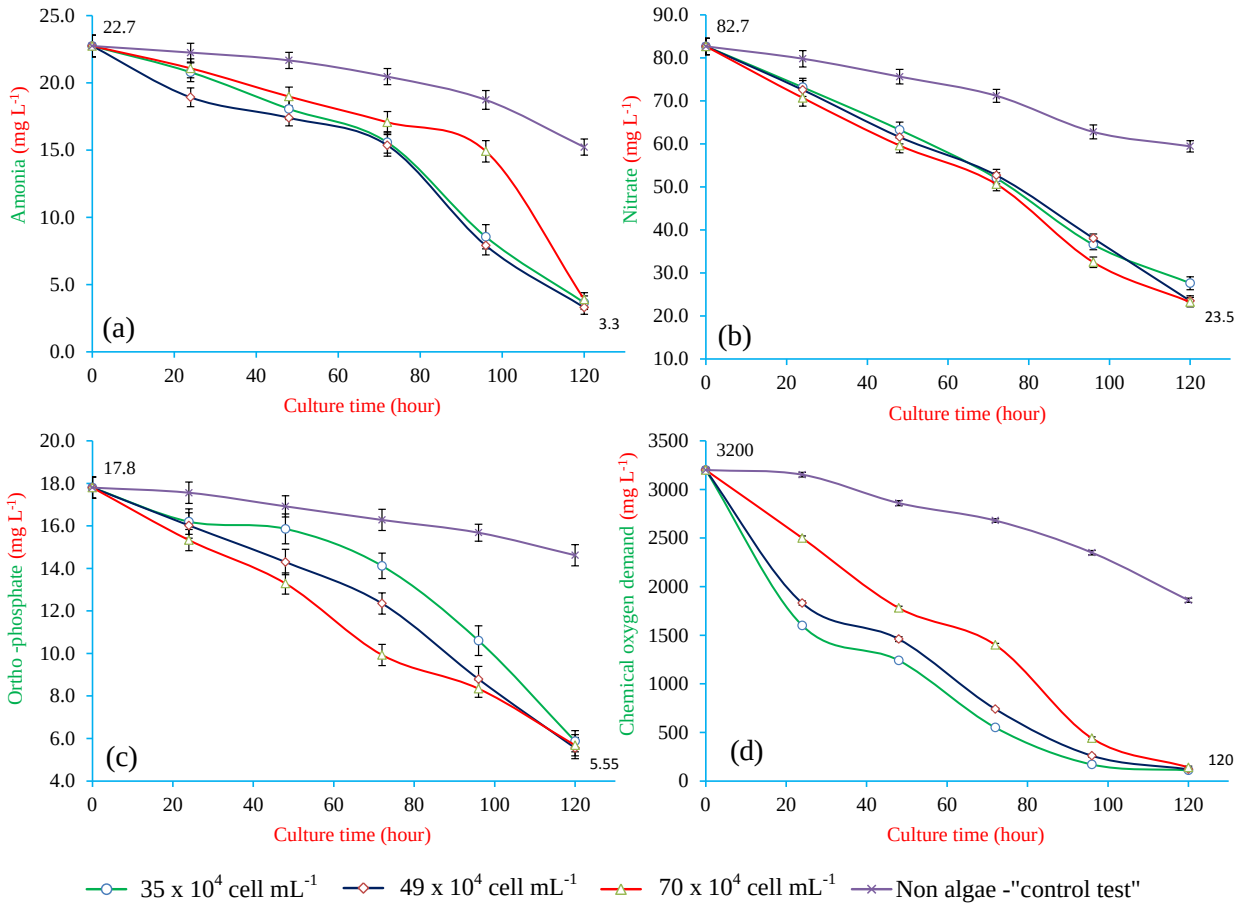

Fig 2. Variations of the (a) ammonia/ammonium; (b) nitrate; (c) chemical oxygen demand, and (d) ortho -phosphate concentrations throughout the growth of *Chlorellasp.* in the experimental treatments

As show in Figure 2a, the NH_4-N was completely removed (around 3 mg L^{-1}) from the media after 120 hours cultivating. However, the NH_4-N removal efficiency was around 86% for algae concentration 49 x 10^4 cell mL^{-1} and it further decreased to 83% when the NH_4-N algae concentration increase (70 x 10^4 cell mL^{-1}). The figure also shows that no significant ammonia removal was observed in control experiments. These results should be explained due to the *Chlorellasp.*concentration was saturated in the wastewater and could not react efficiently when it further increment. The observation is in agreement with the report of Wang et al. (2010) . The trend is clearer for the removal of nitrate (Figure 2b), nitrate concentration was significant reduced when the wastewater had supplied Chlorellasp.(72%) as compared with control experiments (28%) after 5 days cultivation. The higher algae concentration is the higher nitrate is removed and it is confirmed with the study of Jeanfils et al. (1993) who stated that algae could utilize nitrate as a main growth nutrient.

For the phosphorus removal process (Figure 2c), the final ortho-phosphorus concentration was around 5.6 mg L^{-1} with 69% removal efficiency for *Chlorella* sp. concentration 49 x 10^4 cell mL^{-1}. The other *Chlorellasp.*concentrations resulted in mostly less efficiency than the mentioned concentration. The excess amount of *Chlorella sp.*could be one of the reasons for low removal efficiencies as increasing algae concentration. The removal efficiency were higher than the finding of González et al. (1997) in which only 55% phosphorus removal from agroindustrial wastewater by 216 h batch cultivation of *C. vulgaris* and *Scenedesmus dimorphus*. These results indicate that *Chlorellasp.*is very effective in removing ortho-phosphorus.

The removal efficiency for organic pollutants (COD) is shown in Figure 2d. It can be ascertained that the percentage COD removal decreases with increasing in the *Chlorellasp.*concentration from 35 to 70 x 10^4 cell mL^{-1} for initial COD concentration 3200 mgL^{-1}. The best removal efficiency is reached 97% at algae concentration 35 x 10^4 cell mL^{-1}. The results may due to the fact that, the organic chemical in the wastewater is the favorite media for the growth of *Chlorellasp.* It has found that the *Chlorella* metabolic pathway can be altered supplying organic substances (organic acids, glucose, etc.) allow it to adapt to heterotrophic growth rather autotrophic (Eny, 1951).

4. CONCLUSIONS

This study was conducted to access the effect of *Chlorellasp.* on removing inorganic nutrient ($N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^{3-}$) and organic carbon (Chemical oxygen demand-COD) from the wastewater collected from Binh Dien market, Ho Chi Minh city, Vietnam. The experimental results indicated that *Chlorellasp.*has successful removed the pollutant after 5 days cultivation, the best removal efficiencies of inorganic nutrient were 86%, 72%, and 69% at algae density 49 x 10^4 cell mL^{-1} for $N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^{3-}$, respectively. While the best removal efficiency of organic pollutants was reached 97% at algae density 35 x 10^4 cell mL^{-1}. These results indicated the potential of using *Chlorellasp.* as a "green" method to remediate wastewater containing nutrient or organic pollutants.

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PART 2

NATURAL SCIENCE

ELECTRON TRANSPORT AND MAGNETISM OF DYSPROSIUM NITRIDE

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ABSTRACT

We present the electronic and magnetic properties of Dysprosium nitride (DyN) thin films which are grown at room temperature by thermal evaporation of the Dysprosium in the presence of a partial pressure of N_2. The X ray diffraction pattern shows that the DyN film is polycrystalline and textured in the (111) orientation. The resistivity of film as a function of temperature from ambient temperature down to 5K demonstrates that DyN is semiconducting. The magnetization as a function of temperatures and the applied field dependent magnetization at 5K, 10K and 30K confirm that DyN films are ferromagnetic with Curie temperature around 22K and the saturation magnetization at 5K is about $10\mu_B$/Dy. Magnetoresistance is negative and strongest around Curie temperature.

1. INTRODUCTION

Due to the 4f orbital filling up throughout the lanthanide series the rare earth nitrides have very interesting electronic and magnetic properties. They are predicted to be half metals or ferromagnetic semiconductors [2, 3]. Among rare earth nitrides, GdN is the most studied compound [4, 5, 6] and is now a well established ferromagnetic semiconductor with Curie temperature (T_C) about 70K [7]. Some of other rare earth nitrides are known to be ferromagnetic with lower temperatures, for example SmN is a ferromagnet with very small moment below 27 K [6]. EuN is semiconducting and contains nomagnetic ion Eu^{3+} [8], but substoichiometric EuN with concentration of Eu^{2+} near 15% - 20% is ferromagnetic with a Curie temperature as high as 120K [9]. There are already proofs of concept GdN devices, for example a GdN based spin filter Josephson junction [10, 11], GdN nano islands based GaN tunnel junctions [12], or spin filtering nano contacts [13]. DyN has been reported as a ferromagnetic semiconductor with T_C ranging between 17K and 26K [14, 15] and its optical energy gap has been also showed 1.2 eV [16].

In this Letter, we present the electron transport and magnetism of polycrystalline DyN thin films grown by thermal evaporation at room temperature.

2. EXPERIMENTAL DETAILS

DyN films were grown onto four contacts pre-deposited on sapphire (0001) at room temperature by using a thermionics ultra high vacuum system with a base pressure of $1\times10^{-8}Torr$. High purity Dy metal was evaporated at a rate of 0.2 Å/s with a nitrogen pressure of $4\times10^{-4}Torr$. All the substrates were out-gassed for 1 hour at 600^0C then were cooled down naturally to room temperature before growth. GaN layer was grown on top of DyN films to prevent decomposition in air. Thicknesses were determined by via quartz crystal balances calibrated for DyN and GaN. X ray diffraction (XRD) was performed to confirm the crystal structure, lattice constant, and orientation of the films. Electrical transport measurements were conducted in a Physical Properties Measurement System (PPMS) for which the resistivity as a function of temperature was measured from room temperature down to 5K. Hall effect were also conducted using a PPMS to determine carrier concentration and carrier type. Magnetoresistence at different typical temperatures were calculated from equation (*):

$$MR = \frac{\rho(H) - \rho(0)}{\rho(0)} = \frac{\Delta\rho}{\rho(0)}$$

with $\rho(H)$ and $\rho(0)$ being the resistivity with and without the applied magnetic field, respectively. Magnetization of the films was measured using Superconducting Quantum Interference Device (SQUID) with the field oriented in plane. In detail, the magnetization as a function of temperatures is determined by two measurement types: Field Cool (FC) and Zero Field Cool (ZFC), and the applied field dependent magnetization were measured at 5K, 10K and 30K. The thickness of DyN films in this research is about 200 nm.

3. RESULTS AND DISCUSSION

Figure 1 presents diffraction patterns of a DyN film. There are 5 peaks representing the DyN (111), (200), (311), (220), and (222) orientations. This result shows that the film is polycrystalline and textured in the (111) orientation.

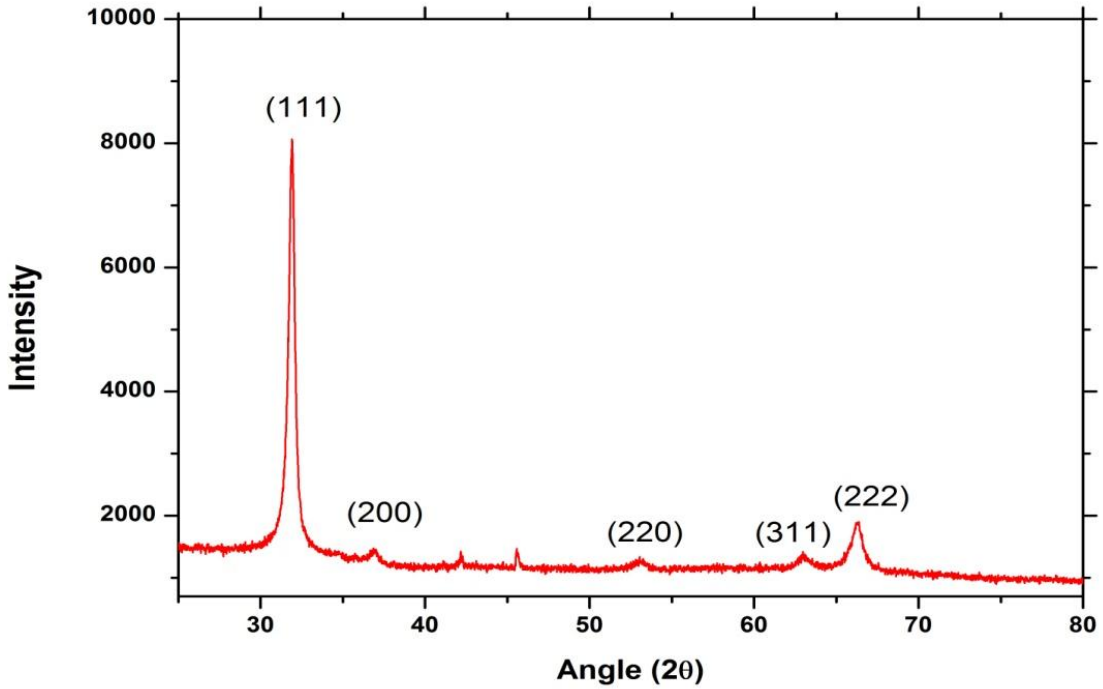

Fig 1. The XRD pattern of a typical DyN film. The film is polycrystalline, but with a strong (111) texture.

The magnetization of DyN as a function of temperature is displayed in Figure 2, for which both the Field Cool (FC) and Zero Field Cool (ZFC) types are conducted with an applied field of 500Oe. There is a divergence between the FC and ZFC curves below 25K. The applied field dependent magnetization at selected temperatures is presented in Figure 3, in which the hysteresis loop is apparent at 5K and 10K and almost disappears at 30K. The saturation magnetization at 5K is about $10\mu_B$/Dy. The magnetic susceptibility as a function of temperature obeys the Curie Weiss law. These data confirm the low temperature ferromagnetic state of DyN with T_C around 22K, in agreement with previous literature results [14, 15].

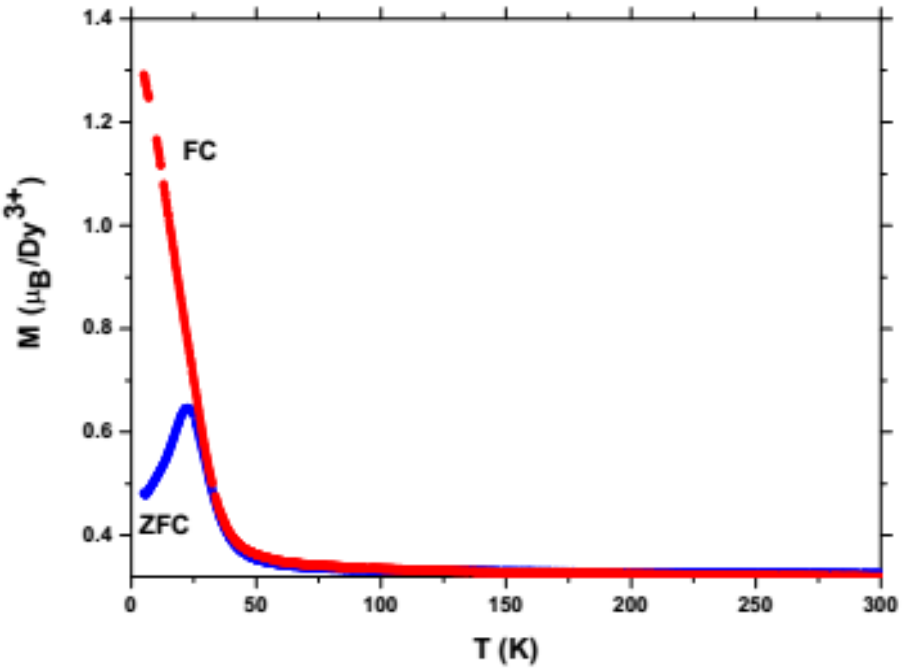

Fig 2. The magnetisation as a function of temperature measured in the FC and ZFC configuration. The divergence of the FC and ZFC curves occurs below 25K

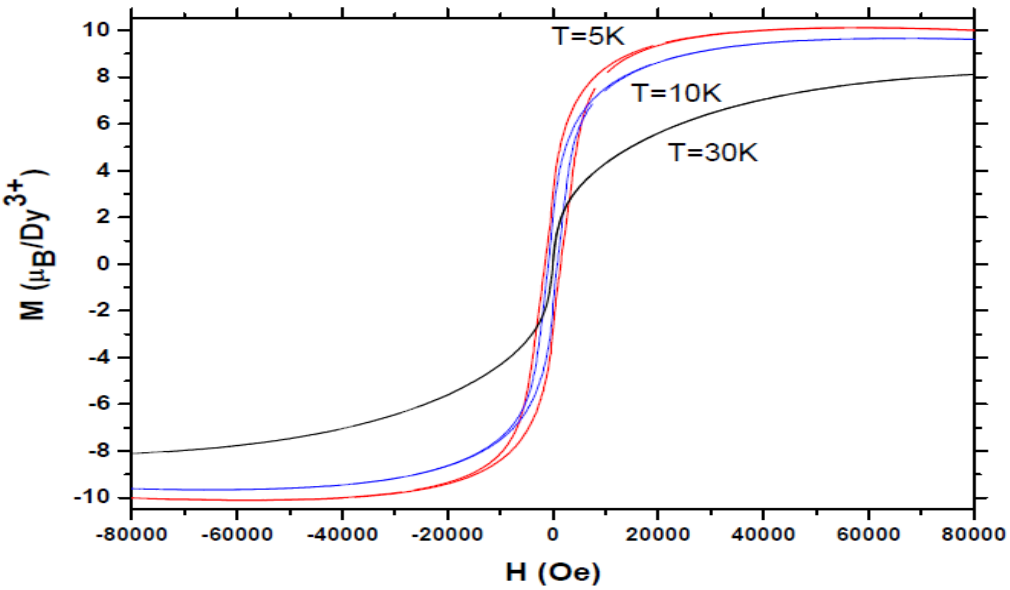

Fig 3. The applied field dependent magnetization at 5K, 10K, and 30K

The resistivity of DyN as a function of temperature is presented in Figure 4. At ambient temperature, its value is approximately 95 mΩcm, which strongly rises as temperature decreases. There is a relatively flat peak near T_C followed by the continuing steeply rising resistivity, signalling that the low temperature phase is likely semiconducting. In addition, the Hall Effect shows the carriers are electrons and the carrier concentration at room temperature is less than 10^{20} cm^{-3} which implies a moderately doped semiconductor due to nitrogen vacancies, similar to moderately doped GdN [6].

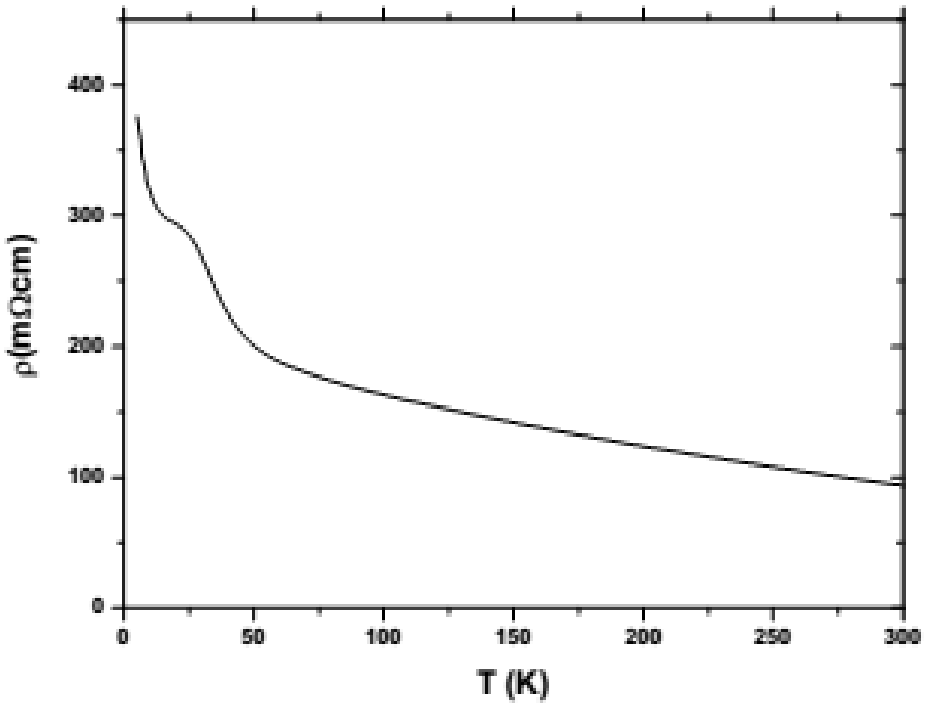

Fig 4. The resistivity as a function of temperature of a typical DyN film. The flat peak around 20K - 25K signals the phase transition between the paramagnetic phase and the ferromagnetic phase

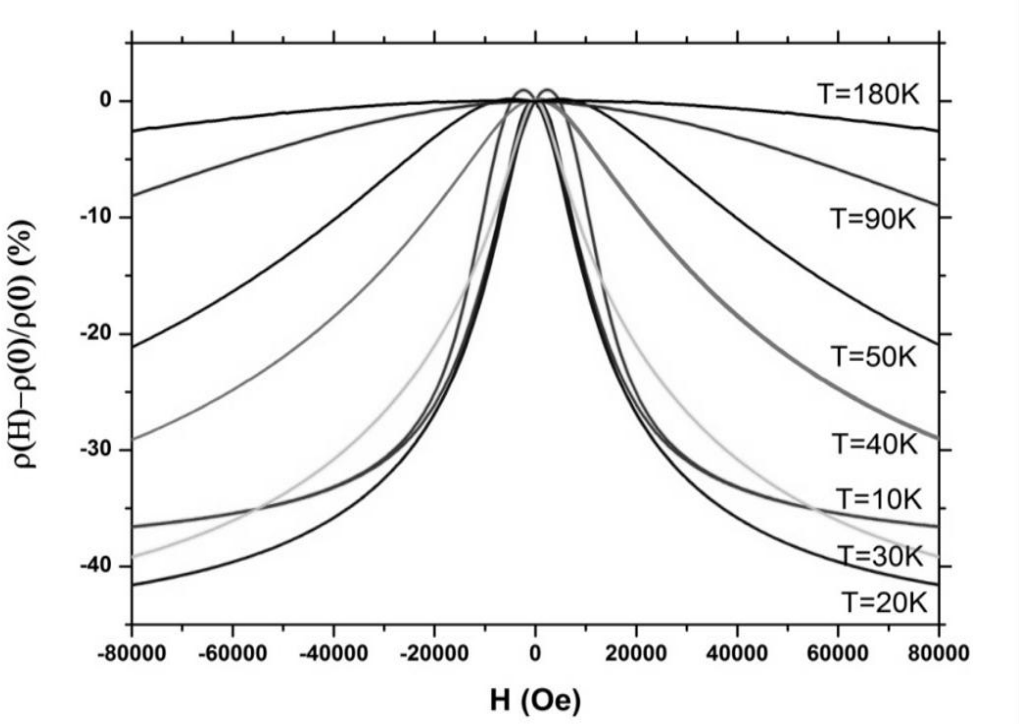

Fig 5. The negative magnetoresistances of DyN measured at selected temperatures show the strongest value occurs around T_C

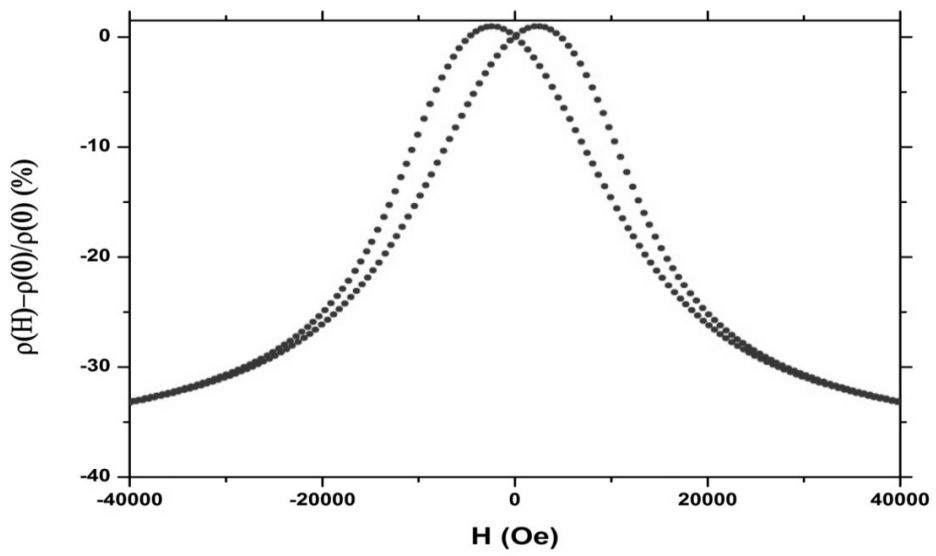

Fig 6. The hysteresis loop of magnetoresistance of a DyN film at 10K. The shape of butterfly signals the domain formation in the ferromagnetic phase

The effect of an applied magnetic field on the resistivity is seen in the magnetoresistance at different temperatures from 10K to 180K in Figure 5. The magnetoresistance in a field perpendicular to the film plane as determined by equation (*) is found to be negative below 250K for whichat high temperature (180K) the magnetoresistance is only a few percent and almost disappears at 250K. The strongest negative magnetoresistance appears around T_C (42%) but it is much weaker at lower or higher temperature. We address the phenomenon whereby the strongest negative magnetoresistance occurs around T_C due to spin disorder scattering which can also be seen in several other materials [17, 18, 19, 20]. At the lowest temperature T=10K (Figure 6), we also see a hysteresis loop of magnetoresistance which is usually indicative of the ferromagnetic domain formation, in which domains change polarity above a certain coercive field. Domain formation typically creates a remanence in the signal as it crosses zero applied field, so consequently there is a butterfly shape of the magnetoresistance [21, 22].

4. CONCLUSION

We have succefully grown DyN films and examined their electron transport and magnetic properties. The magnetization of the polycrystalline DyN sample as a function of temperatures and applied fields shows DyN has a ferromagnetic phase, for which its Curie temperature is about 22K - 25K. Its saturation magnetisation at 10K is about $10\mu_B$/Dy. The electrical properties of DyN show that the sample is a doped semiconductor. The magnetoresistance of this film is negative and also strongest around T_C similar to in GdN samples. There is also a hysteresis in the magnetoresistance at low temperatures which is related to domain walls in the ferromagnetic phase.

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GROWTH AND STRUCTURE OF EUROPIUM NITRIDE THIN FILM

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ABSTRACT

We present the structureand the quality of europium nitride (EuN) thin films grown at room temperature and high temperatures ranging from 600^0C to 800^0C by thermal evaporation of the eurropium in the presence of a partial pressure of N_2. The X ray diffraction pattern, the reflection high energy electron diffraction and Raman spctrashow that the EuN films grown at room temperautre and 600^0C are polycrystalline and textured in the (111) orientationbut the films fabricated at higher temperatures, 680^0C and 800^0C are epitaxial. X-ray absorption spectroscopy confirms the main charge state of europium ion in EuN is 3+ but still existing small amount of Eu^{2+}ions due to nitrogen vacancies.

1. INTRODUCTION

Spintronics involves manipulation of both spin and charge [1] for which one requires materials in which the electronic and magnetic properties are strongly coupled. One class of materials showing this behaviour is dilute magnetic semiconductors (DMS) in which a semiconductor is doped with magnetic elements, for example GaMnAs [2] or ZnO [3]. Another class is intrinsic ferromagnetic semiconductors that are both ferromagnetic and semiconducting without the need for additional doping with other elements, but not many such compounds are known. The rare earth nitrides show promise in this respect, for many of them are believed to be intrinsic magnetic semiconductors [4, 5, 6]. Rare earth elements sit on the sixth period of the periodic table and are characterized by their partially filled 4f shell. Most of them are generally found in the trivalent charge state except Eu that is stable also in the divalent charge state and Ce that tends to form 4+ ions. The magnetic state of rare earth elements and also their compounds strongly depends on the partially filled electronic 4f shell in which the occupation of electrons in the ground state generally obeys Hund's rules. Rare earth ions combine with nitrogen to form rare earth nitrides in a stoichiometric ratio of 1 to 1. They crystallise in the rocksalt structure with a slightly decreasing lattice parameter toward the heavier rare earth elements [7]. Although bulk rare earth nitrides have been studied since the 1960s [7, 8, 9] difficulties in their fabrication and the lack of advanced theoretical calculations at that time prevented a clear picture of their electrical and magnetic properties from emerging. In recent years, the rare earth nitrides (REN) have regained the attention of researchers because of significant advances in the theoretical calculations and the sample growth methods as well as the potential for applying them in spintronics [1, 10, 11]. In this research, we present the structure of europium nitride thin film grown by physical vapour deposition (specifically thermal evaporation of Eu in the presence of excited N_2) in an ultra high vacuum (UHV) chamber under a range of different growth temperatures. The structure and the quality of the films are then determined by x-ray diffraction (XRD), reflection high energy electron diffraction (RHEED), Rutherford backscattering spectrometry (RBS), and Raman spectroscopy. X-ray absorption spectroscopy (XAS) is employed to explore the charge state of europium in EuN.

2. EXPERIMENTS

EuN was grown on an epitaxial AlN template which is pre-deposited on sapphire. A series of EuN films was grown under different growth tempertures, room temprature, 600^0C and 800^0C for the investigation the effect of the growth temperature on thestructural characteristic. Before growing, a mass spectrometer was used to check the residual gases in the chamber. The base pressure in the growth chamber was about 2×10^{-8} Torr. A substrate with area 1 cm^2 was cleaned and fixed to the molybdenum

substrate holder plate by using two molybdenum pins. This sample was then introduced into the load-lock chamber. After re-establishing a high vacuum in the load-lock chamber, the substrate was transferred to the growth chamber and then out-gassed for at least 2 hours at a temperature 600^0C to expel contaminants. High purity europium metal was evaporated from the thermal evaporator. The europium flux was controlled by adjustment of the current flowing through the tungsten basket which contains the europium in a ceramic crucible. This flux was measured by using a quartz crystal microbalance which was connected to a deposition rate controller. The europium flux was chosen at0.2 Å/s. Nitrogen ions were supplied via an ion source producing 125 eV nitrogen ions with a beam current of 0.37mA set by using the control panel. The overall nitrogen partial pressure for growth is at 4×10^{-4} Torr. Under these conditions, the ratio of europium flux to nitrogen ion flux at the surface of the substrate was approximately 250 to 2500. The substrate temperature for growth was chosen at room temperature and a high temperature window ranging from 600^0C to 800^0C. These temperatures were determined by using an optical pyrometer. During the growth, the substrate was rotated by rotating the substrate holder. This was done to allow the substrate surface to be exposed equally to both ionized nitrogen flux and Eu flux. For growth at a high enough substrate temperature, excess Eu metal is expected to re-evaporate as in the case of adsorption controlled growth of EuO [12].The thickness of films was monitored *in-situ* by a quartz crystal micro-balance and then measured *ex-situ* again by Rutherford backscattering spectroscopy (RBS). Reflection high energy electron diffraction (RHEED) was used to analyse the surface structure of the substrate and that of the EuN films during EuN growth. To avoid oxidation after growth, for *ex-situ* experiments, all EuN films were capped with a 35-90 nm AlN capping layer grown at room temperature for which Al metal was evaporated by an e-gun evaporator in the presence of a nitrogen ion source. The Al flux was adjusted to be about 0.1 Å/s while the ionized nitrogen pressure was approximately 4×10^{-4} Torr.

3. RESULTS AND DISCUSSION

RHEED results of EuN films reflect the tendency to form polycrystalline samples at low growth temperatures. This is in contrast with the results which show epitaxial samples can be grown at high enough growth temperatures. Figure 1a presents the RHEED pattern for an AlN template substrate. Visible are sharp streaky patterns which indicate the surface of the AlN template has high crystalline quality and a flat surface. Figure 1 b, c, d and e show the RHEED pattern obtained during a EuN grown at 800^0C and with a growth rate of 0.2 nm/s but measured at different thicknesses of 5 nm, 10 nm, 90 nm and 135 nm respectively, recorded along the direction parallel to the AlN (1-210). Figure 1(f) is a RHEED image of the same EuN film taken following the (1-100) orientation of AlN, which shows only the expected reflections from an epitaxial film. After starting the growth of the film the AlN streaks quickly disappear and a pattern of spots appears. The emergence of the spotty RHEED pattern within a minute of deposition suggests that the EuN growth occurred by the nucleation of two rotational variants of EuN which coalesce into a somewhat rough film as the thickness of the film increases. This is similar to behaviour exhibited by GdN films grown onto GaN [13].

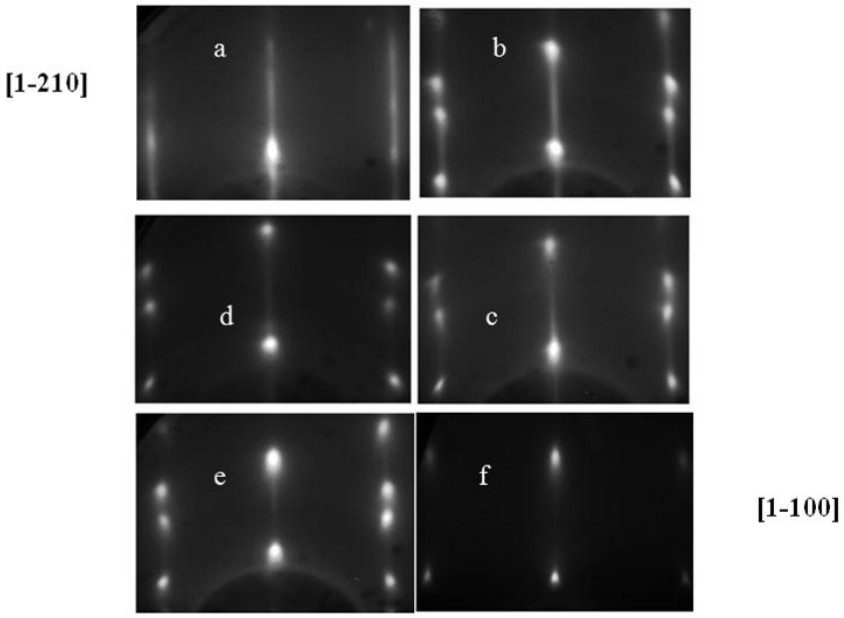

Fig 1. a) RHEED pattern along [1-210] of the AlN surface. RHEED patterns along [1-210] of a 800^{0}C grown EuN film measured at different thickness; b) 5 nm; c) 10 nm, d) 90 nm; e) 135 nm, and f) RHEED pattern of EuN taken along [1-100] after 10 nm of growth

EuN forms in the rocksalt structure with a 3 fold symmetry about the (111) orientation compared to the 6 fold symmetry of AlN about the (0001) orientation. The mismatch between EuN and AlN is about 14% which causes a strain, so two possibly rotational variants of EuN are shown in Figure 25. The existence of two variants means that twin formation will occur after a few mono-layers of EuN. Films grown on YSZ [50] shows "streaky" and narrow RHEED patterns which demonstrates a high crystalline quality but it is worth noting that YSZ has a cubic structure (100) and also the mismatch between EuN and YSZ is only about 2.3 % in compared to 14% for the mismatch between EuN and AlN which may be the reason for the rough surface of EuN on AlN.

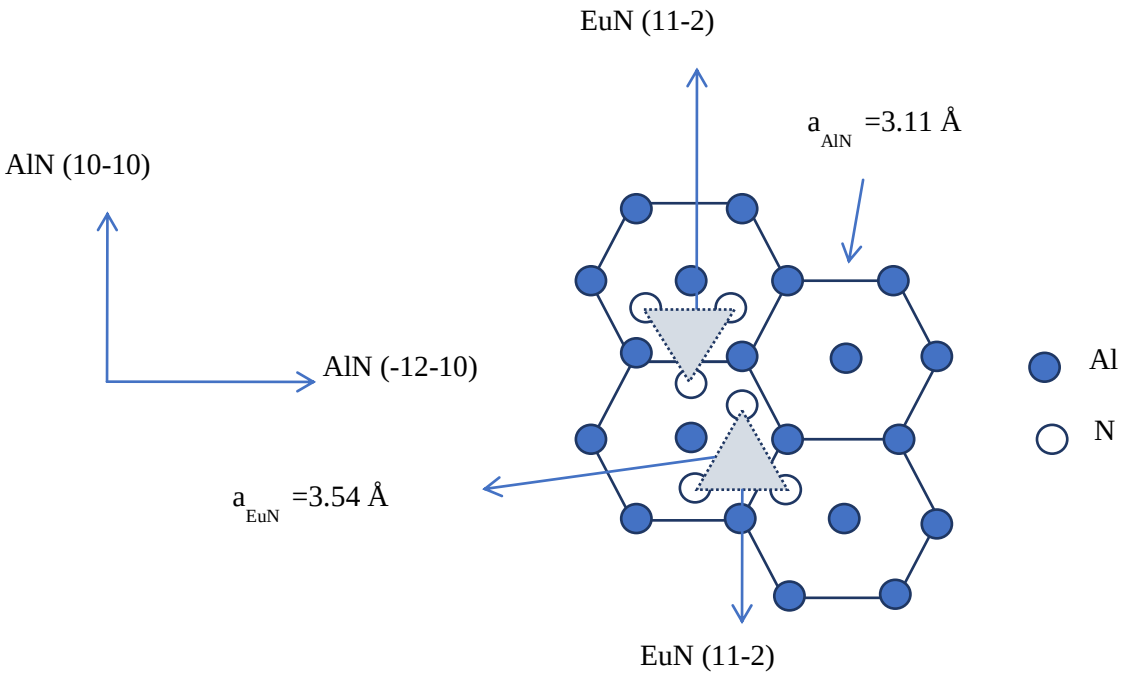

Fig 2. Schematic diagram for the two orientations of EuN on Al polar AlN (0001) in the first layer

There are two possible schematics for the arrangement of the first layer of N atoms in EuN (111) grown on a c-plane (0001) AlN wurtzite structure based on the simple model presented in [13].

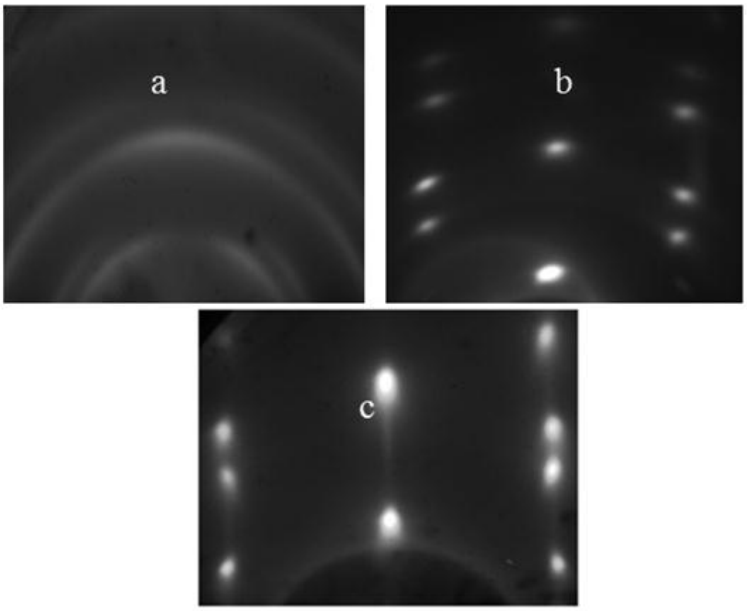

Fig 3. RHEED pattern of 3 different samples grown at various temperatures, a) 600^0C, b) 680^0C, c) 800^0C

Figure 3 presents the effect of growth temperature on the structure of EuN films measured by *in situ* RHEED observation. The RHEED pattern for EuN (Figure 3a) grown at 600^0C indicates that the film is polycrystalline with the appearance of a Debye ring pattern. But the RHEED patterns of EuN grown with substrate temperatures of 680^0C and 800^0C (Figure 3b and 3c) show epitaxial films with the appearance of double spots indicating the formation of twins, as explained above. Increasing the substrate temperature to the point at which europium begins to evaporate contributes to the process by which excess europium on the surface of substrate is desorbed and the europium atoms also have more energy and space on the substrate to move during combination with nitrogen ions to form EuN. The RHEED patterns of films fabricated at room temperature show polycrystalline growth.

In conclusion, from the RHEED data it can be said that the structure of the EuN films is strongly dependent on the growth condition, for which films grown at room temperature and 600^0C are polycrystalline while those films fabricated at 680^0C and 800^0C are epitaxial.

X ray diffraction is used to evaluate the crystalline structure and the orientation of the EuN films. The results show that the films grown at room temperature and at 600^0C are polycrystalline but (111) textured. In contrast with this, the films fabricated from 680^0C to 800^0C are epitaxial. This is in agreement with the RHEED data obtained *in-situ*. In detail, Figure 4 and figure 5a presents diffraction patterns of the films grown at room temperature and 600^0C, respecially. There are 4 peaks representing the EuN (111), (311), (220), and (222) orientations. This result agrees with the RHEED data showing that the film is polycrystalline. As expected, at high substrate temperatures, the structure of the films changes. Figures 5b and 5c show that both films grown at 680^0C and 800^0C develop following the (111) preferential orientation of the rocksalt structure on the c-plane (0001) AlN wurtzite structure. Not surprisingly, the films grown at higher temperature show narrower XRD line-widths, signalling better crystallographic order. The crystalline size extracted from the Scherrer formula is found to be about 15 nm for the film grown at 680^0C compared to 24 nm in the case of the film grown at 800^0C. The lattice constant of the 680^0C film calculated from the diffraction pattern is approximately 4.99 Å in good agreement with the previously reported values of 4.98 Å [17].

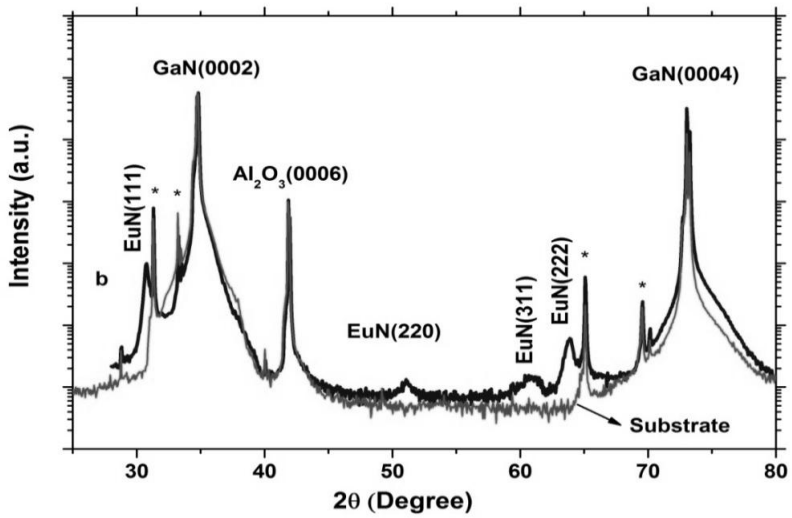

Fig 4. XRD from EuN film grown on GaN templates on sapphire

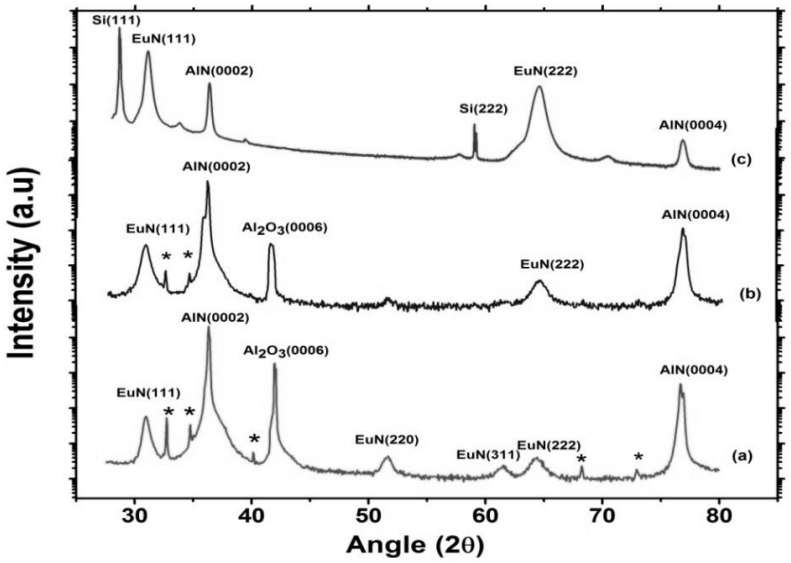

Fig 5. XRD from three typical EuN films grown on AlN templates on sapphire and silicon substrates at three different temperatures: (a) 600^0C, (b) 680^0C, and (c) 800^0C. Those peaks denoted by asterisks represent the substrate and appear due to the non-monochromatic nature of the X ray source

Having the rocksalt structure the rare earth nitrides are expected to exhibit no Raman active mode in first order but disorder in the thin films can cause Raman scattering as discussed in [14, 15]. In EuN films, as in other rare-earth nitrides, the existence of defects such as nitrogen vacancies is likely to be the origin for the disorder of the films. The films grown at different growth temperatures have different Raman spectra intensities (Figure 6). The 600^0C film is polycrystalline having the strongest Raman intensity while the 800^0C epitaxial film has the less Raman intensity. The difference is clearly related to the film disorder.

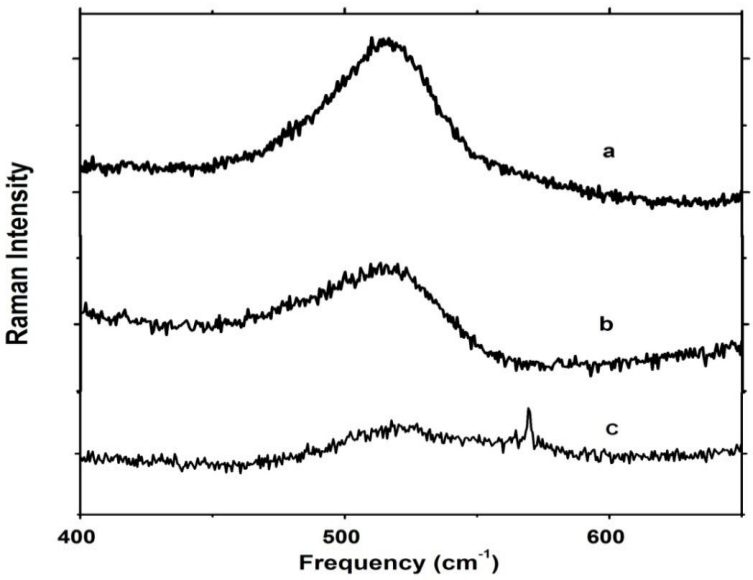

Fig 6. Raman spectra of 3 EuN samples grown at different growth temperatures, a) 600^0C; b) 680^0C and c) 800^0C measured using 514 nm laser light

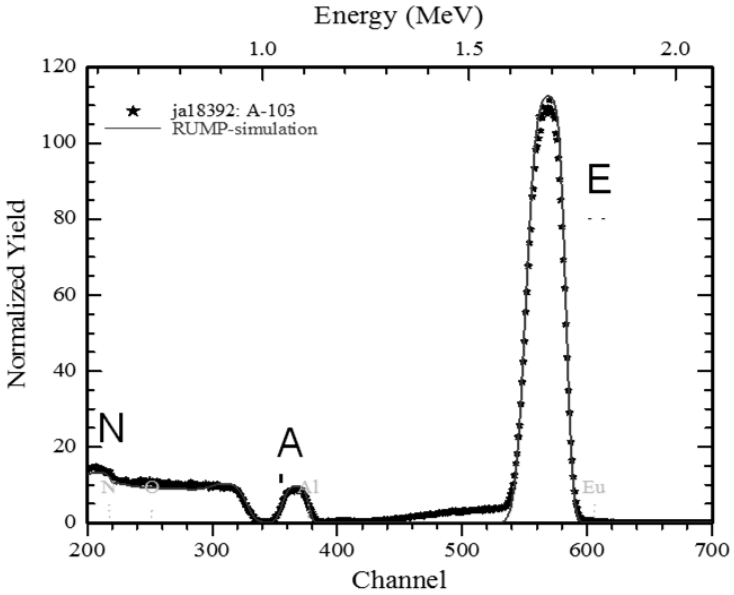

Fig 7. RBS spectrum of film grown at 800^0C on an AlN template. The concentration of europium in term of atoms cm^{-2} is 3.6×10^{17} at.cm^{-2} from which the film thickness is calculated to be about 115 ± 5% nm

The composition and the thickness of EuN films in units of atoms cm^{-2} is extracted from RBS spectra by using the RUMP code [16]. The peak from RBS spectra representing europium is many times bigger than that of the peak representing nitrogen since the nitrogen is a light element in comparison with europium (figure 7), thus the thickness of the films in term of atoms cm^{-2} is determined from the europium. From the lattice parameter of EuN measured from XRD and the thickness of the film in term of europium atoms cm^{-2} we calculate the thickness of the EuN films ranges from 115 nm to 200 nm. The RBS results show thatthe films have Eu to N ratio of close to 1:1, butwithstatistical and common errors estimated to be from 5% to 10%. Similar to the RHEED results,several of the RBS spectraalso show that the surfaces of the films are rather rough.

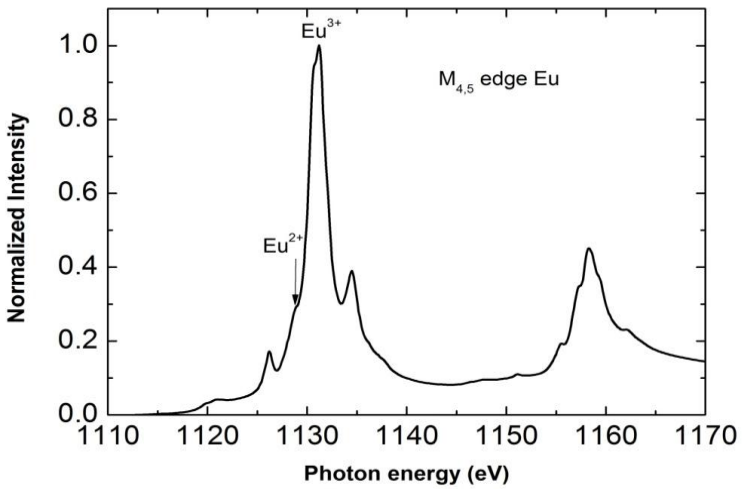

Fig 8. XAS of EuN films grown at 800^0C.

To shed a light on the charge state of the Europiumion in our EuN films we have measured X ray absorption spectrocopy (XAS) at the Eu $M_{4,5}$ edges on film grown at 800^0C (Figure 8). The result shows that the predominant charge state of europium in EuN is Eu^{3+} which is represented by the peak appearing at 1134 eV. However, we still see a shoulder at about 1132 eV, signalling the existence of a small amount of Eu^{2+} ions. The magnitude of the peak coming from Eu^{2+} ions is dependent on the growth conditions. Figure 9 compares 2 samples grown at the same growth temperature 800^0C but at different growth rate, 0.03 nm/s (Figure 9a) and 0.2 nm/s (Figure 9b) in which the film fabricated at higher growth rate has more Eu^{2+} ions (strong shoulder at 1132 eV) than that film grown at low rate. The higher Eu flux gives less chance for the growing film to fully incorporate nitrogen into the lattice. Therefore, we argue the emergence of Eu^{2+} ions in EuN relates to nitrogen vacancies.

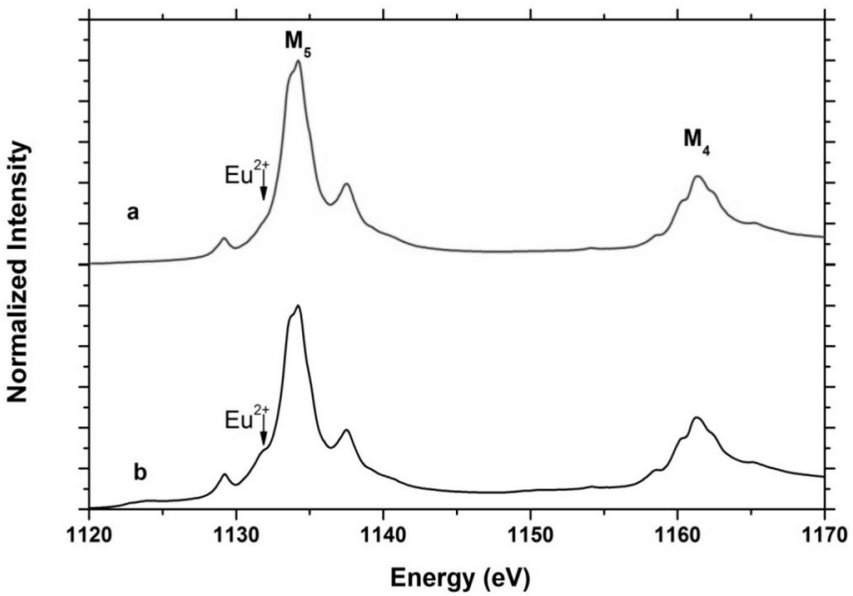

Fig 9. Comparison between XAS of two EuN films grown at the same temperature 800^0C but different growth rate, 0.03 nm/s (a), and 0.2 nm/s (b).The film with higher growth rate has more Eu^{2+}ions than the film with low growth rate

In conclusion, we have shown the structure and the quality of EuN thin films grown at room temperature and high temperatures ranging from 600^0C to 800^0C by thermal evaporation of the eurropium in the presence of a partial pressure of N_2, for which the EuN films grown at room temperautre and 600^0C are polycrystalline and textured in the (111) orientation but the films fabricated at higher temperatures, 680^0C and 800^0C are epitaxial. X-ray absorption spectroscopy confirms the main charge state of europium ion in EuN is 3+ but still existing small amount of Eu^{2+} ions due to nitrogen vacancies.

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STUDY ON HYDRO-DYNAMICAL PROCESSES INFLUENCING SUSPENDED – SEDIMENT TRANSPORTIN THE CO CHIEN ESTUARY

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ABSTRACT

The Co Chien Estuary is the place where the water of the sea and the river strongly interacts together. River Estuary under various hydrodynamic conditions and socioeconomic development on the river, along with the interaction between river flow, tide, and sea waves, was destabilizing and causing difficulties for identification of channel flows, submerged sand dunes and river morphology. To study morphological changes as well as sedimentation and erosion processes at the Co Chien estuary, the MIKE 21 modelling system was chosen to apply. This modelling is a combination of hydrodynamic, wave, flow and sediment transport modelling.

This paper presents the results of wave, flow and sediment transport, analyzing of current status and causing of morphological changes in the estuary area. Simulation results show that erosion occurs more frequently in the river bed and near shore of Ben Tre province. The rate of erosion in rainy season tends to be faster than the dry season. The results of sediment transport by mathematical modelling are quite suitable with the results of status sediment transport measurement in the area of the Co Chien estuary.

Keywords: Co Chien estuary, flow, wave, sediment transport

1. INTRODUCTION

The Co Chien River flows to the Eastern Sea through the two estuary of Cung Hau and Co Chien, (Fig.1). Between the two estuaries is the Thu isle belong to Chau Thanh and Cau Ngang districts, Tra Vinh province. In the area of these two river estuaries are the ancient islets, such as Phung, Long Tri and Co isle. Besides, the presence of new islets: Nghieu and Thuy Tien isle. The recent emergence of these islets and mudflats has shown that morphological changes, erosion occurring in this area are extremely complexes and happened in this area

2. APPROACH SCHEME

The objective of the study is hydrodynamic conditions and suspended - sediment transport in estuaries affected by river flow, tides, sea wave. The MIKE 21 modelling will be applied to calculate and simulate wave, suspended - sediment transport and morphological changes in this study area. In addition, analytical and statistical methods are used. These data were collected such as: waves, tides, currents, suspended - sediment transport and water levels of measurement, monitoring, earth source satellite.

To evaluate a trend of the morphological changes in the Co Chien estuarine and to fully describe the main factors, including waves, currents and tides, there are two modellingincluding modelling of a large computed domain and grid size forcovering all estuaries and part Eastern sea (Fig.2) with main input factorsand another modelling of asmall downscale computed domain and grid size for the Co Chien estuary area with detailed input factors.

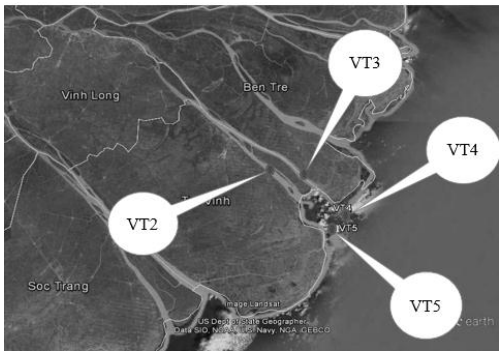

Fig 1. Monitoring sites

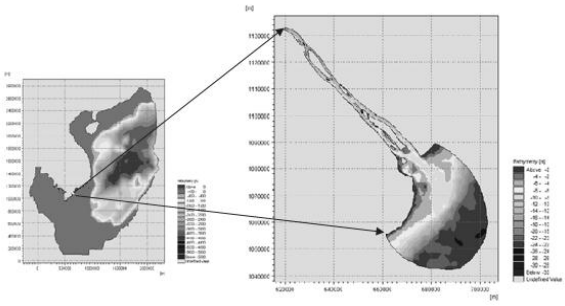

Fig 2. Modelling of the large computed domain and grid size and the downscale size

Applying MIKE model to simulate the suspended sediment transport in the Co Chien estuary.

The modelling of a large grid size, the MIKE 21 SW wave modelling, using wind data from earth satellite sources extracted in 2014 to simulate the wave field, the results are used as input for the modelling of a small downscale grid size; topographic data were collected from the measured data in 2012. The network editorsof MIKE 11 modelling is the canals and river network in the Mekong Delta, with input data from the study *"Research on the impact of climate change on rice production in the Mekong Delta"*, Bao Thanh (2012), [1]. The result of the volume of water in Cho Lach station from MIKE 11 modelling are used as input data for the boundary conditions of MIKE 21 FM modelling.

The boundary conditions in MIKE 11 are defined by the result of MIKE 11 modelling at Cho Lach and Tra Vinh station; the maritime boundary database are the series analyzed data from the hydraulic constants that was taken in the MIKE Toolbox and verified at the Vung Tau station in 2013; the upper stream boundaries database(the current, the water level) are monitoring data from Tan Chau - Chau Doc stations; Estuary boundaries database(the current, the water level) are from the monitoring data from Ba Lai, Ham Luong, Co Chien, Cung Mau, Dinh An, Tran De, Ganh Hao, Cua Lon, Song Doc, Xeo Ro, Rach Gia, Ha Tien. For the sediment transport, the suspended sediment concentration is input at open boundary (Fig 1) and dada collected and provided by study *"Research on the interaction between continental & marine and its impact on coastal ecosystems in the Eastern and Western coast"*, Nguyen Ky Phung, 2010 [2].

In order to calibrate and validate the model result, the computed results are compared with the observed data of water level, wave direction, wave height and suspended sediment concentration at two sites: July 9-16, 2014 and May 05-12, 2015. The computed results and observed data are showed in from Fig.3 to Fig.6:

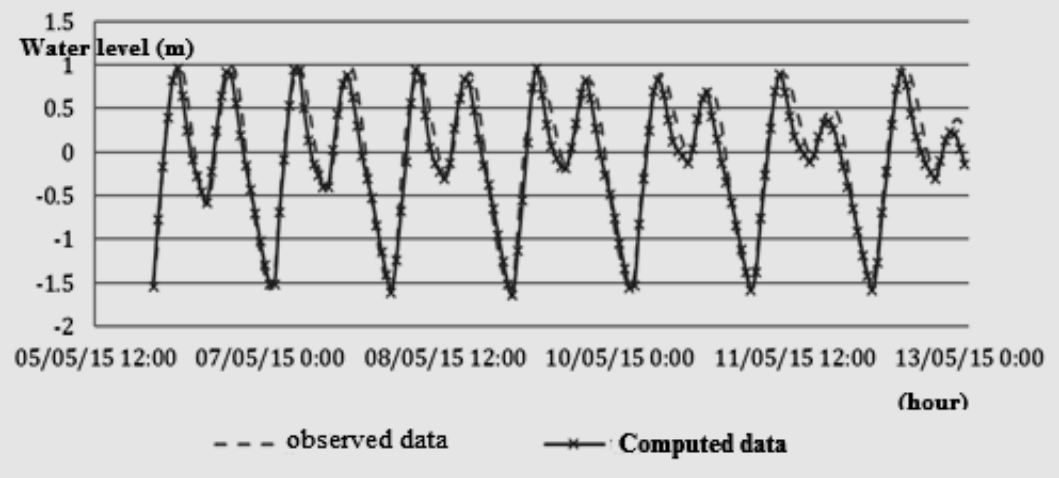

Fig 3. The computed results are compared with the observed data of water level at VT2, 05-12 May, 2015

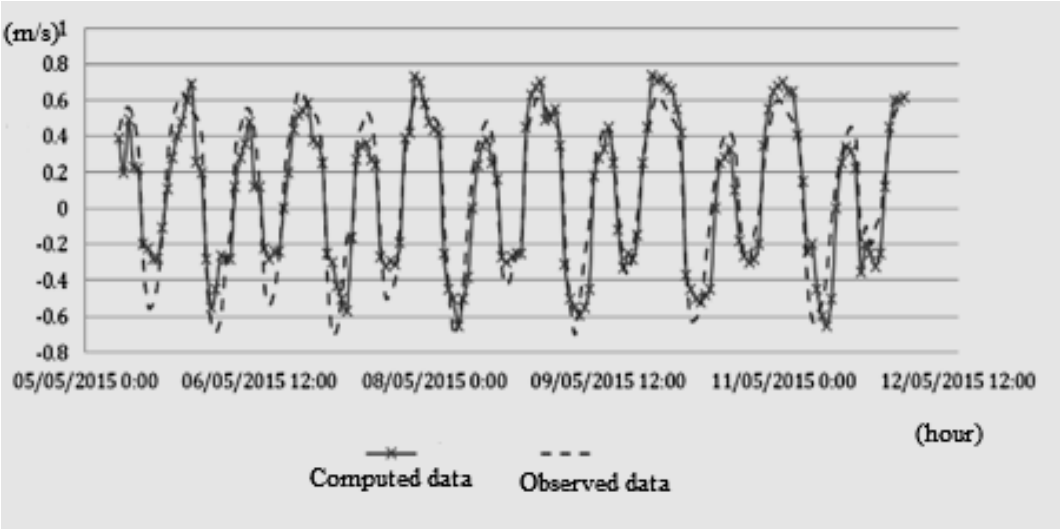

Fig 4. The computed results are compared with the observed data of water velocity at VT2, 05-12 May, 2015

The comparison between the computed and observed data are shown in from Fig. 3 to Fig.6, it is found good agreement with observed data. The error of Nash for these calculations are 0.95 for water level at VT2, 0.85 for velocity of water at VT2 (Fig.2).

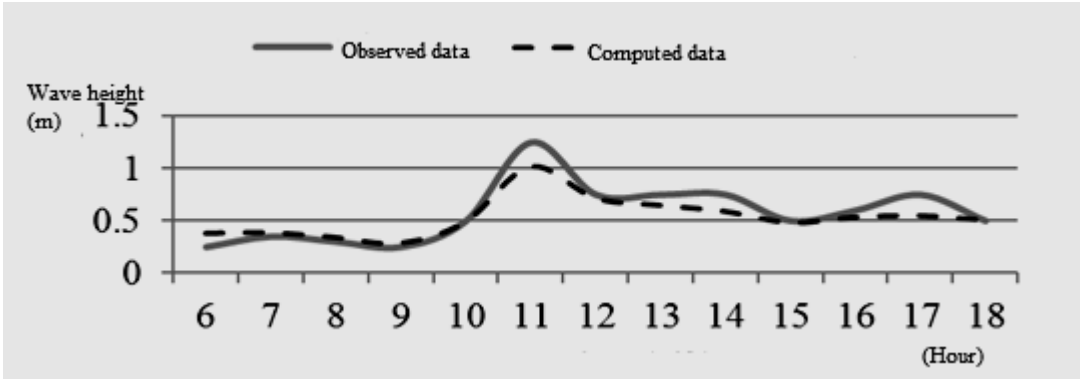

Fig 5. The computed results are compared with the observed data of wave height at VT4, July 9-16, 2014

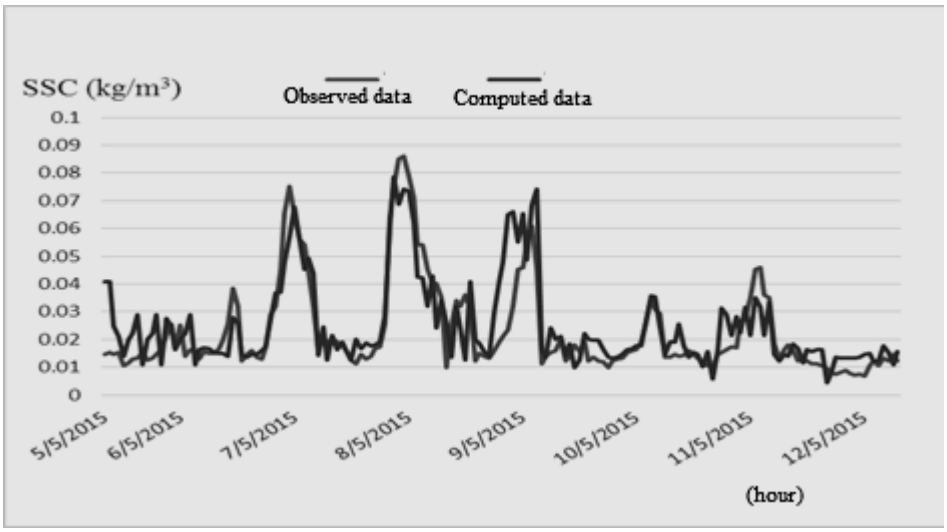

Fig 6. The computed results are compared with the observed data of suspended sediment concentration at VT2, 05-12 May, 2015

In summary, the comparison between the computed and observed data, the computed results presented above can be set up the models to simulate hydrodynamic regime and suspended sediment transport in this study area.

3. RESULTS AND DISCUSSION

Currents

After 12 months of mathematical model simulation, the results of simulation shown that the tidal velocity dominance in the dry season because of the low upstream flow, so the currents flow into the estuary. In the rainy season, the flood in upstream combined with the high tidal currents to make more rapid outflow of currents (Fig.7 and Fig.8).

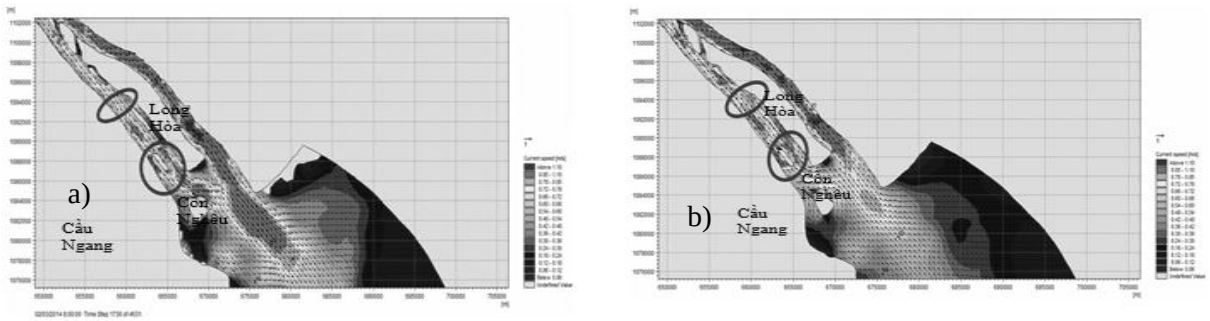

Fig 7. Computed water velocity and direction when low tides (a) and high tides (b) on March 2014

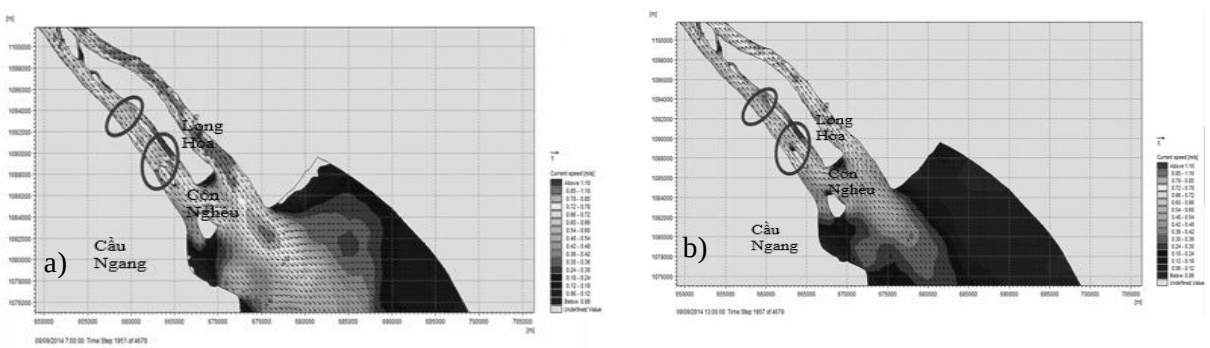

Fig 8. Computed velocity and direction of water when low tides (a) and high tides (b) on September 2014

Waves

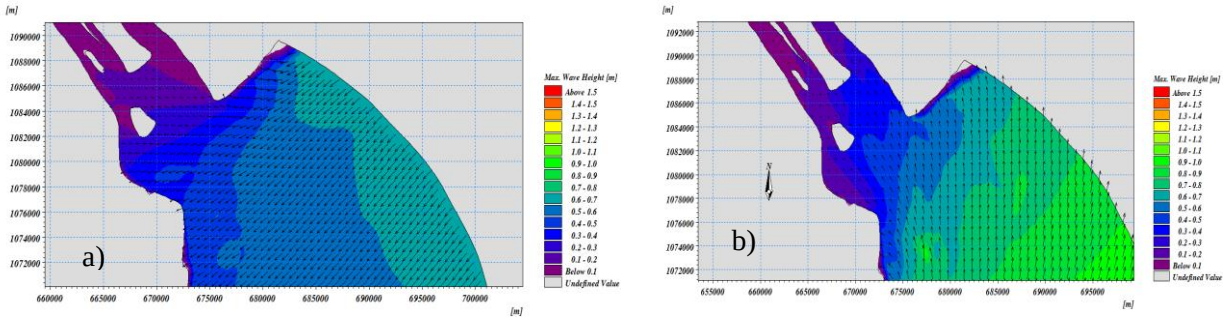

Fig 9. Computed Max wave height on March 2014 (a) and on September, 2014 (b)

The results of simulation showed that waves are significantly affected by the monsoon. The Northeast monsoon tends to coincide with the wind direction. Maximum waves height at offshore were raised up to 2 m. The waves were high and approaching nearly perpendicular to shore when it is approaching the shore and its height gets from 0.1 to 1 m. It can be seen that in the Northeast wind waves and current dominated compared with the upstream flow in the study area. In contrast, in the rainy season, the waves are mainly in the Southwest direction, the maximum coastal wave height is in the range of 0.2 - 0.6 m, while offshore waves have the highest height of 1.5 m, the upstream current is more dominant than the wave flow (Fig.9).

Suspended sediment transport

Dry season:

The contents of suspended sediment at the Cung Hauestuary is higher than at the Co Chien estuary. This is due to the river bed of Cung Hau is more shallow than the Co Chien River. It is easy to behave profligatelysuspended sediment at the bottom by flow, especially in Con Nghieu isle. The high tide flow has pushed the suspended sediment to upstream of the river mouth (Fig.10).

At the low tide, the water flow has pushed a part of the suspended from the river to the sea and along the coast of Tra Vinh. During the low tide, the amount of suspended sediment on the banks of Tra Vinh is also higher than on the banks of Ben Tre province (Fig.11). Therefore, the amount of suspended sediment can be accumulated and deposited at the Cung Hau estuary both at high tide and low tide in dry season.

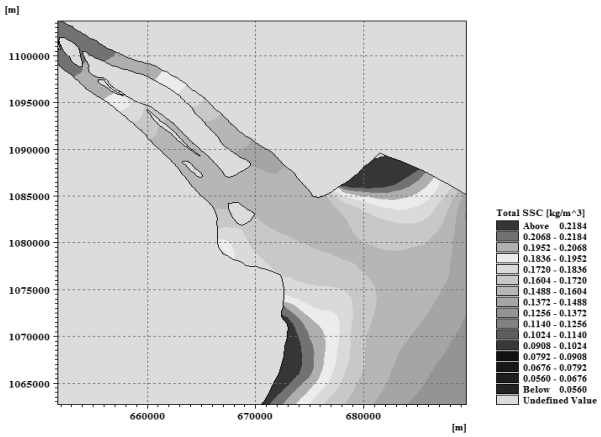

Fig 10. Computed suspended sediment at the high tides in the dry season

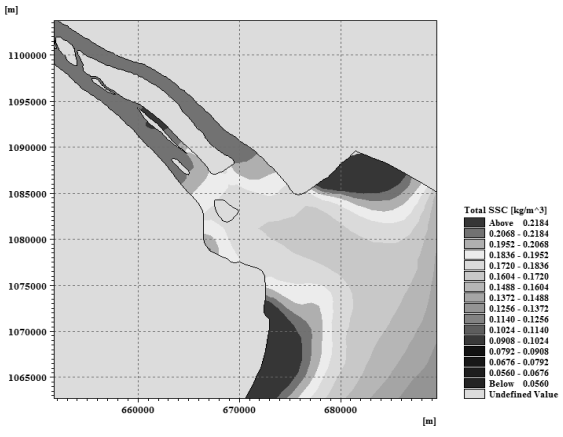

Fig 11. Computed suspended sediment at the low tides in the dry season

Rainy season:

At the high tide, the tidal flow has pushed suspended sediment into the river at both the Cung Hau and Co Chien estuary and its flow reduced the suspended matter content. However, these suspended sediments were not going far into the river like the dry seasonbecause of the huge flow of water from the upstream to the sea, so the tidal flow from the sea is weakened compared to the dry season. At the coastal areas of Ben Tre and Tra Vinh province still have a large amount of suspended sediment, due to the impact of waves and shallow river bed, to make these two areas of shoreline havinghighconcentration of suspended sediment (Fig.11).

At the low tide, the flow of the river are pushing out a part of the suspended sediment content from the river to the sea. At that time, the amount of suspended sediment on the side of the Co Chien estuary is lower than that of Cung Hau estuary because the Co Chien river bed has deep, the flow velocity is stronger, so the suspended content is brought faster. In the rainy season, the upstream flow is strong, so the river currentscarried a large of the suspended sediment from the river into the estuary. This amount is partly due to suspended sediment from the upstream and partly due to suspended sediment from the river, which is easily transported from the river, causing erosion in the river where there are strong flows (Fig.12).

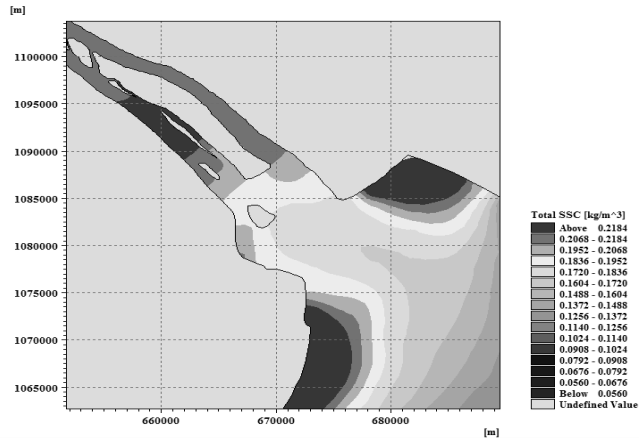

Fig 11. Computed suspended sediment at the high tides in the rainy season

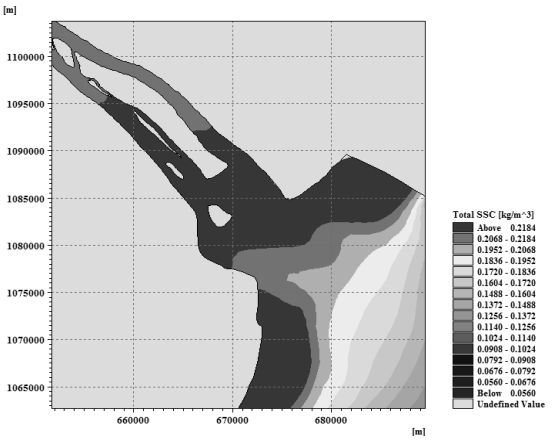

Fig 12. Computed suspended sediment at low tide in the rainy season

Conclusions

In the coastal area of the Co Chien estuary, suspended solids are strongly influenced by the wave regime. Areas in rivers and estuaries are affected by tidal flows and upstream flows, in which the suspended solids in large or smallof amount depends largely on the flow from the upstream.

During the high tide, the suspended solids content was pushed back by tidal flows from the estuary into the river, causing sedimentation with low flow velocities in areas such as Nghieu isle and Cung Hau estuary.

The concentration of suspended solids at low tide is higher than its one at high tide and the dischargesto the ocean. The suspended solids are transferred to other places by the sea current causing these areas to lose a huge amount of sedimentation. A large amount of suspended solids in the river flows out to the ocean. The results showed that the shoreline of Co Chien estuarial zones is highly vulnerable to deposition and erosion.

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ISOLATION AND SELECTION OF THERMOTOLERANT LACTIC ACID BACTERIA FROM AGRICULTURAL WASTES

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ABSTRACT

Global warming has caused many challenges effects on fermentation industry. Among the promising solutions, isolation of thermololerant lactic acid bacteria from different sources is a good answer to deal with environmental problems. This study aims to isolate and to select strains of lactic acid bacteria which have good thermotolerant and fermentation abilities from agricultural wastes collected from Mekong Delta areas and Binh Duong province, Vietnam. Besides, the morphology, biochemical properties and anti-bacterial activities of lactic acid bacteria were investigated. The thermotolerant and fermentation properties of the strains were also checked to select promising strain produced high lactic acid at high temperatures. As a result, 36 strains of lactic acid bacteria were isolated from samples collected in different areas with corresponding biochemical properties: Gram-positive, negative oxidase and catalase activities, positive acid forming. In thermotolerant test, strains CD2, CD4, ND1, ND2, KD2, KD3, KD5, KC2, and BV1 could grow at high temperature up to 47°C. 29/36 strains of lactic acid bacteria could inhibit the indicated strain of Bacillus subtilis and create clear zones on plates with the diameters ranged from 6.33 to 11 mm. Especially, 5 strains (ND3, ND1, ND4, CT1, BA4) could produce inhibition zone larger than 10 mm. Among 10 strains analyzed for acid fermentation, strain CC2 could ferment medium of sucrose 4% (w/v) and produce the highest total acid concentration at 1.425 g/L after 5 days.

Key words: agriculture waste, anti-bacteria properties, lactic acid bacteria, lactic acid fermentation, thermotolerant.

1. INTRODUCTION

Today, lactic acid has many applications in different aspects such as food processing and preservation, medicine and environment. In industry, lactic acid is the precursor for the production of degradable bio-polymer (San-Martın *et al.*, 1992). In medical and pharmaceutical areas, lactic acid and its prosthetic are components of some essential medicine (Chahal, 2000). Polymer catalyzed by polylactic acid plays important roles for their dominant material, physiological and biochemical properties (Tsuji *et al.*, 2008).

Axelsson (2004) stated that the fermentation process contributed greater efficiency than the industrial process. Lactic acid fermented by different sources. In industry, milk whey and sugarcane molasses were two of the most popular sources investigated for lactic acid production because of high sugar and nutrient content (Kotzamanidis *et al.* 2002; Alvarez *et al.*, 2010; Buyukkileci and Harsa, 2004). Lactic acid was used as a precursor for polymer industries which helped to reduce cost and serve for environmental applications (Martineza, 2013).

The climate of Vietnam is naturally appropriate for agriculture development. Annually, a large amount of agriculture waste consisting of rice straw, sugarcane bagasse and fruit waste were discharged to the environment. Those were potential sources for fermentation technology. In recent study, agriculture waste accounted for 65% total waste in farming area (School of Environmental Science and Technology, 2011).

In Vietnam, the application of agricultural wastes in industry and fermentation technology is initially developed and researched by different organizations. Along with the development of larger agriculture scale, this study aimed to isolate strains of lactic acid bacteria (LAB) from agricultural wastes collected in Can Tho, Vinh Long, Ben Tre, An Giang, Binh Duong and Dong Thap provinces and to select strains of bacteria which possess high antibacterial and fermentation properties for the applications in industry and food processing.

2. MATERIALS AND METHODS

2.1. Materials

Isolation sources including corn, cabbage, fruit wastes (mango, pineapple, longan, rambutan, lychee, ambarella, duku, etc.) collected in Can Tho city, Vinh Long, Ben Tre, An Giang, Binh Duong, and Dong Thap provinces. The indicated strain of *Bacillus subtilis* were stored at Food Biotechnology Laboratory, Biotechnology Research and Development Institute, Can Tho University.

MRS broth medium (De Man, Rogosa and Sharpe): peptone (10.0 g/L), meat extract (8.0 g/L), yeast extract (4.0 g/L), D(+) glucose (20.0 g/L), di-potassium hydrogen phosphate (2.0 g/L), Tween 80 (1.0 g/L), di-ammonium hydrogen citrate (2.0 g/L), sodium acetate (5.0 g/L), magnesium sulfate (0.2 g/L) and manganese sulfate (0.04 g/L) (De Man *et al.*, 1960)

Analysis chemical: Gram staining (crystal violet, iodine, ethanol, fushin), catalase test kit (hydrogen peroxide 3%), oxidase test kit.

2.2. Methods

2.2.1. Isolation of lactic acid bacteria from agricultural wastes:

Samples collected from different sources were innoculated to 50 mL MRS broth medium (room temperature, 180 rpm, 48 hours). Dilute the sample by 10 times with saline water (0.85% w/v), then culture the diluted suspension on MRS agar plates. Incubate the plates upside down in 48 hours. After incubation, select the typical colonies to transfer repeatedly on MRS agar plates until the pure colonies were observed. Check the cells on microscope (at 1,000X magnification).

2.2.2. Identification of morphological and biochemical properties of the strains

The pure strains were test for the Gram, oxidase and catalase activities, lactic acid production (by U-ferment reagent) to select strains corresponding to LAB group.

2.2.3. Analyze for lactic acid production of LAB strains

The strains of LAB were first cultured in MRS broth medium (24 hours, 37°C, 180 rpm). Dropping droplets of culture medium on MRS agar plate supplemented with bromocresol purple (0.01% w/v) and calcium carbonate ($CaCO_3$ 0.05% w/v), then incubated at 37°C. Measure for the diameters of clear zone around the colonies after 24 and 48 hours to select strains possess high acid production.

2.2.4. Analyze for the thermotolerant abilities of the selected strains

Culture LAB strains on MRS agar plates and incubate in 48 hours at 37, 39, 41, 43, 45 and 47°C. The colonies forming on plates were checked in order to select strains which performed high thermotolerant abilities.

2.2.5. Analyze for the antibacterial properties and bacteriocin production of the selected LAB strains

This test followed "well diffusion agar" method (Hernández *et al.*, 2004). The indicated strain of *B. subtilis* was first cultured on Nutrient broth (180 rpm, at 35°C**)**. At the same time, LAB strains were cultured into MRS broth medium at 37°C for 36 hours.

"Well diffusion agar" method: This method based on the anti-microbial properties of bacteriocin against the indicated bacteria strain and the forming of prohibitory zone on plates. On theory, the bacteriocins created by LAB strains diffuse through agar medium and have impacts on the indicated bacteria strain. Then, the prohibitory zone will form around the wells on plates.

Preparation of the indicated bacterial strain: The indicated strain was first cultured on plate in 24 hours to the density of 10^9 cells/mL (log 9, checked by Hemocytometer). Inoculated 10% (v/v) bacterial suspension into plates containing fish sauce – peptone agar (2% v/v agar, liquid state at 50°C) and shake well to mix the bacteria within the medium. The bacterial agar medium was poured on plates and were cooled and solidated. Wells on agar plates were created by a sterile metal cylinder with 5-milimeter diameter.

Preparation of bacteriocin suspension: Cultured the LAB strain on MRS broth medium (48 hours) and then centrifuge the medium at 8,000 rpm in 15 minutes at 4°C to remove cells. After centrifugation, the suspension was collected. Adjust pH to 6.5. Add 80 µL suspension (contained bacteriocin) to each well on agar plates (inoculated with the indicated bacterial strain). The prohibitory zones were then measured to determine the antibacterial properties.

2.2.6. Analyze for the lactic acid fermentation at high temperatures

Inoculate 1 mL bacterial culture (10^7 cells/mL) to 99 mL sucrose 4% (v/v) medium and incubate at 37, 38, 39 and 40^{o}C. Check for the total acid content daily in 7 days by titration method.

2.2.7. Data interpreting and analyze method

Each data in this study is the mean of the repetitions. Graphs were built by Microsoft Excel software (Microsoft Inc., USA) and analyzed by Minitab 16.2.1 software (Minitab Inc., USA).

3. RESULTS AND DISCUSSIONS

3.1. The LAB strains isolated from agricultural wastes

Sixty-six strains were isolated from samples of agricultural wastes collected in An Giang, Ben Tre, Binh Duong, Can Tho, Dong Thap and Vinh Long provinces (Table 1).

Table 1. LAB isolated from agriculture waste

Name	Number of strain	Samble	Collected Sources	Name	Number of strain	Samble	Collected Sources
BA	5	Cabbage	An Giang	VC	1	Corn	Can Tho
CA	3	Ambarella	An Giang	XC	1	Mango	Can Tho
CD	4	Rambutan	Binh Duong	NT	3	Longan	Ben Tre
ND	4	Longan	Binh Duong	CT	1	Rambutan	Ben Tre
KD	5	Pineapple	Dong Thap	BV	1	Duku	Vinh Long

Name	Number of strain	Samble	Collected Sources	Name	Number of strain	Samble	Collected Sources
CC	2	Corn	Can Tho	VV	1	Lychee	Vinh Long
KC	2	Pineapple	Can Tho				

3.2. Morphology of colony and cell of isolated strains

Table 2 shows the morphology of 36 bacterial strains isolated from agriculturalwastes. All 36 strains had circular colonies with entire margin. The colony size ranged from 1 to 3 mm. 30/36 strains had milky white and the remains (BA5, CA1, CC2, KC1, KC3 and NT2) had transparent white colonies. Except 3 strains (KC1, KC2 and KC3) with flat elevation, the elevation of the remained colonies was raised. The cells of all strains were immobile.

Table 2. Morphological properties of isolated strains

No.	Strains	Cell morphology	No.	Strains	Cell morphology
1	BA1	Coccus	19	KD3	Diplococci
2	BA2	Streptococci	20	KD4	Bacillus
3	BA3	Bacillus	21	KD5	Diplobacci
4	BA4	Diplobacci	22	CC1	Diplococci
5	BA5	Bacillus	23	CC2	Diplococci
6	CA1	Streptococci	24	KC1	Diplococci
7	CA2	Diplobacci	25	KC2	Streptococci
8	CA3	Diplococci	26	KC3	Bacillus
9	CD1	Diplobacci	27	VC1	Streptococci
10	CD2	Diplococci	28	XC1	Diplobacci
11	CD3	Streptococci	29	XC2	Diplococci
12	CD4	Diplococci	30	XC3	Diplococci
13	ND1	Streptococci	31	NT1	Streptococci
14	ND2	Diplococci	32	NT2	Diplococci
15	ND3	Bacillus	33	NT3	Diplobacci
16	ND4	Diplobacci	34	CT1	Bacillus
17	KD1	Diplococci	35	BV1	Diplococci
18	KD2	Bacillus	36	VV1	Bacillus

Under microscope at 1,000X magnification, the strains were coccus or bacillus (Figure 1). Among them, there were 8 bacillus strains, 7 diplobacilli strains, 1 coccus strain, 13 diplococci strains and 7 streptococci strains.

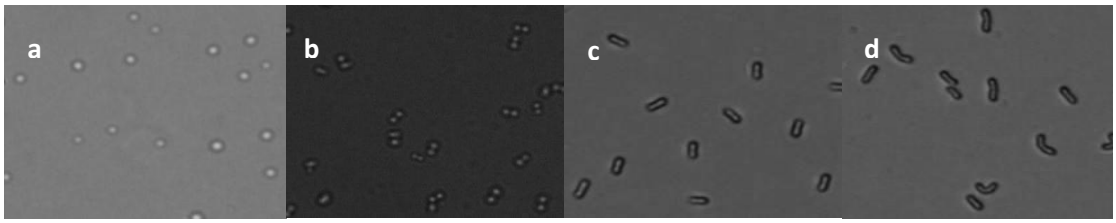

Fig 1. Cell morphology of isolated strains at 1,000X magnification:
(a) Strain BA1 (coccus); (b) train KD3 (diplococci; (c) Strain CD1 (diplobacilli); (d) Strain CA2 (diplobacilli)

3.3. Biochemical properties of isolated strains

The biochemical properties of isolated strains were displayed in Table 3.

Table 3. Biochemical properties of isolated LAB strains

Strain	Gram	Catalase	Oxidase	Uferment test	Zones of $CaCO_3$ degradation (mm)	
					1 day	2 days
BA1	+	-	-	++	0.867	0.967
BA2	+	-	-	+	0.800	0.800
BA3	+	-	-	++	1.000	1.133
BA4	+	-	-	+	1.000	1.100
BA5	+	-	-	++	0.733	0.767
CA1	+	-	-	+	1.200	1.367
CA2	+	-	-	++	1.167	1.467
CA3	+	-	-	+	0.967	1.067
CD1	+	-	-	++	0.900	0.967
CD2	+	-	-	++	1.000	1.070
CD3	+	-	-	+	1.133	1.233
CD4	+	-	-	++	0.967	1.167
ND1	+	-	-	++	1.333	1.367
ND2	+	-	-	++	1.100	1.267
ND3	+	-	-	++	1.167	1.433
ND4	+	-	-	++	1.000	1.067
KD1	+	-	-	+	1.000	1.100

Strain	Gram	Catalase	Oxidase	Uferment test	Zones of $CaCO_3$ degradation (mm)	
					1 day	2 days
KD2	+	-	-	++	1.000	1.133
KD3	+	-	-	++	1.070	1.267
KD4	+	-	-	++	0.867	1.100
KD5	+	-	-	++	1.070	1.100
CC1	+	-	-	++	1.067	1.433
CC2	+	-	-	++	1.130	1.300
KC1	+	-	-	++	1.000	1.100
KC2	+	-	-	+	0.633	0.633
KC3	+	-	-	++	1.067	1.167
VC1	+	-	-	++	0.900	1.000
XC1	+	-	-	++	0.667	0.700
XC2	+	-	-	++	0.733	0.767
XC3	+	-	-	+	0.667	0.733
NT1	+	-	-	+	1.000	1.133
NT2	+	-	-	+	0.967	1.067
NT3	+	-	-	++	1.033	1.100
CT1	+	-	-	+	1.167	1.367
BV1	+	-	-	+	0.967	1.000
VV1	+	-	-	+	1.033	1.100

Results from Table 2 and Table 3 indicated that the isolated strains were lactic acid bacteria with appropriate features such as Gram positive, negative catalase and oxidase activities, abilities to grow on MRS medium, coccus or bacillus cells.

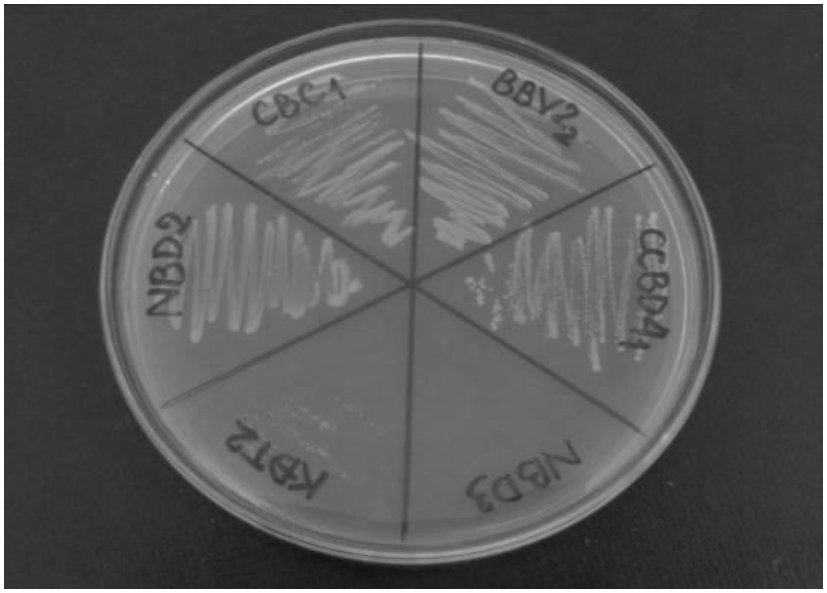

Fig 2. Some isolated LAB strains at 47^{o}C

3.4. Thermotolerant abilities of isolated LAB strains

Table 4 shows that all strains could grow at 37°C. 34/36 strains could grow at 39°C and 41°C. At 43°C, 33/36 strains could from colonies. 12/36 strains could grow at 45°C. At 47°C, only 9 strains could grow. According to Jenkins (2005), thermophillic bacteria could adapt to the temperature higher than 45°C whereas thermololerant bacteria could grow at temperature from 20 to 45°C.

Table 4. Thermotolerant abilities of LAB strains

Strain	Temperatures						Strain	Temperatures					
	37	39	41	43	45	47		37	39	41	43	45	47
BA1	+	+	+	+	+	-	KD3	+	+	+	+	+	+
BA2	+	+	+	+	+	-	KD4	+	+	+	+	+	-
BA3	+	+	+	+	+	-	KD5	+	+	+	+	+	+
BA4	+	+	+	+	-	-	CC1	+	+	+	+	-	-
BA5	+	+	+	+	+	-	CC2	+	+	+	+	+	-
CA1	+	+	+	+	+	-	KC1	+	+	+	+	+	-
CA2	+	+	+	+	+	-	KC2	+	+	+	+	+	+
CA3	+	+	+	+	+	-	KC3	+	-	-	-	-	-
CD1	+	+	+	+	+	-	VC1	+	+	+	+	+	-

Strain	Temperatures						Strain	Temperatures					
	37	39	41	43	45	47		37	39	41	43	45	47
CD2	+	+	+	+	+	+	XC1	+	+	+	+	-	-
CD3	+	+	+	+	+	-	XC2	+	+	+	+	+	-
CD4	+	+	+	+	+	+	XC3	+	+	+	+	-	-
ND1	+	+	+	+	+	+	NT1	+	-	-	-	-	-
ND2	+	+	+	+	+	+	NT2	+	+	+	+	-	-
ND3	+	+	+	+	+	-	NT3	+	+	+	+	-	-
ND4	+	+	+	-	-	-	CT1	+	+	+	+	-	-
KD1	+	+	+	+	-	-	BV1	+	+	+	+	+	+
KD2	+	+	+	+	+	+	VV1	+	+	+	+	-	-

Note: (+) Colony forming (-) No colony

3.5. Antibacterial properties of isolated LAB strains

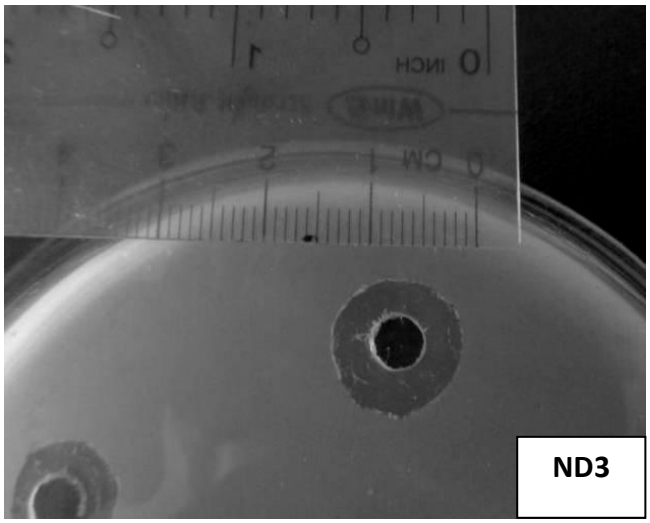

Fig 3. Strain ND3 with dorminant antibacterial properties

Table 5 proves that 7/36 strains (CA3, XC1, XC2, XC3, NT2, VV1, BV1) could not produce bacteriocin whereas the remains could inhibit the indicated strain and create inhibitory zone from 7.33 to 11 mm diameters. Table 5 and Figure 3 showed that 5 strains (ND3, ND1, ND4, CT1 and BA4) could create clear zones with the diameters larger than 10 mm. Among them, strain ND3 had the largest zone up to 11 mm. This inhibitory zone (11 mm) is larger than that of Huynh Nguyen Nhu Thu (2015) with the inhibitory zone at 10.33 mm. Along with thermotolerant test, both tests proved that strain ND1 could grow at 47°C and could produce bacteriocin which effectively inhibited the indicator *B. subtilis*. This strain is one promising strain which could be applied in food fermentation, preservation and biomass production.

Table 5. Inhibitory capacity of LAB strains against *B. subtilis* in "well diffusion agar" test

No.	Strains	Inhibitory zone (mm)	No.	Strains	Inhibitory zone (mm)
1	BA1	8.67^{cde}	19	KD3	7.33^{fghi}
2	BA2	7.67^{efgh}	20	KD4	6.67^{hi}
3	BA3	8.33^{cdef}	21	KD5	7.00^{ghi}
4	BA4	10.33^{ab}	22	CC1	9.00^{cd}
5	BA5	7.67^{efgh}	23	CC2	8.67^{cde}
6	CA1	8.67^{cde}	24	KC1	8.00^{defg}
7	CA2	8.67^{cde}	25	KC2	8.33^{cdef}
8	CA3	0^{k}	26	KC3	8.33^{cdef}
9	CD1	7.00^{ghi}	27	VC1	6.67^{hi}
10	CD2	7.00^{ghi}	28	XC1	0^{k}
11	CD3	6.67^{hi}	29	XC2	0^{k}
12	CD4	6.33^{i}	30	XC3	0^{k}
13	ND1	10.33^{ab}	31	NT1	9^{cd}
14	ND2	9.33^{bc}	32	NT2	0^{k}
15	ND3	11.00^{a}	33	NT3	8.00^{defg}
16	ND4	10.33^{ab}	34	CT1	10.33^{ab}
17	KD1	8.67^{cde}	35	BV1	0^{k}
18	KD2	7.00^{ghi}	36	VV1	0^{k}

Note: The values are means of repetitions with following characters which the values with same characters show no statistical difference at 95% similarity.

3.6. The fermentation capacity of isolated LAB strains at high temperatures

Table 6 shows that strains CC2 and KD3 could produce the highest total acid content at the suitable temperature at 38°C. The highest acid content could be accomplished on day 5^{th} (1.425 g/L). At 39°C, the ability to produce lactic acid of strain CC2 (1.125 g/L) was better than that of strain KD3 (0.675 g/L). However, this total acid content was lower than that in the test of Nguyen Van Chuong (2008) in which sucrose medium were fermented by LAB to produce sour bamboo shoot, a traditional food, with the acid content 3.07% (w/v) at day 7. This lower result was due to the fermentation at high temperature was not favorable compare to at normal condition. According to Streit *et al.* (2008), the temperature has effects on the stability of cell membrane and the activities of the enzymes that also effects fermentation abilities.

Table 6. Total acid contents produced by 10 selected LAB strains

Strain	Temperature (°C)	Total acid content at day 5 (g/L)	Strain	Temperature (°C)	Total acid content at day 5 (g/L)
BA1	37	0.675^{fghijk}	KD3	37	0.525^{ghijk}
	38	$0.825^{defghij}$		38	1.425^{abc}
	39	$0.9^{cdefghi}$		39	0.675^{fghijk}
	40	0.675^{fghijk}		40	0.45^{hijk}
CA2	37	0.525^{ghijk}	KD5	37	0.525^{ghijk}
	38	$0.75^{efghijk}$		38	0.675^{fghijk}
	39	$0.75^{efghijk}$		39	0.675^{fghijk}
	40	0.675^{fghijk}		40	0.525^{ghijk}
CC2	37	0.525^{ghijk}	ND2	37	0.45^{hijk}
	38	1.425^{abc}		38	1.125^{bcdef}
	39	1.125^{bcdef}		39	$0.825^{defghij}$
	40	0.6^{fghijk}		40	0.45^{hijk}
CD2	37	$0.9^{cdefghi}$	ND3	37	0.675^{fghijk}
	38	$0.75^{efghijk}$		38	1.05^{bcdefg}
	39	0.6^{fghijk}		39	$0.75^{efghijk}$
	40	0.45^{hijk}		40	0.525^{ghijk}
CD4	37	0.525^{ghijk}	NT4	37	0.375^{ijk}
	38	0.675^{fghijk}		38	1.125^{bcdef}
	39	0.675^{fghijk}		39	0.675^{fghijk}
	40	0.45^{hijk}		40	0.6^{fghijk}

4. CONCLUSIONS

Thirty-six LAB strains were isolated with corresponding morphological and biochemical properties. Among them, 9 stains (CD2, CD4, ND1, ND2, KD2, KD3, KD5, KC2, BV1) could grow at high temperature up to 47°C. Twenty-nine strains could inhibit indicator *B. subtilis* with the inhibitory zone up to 11 mm (strain ND3). Besides, strain CC2 could ferment the medium of sucrose 4% (w/v) and produce lactic acid at 1.425 g/L in 5 days at 38°C.

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STRUCTURE AND BIOACTIVITY OF FUCOIDAN ISOLATED FROM SOME VIETNAMESE BROWN SEAWEED SPECIES

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ABSTRACT

The aim of this paper is to provide information on the most recent achievements in the elucidation of structure and the investigation of biologycal activity of fucoidans isolated from Vietnamese Brown seaweeds. Our results showed that a highly sulfated fucoidan fraction isolated from Sargassum polycystum contain a backbone built up mainly of →3)-α-L-Fucp(4SO_3-) residues as in many other fucoidans, but rather short sequences of these residues are interspersed by single →2)-α-D-Galp residues also sulfated at position 4. The fucoidan from Turbinaria ornata has a backbone of →3)-α-L-Fucp residues with braches →4)-Galp(1→ at C-4 of the fucan chain. Sulfate groups are attached mostly at C-2 and sometimes at C-4 of both fucose and galactose residues. For the first time a combination of Tandem ESI-MS, SAXS and molecular simulation has been done for determination of conformational structure of fucoidan from Turbinaria ornata. The results indicated that T.ornata fucoidan has a rod like bulky chain conformation: insolution. Fucoidan from Sargassum henslowianum has (1→3)-α-L-Fucp backbone and sulfate groups occupied mostly at C-2, C-4 and sometimes at C-3 position of fucose residues. The results of in vivo bioactivity examination revealed that the S.henslowianum fucoidan in the dose of 100 mg/kgP/day by oral administration helped decrease cholesterol levels on obese mice. The highly sulfated fucoidan fraction isolated from Sargassum mcclurei has the main chain containing a 1→3)-α-L-Fucp(2,4SO_3-)-(1→3)-α-L-Fucp(2,4SO_3-)-(1→ motif with 1,4-linked 3-sulfated α-L-Fucp inserts and 6-linked galactose on reducing end. All fucoidans fractions from S.mcclurei were less cytotoxic and displayed colony formation inhibition in colon cancer DLD-1 cells. Fucoidan extracted from the three species S.mcclurei, S.polycystum and T.ornata of Nhatrang Bay displayed similar antiviral activities while displaying no cell toxicity. Our results showed that the anti-HIV activity of fucoidans is not primarily linked to the sulfate content and the appropriate position of sulfate groups in the fucoidan backbones was also not associated with the antiviral activity. Fucoidans inhibited HIV-1 infection when they were pre-incubated with the virut but not with the cells, and not after infection, blocking the early steps of HIV entry into target cells. These data contribute to a better understanding of the influence of fucoidans structural characteristics on their biological activity.

Keywords: bioactivity, brown seaweed, fucoidan, hypolipidemic activity, structure

1. INTRODUCTION

Fucoidans are sulfated polysaccharides derived from marine brown seaweed. They essentially contain fucose and sulfate groups and with some others, such as galactose, xylose, mannose and uronic acids. Fucoidan is made up of α-l-fucose units linked by (1→4) and (1→3) glycosidic bonds and sulfated at positions 2 and/or 3 and/or 4. Fucoidans were reported to possess various biological effects *in vitro* and *in vivo* such as anti-inflammatory, anticoagulant, antithrombotic, antiviral including anti-HIV, immunomodulatory, antioxidant, and antitumor (Cumashi et al, 2007, Bilan et al, 2013).

Recently, many reports demonstrated that NMR and tandem electrospray ionization mass spectrometry (tandem ESIMS) were useful techniques to determine the chemical structure of anionic polysaccharides, especially fucoidan, which has a very complex structure. With the development of high-resolution instrumental processes, such as scattering techniques (*i.e.*, light scattering, X-ray and neutron scattering), it is possible to study the conformation of a polysaccharide at the molecular level. Small Angle X-ray Scattering (SAXS) is a powerful technique that can provide additional structural information of high-resolution structures, and determine the conformation of molecule in solution (Glatter, 1982).

Vietnam has a coastline of about 3200 km with the climate varying from subtropical in the northern part to tropical in the southern part of the country, very suitable for different seaweed species to grow. The total number of seaweed species along the coast was estimated to be nearly 650, including about 230 Rhodophyta, 125 Phaeophyta, 145 Chlorophyta and 75 Cyanophyta (Huynh & Nguyen, 1998). However, study on fucoidans from Vietnam brown seaweeds is very limited.

This paper aims to review our results on determination of structure and biological activity of fucoidans extracted from Vietnam brown seaweeds.

2. METERIAL AND METHOD

2.1. Seaweed collection

Seaweed species were collected in Vietnam from 2008 to 2011 and identified by Dr. Le Nhu Hau (Nhatrang Institute of Technology Research and Application, VAST). Voucher specimens are deposited in Nhatrang Institute of Technology Research and Application. The collected seaweeds were washed with tap water in order to remove salt, epiphytes, and sand attached to the surface of the samples and then dried by air in the shade. The dried seaweeds were crushed and grounded into a powder form, passed through a 40-mesh sieve and stored at room temperature.

2.2. Extraction and purification of fucoidan

The extraction followed the method of Bilan et al (Bilan et al, 2002). 200g of dried seaweed was treated at room temperature with a MeOH–$CHCl_3$–water mixture (4:2:1 v/v) to remove colored matter, filtered and vacuum dried to get defatted algal biomass. This material was extracted with 2% aqueous $CaCl_2$ solution under mechanical stirring at 85°C for 8 h. An aqueous hexadecyltrimethylammonium bromide solution (10%) was added to extract. The precipitate formed was centrifuged, washed with water, stirred with 20% ethanolic NaI solution for 2–3 days at room temperature, washed with ethanol, and dissolved in water. The solution was dialyzed. Fucoidan was concentrated and recovered as sodium type by freeze-drying.

2.3. Chemical analysis

Neutral monosaccharide compositions were elucidated by the method of Bilan et al (Bilan et al, 2002). Alditol acetate derivative was prepared by hydrolysis of fucoidan sample in 2M CF_3COOH (TFA), 8h at 100°C and analyzed by 17AAFW Shimadzu GC-FID.

Uronic acid content was determined by following the carbazole method (Bitter & Muir, 1962) using D-gluconic acid as a standard. Interference from hexoses in this assay was determined by use of controls containing the same ratio of component sugars as found in fucoidan. Differences in the absorption characteristics of products derived from uronic acid and hexoses were used to determine the final uronic acid content.

Sulfate content was estimated using gelatin/$BaCl_2$ method (Dodgson, 1961) after hydrolysis of fucoidan in 2 M TFA as described above.

2.4. NMR: NMR spectra were recorded on Bruker Avance 500 in D_2O solution using DSS as an internal standard at room temperature.

2.5. ESI-MS: ESIMS experiments were performed on a Xevo TQ MS, Waters-USA. The analyses were carried out in negative mode. Dried fucoidan samples were diluted in 1:1 MeOH–water and introduced into the mass spectrometer. Nitrogen gas was used as a nebulizer gas at 30.00 psi with a flow rate of 650 L/hour and kept at 180^{o}C.

2.6. SAXS measurement: The SAXS was observed with the small-angle X-ray scattering equipment for solution (SAXES) installed at BL-10C section of the Photon Factory, Tsukuba, Japan, from the aqueous solutions of fucoidan with or without salt at room temperature.

2.7. Acid hydrolysis*:* Acid hydrolysis of the fucoidan was carried out using trifluoroacetic acid (0.75 M, 1 h, 60^{o}C).

2.8. Anti-HIV activity assay: MTT assays were realized at Retrovirology Laboratory – CRP Santé – Luxembourg, on human T lymphocyte cell line (MT4), which had been transferred by VLTH-1 (Virus lymphotropique T human). These cell are particularly sensitive to HIV-1, after d6 to d7 of over-infection, they show a strong CPE (Cytophathogenesis effect) guiding to 50 – 80% cell death. RPMI 1640 (Invitrogen) contains L-glutamine (Invitrogen) 2mM, a mix of penicillin/streptomycin (Invitrogen) 100U/ml and 10% of FBS will add to culture medium. MTT assays took a place at day 5 of cell culture. The tests allowed us to estimate the protection against virus (HIV-1 IIIb reference strain) on MT4 cell line of the extracted product.

2.9. Hypolipidemic activity assay: Thirty white house mice of BALB/c strain with weights ranging from 20 to 25 grams were raised in the Animal Section of the Institute of Biological Technology, Vietnam Academy of Science and Technology. The mice were divided into 2 groups: 10 mice in group 1 and 20 mice in group 2. Their diets including low fat diet LFD (for group 1) and high fat diet HFD (for group 2) were based on the formula described previously. Foods were made fresh every day and mice were fed depending on their appetite. They were weighed once a week to track their weight gain. After 5 weeks, mice that gained the most weight from group 2 were divided into 2 subgroups: 10 mice, to drink distilled water, which used to prepare fucoidan solution in subgroup 1 and 10 mice, to drink aqueous solution of fucoidan, with the dosage of 100 mg/kgP/day in subgroup 2. The mice in two subgroups drank either fucoidan or water in 4 weeks straight. During this time, they followed a low fat diet. After that, they were weighed, and their bloods were collected to obtain blood serum and test for cholesterol, LDL-cholesterol and triglyceride levels. The mice were killed by pulling on their neck bones, and then were quickly dissected to obtain their livers, which were weighed along with their fats.

2.10. Cytotoxicity assay: Cytotoxicity of preparations for uninfected Jurkat and SC-1 cells was determined on changes in morphology and the number of viable cells using Trypan blue staining solution (Invitrogene Corp., Carlsbad, CA, USA). For this purpose, the preparation of polysaccharide up to concentration of 10 and 100 µg/mL was added in the medium. After 48 h, Jurkat cells were resuspended in the medium and stained with 0.4% solution of Trypan blue for 5 min. SC-1 cells were removed by trypsin, resuspended in the medium and stained with 0.4% Trypan blue solution for 5 min. Then, the number of viable (unstained) and nonviable (stained) cells were counted in a Neubauer chamber. The number of living cells in the population was estimated by the number of unstained cells (as a percentage of the total).

3. RESULTS AND DISCUSSION

3.1. Fucoidan from brown seaweed *Sargassum polycystum*

A fucoidan was isolated from the brown alga *Sargassum polycystum*. The fucoidan was fractionated by anion-exchange chromatography to four fractions, and the main fraction F4 was analyzed by chemical methods, such as desulfation, methylation, Smith degradation and partial acid hydrolysis with mass-spectrometric control, as well as by NMR spectroscopy. Several 2D procedures, including HMQC-

TOCSY and HMQC-NOESY, were used to obtain reliable structural information from the complex spectra. F4 was shown to contain a backbone built up mainly of 3-linked α-l-fucopyranose 4-sulfate residues, as in many other fucoidans, but rather short sequences of these residues are interspersed by single 2-linked α-d-galactopyranose residues, also sulfated at position 4. Hence, F4 is an example of a new sulfated galactofucan isolated from the brown alga. According to the data obtained, the distribution of galactose residues along the polysaccharide backbone seems to be not strictly regular, but the real sequence of monomers in the polymeric molecules needs additional investigation.

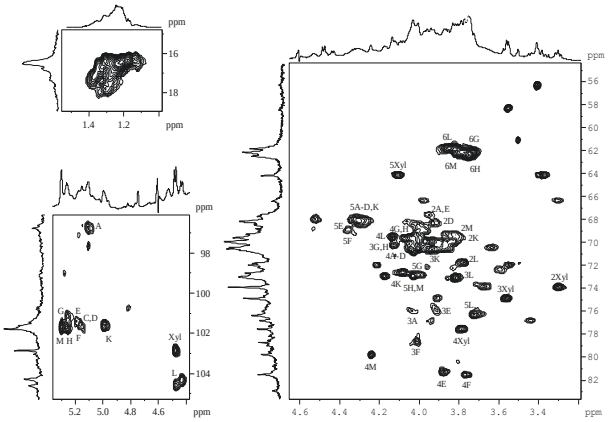

Fig 1. 2D HSQC NMR spectra of desulfated F4

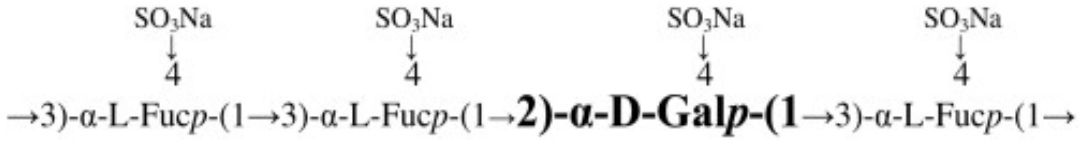

Fig 2. Structure of fucoidan of F4

3.2. Fucoidan from brown seaweed *Tubinaria ornata*

A fucoidan isolated from the brown seaweed *Turbinaria ornata* had high sulfate content and had very simple monosaccharide composition containing mainly fucose and galactose with ratio Fuc:Gal ≈ 3:1. It was classified as galactofucan. Galactofucan from *Turbinaria ornata* was shown to have a backbone of 3-linked α-l-Fucp residues, which could be sulfated at C-2 (mainly) and C-4 (partly). Sulfates also were found at C-2 (mainly) or at C-4 (partly) of →4)-Galp(1→ chains, that were attached at C-4 of a backbone as branching points. Our fucoidan has a rod-like bulky chain conformation in solution. It is the first time a combination of ESIMS, SAXS and molecular simulation has been done for structural determination of fucoidan. Although more studies are needed to obtain a fine structure of the fucoidan, this combination promised a useful way to solve the difficulty of the structural determination of fucoidan.

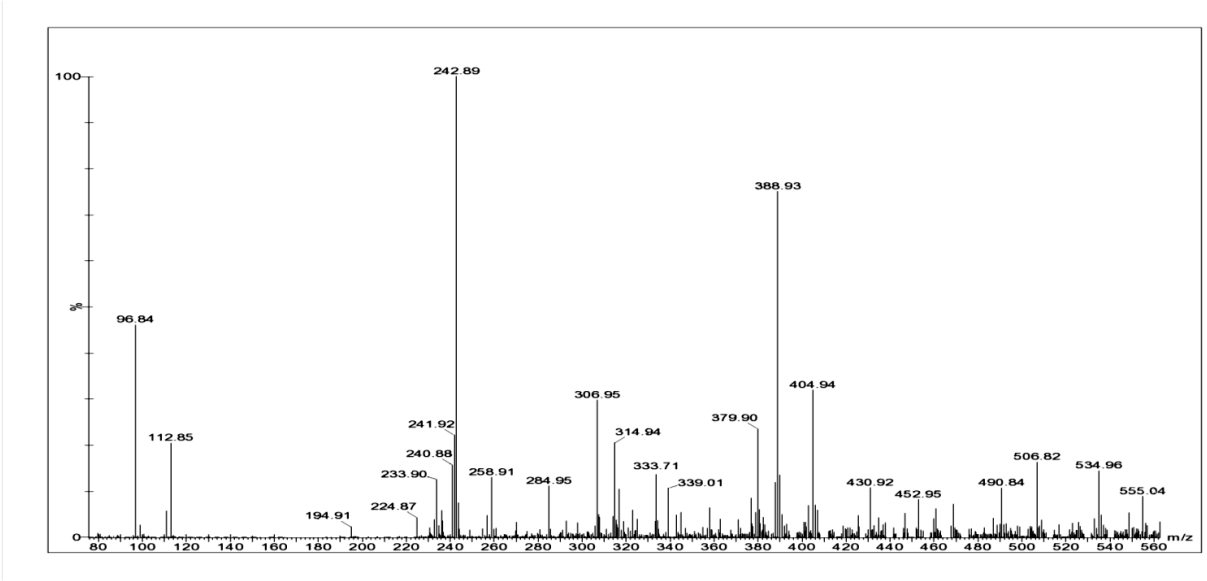

Fig 3. ESI-MS of sulfated oligosaccharides derived from the hydrolysis of fucoidan of the brown alga *Turbinaria ornata*

The SAXS method provides information of local structure of the macromolecule, therefore we aim to use SAXS data and molecular model for a better understanding of fucoidan structure. Although ESIMS gave the chemical structure of oligosaccharide, we built a molecular model based on obtained chemical structure in order to find an acceptable "average structure" of the fucoidan. From ESIMS, we proposed that the backbone of the fucoidan mainly composed of 1→3 linked fucose residues; branches were galactose and/or fucose residues with 1→4 type of linkages and sulfate groups were attached at C2 and C4 of both fucose and galactose residues. Sugar analysis indicated that molar ratio Fucose:Galactose ≈ 3:1. Based on the structural information we proposed some structural units and built molecular models. To find the most acceptable model, the calculated scattering curves were compared with observed SAXS curves. The result indicated that molecular model (Figure 4) built based on unit d fitted quite well with experimental curves. This result can give additional information about the structure of the fucoidan, namely that our fucoidan has a very bulky structure with large branches, which are composed of both galactose and fucose residues (Thanh, T.T.Thuy, 2013).

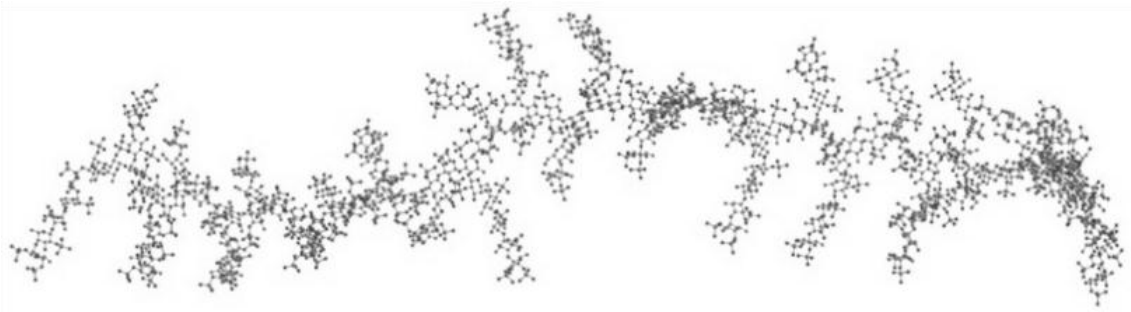

Fig 4. Fucoidan molecular model.

3.3. Fucoidan from brown seaweed *Sargassum mcclurei*

Three different fucoidan fractions were isolated and purified from the brown alga, *Sargassum mcclurei*. The SmF1 and SmF2 fucoidans are sulfated heteropolysaccharides that contain fucose, galactose, mannose, xylose and glucose. The SmF3 fucoidan is highly sulfated (35%) galactofucan, and the main chain of the polysaccharide contains a →3)-α-l-Fuc*p*(2,4SO_3^-)-(1→3)-α-l-Fuc*p*(2,4SO_3^-)-(1→ motif with 1,4-linked 3-sulfated α-l-Fuc*p* inserts and 6-linked galactose on reducing end. Possible branching points include the 1,2,6- or 1,3,6-linked galactose and/or 1,3,4-linked fucose residues that

could be glycosylated with terminal β-d-Gal*p* residues or chains of alternating sulfated 1,3-linked α-l-Fuc*p* and 1,4-linked β-d-Gal*p* residues, which have been identified in galactofucans for the first time. Both α-l-Fuc*p* and β-d-Gal*p* residues are sulfated at C-2 and/or C-4 (and some C-6 of β-d-Gal*p*) and potentially the C-3 of terminal β-d-Gal*p*, 1,4-linked β-d-Gal*p* and 1,4-linked α-l-Fuc*p* residues. All fucoidans fractions were less cytotoxic and displayed colony formation inhibition in colon cancer DLD-1 cells. Therefore, these fucoidan fractions are potential antitumor agents.

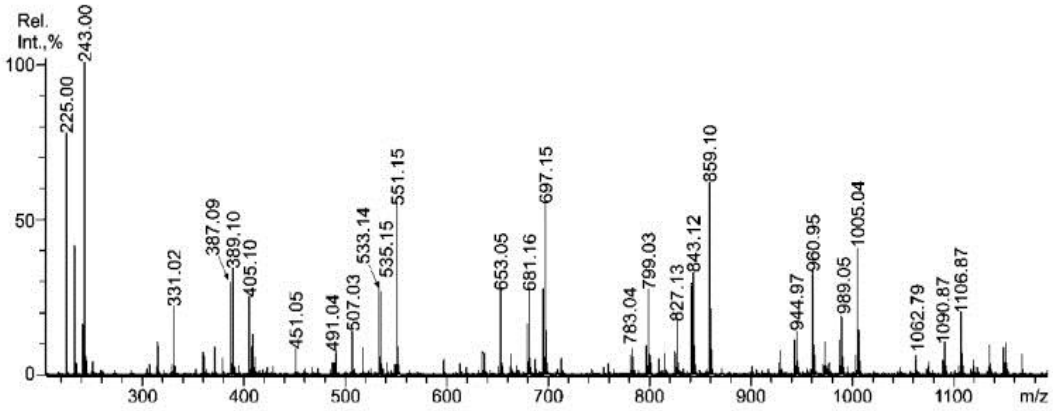

Fig 5. Negative-ion MALDI-TOFMS of LWM oligosaccharide fraction SmF3-AH, obtained from a fucoidan of *S. mcclurei* by autohydrolysis

We examined the effect of sulfated polysaccharides from *S. mcclurei* on the cytotoxicity of DLD-1 human colon cancer cells using 3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2*H*-tetrazolium, inner salt (MTS assay). Fucoidans did not show any significant cytotoxicity after treatment for 24 and 48 h at 1 to 200 μg/mL. These results confirm data obtained in previous studies. The sulfated polysaccharides from other species of brown algae were found to be nontoxic against JB6 Cl41 (epidermal mouse cells), Vero (African green monkey kidney), MCF-10A (human epithelial cells), MCF-7 (human breast cancer cells) and other cells. Our results indicate that these polysaccharides are not cytotoxic towards DLD-1 human colon cancer cells at concentrations from 1 to 200 μg/mL. Next, we determined whether purified polysaccharides inhibited colony formation (soft agar method) in human colon cancer DLD-1 cells. This assay is a well-established model for studying the potential of antitumor agents. DLD-1 colon cancer cells were treated with 100 μg/mL fucoidan in a soft agar matrix, and the cells were incubated at 37°C in a 5% CO_2 incubator for three weeks. The tested polysaccharides had antitumor activity on DLD-1 cells at 100 μg/mL. SmF1, SmF2, SmF3, and SmF3-DS inhibited the colony formation of DLD-1 colon cancer cells by 17, 48, 20, and 18%, respectively. According our results, the degree of sulfation did not play a role in the inhibition of colony formation. After desulfation, no change was observed in the ability of fucoidan SmF3 (35% sulfate content) to inhibit colony formation. Additionally, the extent of colony formation inhibition in DLD-1 colon cancer cells by SmF2 (25.7% sulfate content) was higher than that of SmF3. Thus, we show that fucoidans from *S. mcclurei* (SmF1, SmF2, and SmF3) possess anticancer activity against DLD-1 colon cancer cells. Probably, the presence of alternating sulfated 1,3-linked α-l-Fuc*p* and 1,4-linked β-d-Gal*p* residues is important for this activity. Taken together, these data are the first to demonstrate that fucoidans isolated from *S. mcclurei* have antitumor activity against the DLD-1 colon cancer cells (Pham Duc Thinh, 2013).

3.4. Fucoidan from brown seaweed *Sargassum henslowianum*

The structure and investigate the hypolipidemic activity of a fucoidan extracted from brown seaweed *Sargassum henslowianum* collected at Hai Van – Son Cha peninsula, Hue province, Vietnam by using tandem electro-spray ionization mass spectrometry (ESI-MS). The results showed that the fucoidan has α(1→3)-linked l-fucopyranose backbone and sulfate groups occupied mostly at C-2, C-4 and sometimes at C-3 position of fucose residues. The results of *in vivo* bioactivity examination showed that the fucoidan

in the dose of 100 mg/kgP/day by oral administration helped decrease cholesterol, triglyceride and LDL-cholesterol levels on obese mice (Table 1-2) (Ho Duc Cuong, 2014).

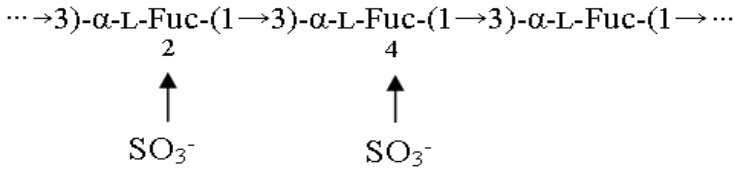

Fig 6. Dominated structure of the fucoidan

Table 1. Changes in blood biochemical levels of mice after administered orally fucoidan

Biological levels	Mice in group LFD (non-obese)	Mice in Group HFD (obese)			
		Compared to Group LFD		*Sargassum henslowianum*	
		Before	After	Before	After
Cholesterol(mg/dl)	87.00± 2.73	138.48±30.61	136.04±31.25	135.32±10.28	104.40±3.87*
Triglyceride(mg/dl)	26.43± 2.88	42.01± 6.21	36.59± 4.07	43.64± 5.77	35.24± 4.70
LDL-Cholesterol (mg/dl)	29.00± 2.73	41.24± 4.46	39.95± 5.91	41.24± 5.91	32.22± 2.23*

*: $p < 0.05$

Table 2. Changes in body, liver and fat weights of mice after administered orally fucoidan

Studied levels	Mice in group LFD (non-obese)	Mice in Group HFD (obese)	
		Compared to Group LFD	*Sargassum henslowianum*
Body weights (g)	29.00 ± 2.73	36.63 ± 2.15	35.33 ± 1.53*
Liver weights (g/10g body weight)	0.33 ± 0.02	0.36 ± 0.02	0.33 ± 0.01*
Fat weight (g/10g body weight)	0.56 ± 0.01	1.29 ± 0.41	1.00 ± 0.35*

*: $p<0.05$

3.5. Anti-HIV activity of fucoidans from three brown seaweed species

We have demonstrated that fucoidans isolated from the three species *Sargassum mcclurei Sargassum polycystum and Turbinara ornata* have significant anti-HIV activity. Although highly sulfated preparation of crude extracts was obtained by anion-exchange chromatography, they did not demonstrate any increased anti-HIV activity. Neither sulfate content nor position of sulfate groups was related to the anti-HIV activity of fucoidans suggesting the involvement of other structural parameters like molecular weight, the type of glycosidic linkage or even a unique fucoidan sequence. Although the presence of sulfo groups seems to be necessary for the anti-HIV activity, our data do not support random sulfation as the main antiviral factor. Fucoidans are structurally complex, known for their antiviral activities due to their direct interactions with either enveloped viruses or with cell membrane surface. In this study we showed

that the antiviral activity of these fucoidans is due to their binding with HIV-1 blocking the early steps of HIV entry. These macromolecules might exert their anti-HIV-1 activity by shielding off the positively charged amino acids present in the viral envelope glycoprotein gp120 or by the strong binding with a specific sulfation motif. This former hypothesis is in agreement with the specific interactions of sulfated polysaccharides with proteins leading to their biological activities such as the binding of heparin with antithrombin III or chondroitin 4 sulfate with plasmodium falciparum or the lyme disease spirochete (Thanh Thi Thu Thuy, 2015).

Table 3. Position and content of sulfate groups and anti-HIV activity of three crude fucoidans

Crude fucoidan	Sulfate group position	Sulfate content (mass %)	Mean IC_{50}, µg/ml (SD)*
F_{SP}	C2 < C4	23.40	0.34 ± 0.12
F_{TO}	C2 > C4	25.60	0.39 ± 0.18
F_{SM}	C2 = C4	30.50	0.96 ± 0.59

** Mean IC_{50} was calculated from three independent experiments; SD, Standard Deviation*

Table 4. Position and content of sulfate groups and anti-HIV activity of three fractions of F_{SM}

Fractions	Sulfate group position	Sulfate content (mass %)	Mean IC_{50}, µg/ml (SD)*
F_{SM1}	Mainly on C4	17.60	0.75 (± 0.6)
F_{SM2}	Mainly on C4	24.71	0.39 (± 0.27)
F_{SM3}	C2 > > C4	33.03	0.18 (± 0.16)

** Mean IC50 was calculated from three independent experiments ; SD, Standard Deviation*

Table 5. Position and content of sulfate groups and anti-HIV activity of four fractions of F_{SP}

Fractions	Sulfate group position	Sulfate content (mass %)	Mean IC_{50}, µg/ml (SD)*
F_{SP1}	Mainly on C4	4.4	NA
F_{SP2}	Mainly on C4	19.3	0.37 (± 0.17)
F_{SP3}	C2 > C4	26.6	0.23 (± 0.4)
F_{SP4}	C2 > C4	27.4	0.15 (± 0.12)

** Mean IC50 was calculated from three independent experiments; SD, Standard Deviation*

3.6. Fucoidan from the brown alga *Sargassum aquifolium*

A fucoidan preparation named FSA was isolated from the brown alga *Sargassum aquifolium* collected from the coastal waters of Vietnam. L-Fucose, D-galactose, D-mannose, D-glucuronic acid, D-xylose, and sulfate were found to be the main constituents of FSA. The preparation was fractionated by anion-exchange chromatography on DEAE-Sephacel eluted stepwise with 0.5, 1.0, 1.5, and 2.0 M NaCl to give four fractions differing in monosaccharide composition and degree of sulfation. Their NMR spectra were too complex to be completely interpreted. Fractions 1.0 M and 1.5 M were analyzed by methylation before and after desulfation. In addition, desulfated 1.0 M was fractionated by anion-exchange chromatography into six fractions according to the uronic acid content. They were characterized by methylation and NMR spectral data, and three structurally different polysaccharides were identified. One of them has a core of alternating 2-linked a-D-Manp and 4-linked b-D-GlcpA residues, about a half of the former bearing single a-L-Fucp or b-D-Xylp at position 3. The second polymer is a (1 / 3)-b-D-glucopyranuronan partially substituted with single b-D-Xylp or single a-L-Fucp at position 4. The third polysaccharide is a xylo (fuco) galactan having a linear core of alternating 4-linked a-D-Gal and 3-linked b-D-Gal residues. The latter bear single b-D-Xylp or a short chain of 4-linked b-D-Xyl, 6-linked b-D-Gal, and variously linked a-L-Fuc. In FSA, these polysaccharides are sulfated at different positions and devoid of regularity. Fractions of FSA possess anticoagulant, cytotoxic, and antitumor activities, which increase with the degree of sulfation. The most sulfated fraction 2.0 M that contains mainly a sulfated fucogalactan, is about half as active as anticoagulant as the standard low-molecular mass heparin (enoxaparin) (Maria I. Bilan, 2017).

4. CONCLUTIONS

By using modern methods including NMR, ESIMS, MALDI-TOF MS, SAXS, structures of fucoidans extracted from Vietnam brown seaweed were determined. Besides, the biological activities i*n vitro* and *in vivo* of fucoidan were investigated. Our results were contributed to a better understanding the structure-activity relationship of fucoidan in particular and sulfated polysaccharides in general.

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DETERMINE THE THICKNESS AND STRUCTURE OF MANGROVE FORESTS FOR ATTENUATION THE IMPACTS OF COASTAL WAVE ENERGY IN BAC LIEU PROVINCE, VIETNAM

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ABSTRACT

Mangrove forests play an important role in coastal disaster mitigation as a natural measure by dissipating wave energy, which performance would change according to mangrove structures. This study was aimed at assessing the wave energy dissipating function in terms of mangrove structures and determining the necessary thickness of the mangrove forest to reduce the impacts of waves on the Bac Lieu coastal zone, Vietnam. Standard plots with the unit distance of 20 m mangrove were set for each transect, ranging from the seaside edge of mangrove to 100 m distance inland. Properties of mangrove structures were measured at three transects to ensure the representation of the study area. Waves were measured along the transects using wave gauges and characteristics of wave attenuation due to the drag force of one existing mangrove species, *Avicennia sp.*, were analyzed. The density, height and diameter of mangrove trees were found to be distributed relatively evenly, with a slight increase of the number of trees per standard plot from 183 at the seaside edge to 218 at the 100 m distance inland. Regarding mangrove root, while its density was relatively uniform along transects, its height varied significantly. The amplitude of wave in the Bac Lieu coastal zone changed substantially with the tidal phase ranging from 0.09 to 0.22 m. The wave reduction between the seaside edge and 20 m and 100 m distances inland from the edge, respectively, increased from 32% to 91%. A number of mangroves characteristics influenced the rate of reduction of wave height per unit distance, most notably the physical structures of mangrove trees, especially their densities. The wave reduction coefficient was positively correlated with the thickness of mangroves ($r = 0.96$). When the distance of wave energy transmission through mangroves was greater or equal to approximately 76 m, the wave energy reduction reached 80% or above, which assures the wave energy would not influence the coastal zone. Therefore, in Bac Lieu with dense mangrove trees, a thin band of mangroves could provide an adequate defense to protect the coastal area in this tidal range under normal wave conditions.

Keywords: Coastal disaster mitigation, field measurements, mangrove tree and root structures, wave energy dissipation.

1. INTRODUCTION

Given the expansion of the tidal-driven inundation in the coastal plains of the Vietnamese Mekong Delta (VMD) [1], waves propagating further inland is projected to become more severe [2;3], leading to adverse effects on socio-economic and environmental settings of the coastal areas. It is projected that the VMD will become one of the most heavily impacted areas of which coastal plains were considered to be highly vulnerable to sea level rise and changes of the hydrological regimes [4;5]. One of the solutions to mitigate impacts of waves on seashore is to enhance ecosystem services of local mangrove [6]. Mangrove forests have a function to help dissipate wave energy in the coastal zone [7;8;9], which function depends

on a number of factors, including forest density, the size of trunks and roots and the water depth [10]. Bac Lieu, a coastal province of the VMD with a coastline of about 56 km, is considered to be strongly affected by sea level rise and changes in tidal regime [11], and the its coastal area has been invested in restoration of mangrove forests to mitigate impacts of waves [11]. Considering climate change and resultant increase in impacts of waves, it is of great significance to understand the relationship between characteristics of mangrove forests, including their types, and their functions of reducing wave energy, and to achieve successful protection and sustainable development in the mangrove coastal zones [12]. As a first step towards this goal, determine the thickness and structure of mangrove forests for attenuation the impacts of coastal wave energy under normal wave condition and propose required widths of mangrove forests for effective protection the coastal zone.

2. MATERIALS AND METHODS

2.1. Field survey on structural properties of mangrove forests

Field surveys were conducted from 21 July 2015 to 13 June 2016 (the period of high waves in a year) in Bac Lieu as shown in Figure 1. Three transects were chosen, which were characterized by different mangrove structures. Three standard-plots (STP) with the area of 400 m^2 (20 m × 20 m) were set along each transect, ranging from 0 m to 20 m, 40 m to 60 m and 80 m to 100 m from the seaside edge of mangrove forests (Figure 1). Structural parameters of mangrove forests, including trunk diameter (D_T), root height (H_R) and tree height (H_T) were measured by using a tape and ruler. These properties are used to consider characteristics of wave reduction in mangrove forests along with the properties of incident waves and sea levels in coastal zone.

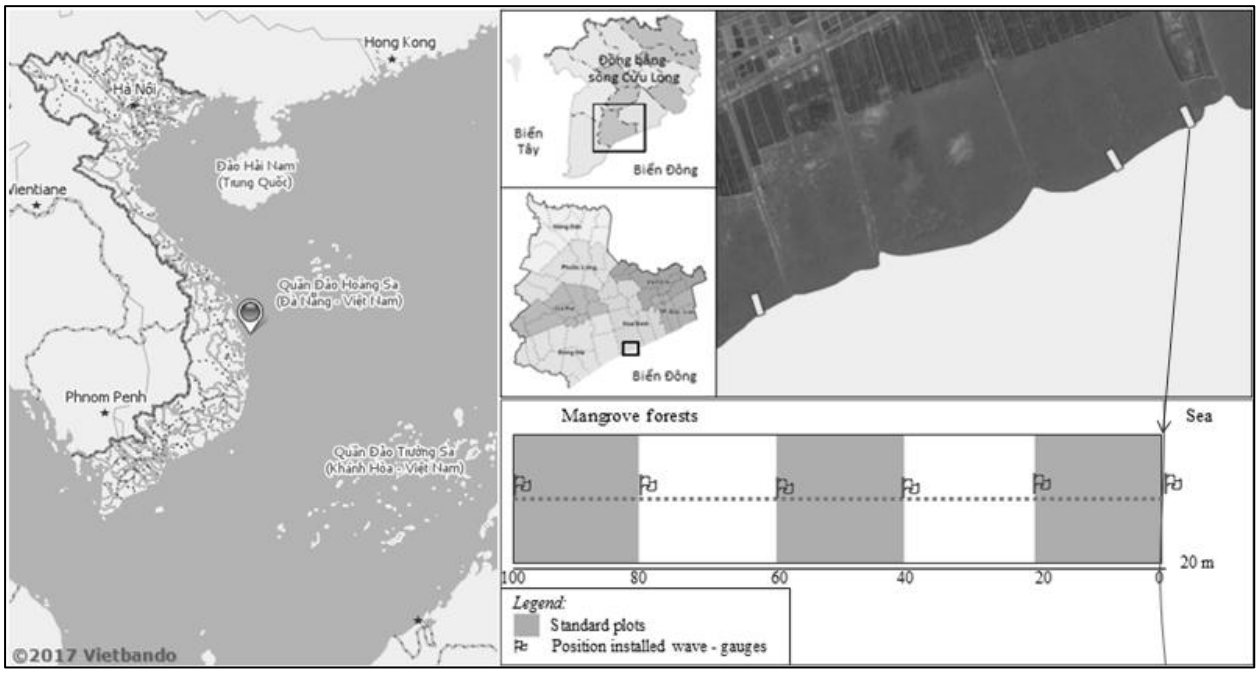

Fig 9. Study site and arrangement of three transects with three standard-plots

(Source: Edited from vietbando.com and Google Earth Pro)

2.2. Field survey on structural properties of mangrove forests

Wave measurements were performed on three periods (including: from 21th to 27th July 2015; from 9th to 11th Jan 2016 and from 13th to 16th June 2016) using wave gauges (Infinity AWH-USB, JFE Advantech) installed at 6 stations starting from the seaside edge of each of the three transects with a 20 m interval to capture properties of waves propagating in the different types of mangrove forests (Figure 1).

Individual wave heights and periods were determined and then significant wave heights (H_s) and periods (T_s) were obtained. Spatial distribution of significant wave heights along each of transects were used to estimate the wave reduction coefficient $r_{\Delta Hs}$ given by Equation (1) [9]:

$$r_{\Delta H_s} = (H_{Si} - H_{Sp}) / H_{Si} \times 100\,(\%) \quad (1)$$

where H_{Si} and H_{Sp} are the significant wave height of incident waves and transmitted wave heights at each of the points, respectively.

3. RESULTS AND DISCUSSION

3.1. The amplitude of wave

The result showed that the amplitude of wave ranging from 0.09 to 0.22 m (Figure 2). The wave has the highest tidal amplitude at the 2nd measurement with the amplitude: Hs = 0.22 m (Hmax = 0.37 m and Hmin = 0.001 m), followed by the 1st measurement with the amplitude value of the wave: Hs = 0.21 m (Hmax = 0.35 m and Hmin = 0.001 m, respectively) and the lowest tidal amplitude the 3rd measurement with: Hs = 0.09 m (Hmax = 0.2 m and Hmin = 0.0006 m). The results of this surveyed were consistent with the findings of the Institute of Marine Engineering (2016) showed that the tidal amplitude in the coastal area of Bac Lieu province ranged from 0.25 to 0.30 m. Thereby, it showed that the amplitude of the wave in Bac Lieu coastal zone were not high and relatively equal between the measuring periods. Due to the time of measurements in the dry season, the wave were not high, the fluctuation of the wave amplitude were not large, it agreed with what was found in the research result of Marine Institute of Technology (2015).

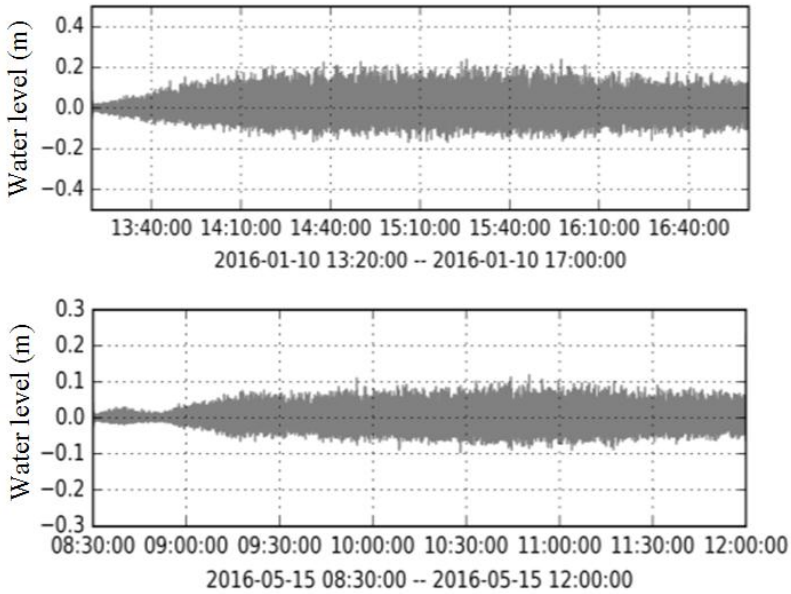

Fig 2. Water level fluctuation observed in Bac Lieu coastal zone

3.2. Structure in mangrove forest

The mangrove tree density was found to have a tendency of increasing gradually from the seashore edge to inland zone, which tendency agrees with what was found in Vuong Van Quynh's research [6]. The tree density in the STP adjacent to the seashore edge (0 to 20 m) was significantly lower than those in the other STPs (40 to 60 m and 80 to 100 m) while there were no significant differences in the mangrove root density among the three STPs as shown in Table 1.

Table 1. Mangrove tree density and root density in three STPs

STPs	Tree density (number of trees/ha)	Root density (number of roots/ha)
0 - 20 m	1,691[b]	1,542,200[a]
40 - 60 m	6,500[a]	1,558,000[a]
80 - 100 m	6,808[a]	1,280,000[b]

[a,b] *Different letter aresignificantly different was recognized at 5% ($P \leq 0.05$) according to the Duncan test.*

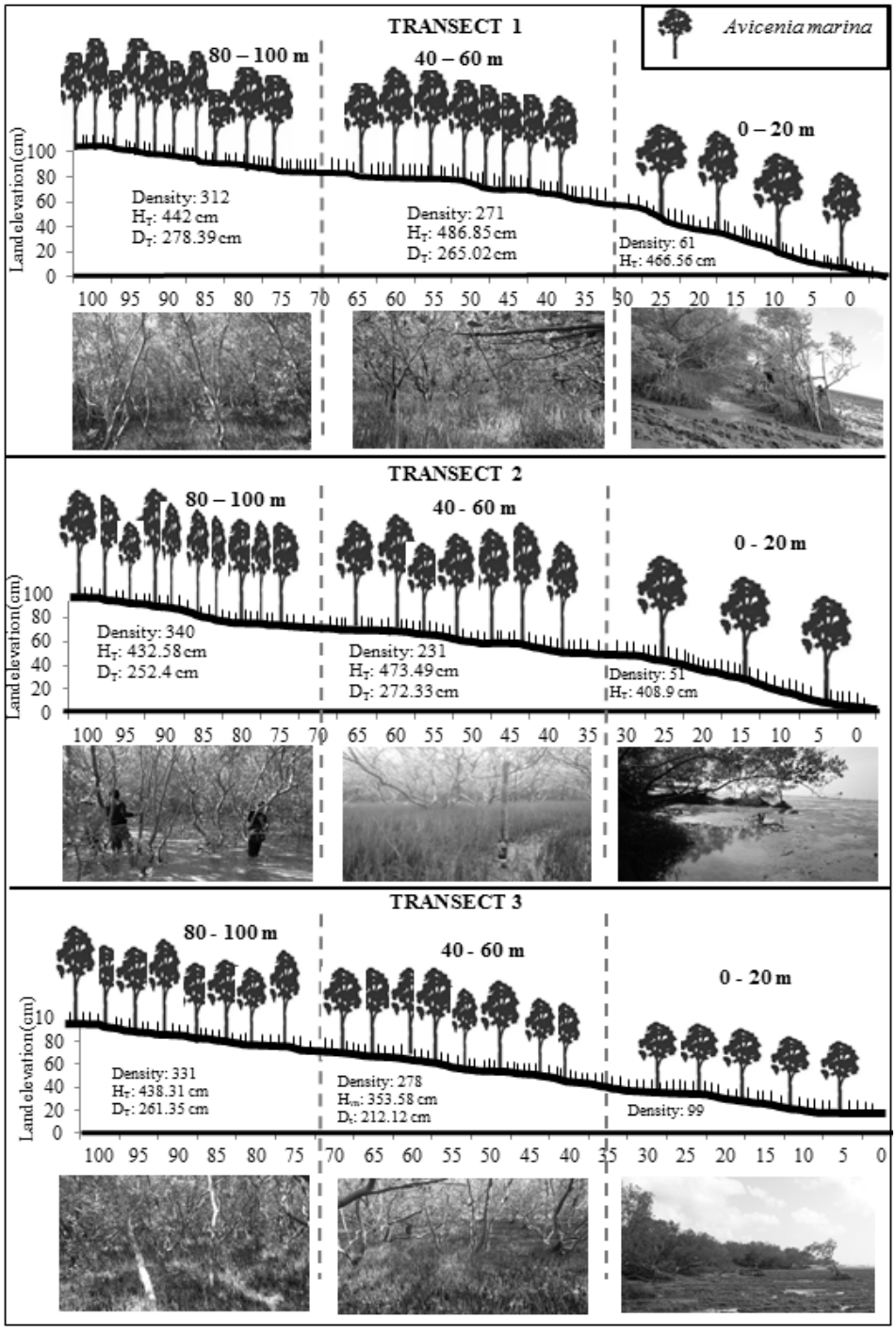

Fig 3. Structures of mangrove forests in three STPs along three transects

Along each of the three transects, tree density, tree hight and tree diameter tend to increase as the ground elevation increases, which means that high trees with large diameters were dominant at the high elevation. Figure 3 presents difference in structures of mangrove among three STPs along the three transects.

3.3. Wave reduction in mangrove forests structure

3.3.1. Wave reduction in mangrove forests

The mangrove forests structure were different in the STPs. In particular, the deeper into the interior the forest structure tends to be higher about tree density. In addition, the data of canopy diameter and trunk diameter shown the different between STP 1 and STP 2. However, there was no different of canopy diameter and trunk diameter in STP 3. Wave reduction coefficients reference to incident wave heights at the seaside edge of the mangrove forest were ranging from 26.09% to 42.86% in STP 1; It mean, from 53.42% to 55.00% in STP 2, and 75.00% to 80.00% in STP 3 as listed in Table 2.

Table 2. Properties of mangrove forest and wave reduction coefficient in STPs

Transect (T) and STP	Tree density (Number of tree/STP)	Tree height (cm)	Trunk diameter (cm)	Tree canopy diameter (cm)	Tree stump diameter (cm)	Root density (number of root/STP)	Wave reduction coefficient (%)
T1 STP 1	61	466.56^{a}	6.26^{a}	385.64^{a}	14.80^{a}	142.00^{ns}	31.25
T2 STP 1	51	408.90^{a}	7.34^{a}	401.31^{a}	12.49^{a}	165.00^{ns}	26.09
T3 STP 1	99	276.73^{b}	3.83^{b}	234.34^{b}	7.20^{b}	140.00^{ns}	42.86
T1 STP 2	271	486.85^{a}	5.07^{a}	265.02^{a}	8.47^{a}	169.33^{ns}	53.42
T2 STP 2	231	473.49^{a}	6.23^{a}	272.33^{a}	9.54^{a}	160.67^{ns}	54.54
T3 STP 2	278	353.58^{b}	3.37^{b}	212.12^{b}	6.62^{b}	107.00^{ns}	55.60
T1 STP 3	312	442.06^{ns}	5.2^{ns}	278.39^{ns}	10.35^{ns}	151.33^{ns}	75.00
T2 STP 3	340	432.58^{ns}	5.23^{ns}	252.40^{ns}	8.03^{ns}	142.00^{ns}	80.00
T3 STP 3	331	438.31^{ns}	5.28^{ns}	264.35^{ns}	9.19^{ns}	145.25^{ns}	N/A

^{ns} Indicates a non-significantly different was recognized statistically at $P \leq 0.05$, $^{a, b}$ Different letter are significantly different was recognized at $P \leq 0.05$ according to the Duncan test

3.3.2. Principal component analysis of mangrove forests parameter

Principal component analysis follow mangrove forests parameter

Based on the assess resulted six mangrove forests parameters follow the principal component analysis methodology (Table 3). The objective of this methodology was determined quantity need to present the data (including six mangrove forests parameters). Scree plot showed the decrease of eigenvalue amplitude and the percent cumulative variability. In terms of factor analysis or principal component analysis, Scree plot helps analysts visualize the relative importance of components. This components must describe at least 80% of the cumulative percentages of variance (Shi et al., 2002). In this case, the components 1 and

2 have an eigenvalue greater than 1 and account for 87.03% of cumulative variance (Table 3).

Table 3. Analysis ofthe main composition based on six parameters of mangrove structure

Main parameter	**F1**	**F2**	F3	F4	F5	F6
Eigenvalue	**3.67**	**1.45**	0.56	0.13	0.06	0.02
Variance (%)	**62.24**	**24.29**	9.4	2.18	0.97	0.4
Cumulative variability (%)	**62.67**	**87.03**	98.62	98.6	99.6	100

The component 3 and 4 have a very small interaction with the variables, which can be easily seen through the cumulative percentile curve of the variance (unchanged from F3 onwards) and the sharp decrease in magnitude of the individual values of F3 and F4 (Resano et al., 2010). The magnitude of the components from 3 to 6 (F3 to F6) was very small compared to components 1 and 2, so there was no need to used components from F3 to F6 to represent the number of metric sets (Figture 4).

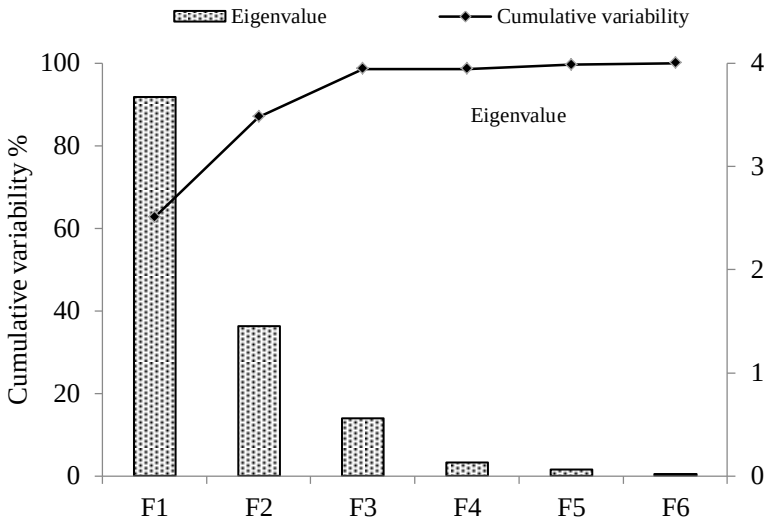

Fig 4. Eigenvalue and cumulative variability (%) presented by Scree plot

The resulted showed in Table 4, the first component and the second component were builted based on interaction with the attributes of the mangrove structure and shown in equation (1) and equation (2):

$$F1 = -0.465x - 0.056y - 0.217z + 0.131\alpha + 0.306\beta + 0.265\varepsilon \quad (1)$$

$$F2 = 0.305x + 0.339y + 0.486z + 0.234\alpha + 0.031\beta + 0.068\varepsilon \quad (2)$$

Table 4. Contents of main components

Main components	F1	F2
Tree density (x)	-0.465	0.305
Root density (y)	-0.056	0.339
Tree height (z)	-0.217	0.486

Main components	F1	F2
Trunk diameter (α)	0.131	0.234
Tree canopy diameter (β)	0.306	0.031
Tree stump diameter (ε)	0.265	0.068

The correlation between attributes and components of mangrove structure was shown in Figure 4. Based on the distribution of structural properties in Figure 5, these attributes could be divided into three regions. Distinct: region 1 including the canopy diameter attributes, tree stump diameter and trunk diameter closest to the X axis (primary component 1) and has a large value indicating that these attributes have an important influence on the first part zone 2, the density of separate tree attributes, and far away from the X axis indicate that this attribute did not significantly affect to the primary one. Zone 3 including attributes such as tree height and root density. Near the Y axis and great value, these two attributes have a great influence on the second major component. In addition, neighboring attributes were correlated (including: root density, stump diameter, trunk diameter and canopy diameter) and contiguous correlated (including: tree density and trunk diameter, stump diameter, canopy diameter) [13].

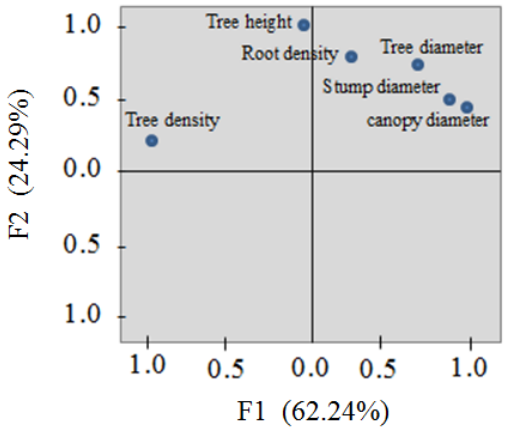

Fig 5. Distribution of mangrove structure attributes

Correlation between the mangrove forests structure and wave reduction coefficients

The main factor analysis was 2 equations (1) and (2) corresponding to F1 and F2 components. The correlation between these components with the wave reduction was shown in Figure 6. Thus, there was a correlation between the two major components and the reduced percentages of wave energy. However, for the first major component, the correlation was tighter (r = -0.86 và y = -0.0453x + 2.3705).

From the results above, there was a negative correlation (r = -0.86) between the primary component 1 and the decreasing percentage of tidal energy. However, the primary component has a negative correlation with the number of trees (Table 4). Therefore, it could be concluded that the tree density was correlation with wave reduction coefficients, in particular, the larger tree density, the lower the wave reduction coefficients were bigger. In addition, attributes such as tree height and canopy diameter have a very poor correlation with the wave reduction coefficients. The reason was that the wave amplitude in the study was relatively low, so limited by the two attributes.

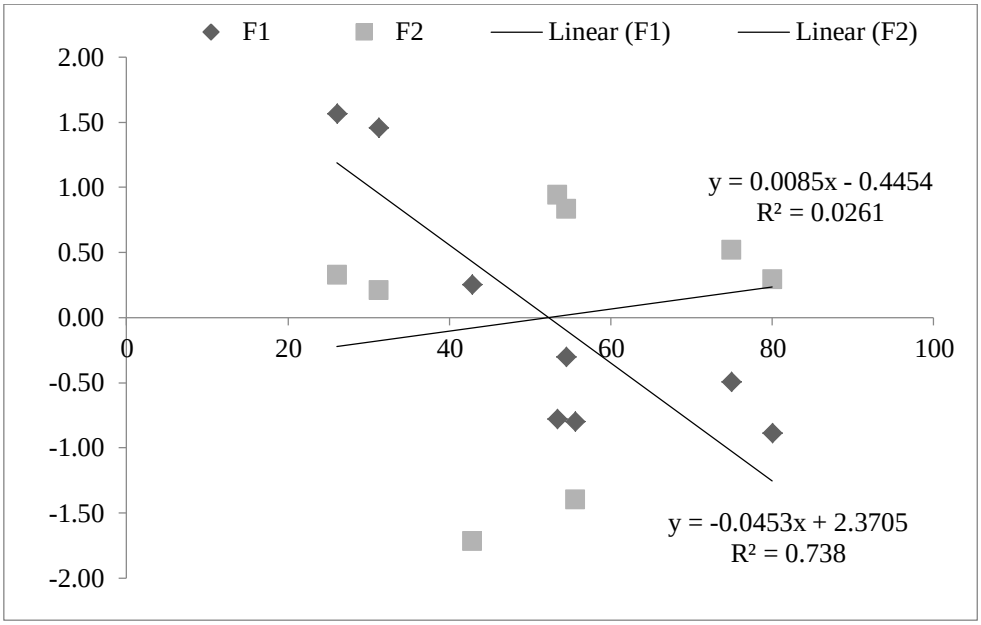

Fig 6. Correlation between mangrove forests structure and wave reduction coefficients

3.4. Relationship between thickness of mangrove forest and wave energy

The ability of the mangrove forest thickness to reduce the tidal power was showed by the correlation between mangrove thickness and the percentage reduction of wave energy. At the same time, the reduction rate also correlation with the thickness of the mangroves (Figure 7). The decreasing percentage of wave power was positively correlation with the thickness of the mangroves (r = 0.96) (Figure 7a). The correlation was very tight so it could be concluded that the greater the thickness of the mangrove forests, the higher the percentage reduction of wave energy. However, the reduction rate was negatively correlated with the mangrove thickness (r = -0.95) (Figure 7b). The value of "r" also showed a strongly correlation between wave reduction and mangrove thickness. Therefore, the greater the thickness of the mangrove forests, the lower the wave reduction rate and vice versa. The thickness of the mangrove forests would be determined where was capable of reduced the wave energy affecting to the coastal area, the reduction of wave energy must be greater than or equal to 80% over or equal to 0.2. Applying the regression correlation between mangrove thickness and the wave reduction coefficients, the resulted from correlation analysis showed that x = 76 (ie: mangrove thickness was 76 m). Thus, in order to protected the coastal area of Bac Lieu province from the effects of waves, mangroves should have a thickness greater or equal to approximately 76 m or more. The resulted of this study were consistent with previous research by Vuong Van Quynh (2010) [6] that the thickness of mangroves in Bac Lieu coastal area should be greater than 73 m to reduced the effects of wave energy to the coastal areas. However, the limitation of the result in normal wave conditions. In case of highly and strongly wave conditions, this length of 76 m may not be enough to achieve the 80 % of wave reduction.

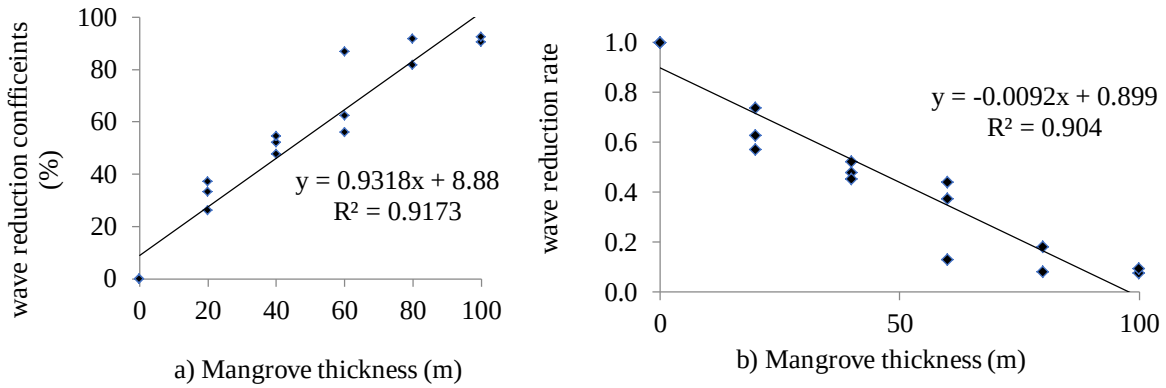

Fig 7. Correlation between mangrove forests thickness and wave reduction confficeint (a) and wave reduction rate (b)

4. CONLUSIONS

Generally, the vertical and horizontal structure of mangrove forests were also affected by the wave energy and vice versa the wave energy would be affected by the mangrove forests structure. The wave energy reduction cofficiency passed through the mangrove forests 100 m thickness was of 91% (corresponding to wave reduction rate about of 0.09). In addition, the wave reduction coefficient was positively correlated with the thickness of mangroves (r = 0.96). When the distance of wave energy transmission through mangroves was greater or equal to approximately 76 m, the wave energy reduction reached 80% or above, which assures the wave energy would not influence to the coastal zone. Therefore, in Bac Lieu coastal zone with dense mangrove trees, a thin band of mangroves could provide an adequate defense to protect the coastal area in this tidal range under normal wave conditions.

Acknowledgements

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EFFECT OFACACIA HYBRID CULTIVATION ON PROPERTIES OF OSMOSIS WATER IN U MINH HA FOREST ZONE, CA MAU PROVINCE

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ABSTRACT

The objective of study was to assess properties of osmosis water on the planted bed of *Acacia hybrid*and *Melaleuca Cajuputi* in U Minh Ha forest zone. The study was performed on the soil of forest including*Acacia hybrid*and *Melaleuca Cajuputi*. Each type of forest chose soil types: deep acid sulfate soil and shallow acid sulfate soil. Each soil type chose two area levels: >10ha and<10ha and each area level, the sample was takenat three different ages of tree with repeated three times. pH indicator at both types of species and deep acid sulfate soil and shallow acid sulfate soil were almost not different, only pH indicator at the *Acacia hybrid*on deep acid sulfate soil was higher than deep acid sulfate soil of *Melaleuca Cajuputi*.H_2S parameter was not different between deep acid sulfate soil and shallow acid sulfate soil on both *Acacia hybrid*and *Melaleuca Cajuputi,* H_2Sparameterwas alsonot different between*Acacia hybrid*and *Melaleuca Cajuputi*. EC parameter in shallow acid sulfate soil was higher than deep acid sulfate soil and EC indicator in *Melaleuca Cajuputi*was always higher than*Acacia hybrid*. $N\text{-}NH_4^+$ parameter was not differ in two soil types, only *Melaleuca Cajuputi*had $N\text{-}NH_4^+$ parameter in shallow acid sulfate soil was higher than deep acid soil, $N\text{-}NH_4^+$ parameter in *Melaleuca Cajuputi*was higher than*Acacia hybrid*. Fe parameter in shallow acid sulfate soil at*Acacia hybrid*was lower than *Melaleuca Cajuputi*, as the same as on deep acid sulfate soil. Al parameter in *Melaleuca Cajuputi*washigher than*Acacia hybrid*corresponding to each soil type.

Keywords:Acacia hybrid, Melaleuca Cajuputi,Osmosis water quality, U Minh Ha,.

1. INTRODUCTION

In the past years, the area of *Melaleuca Cajuputi* forest of U Minh Ha has been decreasing, mainly due to the conversion of forest land use purpose, in which*Acacia hybrid* forest was being exploited by Ca Mau province to development investment, because of high economic efficiency, short business cycle (Le Tan Loi *et al*., 2014). However, to plantation the *Acacia hybrid* on soil of *Melaleuca Cajuputi*in U Minh Ha forest, the most important was plantation technique. Because the *Acacia hybrid*were not resistant to inundation, they could only grow on high planted bed (Le Dinh Kha, 2006). Although there were many studies on *Acacia hybrid* trees such as forest density, forest biomass and forest carbon stocks (Le Đinh Truong, 2013) and economic efficiency (Tran Duy Ruong, 2013), but the study of surface water as well as permeability affects the leaching of substances in the soils and the relationship between them and forest ages or raised bed planting types.Therefore, in order to contribute to solving outstanding and scientific issues in recommending the present and sustainable planting and development of *Acacia hybrid* in the future, contributing to the improvement of income for people and socio-economic development for U Minh Ha forest area in particular and Ca Mau province in general.The research of "effect of *Acacia hybrid*cultivation on properties of osmosis water in U Minh Ha forest zone, Ca Mau province" was performed.

2. MATERIALS AND METHODS

2.1. Data collection

2.1.1. Experimental design

The study was done on the soil of forest including *Acacia hybrid* and *Melaleuca Cajuputi* to collect water. Each type of forest was choose soil types: deep acid sulfate soil at Khanh Thuanward, U Minhdistrict, Ca Mau province (Thuy Son forest company) and shallow acid sulfate soil at Tran Hoi ward, Tran Van Thoi district, Ca Mau province (Kenh Dung research station of South-West Experimental Research Center). Each soil type choosed two area levels including > 10 ha and < 10 ha and each area level, the sample was taken at three different ages of tree with repeated three times. Similarly, *Melaleuca cajupity* forest selected soil types: deep acid sulfate soil and shallow acid sulfate soil. Each type of land was divided into two forest areas planted and preserved natural forests; Each area choosen 3 level ages including less than 3 years and from 3 to 7 years, older than 7 years.

2.1.2. Methodology of collecting water samples

At each point corresponding to each age group *Acacia hybrid* and *Melaleuca Cajuputi*, set up a system to collect osmosis water samples seeped through the bank. The water flowing through the soil layer was collected in the free-fall, which was designed to be 30 cm in depth, 15-20 cm in width and 200 to 300 cm in length. Water permeates through the soil layer and flows into the container (20 cm wide, 10 cm high, 15 cm in length) (Figure1). Water sampling and analysis: The water sample in the container was taken in the middle of the water depth in the container. At that location, use a water tube and then put it into a sealed glass jar. The water samples were stored and brought to the laboratory for analysis. For pH measurement only, the EC was measured at site after sampling for analysis. The water will be once in the beginning of the rainy season. The analyzes included pH, EC, H_2S, $N\text{-}NH_4^+$, Al^{3+}, Fe^{2+} (6 indicators).

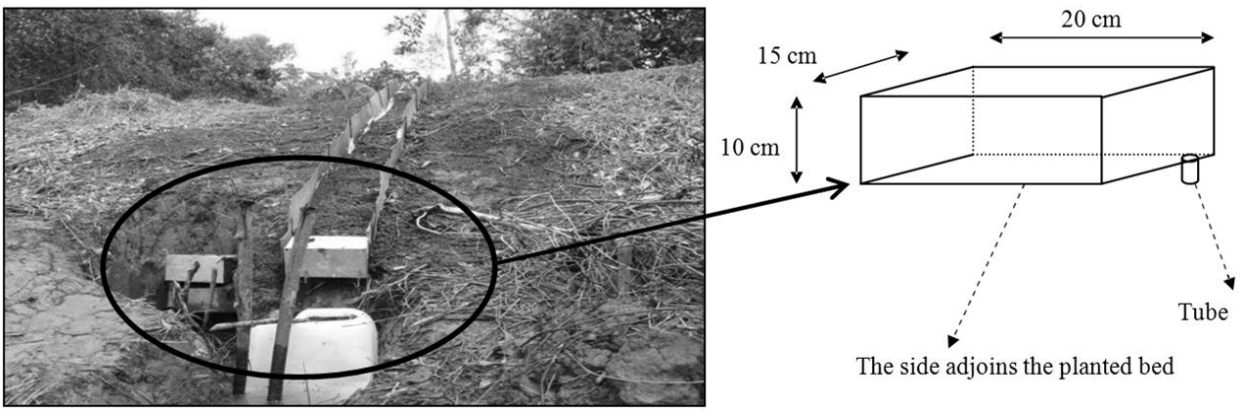

Fig 1. Surface water trough and water sampling box

2.1.3. Water sample analysis

- Water samples were stored and analyzed according to standardized methods.

Table 1. Methods for analyzing indicators of osmosis water

No	Parameter	Method of determining
1	pH	pH HM - 3IP - DKK TOA (Nhật)
2	EC	EC Hi309 equipment
3	$N\text{-}NH_4^+$	Salicylate method
4	Al^{3+}	3500 - Al B. Eriochrome Cyanine R Method
5	Fe^{3+}	Salicylate Thiocianate method
6	H_2S	Iodine method

2.2. Methodology of data analysis

The data was calculated and statistical by the math and statistical software (EXCEL, SPSS). The data were compared and compared at significance level P <0.05 by Duncan's test.

3. RESULTS AND DISCUSSION

3.1. Effects of Acacia hybrid plantation on osmosis water properties

3.1.1. pH

The pH value of water between the different acreage areas in the *Acacia hybrid* and *Melaleuca Cajuputi* plantation areas was significantly different by statistical analysis (Figure 2). Most of the pH was not different between planted and natural forest areas in the shallow and deep acid sulfate soil. However, the pH value in deep acacia in *Acacia hybrid*was statistical significanct higher at 5% than in other sites (Figure 2). In general, the pH of theMelaleuca planted and natural area was lower than the allowable standard of surface water quality for the conservation of aquatic animal (pH: 6 – 8,5 mg/l, QCVN 08:2008/BTNMT, column A_2). The results show that osmosis water in the study area has low pH (Melaleuca forest and *Acacia hybrid* in shallow acid sulfate soil and *Acaciahybrid* in deep acid sulfate soil). The reason was that when planting hybrid Acacia or Melaleuca on shallow soils, the alum whichwas put on the ground was oxidized and the toxicwas washed off by osmosis water to make the pH decrease (Le Dinh Truong, 2013). However, the pH value in *Acacia hybrid* plantation area was neutral (pH ranging from 7 to 7,5). Therefore, planting *Acacia hybrid* at deep acid sulfate soil area does not affect the pH value of water. In addition, the pH value of osmosis water in both Melaleuca and *Acacia hybrid* plantations on shallow soils was lower than the permitted level of surface water quality standards for aquatic animal conservation (QCVN 08:2008/BTNMT, column A_2). Thus, in the acid sulfate soils, especially the soil with shallow acid sulfate soil near the ground, it was necessary to have proper technical measures when it was raised to minimize the impact of alum to water and aquatic animals. The results of this study were consistent with other studies suggesting that in alum areas, the pH value in the soil was generally between 3.5 and 4.5, even 2.5 in some places, so the water environment in these areas have low pH. When water was contaminated with alum, the water source contains many toxins in the form of Al_3^+, Fe^{3+} and SO_4^{2-}(Tran Thi Thu Hang, 1998).

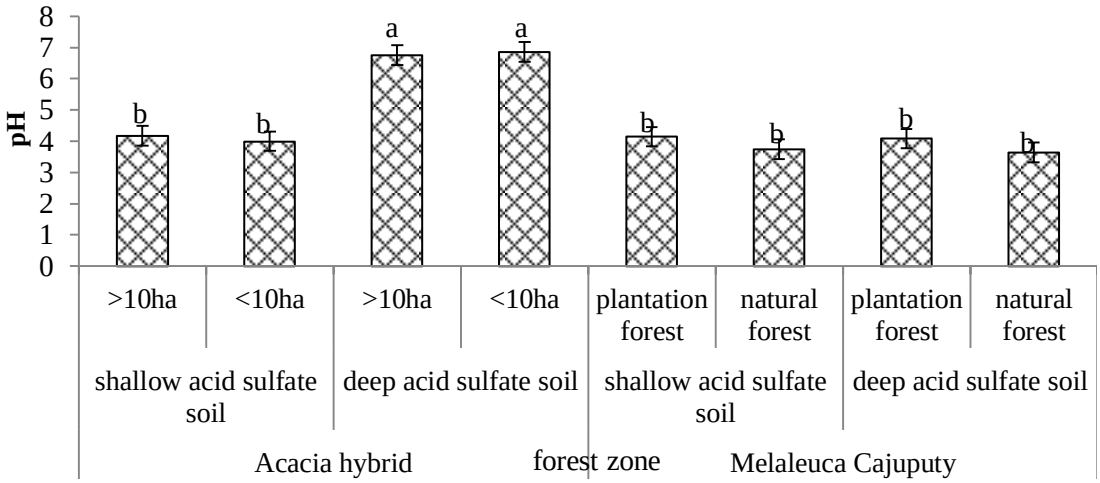

Fig 2. pH values in Acacia hybrid and Melaleuca Cajuputi

3.1.2. EC (mS/cm)

Analytical results showed that the EC value of water in the study area was different by statistical analysis at 5%. Comparing each pair of land categories showed that the EC in the *Melaleuca Cajuputi* plantation was significantly higher than in the *Acacia hybrid*. The EC in the *Acacia hybrid* plantation area was the lowest and there was a statistically significant difference in the shallow acid sulffate soil (Figture 3). However, most EC values in both *Acacia hybrid* and *Melaleuca Cajuputi* plantations were very low and lower than the water quality standard(QCVN 08:2008/BTNMT, column A_2). This result was consistent with Tran Thanh Lap (1998), not only saline soils have high salts in the soil, but in the acid sulphate soils. The influence of acids on the clay minerals the salt concentration in the soil can be high and causing poisoning to plant. All nutrients in the soil exist in the form of cations and conductive anions, based on EC value that can predict the increase of ions' concentrations in the soil solution. Thus, shallow soils will have the ability to release inorganic salts into the osmosis water to increase the EC value. On the other hand, most of the inorganic substances conduct electricity better than organic substances, so the higher the concentration of dissolved ions, the greater the EC (Le Trinh, 1997). Therefore, the EC was an indicator for the approximation of dissolved salts present in water. The continuous *Acacia hybrid* cultivation has reduced the amount of salts in the soil due to the leaching process under the influence of rainwater.

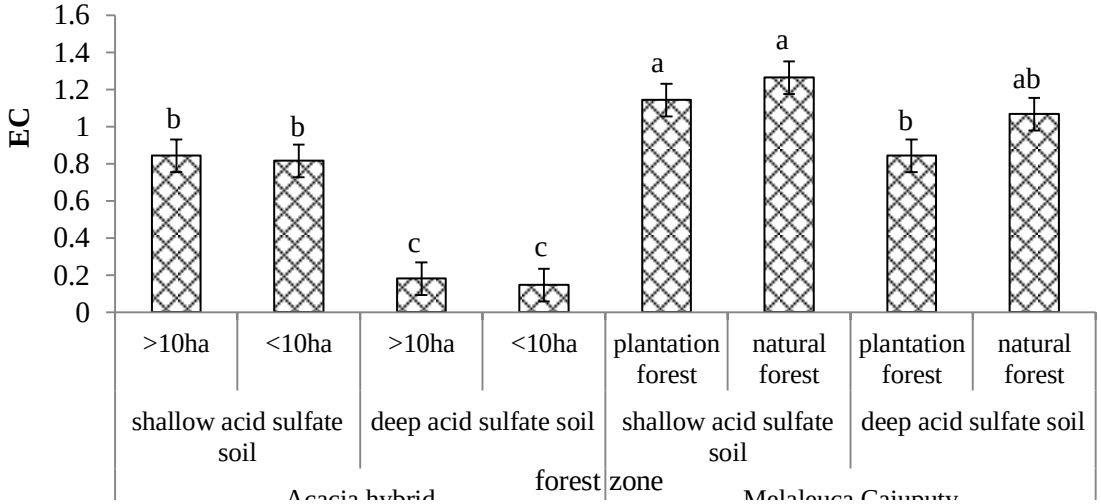

Fig 3. EC of osmosis water in *Acacia hybrid* and *Melaleuca Cajuputi*

3.1.3. H_2S (mg/l)

According to Dang Kim Chi (1998), H_2S in water was made up of ion $SO4^{2-}$ under the impact of bacteria, these bacteria use sulfur of rotten corns in soil as a food source, H_2S has an bad smell of rotten eggs and poinsons aquatic species. The H_2S value of the osmosis water in the *Melaleuca Cajuputi* plantation on the deep acid sulfate soil has statistical significancehigherthan the natural forest area and both in the shallow soils and also higher than all areas in *Acacia hybrid* area (Figture 4). In anaerobic conditions, the ion SO_4^{2-} in the alum materialwas deoxidized when it enters the dehydrated (Le Van Phat, 2008). Under the condition of high CO_2, it will combine with Fe^{2+} in water tocreate $Fe(HCO_3)_2$ simultaneously liberate H_2S (Le Van Phat, 2008). H_2S was a extremely toxic substance to aquatic animals. It can kill fish at concentrations 0,8 mg/l (t = 25 – 30^0C, pH = 6.8) after 3 hours of testing and general standard for drinking wáter waslower 0.05 – 0.1 mg/l (Le Van Cat, 1999). Thus, the results of the analysis showed that although the H_2S in the study area was lower than the toxic concentration of aquatic animal (Le Van Cat, 1999). It has also been shown that H_2S concentration has an impact on the aquatic environment, especially in the *Acacia hybrid* plantation on shallow soils, there will has high risk of poisoning if no preventive actionswere taken.

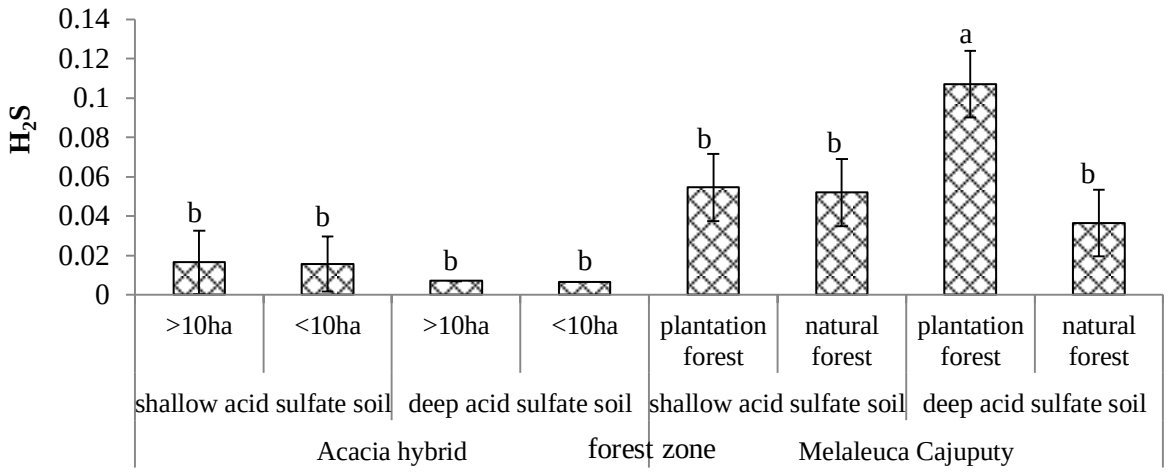

Fig 4. H_2S of osmosis water in *Acacia hybrid* and *Melaleuca Cajuputi*

3.1.4. N-NH_4^+(mg/l)

The N-NH_4^+ content was essential for the development of aquatic organisms, but if the content was too high it will facilitate the growth of phytoplankton causing eutrophication (Le Van Thang, 2007). Figure 5 shows that the N-NH_4^+ values in the osmotic water of the hybrid Acacia and Melaleuca plantation were different when analyzed statistically. In particular, the N-NH_4^+ in hybrid Acacia plantation area was very low compared to the *Melaleuca Cajuputi*plantation. All sites on both the soils were significantly lower than all sites on both the soils of the Melaleuca plantation. And the value of N-NH_4^+ in the *Melaleuca Cajuputi* plantation on shallow acid sulfate soil was also significantly higher than in the deep one. Because the *Melaleuca Cajuputi* foresthas higher N-NH_4^+ content beacuse it leaves more organic material than the *Acacia hybrid* plantation. In addition, the low level of water in the dry season along with the oxidation of organic material makes the environment poorer in oxygenwas a good condition for ammonium persistence to increase N-NH_4^+ content. Figure 5 shows that most of the N-NH_4^+ parameters in the study area were higher than the permissible surface water quality standards for aquatic animal conservation.

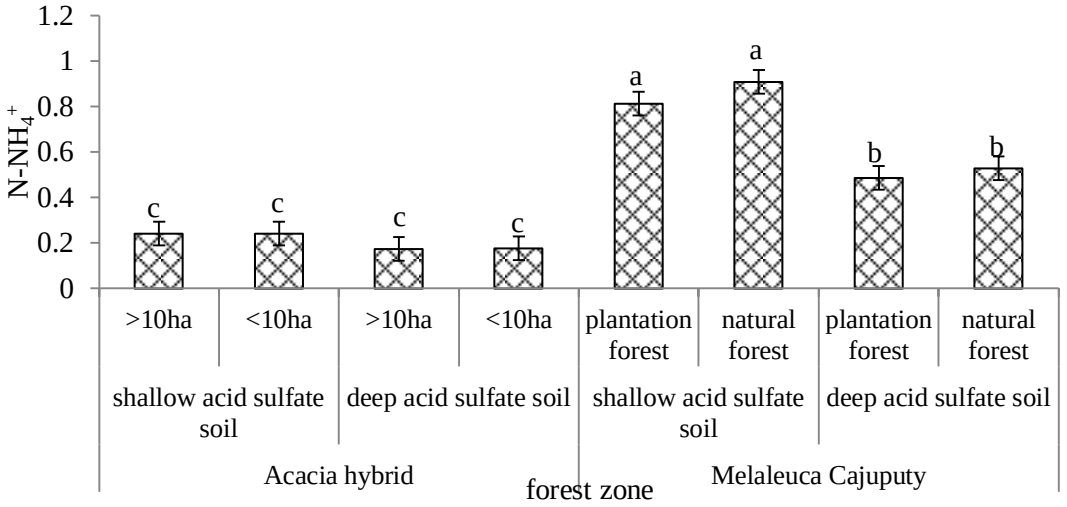

Fig 5. N-NH_4^+ of osmosis water in *Acacia hybrid* and *Melaleuca Cajuputi*

3.1.5. Fe (mg/l)

High level of iron in the water affect the development of aquatic life, especially for aquatic plants. Iron was oxidized to rust on the roots, which reduces the ability to breathe and absorbs nutrients in the plant, causing the plant to become poisoned with iron, reducing its ability to grow and inhibit metabolism in plants. Root iron poisoning was usually reddish brown (Le Van Khoa, 2007). In general, the Fe index of most *Acacia hybrid* plantations was lower than in *Melaleuca Cajuputi* plantations. The statistical analysis showed that the shalow and deep acid sulfate soil of the *Acacia hybrid* plantation were significantly lower than the shallow and deep acid sulfate soil of *Melaleuca Cajuputi* plantation. In the shallow acid sulfate soils in both areas, the highest Fe content was observed (Figure6). Compared with the standards of surface water quality standards for aquatic animal conservation (Fe = 1mg/l, QCVN 08:2008/BTNMT, collum A_2) found that Fe content of water in the study area was higher than the allowable limit. In the study area, the *Acacia hybrid* in the study area (<10 ha) contained more Fe toxicity and water pH in this area was lower than 3, thus facilitating the release of Fe content was higher than other areas.

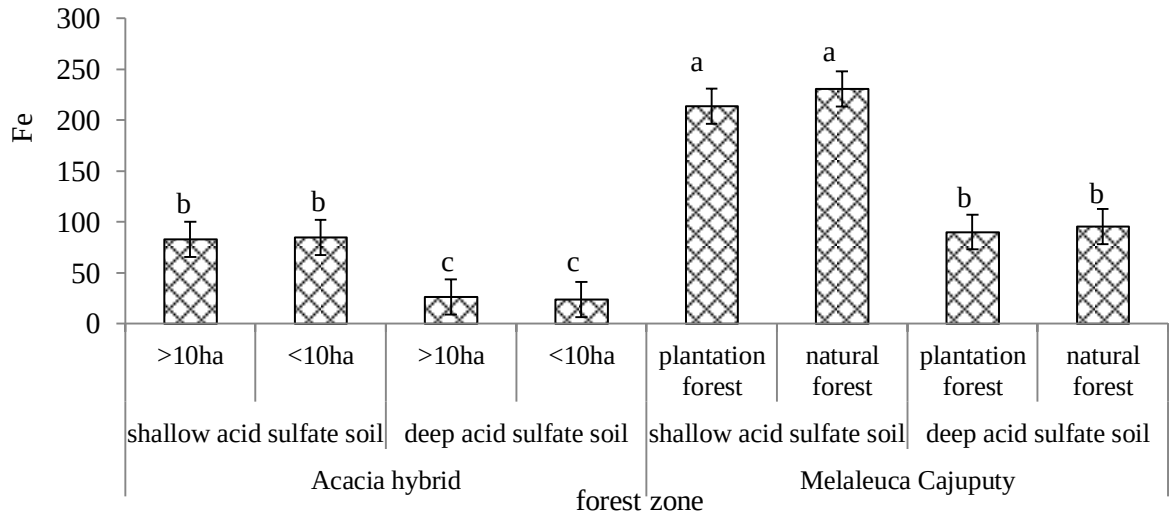

Fig 6. Fe of osmosis water in *Acacia hybrid* and *Melaleuca Cajuputi*

3.1.6. Al (mg/l)

Aluminum in acid sulfate soil was a product of accumulated leaching in part, in the course of feralit; mainly due to alum: after the presence of H_2SO_4 in the soil, H_2SO_4 acts on the glue released intofree Al^{3+}. In acid sulfate soil, aluminum content in waterwas high due to the large amount of dissolved $Al_2(SO_4)_3$ (Le Huy Ba, 2000). The results of the survey Al in the study area were presented in Figure 7, which shows that the Al value of the *Acacia hybrid* and Melaleuca plantation areas was very small and different through statistical analysis. Al on shallow acid sulfate soils in the *Melaleuca Cajuputi* plantation area was significantly higher than Al in the shallow acid sulfate soils of *Acacia hybrid* plantation. Except the deep acid sulfate soil of *Acacia hybrid* plantation where did not find out the existence of Al. Aluminum was toxic to plants and often occurs in recently exploited soils (Vo Quang Minh *et al*, 2012). During the dry season, the soil begins to oxidized, the pH decreases, the toxins that form rainwater contribute to the penetration and release aluminous toxic materials into the canals. They canincrease Al^{3+} content in water; this was agree with research results of Pham Quang Khanh et al. (1996), low pH and increased toxicity, particularly in the months'headthe rainy season. The above findings were also consistent with this study because most of the survey sites belong to shallow or deep acid sulfate soil and either up or down planted bed to plantation forest.

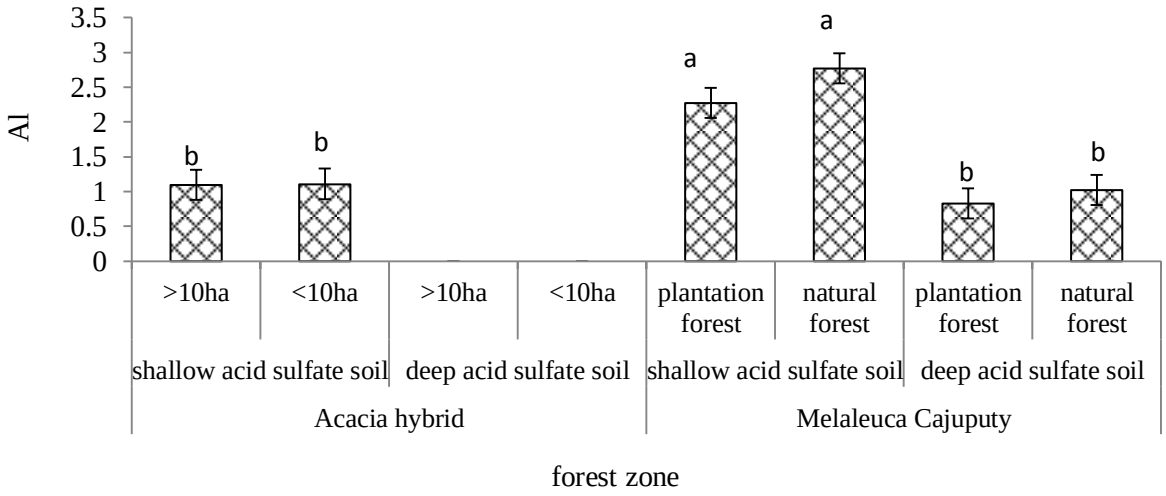

Fig 7. Al of osmosis water in *Acacia hybrid* and *Melaleuca Cajuputi*

3.2. Aggregate the causes change the properties of osmosiswater

- pH

Acacia hybrid area was the area of alum, when the materials of alum were put on the surface with large content, alum materials will be oxidized to make the acid soil soakinto the soil and make the pH parameter change.

- EC (mS/cm)

EC in the *Acacia hybrid* plantation area was high indicates that the water in this area was contaminated with inorganic poisons. This may be due to the fact that in the *Acacia hybrid* area, people dig up soil to make itsmetal toxic rase up. Then it was soaked into the soil by rainwater and makes EC increase.

- Fe (mg/l)

When digging land for *Acacia hybrid* plantation in the acid sulphate soil, people have inattentive to

bring the Fe toxic of the acid soil with high level up to the ground. It will penetrate into the soil and canals with rainwater make the canals heavily contaminated with inorganic toxins. High levels of iron in the water affect the development of aquatic life.

- *Al (mg/l)*

When digging up alumsoil to plant *Acacia hybrid*, people have accidentally put Al toxicity of the alum soil up with high levels. During the dry season, when the water withdraws, the soil begins to be oxidized, the pH decreases, the toxins have been formed but not release much to the canal, until the beginning of the rainy season, the rainfall contributes to the osmosis and the discharge. The toxins were removed with water, and the rainwater was washed away by the capillary material on the ground to the canals to increase the Al^{3+} content in the water.

- *H_2S (mg/l)*

The reason for the H_2S parameter in *Acacia hybrid* plantation in the high alum soil was that during the decomposition of aquatic plant residues in water and in soil with poor oxygen conditions, higher than other areas.

- *N-NH_4^+ (mg/l)*

The process of decomposing aquatic plant residues in soils and canals of *Acacia hybrid* trees at the age of 4 and poor environmental conditions cause higher levels of N-NH_4^+ than the others. Water levels drop in the dry months along with the oxidation of organic matter that causes the environment to be poor in oxygen. This was a good condition for ammonium persistence to increase N-NH_4^+ content.

3.3. Propose some solutions

It was necessary to survey and evaluate the soil quality before planting. Since this was an area of alum so it was necessary to determine the alum stage and the ability of the alum to influence the environment when it was raised. It was necessary to apply planted bed method to shallow areas to avoid toxic substances washed away by rain, thus avoiding harmful effects to aquatic animals and fishes in the area including. *Acacia hybrid*was a preferred species of light, so the direction of the shade should be favorable light mode, so that plants receive more sunlight, facilitating the process of photosynthesis. Therefore, orientations should be arranged in the direction of East - West.

- Technical to raised bed: The height of the planted bed was 80 cm or more above the forest floor, ensuring that it was not submerged during the rainy season (even during heavy rains). The width of the planted bed was usually 6m or more, the planted bed must be relatively flat, high in the middle and lower to the sides to prevent water logging in the rainy season.It was necessary to study the appropriate rate of ditches and direction for creating suitable ditches, to create a well-ventilated water source, to regularly dredge so that the water environment was well-suited for aquatic animals and fish stocks in the area. When planting *Acacia hybrid* plantation in U Minh Ha area, it was not advisable to plant the forest immediately, but it takes time to create vegetation (creating vegetation in the rainy season) to limit the leaching of toxins into the ditch.

4. CONCLUSION

In both *Acacia hybrid* and *Melaleuca Cajuputi* plantations, the pH value of the osmotic water was almost no different between the area sizes and the shallow acid sulfate soil lower than deep acid sulfate soil. The pH and EC values in the *Acacia hybrid* area tend to be lower than in the *Melaleuca Cajuputi* plantation. However, H_2S content did not differ between *Melaleuca Cajuputi* and *Acacia hybrid* areas. In general, Fe in the *Acacia hybrid* area was higher than that of *Melaleuca Cajuputi*. Similarly, the shallow

acid sulfate soils have higher Al values compared to the deep acid sulfate soils. Most of the Fe, Al, N-NH_4^+ in the *Acacia hybrid* and *Melaleuca Cajuputi* plantations, both of the shallow and deep alum soil werehigher than the surface water quality standards for aquatic animal conservation.

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ON THE RELATIONSHIP BETWEEN BIOMASS OF ALGAE AND CHEMICAL CHARACTERISTICS IN RICE FIELD IN WINTER-SPRING CROP 2016 - 2017 IN CHO MOI DISTRICT, AN GIANG PROVINCE

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ABSTRACT

The relationship between biomass of algae and chemical characteristics (such as pH, disloved oxygen, nitrate, ammonium and phosphate) in intensive cropping rice are assessed in this study. Three rice fields are similar to soil condition and farming techniques. Each rice field is 1,000 m^2. The Kruskal-Wallis non parametric test inthe software SPSS (version 20.0) were used to examinatethe differences in biomass of algae (µg/L) between the fertilizer periods and the days after fertilizing. The results showed that biomass of algae in the first period (early stage of branching) was the highest and the lowest in the fourth period (ripening stage), with $p < 0.01$. However, the biomass of algae (µg/L) in the rice field was not significant difference statistically between the days after fertilizing($p > 0.05$). In addition, the Stepwise method was used to construct a linear multivariable regression between biomass of algae andchemical characteristics. The results showed that a corresponding significant positive correlation was found between biomass of algae and dissolved oxygen in rice field ($r = 0.497$; $p <0.01$). Besides, there are 462 grams of fresh algae supplied to 1,000 m^2. In general, we can see the practical role of algae in the rice field. Therefore, it is necessary to continue to study in the next rice crop to estimate the total amount of algal biomass supplied annually for rice fields.

Keywords: algal biomass, Cho Moi district, dissolved oxygen, intensive cropping rice, Winter-Spring crop 2016-2017, regression.

1. INTRODUCTION

Cho Moi is an island district located between the Tien and Hau rivers. Since 1995, Cho Moi district has closed dykes to prevent floods and product rice three crops per year. Dykes have brought many practical benefits such as increased annual rice yield, convenient for waterway, etc. However, the use of chemical fertilizers and pesticides to maintain productivity, at once it do not discharge floods so poisoned stagnant in the soil (Tran Nhu Hoi, 2005). Thus, it has a negative impact on soil nutrition as well as water quality (Nguyen Thi Gai, 2012). This may be the cause of the decline in the diversity of species living in rice fields, especially microalgae.

According to De (1939), the natural fertility of rice land because of the cyanobacterial fixed nitrogen from nitrogen gas (quoted in Vu Quang Manh, 2004). After they die, thanks to mineralization or nitrification process, finally nitrogen compounds are increased. In addition, they can releasesome compounds are bioactive in soil, which are absorbed by higher plants (Vu Quang Manh, 2004). Besides, algae also played an important role in stabilizing and improving the properties of physical soil by binding the particles and increasing organic matter (Dang ThiSy, 2005). Thus, when put microalgae into rice field, it has the potential to alter the microbial system, reduce acidity, alum, increase alkalinity and change soil structure in the direction of benefit crops. It combined with hundreds of species of microalgae and other

microorganisms contributes to the balance and stability of the wetland ecosystem (Nguyen Van Tuyen, 2000).Research question: What is the affect of water invironment and nutrient on algal biomass in the rice field? Hence,it is important to carry out this study to assess the relationship between them and to estimate algal biomass through these parameters, aiming to utilize algae nutrients to reduce the use of fertilizers.

2. MATERIAL AND METHOD

2.1. Study area

The study was carried out in Winter-Spring crop 2016-2017 (from December in 2016 to March in 2017) in Long Hoa hamlet, Long Kien commune, Cho Moi district, An Giang province.

2.2. Material

Tools, machines and equipments: Plastic buckets 10 L, plastic cal, plastic cup, Whatman fiberglass GF/C 1822-0.45, test tubes, vacuum filters, water boilers, centrifuges, colorimeters, distillers, pH meters, DO meters…

Chemical analysis of algae and water samples: such as chlorophyll-a, ammonium, nitrogen, nitrate and phosphate in water rice field.

Softwares: SPSS (version 20.0) and MS EXCEL 2010.

2.3. Method

2.3.1. Interview

Farmers were interviewed directly on semi-structured questionnaires, such as rice varieties, graindensity and rice sowing methods, time of tillage, plough the soil looseslide down to the ground, water level in rice field, water retention time, fertilizers, diseases, pesticides, rice yield…

2.3.2. Method of measuring water level, pH and DO in rice fields

Measure water level in rice field at 15 points/a field. Itis calculated from the land surface to the water level. Then calculate the average of the points. Water pH and DO content in the field were measured at 15 points/a field by pH and DO meter.

2.3.3. Method of collecting, filtering,and analyzingwater and algae samples

Collecting water samples: Fristly, observe and record the weather, phenomena occur in rice fields while collecting samples such as water color, the shape and color of the rice, diseases, etc. Water samples were collected at many points in the field as along the dikes and waterways in the field then mixed into a common sample. Put it into plasticcal 2 L then put it into black plactis wrap and store in container. The sampling period consisted of four periods such as first period (22-26 days after sowing called early stage of branching), second period (32-36 days after sowingcalled end stage of branching), third period (42-46 days after sowingcalled earing and flowering stage), and fourth period (86-90 days after sowingcalledripenning stage). After one day of fertilizer, the water and algae samplewere collected in the morning from 6 to 10 hours, one time two days. Each session lasts 6 days. The total sample size was 80 samples (including 72 samples in rice field and 8 samples in canals).

Filtering water and algae samples: The water sample was filtered with Whatman fiberglass, the filtered water (without add 3 mL $MgCO_3$ 1%) was analyzed for nitrogen and phosphorus. The algae are on filter paper (add 3 mL $MgCO_3$ 1%) to analyze chlorophyll-a.

Analyzing waterchemical parameters: Nitrate was analyzed by spectroscopic method using salicylate, phosphate by spectra method using ascorbic acid (APHA, 1998), andammonium by distillation and titration method (TCVN 5988:1995).

Analyzing chlorophyll-a: Chlorophyll-a analyses were performed following Nush (1980) method (modified by TCVN 6662:2000), through 90^o ethanol extraction. Chlorophyll-a concentis calculated according to (1):

$$chlorophyll-a(\frac{\mu g}{L}) = \left(\left[E_{665} - E_{750}\right] - \left[E_{665a} - E_{750a}\right]\right) \times \frac{V_1 D}{V_2 d} \times 29,6 \quad (1)$$

Where: V_1: Volume of alcohol 90^o (18 mL);

V_2: Volume of water in rice field,

D: Dilution factor;

d: Light through the cuvette (1 cm);

E_{665}, E_{665a}: Chlorophyll-a content was measured at 665 nm before and after acidification with HCl 2N;

E_{750}, E_{750a}: Chlorophyll-a content was measured at 750 nm before and after acidification with HCl 2N.

2.3.4. Statistics and calculation ofresearch data

Biomass of algae (µg/L) is calculated according to:

$$B(\mu g / L) = chlorophyll\_a \times 67 \quad (2)$$

Biomass of algae (g/1000 m^2) is calculated according to:

$$B_{s_i}(\mu g / 1000m^2) = B \times h \times 10^4 \quad (3)$$

Where: h: water level in rice field (cm),

10^4: *Conversion coefficient*, sample colletion (i = 1, 2, 3, and 4).

Total of algal biomass (µg/L) supply rice field in Winter-Spring crop is calculated according to:

$$B_{total}(\mu g / L) = \sum_{i=1}^{4} B_{s_i} \quad (4)$$

Statistical procedures were conducted, through the Kruskal-Wallis nonparametric test in SPSS softwear, for biomass of algae, in order to verify the differences between 4 groups (4 periods of fertilization) or 3 groups (3 times after fertilization/period) in rice field. Asympic significance is the threshold for concluding that there is a difference between groups. If the asympicsignificance level is < 0.05 then there is a difference between the groups of data to be compared. And when the mean rank is higher, the larger the data group (Le Thanh Phong, 2011). Besides, the Stepwise method in SPSS softwear was used to constructa linear multivariable regression between biomass of algae and chemical characteristics (pH, DO, NH_4^+, NO_3^-, and PO_4^{3-}). Correlation coefficient was assessed by Ton That Phap *et al.* (2006).

3. RESULT AND DISCUSSION

3.1. Rice cultivation techniques of farmer

The interviews showed that the farmer used certified variety IR50404 in the Winter-Spring crop with the density of 27 kg/1000 m^2. Some fertilizes were used in this crop such as urea, super phosphate, KCl, DAP, and NPK. They were divided into four periods (Table 1). The formula for each hectare of this crop is 123.2 kg N - 72.6 kg P_2O_5 - 38 kg K_2O. It excessed the recommendation of the Department of Agriculture and Rural Development of An Giang province (2011). Acording to recommendation, for alluvial soil along the river (in Cho Moi district), the formula for each hectare of paddy rice land is 90-100 kg N, 30-40 kg P_2O_5, 30-40 kg K_2O.

Table 1. Type and amount of pure fertilizer (kg/1000 m^2) in the Winter-Spring crop

Periods	kg N	kg P_2O_5	kg K_2O
Period 1 (21 NSS)	3.02	2.44	-
Period 2 (31 NSS)	4.00	3.10	0.40
Period 3 (41 NSS)	3.00	1.72	3.40
Period 3 (85 NSS)	2.30	-	-
Total	12.32	7.26	3.80

In addition, pesticides are mainly used to kill snails, weeds, leaf rollers, rice blast and leaf blight. Farmer has used a combination of two pesticides such as Michelle 62 EC and Cantanil 550 EC (active substance butachlor and propanil) to kill grasses. The leaf rollers were killed by five kinds of insecticides, such as Docytox 60 EC, Indosuper 150 SC, Tungcydan 30 EC, Tungperin and Reasgant 1.8 EC. According to recommandation of PhuNong Co., Ltd. (2016), there is no need to mix Indosuper 150 SC with other insecticides.

Besides, Fuan 40 EC and Trizole 75 WP were used to prevent blast. Tilt super 300 EC were used to prevent lemongrass disease. Most of the pecticideswere used by farmers belong to the list of those authorized by the Ministry of Agriculture and Rural Development, except for Tungperinand Tungcydan 30 ECinsectide because Tungperin has low toxicity to mammals and is rarely absorbed through the skin (Pham Nho, 2012), and Tungcydan 30 EC is toxic to fish and aquatic organisms (Ngoc Tung Food Manufacturing Company, 2011). Tungcydan 30 EC was sprayed in the third period, so it should have the ability to affect algal biomass in this period.

After 95 days, farmers harvested them. The average rice yield was 700 kg/ton (equivalent 7 tons/ha). But it was lower than the average rice yield in Cho Moi district in 2014-2015 (An Giang Statistical Office, 2016) about 0.47 tons/ha.

3.2. Fluctuation of chemical parameters in rice fields and Xa Mach canal

3.2.1. Fluctuations in chemical parameters in rice fields

Water temperature and water pH

Temperature is an important factor affecting the growth and survival of algae (Lam My Lan, 2000). Temperature variation by day depends on the intensity of the light. Temperatures in water rice field ranged from 24.7 to 29.5°C. According to Lam My Lan (2000), from 15 to 30°C is very suitable for algal growth.

Through 4 serveys showed thatwater pH ranged from 6.19 to 7.56 (Fig. 1). WaterpH in the first period was the highest and tended to decrease in the second, third and fourth peroids. Because surface area of the field is large, it easy exposes to sunlight. So it promotes the photosynthesis of algae. In addition, photosynthesis absorbs carbonic faster than carbonic produced from their respiration, so carbonic must be extracted from bicarbonate metabolism and high carbonate production leading to increased water pH (Boyd, 1990).

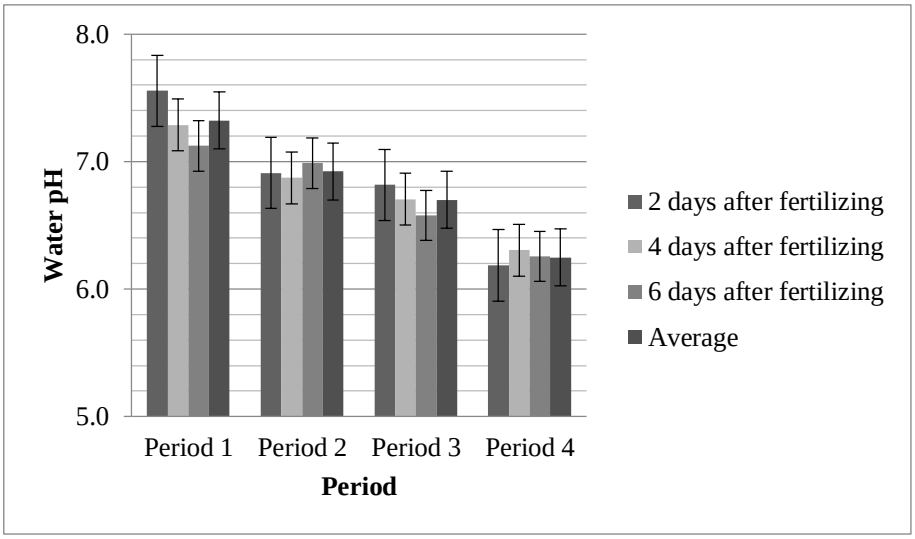

Fig 1. Water pH in rice fields through four surveys

Water pH value in later periods tends to decrease. After fertilization the rice begins to increase in height and the number of shoots. This makes the surface area of the field with sunlight decrease gradually leading to the intensity of illumination decreases. So the photosynthesis of algae is limited. In order to provide energy and sustain life, algae carry out intracellular metabolism along with their primary cytoplasmic decomposition, which produces high levels of carbonic that react with water to produce ion H^+ and ion HCO_3^- so reduces water pH (Boyd, 1990).

Through 4 serveys, water pH in the field ranged from 6.25 to 7.32. According to Tran Ngoc Hai and Tran Thi Thanh Hien (2000), water pH suitable for the growth of most algae is from 7 to 9, optimal from 8.2 to 8.7. Thus, water pH in the first period is suitable for algae to grow. This is a favorable condition for algae to grow rapidly.

Dissolved oxygen content (DO, mg/L)

Through 4 serveys showed that DO content in rice field ranged from 1.74 to 7.60 mg/L (Fig. 2). DO content in the first period was the highest and tended to decrease in the second, the third and the fourth. Because algal density in the first period was high, they use sunlight to synthesize foods from carbon dioxide and water. Photosynthesis in algae generally involves the green pigment chlorophyll and generates oxygen as a byproduct. Oxygen is dissolved in water of rice field. This is suitable to study results of Duong Tri Dung (2009), DO content in water is high, water contains algae is large because algae are involved in photosynthesis. Thus, algal growth in rice fields has a significant effect on the dissolved oxygen content of water. This can show that DO content in Xa Mach canal ranges from 2.89 to 3.72 mg/L (Table 2), it is much lower than DO content in rice fields.

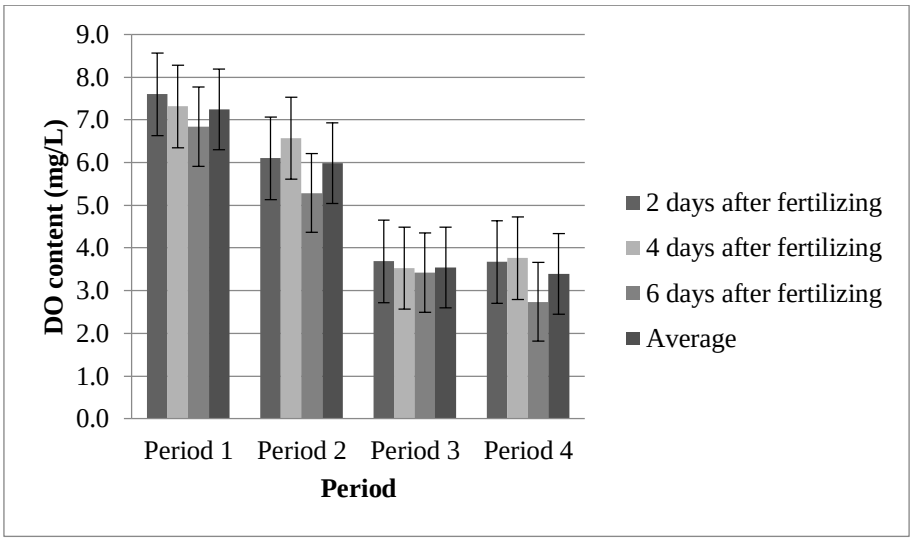

Fig 1. DO content(mg/L) in rice fields through four surveys

DO content tended to decrease significantly in the third and fourth periods because at this time the number of shoots and height of rice increased the maximum leading to the sunlight shines on the fieldvery little.Photosynthesis in algae was low. Besides, organic matter decomposition (rice leaves, straw, etc.) are accumulated in the soil in the previous crop. Therefore, the demand for oxygen increases, consuming more oxygen in water (Duong Tri Dung, 2009).

Nitrate and ammonium content(mg/L)

Nitrogen is one of the most important elements of aquatic life, and it is usually absorbed by plants in the form of nitrate (NO_3^-) and ammonium (NH_4^+). On which, nitrate is nitrogen that plants are most absorbable, not harmful to aquatic life (Nguyen Van Be, 1996). Nitrate in rice field ranged from 0.07 to 0.48 mg/L (Fig. 3). According to Duong Tri Dung (2009), and Vu Ngoc Ut and Duong Thi Hoang Oanh (2013), nitrate content suitable to growth of phytoplankton ranged from 0.1 to 1 mg/L. Hence, most of nitrate contain in rice field are suitable for the growth of algae, except on 6 NSB (6 days after fertilization) of the fouth period has relatively low nitrate content (0.07 mg/L).

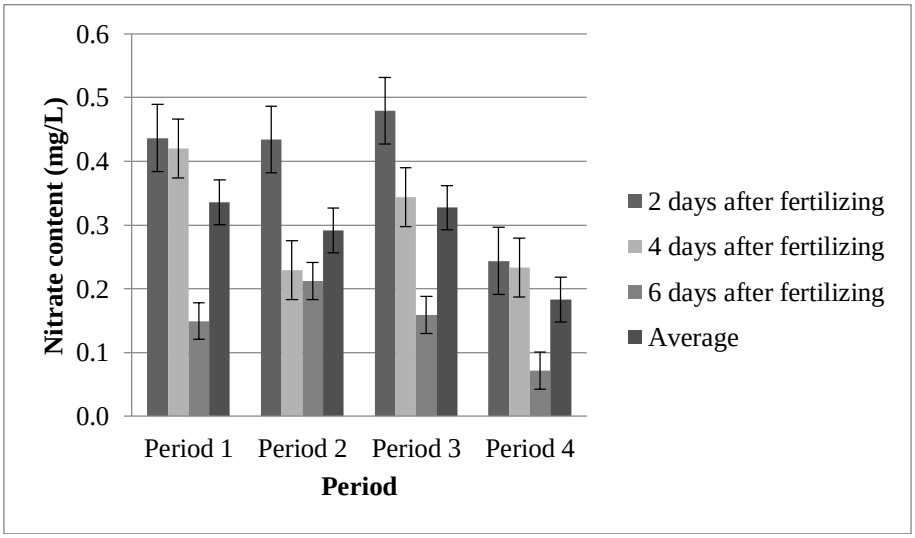

Fig 2. Nitrate content(mg/L) in rice fields through four serveys

Ammonium content in rice field ranged from 0.14 to 2.78 mg/L (Fig. 4). Especiallyin 2 days after fertilizing of the first and the third periods, ammonium content ranged from 2.06 to 2.78 mg/L. It wasrelativelyhigh but it was not toxic to aquatic organisms including algae (Nguyen Van Be, 1996).

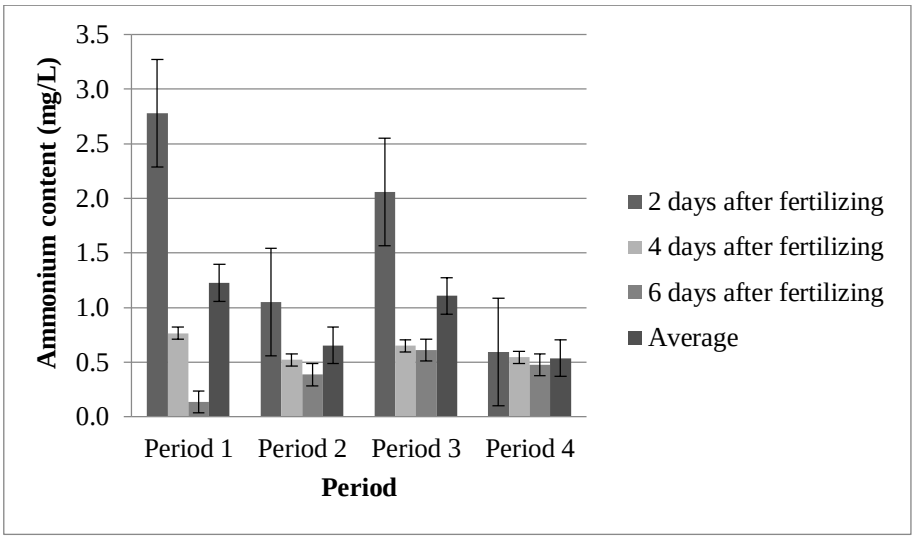

Fig 3. Ammonium content (mg/L) in rice fields through four serveys

Although total %N and $\%P_2O_5$ (Table 1) were used at the second period is higher than the first and third periods, nitrate content (0.29 mg/L) and ammonium content (0.65 mg/L) in the second period were lower than because it was rain after fertilizing in the second period. Rain can causes the removal of nitrogen and phosphrus fertilizer to drainage around the field.

In the same fertilization period, nitrate and ammonium content tended to decrease in the days after fertilization, due to nutrient uptake from rice and algae in rice fields. In addition, nitrogen extraction due to high temperature and wind, and change of water pH in rice field so ammonium was lost in the form of ammoniac (Nguyen Van Be, 1996) or in anaerobic conditions nitrate quickly degraded to nitrogen freedom separated from water (Dang Kim Chi, 2001). The ammonium content at 4 and 6 days after fertilization is very suitable for algal growth (Duong Tri Dung, 2009, Vu Ngoc Ut and Duong Thi Hoang Oanh, 2013).

Phosphate content (mg/L)

Phosphorus is an important component of nucleic acid and adenosine phosphate is an element of energy exchange. In the water environment, phosphorus exists in many forms but the algae easily absorbed in the form of dissolved phosphates (PO_4^{3-}) (Lam My Lan, 2000). Phosphatecontent in rice field ranged from 0.04 to 0.37 mg/L (Fig. 5). According to Vu Ngoc Ut and Duong Thi Hoang Oanh (2013), phosphatecontent is suitable foralgal growth range from 0.018 to 0.098 mg/L. Phosphatecontent at 2 days after fertilizing of the third and fouth period exceeds 0.098 mg/L but not exceeding 18 mg/L inhibit the growth of algae.

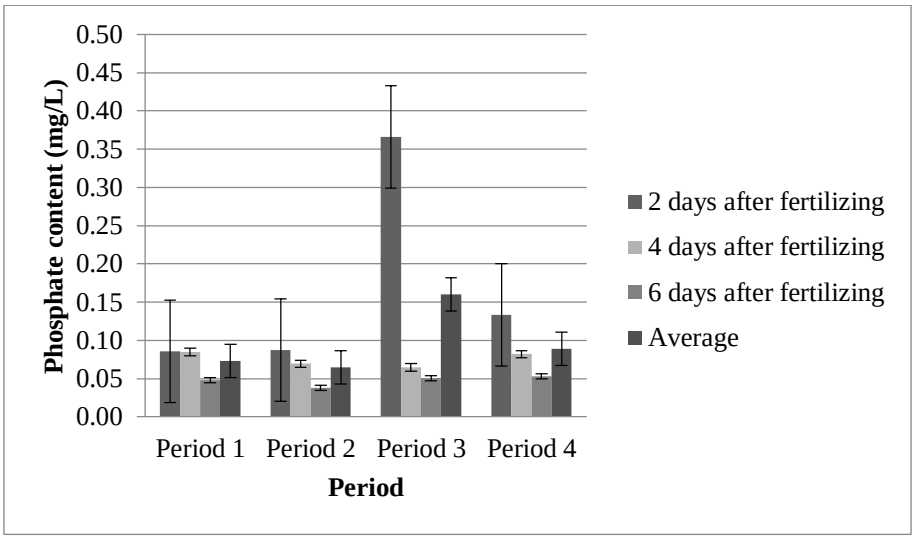

Fig 4. Phosphate content (mg/L) in rice field through 4 serveys

Although the amount of phosphorus fertilizer applied in the second periodwere 3.1 kg P_2O_5/1000 m^2 higher than in the first and third periods, the phosphatecontent in rice field was lower than two periods due to rain effect. In addition, the amount of phosphorus fertilizer applied in the first period was 2.44 kg P_2O_5/1000 m^2 higher than in third period, but the phosphatecontentin rice field was much lower (0.28 mg/L) due to the algae consume phosphate in rice field. Because of algal biomass was close possitive correlation with phosphate content in water (McVea and Boyd, 1975).

In general, water pH in rice field in the first period was suitable for algal growth, phosphate content of two times (2 days after fertilizing of the third and fourth period) exceeded 0.098 mg/L but not exceeding 18 mg/L inhibit the growth of algae. Ammonium content in 2 days after fertilizing of both of the first, second and third periods respective exceed 1 mg/L but it does not poison algae.

3.2.2. Fluctuations in chemical parameters in Xa Mach canal

Water pH of Xa Mach canal through four serveys ranged from 6.83 to 7.12 (Table 2). According to Tran Ngoc Hai and Tran Thi Thanh Hien (2000), water pH is suitable for the growth of most algae range from 7 to 9. Therefore, only water pH in the canal at the third period is within the appropriate range for the algae to grow. Nitrate and ammonium concentsranged from 0.06 to 0.39 mg/L and from 0.25 to 0.52 mg/L respectively. According to Vu Ngoc Ut and Duong Thi Hoang Oanh (2013), nitrate and ammonium contents in water suitable for the growth of most algae is from 0.1 to 1 mg/L. Therefor, nitrate content in boths of the third and fouth periods, ammonium content in all four periods, and phosphate content in all of three periods (the first, second and third) are in the appropriate range for algal growth.

Nitrate content in canal in the first and second periods is relatively low compared to the appropriate levels for algal growth. This may be the cause of the algal biomass in these two periods lower than that of the third and four periods. Phosphate content in the fourth exceeded 0.098 mg/L but not exceeding 18 mg/L inhibit the growth of algae. In general, water pH in the canal is lower than water pH in the rice field. At the same time, the content of ammonium, nitrate and phosphate in the canal was also much lower than in the field due to use of nitrogen and phosphorus fertilizers in rice field.

Table 1. Water pH, DO, nitrate, ammonium, andphosphate content in canal

Servey periods	pH	DO	NO_3^-	NH_4^+	PO_4^{3-}
		----------mg/L----------			
Period 1	6.95	3.72	0.06	0.25	0.07
Period 2	6.83	3.21	0.08	0.34	0.04
Period 3	7.12	3.69	0.19	0.34	0.08
Period 3	6.85	2.89	0.39	0.52	0.11

3.3. Fluctuation of algal biomass in rice field and canal

3.3.1. Fluctuation of algal biomass in rice field

The algae in rice field grow and deverlop depending on the natural environment (temperature, sunlight, water pH...), nutrient conditions (type and amount of fertilizer), water retention time. In addition, they were affected by the use of pesticides on rice field. Therefore, algal biomass increase more or less depends on the above conditions.

Fluctuation of algal biomass in rice fieldaccording to feritilizing periods

In fertilization periods, algal biomass was the highest in the first period, and thenalgal biomass decreases in the next periods. Biomass of algae in the second period, the third period and the fourth period decreased corresponding, with $p < 0.01$ (Table 3). This result is consistent with the research result of Reynaud and Roger (1978). Their research was carried out in the rice fields of the Senegalese republic of West Africa. The results showed that the total biomass of algae was the highest at the shoot to flowering stage, after the algal biomass is reduced.

Table 2. Algal biomass(µg/L) andKruskal-Wallis test according to periods after fertilizing

Periods after fertilizing	No. of sample	Range (µg/L)	Medium (µg/L)	Water level (cm)	Mean rank (calculated in mg/L)
Period 1 (22-26 days)	9	0,096-13,952	3,894±4,793	2,60	26,67
Period 2 (32-36 days)	9	0,186-1,524	0,749±0,528	3,06	18,56
Period 3 (42-46 days)	9	0,147-1,290	0,748±0,395	2,97	19,44
Period 4 (86-90 days)	9	0,065-0,857	0,291±0,249	1,94	9,33
Asym. Sig.					0,006**

*Note: ** Difference is statistically significant at significance level 0.01*

Algal biomass in the first period was the highest due to the low coverage of leaf canopy on the rice field. In addition, it was sunny so it easy exposed to sunlight. It promotes the photosynthesis of algae so algal biomassincreated. According to Vu Ngoc Ut and Duong Thi Hoang Oanh (2013),

bacillariophytaneed direct light. So they have facilitated rapid growth and increased density. This problem fits the fact when we carried out to collect sampling of algae. We saw that there were many specimens of algae, yellowish brown appear on water surface (Fig. 6).

Fig 5. Yellowish brown algae appear on water surface in 24 days after sowing

Algal biomass in the second period was lower than the third period although the mount of nitrogen and phosphorus fertilizers was higher than that of the second and third period due to the influence of raining. Nitrogen and phosphorus fertilizers are lost by removing them from soil surface and and evacuating into the air. At the same time, low light intensity limits the growth of algae.

Algal biomass in the fourth period was the lowest due to rice was ripe. The coverage of leaf canopy on the surface rice field was dense so sunlight exposed low. In addition, the amount of fertilizers for rice was also less than in the previous three periods. Besides, there was a sudden decrease in water pH (Fig. 1), so the algae did not respond in time. This is evidenced by the lowest DO content in water compared to the previous three periods due to the oxygen production from photosynthesis of algae that is slower than the oxygen consumption for the decomposition. The consumption of oxygen is due to the decomposition of organic matter in rice fields.

Fluctuation of algal biomass in rice fieldaccording to days after fertilizing

Alage biomass at 4 days after fertilizingranged from 0.065 to 13.952 (µg/L). Algal biomass at this time was the highest because nitrate, ammonium and phosphate contents in rice field (Fig. 3, Fig. 4 and Fig. 5) are within appropriate levels for growth of algae (Vu Ngoc Ut and Duong Thi Hoang Oanh, 2013, and Duong Tri Dung, 2009). However, Kruskal-Wallis test (Table 4) showed that algal biomass (µg/L) in paddy field between days after fertilizing was not statistically significant (with Asym. Sg. = 0.192 > 0.05). That is, algal biomass appeared in the rice field at 2, 4 and 6 days after fertilizing were equivalent. This shows that nitrogen and phosphorus content in the rice field at 6 days after fertilizing is still sufficient for the algae to absorb and increase biomass.

Table 3. Algal biomass (µg/L) and Kruskal-Wallis test according to days after fertilizing

Days after fertilization	No. of sample	Range (µg/L)	Medium (µg/L)	Water level (cm)	Mean rank(calculated in µg/L)
2 days	12	0.186-1.539	0.804±0.429	3.1	20.5
4 days	12	0.065-13.952	2.923±4.432	2.7	21.0
6 days	12	0.096-1.824	0.535±0.547	2.3	14.0
Asym.Sig.					0.192^{ns}

Note: ^{ns}: Difference is no statistically significant at significance level 0.05

Algal biomass in Xa Mach canal

Through 4 surveys showed that, algal biomass in Xa Mach canal in the first, second, third and fourth periods correspond to 239; 211; 317; and 268 µg/L. The average algal biomass in the canal was 272 µg/L. Algal biomass in the rice field in three previous periods was higher than in canal, an average of 2.8 to 14.4 times compared to in the canal. Particularly in the fourth period, algal biomass in the rice field was only 1.1 times higher than in the canal. Because Bacillariophyta, Cyanophytaand Chlorophyta speciesappeared few, on which Euglenophyta species appeared more than but with a sparse density. According to Lam My Lan (2000), Euglenophyta have lower biomass than the two Chlorophyta and Cyanophyta.

3.3.2. Estimated total biomass of algae in rice field

Calculated results showed that total of algal biomass supply to 1000 m^2 of paddy land for Winter-Spring crop through four periods after fertilizing is 17,047 µg/Lequivalents to 462 grams (wet weight).As a result, the amount of fertilizer, light intensity, coverage of leaf canopy, etc., greatly influenced the photosynthesis of algae, thus affecting the total biomass of algae appear in the rice field.

3.4. Relationship between algal biomass and water chemistry parameters

The results from analyzing multivariate regression (Table 5) showed that DO content (mg/L) was the only variety with high prediction biomass of algae in rice field followed the equation: Biomass of algae (µg/L) = 0.521 DO (mg/L) - 1.342 (with $p < 0.01$ and $R = 0.448$). Biomass of algae ismoderate positive correlation with dissloved oxygen in rice field ($R = 0.448$). According to Ton That Phat *et al.* (2006), correlation coefficient ranges from 0.4 to 0.7, the correlation is moderate.

Table 4. Correlation of biomass regression with chemical parameters in rice field

Pair of correlations	No. of sample (n)	F value	Adjusted R square (R^2)	Correlation coefficients (R)
Algal biomass_pH	36	0.733^{ns}	0.164	0.405
Algal biomass_DO	36	0.002^{**}	0.248	0.448
Algal biomass_NO_3^-	36	0.785^{ns}	-0.036	0.087
Algal biomass_NH_4^+	36	0.960^{ns}	0.195	0.441
Algal biomass_PO_4^{3-}	36	0.842^{ns}	0.0001	0.010

Hence, DO content increased from three units, algal biomass increased to 0.221 units, of which the amount of dissolved oxygen provided by the algae accounted for 24.8% of total DO content in water, 75.2% of total DO content may be suppied by other factors, for example, diffusion of oxygen from the air, oxygen release from photosynthesis of weeds, vegetables, timbers, etc.This result is consistent with the result of McVea and Boyd (1975).According to McVea and Boyd (1975), there was a positive correclation between phosphateand chlorophyll-ain 12 algal ponds. The mainly reason is that the coverage of the leaf capony on the rice field has affected sunlightilluminate. After earing stage, the rate of photosynthesis of algae in rice field is greatly reduced.

4. CONCLUSION AND RECOMMENDATION

4.1. Conclusion

Based on the results, it is safe to conclude that, the amount of nitrogen and phosphorus fertilizers for rice in excess of recommended from 1.23 to 1.37 times and 1.82 to 2.42 times, respectively.

At the time we took our sample, water pH in the first period is interest to algal growth. Nitrate, ammonium and phosphate content in 4 days after fertilizing of all four periodssteady suitable algal growth. But in 2 and 6 days after fertilizing do not suitable algal growth. They do not exceed to cause inhibition of algal growth. In five chemical parameters, dissolved oxygen was the only variety with high prediction biomass of algae in rice field.

Algal biomass appeared the higest in early stage of branching, and lowest in ripenning stage. However, the algal biomass between the days after fertilizing was statistically similar. Weather in Winter-Spring crop is favorable for algae to increase biomass faster, it was estimated that total fresh algae supply for rice field in this crop is 462 g/1000 m^2 of rice land (calculated in four periods).

4.2. Recommendation

The total nitrogen and total phosphorus requirement in the rice field should be studied to determine the growth of algae in the N: P ratio.

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BIOLOGICAL PARAMETERS OF *BUTIS BUTIS* (HAMILTON, 1822) POPULATION FROM THE MEKONG DELTA

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ABSTRACT

The goby *Butis butis* is a commercial fish for food supply and has been increasingly catching, but information on its population biology is unknown. This study was conducted in coastlines in the Mekong Delta to provide new knowledge on the population biology of *B. butis*. The analysis of length-frequency data of 604 individuals caught by gill nets from January to December 2016 showed that the von Bertalanffy curve was $L_t = 24.02\left(1-e^{-0.61(t+0.04)}\right)$. This gobiid species reached 4.92 yrs in the longevity and 2.55 in the growth performance. The species showed 1.98 yr^{-1}, 1.42 yr^{-1}, 3.40 yr^{-1} and 0.58 in the fishing mortality, natural mortality, total mortality and exploitation rate respectively based on the analysis of length-converted catch curve. Two recruitment peaks in July and September were recorded in the goby population, and the relative yield-per-recruit and biomass-per-recruit analysis showed that E_{max} = 0.733, $E_{0.1}$ = 0.620 and $E_{0.5}$ = 0.347. The species *B. butis* is a potential aquaculture candidate because of its high growth parameter. The goby *B. butis* stock was overexploited, suggesting that the mesh size of fishing gears should be increased and avoid catching during the recruitment period for sustainable fishery management.

Keywords: Butis butis; mortality; growth; longevity; exploitation rate

1. INTRODUCTION

Fishery assessment and management are strongly related to growth, mortality and exploitation rates obtained from the yield-per-recruit analysis ADDIN EN.CITE (. The growth performance estimated from the growth and asymptotic length relationship analysis varies with gender and location, according to Pauly & Munro (1984). The understanding of biological parameters of gobiid population in the Mekong Delta, where they diversify with 58 species (Tran et al., 2013) and have been overfishing (Trinh & Tran, 2012), is limited to a few species such as *Pseudapocryptes elongatus* (Tran, 2008), *Parapocryptes serperaster* (Dinh et al., 2015), *Glossogobius giuris* (Dinh et al., 2017).

The Duckbill sleeper *B. butis* (Hamilton, 1822) is known as a member of the family Eleotridae (Ryan, 1981; Riede, 2004) but now moved into the family Butidae based on the Gobioidei phylogeny study of Thacker (2009) and Thacker (2013). This species is an amphibious fish widely distributed in marine, brackish and freshwater from East Africa to Fiji, according to Ryan (1981) and Riede (2004). The species *B. butis* feeds mainly on crustaceans and small fishes in Sri Lanka (Pethiyagoda, 1991); shrimps, prawns, zoobenthos and crustaceans in Thailand (Monkolprasit, 1994); and zoobenthos and crustaceans in Cambodia (Rainboth, 1996). The genus *Butis* comprises six species including *B. amboinensis*, *B. butis*, *B. gymnopomus*, *B. humeralis*, *B. koilomatodon* and *B. melanostigma*; but only three species *B. butis*, *B. koilamotodon* and *B. humeralis* have been found in the Mekong Delta until now (Tran et al., 2013). The species *B. butis* lives mainly in estuarine and coastline areas (Tran et al., 2013) and is a native commercial target fish for catching (Rainboth, 1996; Diep et al., 2014). This goby wis a multiple spawner with a high batch fecundity of 15,000 – 78,500 eggs/female, laying egg for a year-round (Dinh & Le, 2017). However, knowledge of its population biology is unknown. The present study, therefore, aims to provide some basic parameters of this species population including growth performance, exploitation rate,

mortality indices, length at first capture, recruitment time, longevity, growth performance and fishing status, which will be useful for the fish population assessment and management.

2. MATERIALS AND METHODS

2.1. Study site

The present study was conducted for a year round from January to December 2016 along the coastlines in the Mekong Delta ranging from Bac Lieu to Soc Trang and Tra Vinh provinces, Vietnam (Figure 1). These three regions are fringed by large areas of *Avicennia marina* and *Sonneratia caseolaris* mangroves with a vast mudflat and semi-diurnal tide. Like other parts of the South of Vietnam, these provinces has two seasons including the dry (January–May) and wet season (June–December). It rarely rains in the dry season but heavy rains in the wet season (roughly 400 mm per month) and the mean annual temperature is ~27^{o}C, according to Le et al. (2006).

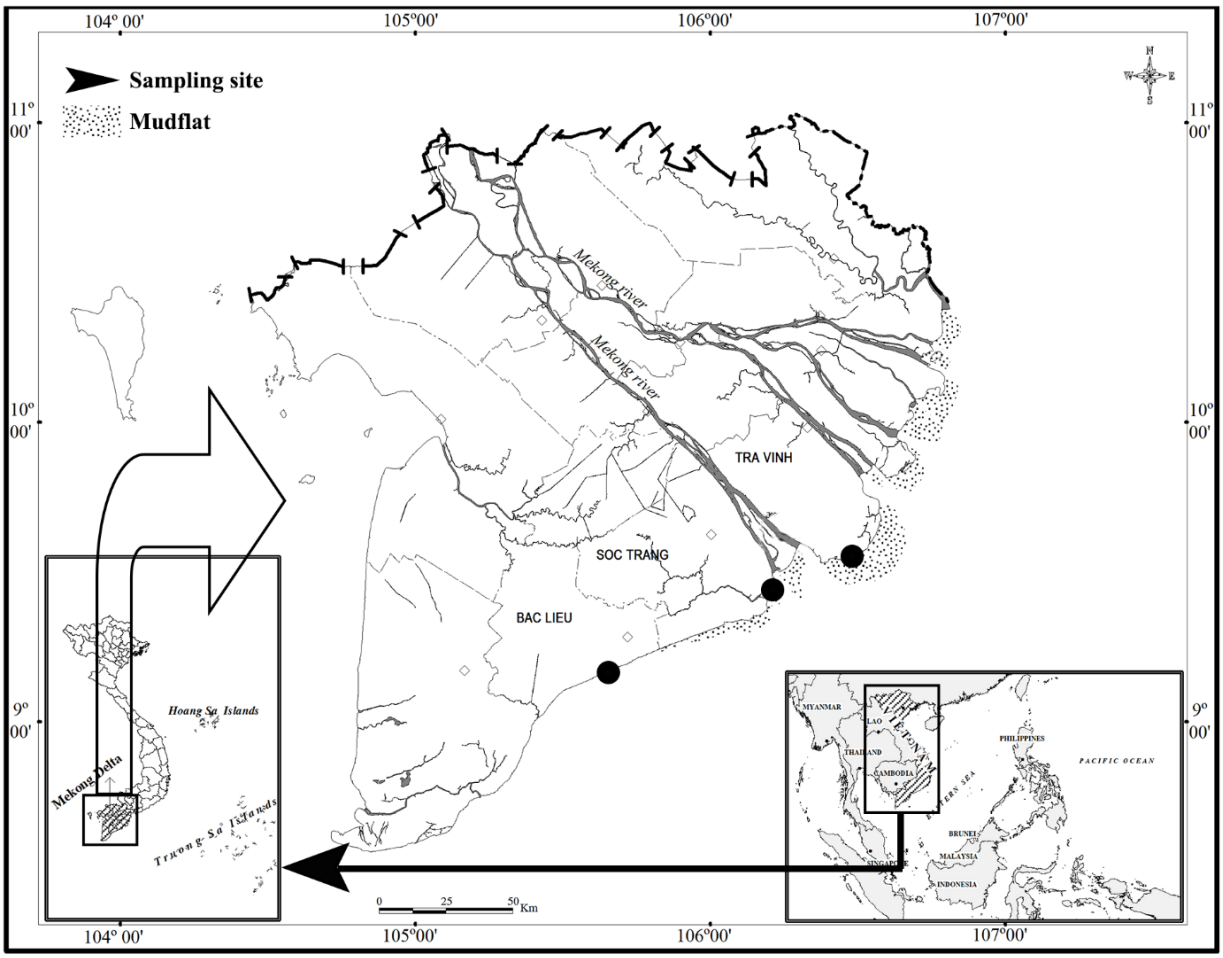

Fig 1. The map of study region (●: Sampling site)

2.2. Fish collection and analysis

Fish was monthly collected using a group of nine gill nets with 1.5 mm mesh size in the cod-end. A group three gill nets was set at the highest tide along the margin of mangrove forest in each study site and retrieved after 2-3 hours during ebb tide to collect fish. Fish specimens were identified using external morphology description of Tran et al. (2013) and anaesthetized in benzocaine before being preserved in 5% formalin and transported to the laboratory. Fish specimens were measured to the nearest 0.1 cm in total length (TL) and the nearest 0.01 g in body weight (W) after sexual determination using genital papilla shape that was triangle in the male and oval in the female.

2.3. Data analysis

Length frequency data were used to calculate the biological parameters of the fish population by inputting them into FiSAT II software, according to Gayanilo et al. (2005). The asymptotic length (L_∞) and the growth parameter (K) of fish were estimated by performing the ELEFAN I procedure (Pauly & David, 1981; Pauly, 1982; Pauly, 1987). The total mortality index (Z) was estimated from the length-converted capture curve process (Beverton & Holt, 1957; Ricker, 1975). According to Pauly (1980), the natural mortality (M) was estimated as.

$$\text{Log}M = -0.0066 - 0.279\text{Log}L_\infty + 0.6543\text{Log}K + 0.463\text{Log}T$$

where L_∞ and K were two parameters of the ELEFAN I, and T was the mean annual water temperature (^oC). The fishing mortality (F) consequently was calculated as $F = Z - M$ and the exploitation rate (E) was determined from equation $E = F/Z$, according to Ricker (1975).

The recruitment pattern and the probability of capture were estimated by performing the length-converted catch procedure, and the length at first capture (L_c) was computed by plotting the cumulative probability of capture against the class mid-length, according to Pauly (1987). The yield-per-recruit model of Beverton & Holt (1957) was used to determine the fish stock and yield, according to Sparre & Venema (1992). The maximum exploitation rate (E_{max}), the potential exploitation rate ($E_{0.1}$) and the exploitation rate with the reduction of stock to 50% ($E_{0.5}$) were calculated by performing the knife-edge selection (Beverton & Holt, 1966). The growth performance (Φ'), which was determined as $\Phi' = \text{Log}K + 2\text{Log}L_\infty$ (K and L_∞ are two parameters of the von Bertalanffy curve), was used to compare the von Bertalanffy growth parameters of *B. butis* and other goby species dwelling in the same or different habitat (Pauly & Munro, 1984). The goby longevity (t_{max}) was calculated as $t_{\max} = \frac{3}{K}$ where K was the growth constant (Taylor, 1958; Pauly, 1980).

3. RESULTS

The species *B. butis* population displayed three fish size groups, which were known as three blue lines in the Figure 2, based on the length-frequency data analysis of 604 individuals (260 females and 344 males, Table 1, 5.6–15.8 cm TL) in this study area. The small fish group grew faster than the bigger fish group since its the slope was slightly sharper than the larger fish group. The von Bertalanffy growth curve of *B. butis* was $L_t = 24.02\left(1 - e^{-0.61(t+0.04)}\right)$ based on the analysis of growth increment data obtained from the NORMSEP procedure (Figure 3).

Table 5. The number of *Butis butis* caught from the study sites

Length frequency	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
<6.0			1	1	5							
6.0-6.9		10			7					21		
7.0-7.9	2	8	2	11	15	2			11	29		11
8.0-8.9	6	4	3	19	17	10	3	9	7	19		
9.0-9.9		9			13	4	3	7	12	16		
10.0-10.9	14	3	5	18	3	5	2	12		13	11	13

Length frequency	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16
11.0-11.9	12	2	5	10	11	3	6	6		8	13	12
12.0-12.9		5	5	9	5	2		4		8	5	2
13.0-13.9	10	1				8	2			1	4	11
14.-14.9	9	1				7	5					2
>15.0	1						2					11

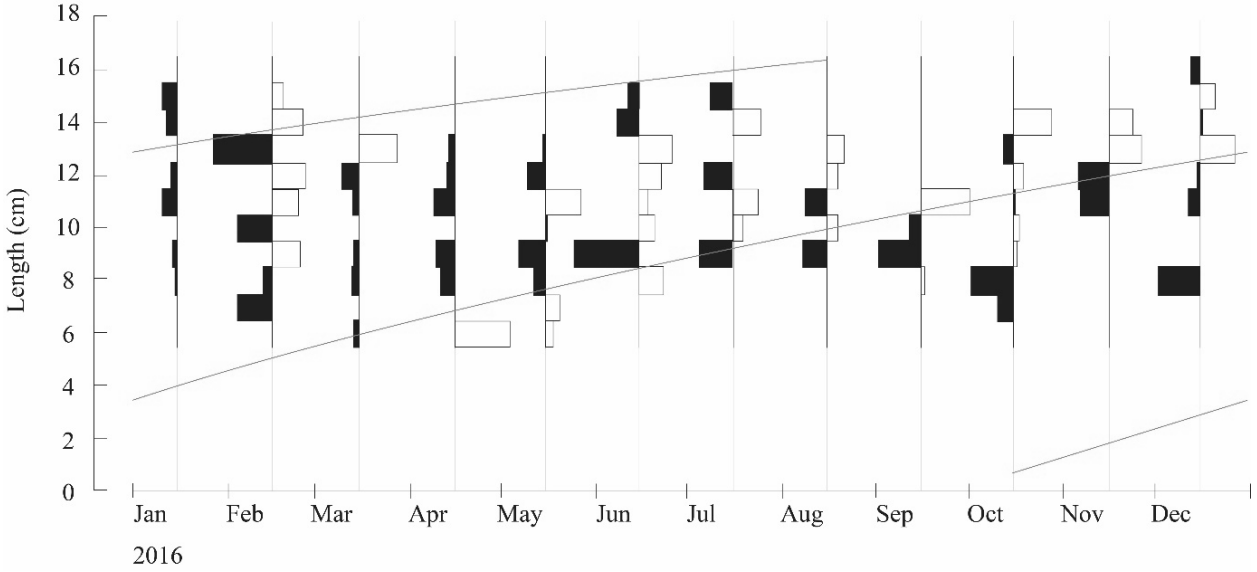

Fig 2. Length-frequency distribution of *Butis butis* (n = 604). Three curves (e.g., three blue lines) show the increase of fish length over time

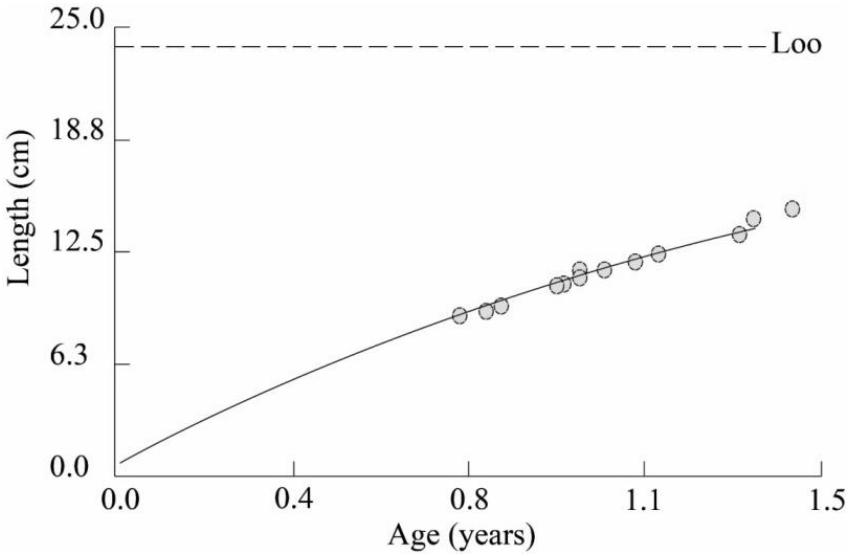

Fig 3. The von Bertalanffy growth curve of *Butis butis* based on growth increment analysis (L_∞ = 24.02 cm, K = 0.61 yr^{-1} and t_0 = –0.04 yr^{-1})

The species showed 3.40, 1.42 and 1.98 in the total, natural mortality and fishing mortality respectively based on the length-converted catch curve analysis (Figure 4). The exploitation rate and

length at first capture (L_c or L_{50}) of this species were 0.58 and 10.47 cm TL respectively based on the capture probability analysis (Figure 5). The optimum yield ($E_{0.1}$), yield at the stock reduction 50% ($E_{0.5}$) and maximum sustainable yield (E_{max}) were 0.620, 0.347 and 0.733 respectively obtained from the relative yield recruitment analysis (Figure 6). Moreover, this gobiid species reached 2.55 in the growth performance and 4.92 in the longevity respectively.

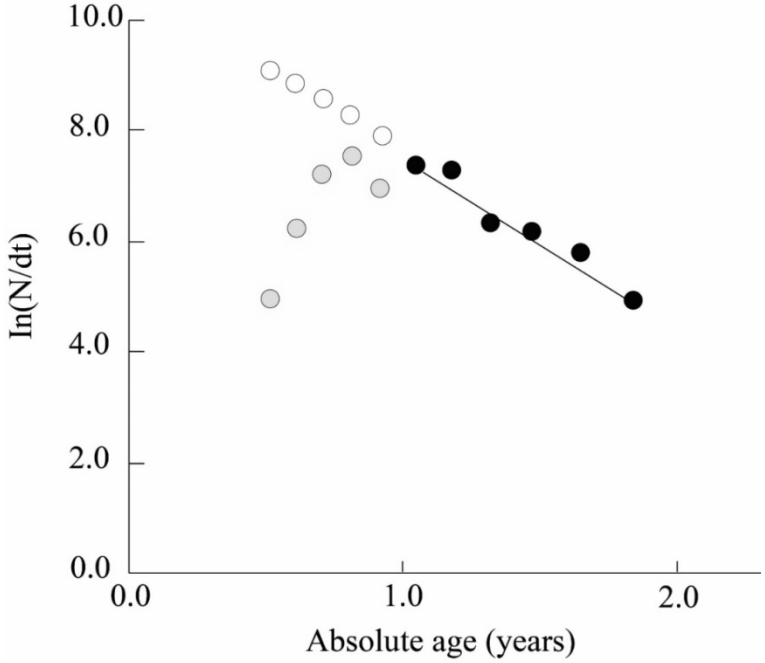

Fig 4. The length converted catch curve of *Butis butis* (Z=3.40, M = 1.42, F = 1.92 and E = 0.58)

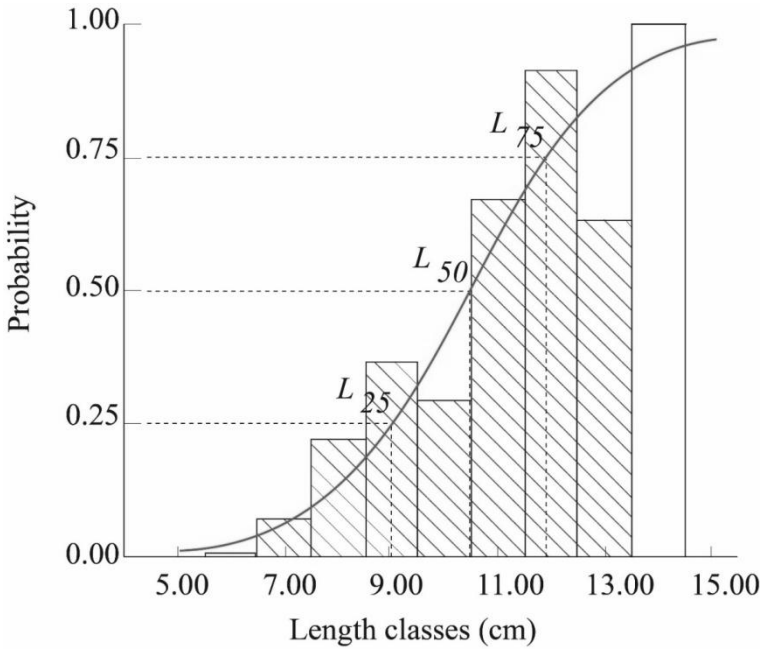

Fig 5. The probability of capture of *Butis butis* estimated from the logistic transform curve, e.g., red line (L_{25} = 9.02, L_{50} = 10.47 and L_{75} = 11.91 cm)

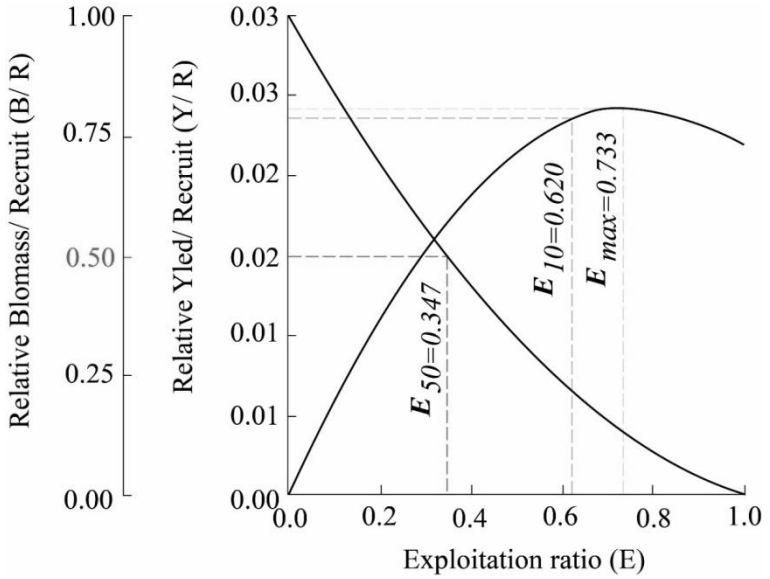

Fig 6. The relative yield-per-recruit and biomass-per-recruit of *Butis butis* (E_{max} = 0.733, $E_{0.1}$ = 0.620 and $E_{0.5}$ = 0.347).

4. DISCUSSION

The variation in growth parameter (K) and asymptotic length (L_∞) are found in some gobiid fishes, according to the study on the population biology of *P. serperaster* of Dinh et al. (2015). The growth performance (Φ') of *B. butis* obtained from a combination analysis of K and L_∞ was lower than some gobiid species living in the same or different habitat like *P. elongatus* (Tran et al., 2007), *Periophthalmodon schlosseri* (Mazlan & Rohaya, 2008), *G. matanensis* (Mamangkey & Nasution, 2014), *P. serperaster* (Dinh et al., 2015) and *G. giuris* (Dinh et al., 2017) (Table 2). It seems that *B. butis* did not grow as well as these five gobiid species. However, the species *B. butis* might adapt and grow efficiently than some other species including *Periophthalmus barbarrus* (Etim et al., 2002) and *G. giuris* (Dinh et al., 2017) since its Φ' were higher than these species (Table 2). When studying the population biology of *G. giuris*, Dinh et al. (2017) found that smaller in K and L_∞ lead to the lower in Φ' of *G. giuris* compared to other gobies. Similarly, Φ' of *B. butis* in the present study was lower than *P. elongatus* (Tran et al., 2007), *P. schlosseri* (Mazlan & Rohaya, 2008), *G. matanensis* (Mamangkey & Nasution, 2014) and *P. serperaster* (Dinh et al., 2015) as its K and L_∞ were smaller than these four gobiid species. By contrast, the *B. butis* displayed a higher in the Φ' compared to *P. barbarrus* (Etim et al., 2002) and *G. giuris* (Dinh et al., 2017) since its K and L_∞ were greater than these species (Table 2).

Comparing to *P. elongatus* (Tran et al., 2007) and *P. serperaster* (Dinh et al., 2015), *B. butis* played more potential for artificial spawning research as its t_{max} was higher than these two species. Dinh et al. (2017) reported that the growth constant of *G. giuris* is probably related to its longevity. Similarly, the goby *B. butis* in the present study displayed the higher and the lower in the longevity and growth parameter respectively than some gobiid species living in the same or different habitat such as *P. barbarrus* (Etim et al., 2002), *P. elongatus* (Tran et al., 2007), *P. schlosseri* (Mazlan & Rohaya, 2008), *P. serperaster* (Dinh et al., 2015) and *G. giuris* (Dinh et al., 2017) (Table 2).

When studying the population structure of *G. giuris*, Dinh et al. (2017) indicated that the lower in natural mortality (M) is lead to the better in natural food resource using and predator avoiding. Indeed, the species *B. butis* could adapt and use food resources more efficiently than *P. elongatus* (Tran et al., 2007) and *P. serperaster* (Dinh et al., 2015) but less than *G. giuris* (Dinh et al., 2017) in the Mekong Delta since its M was lower and higher than these three species respectively (Table 2). The higher in economic value might lead to the greater in the fishing mortality of *B. butis* compared to *P. elongatus*, *P. serperaster* and

G. giuris (Table 2). Additionally, the different economic value or fishing gears might cause the differences in the fishing mortality and length at first capture between *B. butis* and other gobiid species (Table 2).

Table 6. Population parameters of various gobiid species

Species	L_∞	K	t_{max}	Z	F	M	L_c	E	Φ'	Sources
Periophthalmus barbarus	21.60	0.55	5.45	4.21	2.86	1.35	10.2	0.68	2.41	Etim et al. (2002)
Pseudapocryptes elongatus	26.00	0.65	4.35	2.91	1.47	1.44	11.75	0.51	2.64	Tran et al. (2007)
Periophthalmodon schlosseri	29.00	1.40	2.14	-	-	-	-	-	3.10	Mazlan & Rohaya (2008)
Glossogobius matanensis	46.20	1.20	-	3.73	1.94	1.79		0.52	3.42	Mamangkey & Nasution (2014)
Parapocryptes serperaster	25.52	0.74	4.05	3.07	1.57	1.51	14.6	0.49	2.67	Dinh et al. (2015)
Glossogobius giruis	20.53	0.56	5.36	3.17	1.77	1.40	7.41	0.56	2.37	Dinh et al. (2017)
Butis butis	24.02	0.61	4.92	3.40	1.98	1.42	10.47	0.58	2.55	Present study

The exploitation rate of *B. butis* was higher than E_{50}, showing that the goby stock was overfished, supported by the short length at first capture. It suggested that the mesh size of gill nets should be increased and avoid catching fish in the recruitment time (April and September) for sustainable fishery management. Likely, the fish stock of *G. giuris* is also overexploited (Dinh et al., 2017). By contrast, populations of *P. elongatus* (Tran et al., 2007) and *P. serperaster* (Dinh et al., 2015) have not been overfishing since both *B. butis* and *G. giruis* showed the higher economic value and the smaller L_∞ and L_c compared to *P. elongatus* (Tran et al., 2007) and *P. serperaster* (Dinh et al., 2015). Moreover, the difference in studying time of the present and previous studies may result in these differences, suggesting that the mesh size of fishing gears should be increased for sustainable fishery management.

In conclusion, the species *B. butis* showed high population recruitment and is a potential candidate for aquaculture production because of high growth constant. The fish stock was subjected to overexploitation, suggesting the mesh size of fishing gears should be increased and avoid catching in April and September for future sustainable fishery management in the study region.

Acknowledgments

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BIOCATALYSIS FOR BROWN ALGAE POLYSACCHARIDES MODIFICATION AS A BASIS FOR OBTAINING AND STUDYING FRAGMENTS RESPONSIBLE FOR THEIR BIOLOGICAL ACTIVITY

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ABSTRACT

In this study, fucoidans were isolated from Russian and Vietnamese brown algae *Fucus evanescens, Saccharina gurjanovae, Sargassum mcclurei*, and *Turbinaria ornata*. Structures of four fucoidans were investigated using methylation analysis of desulfated polysaccharides; mass-spectrometry and NMR spectroscopy of low molecular weight derivatives obtaining by enzyme hydrolysis and autohydrolysis of fucoidans. Fucoidan from *F. evanescens* represented 1,3;1.4-α-L-fucan. Fucoidans from *S. gurjanovae, S. mcclurei*, and *T. ornata* are galactofucans.

The anticancer activity of sulfated polysaccharides from *Turbinaria ornata* and modified derivatives of native fucoidan against several cancer cell lines was studied. It was shown, that the sulphated galactofucan and its derivative obtained by enzymatic hydrolysis inhibited colony formation of human colorectal, breast adenocarcinoma, and malignant melanoma cell lines *in vitro*.

Keywords: brown algae, fucoidan, chemical and enzymatic modification, autohydrolysis, structure, anticancer activity

1. INTRODUCTION

Brown algae are widely distributed in the world ocean and are the basis of the feeding of marine organisms, especially invertebrates and microorganisms. These algae synthesize unique polysaccharides: laminarans, alginic acids, and fucoidans. Analogues of fucoidans have not yet been found on land. The enzymes involved in the transformation of laminarans and alginic acids are often found in marine organisms, whereas reports about sources of fucoidanases are rare (*1*). The biochemical reactions catalyzed by enzymes, in particular polysaccharides hydrolases, are base of the vital processes of living organisms. The study of the specificity, mechanism of action, establishment of the structure of the active centers of enzymes are necessary for biotransformation of substrates to produce biologically active fragments with standard chemical characteristics. The classic application of enzymes as a tool to establish the structure of the substrate is also important.

Currently, fucoidans are attracted attention due to diverse biological activity, beneficial effect on the body, low toxicity, and plant origin (*2, 3*). The study of the structure of these polysaccharides and biological activity can help in understanding of what fragments of the structure of fucoidans determines

their biological properties. Publications about the producers of fucoidanases - enzymes involved in the biotransformation fucoidans are rare (*4-6*). This is due to several reasons: the lack of quantitative methods for determining the activity of fucoidanases; using as substrates a structurally uncharacterized or poorly fractionated fucoidans, and structural diversity fucoidan.

The aim of this study are identification and establishment of the structure of fucoidans synthesized by brown algae growing in the seas of the Far East of Russia and Vietnam to expand the collection of structurally different fucoidans; searching of new sources of fucoidanases and production of the chemical and enzymatic transformed fucoidans; the study of antitumor activity of the fucoidans to create the active supplements on their base, a preparation for medicine, food, veterinary medicine.

2. MATERIALS AND METHODS

2.1. Materials

The brown algae *Turbinaria ornata* (**To**) and *Sargassum mcclurei* **(Sm)** were collected in May and June 2010, respectively, from Nhatrang bay (South China Sea, Socialist Republic of Vietnam); *Saccharina gurjanovae* **(Sg)** and *Fucus evanescens* **(Fe)** – in August 2012 at the coast of island Big Shantar and July 2009 from Kraternaya bay (Sea of Okhotsk, Russia). The samples of algae were powdered, defatted by organic solvents and dried.

Mollusks *Lambis* sp. were harvested in May 2013 from the South China Sea (Socialist Republic of Vietnam); *Patinopecten yessoensis* – in and July 2012 from the Troitsa Bay, Sea of Japan (Russia) and were stored frozen at -20ºC until use. Enzymes from collected mollusks were isolated and purified by described methods (*7, 8*).

2.2. Instrumental methods

NMR spectra were obtained on an Avance DPX-500 NMR spectrometer (Bruker, Germany) resonating at 75.5 MHz at 35°C. The sample concentration was 10 mg of polysaccharide/mL of D_2O for 1D and 2D experiments.

GLC-MS experiments were carried out on Hewlett-Packard 6850 instrument (USA) equipped with HP-5MS capillary column (30 m x 0.4 mm) with temperature gradient from 150 to 230°C at 3°C/min.

MALDI-TOFMS spectra were recorded using an Ultra Flex III MALDI-TOF/TOF mass spectrometer (Bruker, Germany) with a nitrogen laser (337 nm), reflector and the potential LIFT tandem modes of operation.

ESIMS spectra were recorded using an ESI Q-TOF mass spectrometer (Agilent 6510 LC Q-TOF, USA) with a dual electrospray-ionization source.

2.3. Analytical procedures

Total carbohydrates were quantified by the phenol-sulfuric acid method (*9*). Monosaccharides composition was determined by HPLC with column ISA-07/S2504 (0.4 x 25 cm, Shimadzu), bicinhoninate assay, and a C-R2 AX integrating system (Shimadzu, Kyoto, Japan) after hydrolysis by 2 M trifluoroacetic acid (6 h, 100°C). Monosaccharides (rhamnose, ribose, mannose, fucose, galactose, xylose, and glucose) were used as standards for HPLC. The content of proteins were determined by the methods Lowry et al. (*10*) and Bradford (*11*). Sulfate group determination was carried out using the $BaCl_2$ gelatin method (*12*).

2.4. Isolation of fucoidans from brown algae

Samples of defatted algal fronds were extracted with 0.1 M HCl or 2% $CaCl_2$ with heating. The extracts were neutralized, centrifuged, dialyzed, concentrated, and lyophilized to obtain of fraction of water-soluble polysaccharides. Fucoidans were separated and purified by anion-exchange chromatography of polysaccharides extracts. The obtained fractions were concentrated, dialyzed, and lyophilized.

2.5. Chemical modifications of fucoidans

Desulfated (DS) fucoidan fractions from S. mcclurei and T. ornata were prepared according to (8, 13). Desulfated fucoidans were methylated and hydrolysed, then the methylated monosaccharides were reduced and acetylated. Partially methylated alditol acetates were analyzed by GLC–MS (14).

2.6. Depolymerization of fucoidans

Obtaining of oligosaccharide fractions by autohydrolysis of fucoidans from *S. mcclurei*, *T. ornata* and *S. cichorioides* was described (*7, 8, 13*). The depolymerized derivatives of fucoidans from *T. ornata* and *F. evanescens* by enzymatic hydrolysis were prepared according to described method (*8, 15*).

2.7. Biological activity

Anticancer activity of fucoidans was assayed with human colorectal adenocarcinoma HT-29, breast adenocarcinoma T-47D, and malignant melanoma SK-MEL-28 cell lines by soft agar clonogenic method. The cell proliferation assay (MTS method) was used to estimate cell cytotoxicity. All figures shown in this manuscript are representative of at least three independent experiments with similar results. Statistical differences were evaluated using the Student's t-test and considered significant at $p \leq 0.05$.

3. RESULTS AND DISCUSSION

3.1. Isolation and characterization of fucoidan fractions from brown algae

The fucoidan fractions were isolated by Vietnamese (Sargassum mcclurei, Turbinaria ornata) and Russian (Saccharina gurjanovae, Fucus evanescens) brown algae (7, 8, 13, 15). The yields, monosaccharide composition, and degree of sulfation of the purified fucoidans are listed in Table 1.

Table 1. Yields and monosaccharide composition of fucoidan fractions

Fucoidan	Eluent [NaCl], M	Yield, %*	SO_3Na, %**	Monosaccharide composition, mol %				
				Fuc	Gal	Man	Xyl	Glc
S. mcclurei								
SmF1	0.7-0.8	0.2	17	27.2	19.6	34.0	6.4	12.8
SmF2	0.8-1.4	0.5	26	44.8	34.1	5.4	5.3	10.4
SmF3	1.4-1-8	0.3	35	58.5	41.5	0	0	0
T. ornata								
ToF1	0.8	0.1	18	62.5	12.5	25.0	0	0

Fucoidan	Eluent [NaCl], M	Yield, %*	SO_3Na, %**	Monosaccharide composition, mol %				
				Fuc	Gal	Man	Xyl	Glc
ToF2	1.2	0.3	32	83.3	16.7	trace	0	0
S. gurjanovae								
SgF1	1.0	1.7	10	64.1	27.4	5.7	2.8	0
SgF2	2.0	2.5	24	75.9	21.2	1.8	1.1	0
F. evanescens								
FeF	1-1.5	4.6	28	96.2	2.0	0	1.8	0

* *% of dry degatted algae weight.*

** *% of sample weight*

The fucoidan from *F. evanescens* was sulfated fucan. Other isolated fucoidans were sulfated heteropolysaccharides. Fucan **FeF** and galactofucans **SmF3**, **ToF2** and **SgF2** were more homogeneous and high-sulfated. These fractions were changed for structural elucidation.

3.2. Investigations of fucoidan structure

3.2.1. Fucoidans SmF3 from S. mcclurei and ToF2 from T. ornata

The desulfation of fucoidan **SmF3** and **ToF2** was performed to simplify the structure of these polysaccharides. The desulfated **SmF3DS** and **ToF2DS** fucoidans were methylated with methyl iodide in the presence of sodium hydroxide in DMSO. The methylated polysaccharide was hydrolyzed, and the resulting mixture of partially methylated monosaccharides was analyzed as alditol acetates by GLC-MS (*14*) (Table 2).

Table 2. Methylation analysis of desulfated fucoidan **SmF3DS** and **ToF2DS**

Partially methylated fucitol or galactitol acetates	Linkage type	mol %	
		SmF3DS	ToF2DS
2,3,4-tri-*O*-methyl-fucitol	Fuc1→	5	8
2,3-di-*O*-methyl-fucitol	→4Fuc1→	12	-
2,4-di-*O*-methyl-fucitol	→3Fuc1→	46	62
2-*O*-methyl-fucitol	→3,4Fuc1→	-	9
2,3,4,6-tetra-*O*-methyl-galactitol	Gal1→	8	6
2,3,6-tri-*O*-methyl-galactitol	→4Gal1→	18	15
2,3,4-tri-*O*-methyl-galactitol	→6Gal1→	2	-

Partially methylated fucitol or galactitol acetates	Linkage type	mol %	
		SmF3DS	ToF2DS
3,4-di-*O*-methyl-galactitol	→2,6Gal1→	1	-
2,4-di-*O*-methyl-galactitol	→3,6Gal1→	2	-
1,2,3,4-tetra-*O*-methyl-galactitol	→6Gal	6	-

Then the both fucoidans were depolymerized by autohydrolysis, and fucoidan from *T. ornata* – by enzymatic hydrolysis with fucoidanase from marine mollusk *Patinopecten yessoensis*. Mass-spectrometry analysis of low-molecular weight derivatives of fucoidan **SmF3** indicated the presence of following fragments in its structure: Fuc-2-OSO_3^--(1→3)-Fuc-2-OSO_3^-, Fuc-(1→3)-Fuc-2,4-OSO_3^-, Fuc-2-OSO_3^--(1→4)-Fuc-2,3-OSO_3^-, Fuc-2,4-OSO_3^--(1→3)-Fuc; Gal-4/6,3-OSO_3^--(1→3/4)-Fuc-2/3-OSO_3^-, and Fuc-2,4-OSO_3^--(1→4)-Gal-2-OSO_3^-, Fuc-(1→4)-Gal-3-OSO_3^-)-(1→3)-Fuc-2-OSO_3^--(1→3)-Fuc-2-OSO_3^-, Fuc-2-OSO_3^--(1→4)-Gal-(1→3)-Fuc-2-OSO_3^--(1→4)-Gal-(1→3)-Fuc, Gal-2-OSO_3^-)-(1→3)-Fuc-2-OSO_3^--(1→4)-Gal-(1→3)-Fuc-(1→3)-Fuc. Fucoidan **ToF2** included the following fragments: Fuc-2,4-OSO_3^--(1→2)-Fuc, Fuc-2-OSO_3^--(1→4)-Fuc-2-OSO_3^-, Gal-2-OSO_3^--(1→3)-2-OSO_3^--Fuc, Fuc-4-OSO_3^--(1→4)-Gal-3-OSO_3^-, Fuc-2-OSO_3^--(1→4)-Gal-3-OSO_3^--(1→4)-Fuc, Gal-4-OSO_3^--(1→4)-;Fuc-4-OSO_3^--(1→3)-Fuc and HexA-(1→2)-Fuc-4-OSO_3^-.

3.2.2. Fucoidan SgF2 from S. gurjanovae

Fucoidan **SgF2** from *S. gurjanovae* was additionally purified by anion-exchange chromatography to obtain more homogeneous fraction (Fuc:Gal =1:0.3). Depolymerization of fucoidan by autohydrolysis was carried out to obtain high (HMW) and low-molecular weight (LMW) fractions. The ^{13}C NMR spectrum for HMW fraction contained six intensive signals with chemical shifts of 99.7 (C-1), 67.9 (C-2), 77.5 (C-3), 81.0 (C-4), 68.4 (C-5), and 16.8 (C-6) ppm. These signals corresponded to the residues of 4-sulfated fucopyranose substituted in the C-3 positions. It is known, that the selective desulfation at C-2 happens in the process of autohydrolysis. Thus, fucan backbone of this galactofucan consisted of (1→3)-linked 2,4-sulfated fucopyranoside residues.

Mass-spectrometric analysis of oligosaccharides fractions revealed the presence of Fuc-2,4-OSO_3^-, Fuc-2-OSO_3^--(1→3)-Fuc-2,4-OSO_3^-, Gal-(1→3)-Fuc. The galactose residues were found to be linked by (1→4)- and/or (1→6)-type of linkage and formed chains with DP=1-5, or, probably, more. Sulfate groups, probably, occupied positions C-2 and/or sometimes C-3 of Gal residues.

3.2.3. Fucoidan FeF from F. evanescens

It is known, that fucoidan from *F. evanescens* was sulfated mainly at C-2, less at C-4 and acetylated 1→3;1→4-α-L-fucan (*16*). Enzymatic hydrolysis by fucoidanase from *Lambis* sp. was used for more detail investigation of its structure.

Products of enzymatic hydrolysis of fucoidan from *F. evanescens* were obtained and separated to obtain HMW and LMW (73%) fractions. LMW was fractionated by anion-exchange chromatography with yields of fractions 1, 2, 3, 4 and 5 – 3.6, 4.0, 5.4, 13.7 and 15.8%, respectively.

1D and 2D NMR techniques (^1H, ^{13}C, COSY, TOCSY, HSQC, HMBC) were applied to get more precise information on the average structure separated fractions. NMR spectra were resolved enough for detailed investigation by NMR spectroscopy only for fractions 3, 4 and 5.

Data of NMR spectrometry were shown in Table 3.

Table 3. NMR data for fraction 3, 4, 5

Fraction/Residue	$^{13}C/^{1}H$ chemical shifts (ppm)					
Fraction 3	H-1/C-1	H-2/C-2	C-3/C-3	H-4/C-4	H-5/C-5	H-6/C-6
A α-L-Fuc*p*-2-OSO_3^--(1→3)-	5.33/95.4	4.47/76.4	4.02/68.5	3.89/73.3	4.46/68.1	1.23/16.6
B →3)-α-L-Fuc*p*-2-OSO_3^--	5.49/91.7	4.52/74.7	4.02/74.1	4.06/70.0	4.22/67.1	1.24/16.6
Fraction 4						
A'' α-L-Fuc*p*-2-OSO_3^--(1→3)-	5.29/98.7	4.47/76.9	4.20/68.6	3.89/73.5	4.54/68.2	1.25/16.7
B''→3.4)-α-L-Fuc*p*-2-OSO_3^--(1→4)-	5.35/100.6	4.73/75.1	4.03/77.2	4.24/79.6	4.47/68.6	1.23/16.5
C''→4)-α-L-Fuc*p*-2-OSO_3^--(1→3)-	5.34/95.3	4.47/76.7	4.19/68.9	4.00/83.9	4.45/70.5	1.39/16.9
D'' →3)-α-L-Fuc*p*-2-OSO_3^-	5.49/91.8	4.52/74.7	4.14/73.9	4.01/69.9	4.23/67.1	1.24/16.6
E''α-L-Fuc*p*-(1→4)-	5.49/100.1	3.82/73.5	4.05/70.6	3.84/70.7	4.27/68.0	1.37/17.2
Fraction 5						
A' α-L-Fuc*p*-2-OSO_3^--(1→3)-	5.35/95.0	4.47/76.6	4.11/68.8	3.89/73.2	4.51/68.0	1.25/16.8
B' →3)-α-L-Fuc*p*-2-OSO_3^--(1→4)-	5.29/100.6	4.60/74.7	4.18/73.5	4.12/70.0	4.41/68.6	1.26/16.5
C'→4)-α-L-Fuc*p*-2-OSO_3^--(1→3)-	5.34/95.3	4.49/76.7	4.19/69.0	4.00/83.8	4.52/68.9	1.39/16.6
D'→3)-α-L-Fuc*p*-2-OSO_3^-	5.49/91.8	4.52/74.7	4.05/73.9	4.08/69.9	4.23/67.1	1.24/16.7

NMR of fucooligosaccharides clearly indicates that fraction 3 mainly contains sulphated disaccharide, fraction 5 is sulphated linear tetrasaccharide, fraction 4 is sulphated branched pentasaccharide, whereas other components of these fractions are in the trace amounts (Fig. 1). These observations correlated by data of mass-spectrometry analysis.

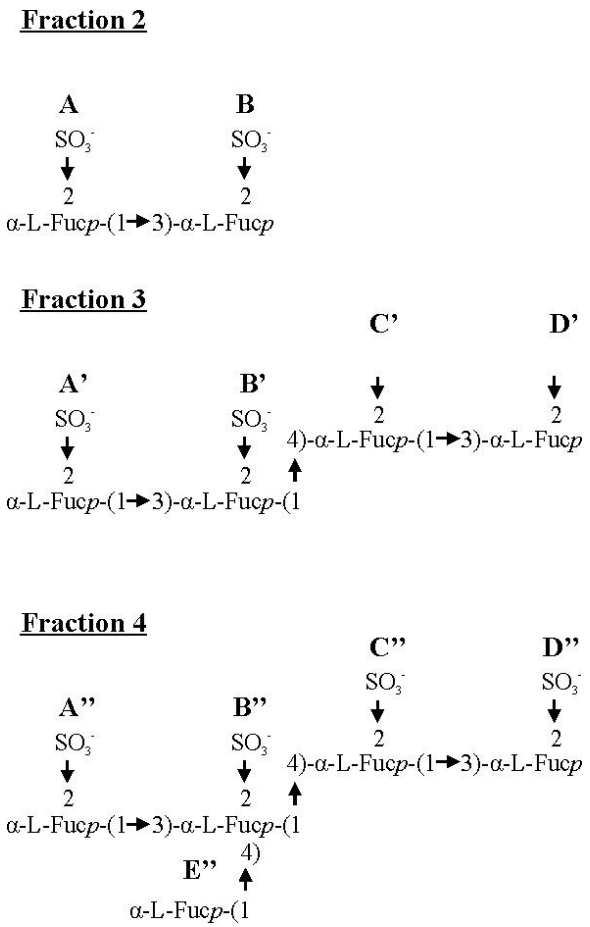

Fig 1. Structures of fractions 3,4,5

3.3. The effect of fucoidans from *T. ornata* on colony formation of human cancer cells

In the present work we examined the effect of sulfated polysaccharides from *T. ornata* and derivatives of **ToF2** on the cytotoxicity of cancer cells using 3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium, inner salt (MTS assay). Fucoidans did not show any significant cytotoxicity after treatment for 24 and 48 h at 1 to 200 μg/mL.

Then we performed the soft agar colony formation assay using human colorectal HT-29, breast T-47D adenocarcinoma, and malignant melanoma SK-MEL-28 cell lines, to demonstrate the cancer suppressive effects of fucoidans (**ToF1**, **ToF2**) from brown alga *T. ornata*, the enzyme-resistant fraction (**ToF2ER**) and desulfated fucoidan (**ToF2DS**) obtained from **ToF2** (Fig. 2). The fraction **ToF2ER** was characterized as highly sulfated (37%) galactofucan (Fuc:Gal = 1:0.3).

The fucoidan with a low degree of sulfation **ToF1** (100 μg/mL) possessed slight antitumor activity against tested cell lines. It suppressed colony formation of HT-29 and SK-MEL-28 on 13 and 34%, respectively. **ToF1** had no effect on colony formation of T-47D cells. On the other hand, the highly sulfated fucoidan **ToF2** was more effective in this experiment at the same doses. **ToF2** was found to inhibit colony formation of HT-29, T-47D, and SK-MEL-28 cells on 24, 15, and 44%, respectively (Fig. 2).

Desulfated fucoidan **ToF2DS** exhibited slight activity against colony formation of SK-MEL-28 cells. However, its effect was less than the effect of sulfated polysaccharide **ToF2**. Desulfated fucoidan had no inhibiting activity on colony formation of HT-29 and T-47D cells (Fig. 2). Fucoidan **ToF2ER** had a lower molecular weight and contained more galactose and sulfate groups than native fucoidan **ToF2**. Its anticancer effect was comparable to the effect of native fucoidan.

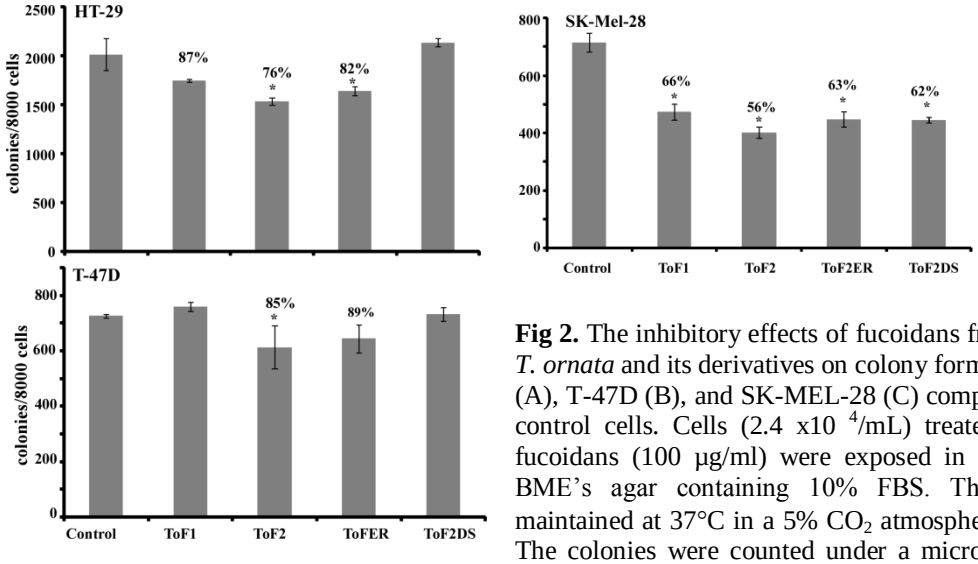

Fig 2. The inhibitory effects of fucoidans from brown alga *T. ornata* and its derivatives on colony formation of HT-29 (A), T-47D (B), and SK-MEL-28 (C) comparing untreated control cells. Cells (2.4 x10 ^{4}/mL) treated with/without fucoidans (100 µg/ml) were exposed in 1 mL of 0.3% BME's agar containing 10% FBS. The culture was maintained at 37°C in a 5% CO_2 atmosphere for 3 weeks. The colonies were counted under a microscope with the aid of the ImageJ soft ware program. Data are represented as the means SD of the number of colonies are determined from three independent experiments.

Based on the obtained results, we first demonstrated that the highly sulfated polysaccharide **ToF2** isolated from *T. ornata* and its derivatives **TOF2ER** obtained enzymatic hydrolysis, and inhibited colony formation of human colorectal, breast adenocarcinoma, and malignant melanoma *in vitro*. A fucoidan with a low content of sulfate groups, and desulfated fucoidan had slight anticancer activity *in vitro*.

4. CONCLUSIONS

In the results of the present investigation, the eight fucoidan fractions were isolated by Vietnamese (*Sargassum mcclurei*, *Turbinaria ornata*) and Russian (*Saccharina gurjanovae*, *Fucus evanescens*) brown algae.

The fucoidan from *F. evanescens* was pure sulfated fucan. Fractions of fucoidans obtained from other algae were sulfated heteropolysaccharides. Structural characteristics of fucoidans **FeF**, **SmF3**, **ToF2** and **SgF2** was investigated by using methylation and mass-spectrometry and NMR spectroscopy analyses of productes of enzyme hydrolysis and autohydrolysis of fucoidans.

It was shown that fucoidan **ToF2** contained a main chain formed by (1→3)-linked fucose residues with branches at C-2 and C-4. These could be represented by single residues or short chains, consisting of fucose and galactose. Single HexA residues could be in branches at C-2 of the main chain of fucoidan. Sulfate groups occupied the positions at C2 and/or at C4 of fucose and C-2, C-3 and C-4/C-6 of galactose residues.

Fucoidan **SmF3** can be described as follows: the main chain of the polysaccharide, possibly, was →3)-Fuc-2,4-OSO_3^--(1→3)-Fuc-2,4-OSO_3^--(1→ motif with 4-linked 3-sulfated α-L-Fuc*p* inserts and 6-linked galactose on the reducing ends. The likely branching points were 1,2,6- or 1,3,6-linked galactose (methylation analysis) and/or 1,3,4-linked fucose (MS analysis) residues, which could likely be glycosylated with terminal β-D-Gal*p* residues or, probably, chains of alternating sulfated α-L-Fuc*p* and β-D-Gal*p* residues. Both α-L-Fuc*p* and β-D-Gal*p* residues were sulfated at C-2 and/or C-4 (and some C-6 of β-D-Gal*p*) and potentially at the C-3 position of terminal β-D-Gal*p*, 1,4-linked β-D-Gal*p* and 1,4-linked α-L-Fuc*p* residues.

A main chain of galactofucan **SgF2** was represented by a repeating unit →3)-α-L-Fuc*p*-2,4-OSO_3^--(1→. Shorter (1→4)- and/or (1→6)-linked sulfated Gal chains were attached at positions C-2, C-3 of fucose residues. Single Gal residues were also terminal to Fuc chain and linked by (1→3)-type of linkage. Sulfate groups, probably, occupied positions C-2 and/or sometimes C-3 of Gal residues.

The sulfated fucan FeF was hydrolysed by fucoidanase from *Lambis* sp. fraction were separated and studied by NMR spectroscopy. Structures of fractions 3, 4, and 5 was characterized as α-L-Fuc*p*-2-OSO_3^--(1→3)-α-L-Fuc*p*-2-OSO_3^-, α-L-Fuc*p*-2-OSO_3^--(1→3)-;α-L-Fuc*p*-(1→4)-α-L-Fuc*p*-2-OSO_3^--(1→4)-α-L-Fuc*p*-2-OSO_3^--(1→3)-α-L-Fuc*p*-2-OSO_3^- and α-L-Fuc*p*-2-OSO_3^--(1→3)-α-L-Fuc*p*-2-OSO_3^--(1→4)-α-L-Fuc*p*-2-OSO_3^--(1→3)-α-L-Fuc*p*-2-OSO_3^-.

The anticancer effect of the fucoidans **ToF1**, **ToF2**, desulfated fucoidan **ToF2DS** and enzyme-resistance fraction **ToF2ER** from *T. ornata* was investigated by the soft agar colony formation assay using the human colorectal HT-29, breast T-47D adenocarcinoma, and malignant melanoma SK-MEL-28 cell lines.

It was shown that the heterogeneous sulfated fucoidan **ToF1** had slight activity against colony formation of colorectal carcinoma cells HT-29 and melanoma cells SK-MEL-28. The sulfated galactofucan **ToF2** inhibited colony formation of HT-29, T-47D, and SK-MEL-28 cells on 24, 15, and 44%, respectively. The anticancer effect of ToF2ER was comparable to the effect of native fucoidan **ToF2** (18, 11, and 37% for HT-29, T-47D, and SK-MEL-28 cells, respectively). The desulfated fucoidan **ToF2DS** exhibited slight activity against colony formation in SK-MEL-28 cells and did not inhibit colony formation in HT-29 and T-47D cells.

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PART 3

ECONOMICS AND HUMAN SOCIETY

PREMIUM MARKETING STRATEGY FOR SON DOONG CAVE: AN EXPERIMENTAL APPROACH

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ABSTRACT

Son Doong cave (Quang Binh, Vietnam) has recently become a highly attractive ecotourism destination where visitors are limited and pay a high price. Therefore, Son Doong cave urges a specific strategy to develop its advantages and promote travel intention of tourists. In order to deliver some suggestions, this study aims to examine relationships between materialism, environmental beliefs, ecotourism attitude, ecotourism intention, and willingness to pay premium are researched in the case of visitors to the Cave. Drawing from the theory of planned behavior and post-materialism assumptions, this study investigates key antecedents of the intention to engage in ecotourism and to pay premium prices for the experience. A conceptual model incorporates environmental beliefs, attitudes toward ecotourism, behavioral indications, and willingness to pay premium (WTPP), in combination with materialism and general tourism motivation. The study findings show that materialism is positively associated with environmental beliefs, ecotourism intention and indirectly increase willingness to pay premium but it is negatively related to ecotourism attitude.

Keywords: Ecotourism, Materialism, Premium

1. INTRODUCTION

Son Doong cave was found by a local named Ho Khanh in 1991, but until 2009 it was fully discovered by the British Cave Research Association. The cave is hidden inside Phong Nha-Ke Bang National Park and ranked as the largest cave and one of the most beautiful places in the world. Since 2013, the National Park Management Board of Phong Nha Ke Bang National Park, Central Vietnam has opened the cave to the public with a new trekking tour which has been operated by Oxalis Adventure Tours. Because of restricted entrance, the only way to Son Doong cave is trekking. There is no paved road leading directly to the cave, which is wholly adventurous. The tour is organized from February to August only when the weather is suitable and safe for trekking. Thus, ecotourism is the only type of tourism activities for discovering Son Doong cave. Under strict regulations on environmental conservation by the government and with difficult entry, the tour is highly restricted to the public.

However, at the beginning of 2017, a rumor that Quang Binh government has approved the cable car project into Son Doong of FLC Group has spread on social media. It leaded to the severe public concern that Son Doong cave would be under threat of mass tourism, especially unregulated mass tourism. Although Quang Binh authorities have denied rumors of the project, the tourism management effectiveness of relevant unique ecotourism sites should been still taken into consideration.

It is truly necessary to formulate a sustainable tourism strategy for Son Doong cave to develop its advantages as well as promote tourists' intention to visit the site. Ly (2015) contributed to the ecotourism management literature by studying about Hang En cave Site applied on the six elements of management cycle of Hocking et al. (2006). He aimed to offer ecotourism management implication to other similar sites, even Son Doong cave. Following this effort, this study explores the impact of some factors that may affect tourists' willingness to spend on the ecotourism activity. Study found that demand is relatively responsive to price in a divergent way (Richer & Christensen, 1999). Thus, in the case of Son Doong

expedition tour, why does people are highly attractive and be acceptable at such high price (about $3,000)? As stated by Mr. Nguyen Chau Thu, Director of Oxalis Adventure Tours, other than international tourists, Vietnamese ecotourists are also a good market segment to be focused on. Since last year, figures reveal that among the group of visitors to Son Doong, Vietnamese people are increasing in number. However, the tour price is a fairly large amount of money (nearly 65 million VND) which may be a big barrier for them.

Following the research of Hultman, Kazeminia, and Ghasemi (2015), this study addresses the impact of materialism in the context of ecotourism to understand visitors' behavior. Focusing on the willingness to pay premium of ecotourists, Hultman et al. (2015) drew a conclusion on the relationship between willingness to pay premium and materialism and environmental beliefs, ecotourism attitudes and intentions. The case of trekkers to Son Doong cave is applied to explore the importance of materialism in their behavior, the differences in their environmental attitudes and intentions, and provide insights to general ecotourism market in Vietnam. The study is to answer the question what is the relationship between materialism and environmental beliefs, ecotourism attitudes, ecotourism intention and willingness to pay premium in the case of trekkers to Son Doong cave. Besides, researchers hopefully deliver some suggestions for the authorities and managers to develop strategy and services of Son Doong cave, as well as other ecotourism destinations of Vietnam.

2. CONCEPTUAL MODEL DEVELOPMENT

Ecotourism

Ecotourism, a type of tourism activities, is considered as an ideal form of visiting a destination when visitors are placing much more concern on environmental issues and ecological sustainability. Ecotourism was defined as "travelling to relatively undisturbed or uncontaminated areas with the specific objectives of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in these areas" (Ceballos-Lascurain, 1988, as cited in Orams, 1995, p. 4). In the situations where people have paid increasing concerns over environmental problems and solutions, the importance of ecotourism in the market place continues to grow (Singh, Slotkin, &Vamosi, 2007).

Ecotourism has received increasing attention from researchers and become an interesting topic. From academic perspective, ecotourism is a multi-attribute concept which includes environmental focus, environmental learning and travel experience, and sustainability (Weaver, 2001). Regardless of how ecotourism was defined, they share a common ground that ecotourism is nature-based and learning-oriented (Weaver, 2005). Although environmental awareness and concern have increased enormously, there still existed an attitude-behavior gap in consumers (Kilbourne& Pickett, 2008). There exist factors hindering people to perform consumption behaviors oriented toward the environmental sustainability.

Ecotourists who are willing to pay premium to participate in ecotourism belongs to a niche market. The market is potential but the lack of understanding about their behaviors is hindering the opportunities to be benefit from them. As such, it is expected that the study can be able to make contributions to both theory and practice related to ecotourism market. As Foster, Sampson, and Dunn (2000) suggested that hospitality and tourism industry are under pressure to be aware of and act favorably toward environment, and one of the main reasons is customers' increasing demand. In an attempt to understand the attitudes, intentions and behaviors of visitors, tour operations are able to make offers that well-met the increasing demands.

Environmental beliefs

The conceptualization of general environmental beliefs is drawn from the new ecological paradigm

(NEP) (Dunlap, Van Liere, Mertig, & Jones, 2000). Environmental beliefs are "broad beliefs about the [fragile] biosphere and the [adverse] effect of human action on it" (Stern, Dietz, &Guagnano, 1995, p. 85, as cited in Kazeminia et al., 2016). The NEP focuses on the beliefs that human impose negative impact on the balance of nature. It also provides a measure of environmental attitudes, beliefs and values towards specific environmental issues. Consistent with the NEP, the theory of reasoned action (TRA) developed by Fishbein and Ajzen in 1975 also suggested that behavioral attitudes are a function of the beliefs on consequences of consumptions and the evaluation of such results (Bang, Ellinger, Hadjimarcou, &Traichal, 2000). As long as consumers orient their knowledge and awareness toward environmental issues, their actual behaviors will be influenced (D'Souza, Taghian, &Khosla, 2007). Further, according to Meijers and Stapel (2011, as cited in Ramchurjee&Shuresha, 2015), an individual who believes that his actions are likely to cause future consequences, he tends to behave in an environmental friendly manner and make sustainable choices.

Empirical findings had revealed the relationships between environmental behavior such as travel model choice, behavioral intentions and general environmental beliefs (Nordlund&Garvill, 2002). Authors argued that the relationship between general environmental beliefs and behavioral intentions varies with the type of behaviors as well as the measurements of environmental beliefs; however, the correlation between two variables is positive consistently (Gigliotti, 1992; Steel, 1996). Thus, in this study, the construct of environmental beliefs is understood as general beliefs which refers to "non-issue-specific cognitive orientations" (O'Connor, Bord, & Fisher, 1999, p. 462) rather than specific beliefs.

Ecotourism attitudes and intention

The theory of planned behavior (TPB) (Ajzen, 1991) has been a widely used framework to explain how attitudes predict and form behavioral intentions (Armitage & Conner, 2001). The theory has been applied in many scholarly researches on understanding consumer behaviors. Attitude was found to be the most investigated construct in social sciences and used to explain the consistencies or conflicts in people behaviors (Singh et al., 2007). Kraus (1995, as cited in Jalilvand & Samiei, 2012) also concluded that attitudes are an important psychological construct due to its influence and prediction of many behaviors. Similarly, in environmental friendly consumptions, the TPB along with the TRA were applied to examine the linkage between attitude and behavior (Lee, 2007; Han, Hsu, &Sheu, 2010). According to TPB, attitudes toward a certain behavior are developed by "evaluation of the consequences of engaging in the behavior weighted by beliefs that the behavior will lead to these consequences" (Baumgartner &Pieters, 2008, p. 367, as cited in Hultman et al., 2015).

Attitudes are described to include two components: cognitive and affective. Cognitive attitude is the extent to which people perceive ecotourism is beneficial and advantageous; affective component is the emotions and drives generated by the participation in ecotourism activities (French et al., 2005). Empirical evidence indicated that favorable attitudes and greater awareness toward environment have positive influence on ecotourism intentions such as choosing green accommodations (Han et al., 2010). Affective component is reported to have both direct effect and indirect effect through cognitive attitude on the final decision (Slovic, Finucane, Peters, & MacGregor, 2004). With respect to environment-related matters, Meneses (2010) found that affective component plays a more important role that cognitive component in forming attitudes. Thus, in this study, ecotourism intention is included as an important variable in the model for better explanation and understanding of the relationship between ecotourism attitudes and willingness to pay. This study emphasize on affective component of attitude and its linkage to ecotourism intention and willingness to pay premium.

Behavioral intention, the extent to which individuals plan to take an action, is considered as the most immediate determinants of actual behaviors (Azjen, 1991). In the context of ecotourism, intention is a combination of positive attitudes toward ecotourism and pro-environmental beliefs (Hultman et al., 2015; Sharpley, 2006). The TPB has been examined in various settings and results showed that it predicted

successfully not only the behavioral intentions but also the likeliness of actual performance of such intentions (Armitage& Conner, 2001).Thus, the following hypotheses are proposed:

H1: Environmental beliefs positively influence ecotourism attitudes.

H2: Ecotourism attitudes positively influence ecotourism intentions.

Materialism

Materialism has been conceptualized as either an attitude, value, belief or personal trait (Ahuvia, 2008; Belk, 1985; Chang &Arkin, 2002; Richins& Dawson, 1992, Trinh &Phau, 2012). Belk (1985) viewed materialism as "the importance a consumer attaches to worldly possessions" (p. 291). Shrum et al. (2012, p. 17) defined materialism as, "the extent to which individuals attempt to engage in the construction and maintenance of the self through the acquisition and use of products, services, experiences, or relationships that are perceived to provide desirable symbolic value." Such definitions have expanded the act of acquisition to include not only physical products and services, but also experiences and relationships. Van Boven and Gilovich (2003) argued in their study that experiential purchases – the act of acquiring life experiences – make people happier than material purchases.

Recent studies on the topic indicated that materialism has negative impact on environmental beliefs (Hultman et al., 2015; Kilbourne& Pickett, 2008). Further, David (2000, as cited in Kazeminia et al., 2016) stated that materialistic individuals have less favorable beliefs and attitudes toward environment. Materialistic individuals were found to be less likely to change their consumption behaviors for the benefits of environment (Fairweather, Maslin, & Simmons, 2005). Besides, materialists tend to have less favorable beliefs and attitudes and are less likely to act for supporting environment (Davis, 2000, as cited in Kazeminia et al., 2016).

Materialistic individuals place a great emphasis on the amount and quality of their material possessions and the accumulation of income and wealth (Richins& Dawson, 1992). On the other hand, the protection of environment requires reduction in overconsumption of material goods (Moisander&Pesonen, 2002). As a result, materialism is supposed to be against the notion of environmental protection. Previous studies indicate that materialistic values impose a negative effect on willingness to pay premium which is a result of greater interest in the product or service offerings (Dittmar, Long& Bond, 2007; Podoshen&Andrzejewski, 2012).

On the basis of the discussion, the following hypotheses are proposed:

H3: Materialism negatively relates to environmental beliefs.

H4: Materialism negatively relates to ecotourism attitudes.

H5: Materialism negatively relates to ecotourism intention.

H6: Materialism negatively relates to willingness to pay premium for ecotourism.

Willingness to pay premium (WTPP)

Literature pointed that behavioral intentions do not always lead to actual behavior, which always results in intention-behavior gap. According to Witherspoon (1994, as cited in Bergin-Seers, 2009), about a half of consumers who hold environmental beliefs did not turn it into actual purchases. Thus, other than examining the actual behavior of ecotourists, this study focuses on a more specific variable of behavioral intention, which is willingness to pay. Willingness to pay is considered as another way to assess intention (Barber et al., 2012). Although a rich literature investigated WTP in both product and service consumption, less research take WTPP as the main construct to study.

Willingness to pay of consumers is defined as "the maximum price a buyer is willing to pay" (Didier & Lucie, 2008; Voelckner, 2006; Wertenbroch&Skiera, 2002). In addition, Ajzen and Peterson (1988, as cited in Lu et al., 2014) had conceptualized willingness to pay as the individual intentions to pay a certain amount of money in return for products or services consumption. The similar definition is provided by Lusk and Hudson (2004) as the price or amount of money that individuals are willing to give up to acquire physical products or to experience services. The willingness to pay is a function of quality, price level and the benefits of such products or services. In tourism industry, tourists' willingness to pay for a destination indicates its economic value with reference to their evaluations (Tisdell, 2006, as cited in Reynisdottir, Song, &Agrusa, 2008).

Ecotourists' willingness to pay premium decisions reflect the economic evaluation of both personal and non-personal benefits that they expect to obtained from the consumption activities (Reynisdottira, Song, &Agrusa, 2008). Ajzen and Driver (1992) suggested that feelings and beliefs both have significant effect on willingness to pay in tourism context. The amount tourists are willing to pay more to visit a destination reflect their beliefs about the benefits of the environmental protection at the place and also the feelings that they expect to have during their visit (Hsee&Rottenstreich, 2004; Kahneman et al., 1999). In another situation, Laroche et al. (2001) found that attitudes are the most importance predictors of consumers' willingness to pay for environmental friendly products.

In ecotourism sector, according to Holden and Sparrowhawk (2002), the price of ecotourism products and services are higher than that of mass tourisms due to its reliance on environment. Consumers accept to pay a higher price to visit a destination due to the beliefs that such overcharging part is contributed to environmental protection or conservation activities at their visiting destinations (Becken, 2007; Manaktola&Jauhari, 2007; Scott, Christie &Tench, 2003). Visitors' willingness to pay for environmental protection is also founded in different destinations across countries (Farhar, 1999; Fairweather et al., 2005; Hansla, 2011; Laroche, Bergeron, &Barbaro-Forleo, 2001).

Moreover, Kahneman et al. (1999) noted that willingness to pay valuation is a result of affective attitude toward ecotourism destinations. They also further suggested that willingness to pay for public goods such as national parks is derived from the expected feelings of the visit rather than the rational evaluation of costs versus benefits of such action. This argument is explained by two possible reasons. Firstly, environmentally friendly consumption is driven by intrinsic motives which are closely correlated to feelings or emotions. Secondly, the lack of knowledge about the actual value of such consumption such as how much their consumption reduces the negative impacts on environment leads individuals to rely more on their feelings in decision making process.

Thus, the following hypotheses are proposed to indicate the relationship between WTPP and ecotourism attitudes and intentions:

H7: Ecotourism attitudes positively influence WTPP for ecotourism.

H8: Ecotourism intention positively influences WTPP for ecotourism.

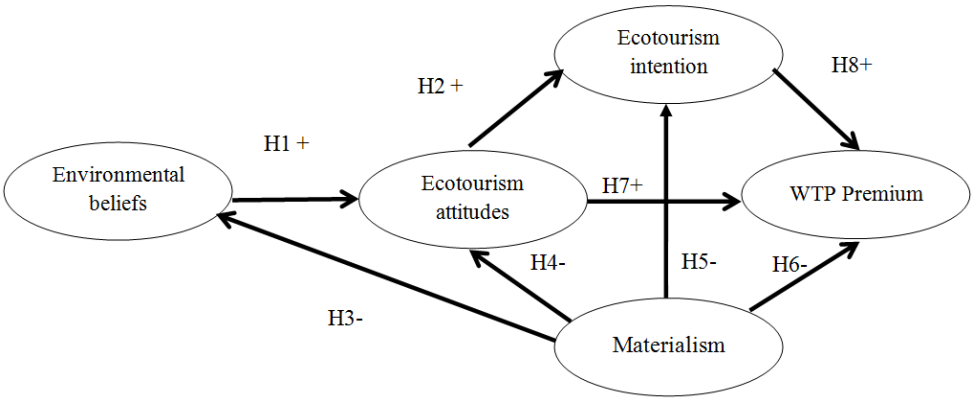

Fig 1. Developed Conceptual Model

The proposed conceptual model depicts the relationship between factors discussed above as in Figure 1. The framework is adapted from the study of Hultman et al. (2015) in the context of ecotourism. Applying to a specific case of Son Doong cave, Vietnam, the framework is used to explain the drives of willingness to pay premium of trekkers or ecotourists to the destination. It suggested that materialism has impact on environmental beliefs, ecotourism attitudes and intention. WTPP is determined by materialism, ecotourism attitudes and intention.

3. METHODOLOGY

This study used a self-administered questionnaire to collect data via an online panel. Because most of Son Doong Cave'svisitors is international tourists, contacting them via online channel is more effective. Further, an Internet survey enables researchers to reach a large pool of respondents quickly and inexpensively, to simplify the survey design and data entry process (Granello& Wheaton, 2004).Sample includes those who have already visited or on the waiting list to Son Doong cave. The sample is expanded to include a sub-segment of those who have the intention to visit the destination and are saving money. The sampling method employed is snowball sampling and convenience sampling.

Out of 367 questionnaires sent, valid responses after data screening are 330 in total. However, in order to improve the sample size for better analysis, 30 responses are selected from the sample using random selection. The merged sample is boosted up to 360 concluding 330 original responses and 30 randomly selected responses. Besides demographic data, the questionnaire consists of 33 scale items measuring materialism,environmental beliefs, ecotourism attitudes, ecotourism intention and WTP premium.

4. RESULTS

An initial exploratory factor analysis using VARIMAX rotation with SPSS 22 was conducted to examine the 33 scale items that represented materialism, environmental beliefs, ecotourism attitudes, ecotourism intention and WTPP. The final five factor solution identified 30 items that explained 64% of the variance with a Kaiser-Meyer Olkin value (KMO) of 0.775 and the Bartlett's test also is significant at the level of 0.00. These factors were, materialism (α=0.8), environmental beliefs (α=0.779), ecotourism attitudes (α = 0.772), ecotourism intention (α=0.795) and WTPP (0.792). The results of the reliability analysis revealed satisfactory reliability coefficients above the standard of 0.70 recommended by Nunally (1978). Then, confirmatory factor analysis was used to further refine the constructs. A further 3 items were removed due to cross loadings and the constructs were introduced into a structural model with multigroup analysis.

The goodness-of-fit indices for the three experimental conditions were deemed acceptable. First, the impact of the environmental beliefs on ecotourism attitude was examined. Environmental beliefs produced a significant and positive impact on ecotourism attitude. Thus, H1 was supported. H2 was also supported when testing the impact of environmental beliefs on ecotourism intention. It can be concluded that environmental beliefs have a positive association with ecotourism attitude. Interestingly, materialism produced a significant and positive impact on environmental beliefs(β=0.429; $p < 0.01$) and ecotourism intention ($\beta = 0.307$; $p < 0.01$), rejecting H3 and H5. But the relationship between materialism and ecotourism attitudes and WTPP are negative ($\beta = -0.245$; $p < 0.01$) and ($\beta = -0.044$; $p < 0.01$), supporting H4 and H6. Interestingly, if only material happiness and material success were measured, both ecotourism attitudes and WTTP would be significantly and positively impacted.

For H7 ($\beta = 0.015$; $p < 0.01$), the hypothesized relationship is not supported. However, H8 is supported at the significant level of 0.05, indicating ecotourism intention associates positively with willingness to pay premium.

5. DISCUSSION AND RECOMMENDATION

5.1. Discussions

This study provides a different view on the relationship between materialism and aspects related to environment and ecotourism. Materialistic individuals do not hold a favorable attitude toward ecotourism, which indicates a negative relationship between two factors. Although materialistic value does not influence the intention to engage in ecotourism in the same way as attitude, the study of Lu, Gursoy, and Del Chiappa (2014) made similar conclusion on the relationship between two factors. They explained that because the primary objective of ecotourism activities is environmental protection, people with materialistic values may hold unfavorable attitude toward them. The root cause for the situation is the dissonances between materialism and environmentalism – the concern for environment and sustainability, as argued by Kilbourne and Pickett (2008).

In addition, the study finding suggests a positive relationship between materialism and environmental beliefs, which is inconsistent with previous studies. In the study on the "green" side of materialism, Strizhakova and Coulter (2013) has proposed that at individual level, there is coexistence between materialism and "environmentally friendly tendencies" which addresses both concern, willingness to pay more and perception about environmentally friendly products and the likelihood to engage in environmentally friendly behaviors. They suggest that individuals may hold materialistic value while pursue a "greener" lifestyle.

Discussing WTPP for environmentally friendly products, the study of Manaktola and Jauhari (2007) provided an overall view on the proposed relationship. They stated that previous studies did either support that consumers are willing to pay more for environmentally friendly products or suggest otherwise. A similar explanation is used to explain the non-significant relationship between materialism and WTPP. However, when looking at the material values separately, Material happiness and Material Success could increase WTPP.

The measurement of materialism using four groups of items has provided a new point of view on the variable. The measurement scale focuses to depict materialism as a way of life to signal personal status rather than the desire for consumption. Yang (2006) suggested that materialistic individuals pursue possessions as "the forefront of personal goals that dictate their "way of life." According to Trinh and

Phau (2012), the scale of Richins and Dawson concentrated on consumption and possession and "thus lacked the ability to measure status latent". The new measurement scale is developed to close that gap. Individuals hold materialistic values make consumption for more things than the functionality of items. They pursue social recognition, status signaling, and distinctness from others. Thus, the idea of distinctiveness is introduced in the scale. As revealed by the study result, the two components Material Essentiality and Material Distinctiveness contribute greatly to explain materialism in comparison with the other components, Material Happiness and Material Success. The additional component of distinctiveness contributes greatly to evaluate the status latent of materialism. Thus, the focus is no longer on material possession and more on way of living. As a result, it may explain why materialism does not have negative influence to other factors in the model as indicated by previous studies.

Besides, the study confirmed the positive linkage between environmental beliefs and ecotourism attitude, between ecotourism attitude and intention. The finding is in-line with previous studies as well as the common thought about environmentally friendly behavior. Individuals who think of the consequences of their behaviors are more likely to form favorable attitude toward ecotourism. As mentioned above, ecotourism activities help to preserve natural environment, which consequently make individuals to feel less burden by their behavior's consequences. The positive relationship between ecotourism attitude and intention is consistent with the theoretical rationale provided in the previous part. The theory of reasoned action (TRA) demonstrates the strong linkage between attitude and intention of individuals. Similarly, the finding also supports the key idea of the theory of planned behavior (TPB) which explains the correlation between those two variables.

With respect to the dependent variable – willingness to pay premium (WTPP) for ecotourism, the study finding suggested inconsistent result. At first, affective attitude toward ecotourism activities does not help to explain WTPP decisions. The non-significant relationship between two factors is against the result obtained in the study of Hultman et al. (2015). Also, Laroche et al. (2001) demonstrated a strong relationship between attitude and consumers' willingness to spend more for green products. The situation did not hold the same for the case of ecotourism. The study's result is datable; however, it can be explained with the reason that ecotourists' feelings about preservation behavior at the destination do not influence their intention to pay more. Moreover, the WTPP decision may be influenced by many other factors than merely ecotourism attitude. As a result, the attitude does not have prediction ability on WTPP.

5.2. Formulating Premium Marketing Strategy

Based on the result of data analyzing in the research, some following managerial significance are proposed to enhance tourism management for Son Doong cave.

Firstly, this study offers managers a means of identifying specific aspects of materialism which can be applied in communicating to ecotourists. Materialism does have influence on other factors as revealed by the study results so that it can be an important factor to be considered for attracting ecotourists to the place. Materialistic values are positively associated with ecotourism intention which then influences the WTPP of ecotourists. Provincial governance and ecotourism operators should devote time and effort to target at those with high materialistic values rather than mass tourists. They should emphasize the importance of engaging in ecotourism activities as a materialistic way of life. Especially in the case of Son Doong cave, ecotourists accept to pay such high amount of money for the tour; that is their lifestyle, their way to have happiness and also a signal for their social status.

Secondly, this study provides marketers with insights into which cues will enhance WTPP, ecotourism attitude and ecotourism intention, creating a synergy among different methods of marketing communications. The study results suggest that there is a positive relationship between ecotourism interest and ecotourism intention, which then encourage ecotourism to pay more for such activities. In order to attract more visitors, management of ecotourism destinations should send out messages that help increasing interest of visitors. Similarly, tour operators can develop communication strategy that aim at building up customers' beliefs in the environmental as a whole and specifically at ecotourism destinations. Local residents should also be involved in environmental conservation activities at the destinations.

Furthermore, in the case of Son Doong, it is definitely clear that ecotourism activities bring also economic benefits local people along with natural conservation. A part of the tour expense is contributed to the conservation activities at Son Doong. Local people have been also recruited to be part of the tour guide crew. Hence, the benefits are far more than just maintaining and improving natural quality, which is the reason why ecotourism activities at Son Doong cave as well as other destinations should be encouraged. However, the management of local authority should also be imposed strictly in order to reduce the problem of over-exploitation of the place.

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USING THE THEORY OF PLANNED BEHAVIOR TO EXPLORE CONSUMER PERCEPTION TOWARDS DIETARY SUPPLEMENTS TO TREAT DIABETES IN PROVINCIAL VIETNAM: A RESEARCH AGENDA

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ABSTRACT

In Viet Nam, the prevalence of diabetes is growing at alarming rates and has almost doubled within the past 10 years. Currently, it's estimated that one in every 20 Vietnamese adults has diabetes. In addition, the number of people with a pre-diabetic condition is three times higher than those with diabetes.The treatment costs, along with travel costs to hospitals as well as the loss of productivity due to illness and prolonged stays in hospitals can debilitate a whole family and drain funds for basic subsistence. Because of this many people have begun using dietary supplements and functional foods to aid diabetes treatment. However, the concepts of dietary supplements and functional foods are not clearly distinguished in Vietnam. To shed light on the consumer perception toward using these supplements to aid the treatment process, this this paper proposes a preliminary study to explore the antecedents such as behavioral, normative and control beliefs.

Keywords: conceptual paper, diabetes, dietary supplement, theory of planned behavior

1. INTRODUCTION

In recent times, with the notion of changing nutrition intake forms from basically satisfying metabolic requirements to enhancing health and minimizing disease risks, nutraceutical products has been increasing its popularity day by day, both in variety and sales (Cox, Koster& Russell, 2004). According to Kalra (2003), nutraceutical product is defined as a food or fortified food product that provides extra medical health benefits beside normal nutritional value found in conventional food, thereby it can assist users in diseases prevention and treatment. One major class of nutraceutical products is dietary supplement, which is a concentrated form of food-derived nutrients. Different from functional foods, dietary supplements are considered as neither food nor meal replacement, but are designed to be taken beside daily ingestion for supplement nutrients or perceived health enhancement (Phillips, Rimmer, 2013). In Vietnam, these concepts are interchangeably equated (without noticing the differences between them).

The Vietnamese market for dietary supplements is continually increasing in size and variety. According to Department of Food Hygiene Safety, in 2011, 43% of Ho Chi Minh City and 63% of Hanoi population are dietary supplement users. Impressively, in the period of 2012-2013, the number of dietary supplement sellers has reached 3,512, increasing 226%; and the number of product types is approximately 6,851, increasing 124% (Vietnam Association of Functional Foods, 2014). The growth of dietary supplements can be viewed as the result of medicine and life sciences development that investigate the interrelationship between nutrition and health, or between food components and disease risks to be specific. Simultaneously, technical advances in food engineering and manufacturing have create more opportunities to develop and produce health products (van Kleef et al., 2002; Verschuren, 2002.). Heasman and Mellentin (2001) even depict the functional foods „revolution" as a scientifically grounded, hightechnology, marketing-led and unstoppable vision of food and nutrition.

Vietnamese supplement users contains not only healthy individuals who want to maintain and improve

overall health, but also patients who are suffering from chronic diseases (Vietnamese Association of Functional Food, 2014). Being products with medicine-like impacts, dietary supplements represent a elementally new kind of wellbeing as opposed to conventional healthy eating practices (Thorne, Paterson, Russell, & Schultz, 2002). As a result, people may accept and adopt it in various ways. Hence, consumer insights about dietary supplements should be carefully considered when selling and marketing these kinds of products. Within this study, consumer perception about supplements for diabetes will be focused and investigated.

Diabetes mellitus is one of the most popular chronic diseases all around world, becoming a leading health care matters in many developing nations. In Vietnam, the incidence of diabetic cases has been growing dramatically in the recent years. According to National Hospital of Endocrinology (2012), the proportion of diabetic patients aged 30-69 has reached 5.4%, double in comparison with 2002, and the undiagnosed diabetic patients still accounts for 63.6% of the cases. It is estimated that in 2030, the number of people aged 20-79 living with diabetes will be 3.42 million. Notably, diabetes is reported to have the highest rate in urban areas, where lifestyle is mostly characterized by physical inactivity and unhealthy eating (Diabetes goes boom in Vietnam, 2013). With its continuing rising rate, diabetes is acknowledged as a public health burden for Vietnamese that requires appropriate methods to be reduced and handled (Khue, 2015). This leads to a rising demand among diabetic community for nutrition-promoted products, which include dietary supplements in particular.

Among 3 types of diabetes (type 1, type 2, and gestational), type 2 diabetes represents a great majority of the cases (approximately 85-90% of diabetic patients), and it is the only type that can be prevented and controlled by lifestyle modifications and medication, which includes dietary supplements. In fact, dietary supplements did not cure diabetes, but it is considered to have positive effects for type 2 diabetes prevention and treatment by helping control blood glucose level. This study will concentrate on type 2 diabetic community that use dietary supplements for assisting treatment.

To be specific, this study will use Theory of Planned Behavior to investigated factors that influence diabetic patients "purchasing behavior towards dietary supplements to support disease treatment. In general, Vietnamese diabetic supplement consumers" perception, demographic, and motivations to purchase will be evaluated.

2. CONCEPTUAL MODEL DEVELOPMENT

Based on the Theory of Planned Behavior (Ajzen, 1991) as well as the previous literature review, this research proposes a new framework to explore and evaluate factors affecting supplements using intention.

In this adapted framework, Perceived health value is a new factor which is subsumed besides the standard components. A person who values his/ her own health is considered to have higher tendency to engage in precautionary health behaviors, such as using dietary supplements to improve their health (Conner et al., 2001). Meanwhile, the Theory of Planned Behavior seems to be not effective when ignoring the effects of this factor, and focusing too much on consumer perception about the product-related issues (Conner et al., 2001). Hence, by adding this element, this research is expected to take a deeper look at consumer insights when decide to purchase diabetic supplements.

Even though purchasing dietary supplements may seem relatively straightforward and unlikely to encounter any significant obstacles, previous studies about supplement have pointed out several reasons that make consumers not purchase these products even if they want to, such as the consumers‟ income and supplements availability in the market. Therefore, in comparison with the Theory of Reasoned Action, in which intention is determined by only Behavioral attitudes and Subjective norms, the Theory of Planned Behavior seems to be more suitable within this case.

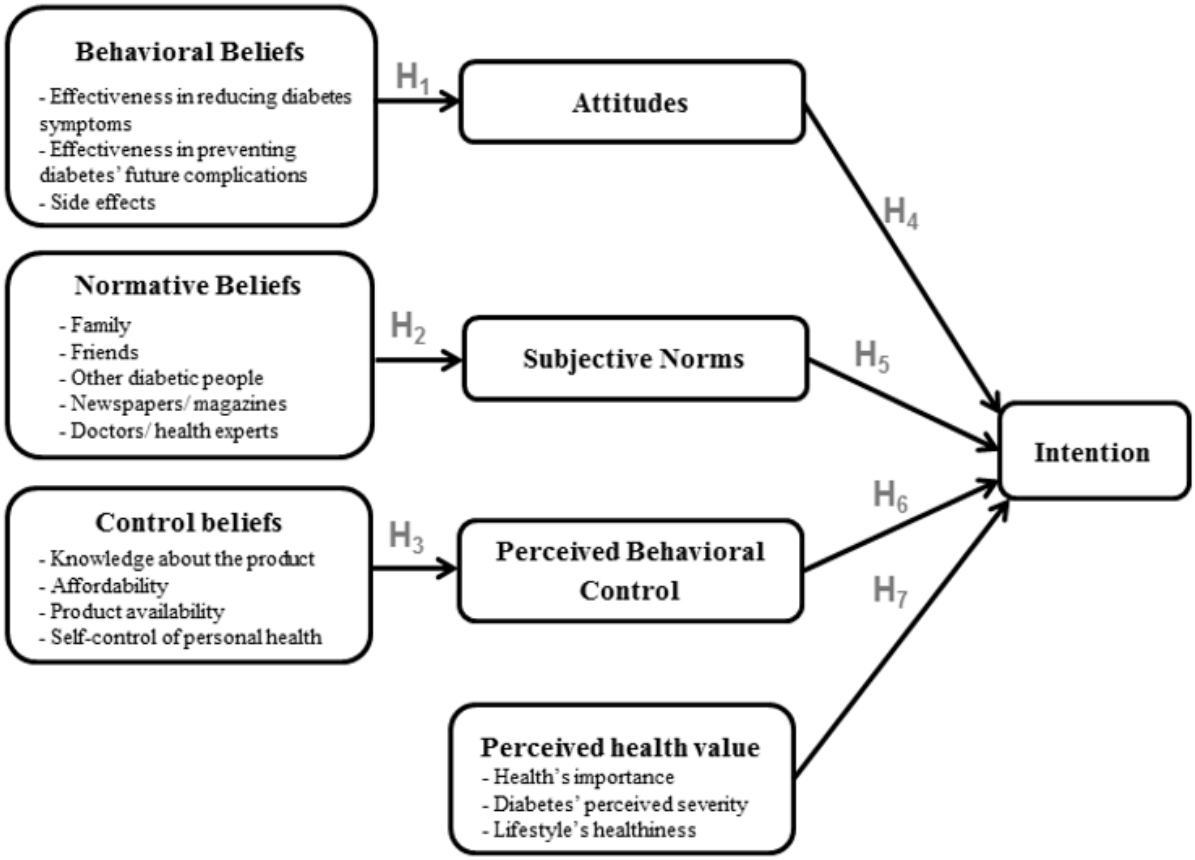

Fig 1. Suggested model, adapted fromthe Theory of Planned Behavior (Ajzen, 1991)

Suggested Hypotheses:

- H1: Behavioral beliefs have positive effects on consumer attitudes towards diabetic supplement.

- H2: Normative beliefs have positive effects on subjective norms.

- H3: Control beliefs have positive effects on consumers' perceived behavioral control.

- H4: Attitudes have positive effects on consumer intention to use diabetic supplement.

- H5: Subjective norms have positive effects on consumer intention to use diabetic supplement.

- H6: Perceived behavioral control have positive effects on consumer intention to use diabetic supplement.

- H7: Perceived health value have positive effects on consumer intention to use diabetic supplement.

3. METHODOLOGY

Scope of research

The research is conducted in 3 provinces in Southeast Vietnam: Binh Duong, Vung Tau and Dong Nai. Being one of Vietnam's key economic hubs, Southeast region has been witnessing a rapid increase in obesity and diabetes. According to National Institute of Nutrition's research (2007), 13.7% of population living in Southeast region (including Ho Chi Minh City) are overweight and/ or obese, highest percentage of all the country. Meanwhile, the estimated rate of impaired glucose tolerance (pre-diabetic state, which may precede type 2 diabetes mellitus by many years) of this area is approximately 17.5%, highest

proportion in Vietnam, followed by Mekong Delta region. This region also has the highest population density and growth rate, as well as the highest average income and living standards in Vietnam (Trang, 2013). Southeast residents are recorded to have the highest life expectancy, which is probably resulted from general interest in improving and maintaining wellbeing. These factors may contribute to the excessive demand in health-related products, particularly dietary supplements. More important, since most of dietary supplements have relatively high price, its target consumers should come from middle to high income class, which accounts for a great majority in Southeast Vietnam.

Sample Target

Both diabetic supplements users and non-users are recruited equally, which is approximately 150 participants for each group (300 participants in total). Respondents of this research are residents living in 3 provinces of Southeast Vietnam: Dong Nai, Vung Tau, and Binh Duong. Moreover, they have to satisfy these following conditions:

- People with type 2 diabetes.

- Adults older than 40 years old. This is the age range which is suggested to have a notably high risk of being diabetic. Moreover, people at this age usually have stable income, which can purchase dietary supplements.

- Have middle to high income, due to the fact that most dietary supplements are costly.

- Having basic knowledge about dietary supplements, as well as diabetes

Data collection instrument

Attitude	ATT1	Using dietary supplements to treat diabetes is beneficial.	Rezai et al., 2012; Lino et al., 2014
	ATT2	Using dietary supplements to treat diabetes is totally safe.	Urala and Lähteenmäki, 2007
Behavioral Beliefs	BB1	Using dietary supplements could help me to reduce diabetes symptoms.	Glasgow et al., 1997
	BB2	Using dietary supplements could preventme from diabetes future complications.	
	BB3	Using dietary supplements could cause many side-effects.	Urala&Lähteenmäki, 2004
Subjective Norms	SN1	Most diabetic people, like me, are taking dietary supplements to help control their diabetes.	Conner et al., 2001; Lino et al., 201
	SN2	Doing what other diabetic people do is important to me.	
	SN3	Most people who are important to me would want me to take dietary supplements to treat my diabetes.	

Normative Beliefs	NB1	My family's opinions about taking diabetic supplement are important to me.	Mitchell & Ring, 2010; Lino et al., 2014; Conner et al., 2001
	NB2	Other diabetic people opinions about taking diabetic supplement are important to me.	
	NB3	Newspapers/ magazines information and opinions about taking diabetic supplement are important to me	
	NB4	Doctors/ health experts opinions about taking diabetic supplement are important to me.	
	NB5	My friends opinions about taking diabetic supplement are important to me	
Perceived Behavioral Control	PBC1	I have absolute control over whether I take dietary supplements to treat diabetes.	O'Connoret al., 2010; Lino et al., 2014
	PBC2	I can afford buying dietary supplements.	Lino et al., 2014; Pawlak et al., 2008
	PBC3	There are factors outside my control that could prevent me from taking dietary supplements to treat my diabetes	Lino et al., 2014; Conner et al., 2001
Perceived Health Value	PHV1	My health is very important to me	Sebastian et al., 2007
	PHV2	I have a healthy lifestyle.	Kirk et all. 1999; Radimer et al. 2000; Greger, 2001
	PHV3	Diabetes is a severe condition.	Hampson and Foster, 1997; Cox et al., 200
Intention	IT1	During the next three months, I plan to use dietary supplements to help control my diabetes	Lino et al., 2014
Control Beliefs	CB1	I have an adequate knowledge about dietary supplements to treat diabetes	Verbeke, 2005

	CB2	Dietary supplements to treat diabetes are expensive	Lino et al., 2014
	CB3	Dietary supplements to treat diabetes are easy to find	
	CB4	I am totally in control of my health.	

Data Analysis

SPSS for Windows software (21.0) was utilized for data analyses. To be specific, the data will be recorded and investigated based on the following steps in SPSS:

- Descriptive Statistics: to summarize all features of the data collected by calculating the variance, standard deviation and mean.

- Reliability Test: to find the confidence level of the scale system. Then, Cronbach's alpha will be used to measure internal consistency, thereby determine the positivity correlation (if any) among items.

- Exploratory Factor Analysis: to reduce the number of variables through main factors, thereby support the following steps of analyzing and comparing determinants which are likely to influence the purchase intention of dietary supplements.

- Correlation Analysis: to evaluate and determine the strength of correlation between any 2 set of variables.

- Regression Analysis: to estimate and predict the relationship between each independent variable and the dependent variable. Particularly, this method can predict how the dependent variable's value will change in accordance with each independent variable‟ value.

4. EXPECTED CONTRIBUTION AND FURTHER RESEARCH DIRECTION

This paper will contribute to the body of marketing literature by expanding the knowledge of dietary supplements from the provincial consumer perception. To the best of our understanding, there has never been a publication of research that study the same subject, especially in term of clearly differentiating between dietary supplements and functional foods in Vietnam.

As it is a preliminary study, this study would lay the foundation for further research into the topic. As Vietnam has an alarming growth rate of people who are suffering from diabetes¸ it would also benefit the public to further the study by looking into preventing behavior – using supplements as an instrument to prevent diabetes as well.

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REALITY OF EDUCATIONAL RESEARCH AND BASIC RESEARCH OF SEVERAL UNIVERSITIES IN THE MEKONG DELTA

Le Binh Do, Thi Dieu Duong, Thi Lien Huynh, Duy Thanh Hang

ABSTRACT

Educational research and basic research not only contribute to enhance the quality of education and training but also create new knowledge for human kind. This article presents the results of survey about the reality of educational research and basic research of several univerties in the Mekong Delta.

Keywords: Lecturer, educational research, basic research, Mekong Delta.

1. INTRODUCTION

Science and technology play an important role in the industrialization and modernization of the country. The revised Law of Science and Technology in 2013 [1] has a lot of breakthrough contents creating motivation for individuals and organigations in scientific research. In particular, in the field of education, scientific research has become an indispensable part of the education and training activities. In universities, scientific research has become a mandatory task of lecturer [2]. Educational research and basic science contribute to improve the quality of education and training. However, educational research in our country is still limited [3]. In fact, educational and basic research projects of the provinces in the Mekong Delta from 2010 to 2015 have a very low ratio in comparison with the total research projects of the whole region [4]. Specifically, in Tien Giang province, there are a total of 55 provincial level scientific research projects approved, but only one research topic on education, accounting for 1.8% of the total scientific projects from 2010 to 2015. Kien Giang province has a higher number of educational research projects but only accounts for nearly 9% of total projects (9 out of 100 projects). In three years, An Giang has only two educational research projects in the total of 42 provincial level projects approved, accounting for 4.8% and Can Tho is about 6,4%. Most of the large-scale research projects in the provinces in the Mekong Delta are focused on agriculture, science and technology and natural science while educational research is only funded as basic level research projects. The majority of educational and basic researchs are conducted by lecturers working at universities and colleges in the region. This article presents the results of survey about the reality of educational research and basic research of Can Tho University, Dong Thap University and An Giang University in the Mekong Delta.

2. OVERVIEW OF SURVEY METHODS

2.1. Objectives of survey

Evaluating the reality of educational and basic researchs of Can Tho University, Dong Thap University and An Giang University in the Mekong Delta.

2.2. Contents of survey

1) Perception of lecturer on scientific research activities; 2) Motivation to participate in scientific research; 3) Factors affect on the scientific research activities of lecturer; 4) Resources for research activities; 5) Form of publication and transfer of scientific research results.

2.3. Participants for survey

The survey is conducted with 60 lecturers, education experts at Cantho University, Dong Thap University and An Giang University in June and July 2017.

2.4. Research methods

We combine several types of research methods: survey (questionnaire), observation, analysis, experience summation and expert opinion, then use mathematical statistics to process the survey results.

3. RESULTS AND DISCUSSION

3.1. Reality of lecturers' perception on scientific research activities

Survey on lecturers' perceptions of scientific research activities, we set the criteria from high to low: very important, important, less important and not important. Survey results are shown in Figure 1.

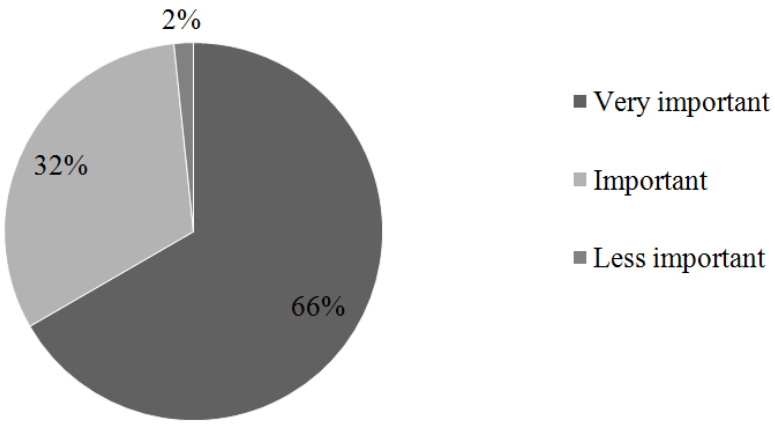

Fig 1. Lecturers' perceptions about the importance of scientific research

There is only 2% of lecturers rating scientific research activity is less important. On the other hand, 66.7% of lecturers believe that it is very important and 32% of lecturers say that it is important. The result shows lecturers are aware of the importance of scientific research and consider it is a main task beside the teaching task.

3.2. Motivation to participate in scientific research

To evaluate the motivation of the lecturers as they participate in scientific research, we set out the following specific criteria: mandatory task, increased income, enthusiasm, demonstrating the ability of research, teaching service, enhancing expertise, request for emulation and reward. Survey result is shown in Fig 2.

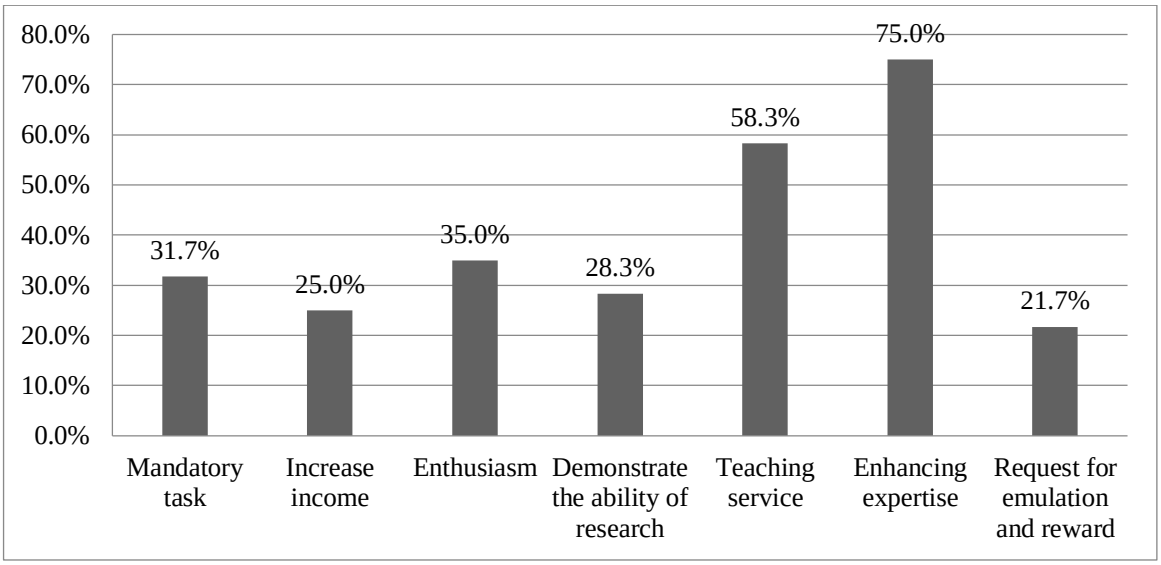

Fig 2. The motivation of lecturers in scientific research

There are two factors being the most chosen are scientific research to enhance their expertise (75%) and scientific research to apply for teaching (58,3%). In contrast, the least chosen is request for emultion and reward (21,7%). Other factors such as emthusiasm, mandatory task demonstrating the ability of research and increase income account for 35%, 31,7%, 28,3% and 25%, respectively. The above data shows that the majority of lecturers are aware of scientific research for improving their professional skills and applying for teaching.

3.3. Factors affect the scientific research of lecturers

To assess the factors affecting the research activities of lecturers, we propose group of objective factors and group of subjective factors for lecturers to choose. The result is shown in Figure 3.

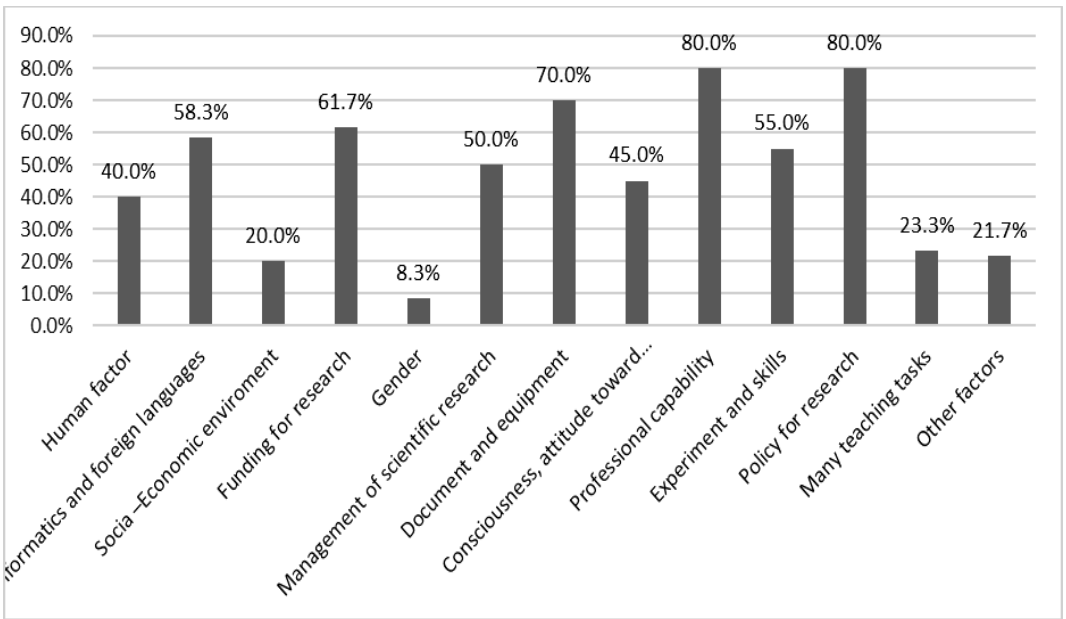

Fig 3. Factors affect the scientific research of lecturers.

The group of objective factors considered by experts having a great impact on the research of lecturer, such as policies for scientific research (80%), document and equipment for research (70%), resources (budget) (61.7%). In contrast, the group of objective factors has a less impact such as the socio-economic

environment (20%) and gender (8.3%). On the other hand, the group of subjective factors has a great impact on the researcher's performance, such as the professional capability (80%), experience and skills in research (55%), ability to use information technology and foreign languages (58.3%), management and administration of scientific research (50%). In addition, other subjective factors are mentioned as consciousness, attitude toward research (45%), many teaching tasks (23.3%),...

In general, for high quality scientific research, universities need to promulgate policies to create motivation for research, invest resources, equip physical facilities (equipment, funds, …) for the scientific research and lecturers must be trained regularly to improve their professional capacity.

3.4. Resources for scientific research of lecturer

The resources for the educational and basic scientific research activities such as funding, equipment and document are evaluated in four levels: good, fair, medium and weak and quantified into points for which good, fair, medium and weak are accounted for 4 points, 3 points, 2 points and 1 point, respecially, then calculated the mean value. The results are shown in Table 1.

Table 1. Resources for scientific research of lecturers

Resources for scientific research service	Opinion of the expert				Mean
	Good	Fair	Medium	Weak	
About funding	11,6%	45%	35%	8,3%	2,22
About document and equipment	11,6%	63%	16,7%	8,3%	2,4

Table 1 shows that the opinions of interviewers on research funding (2.4 points) and facilities (equipment and documents) (2.2 points) are approximately above the average level. In details, there are approximately 57% experts evaluating funding is good and fair. In contrast, 43% accounts for medium and weak. For facilitites (document and equipment), there are about 75% interviewers assessing good and fair and only 25% counts for medium and weak (mainly focus on facilities for basic research). In general, funding for scientific research activities and facilities for basic research at universities have not met the requirements of reality.

3.5. Form of publication and transfer of scientific research results

Figure 4 presents the forms of publication of the results of educational and basic scientific research. There are 70,0% results published in domestics journals. In contrast, there is only 13,3% annouced in international journals. In addition, final report and scientific seminar account for 68,3% and 63,3%, respectively. However, the transfer and application of educational and basic research results into reality are still limited.

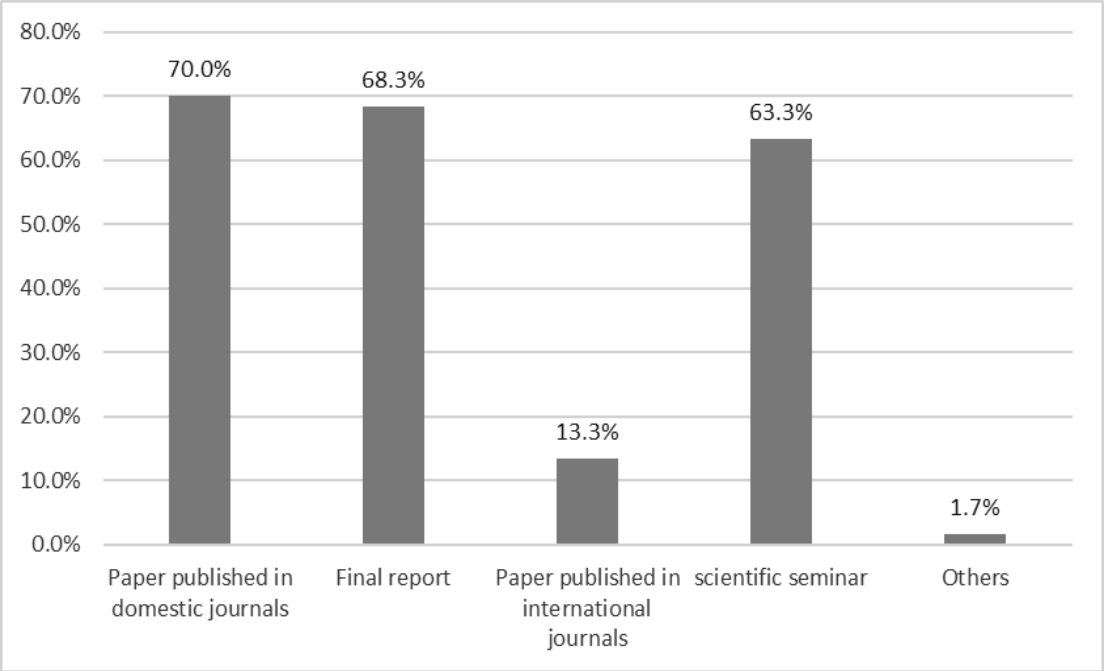

Fig 4. Form of announcement of results of scientific research

5. CONCLUSION

The survey result shows that almost lecturers are aware of the role of research activities in the university. Many teachers have dertermined the motivation for doing scientific research is to serve the teaching and to advance professional capability. The factors such as policies and resources for research (funding, document and equipment) have a great impact on the research. However, the budget and especially facilities for basic research at universities in Mekong Delta are only just above means so they can not meet the requirements of reality. Approximately 70% of the educational research and basic research results have been publicised in domestic journals. However, the transfer and application of research results into reality ís still limited.

In order to increase the quality of research activities in the Mekong Delta in the future, we believe that it is necessary to increase the resources for educational and basic researchs, such as increasing the budget, facilities (document, equipment,...) and periodically training to improve lecturers' professional qualifications. In addition, there should be policies to encourage lecturers participating in scientific research. The results of educational and basic research should be more transferred and applied into reality.

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ELF STUDENTS' ATTITUDES TOWARDSTHE EFFECTIVENESS OF CBI APPLICATION INTOTEACHING CUTURE SUBJECT AT COLLEGE

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ABSTRACT

This study investigates the attitude of EFL students towards the effectiveness of applying Content-Based Instruction (CBI) into British Study learningat college. A quantitative method was employed to 45 participantscomprising two English-major classes at a Teacher Training College in Kien Giang Province. The participants received British Study instruction with CBI during the entire course. Findings from quantitative data collected proveda confirmation of the research hypothesis. Data analysis also revealedparticipants'perceptionof an increase in both analytical/ critical thinking skill and higherachievement of academic English. Furthermore, the results also illustrated that participants' strength in listening, speaking, and reading skills was developed through their English performance of giving presentations.

Keywords:Attitude, Content-based instruction, Culture Subject Teaching

1. INTRODUCTION

Worldwide, the English language education was introduced into classes at schools centuries ago. Today, the language is the most widely learned second language in the world. Therefore, a lot of methods and approaches have been used for foreign language teaching. Methods and approaches used nowadays which were based on "Approaches and methods in Language Teaching" by Richards and Theodore (2001) are categorized into nine different approaches/methods, such as Oral Approach and Situational Language Teaching, Grammar Translation Method, Audio-Lingual Method, Communicative Language Teaching, Total Physical Response Method, Silent Way, Community Language Learning, Suggestopedia and Direct Method. Among these methods and approaches, Grammar-Translation Method focuses on developing students' appreciation of the target language's literature and teaching the language. Students are presented with target language in the following reading passages and answer questions but hardly use the language in communication. Silent Way is the theoretical basis of Gattegno (1963) that teaching must be subordinated to learning and thus, students must develop their own inner criteria for correctness. All the four skills: reading, writing, speaking, and listening are taught from the beginning. However, with this method, the role of the teacher in the classroom seems to be overshadowed and positive verbal communications of the teacher is limited.

Deputy Minister of Information – Communications of Viet Nam, Do Quy Doan (2010) said that "Viet Nam has lacked a strategy for teaching and learning a foreign language for a long time - the process of teaching and learning improvisation. Sometimes foreign languages are very developmental, but sometimes they saturated, even foreign language teachers choose to leave their jobs. Besides, education at college and university level is facing the same problem. This is now that the students' input level is so low that the output level of students might not be adequate. Consequently, it has been so difficult for teachers to teach foreign language. Infrastructure condition is hardly sufficient to satisfy the requirements of teaching and learning foreign languages. The application of out-of-date methods into teaching so far

might have led to the inefficiency in exploring the value of English lesson content. And above all, students might have got used to copying down the lessons from the teachers' explanation; they might not really have had a passion for their language learning. In other way of speaking, they may not have discovered the appropriate methods to study English in an effective way. A lot of students have been so accustomed to only the single method that they may have lacked some necessary skills for their English learning. This was the case of the students at the current research context who may be familiar with Grammar Translation Method and who could be good at translating from one language to another while could be strange to communicative skills.

Good methods and approached to teach culture subjects

Learning about the culture is very necessary especially for students learning foreign languages. So as to learn other languages as well as using language effectively and in accordance with the context, learners need to know the culture of the country. Crawford-Lange and Lange (1987) stated "*To study language without studying the culture of native speaker of the language is a lifeless endeavor*". Teaching culture is becoming more efficient and easier thanks to a variety of methods. Specifically, a study of Cullen and Sato (2000) has proposed a number of techniques to teach cultural in effective ways and to bring many benefits to EFL such as information sources, activity-types and selling-points.

Information source

According to the researchers, having a comprehensive picture of the culture from many angles, we need to provide EFL students with different types of information. The combination of the use of sound and image resources tactile materials can increase the excitement as well as learning how to handle different students. These include the use of videos, CDs, TV, readings, internet, stories, student's own information, songs, newspapers, realia, fieldwork, interviews, guest speakers, anecdotes, souvenirs, photographs.

Activity types

A part from the provision of information, the activity type is also an important method in teaching culture. In this study, the researchers made the some major activity suiting culture teaching such as quizzes, action logs, reformulation, noticing, prediction, research. According to them using quizzes is one of the more successful activity types. Quizzes can be used to test materials that you have previously taught, but they are also useful in learning new information.

Some practical ways to integrate culture

Peterson and Coltrane (2003) suggested some instruction strategies to teach culture that may seem helpful for teachers looking for some practical ways to integrate culture in their lessons. There are using authentic materials such as films, news broadcasts, television shows, websites, photographs, magazines, newspapers, restaurant menus, travel brochures, and other printed materials to engage the students in discussion of cultural issues or we can use proverbs as a way to help students to explore the target culture. Furthermore, having students act out a miscommunication based on cultural differences and presenting objects such as figurines, tools, jewelry, or images that originate from the target culture serves as a foundation from which the teachers can discuss other cultural historical, and linguistic factors, or the students can be asked to do further research to find more information about the items presented and using exchange students, immigrant students, or students who speak the target language at home as expert sources for classroom discussion. Moreover, we can learn texts as sources for learning culture and sing

film songs and television segments to provide students with an opportunity to witness behaviors which are not obvious in texts.

Content-based instruction (CBI)

According to Scheleppergrell, Achugar and Oteíza (2004), Content-based instruction (CBI) began to gain prominence in the 1980s in the United States when approaches were needed to promote simultaneous content and language learning for a growing number of English language learners in the schools. Content-based instruction (CBI) is an approach to teach ESL that attempts to combine language with disciplinary learning, suggesting that teachers can build students' knowledge of grade-level concepts in content areas. Meanwhile, students' English proficiency is being developed. In addition, according to Lynda Chapple and Andy Curtis (2004), CBI assists to increase speaking, listening skills and confidence when students use English. They also identified other enhanced aspects of learning, namely analytical/critical thinking skills.The literature mentioned above leads the researchers to their selection of CBI to be the reliable research variable for this study about students' attitudes towards a kind of language instruction when studying Cultural Subjects.

Content-based instruction (CBI) is "the integration of a particular content [e.g., math, science, social studies] with second language aims...It refers to the concurrent teaching of academic subject matter and second language skills" (Brinton, Snow &Wesche, 1989, p.2). Content-Based Instruction (CBI) is a significant approach in language education. CBI is designed to provide second-language learners instruction in content and language. According to Krashen (1982), in content-based instruction, students can acquire the content area of the subject matter with comprehensible input, and simultaneously increase their language skills. In order to achieve the goal of language skills improvement, Krashen states that the focus of the teaching is on the authentic and meaningful input, not on the grammatical form. In addition, Stryker and Leaver (1997) defined CBI as a philosophical orientation, a method, a syllabus design when it is for a single course or as a framework when for the whole instructional program. It is basically the integration of content and language. CBI is a systematic approach to teach selected content teaching based on learner's need and interested as well as their learning styles. CBI has been practiced in a variety of language programs ranging from vocational schools, immersion programs to English for Specific Purposes classes. CBI is widely used when there is a crucial need to teach both the content and the language.For these reasons, the research was carried out to investigate the EFL students' attitude towards the effectiveness of CBI when it is applied into teaching British Study at college education.

Theoretical framework of the current research

Here these studies generally discussed five effective aspects students can address. These are as follows: (1) achievements of high academic English according to Song (2006) when study with CBI; (2) an increase in listening and speaking skill according to a study of Hui (2011); (3) an increase in reading skill mentioned in studies of Ya-Ling (2010) and Glenn (2005); (4) a development of self-confidence according to a study of Dupuy (2000); (5) an increase in analytical/critical thinking skill according to a study of Chapple and Curtis (1999). There have been many scientists research the effectiveness of CBI. Thus, to investigate the attitudes of students towards applying the CBI, we should investigate the attitudes of the students towards the factors above.

2. RESEARCH METHODS

The current study is expected to examine EFL students' attitudes towards the effectiveness of applying

CBI into teaching British Study at college. Specifically, an attempt was made to provide answers to the following question:**What are the EFL students' attitudes towards the effectiveness of applying content-based instruction into teaching British study at college?**

The original sample chosen randomly to participate in the current research was 45 third year English-major students aged 21 to 24 at a Teacher Training College in KienGiang Province, the majority of whom were female. All of them receiving British Study instruction (with the duration of 30 periods) with CBI and the final sample were 45 students in Primary English Teaching. The participants shared basic characteristics of English educational background.e.g.their Vietnamese first language, Primary English Teaching major, 7 years receiving English instructionat lower levels of education.

A quantitative design was selected to test participants' attitudes towards the effectiveness of applying CBI into teaching British Study. However, it should be noted that in addition to the initial intention to determine the participants' attitudes towards the effectiveness of applying CBI into teaching British Study, the researcher also aims at discovering how many effective aspects the participantswill be able toobtainalong with their attitudes. Owning to the descriptive nature of this study, data collection method is conducted employing a questionnaire about the participants' attitudes towards the effectiveness of CBI when it was applied into British Study instruction as research instrument. An analysis of the data collected couldresult in contribution to reliability and validity for the final results of the research. In the current research, a 4-point scale questionnaire was designed to collect the data. The allowance of being able to collect a large amount of data economically and effectively was the reason for employing the research instrument. Concurrently, the questionnaire was designed using a consistent and controlled format, in which participants were asked the same structured questions. The questionnaire consisted of 3 sections. Section 1 is a preamble with the instructions of how to provide the data required. Section 2 includes participants' personal information. Section 3 consists of 18 questions around the subject the research mentions. An integral part when distributing questionnaire was that a guarantee that participants' information would be kept confidential.

A reliability of the test checked on 20 participants before the questionnaire was officially distributed officiallyreached standard rate. An analysis of reliability of the questionnaire, a descriptive analysis was performed to explore the attitudes of participants concerning five aspects: (1) an achievement of higher academic English, (2) an increase in listening and speaking skill, (3) an increase in reading skill, (4) the development of self-confidence, (5) an increase in analytical/critical thinking skill, with the support of a data analysis tool – SPSS.

3. FINDINGS AND DISCUSSION

3.1. Findings

Table 1. EFL students' attitudes towards the effectiveness of applying CBIinto teaching British Study

	N	**Mean**	Std. Deviation	Std. Error Mean
Mean General	46	**2.9167**	1.03946	.15326

As can be seen from Table 1, the average mean score of positive attitudes (M = 2.9167 ± 1.0) was statistically significantly higher than average with t (45) =5.981, p = .000. Generally, it can be inferred that with the five effectiveness aspects supported by CBI, EFL students have a positive attitudes with it.

Table 2. EFL students' attitudestowards their achievements of high academic English

	N	**Mean**	Std. Deviation	Std. Error Mean
Mean High	46	**2.9457**	.53206	.07845

Table 2 shows that the average mean score of the achievements of high academic English (M = **2.9457 ± .53**) was statistically significantly higher than average with **t (45) =12.054, p = .000.** In general, it can be inferred that EFL students perceive that they could obtain high academic English if instructor applies CBI into teaching British Study.

Table 3. EFLStudents' attitudestowards their speaking & listening skill when CBI was applied

	N	**Mean**	Std. Deviation	Std. Error Mean
Mean Speak	46	**2.8333**	.65828	.09706

The average mean score of the speaking skill (M = **2.8333 ± .65**) was statistically significantly higher than average with**t (45) =8.586, p = .000.** T**able 3** confirmedthat EFL students think it is possible for them to increase their speaking and listening skill when studying the subject with CBI.

Table 4. EFL students' attitudestowards their reading skill when CBI was applied

	N	**Mean**	Std. Deviation	Std. Error Mean
Mean Read	46	**2.8768**	1.13607	.16750

The average mean score of the reading skill (M = **2.8768 ± 1.1**) was statistically significantly higher than average with**t (45) =5.235, p = .000** (Table 5)**.** There is a confirmation of students' attitudes of an increase in their reading skill development when receiving English through CBI.

Table 5. EFL students' attitude towards their development of self-confidence when CBI was applied

	N	**Mean**	Std. Deviation	Std. Error Mean
Mean Self	46	**2.8370**	1.4928	.22106

The average mean score of self-confidence (M = **2.8370 ± 1.5**) was statistically significantly higher than average with **t (45) =3.786, p = .000** (Table 5). ELF students suppose they can develop their self-confidence when receiving CBI.

Table 6. EFL students' attitudestowards their analytical/critical thinking whenCBI was applied

	N	**Mean**	Std. Deviation	Std. Error Mean
Mean Think	46	**3.0598**	2.06302	.30418

In table 6, the average mean score of **t**he analytical/critical thinking (M = **2.8370 ± 1.5**) was statistically significantly higher than averagewith **t (45) =3.484, p = .001.** There is a possibility the analytical/critical thinking skill of EFL students will be enhanced if they receive CBI instruction in British Study in EFL students' thought.

Table 7. A comparison in EFL students' attitudes towards the five effectiveness brought about by CBIduring their British Study course

Aspects	**N**	**Mean**	Std. Deviation
Mean High	46	**2.9457**	.53206
Mean Speaking	46	**2.8333**	.65828
Mean Reading	46	**2.8768**	1.13607
Mean Self-Confidence	46	**2.8370**	1.4928
Mean Thinking skill	46	**3.0598**	2.06302

To sum up, from data analysis, it can be concluded that EFL students have positive attitudes towards the effectiveness of CBIapplied into teaching British English. While as mentioned, attitudes play a crucial role in the effectiveness of teaching methods. Descriptive statistics suggests that EFL students believe they could gain five effective aspects of CBI, among which the least increasing component was their speaking skill;yet, their analytical/critical thinking skill was the most increasing one.. All five aspects of the effectiveness of CBI were confirmed in this case, which revealed a positive sign when applying CBI in teaching British Study. Moreover, through receiving English with CBI, it is effective for EFL students to improve and develop themselves in Intercultural Subjects at higher educational system.

3.2. Discussion

Findings from the data reported that there was a statistically significant difference in attitudes of five effectiveness aspects of CBI. The data showed statistically insignificant that the students think they achieve high academic English and the analytical/critical thinking skill is increasing. This incorporates with findings from Lynda Chapple and Andy Curtis (1999), Ballin Song (2006) that CBI can help students have a high academic English and develop analytical/critical thinking skill. Moreover, students could take on three effective aspects which CBI brings out. This incorporates with findings from Li Hui (2011), Ya - Ling Tsai (2010), Glenn (2005), Beatrice C. Dupuy (2000). The data also illustrated that the speaking, reading, listening skill and self-confidence are increasing but not outstanding.

In the study of Lynda Chapple and Andy Curtis (1999), when the analytical/critical thinking skill is increasing, the self-confidence is increasing, too. However, in the current research, this was not the case. The increase in self-confidence development is not as the same as that in the analytical/critical thinking skill, but it was lower. Nevertheless, this still supports Lynda Chapple and Andy Curtis's findings in their research that CBI is the effective method which can help students' increase their analytical/critical thinking skill. The difference occurred as a possible result of the limited time and the number of subjects learnt. In the study of Lynda Chapple and Andy Curtis (1999), the students just participated in an English course and the course duration was long enough meanwhile theseinvolved participantshad tosit for a lot of subjects at the same time, which may be cause a distraction from British Study Subject.

4. CONCLUSION & IMPLICATIONS

4.1. Conclusion

The findings of this research indicated that the participants have perceived that they increased all five aspects of effectiveness of CBI. This means that positive attitudes towards the effectiveness of CBI applying into teaching British Study were confirmed. Particularly, the EFL students receiving CBI

showed that not only did they increase analytical/critical thinking skill and achieve high academic English level but they also developed their self-confidence and enhanced some English skills i.e. speaking, listening and reading. In summary, the current study asserted that the EFL students had positive attitudes towards the effectiveness of applying CBI into teaching British Study. This leads to the confirmation of the research hypotheses which the researcher puts forth at the beginning stage of research implementation.

4.2. Implications

In light of these findings, some pedagogical implications may be proposed. Firstly, the role of CBI in the development of EFL students' English skills is a beneficial aspect to be implemented in the EFL classroom when intercultural subjects are taught in EFL contexts. Integrating teaching cultural subject and learning language should be conductedwith CBI for two main reasons: (1) CBI focuses on using language as a vehicle for understanding and communicating really meaningful contents. CBI increased a lot of necessary skills and met the required elements as a method of culture teaching. Therefore, CBI should be recommended into the curriculumfor EFL students, which guarantee assistance to their acquisition ofcultural knowledge and to their growth of English skills. (2) CBI is a systematic approach to teach selected content teaching based on learner's need and interested as well as their learning styles. According to Krashen, to achieve the goal of language skill improvement, the focus of the teaching is on the authentic and meaningful input, not on the grammatical form. Hence, it can be supposed that students can learn culture without stress and find their interest in learning Cultural Subject.

Secondly, pedagogical implication is related to the method chosen for teaching culture. CBI method in the current research was proved by many researchers in teaching culture field to be a better method than any other ones e.g. Li Hui (2011), Ballin Song (2006) ,Ya - Ling Tsai (2010), Glenn (2005), Beatrice C. Dupuy (2000), Lynda Chapple and Andy Curtis (1999), Kazuyoshi Sato and Brian Cullen (2000), Peterson and Coltrane (2003)) especially in FL setting where everything should be provided appropriate due to lack of environment. Moreover, CBI can do it. CBI is a method which helps EFL students learn with videos, films, and images, listen to the presentations, and propose their inquiries to instructor, to peers and in groups when learning about some topics without any worries about grammatical mistakes but just focuses on content. From the mentioned benefits, it is a great idea to apply CBI into teaching cultural subjects in the future for enabling EFL students to develop themselves in a natural way.

4.3. Suggestions for further research

There were some unavoidable limitations throughout the process of research implementation such as small size of population carried out locally due to which the results could not be statistically generalized, and the limited time of the research.The current research reveals that the EFL students have positive attitudes towards the effectiveness of applying CBI into teaching British Study. The participants' skills were statistically significantly improved and increased in all five aspects: achievements of high academic English, listening, speaking, reading skill, analytical/critical thinking skill and self-confidence. Yet, it still neither provides enough evidence to prove the students' attitudes on a wide range of learners nor guarantees the positive attitudes of the effects in the long run. For these reasons, further research should be carried out with larger sizes of population at different levels of education so as to prove that students have positive attitudes towards the effectiveness of applying CBI into teaching Cultural Subjects.

Though the results showed a positive attitudes of EFL students about the possibly of an increase effective impact of CBI on their five aspects, in this research context, listening and speaking skills were

the least increasing components, which intrigues a suggestion that in the future further in-depth research should be carried out considerately and qualitatively to find the way to enhance listening and speaking skills of EFL students when receiving instruction with CBI for Cultural Subjects.

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APPENDIX

QUESTIONNAIRE FOR STUDENTS' ATTITUDES TOWARDS THE EFFECTIVENESS OF APPLYING CBI INTO TEACHING BRITISH STUDY AT COLLEGE

Dear participants!

The purpose of this survey is to explore **your attitude** of **an investigation** towards the effectiveness of applying content-based instruction method into teaching British study at college. The questionnaire is voluntary and the data collected are strictly confidential. All participants will NOT be identified. The data collected will be analyzed and used to identify any educational needs which can then be implemented as appropriate. You will show your agreement to take part in this survey by completing the questions below. For the questions with 1 option, please put a tick (✓) in the box (☐).

Thank you for your cooperation!

Personal information

1. Your name
2. Your age: …….
3. Gender: Male ☐ Female ☐
4. Courses: 34 English Teaching 1 ☐ 34 English Teaching 2 ☐

QUESTIONNAIRE

For questions from **1 to 18**, please put a tick (✓) in the box (☐) which shows the extent to which you agree with the statements given.

After learning British Study subject,

1. Your score of the subject in the final exam was…..

☐ 1. 0-3 ☐ 2. 4-6 ☐ 3. 7-8 ☐ 9-10

2. The extent to which you rate your understanding about British Culture was …

☐ 1. Less than 30 % ☐ 2. 50 % ☐ 3.70 % ☐ 4. Nearly 90 %

3. In terms of learning about culture and politics of one country, which way would you like choose to be taught?

☐ 1. Learning through group presentations with films, videos, and images

☐ 2. Reading the text summarizing the main ideas

☐ 3. Teachers' explanations about all of the content

☐ 4. The class's reading and discussing content together

4. Suppose that, in a speaking test, the topic you got were an introduction about British culture. You would:

☐ 1. Analyze and figure out the main characteristics about the topic

☐ 2. Outline the main points of the topic

☐ 3. Present a few general features about the topic

☐ 4. Hardly remember the specific characteristics of the topic

5. When you listened to the presentations of other groups, you understood ……of those presentations. (listening)

☐ 1. Less than 30 % ☐ 2. 50 % ☐ 3.70 % ☐ 4. Nearly 90 %

6. When you hear the other groups' presentations, do you notice some mis-pronounced words? (listening)

☐ 1. Regularly ☐ 2. Sometimes ☐ 3.Rarely ☐ 4. I did not notice

7. During your presentation, how often did you make mistakes in pronunciation? (speaking)

☐ 1. Regularly ☐ 2. Sometimes☐ 3.Rarely ☐ 4. I did not make mistakes

8. During your presentation, how many mistakes which created mangled content did you make? (which was corrected by the teacher later)

☐ 1. I do not have mistake because I prepared it carefully

☐ 2. 1-2 mistakes ☐ 3. 3-4 mistake ☐ 4. More than 5

9. When reading to prepare the content of your presentation, how much did you understand it finally?

☐ 1. Less than 30 % ☐ 2. 50 % ☐ 3.70 % ☐ 4. Nearly 90 %

10. When studying another subject and seeing some words which appeared in British Study subject, you would:

☐ 1. Not need to investigate , I remembered these words and their meanings

☐ 2. Discover that it was familiar, but you couldn't remember.

☐ 3. I guessed them vaguely ☐ 4. Have to look them up in the dictionary.

11. Do you often volunteer to present in front of the class?

☐ 1. Never ☐ 2. 3-4 times ☐ 3. 5-6 times ☐ 4. More than 6

12. When your presentation about British culture was finished and your group was asked some questions. You:

☐ 1. Responded rapidly ☐ 2. Answered after a few minutes thinking

☐ 3. Consulted with your group mates ☐ 4. Did not give replies

13. When your group divided the content of one of the British Study matters, you:

☐ 1. Were the leader ☐ 2. Chose to do the appropriate part to my ability

☐ 3. Did that part of work assigned

☐4.Did unrelated to content-tasks such as power point technique presentation

14. Before your presentation, the possibility that you trusted your team would get high marks would be:

☐ 1. Less than 30 % ☐ 2. 50 % ☐ 3.70 % ☐ 4. Nearly 90 %

15. During the other group presentations, you …….. took notice of doubted/ confusing content.

☐ 1. Regularly ☐ 2. Sometimes ☐ 3.Rarely ☐ 4. Never

16. When you listening to the presentation content of other group, the inquiries you often made were:

☐ 1. No inquiries ☐ 2. 1-2 ☐ 3.3-4 ☐ 4. More than 5

17. Did you often give comments to false content or a problem presented by other groups?

☐ 1. Yes , immediately ☐ 2. Sometimes

☐ 3. I recognized the problem, but shy to comment ☐ 4. I have no comments

18. While discussing the content, all people except you admitted this content was true .You would :

☐ 1. Accept the content like the majority and thought that you were wrong

☐ 2. Not accept but did nothing

☐ 3. Politely make questions to raise discussion for the whole class

☐ 4. Argued strongly to protect your opinion

IMPACTS OF CLIMATE CHANGE AND PRODUCTION PRACTICES ON AGRICULTURE IN THE MEKONG RIVER DELTA

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ABSTRACT

Climate change is identified as one of the greatest human challenges in the 21st century. Climate change has been and will have a very serious impact on all parts of the Mekong Delta. Over the past decade, a great deal of scientific research has been conducted to provide a deeper insight into climate change and the risks of climate change to the region's socio-economic development. It is drought, salinity intrusion, tides, tornadoes, river bank erosion. Along with that, the retention of old, obsolete production practices that neglects quality and environmental protection have seriously affected the sustainability of agriculture in the region. The paper outlines the impacts of climate change and production practices on agriculture in the Mekong Delta as well as offers some solutions to promote the sustainable development of agriculture in the Mekong Delta in the coming years.

Key words: climate change; the Mekong Delta; agricultural resources; agricultural production; production practices; adaptation to climate change.

The Mekong River Deltas (MRD)(1) natural elements, including soil and climate, are favourable for agricultural production, especially rice, fruit trees, and aquaculture. Every year the region contributes 56% of national food production, more than 90% of rice exports, 70% of aquaculture, and 60% of seafood exports to the whole country's export values(2). However, MRD's agricultural production has been seriously affected by climate change recently. In addition to the impacts of natural disasters, the area has experienced an increase in negative impacts caused by human activities. That includes the traditional and outdated farming techniques which focus on productivity instead of quality and environmental protection. This is threatening the sustainable development of the MRD agriculture.

1. IMPACTS OF CLIMATE CHANGE TO MRD AGRICULTURE

Climate change has posed challenges to the country's livelihood, food security, and energy and water sources, particularly in the MRD.

First, the MRD is currently facing severe drought and saltwater intrusion causing heavy loss and great impacts on agricultural production and local life. According to the Ministry of Planning and Investment's estimations, 45% of the MRD may suffer saltwater intrusion it hydroelectric dams in the upper MRD conserve water or provide enough water to push saltwater back to the sea. In late 2015 and early 2016, the MRD suffered the biggest drought and saltwater intrusion in its history. This decreased productivity, growth rates, agriculture and aquaculture scales. Estiin; loss in the first six months of 2016 was nearly VND 4,700 billion(3). Accordin September 2016 survey results, drought and saltwater intrusion had been increa since 2011 and increasingly expanding into provinces in the MRD. Four provii suffering the biggest losses were Ca Mau, Kien Giang, Soc Trang, and Tra Vinh (See Table 1). Climate change has raised the sea level and flood tides higher than they were five years ago. This has caused coastal landslides floods and salinization.

Table 1. The increase of drought and saltwater intrusion in the MRD in fiverecent years (survey on 199 people)

Location		Very often	Often	Rarely	Never	Total
Ca Mau	Number (People)	11	30	6	1	48
	Percentage	12.4%	34.5%	30.0%	33.3%	24.1%
Kien Giang	Number	39	0	2	2	43
	Percentage	43.8%	0%	10.0%	66.7%	21.6%
Soc Trang	Number	29	19	1	0	49
	Percentage	32.6%	21.8%	5.0%	0%	24.6%
Tra Vinh	Number	10	38	11	0	59
	Percentage	11.2%	43.7%	55.0%	0%	29.6%
Total		**89**	**87**	**20**	**3**	**199**
		100%	**100%**	**100%**	**100%**	**100%**

Source: Author's survey in September 2016.

The Ministry of Agriculture and Rural Developments report stated that due to impact of climate change, particularly the El Nino phenomenon, saltwater intrusion in MRD occurred two months earlier than usual, and travelled more than 90 kilome inland. Saltwater intrusion has caused serious damage to agricultural production. The total area of damage was 126,798 hectares. Of this amount, 78,137 (62% of total) hectares lost more than 70% productivity; 45,740 lost between 30% and 70% (36%); and 2,921 lost under 30% (2%). Many shrimp farming areas suffered from diseases - shrimp died of prolonged heat or a lack of fresh water. Several orchards dried up, and a number of forests were at the high fire alert levels (level four or five)(4).

Second, climate change has led to unsustainable development within MRD agriculture. The attraction of profits from natural exploitation (aquaculture, exploitation of natural land) or mistakes caused by previous economic development policies have negatively affected the sustainability of agriculture in the MRD. Due to the impact of climate change, many agricultural areas in the MRD have been seriously affected, and productivity and production areas have decreased. To provide food for the MRD itself, as well as for the entire country, the local people have shifted to new production models applying more modern science and technology. This is a positive sign showing the capacity of local people in coping with climate change. However, this process has also negatively impacted natural habitat, because the environment has not been protected, affecting the most vulnerable groups - the farmers and the poor, particularly the Khmer and the Cham ethnic minority groups.

2. IMPACTS OF PRODUCTION PRACTICES ON MRD AGRICULTURE

In recent years, the agriculture of the MRD has made strong developmental advancements. However, many farmers maintain outdated, unsuitable farming methods like using multiple insecticide sprays and high fertilizer doses. Plant protection products and chemical fertilizers have been used more often and in higher amounts. Currently, about 2 million tons of chemical fertilizers and hundreds of thousands of tons of plant protection products are used annually in the MRD, increasing the possibility of soil pollution and land degradation.

According to the September 2016 survey, 179 out of 197 interviewed respondents reported that, the

current agricultural production methods use more chemical fertilizers and pesticides than before (See table 2).

Table 2. Situation of using fertilizers and pesticides in agricultural production in the MRD

Location		Agree	Disagree	Other	Total
CaMau	Number (people)	44	3	1	48
	Percentage	24.6%	17.6%	100.0%	24.4%
Kien Giang	Number	43	0	0	43
	Percentage	24.0%	0%	0%	21.8%
SocTrang	Number	35	14	0	49
	Percentage	19.6%	82.4%	0%	24.9%
Tra Vinh	Number	57	0	0	57
	Percentage	31.8%	0%	0%	28.9%
Total		**179**	**17**	**1**	**197**
		100%	**100%**	**100%**	**100%**

Source: Author's survey in September 2016

The use of mechanical fertilizers has significantly increased crop yields, but an inappropriate amount can easily lead to environmental pollution. Residual fertilize penetrate into rivers and streams, harming plants and animals. The number of fish, craband snail species in the MRD has significantly decreased. In addition, the large-scale spraying of pesticides has caused considerable harm to the natural and soc environment. The use of plant protection products and chemical fertilizers has broken the ecological balance, causing harm to the environment and human health.

The over-development of aquaculture has caused many adverse effects to t environment, particularly the land environment. Serious pollution in aquamari farming areas is derived from a lack of thorough treatment for wastewater pollutan In the MRD, brackish water shrimp farming releases 621,022 tons of BOD; 14,868 tons of nitrogen; and 3,034 tons of phosphate[(5)].

3. SOME SOLUTIONS FOR PROMOTING SUSTAINABLE DEVELOPMENT IN THE MRD IN THECOMING YEARS

First, localities should thoroughly grasp and creatively apply a mindset sustainable development, ensuring harmony between economic developme objectives and environmental protection goals. It is necessary to be active in prograi and action plans to concentrate on taking appropriate advantage of the regio potentials to further boost the transformation of economic structure. This creal motive and promotes rapid, effective, and sustainable agricultural development. On this basis, key products that are competitive in both domestic and internatior markets will be created. It is also important to strongly promote the consumption products with competitive advantages, such as rice, seafood, and fruit.

Second, local authorities should thoroughly implement Party's guidelines and Stai policies on environmental protection, responses to climate change, and regional sustainable development. Among these, it is necessary to promote communicati on climate change among the people and to analyze local agricultural developrru under the impacts of climate change in order to develop appropriate responses, the same time, raise the awareness of the Government, mass organizations, enterprises and the people as a whole to achieve unity and action in coping with climate change.

Third, actively build technical infrastructure to cope with symptoms of climate chan particularly

drought, saltwater intrusion, and lack of fresh water. It is also necessary localities to build a solid system of dykes and irrigation canals for rice fields, and to devel land and waterway transportation systems that are capable of efficiently transporting fo products to domestic and international markets. Additionally, industries should priorit studying and applying modern technologies such as greenhouse technology, se technology, agricultural product processing technology, drip irrigation technology, e to increase the productivity and quality of agricultural products.

Fourth, promote links in agriculture to enhance the capacity and efficiency agricultural production. Experiences of agricultural models around the world have effectively supported the development of agricultural technological activities. In the MRD, the "four stakeholders" connection model (the government, the scientists, the enterprises and the farmers) has been established and implemented for several years but its effectiveness is limited. Therefore, in order to carry out agricultural production in the context of climate change, the MRD should perfect the link between "houses" in agricultural production to suit the regions conditions. In the short term, it is necessary to raise farmers' awareness, particularly the awareness of science and technology.

Fifth, diversify plants and use fertilizers and pesticides appropriately. Planning agencies and scientists need to conduct thorough research on the impacts of drought and saltwater intrusion in order to adjust the plan of production areas, particularly concerning rice production. Accordingly, invest in growing forests, developing shrimp-rice models, and growing rice in saltwater, fresh water, and alluvial areas along riversides or large canals. Localities need to strengthen their scientific and technological solutions to adapt to climate change. For example, conduct studies on shrimp, fish that can endure drought, and plants that can grow on high-salinity land. It is necessary to replicate effective production models such as "3 reductions 3 gains" "1 must 5 reductions," and "4 rights" in order to economize production expenditures, enhance productivity and protect the environment.

Sixth, strengthen cooperation with other countries in the Greater Mekong sub- region and the international community to cope with climate change. There should be increased exchanges with other countries within the Mekong River Commission and with China concerning sharing information and exploiting the Mekong's water source. It is also necessary to cooperate with experienced countries including Holland, Israel, and Australia in order to take advantage of international organizations in responding to climate change in the MRD. Strengthening international cooperation will help Vietnam cope with climate change and encourage agricultural techniques toward sustainable agricultural production.

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ENHANCING FIRST-YEAR STUDENTS' READING COMPETENCE THROUGH EXTENSIVE READING AT NHA TRANG UNIVERSITY

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ABSTRACT

It is necessary for students of English major to master reading competence. However, most first-year students majoring in English at Nha Trang University in Vietnam do not feel excited to get engaged in their reading process. One of the main reasons is that they are forced to read their textbook without any motivation. Based on the results of previous studies, theories and practices on extensive reading in teaching language learners, this paper reports an investigation into the use of extensive reading in teaching reading comprehension and students' opinions on whether this reading approach could improve their reading competence and motivate them in their reading ability. Moreover, it also proposes practical applications of extensive reading in English major classes. The research was conducted in an English major class of 32 students at Nha Trang University, Vietnam. Qualitative methods were used as main tools to collect data for analysis from class observations, an open-ended questionnaire, students' final test scores, group interviews, students' summary notebooks and weekly reading log. The results of the research show that extensive reading can enable students to improve their reading competence and feel motivated in reading.

Key words: extensive reading, reading competence, motivation, freshmen

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1. INTRODUCTION

There is no doubt that reading comprehension is one of the important and basic English learning skills that English students must master because it enables them to absorb knowledge from different learning materials in English. It is a learning process in which students feel excited to actively get involved in constructing and understanding the meanings of a text (Nation, 2005). However, most first-year students of English major at Nha Trang University find it difficult and uncomfortable to concentrate in reading classes because of some main reasons. One of the main reasons is the rigid curricula and limited teaching hours. According the curricula, the course of Reading Comprehension 1 has only 30 periods which lasts 15 weeks during the first semester. With this limited amount of time, it is really difficult for first-year students to improve their reading competence. Another factor influencing their reading competence is their reading textbook whose topics are not interesting enough for all of them to read. Many of them do not feel happy to be forced to read what they are not interested in. Their reading habit at their high schools is also an obstacle to their reading competence and pleasure for reading. They tend to translate every English sentence into Vietnamese while reading, which really has a negative impact on their reading skills and reading pleasure. Therefore, they read English texts more slowly than they read in

Vietnamese. Habitually, most of them at high school were taught how to answer all the questions related to the exercises in their textbooks without any focus on reading for pleasure. After entering Nha Trang University, these students still keep this reading habit. Therefore, they feel bored and unmotivated in reading. Yildirim (2014) maintain that teachers who prefer using intensive reading in teaching really make students have negative attitudes towards reading. These factors really hinder most first-year students at Nha Trang University from reading effectively although they have studied English for seven years from their secondary schools to high schools. To solve this problem, one of the effective reading approaches proposed by many educational experts is extensive reading.

Extensive reading is defined as a teaching approach which stimulates students to read as much as they can (Day, Prentice et al., 2016) in order to understand and gain "content matter knowledge, skill improvement and enjoyment" (Nation, 2007, p.8). Unlike intensive reading which tends to provide planned and restricted exposure to language input, extensive reading gives students autonomy to choose various materials to read without any tension, which makes them self-selected and exposed to authentic texts. All these factors facilitate students to comprehend a new language quite fast and without pressure (Renandya & Jacobs, 2008).

Based on the definition, other theories and researches on extensive reading, this study was carried out in a class of thirty two first-year students at Nha Trang University in 2016 to explore the effectiveness of this reading approach in teaching a course called Reading Comprehension 1 during the first semester of 15 weeks. There are two main reasons why this class was chosen. First, extensive reading was new to most students in this class. Second, most of them felt passive and uninterested in reading.

The study was was conducted to investigate the impacts of intensive reading and extensive on the reading competence of first-year students at Nha Trang University through the following questions.

1) Which reading approach is more effective, intensive reading or extensive reading?
2) What do students think about these two reading approaches?
3) How does extensive reading stimulate students in their reading process?

2. LITERATURE REWIEW

The findings of many studies have showed that extensive reading has positive impacts of on language learners (Day & Bamford, 2009; Leung, 2002). They maintain that extensive reading is really beneficial in promoting language learners' reading competence and motivation in reading.

There are also many theories about the importance of extensive reading. Day and Bamford (2009) maintain that extensive reading can help students promote their reading ability in the target language, develop their positive attitudes toward reading, stimulate them to read, and acquire reading proficiency in the target language. Some educational professionals also state that extensive reading indeed plays an important role in improving language learners' fluency because it helps them improve their vocabulary, and increase their reading speed and comprehension (Stanovich, 2000; Blevins, 2005; Samuels, 2006; Iwahori, 2008). Nuttall (1982) also emphasizes the importance of enjoyment in extensive reading in comparison with any other kinds of motivation in language learning.

3. RESEARCH METHODOLOGY

The main purpose of this study is to answer the previously mentioned questions related to the

implementation of extensive reading in teaching reading. The methodology of this study comprises of research design, data collection, data analysis and discussion. The research design is related to the approach in conducting the study. The data collection deals with the way how data was collected and the data analysis and discussion refers to the measurement of the implementation of extensive reading in teaching reading.

3.1. Research design

The study was conducted in an English major class with the participation of 32 first-year students who studied a subject called Reading Comprehension 1. Their main textbook was Elementary Effective Reading 1 by Chris Gough and published by Macmillan, 2009. The main teaching methods for this course were intensive reading in class and extensive reading beyond class. In the study, the students were required to read some texts in this textbook based on the curricula requirement and also encouraged to read any English texts of their interest at home.

Each student was also required to complete a weekly reading log which includes information about each text they had read at home such as its title, author, word length, new vocabulary numbers, reading time. The information of this form helped the researcher to check each student's task performance and reading progress.

In the study, I acted two roles as a teacher and a researcher. As a teacher, I encouraged the students to read five English texts every week which they then summrized in their summary notebooks. Before teaching a text in the textbook in each reading period, I spared about half an hour for the students to discuss their summaries in pairs and then some of them were randomly selected to present their summaries in front of the class. During these class activities, I played roles as a teacher and a researcher to check their reading comprehension, observe and take notes of their attitudes, behaviours and task performance.

3.2. Data collection

For the reliability and validity of the study, all the data from class observations, the students' summary notebooks, their weekly reading logs, their final test scores, an open-ended questionnaire, group interviews between the researcher and eight groups of students were collected and analyzed carefully. All the summary notebooks of the students were collected periodically on the 5th week, 10th week and 15th week to check what they had read and summarized from their comfort at home. The summary notebook of each student was also attached with a previously-mentioned weekly reading log.

Regarding class observations, all the class activities were observed and noted carefully especially when the students took part in class discussions and presented the summaries of what they had read at home.

The next factor which was also given attention was the results of the students' final test scores at the end of the semester. To ensure the effectiveness of extensive reading in their reading competence, their final test scores were compared with those of other students in two other reading classes in which the intensive reading approach was mainly used by another teacher.

After the study, the students were required to answer five open-ended questions in a questionnaire which was designed to find out what the students thought about the application of intensive reading and extensive reading in teaching the course. To ensure the reliability of the data, group interviews with four

students per group was conducted to check and compare all the findings of the study. The interviews wered recorded, transcribed and then analyzed carefully.

3.3. Data analysis and discussion

All the data related to class observations, an open questionaire, students' summary notebooks and interviews between the researcher and students was collected, analyzed and triangulated to explore the students' attitudes, behaviors and opinions towards the implementation of extensive reading in teaching reading. Moreover, the researcher compared the final test scores of the students in the study with those of other students in two other classes.

Class observations

The results of the class observations showed that most students felt very excited to discuss and present what they had read extensively at home. They actively took part in class discussions with their classmates and felt comfortable to exchange information about the contents of the texts that they had read and summarized. This means that extensive reading really makes most students feel active and interested in their reading process. Through extensive reading from their comfort at home and class activities like discussions and presentations, most students felt more confident about their reading and speaking skills. They knew how to express the main ideas and supporting details of a text clearly. Most of them felt confident to make a presentation about the content of a text they had enjoyed reading. The students' reading comprehension was better when the teacher asked them to read and answer some questions about four different texts at an elementary level related to the topics that they had read extensively. They seemed to read faster and could understand the meaning of the texts easily.

Class observations also showed that many students did not feel interested in reading the texts in the textbooks because they seemed to be very easy and boring for them to read. They did not feel excited to discuss the contents of the texts in the textbook. Some students tended to look up the meanings of new words on their mobile phones while reading, which really had a negative impact on their enjoyment in reading. In this aspect, students' limited vocabulary is also an obstacle to their reading skill for pleasure.

An open-ended questionnaire and group interviews

Analyzing all the students' responses to a questionnaire including five open questions showed that 30 students felt more interested in extensive reading than intensive reading because they had freedom to select what to read. They said they could understand the main idea and supporting details of a text more quickly because their vocabulary about topics had been improved. Two students first found it quite difficult to choose what reading sources were suitable for their level to read. However, after receiving some instructions from the teacher, they could know what to read. Twenty nine students felt more self-confident about their reading ability. They could read faster than before. Most of them knew how to guess the meanings of new words from the context and neighbouring words.

Through informal interviews with eight groups of students about the effectiveness of extensive reading and intensive reading, they said that the former provided more knowledge and vocabulary about many fields than the latter because they had more autonomy and felt comfortable to select what to read. They also said that they felt more confident and comfortable to read English texts than before. Twenty six students felt more active in their reading process and more interested in extensive reading than intensive reading while other six students said that sometimes they did not have time to read five English texts every week at home because of their part-time job and so much other homework to do.

Students' summary notebooks

Most students read and summarized seventy five English texts. Four students did not do these tasks well. They did not summarize enough seventy five English texts as required. They just copied nearly fifteen original texts from other reading sources into their summary notebooks. They said that they were too busy with their part-time jobs and other homework to summarize all. Two students tried to fullfil their summary tasks although they also had a part-time job.

The weekly reading logs enlosed in the students' summary notebooks indicated that they felt interested in reading a variety of English texts online and from other English books. Looking at the categories of word numbers, reading time and new vocabulary numbers in the students' form, the researcher found that they had made significant progresses in their reading speed and vocabulary.

Students' final test scores

The results of their final test scores showed that this class had fewer students with low marks than two other classes in which intensive reading was the main teaching method. Moreover, the rates of students with seven mark and over was also higher than two other classes. This means that extensive reading really helps improve their reading comprehension.

4. . CONCLUSION, SUGGESTION AND IMPLICATION

The results of the study shows that extensive reading is more effective than intensive reading because this approach really improves students' reading comprehension and stimulates them to get actively engaged in their reading process. Unlike the intensive reading approach, it gives students autonomy to select what to read and makes them feel more confident to read a text without any pressure and stress.

Based on the research findings, some suggestions are proposed to teachers who want to apply extensive reading in teaching. The suggestions are as follows

1) Teachers should encourage students to read what they are interested in and what they read must be suitable at their level. They can give clear guides or recommend some books, reading materials from websites to students who can not know what to read on the first days.

2) Teachers should advise students not to stop reading to look up new words. They should instruct their students to guess the meanings of new words from the context or neighbouring words. They should explain to their students that looking up new words while reading will reduce their reading ability and reading pleasure.

3) Students should be encouraged to read as much as they can at home. Their reading must be summarized in a notebook which is checked periodically by their teachers. Before each reading period, teachers should also spare fifteen or twenty minutes for students to discuss and present what they have read. To check their reading comprehension, teachers should ask students some questions about the text that they have read.

4) To students who are afraid of reading, teachers should give them some interesting and easy materials on various topics at their level and encourage them to read. At first, they will feel uninterested in reading but gradually the content of these article will give them a motive to read.

The findings of the study can be implied that extensive reading can be widely used in other reading

classes to improve students' reading comptence. However, some problems related extensive reading activities should be taken into consideration to ensure the effectiveness of this approach in teaching reading comprehension.

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APPENDIX A

Weekly reading log

Student's full name: ..... Class: .....

Title	Author	Reading Time	Word length	New word Numbers

APPENDIX B

Questions for individual students

1. Which reading approach do you prefer, extensive reading or intensive reading? Why?
2. What benefits can you get from extensive reading?
3. Is intensive reading beneficial to your reading process?
4. Which reading approach stimulate you to read?
5. Do you have any problems with extensive reading?

Questions for group interviews

1. What do you think about the application of extensive reading in your reading process?
2. What do you think about the application of intensive reading in class?
3. Which reading approach helps you improve your reading ability and vocabulary?
4. Is extensive reading more beneficial than intensive reading?
5. Which reading approach helps you improve your vocabulary?

EFL UNIVERSITY TEACHERS' PRACTICE OF USING TECHNIQUES TO PROVIDE AND SCAFFOLD UNDERSTANDING OF INPUT IN NON-LINGUISTIC CLASSES

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ABSTRACT

This study was conducted to investigate EFL university teachers' practice of using techniques to provide input and scaffold understanding of input in non-linguistic classes. It also explored the underlying reasons behind the participants' practice over the given techniques. In order to answer two research questions, a descriptive mixed method approach, with a questionnaire being administered to 30 teachers of English at 5 higher education institution in the Mekong delta, including An Giang university, Can Tho university, Dong Thap university, Kien Giang university and Tay Do university. The findings of this study positively indicated that (1) EFL university teachers did not pursue a single technique in providing input and scaffolding understanding of input in their non-linguistic classes, that (2) techniques used for providing lesson content and facilitating learners' cognitive thinking process were employed more frequently than those for providing linguistic data and promoting learners' knowledge construction process (3) the effectiveness of the techniques in promoting learners' thinking and learning process; the convenience of techniques employment in terms of time; learners' preferences in learning style; teachers' beliefs and teaching habit, teachers' experience of language teaching and learning; students' language proficiency level were the reasons underlying their practice. Based on the findings of the teachers' practice in this present, the researcher makes some implications for the participants so as to help them move closer to the achievements of dual-focused goals.

Key terms: non-linguistic, providing and scaffolding input, techniques

1. RATIONALE

Since the late 1980s, the impact of the Economic Renovation policy and of internationalization has led to a need for higher levels of foreign language proficiency in Vietnam. However, as indicated by Nguyen (2011), 98% of Vietnamese pupils after spending seven years (from grade 6 to grade 12) studying English cannot still use it for basic communication (Nhan, 2013). According to Vietnam News (2008), findings from a survey on English language competence reveal that more than half of non-linguistic university graduates did not use English for doing research or communication after graduating up to six years. Linh (2016) names this circumstance of language teaching and learning a crisis. Because the need for producing school-leavers with an independent competence in the English language has become more urgent, the English language pedagogy in Vietnam has started its changes, with the introduction of recent approaches that emphasize development of communicative competence and communication in teaching and learning. In recent years, with the introduction of Project 2020, the policy regarding English language education has further emphasized a deeper integration of English into the curriculum, especially the use of English as a medium in teaching science subjects. The Project also stresses the demand for standardizing graduates' levels of English proficiency. At many universities, following the requirements

of the Ministry of Education and Training, the proficiency standards for English majors have been established. In that context, apart from the focus of training target language skills on skills courses, there seems to be a need to stress the language skill objectives in non-language skills courses as well. Assuming that in these courses, the language medium is English, and the purpose is not only to impart content knowledge, but also to enhance students' English language proficiency, it is essential to gain insight into how such courses are implemented in the classroom. Research into many EFL teaching aspects are abundant (Klassen and de Graff, 2001, Marsh, Maljers, and Hatiala, 2001, Munõz, 2006, Pe´rez-Vidal, 2011, Nave´s and Victori 2010; Smith, 2004, Ruiz and Lasagabaster, 2010, Yusof, Tayib, and Mansor, 2004,), however, little attention has been paid to how techniques are deployed in university EFL contexts for English majors who learn subjects other than English language skills. From the above-mentioned points, this study is conducted to gain insights into how the teachers in these contexts make use of techniques in their non-language skill classes.

The study attempts to answer the following question:

1) Which techniques do EFL University teachers use in providing input in their non-linguistic classes?

2) Which techniques do EFL University teachers use in scaffolding learners' understanding of input in their non-linguistic classes?

2. RESEARCH METHODS

2.1. Participants of the study

30 EFL teachers, including 21 females (70%) and 9 males (30%), teaching non-linguistic subjects at 5 higher education institutions in Mekong delta, namely, An Giang University with 12 participants, Can Tho University with 10, Dong Thap University with 5, Kien Giang University 4 and Tay Do University 4) participated in this study. Amongst 30, 5 (16.7%) gained PhD and the rest (83.3%) earned Master degrees. The majority of participants were aged between 30 and 40. In terms of their seniority, 1 participant has been teaching for less than 5 years, 5 from 5 to 10 years, 10 from 10 to 15 years and 15 for more than 15 years.

2.2. Research instruments

Questionnaire

The questionnaire consists of two main sections. The first section obtains participants' demographic information including their age, sex, and their highest degree, their teaching experience, non-linguistic subjects they used to teach. The second section included 27 items broken into the two main learning views. The former contained 12 questionnaire items with the scale from 5 (always) to 1 (never) that were mainly based on Cognitivist learning theory. Amongst them, half of the items were used to investigate techniques used in providing lesson information while the rest used to explore techniques employed in providing language data. Designed the same scale to the former, 15 items were representative techniques EFL university teachers used in scaffolding understanding of input in non-linguistic classes. Amongst them, 9 were broken in terms of Cognitivist learning theory and 6 in terms of Constructivist learning theory.

Semi-structured interviews

After reaching a pattern on techniques EFL university teachers used in providing and scaffolding understanding of input in non-linguistic classes, the researcher conducted semi-structured interviews to examine the underlying reasons behind the participants' employment or avoidance of these techniques. The interview was recorded and conducted in Vietnamese so that informants could feel at ease in providing the information. Thus, reliability of the responses could be more reliable.

3. FINDINGS AND DISCUSSION

3.1. Techniques used in providing input

Table 3.1. Techniques used in providing input

	Items	Always	Often	Sometimes	Seldom	Rarely	M	SD
1	giving examples	56.7	43.3				4.57	.498
18	I ask questions to promote students' thinking process	23.3	66.7	10			4.13	.571
9	I model correct language use.	43.3	40	13.3	3.3		4.23	.817
7	I use graphic organizers to display the lesson content.	30	53.3	16.7			4.13	.681
6	I supply the language students need	36.7	43.3	20			4.17	.747
5	I pre-teach vocabulary before going into the lessons.	6.7	43.3	20	10	20	3.07	1.285
15	I use clues to make sense of the texts.	33.3	43.3	23.3			4.10	.784
3	I use illustrations to define key terms	16.7	50	23.3	10		3.73	.868
10	I deliver linguistic rules	10	34.4	33.3	10	12.3	3.47	.937
13	I familiarize students to specific subject vocabulary	13.3	53.3	33.3			3.80	.664
14	Providing samples of task		43.3	36.7	13.3	6.7	3.17	.913
4	grouping terminology in glossaries	3.3	33.3	53.3	3.3	6.7	3.23	.858

As also indicated in the table 4.1, the majority of techniques were commonly employed since the average scale of frequency of all items is far more than 50%, except for techniques 5, 10, 14 and 4. Amongst the frequently-used techniques, technique 1 was the most frequently employed, with 60% of the participants reporting that they always provided students with examples while the rest (40%) acknowledged that they often did so (M=4.57). Item 18, accounting for up to 90% of the teachers who

both always and often used it (M=4.13), ranked the second while items 9 and 7 ranked third, both totaling of 83.3% of the teachers who both always and often applied it (M=4.23 and M=4.14 respectively). Also to be considered is techniques 6, 15, 3, 10 and 13 which were the last four mostly used techniques. 80% (M= 4.17), 76.6% (M=4.10), 66.7% (M= 3.73) and 66.6% (M= 3.80) respectively were the sum of percentage of teachers who always and often employed them.

As shown in the table, since the sum of percentage of the teachers who always and often employed techniques 5 (46.6%, M= 3.07), 10 (44.4%, M= 3.47), 14 (43%, M= 3.17) and 4 (36.6%, M= 3.23) was lower than the average scale of frequency (50%), they were segmented into the category of the less frequently used techniques. Amongst the above-listed techniques, technique 4 was the least frequently used while technique 14 and 10 ranked the second and the third respectively.

Another worth-considering finding was the difference in the frequency use level of techniques the teachers applied to provide learners input in term of lesson content and in term of the target language. More specifically, the participants' practice of using techniques in delivering lesson content to students more frequently than that in providing them the linguistic data (M= 2.03; M=2.33).

3.2. Techniques employed in scaffolding understanding of input

Table 3.2. Techniques used in scaffolding understanding of input

	Items	Always	Often	Sometimes	Seldom	Rarely	M
27	I modify talking speed	36.7	60	3.3		4.33	.547
16	I translate difficult vocabulary into Vietnamese	20	66.7	6.7			
26	I use Vietnamese to explain the lesson content	30.0	46.7	16.7	6.7	4.00	.871
11	I organize interactive activities to help students improve language	33.3	40	16.7	10	3.97	.662
17	I use synonyms or antonyms of difficult words	20	63.3	16.7		3.90	.548
23	I use clear instruction for assignments and activities	10	70	20		3.90	.548
2	I organize hands-on activities to help students explore new knowledge	20	46.7	26.7	6.7	3.80	.847
8	I use problem-solving activities to help students construct new knowledge	40	33.3	26.7		4.13	.819
21	I use different interactive formats to help students exchange subject knowledge	10	46.7	33.3	10	3.47	.817

	Items	Always	Often	Sometimes	Seldom	Rarely	M
25	I use subject-specific vocabulary in different context	13.3	46.7	33.3	7.6	3.63	.890
22	I use games to help students review core lesson concepts	13.3	16.7	36.7	23.3	3.00	1.174
12	I ask students to summarize the lesson content	13.3	33	50.4	13.3	3.47	.900
20	I ask students to convert information from texts into graphic organizers	26.7	46.7	26.7		3.00	.817
19	I use follow-up activities to reinforce lesson core concepts	3.3	30.0	60.0	3.3	3.73	.740

As indicated in the table 4.2, the number of techniques were less employed was far lower than that were less frequently used (4 as opposed to 11). The technique 20, 22, 12 fall into the group of the less commonly used techniques as the sum of the percentage of participants who always and often applied these techniques was far less than the average scale of frequency. Specifically, the sum of the percentage of the participants who always and often asked students to convert information from texts into graphic organizers accounted for 26.7%, (M= 3.00), used games to help students review core lesson concepts 30%, (M= 3.00), used follow-up activities to reinforce lesson core concepts 33.3%, (M= 3.73) and asking students to summarize the lesson content 46.3%, (M= 3.47). Amongst the less commonly use techniques; asking students to convert information from text into the graphic organizers was the least frequent used.

In the sharp contrast, the sum of percentage of teachers who always and often employed the rest was far more than the average scale of frequency. The sum of technique 27 accounted for 96.7% (M= 4.33), becoming the most frequently applied technique while techniques 16, 26, 11 obtained 83.3%, 80% and 73.3% respectively, becoming the second, third and fourth most commonly used ones. It can be clearly seen that technique 27, 8, 17, 26, 16, 11 were belonged to the group of the 6 most frequently employed and that technique 27 was mostly used.

Another worth-considering finding was the difference in the frequency use level the participants used techniques in terms of Cognitivist and Constructivist learning theory to promote learners' meaning and form interpretation process. Specifically, the frequency use of techniques in scaffolding understanding of input in terms of Cognitivist theory was slightly frequent than that in terms of Constructivist learning theory (M= 2,30; M=2.25 respectively).

3.3. Reasons underlying teachers' practice of using techniques in providing input

It was clearly indicated that ***giving examples*** is the main technique EFL university teachers used in providing input to their students in non-linguistic class. The reasons lied on their teaching habit, the convenience in their technique employment and the positive effect of this technique on boosting learners' ability to grasp the feature of the discussed issues. They revealed that:

"I get used to providing examples after I introduce a new subjects issue to learners. It is like teaching habit" (interviewee 1) "Giving examples are simple and easy-to-do…If you use visual aids as videos, pictures, you have to spend more time searching for the Internet" (interviewee 2).

Kurtus, (2001) and Frank (2009) state that the teacher could abstractly explain to students what something is but when the teachers give them an example, they can literally "imagine for themselves" what they are hearing about (p.76).

To turn to the reasons why the technique ***asking questions*** was commonly used, EFL teachers reported that they appreciated its positive effects on promoting students' learning and thinking process, checking their lesson understanding and keeping students whose mind wanders stay focused.

"It is the best way to check students' lesson understanding. When listening to the answers, you can know where and how they went wrong." (interviewee 2)

"Some students, because of not being interested in the lesson, will make noise in the class or do their personal things. I usually ask them to stand up and answer my questions" (interviewee 3)

The comments support for the arguments of Guy Claxton, professor in education and director of CLIO development university of Bristol stating that "Good learning starts with questions, not answers". According to him, questioning enables teachers to lead students to the lesson content since they themselves have to figure out the answer to the question. With regard to the reasons underlying the teacher's practice of ***using graphic organizers to display the lesson content***, the teachers revealed that it was helpful to increase students' lesson engagement, facilitate their meaning-focused processing and capture learners' attention. They reported that:

"Videos, pictures, diagrams are more eye-catching and have more color than passages full of words…Learners, even students who are adults, usually like watching pictures, videos, timelines. It seems to me they enjoy looking at the visual aids than their book." (interviewee 1)

"A picture is more than a thousand words" (interviewee 3)

These are back up for what (Mayer, 2003) arguing that an advance or graphic organizer can be used to organize and interpret new incoming information. Additionally, graphic organizers including mind maps, tables, charts, diagrams and timelines, videos and multiple resources consisting of PowerPoint presentation are used to insure learners' understanding and maintain their attention and motivate active participation in the learning process levels Fernández et al (2009). Leisen (2015) states that presenting subject specific matters visually (through graphic organizers including mind maps, tables, charts, diagrams and timelines enables learners to clarify the relationship of complex matters presented in a foreign language. Snow (1990) argues that visualization techniques assist in making lesson content clear and meaningful. To sum up, there was a wide range of reasons why EFL university teachers employed some techniques more frequently than the others. Teaching habit, the convenience of technique employment, the positive effect of boosting learners' cognitive ability, meaning interpretation process**,** checking their lesson understanding, keeping students stay focused were the found reasons.

3.4. The reasons underlying teachers' practice of using techniques in scaffolding understanding of input

When being asked about the reasons for ***modifying talking speed***, participants revealed that they

adapted their taking speech to make it inconsistent with learners' level of language proficiency.

"I never speak fast because my students are freshman and did not frequently expose to English in their high school…I even use simple sentences to explain the content or give instruction of task" (interviewee 2)

These responses support the argument that the teachers' elaborative speech such as slowing down the rate of speech, increasing the pauses between phrases, using simple (short) sentences, or repeating and paraphrasing frequently (Echevarrìa, et al. 2010) have been proven to be the best ways in maximizing the amount of words students can listen to and increase learners' comprehension of oral texts (Chaudron, 1985, Long, 1985, Paker & Chaudron, 1987, as cited in Wesche, 1994).

To turn to the reason why the interviewee translated ***difficult subject specific vocabulary into Vietnamese,*** the interviewees revealed that not only is direct translation not time-consuming but it also helps learners have a precise gain of the meaning of the words.

"To me the quickest and the most pleasant way to assist learners in gaining the meaning of the difficult words is translating them into Vietnamese. It seems to me that students get the main issues of the lesson when they are taught in Vietnamese"

The facts support for the argument of Sophie and Georgiou (2011). Learners, at the initial stage, are linguistically not yet able to understand a subject with a lot of terminologies. Therefore, they suggested the teachers to clarify key concepts in students' L1 to facilitate learners' meaning interpretation process.

To turn to what encourage the teacher organize interactive activities to help their students improve language, the interviewees stated that peer-teaching was the main reason.

"Students are afraid of talking to the teachers because they are afraid of showing their innocence or misunderstanding of the lesson. They are afraid of get punished or losing face. When they talk to their friends, they are not hesitant to ask their friends to give them more explanation or examples of the lesson issues they misunderstood or are vague." (Interviewee 2)

The fact is back up for Gass (1977) suggesting that interaction functions as an attention-drawing device to drive learners' attention to their unknown part of language. For these reasons, it is generally believed that learning may take place during the interaction.

In sum, it should be noted that, although teachers are working from the same framework, certain contextual factors would influence their practice of using technique in providing input and scaffolding understanding of input. Individual education and experience of teaching and language teaching are all aspects that may contribute to the types of techniques used in the classroom.

The work of teaching is simultaneously mental and social. It is also physical, emotional, practical, behavioral, political, experiential, historical, cultural, spiritual, and personal. In other words, teaching is very complex, influenced not only by these dimensions and perhaps others, but also requiring their contingent orchestration in support of students' learning. When language teaching in particular is in focus, the complexity is even greater, shaped by teachers' views of the nature of language, of language teaching and learning in general, and by their knowledge of the particular sociocultural setting in which teaching and learning take place (Adamson, 2004). Teachers' application of techniques in this study reveal how they view teaching and learning, what they see language is, and how it can be learnt. Through their practice, their teaching approach can also be revealed.

In a foreign language is used as a tool in the learning of a non-language subject. While language and subject learning are both the aims, the main focus of teaching is the subject, not the language although they have have a joint role (Marsh, 2002). The content or subject matter is at the heart of what is taught as it determines what thinking skills, what language and what aspects of cultural understanding the teacher aims to teach (Spratt, 2012). The findings of this study presented in the part 4.1 supported these arguments. It can be clearly seen that the participants paid more attention to the provision of lesson information rather than to linguistic data. From the data analysis presented in the table 4.2, it can be said with certainty that the teachers in this study attached much importance on facilitating learners' thinking process so as to check if the learners can recognize their intention when they modified talking speed, when they translated difficult subject-specific vocabulary into Vietnamese, when they used synonym and antonym to explain difficult words and why they used Vietnamese to explain the lesson content. Looking at the teachers' practice from the lesson content perspective, it can be said that the teachers in this study were successful in growing learners' expertise. According to Coley (1999, 2006), content matter is not only about acquiring knowledge and skills, it is about the learners creating their own knowledge and understanding and developing skills. Coley also stresses that content is related to learning and thinking (cognition). For the content to be constructed, it must be analyzed for its linguistic demands; thinking processes (cognition) need to be analyzed in terms of linguistic demands. Ironically, another goal of lesson, developing learners' language proficiency, could become hardly be achievable as this employment of techniques in promoting learners social interactive classroom is moderate. Evidently speaking, amongst the 6 mostly frequently used techniques, only 2 techniques come from Constructivist learning theory. Therefore, the limitation of communicative activities or the limitation of meaning and form negotiation process may undermine the quality of developing learners' target language proficiency and even learners' knowledge construction. Since language is used as a medium of instruction, the teachers' use of the target language to facilitate learners' meaning content through discovering and exchanging information in the target language is really important.

There are many reasons underlying the teachers' practice of technqiues in this study. It can be assumed that the teachers come to teacher training with ideas about the teaching/learning process formed from the years they themselves spent as students (Lortie, 1975). Language learning and teaching in Vietnam is dominantly influenced by traditional approaches. The teachers' also pay more attention to learners' learning product than learning process. Therefore, the absence of social interactive activities between students and teachers or between students and students is often recorded. However, the circumstance of language and teaching in Vietnam now has shown a sign of changing. Teachers' awareness of the role of a facilitator and students as the information processor and knowledge constructor may be hard to be transformed into practice. Another reason is the school policy where teachers in general and language teachers in particular have to follow. Therefore, it discourages teachers who are really desirable in making a breakthrough in teaching. Coming into the class with a safe teaching method that they applied over and over is safe and secured to them. Another reason is the lack of national training program in Vietnam (Linh, 2016). Embedded with this view is the assumption that language teachers who were assigned to teach non-linguistic subjects may bring to the classrooms in which lesson content and language data are integrated teaching methods they were used to applying in their traditional foreign language classrooms.

4. CONCLUSION AND SUGGESTION FOR FURTHER STUDY

The results revealed the research questions of the study that the teachers employed varied techniques in giving learners input and facilitating learners' comprehension of input and that they used techniques in

providing learners lesson information more frequently than that in providing language data. Their practices of using techniques in facilitating learners' meaning process was affected somehow since they might have assumed that the main focus of teaching, in a learning context where language and content are intergraded, is the subject, not the language. The high level of frequency use of techniques, namely, modifying talking speed, translating difficult words into Vietnamese, using learners' L1 to give further explanation of the subject issues, using synonyms or antonyms to explain difficult words, using clear instruction for assignments and activities to facilitate learners' meaning interpretation process were the convincing evidence for their assumption. However, the teachers' employment of techniques in the non-linguistic classes where the focus is on contents other than language skills, features and structures, aid support for the argument that the teachers are more likely to know how to create a contextualized learning context. They produced an integrated context where learners depart from what they already knew, and then move towards new concepts from there. In so doing, learners' cognitive contents, learning experiences were activated and that their personal explorations and learning autonomy were promoted through the teachers' practice.

The current research investigates EFL university teachers' practice of using techniques in providing and scaffolding understanding of input in non-linguistic classes. From the data, a simple picture was illustrated. However, future research with larger population and more extended time can help to achieve better views. Observation should also be used to provide valid data about teachers' practice.

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MULTI-STRATEGY-BASED LISTENING TEACHING APPROACH

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ABSTRACT

This study intends to see if using the multi-strategy-based listening teaching approach affects EFL students listening proficiency. This study included both experimental (using multi-strategy-based approach in teaching listening) and survey research (a questionnaire to get students' feedback towards the approach applied). 47 English major students learning in the course Listening 1 in the English Department, Kien Giang University were chosen as participants. At first, the researcher gave them the pre-test and she recorded the students' scores. Then the researcher used various strategies in teaching to help students listen better. The strategies include asking students to do homework each week, teaching listening techniques, encouraging students to guess words before listening, and listening to English songs. Besides that, the teacher's instructional process and the exercise design must be appropriate so that the students could listen with their best ability. At the end of the semester, the teacher gave students the post-test and compared the test scores at the beginning and the end of the course Listening 1. The results showed that students had a significant increase in listening ability after one semester the teacher applied the multi-strategy-based listening teaching approach. Afterwards, a questionaire was conducted to gain students' attitudes towards the trategies they learned with. The results of the questionnaire showed that the students had a positive attitude about the multi-strategy-based listening approach. The strategies were ranged from high to low impact as the following: teaching listening techniques, encouraging students to guess words before listening, asking students to do homework each week, the teacher's appropriate instructional process, appropriate exercise design, and listening to English songs. This suggests that using the multi-strategy approach in teaching listening can improve the students' listening ability.

Key words: multi-strategy-based approach, listening strategies, teaching listening

1. RATIONALE

Most people who learn English know that listening is one of the key skills among listening, speaking, reading and writing. When communicating with foreigners, if the learners cannot listen well, they will not be able to answer and of course cannot communicate. For English major students, listening is one of the most important skills. Most of the teacher's lectures are in English, so students who are not able to listen and understand will find it difficult to learn and then feel frustrated.

Students have a lot of difficulties listening English. In the listening classes, students often feel very awkward when the teacher plays the CD as they feel that the voice on the disc is going continuously, they do not hear what the speakers say and cannot do the listening exercises. Actually, students do not have to listen to all the words in the listening text, they just listen to some key words to guess the topic or the main idea (for the question of the main idea) or just listen to the necessary words (for questions of details).

However, students do not know how to listen effectively, and most students are afraid of studying listening skill. In international examinations, the number of candidates who fail in the listening skill is often more often than that in other skills. Therefore, finding a solution to increase the listening ability for

English students is essential, especially for freshmen who need to improve their listening skills to make the foundation for studying the next listening modules.

2. LITERATURE REVIEW

2.1. What is listening?

According to Tran N. (2009), "listening" requires the listeners to grasp what people are saying as well as understand the culture, traditions and practices of the speakers. The problem here is how to understand what people mean, not just what they say. Therefore, it is very difficult to understand what people mean, how their attitudes are, what they imply. To understand what the speakers mean, the listeners must have experience and knowledge of the subject being discussed.

2.2. How to listen effectively?

According to Tran N. (2009), the listeners should not listen to every word, and should listen and understand phrases and sentences. The ability to learn by themselves is much more important than just what was taught in class. When starting learning English, listeners need to learn how to recognize stress, build vocabularies to create a background for listening and comprehension. Besides, we have to put the vocabulary into context or situations because they support a lot in word recognition, and so it is easier to memorise the words.

According to Nguyen H. (2006), listeners need to build their capacity to have a logic judge between language and context. It is the ability to guess words in context to understand sentences and the ability to guess the parts they cannot catch. In addition, listeners also need to build a habit of concentration while listening. They should not think about the new words in one sentence and miss the next few sentences.

2.3. What is the role of the teacher in teaching listening?

According to Truong C. (2007), the teacher plays a very important role in preparing the students for their listening. Teachers must ensure that:

- Students must understand the requirement in English to be able to do the listening exercises
- Students must know exactly what the task requires them to do
- Students need to know that they do not need to hear all the words in the listening text.

The next step is to encourage students to predict what they are going to hear by asking questions related to the topic of the text, use pictures to help students predict the content of the text and guess the reply. Another important point is that while listening, students need to listen carefully to understand information from the listening content. They should not be asked to listen, read, write too much at the same time.

2.4. What are the main listening trategies?

We need to have clear purpose while listening. This is also the factor that requires us to seek the appropriate strategies to meet our requirements. By understanding this, the listeners can feel confident while listening, otherwise the listeners will be very passive and confused. Graham (2006), also provides some useful listening techniques for English learners. The main listening techniques are: listening for main ideas, listening for details, listening for the information needed.

Also, according to Lam (2010) and Field (1998), the following methods are also very effective for learning English: listening to English songs, doing exercises and tests, listening to English speakers as much as possible, and practice listening frequently.

3. RESEARCH METHODOLOGY AND RESULTS

3.1. Pre-test

At the beginning of the course Listening 1, the teacher gave the pre-test to get the students' listening ability. The content of this test is taken from the book *New Headway* (intermediate level). The mean score of the class (47 students) is 3.5 out of 10 points.

3.2. Teach the course Listening 1 using multi-trategies

a. Assigning a listening task as homework and giving a test each week

The teacher assigned a listening task as homework along with listening file and tapescript. The task is 15 lessons in the book *Learning to Listen 1* and 15 lessons in the book *Learning to Listen 2*. The teacher asked the students to listen to 2 lessons a week and give a test every week.

The series *Learning to Listen* includes some listening exercises with familiar topics. Each lesson has 8 exercises, including 1-2 exercises for vocabulary relating to the listening texts, 1 phonetic exercise (stress, accent, intonation, sound distinction), 4 - 5 listening exercises with a variety of genres, and 1 speaking exercise.

To encourage the students to listen regularly, the teacher required students to listen and do exercises in two lessons a week. Teachers explained the way to do some difficult exercises, or explained some parts related to foreign cultures so that the students could understand and do the exercises easier. The teacher did not need to give answer keys because the students already had scripts and when they could not hear a word, they could see the script and listened again. In each class meeting, the teacher gave a test to check if the students did the homework. The content of the test was taken from the two lessons she told the students to listen in the week. The test content was not exactly the same as the exercises in the homework assignments. The researcher usually changed some information in the homework book to make the test, or she designed the test in a different format in comparison with the homework assignments. This helped the students try to listen seriously rather than learn the tapescript by heart.

During the semester, the teacher gave 10 listening tests, and this mean score was counted as attendance grade. Designing the tests and marking them each week could make the teacher very busy. However, giving a test each week was very effective because most students wanted to get good grades, and they tried to practice listening at home frequently. The evidence was that the average attendance grade for the whole class was quite high: 8.22 out of 10. Results from the interview also showed that if teachers did not give a test in every class meeting, 30% of students would not listen to English exercises at home; 83% of students thought that doing listening homework helped them improve their listening skills; 49% of the students said that they did not know how to find materials for themselves after class; 94% of students said that the homework was appropriate to their ability; 90% of them said that the homework was very helpful for them to practice their listening skills; and 96% of students wanted to have listening homework in the courses Listening 2, 3, 4.

b. Encouraging students to guess the words before listening

Encouraging students to predict the words they will hear is one of the most important skills in listening to English. Before playing the CD, teachers often asked open-ended questions, asked students to look at the pictures, the questions or the choices in the multiple choice exercises. She asked what vocabulary the pictures or choices would relate to and asked them to predict what the speakers would say. Teachers wrote the students' prediction on the board and at the listening time, when listening to some of the words they had predicted, students would be able to catch the correct answer easily. Teaching students how to guess beforehand also helped students become more focused while they listened.

c. Assigning appropriate exercise form

Exercises in listening exercises also have a great impact on the outcome. When listening, students need to concentrate and be able to quickly write what they hear. So in the lecture notes Listening 1, the exercises were designed in the form that asked the listeners to do very quickly: tick or circle the correct sentence, choose right / wrong, fill in with words (fill only one or two words), write short answer. The exercises in the lecture notes did not ask the listeners to listen and read and write too much. According to the results of the interview, 89% of students said that the types of listening exercises in the classroom were quite various and 92% thought that the types of exercises given in class were appropriate for them to hear and do very fast.

d. Teaching listening through English songs

At the end of each class meeting, the teacher spent about 10 minutes for English songs and asking students to fill the gaps in the lyrics. Statistics showed that 100% of the students in the class liked to learn English through English songs.

Statistics on the impact of statergies showed that that students increased their listening ability thanks to English songs was not as high as other strategies, but all students preferred English songs. These songs helped them like to listen and enjoy learning English.

e. Teaching students some techniques in listening

After a few lessons, the teacher gave some listening techniques designed in the form of True / False exercises to help students gain some experience in their listening skills. The teacher then corrected and emphasized the listening techniques to help students listen better. These basic listening techniques are focused on helping students realize that they do not need to hear all the words that are played on the disc but they can hear key words and make inferences, or what kind of exercises they need to listen for main ideas, what they need to listen for details, where they need to guess, how to take notes, how to guess, how to do word completion exercises ...

According to statistics from the interview, 98% of students learned a lot of listening skills when they learned Listening 1; 96% of students said that the instruction of listening techniques helped them listen better; and 96% of students knew how to apply listening strategies to different types of exercises.

f. The teacher's appropriate instructional process

The teaching process of the teacher as well as the way to arrange the listening activities in the lecture had a great impact on the quality of listening. In each lesson in class (corresponding to a listening topic), the teacher designed one or two activities or vocabulary exercises related to the topic. This was to help students review vocabulary, learn new words appearing in the listening, learn how to pronounce the new words and listen more easily.

The next step was to help the students understand the instruction of the listening tasks. The teacher could ask short questions in English to check if students understood the requirements. After students clearly understood the requirements and knew what they were going to do, the tecaher gave them some time to look at their pictures, the choices in the exercise, and predict what they would hear in the listening.

Then the teacher played the CD for two times (or sometimes one time for easy exercises), and asked the students to work in pairs to compare their answers and say out their answers. The teacher wrote down all students' answers and the keywords they heard. Then the teacher let them listen the last time and stopped when necessary to correct or explain something and then gave the correct answers.

Through the statistics of the questionnaire, 100% of students said that the teaching process the teacher conducted was appropriate; 98% of respondents said that teachers often explained new words before asking students to do the exercises; 98% of students thought that the teacher always clearly instructed the requirements of the tasks and they always knew exactly what the assignment asked them to do.

3.3. Post-test

The post-test was given at the end of the course Listening 1. The post-test had the same content as the pre-test. At this time, the mean score of the whole class increased significantly: 7.7 out of 10 points.

When comparing the listening ability at the beginning of the course and after one semester applying multi-strategy approach in teaching listening, the SPSS statistical software showed that students' listening ability was markedly different, p =. 00. This showed that after applying new approach in teaching, students did improve their listening ability.

3.4. Questionaire to gain students' attitudes towards the multi-strategy approach

The interview was designed to gain students' opinions and attitudes towards the six groups of strategies piloted. Xxxx k neu ten The questionaire based on the criteria set forth by God (1999) for students to understand the factors that affect their listening ability. The interview was as the following:

QUESTIONAIRE

Please answer the following questions about the course Listening 1 by giving the score in agreement with each sentence (tick in ONE choice in each sentence). Scores from 1 to 7 with:

1 point =strongly disagree;

2 points = disagree;

3 points = slightly disagree;

4 points = neutral;

5 points = slightly agree;

6 points = agree;

7 points = strongly agree

Question codes	***Content***	***Levels of agreement***						
		1	*2*	*3*	*4*	*5*	*6*	*7*
N1.1	*That the teachers gives listening task as homework and gives tests each week is very helpful because it gives students the opportunity to practice their listening skills.*							
N1.2	*You usually do your homework for Listening 1.*							
N1.3	*In addition to homework assignments, you do not know how to find resources to listen more at home.*							
N1.4	*You prefer to find your own listening materials at home rather than having homework assignments.*							

Question codes	***Content***	***Levels of agreement***						
		1	*2*	*3*	*4*	*5*	*6*	*7*
N1.5	*You have learnt a lot after listening to the textbook that the teacher asks you to do at home.*							
N1.6	*The homework is suitable with your level.*							
N1.7	*The amount of homework to listen to every week is too much.*							
N1.8	*You want the teacher to give the homework but do not give the test every week.*							
N1.9	*If the teacher does not give you a test every week, you probably will not do your homework assignments.*							
N2.1	*Before listening, students need some time to go through the choices or pictures and predict the content they will hear.*							
N2.2	*Before you listen, you often look through the choices, pictures or exercises and try answering them.*							
N2.3	*Reading questions and guessing answers often helps you focus more while listening.*							
N2.4	*The teacher often encourages you to predict what you are going to hear through open-ended questions, pictures, or multiple choice questions.*							
N3.1	*The types of listening exercises in class are varied.*							
N3.2	*The exercises designed by the teacher are suitable for both listening and doing quickly (marking, multiple choice, circle right and wrong, gap fill)*							
N3.3	*The vocabulary exercises before each listening are very useful.*							
N4.1	*You enjoy listening to English songs.*							
N4.2	*Sounds and rhythms in English songs make it easier for you to memorize words.*							
N5.1	*The exercises on listening techniques (designed in the form of a right / wrong exercise in the lecture notes Listening 1) help you listen better.*							
N5.2	*When you learn Listening 1, you learn a lot of listening skills.*							

Question codes	***Content***	***Levels of agreement***						
		1	*2*	*3*	*4*	*5*	*6*	*7*
N5.3	*You know what kind of tasks to listen for details, what kind of tasks to listen to just the key words but not all the words in the listening text.*							
N6.1	*The teacher's instructional process is very appropriate (explaining the exercise instruction, explaining the new words, getting students to listen twice, listing all the students' answers on the board, listening the third time and stopping to explain when neccesary.*							
N6.2	*Before listening, the teacher clearly explains the requirements of the exercises.*							
N6.3	*The teacher often explains new words before asking students to listen.*							
N6.4	*When doing the listening exercises, you always know exactly what the tasks requires you to do.*							
H1.1	*Your current listening ability has increased in comparison to that when you started learning Listening 1.*							
H1.2	*You feel you have a good listening ability.*							
H1.3	*When you continue learning Listening 2, 3, 4, 5, you want the teacher to continue giving homework assignments as those in Listening 1.*							
H1.4	*You find learning to listen is not difficult and you like listening to English.*							

Open-ended questions:

What factor has the most influence on your listening? Number from 1 to 10 (1 is the most important, 10 is the least important).

a. ___ skills

b. ___vovabulary

d. ___exercise form

f. ___listening topics

g.___background knowledge about the topics

c. ___learners' ability to pronounce words correctly

e. ___leraners' concentration while listening

h. ___skills to take notes while listening

i. ___ability to guess content before listening

j.___ability to make inferences from key words heard

Thank you!

The interview was designed to focus on the six main groups of strategies listed in 3.2 with:

- Question codes N1.1 – N1.9: asking students to do homework and giving tests each week

- Question codes N2.1 – N2.4: encouraging students to guess words before listening

- Question codes N3.1 – N3.3: appropriate exercise design

- Question codes N4.1 – N4.2: listening to English songs

- Question codes N5.1 – N5.3: teaching listening techniques

- Question codes N6.1 – N1.4: the teacher's appropriate instructional process

and the question codes for the effectiveness (H1.1 – H1.4).

The reliability of the above table was determined by the SPSS software as $\alpha = .707$. Statistical results are presented below:

Case Processing Summary

		N	%
Cases	Valid	47	52.2
	Excluded(a)	43	47.8
	Total	90	100.0

a Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.707	29

Statistics showed that students had positive attitudes towards the strategies the teacher applied; the percentage of students whose listening ability increased was 93%; and 90% of students felt that listening was not difficult and they liked listening to English.

The following is a summary of the effectiveness and the impact of these six groups of strategies on students' listening ability.

Coefficients(a)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta	
1 (Constant)	2.267	1.904		1.190	.241
N1	.180	.194	.147	.928	.359
N2	.251	.211	.179	1.187	.242

N3	.029	.204	.022	.143	.887
N4	.017	.099	.025	.173	.864
N5	.447	.161	.425	2.780	.008
N6	.168	.186	.134	.899	.374

a Dependent Variable: H

R square = 0,504

The data in the Unstandardized Coeficients column showed a positive sign, indicating that the six groups of strategies had a positive effect on the effectiveness of the listening, in which the fifth strategy group (teaching some listening techniques) had the most impact and the fourth group (teaching listening through English songs) had the least impact. The solutions were arranged in the following order from high to low impact: teaching listening techniques, encouraging students to guess words before listening, asking students to do homework each week, the teacher's appropriate instructional process, appropriate exercise design, and listening to English songs.

From the above results we can write the multiple regression equation as follows:

$Y_H = 2.267 + 0.180X_{N1} + 0.251X_{N2} + 0.029\ X_{N3} + 0.017X_{N4} + 0.447X_{N5} + 0.168\ X_{N6}$

In which: Y_H: students' listening ability

X_{N1}: asking students to do homework and giving tests each week

X_{N2}: encouraging students to guess words before listening

X_{N3}: appropriate exercise design

X_{N4}: listening to English songs

X_{N5}: teaching listening techniques

X_{N6}: the teacher's appropriate instructional process

The above equation shows that the six groups of strategies are directly proportional to the students' listening efficiency. That means that when students do well the multi-strategy approach guided by the teacher, the students' listening ability will increase accordingly.

4. CONCLUSION

Research shows that using the multi-strategy approach in teaching listening can improve the students' listening efficiency. The strategies were ranged from high to low impact as the following: teaching listening techniques, encouraging students to guess words before listening, asking students to do homework each week, the teacher's appropriate instructional process, appropriate exercise design, and listening to English songs.

Improving listening skills not only helps students learn English well, but also provides a foundation for students to learn other subjects, and gives students more confidence in learning and communicating in English.

The above strategies can easily be applied to English major classes and in non-major classes. I suggets that when teaching listening, teachers should provide students with some resources for students to listen at home and at least one listening book as homework and have regular checks. When teaching, teachers should also pay attention to introducing vocabulary related to the topic of the listening text because lack of vocabulary is a major difficulty students learn listening.

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USING CLIL FOR TEACHING NON-ENGLISH MAJOR STUDENTS IN KIEN GIANG UNIVERSITY: PROMOTING CULTURAL DIVERSITY AWARENESS IN THE FOREIGN LANGUAGE CLASSROOM

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ABSTRACT

In today's globalized world exposure to cultural learning can be regarded as highly beneficial for developing language and content, as well as for raising multicultural awareness. In this research, a present CLIL (Content and Language Integrated Learning) project was designed to increase students' awareness of cultural and linguistic diversity and develop awareness of the self and others. The project was piloted for 16 weeks with 60 non-English major students in the Center of Foreign Languages in Kien Giang University, Vietnam. Its aim was to promote cultural diversity awareness and build bridges across languages and cultures among non-English major students through the implementation of CLIL method. The integration of content subject and language skills was a part of the lessons. This activity gave the students a chance to get knowledge of the content subject and use the target language as well as unfold the different countries and diverse cultural contexts. Different activities were designed, and every effort was made so that the teaching strategies employed were tailored to the students' needs and interests. Some websites were introduced and multi-media resources were used to support the cultural information, highlight the relationship between the students' own and other cultures, and raise their interest in 'otherness'. The evaluation of the study indicated the positive effect of CLIL on the students' skills development in the target language along with significantly enhanced cultural diversity awareness. Barriers to CLIL are mostly insufficiency of Internet access, time and students' limited vocabulary.

Key words: CLIL, cultural diversity, multicultural awareness, non-English major students

1. RATIONALE

While Content and Language Integrated Learning (CLIL) has received a considerable amount of research interest lately, its increasing popularity as an approach to teaching content subjects in a foreign language requires concerted investigation that reflects and recognizes its fundamentally contextualized nature. It is proved that CLIL provides an efficient context for allowing learning to take place in a naturalistic setting, while a clear purpose for using the language is also provided (Naves, 2009, p. 25). Given their extensive exposure to the target language, CLIL learners essentially make extensive use of it and use it in more complex ways compared to regular mainstream classrooms, while they also process larger amounts of information which in turn improves their comprehension skills (Anagnostou, Griva & Kasvikis, 2016; Drew, 2013; Padadopoulos & Griva, 2014). It is also believed that CLIL facilitates the achievement of intercultural competence as an educational objective (Griva & Kasvikis, 2015; Griva, Chostelidou & Semoglou, 2015; Wolff, 2007). The integrative nature of CLIL lends itself for adopting "not only a dual focused but a triple-focused approach: simultaneously combining foreign language learning, content subject and intercultural learning" (Sudhoff, 2010, p.36). Therefore, it is considered an

objective to promote cultural diversity awareness and provide the students with the opportunity to learn about and respect other ways of living, other beliefs, and customs. This paper presents insights into using CLIL for teaching non-English major students to promote cultural diversity awareness in the foreign language classroom.

2. LITERATURE REVIEW

2.1. What is CLIL

CLIL is a method which entails teaching one of the 'content' subjects in the target foreign language. The target language therefore ceases to be the target of instruction and becomes instead the medium through which the content is conveyed. To be more specific, CLIL entails approaching a curriculum subject through a language which is not the one initially intended to be used.

According to Genesee (2003), CLIL is a bilingual/immersion content-driven methodology where mastery of academic objectives is considered as essential as the proficiency in the target language.

2.1. Why use CLIL

On a practical level, course design reflects the 4Cs of CLIL as suggested by Coyle (1999), namely: Content (lesson topic), Communication (Content required language and content compatible language), Cognition (HOTS: higher order thinking skills and LOTS: lower order thinking skills), Culture (community or citizenship lesson focus). Based on the European Commission, CLIL is considered to be highly effective in fostering intercultural awareness and communication as well as developing linguistic competence and pragmatic interaction skills. Its efficiency as a methodology lies in its ability to foster multilingual interests and attitudes offering alternative means of curricular subject approach. Moreover, it provides extensive practice in the target language within curricular restrains through a realistic context for target language use. In terms of curriculum content, CLIL encourages diversity in teaching approach and syllabus design promoting cross-thematic unity and curriculum cohesion. A variety of realistic tasks based on authentic/semi-authentic multimodal stimulus encourage student participation and class advancement both in the target language and the subject being taught.

According to another researcher (Dalton-Puffer, 2011), CLIL students tend to be more fluent in the target language and willing to take more risks, feeling much more confident about their abilities than their non-CLIL peers. Concluding, despite the demands CLIL poses on the learners, presenting them with an enriched learning environment, which aims at the development of both content and language, can positively affect mainstream CLIL learners' performance (Jappinen, 2006).

2.2. CLIL in Europe

CLIL has existed in Europe since 1994 when a group of researchers in educational programmes funded by the European Union initially introduced the term (Marsh, 2003). According to Marsh (2009), CLIL was defined as an educational approach with a dual focus aim during which one additional language, other than the one initially intended, is used for learning both the content and the language. Additionally, Meyer (2010) seems to believe that CLIL is efficient for mastering various cognitive fields as well as linguistic competency within the curriculum teaching constraints. Nevertheless, the term CLIL is frequently used to refer to a number of teaching practices which all apply language use in the framework of cross-thematic instruction, suggesting the clear European support for the methodology as a way leading towards multilingualism.

CLIL has already been applied in many European schools as it is widely regarded a highly efficient methodology for all educational levels. In the last ten years, it has met considerable recognition followed by rapid expansion in various teaching environments. CLIL is widely accepted in most European teaching settings as a highly effective method of language learning for learners and a means for professional development for teachers (Ioannou- Georgiou, 2012).

2.3. CLIL in Vietnam

In Vietnam, among various measures introduced in the National Foreign Languages 2020 Project by Vietnam's Ministry of Education and Training to enhance foreign language competence of Vietnamese people, the implementation of Content and Language Integrated Learning (CLIL) has received much public attention and feedback from those concerned. In order to enhance the quality of FL teaching and learning for Vietnamese people, CLIL is adopted and piloted in upper-secondary schools for gifted students. This top-down policy leads to several critiques from the public and insiders. The first critique about the significance of CLIL can be the consequence of unclear declarations by the government regarding CLIL's objectives in the Vietnamese context. The second critique is about the lack of qualified teachers in both content and language. The third critique is related to students' readiness. The choice of gifted students in upper-secondary schools for CLIL should be reconsidered in order to better benefit from this new approach. The last critique is about the lack of CLIL materials, which leads to contemporary but problematic solutions. (Thuy, 2016).

2.4. Promoting cultural diversity and intercultural competence in CLIL Contexts

In modern educational contexts, students can contact diverse cultures and languages. In such multicultural educational contexts, all students need to receive training so as to develop awareness and acceptance of diversity, as well as respect of the cultural mosaic (Porto, 2010). In addition, exposure to multiculturalism will involve awareness of various types of identities on the part of the students since identity, in essence, entails an exploration of the way individuals view and think about themselves and the way they are seen by others including their personal, social, and cultural identity (Barker, 2003, pp. 220-228). Building on cultural awareness and acceptance, which can be attained by means of relating an individual's culture with the majority one and drawing on one's own cultural asset, i.e. knowledge, beliefs, and values, can provide a solid ground for promoting efficient intercultural communication (Ho, 2009). Developing the students' ability to cope with their cultural capital when interacting with people from various cultural backgrounds need to be promoted in the era of globalization.

It should be noted that intercultural competence is among the eight key competences for lifelong learning which are proposed by the European Commission (2012) and include: a) communication in one's first language, b) ability to communicate in foreign languages, c) competence in science and technology d) digital competence (using communication and information technology in a critical way), e) "learning to learn", f) civic and social competence, which involves interpersonal and intercultural relationships, g) having a sense of entrepreneurship, being able to transform creative ideas into actions h) cultural awareness and expression.

It is clear that given its significance intercultural competence deserves particular attention within the CLIL classroom while its development should take place in a structured way. In this respect, a model of intercultural competence proposed by Byram and Zarate (1994, p.15) presents "four sets of skills, attitudes, and knowledge", which are referred to as 'savoirs' 'knowings': knowledge of self and other, 'knowing how to understand', 'knowing how to learn/to do', 'knowing how to be'.

3. RESEARCH METHODOLOGY AND RESULTS

3.1. The purpose of the project

The project was to develop the students' awareness of cultural diversity. Its purpose was to promote multicultural understanding, intercultural competence and citizenship awareness. In particular, the following objectives were set: developing the students' skills in EFL; enhancing their awareness of self and others; increasing their understanding of cultural and linguistic diversity; enhancing their knowledge on the content subject they learnt.

3.2. The participants

The sample of the study were 60 non-English major students, aged between 19 and 26, attending evening classes at the Center of Foreign Languages in Kien Giang University in Vietnam. Of the 60 students, 8 were immigrant children of Chinese and Cambodian origins. For some bilingual students who participated in this CLIL project, speaking one minority language at home, and using another language, the majority language, Vietnamese at school, and English was the foreign language to learn. Most of them started learning EFL at the age of six or seven while their exposure to the target language varied. The students' EFL competence level was identified as A1 – A1+ Elementary Level) according to the CEFR (Common European Framework of Reference for Languages).

3.3. The design of the project: integrating content and target language

3.3.1. The CLIL lessons: cultural diversity awareness

The CLIL lessons provided the students with the opportunity to develop awareness of cultural diversity in the foreign language classroom. Towards this aim, the students were asked to do a variety of activities including on-line ones, designing posters, working on arts, taking part in role-playing, delivering presentations, and participating in debates among others. These activities provided the students with a rich experience of real language in use, stimulated their curiosity, challenged them to engage actively and develop their creativity, free expression as well as their interaction skills. The content they learned were Geography, Biology, Maths, Social Sciences, ICT, Art, History, Music… These lessons taught were taken from book – Compact Key for School by Emma Heydeman (Level A2), Cambridge University Press, 2014 (Table 1). In each lesson, one activity was designed to deliver in an activity-based context to promote their cultural diversity awareness.

Table 1. The thematic lessons

Unit	Topics	Grammar	Vocabulary	Functions
1 My family, my friends & me	People Daily life	*have got* Present simple Question words	Family Daily activities Describing people	Talking about routines and habits Asking for and telling the time Describing everyday activities
2 In my free time	Hobbies & leisure Personal opinions	Adverbs of frequency *Do you like ...? / Would you like ...?*	Free-time activities	Expressing preferences, likes and dislikes Giving and responding to invitations
3 Eating in, eating out	House & home Food & drink	*There is / are, a / an, some & any* *How much / many? a lot, a little, a few* *(don't) have to*	House & furniture Food & drink	Saying where things are Describing food Ordering food Expressing obligation
4 What are you doing now?	Sport Clothes	Present continuous Present simple vs present continuous	Sport Clothes	Talking about what people are doing now Describing what people are wearing
5 Great places to visit	Places & buildings Shopping	Past simple *ago* Time expressions *in / at / on*	Places Days & dates	Describing places Talking about dates Talking about events in the past
6 Getting there	Transport Travel	Comparative adjectives Superlative adjectives	Transport Directions	Making comparisons Asking for and giving directions
7 School rules!	School & study Entertainment	*must / mustn't* *should / shouldn't* *can / could* Adverbs of manner	Education Musical instruments	Expressing rules and obligation Giving advice Talking about ability in the present and past
8 We had a great time!	Holidays Personal experiences	Past continuous Past simple & past continuous	Holiday activities Adjectives of opinion	Talking about events in progress in the past Giving opinions
9 What's on?	Entertainment & media Television	*be going to* Infinitives & *-ing* forms	Going out TV programmes Word-building	Making suggestions Talking about future plans
10 Are you an outdoors person?	The natural world Weather	*will, won't & may* First conditional	The countryside Weather & seasons	Following instructions Making predictions about the future Expressing certainty and doubt
11 Healthy body, healthy mind	Health & medicine Personal feelings	Present perfect *just* *yet / already* Present perfect with *for* & *since*	The body Health & illness Adjectives	Talking about recent past events Talking about health problems Discussing personal feelings
12 Technology & me	Communication Appliances	The passive: present The passive: past	Communication & technology Describing objects	Describing simple objects Checking understanding

Reading	Writing	Listening	Speaking
Part 2: Sentences about a family	Part 6: Descriptions of things people use every day	Part 3: A conversation about a school day	Part 1: Describing people
Part 3a: Five conversations	Part 7: Completing an email about a boy's family, friends and hobbies	Part 4: A conversation about a cinema club	Part 1: Asking and answering about free time
Part 5: An article about a boy from Mali	Part 8: Completing notes about a class dinner	Part 5: A talk about a school trip to a cookery school	Part 2: Asking and answering about a café and a museum
Part 4: An article about a young businessman	Part 9: An email about clothes	Part 1: Five short conversations	Part 2: Asking and answering about a sports shop and a magazine
Part 2: Sentences about a school trip to a football museum	Part 9: An email about a shopping trip	Part 5: Information about a Hollywood tour	Part 1: Questions about things you did this week
Part 3b: A telephone conversation about a party	Part 7: An email about a trip to San Francisco	Part 2: A conversation about getting to a birthday party	Part 2: Asking and answering about a boat tour and a transport museum
Part 1: Notices	Part 9: An email about school	Part 5: A talk by a new teacher	Part 1: Questions about school subjects
Part 4: An article about a holiday in Guadeloupe	Part 8: Completing notes about a teacher's wedding present	Part 2: A conversation about where friends stayed on holiday	Part 2: Asking and answering about a holiday and a travel programme
Part 3b: A telephone conversation about plans for the weekend	Part 9: A message to a friend about a show	Part 4: A conversation about an audition for a TV show	Part 1: Questions about plans for the evening and a holiday
Part 1: Notices	Part 8: Completing a booking form for a weekend trip	Part 1: Five short conversations	Part 2: Asking and answering about a camping trip and an adventure park
Part 5: An article about the history of glasses Part 3a: Five conversations	Part 6: Descriptions of words about health	Part 3: A conversation about a healthy living day	Part 1: Questions about yourself and the weekend
Part 4: An article about young people and technology	Part 7: Completing emails about a lost MP3 player	Part 2: A conversation about favourite things	Part 2: Asking and answering about a web page and a computer game

3.3.2. The tasks incorporated in the lessons

The aim of the tasks was to enable the students to cooperate and communicate in English, besides making decisions, solving problems and co-deciding on issues related to cultural diversity. When teaching each lesson, besides teaching the language and the skills, the researcher designed one task that gave the students a chance to learn the content subject (for instance, Geography, History, Music, Art… of other parts of the world) and they used English during the process of doing the activity. The tasks were group work activities that required the students to design a class survey or questionnaire, plan a tour, make a

poster display, have a short report about something, deliver presentations using pictures, diagrams, power point or video clip…

These are the activities for CLIL method in details.

Lesson 1 (After Listening lesson – topic: School Day): Geography

In small groups, students choose four or five islands around Great Britain and research each one. They find out about the population and services, e.g. schools and shops. Students produce a short report on each of their chosen islands. As a class, they produce a large map of Great Britain and stick their reports near their chosen islands.

Lesson 2 (After lesson – topic: Adverbs of frequency): Maths – using graphs

In small groups, the students design a class survey about free-time activities using *how often do you…? Or Do you ever…?* This could be an oral survey or the students could use a free online survey tool like Survey Monkey to create a written survey. When the students have done their survey, they should present the results using bar graphs and pie charts.

Lesson 3 (After Reading lesson – topic: Food): Geography / Social Sciences

The information about Mamadou was taken from the Oxfam Cool Planet website which has information about kids from all over the world. Divide the class into three teams. Each team looks at the website and finds some information about their food. They tell the rest of the class three facts. Give them some questions to help the., e.g. *Where do they grow these crops? Who buys them? How does this help the farmers?*

Lesson 4 (After Vocabulary and Grammar lesson – topic: Sports): Sport

In small groups, students choose a country in another part of the world and find out information about a sport in that country which isn't normally played in the students; own country. Students should find information about the requirements needed, the clothes and the rules. The groups present their sport to the class using pictures and diagrams.

Lesson 5 (After Listening lesson – topic: Great places to visit): Geography

In small groups, students plan a tour of their own tour for tourists. Each group should think of a date for the tour, a pace to meet, somewhere to have lunch, a place to go in the afternoon and the price.

Then they should prepare a short description of their tour with a map. Each group takes turns to read their tour description. The others listen and write down the key information, i.e. the date, meeting place, lunch, afternoon visit and price.

Lesson 6 (After Writing and Grammar lesson – topic: Superlative form): Geography

In small groups, the students look for information about superlative places, buildings, transport, etc. in the world, e.g. the widest bridge, the biggest park, etc. The students then write a web page for the other groups. When the groups have found the answers, they make a poster to illustrate some of the superlative things they have found.

Lesson 7 (After Listening lesson – topic: A famous artist): Art

In small groups, the students use the Internet to find some information about a famous artist. Then they prepare a short presentation for the class using PowerPoint. They should use *can/could* and adverbs in their presentation.

Lesson 8 (After Speaking lesson – topic: Holidays): History (Ancient Civilizations)

In small groups, students choose an Ancient Civilization (e.g. Egypt, China, Greece, etc.) and look on the Internet for some information on cities, transport, clothes, food and drink, etc. Each group produces a poster display with the information. The British Museum website has some interesting web links for students (http://tinyurl.com/ycb8xfc).

Lesson 9 (After Grammar and Vocabulary lesson – topic: Arts Festival): Music

In small groups, students find some information about a type of music, e.g. jazz, classical, opera, folk, rap, etc. Each group produces a short presentation with information about famous musicians, instruments, concerts and a short sound or video clip to illustrate their chosen type of music.

Lesson 10 (After Reading lesson – topic: Weather): Geography / Maths

In small groups, students choose a city from a very different part of the world and write a short answer for the website question: *When is the best time to visit your city?* The students should find information about the city's weather and seasons and present this information using a weather map, a temperature bar chart and rainfall and average temperatures per month, season and year. The group's answer should include a map to show where it is, a photo of the place and the information about the weather. As a class, read all the answers and vote on the best place to visit in winter, spring, summer and autumn. The KidsGo website (http://kidsgotravelguides.com/) has travel information for young people, including information about the weather.

Lesson 11 (After Reading lesson – topic: Health and medicine): Biology

In small groups, students choose another product related to health, for example, the toothbrush or toothpaste, the hearing aid, the walking stick, a hairbrush or soap. Encourage each group to choose something different. They should find some information on the Internet and write their own short history.

Lesson 12 (After Grammar lesson – topic: Technology – passive voice): ICT / Maths

In small groups, students design a technology questionnaire to find out what their classmates think about new technology, if they use it and what they think technology will be like in the future. Give the students some example questions but encourage the groups to write some of their own, e.g. *1. Do you use technology at school? 2. Do you often use the Internet to find information?*

Are you interested in new technology? 3. Does your family use new technology?4. What will technology be like in the future? 5. Will we use books in the future? Students use a web tool like Survey Monkey to create their questionnaire and then encourage their classmates to complete it. Each group should then present their results to the class using spreadsheets software like Microsoft Excel to produce graphs, charts and diagrams to illustrate the results, etc.

3.4. Implementing the CLIL project

3.4.1. The procedure

* *Pre-stage:* During the pre-stage every effort was made to adopt appropriate means so as to motivate the students, arouse their interest in the topics at issue and engage them in the learning process. The teacher used multi-media resources and brainstormed, gave suggested questions, introduced some websites to facilitate the students' activity and develop their cognitive skills.

It was during this stage that the students were prepared to cope with the demands of each one of the tasks presented to them within the lessons. At this stage, it was also necessary to consider grouping issues as well as cooperation rules, which facilitated the students in working together and attain the most optimal outcomes for their team and class.

* *While stage:* During the while-stage the students were given the opportunity to work in groups using authentic materials and exploring the cultures of other countries. The websites or sources provided, aimed at helping the learners get the necessary information or vocabulary so as to be able to express their ideas.

The students were engaged in a variety of inquiry-based activities which called for investigating, collaborating, interacting and communicating with each other while trying to 'solve the problem'. They were encouraged to get involved in reflecting on cultural diversity, comparing and/or contrasting different cultures to the majority culture, exploring and degrading cultural stereotypes, respecting 'otherness'. Meanwhile, the teacher organized, managed and helped the students.

* *Post-stage:* At this stage the students' outcome or end product was presented to the rest of the class. They answered their friends' questions and took notes while listening to other groups' presentations. They learnt about the content subject, knew more knowledge about other countries' cultures and formed different perspectives to multicultural values and culture diversity. Moreover, they were given the chance to collaborate and empathize with schoolmates from different cultural and linguistic backgrounds and become familiar with other cultures and customs.

3.4.2. Estimating the effectiveness of the project

A summative and formative evaluation process was conducted to record the feasibility of the project by using the following instruments:

* *Teacher's Journal:* Journal entries were kept by the researcher on completion of every teaching session. The structure of the journal was based largely on the "reflection questions to guide journal entries" provided by Richards and Lockhart (1994, p.16-17) and focused on issues related to the objectives of the lessons, the material used, the teaching aids, the ways of communication, the students' attitude at the beginning, in the middle and at the end of each activity, etc.

Through a qualitative analysis of the journal entries, it was revealed that employing the extra activities using CLIL, creating a multisensory environment and having the students participate in cooperative activities promoted extensive communication in the target language and mutual understanding. This, in turn, led not only to a more positive attitude towards EFL on the part of the students but also enhanced their multicultural understanding.

* *Follow-up structured interviews:* Structured interviews were conducted with the students to collect information about their attitudes towards the implementation of the CLIL project as well as to evaluate the benefits of what they had learned through the lessons. The students were encouraged to reflect in order to answer the following questions: What did you learn from the CLIL project? Do you think you change your awareness towards culture diversity? What did you like most from the CLIL project? What were the main difficulties?

Through a qualitative analysis of the interview records, it was revealed that the students had thoroughly enjoyed learning by being involved in multicultural activities and were proud of their contribution to the CLIL project. They mostly liked having been involved in various creative and cooperative activities. They also showed a particular preference for doing artworks, designing posters, delivering power point presentations along with assuming roles.

Concerning the difficulties the students encountered during the CLIL project, it was revealed that they had faced particular problems with general and specific vocabulary items related to the topics they presented, the Internet access was not always good and they didn't have much time for the CLIL activity. Although a significant number of them showed some preference for doing artworks and designing posters, a certain number of the students regarded taking part in making a questionnaire as a rather challenging activity. Regarding the benefits of the project as perceived by the students, the majority of them stated that they had had the opportunity to develop 'content knowledge' in an alternative way while learning about different cultures and becoming aware of culture diversity.

4. CONCLUSION

The CLIL project was designed with the purpose to promote multicultural understanding and culture diversity awareness within EFL teaching. The following learning outcomes were identified for the particular triple-focused educational framework which aimed at "combining foreign language learning, content subject and intercultural learning" (Sudhoff, 2010).

Outcomes related to *cognitive skills* were attained through engaging the students in numerous inquiry-based activities requiring their active involvement in problem-solving and decision making. Thus, the project offered them the opportunity to combine academic or cognitive development (see Griva & Kasvikis, 2015). Outcomes related to *communication skills* were attained through role plays, presentations, and participation in debates, during which the students asked for clarifications, negotiated beliefs and stereotypes and expressed their views on diversity in EFL. The project also created a naturalistic learning setting and a clear purpose for using the target language (Naves, 2009; Anagnostou, Griva & Kasvikis, 2015).

Outcomes regarding c*ultural diversity awareness* were attained through engaging the students in content-based activities that enhance understanding of issues related to multicultural citizenship and diversity. The project had an impact on introducing different cultures, raising awareness of various cultural values and fostering intercultural competence. Concluding, the CLIL implementation can be regarded as advantageous for the learners since it succeeded in transforming the language classroom into a "culturally sensitive place to learn" (Porto, 2010, p. 47) dismissing racial conflict, establishing acceptance towards diversity and dispelling stereotypes.

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FARMERS' INDIGENOUS KNOWLEDGE TO ADAPT TO FLOODS IN AN GIANG PROVINCE

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ABTRACT

This research was carried out to systematize and assess the appropriateness of farmer's indigenous knowledge and their adaptive capacity with floods. The research aimed at providing scientific foundation for proposing solutions to conserve and enhance the effectiveness of valuable indigenous knowledge in reducing vulnerability of people living in flooded areas. The results showed that local people are using several effective indigenous knowledges for coping with floods. However, the valuable indigenous knowledge has not recorded yet, nor documented in written materials for sharing to young generation and communities. Besides, some indigenous practices are not suitable in practice which required reevaluation for current flood adapation strategies. The research suggested some solutions to conserve the most valuable indigenous knowledge for pro-active adaptation of local people in changing climate.

Keywords: Climate change, indigenous knowledge, flood, adaptation

1. INTRODUCTION

An Giang, one of the headwater provinces in the Mekong River Basin, should be influenced by the annual floods. When floods coming, besides bringing a huge amount of silt and improving soil fertility, field sanitation, washing alum (Dao Cong Tien, 2001); as well as creating jobs and income for local people through natural fishing, aquatic vegetable picking, tourist services, ect. However, from 2000 to the present, the abnormal flood circumstances have affected livelihoods of local people. To be able to adapt to the changes of the flood, with the changes of the society and environment, human must always know how to use indigenous knowledge to exploit natural resources appropriately and manage more flexibly (CRES, 2010).

Indigenous knowledge in adapting to floods in An Giang is understood as experience that has been accumulated by the local community over many generations and inherited widely. It is reflected in the lives of local people and harmonized responses to floods every year to effectively exploit resources brought by the flood, but to avoid the damage caused by floods (PHT Van et al., 2011). Responding to floods activities based on prior knowledge of the local community should be investigated and disseminated effectively to contribute to the sustainable development of the locality before the circumstances of climate change are affecting vagaries of floods.

However, the fact that there has not had many systematical research and evaluation relevance system to indigenous knowledge to adapt to flooding changes in agricultural production in the study area in the scene of climate change. Therefore, the topic "The situation and solutions for using indigenous knowledge of the local people in adapting to floods in An Giang province" was conducted to explore the role and contribution of indigenous knowledge in adaptation with the change of the flood. The results of the research will be the basis for the application and conservation of indigenous knowledge, as well as the

scientific basis for further studies to help bring solutions to minimize the impact of abnormal floods on agricultural production.

2. RESEARCH OBJECTIVES

Systematize and evaluate the suitability of indigenous knowledge and the ability of farmers to adapt to floods in different conditions.

Propose conservative measures and promote the value of using indigenous knowledge of farmers in An Giang province.

3. RESEARCH METHODS

The information was collected by using a combination of quantitative and qualitative research methods. In particular, qualitative research methods including carrying out the evaluation with the participation of people and using the following tools such as Timeline; Seasonal Calendar; Venn Diagram; Problem Ranking Matrix; and detailed interviews of local leaders. Quantitative research methods are included interview local experienced households living with floods (around 180 households) in the upstream (Phu Huu commune), middle-stream (Vinh An commune) and downstream (Vinh Phuoc commune).

4. RESULTS AND DISCUSSION

4.1. Flood occurrence during 1926 - 2015 and adaptation with flood of people in An Giang province

4.1.1. Flood occurrence over the years in the period of 1926 – 2015 in An Giang province

The annual flood season in the upstream lasts about 6 months; at the same time, the level of inundation varies between 0.3 to 3 meters depending on the topography of each place. Floods are divided into three levels including high, medium and low levels according to upstream flood levels, corresponding to the water level at Tan Chau Station at more than 4.5 m, 4 - 4.5 meters and less than 4 meters respectively. Large flood occurs when at the same time having a large amount of water pouring in from upstream, large long-lasting rains and the impact of surges in place. The daily increase and decrease flood levels for about 10-20 centimeters for big floods and 5-7 centimeters in normal floods (Duong Van Nha, 2006). According to the data recorded by meteorological radio of An Giang province from 1926 to 2015, there has appeared 22 times of greater floods and 31 times of small floods. In particular, 2015 was a special year having the smallest flood of all the years (Figure 1). Small floods have caused considerable disturbance of crop calendar, affecting agricultural production, causing difficulties to the people's livelihood depending on floods as fishing, fishing gear production and means participating in fishing fish during floods.

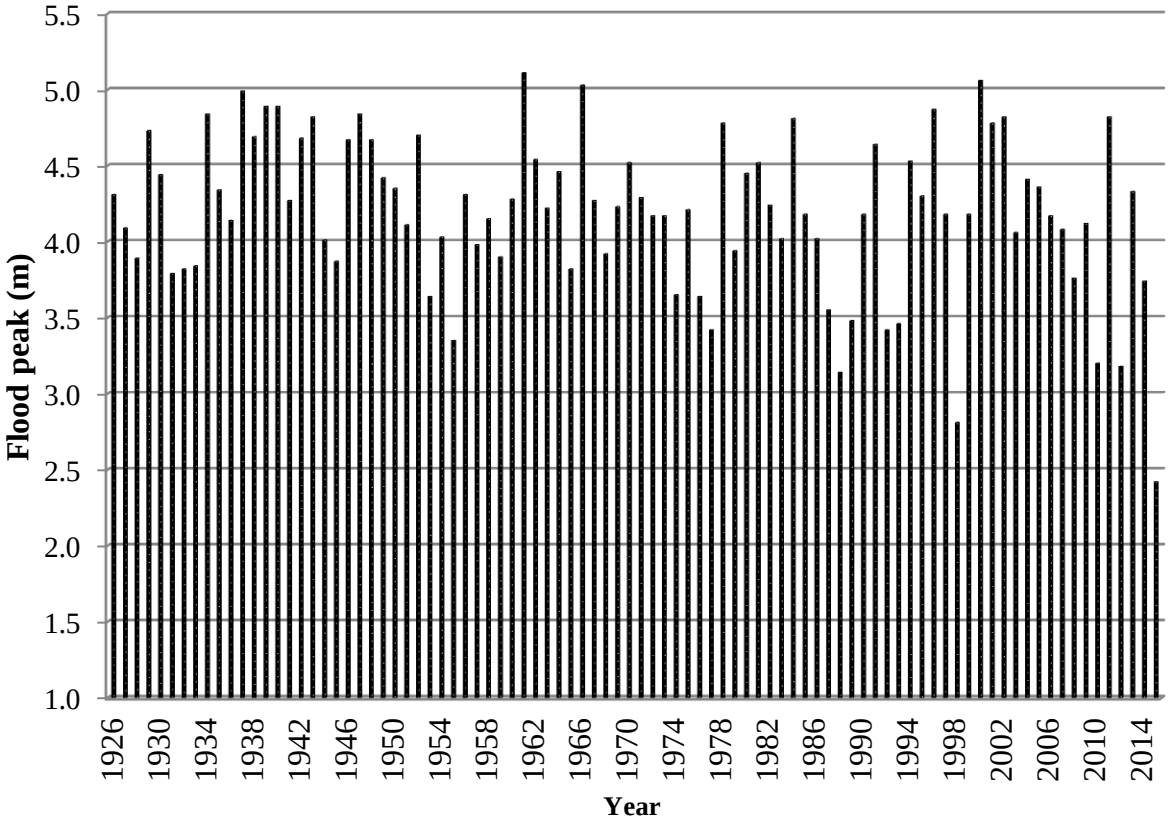


Fig 1. Flood peak of Tan Chau from 1926 to 2015

Source: Meterological radio of An Giang, 2016

4.1.2. Adaptability and flood forecasting of the people in An Giang Province

According to Mr. Nguyen Minh Nhi, former Chairman of An Giang People's Committee, An Giang people in particular and the Mekong Delta in general are familiar with the annual flood season and was named as "flooding season". This is the name that many generations of people in the wetland calling the floods. This call is full of optimism, expressing the spirit of active living with floods; considering flood exploitation as one of the advantages to develop. Limiting the harmful effects of the initial flood is "avoiding flood" through measures such as building houses with floor, moving people and animals to higher places, choosing plants and arranging appropriate seasonal schedule to keep up harvested before the flood, ect. To do so, the people living in the flood zone are experienced the impending flood situation such as high or low flood, flood sooner or later. The experience that people are used to predict floods including small flood in every 3 years will have one major flood year; looking downwind in the South. If strong winds accompanied by rain, fast and flowing water over, the flood of that year will be high, whereas if the flood of small anticyclone. Besides, in recent months in the flood season, they also see the expression of a number of species of plants, insects, and fish eggs to predict the flood situation in the coming years that helps them prepare appropriate seasonal schedule and prepare fishing gear and means of fishing accordingly. However, people also said that in recent years the flood prediction based on the above expression has been no longer true, namely in 2011, though small bamboos grow less than mature bamboos, the floor was still high; or in 2015, water had its infancy, but still did not have flood (PRA, 2016).

4.2. Situation on indigenous knowledge of the local people in flood forecasting, weather and agricultural production

4.2.1. Indigenous knowledge of the local people in flood forecasting

Household interview results (2016) showed that people used natural characteristics to predict flood. These experiences mainly passed on from generation to generation (Table 1). In addition, upstream communes seem to have more flood forecasting experience than midstream and downstream ones because floods occur earlier with higher vulnerability (Figure 2).

Table 1. Prediction for severe floods

Signs	Descriptions
Flood period	- In May and July of the Lunar year, the water rises quickly; In July and August, flood starts. - Big flood takes place during Year of Dragon or October of Lunar year. - Every 3 year with small flood, 1 big flood will take place.
Water color	- The water is red or dark. - More algae in water(water ovum) or water ovum appears early (In May, June of lunar year)
Plant observation	- Reed shoots have 4-5 segments during Lunar May (2 segments indicate small flood) - Reed leaf tip has more than 2 segments. (1 segments indicate small flood) - Reed has 50 cm long segments. - Grass leaf grows near the tip or grows multiple segments. - Young bamboo shoot grows higher than older ones. - Elaeocarpus_hygrophilus roots grows more than usual.
Animal behavior observation	- Bees, ants, termites, weavers nest on tall trees; rats burrow on high places. - Swallow, storks come in groups - Spider web appears more than usual in lunar July
Water measure	- On December 30 of lunar year, people weigh a bottle of river water; On January 1, people get a different river water bottle at the same position then weigh two bottles, big flood are about to take place if the later bottle is heavier.

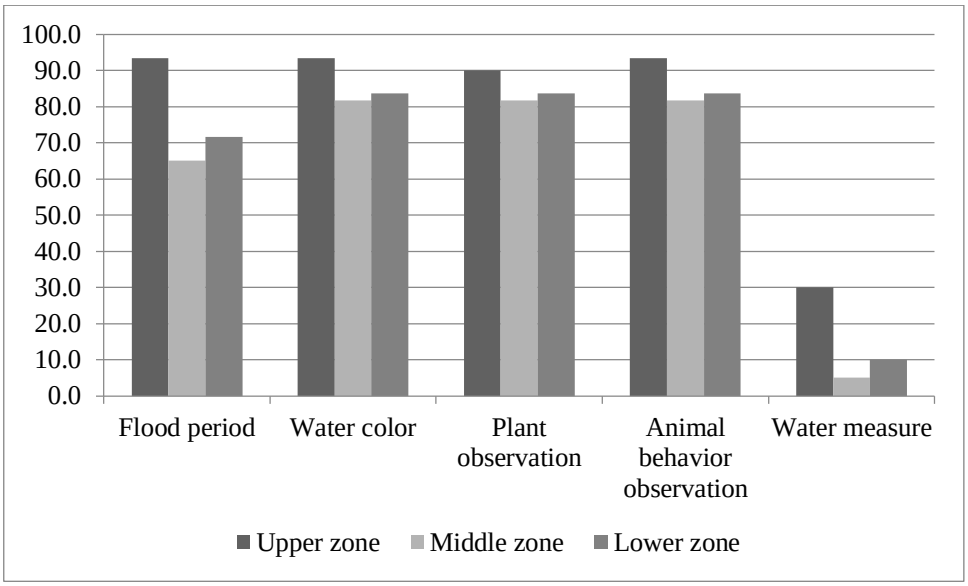


Fig 2. The difference in people's flood forecasting in flood areas

Source: Interviewing household, 2016, n=180

4.2.2. Indigenous knowledge of the local people in weather forecasting,

Household interview results (2016) showed that upstream communes seem to have more weather forecasting experience than midstream and downstream ones.

Table 2. Signs for rain forecasting

Signs	Descriptions
Rain period change	- Rains start in the beginning of lunar March or April. - More rains take place during lunar June, July.
Night sky observation	- Gloomy sky or less stars means rain the day after.
Daytime sky observation	- Windy and cloudy with thunderstorms - Large pale blue clouds - Heavy, soaked or black clouds with cold winds - It was hot for several days
Animal behavior observation	- Dragonfly flying low means rain flying high means sun, flying in the middle means shady - Ants stay higher place or move their nests and eggs to higher places. - Winged ants appear, rains take place the day after. - Termites appear, rains take place the day after. - Flies and gadflies attack paddy fields, rains are about to take place.

4.2.3. Indigenous knowledge of the local to adapt to floods in agricultural production

Currently, due to unusual and complex weather, unpredictable nature so the accuracy of flood and weather prediction is no longer as high as before, in addition to the impact of science and technology, the number of people with indigenous knowledge is not many. Specifically, 89.4,% of the interviewees said that the current flood situation is not predictable; 10.0% said that they change their predictions a little and only 13.3% said that the weather situation remains in their predictions (Figure 3).

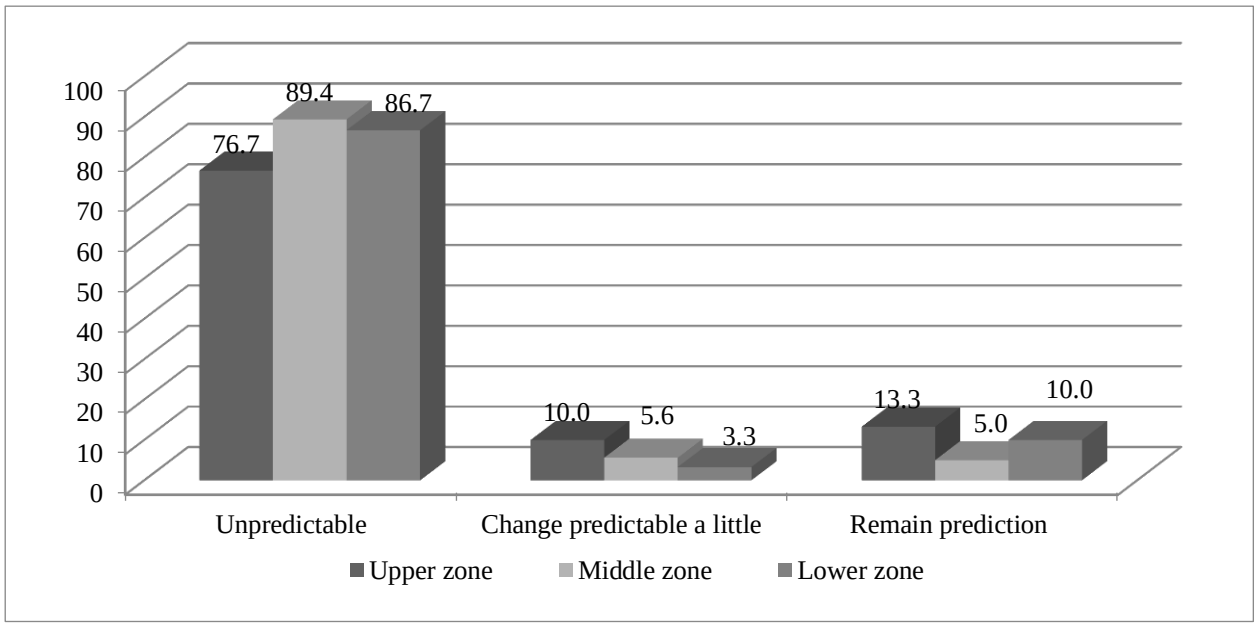


Fig 6. Assessing the accuracy of the predicted flood and weather local people

Source: Interviewing household, 2016, n=180

However, in agricultural production, local people in three research areas still obtain a lot of experience to adapt such as crop calendar change, seed cultivation, fertilization, tillage and harvest accordingly (Figure 4).

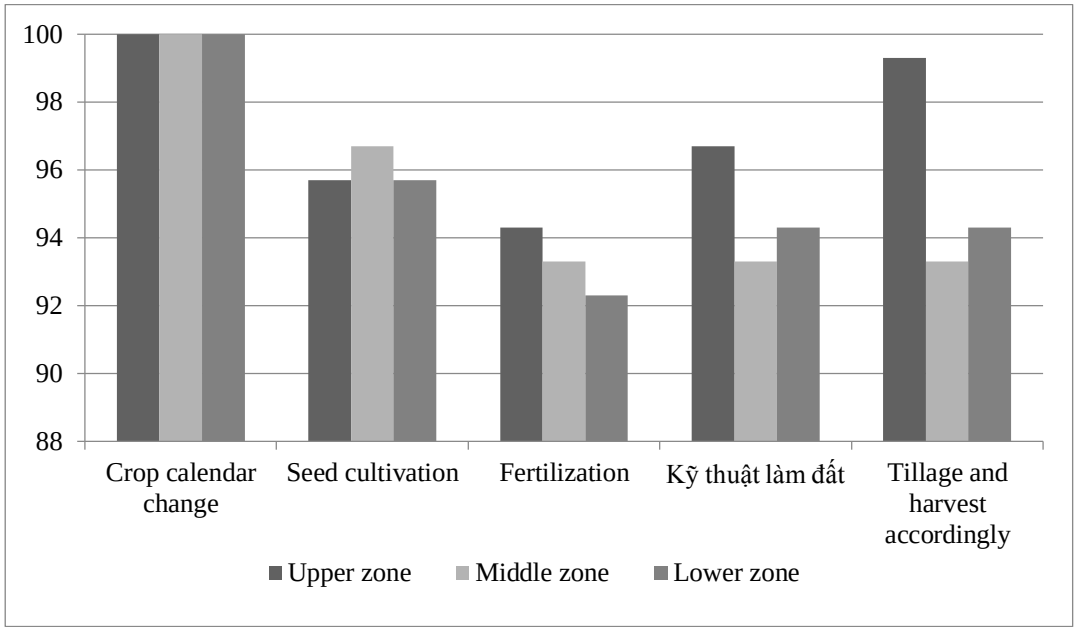
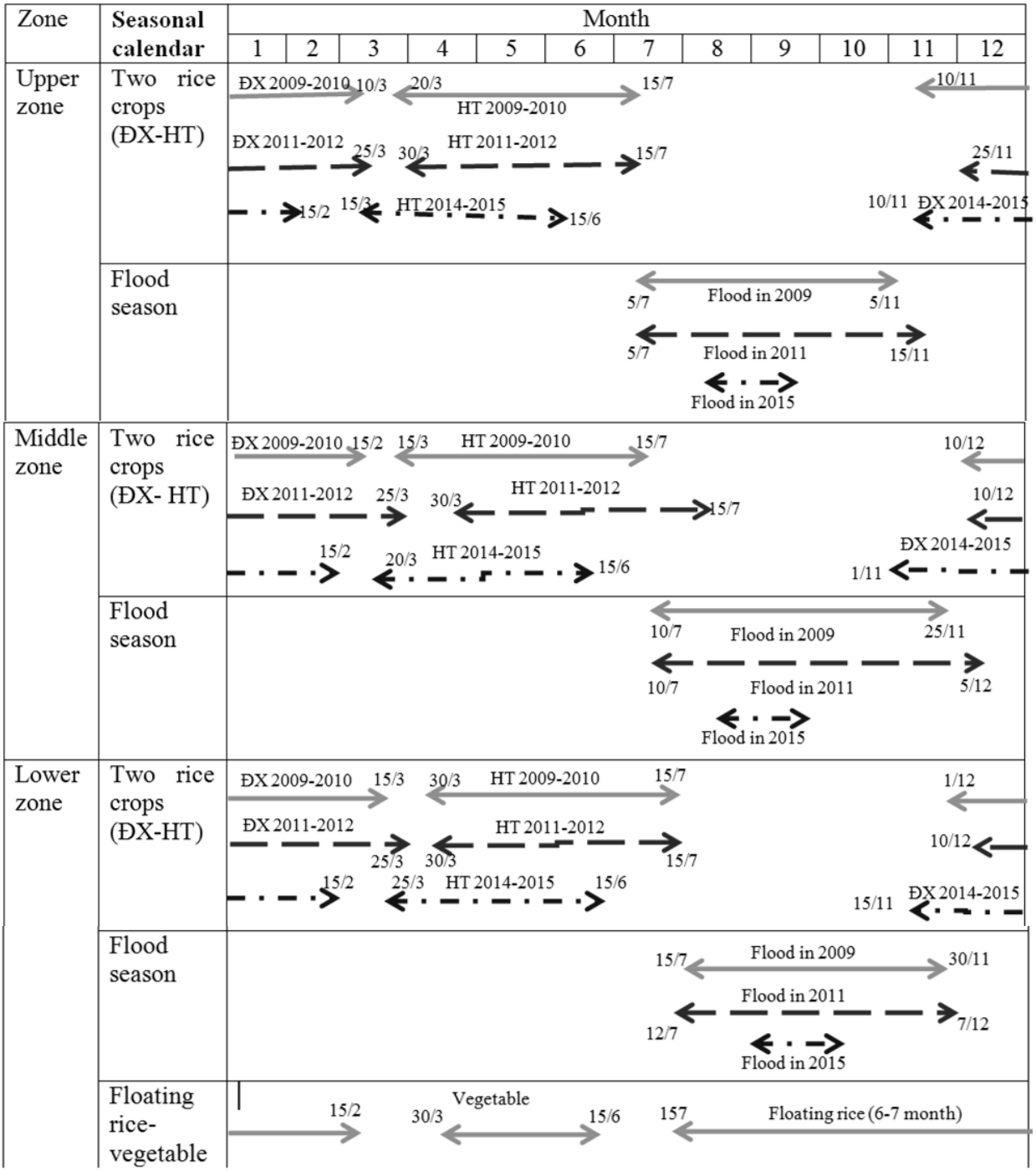


Fig 4. Indigenous knowledge to the local people in adapting to flood in agriculral production

Source: Interviewing household, 2016, n=180

Focus group discussion results showed that people with more experience in changing crop calendar according to different level of flood years (Table 3). However, extraordinary floods also caused disadvantages in rice cultivation such as short recover for the soil, no time to decompose rice straw after tillage, farmers must pumped flood water out of the field to do seeding. In particular, small flood in 2015 reduced the sediment of the soil, which increases the cost of cultivation of rice and vegetables.

Table 3. Seasonal calendar of high flood, medium flood, small flood in study side



Note: ĐX: Winter Spring, HT: Summer-Autumn.

Source: PRA, 2016

4.3. The information channel used to monitor rainfall, flooding for the next generation

People use various information channels to predict the flood from reviewing rain and flood information through the daily weather forecast to exchange information between together. In particular, daily weather report on TV is the most effective assessment thanks to easy access, regularity and relatively accurate information. Local news channel and neighbors' information is the 2nd most effective assessment; Communal meeting and radio are the two least effective information channels (Figure 5). The local knowledge on forecasting weather, flood is transferred to the next generation based on weather expression observation, television forecasts; folk songs, proverbs about weather predictions such as "dragonfly flying low means rain flying high means sun, flying in the middle means shady" or "big flood in Dragon lunar year" are no longer applicable. The indigenous knowledge on coping with floods transferred to the youngsters such as house reinforcement during the rainy season, moving to safe place, learning to protect themselves in the flood season (Table 4) ... in which self protection such as swimming skill is the most focused. Up to 92.2% of interviewees said that all family members are able to swim, not including children younger than 5 years old. Swimming skill is taught by family members (75.6%); learning with neighboring children (8.9%); 2.2% of children learns from local swimming class and 1.1% learns to swim in school. In the upstream area, the proportion of children able to swim since 4-5 years old is higher than the midstream and downstream areas because flood takes place earlier than the other areas.

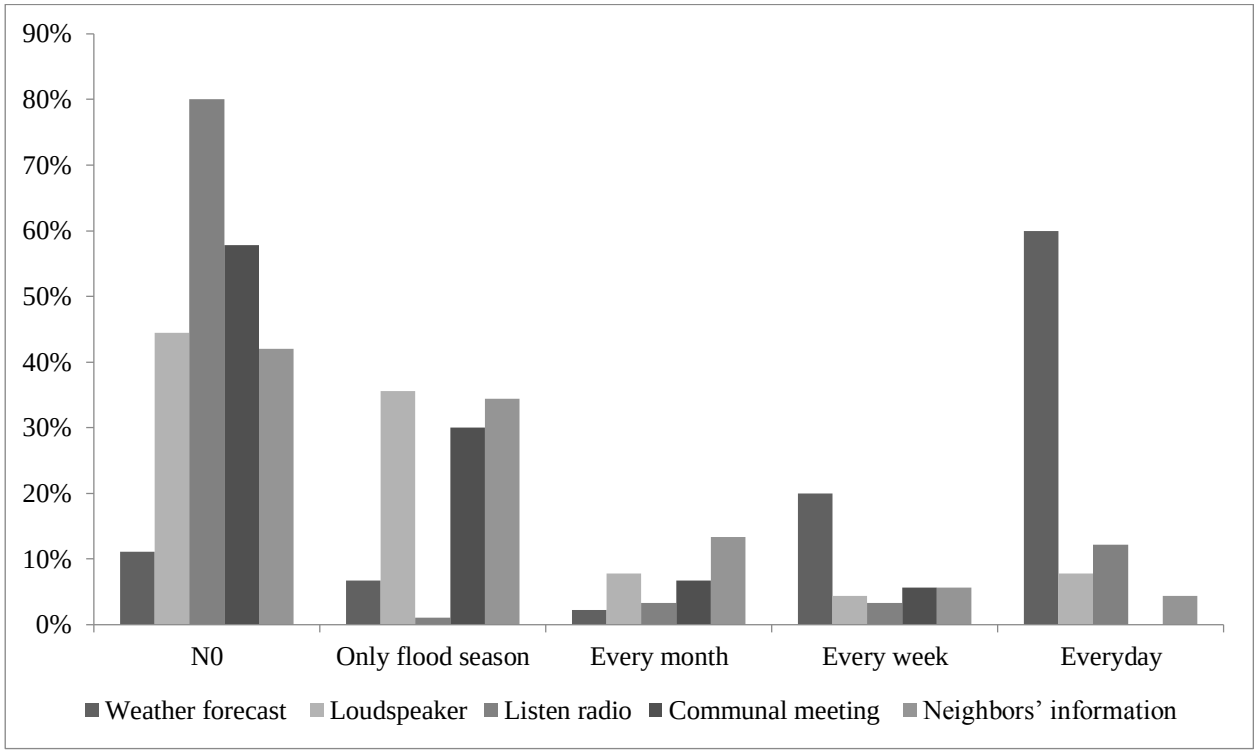


Fig 5. People use various information channels to predict the flood

Source: Interviewing household, 2016, n=180

Table 4. The importance of the teaching indigenous knowledge for the next generation

Skills	Mean	Std.	Importance
How to identify flooding period, flood water level, weather	3,07	1,467	High
Self protection during flooding season	4,36	0,975	Very high
Disadvantages and benefits of flood	2,74	1,312	Pretty high
Experience and skills in fishing	2,01	1,176	Low
Preparing house, food, clean water …	2,30	1,328	Pretty high
Usual diseases, natural cures	2,07	1,243	Pretty high

Note: Scale from 1 to 5 :(1: ≤ 1: Unimportant, 2: 1,1- 2: Low important, 3: 2,1 - 3:pretty important, 4: 3,1 - 4: Highly important, 5: 4,1 - 5: very important).

Source: Household survey results in 2016, n=180

4.4. Conservation measures and promoting indigenous knowledge in flood adaptation

- The local knowledge mainly due to collected experience during agricultural production and transferred by word of mouth for the next generation without writing and widely dissemination. Therefore, in order to preserve and promote indigenous knowledge, it should be collected, documented and widely disseminated to the people.

- Local knowledge becomes less effective due to flood change and extreme weather. Therefore, local knowledge and scientific and technical knowledge should be combined to promote the its values and overcome the limitations.

- In order to maintain and promote local knowledge, it should be integrated into projects of local development.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The study results showed that local knowledge decreases vulnerability and increase adaptation to flood changes. Also, people in upstream areas have higher indigenous knowledge to adapt to the flood than midstream and downstream area. However, recently, due to unusual flooding events, and the impact of media and communications technology, some local knowledge no longer be focused and disappear.

Therefore, it is necessary to take measures in order to preserve and promote valuable indigenous knowledge in the sustainable development of the community such as the experience in agricultural production, weather forecasting, flood forecasting and the native rice varieties.

5.2. Recommendations

- It is necessary to recognize and preserve the remaining indigenous knowledge to accurately predict and adapt to floods more efficiently and sustainably, as well as facilitate the exchange and sharing of experiences between the people in the same and other localities.

- In order to develop local knowledge effectively and sustainably currently and in the future, community knowledge should be strengthened and combined with technological advances to help farmers adapt to environmental changes.

- Indigenous knowledge should be documented and summarized into a book to predict and adapt to flood changes and extreme weather events.

- Indigenous knowledge should be integrated into farmer service system and technical transfer such as providing suitable seed varieties for local conditions.

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LECTURERS' EXPECTATIONS ABOUT IMPLEMENTING CRITICAL THINKING IN EDUCATING THE GEOGRAPHY PEDAGOGY STUDENTS AT CAN THO UNIVERSITY

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ABSTRACT

This study investigates the lecturers' expectations about implementing critical thinking in educating the geography pedagogy students at Cantho University (CTU) due to interviewing seven of 13 lecturers at the Department of Geography Education, the School of Education, CTU. According to the research findings, the participants are facing some difficulties in their employing critical thinking in relation to traditional learning methods, the number of students in classes, the school time, traditional teaching ways, and the university facilities. Furthermore, the participants have also held some reasonable expectations which are related to the student habits and perceptions, class size, the school time/hours, and the school facilities. Due to the emerged problems as well as the participants' expectations, it seemed that their most concern was about the student habits and perceptions in education.

Keywords: Cantho University, critical thinking; geography education; higher education; lecturers' expectations

1. INTRODUCTION

For the last few years, the Vietnamese government has been trying to develop Vietnamese students' thinking skills; however, they still have not got a fully success in relation to engaging and improving the student thinking and attitude towards new learning approaches. The Vietnamese students are not very independent, creative and active in their learning environment [10]. So to develop the Vietnamese students' thinking skills, especially critical thinking-one of the most important competences in a lot of education systems on over the world, we need to replace repetitive teaching and learning ways by new and modern beliefs in education as typical cultural features in the Vietnamese society affected by Chinese traditions influence on the main teaching and learning ways [6].

Being established in 1966 with 51 years of operation, CTU has gained a reputation for being one of the best universities in Vietnam. CTU has focused on developing student skills rather than providing knowledge, so critical thinking strategies in education can be concerned in the classrooms seriously. However, during the time that active learning and teaching approaches have been conducted, some specific problems emerged. For instance, student habits are still biased towards traditional ways; therefore, students do not absolutely believe practical values of some new learning approaches. Furthermore, the school facilities sometimes at CTU are good, but it sometimes cannot meet the standards of critical thinking in educating the geography pedagogy learners as thinking standards include some important requirements consisting of clearness, accuracy, importance or relevance, sufficiency, depth, breadth and precision of the reasoning [7].

The Department of Geography Education at CTU is at the same situation with the university, so the geography pedagogy lecturers are coping with some serious problems in relation to how to implement

critical thinking well. In this situation, specifying and clarifying the problem and the lecturers' expectations are essential for educational administrators and other related people to identify what is happening and what they should do to improve the geography pedagogy students' thinking skills. It is believed that research on lecturers' expectations about implementing critical thinking in educating the geography pedagogy students at CTU will play an important role in this case as it aims study the geography lecturers' expectations in order to better implement critical thinking.

2. METHODOLOGY

2.1. Setting research questions

The central research question

How the geography education lecturers at CTU expect towards employing critical thinking in educating the geography pedagogy students?

The sub research questions

1) What are difficulties of implementing critical thinking in educating the geography pedagogy students at CTU?

2) How the geography education lecturers at CTU expect in employing critical thinking in educating their geography pedagogy students?

2.2. Strategy of inquiry

This research based on a qualitative research approach and the Social Constructivist Paradigm because it aims to explore the meaning and understanding of the participants. The interpretive paradigm is a typical approach to the qualitative research as the constructivist researcher tries to interpret the data based on the participant's views of issue. A qualitative researcher needs to begin with 'What' and 'How' in their open-ended research questions and uses observations, interviews, documents, and audio-visual materials as the types of data collection [4]. In this study, I explored and interpreted the lecturers' expectations about implementing critical thinking in educating the geography pedagogy students at CTU, Vietnam; therefore, choosing the qualitative research approach and Social Constructivist Paradigm with open-ended research questions supported me to gather information about the participants' perspectives on the issue.

2.3. Proposed methodology

I collected an exploratory case study as the methodology of this research because I aim to examine the geography education teachers' expectations about enacting critical thinking in their classes. I conducted this study at CTU where the issue is emerged. I chose some examples which are typical among lecturers at the Department of Geography Education, so I constructed and explored the research issues based on sampling. As a result, I can make some main conclusions for the research of the lecturers' expectations. An exploratory case study can help the inquirer to answer the questions of "What is happing?" and "How is it going?". Furthermore, an exploratory case study also supports the researcher to investigate a topic in depth and provide a convincing explanation based on real situations [3].

2.4. Population

There are in total 13 teachers who are working at the Department of Geography Education.

Table 1. The population

Specialty	The number of lecturers
Natural geography	05
Socio-economic geography and teaching methods in geography	07
Secretary	01

Source: The website of the Geography Education Department at CTU

2.5. Data gathering strategies

2.5.1. Sampling

The inquirer can collect all cases that meet the criterion in his or her purposeful sampling [1]. In this study, the criterion specified by the author consists of the following requirements: i) five years experienced lecturers of the geography education field, ii) all lecturers who are directly teaching in this area. Particularly, my sample selected up seven lecturers who have meet the criterion.

2.5.2. Research methods

a) Data collection

Interview is an attractive proposition in which researchers can gain straightforward factual information in order to explore a complex phenomenon. In specific, there are three types of interviews that researchers can use to gather their data consisting of structured, unstructured and semi-structured interviews [1]. Among them, semi-structured interview enables the author to collect personal notions as it concentrates on participants' perspectives [3].

Appropriately, I selected interview as my data collection method. I appreciated semi-structured interview as it can support me to drive the interviews to be flexible in term of the order of which topics or questions come first. Specifically, the group of questions about the participants' understanding of critical thinking was carried out first. Then, I asked the respondents some questions about their expectations of employing critical thinking in education.

b) Data recording

I used three types of data recording consisting of audio recording, note taking, interview protocol. These data recording types can help me to save the data. The data recording is very important for me to demonstrate of original information. Also the audio recording, note taking and interview protocol can create a more convincing and adequate data collection of the topic as they support me to prove the primary information.

Audio recording and note taking can help the research to save and present primary information when he or she analyzes and interprets data collected. Additionally, the author can get verbal answer due to participants' voice if he or she relies on using audio recording as a type of data recording. Furthermore, using the interview protocol can increase the reliability and validity of the research [4].

c) Data analysis

To analyze the data, I followed six following steps [4]:

Step 1: Prepare and organize the data.

Step 2: Read through all data.

Step 3: Code and organize the material into segments.

Step 4: Put the data into different themes.

Step 5: Describe the themes with typical meaning of each data sort.

Step 6: Analyze and conclude about the issue as well as develop some valuable recommendations.

3. FINDINGS AND DISCUSSIONS

3.1. The difficulties of implementing critical thinking in educating the geography pedagogy students at CTU

Four of seven participants believed that employing critical thinking in educating the geography pedagogy students at CTU is not difficult due to their good understanding about critical thinking strategies as well as their good learner. Specifically, the participants pointed out that they have studied about critical thinking and how to apply it in education in order to develop their learners' thinking skills. In addition to this, the participants realized that at the present, the geography pedagogy students are more active and confident compared with what they performed in the past. However, there are still three participants who believe that implementing critical thinking in teaching geography pedagogy students at CTU is quite challenging. For example, these three participants said that "the students are not active and collaborative in their class activities, so the learning environment sometimes is quite quiet and boring". In some cases, the lecturers need to impart their knowledge by talking and writing something on the black board.

When being asked about what are difficulties in employing critical thinking in educating the geography pedagogy students at CTU, the participants emphasized some main problems below.

1. The students still have a bias favor of traditional learning methods; therefore, they prefer listening and writing information from the lectures. As all participants stressed, it is very hard to improve the students' critical thinking in case they have passive learning habits and negative perceptions towards new learning approaches.

2. The crowded class stops or challenges discussing, arguing and group working, so critical thinking cannot be employed and developed effectively. All participants said that in the big class the geography pedagogy students do not have enough chances to share their thought and debate or discuss with their peer learners, so they cannot demonstrate their understanding. Additionally, the students cannot improve their higher thinking levers and communication skills because they do not interact and collaborate with their teachers and friends regularly.

3. The school time is not enough for the geography pedagogy lecturers to carry out their lectures within developing critical thinking. Although the number of credit points in the geography pedagogy training program was increased to one hundred and forty, the participants realized that it is still not enough if we want to employ critical thinking in education effectively. They believed that to apply new teaching and learning approaches as well as develop critical thinking well; we need more time to support the students obtaining further understanding and professional skills.

4. In the Department of Geography Education, there are some of lecturers who usually use traditional teaching ways such as lecturing, analyzing and explaining. The problem is that the learners will not know which learning way is better and more reliable if some of the teachers still rely upon traditional teaching methods.

5. Even though the library and computers with internet connection at CTU are very good supportive facilities. The university leaders need to provide the geography pedagogy students with more books and learning materials which enable and enhance the development of critical thinking. This also means that the learning and teaching material is not sufficient for employing and developing critical thinking.

3.2. The lecturers' expectations towards employing critical thinking in educating their geography pedagogy students at CTU

Due to some difficulties of implementing critical thinking in educating the geography pedagogy students at CTU, the lecturers pointed out their expectations as below:

Table 2. The lecturers' expectations

Perception aspect	The number of participants who identified this aspect of their xpectations
Lecturers and student habits and perceptions	07
Class size	07
The school time/hours	07
The school facilities	06

3.2.1. Theme 1: Lecturers and student habits and perceptions

All participants indicated their expectations on the lecturers and student teaching and learning habits and perceptions. They generally viewed that that "One of the most important things is that we should provide the learners with the definition and roles of critical thinking in education". Besides, the participants strongly suggested that "It firstly focuses on changing the learner mind, after that we help them to learn how to develop their critical thinking". In relation to the lecturers' habits and perceptions, the participants sincerely shared that some of the geography pedagogy teachers at CTU still rely on traditional teaching ways regularly. Thus, all participants expected that the geography pedagogy lecturers and students should change their perceptions in term of teaching and learning methods as these standpoints are outdated compared with modern learning society.

Discussion:

The lecturers and students habits and perceptions were identified as the most dominant theme which has affected critical thinking. This means that the most important thing that needs to focus is the learners' habits and perceptions towards critical thinking in education. As all participants expected, the active and positive teaching and learning habits and perceptions will lead both lecturers and students to better and more effective employment of critical thinking in their classes.

This theme of the participants' expectations was evident that has made in other previous studies. University level of education system aims to move student to working and researching at the critical and analytic level; therefore, the habits of thinking skills need to consist of meta-analysis and conceptual analysis [8]. The practice of listening, thinking, analyzing and participating is extremely important factors that enhance the learners to improve critical thinking effectively [6]. Hence, to employ critical thinking in education, the first important thing that needs to concentrate is about the teaching and learning habits and perceptions.

3.2.2. Theme 2: Class size

The class size was the second theme that all participants indicated as their expectation. To them, "The class should be less crowded so that they can pay more attention to every single learner". In many situations, it is very hard to create and carry out active teaching and learning activities due to a large number of the students. Some of the participants shared their experience that "Sometimes we have to divide the class into two different smaller classes or groups which require us to spend more time on teaching without extra payment".

Discussion:

The class size could be considered as the second most dominant in this case. First, the participants expected that they can create more active learning activities in order to make their learners active and confident in the classrooms due to a small number of students. Second, the lecturers have more chances to pay their attention to each learner; therefore, the interaction between the lecturers and learners as well as among learners will be better and more frequent. Additionally, the teachers have more time to fix problems emerged in learning process as well as provide learners with more feedback.

Although none of previous studies directly mentioned about the class size in developing critical thinking; however, the participant's expectations could be supported by some notions. For example, in developing critical thinking teacher needs to ensure that learning opportunities are available to all students in the classrooms because this makes the students more comfortable to learn new things. The teachers need to give learners good chances to share their thought with others [2]. Undoubtedly, critical thinking can be described as a contested concept in the class in which all learners have the right to discuss with and evaluate their peer learners' perspectives.

3.2.3. Theme 3: The school time/hours

None of participants forgot to mention about the school hours. They viewed that only one hundred and forty credits are not enough for the teachers to educate and train the geography pedagogy students. The participants realized that "To develop critical thinking of the learners, we needs more time for the students to give evidence and convince other people about what they are talking about, so teaching and learning should not be hurried up". In this circumstance, "We seriously need more school time as it supports us to not only provide the students with more knowledge and skills but also develop their critical thinking".

Discussion:

The findings of this study reported the impacts of school time on employing critical thinking in educating the geography pedagogy students. More specifically, the participants noted that some of the Vietnamese students as well as the geography pedagogy learners at CTU have found that it is hard to adapt to the credit education system which asks them to be self-study. It also means that the learners mainly focus on learning in the classes. Hence, the participants expected that the policy makers of The Minister of Education and Training (MOET) in Vietnam will consider the numbers of credit points or school hours in the training program.

Although it has not found any study that closely supports the notions of this theme, it is appropriate to the context of Vietnam. The credit system is still new in Vietnam, so the Vietnamese government and the MOET are trying to apply and modify it in all educational institutes. It is interesting that in the last few years the number of credit points has been changed several times because of an incompatible number of credit points to the training programs; therefore, the participant views in this theme are reasonable to the current situation of the Vietnamese education.

3.2.4. Theme 4: The school facilities

In relation to the school facility, the majority of the participants (six) raised their notions that "CTU should improve learning resource and spaces for the geography pedagogy learners as they can enable them to develop critical thinking". The participants believed that "When the students can get enough information and knowledge about the issue that they are asked to learn, they will be able and willing to debate in their learning task". This means that the geography pedagogy students need to be provided more books, academic journals, reliable websites and independent learning environment.

Discussion:

Most participants in this study commented on their expectations on some notions about the school facilities as it relates to the development of critical thinking. The most important facility is the number of book for geography education field because in employing critical thinking, the students have to base their thought and action on relevant evidences from reliable and valuable sources. The online source sometimes gives the geography pedagogy learners more chances to improve their understanding, so it needs to provide the students with more laptops or computers with Internet connection. The participants also expected that the geography pedagogy students need more functional rooms for map making, teaching practice because those supportive facilities are very important for both learners and teachers to implement critical thinking.

There are some notions in the literature that support the participant views in this situation. The teaching faculties and library system have an interrelationship which enables the learners to develop their critical thinking due to literacy information [5]. Librarians, teaching faculty, and institutional administrators need to work together to establish priorities, provide resources, and reward participation in order to create a successful information literacy program throughout the curriculum. In particular, to improve critical thinking the learners must match search and match their relevant subjects with appropriate sources of information. Let the students select controversial topics and using library and information technology to search and prepare what they should believe and what they should do [9].

4. CONCLUSIONS AND IMPLICATIONS

4.1. Conclusions

In regard to implementing critical thinking, the participants have coped with some serious problems in their teaching career. These difficulties mainly relates to the lecturer and student habits and perceptions, class size, and school time. Amongst such problems, the student habits and perceptions were identified as the hardest things to improve in order to better employ critical thinking.

This study has presented a number of lecturers' expectations about employing critical thinking in educating the geography pedagogy students at CTU which have a close connection to other broader previous studies. It can be inferred that those expectations show how challenging implementing critical thinking is in educating the geography pedagogy students at CTU.

4.2. Implications

From this study, there are some implications that are described below.

4.2.1. Further research

It requires further research in other areas as it needs to provide with various information.

Future research needs to focus on how lecturers practice their employing of critical thinking.

Further study needs to research on the thinking and beliefs of the students about critical thinking.

4.2.2. National policy and practice

It suggests that the policy makers who work in the Vietnamese government and the MOET need to pay more attention to making any policy related to critical thinking in education.

The study also asks the policy makers about the guideline and framework which help people to employ critical thinking.

4.2.3. University leaders

This study suggests that both university and faculty leaders should make more specific policies that satisfy the participants' expectations in regard to the development of critical thinking.

In addition, the university policy needs to concentrate on the employment of critical thinking in the geography pedagogy field in specific and in all training areas in general.

4.2.4. Lecturers

Some lecturers should be more active in learning and preparing themselves for a better understanding of critical thinking and how to develop higher thinking skills in the class.

Some teachers also need to be more open and flexible in their thinking and beliefs in relation to developing critical thinking.

4.2.5. Students

The learners need to change their mind in relation to teaching and learning tasks.

The students need to be more confident, active, collaborative and critical in learning environment.

The students themselves should create positive and active learning habits as these habits play a vital role in developing critical thinking.

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USING LESSON STUDY FOR TEACHER DEVELOPMENT: A CASE STUDY OF VIETNAMESETEACHERS' BELIEFS

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ABSTRACT

In this article, we present a case study of four Vietnamese teachers of English in a Community College working in a Lesson Study group that prepared them for teacher development in teaching English as a foreign language. By conducting Lesson Study, the teachers indicated that they were fully aware of the important roles of Lesson Study in their professional development strategies. They declaimed that Lesson Study in which a small group of instructors jointly designs, teaches and refines a single lesson could offer the opportunity for mutual learning, collaboratively designing more effective lesson plans which focus on learning goals, and rendering timid teachers more confident in having their teaching observed by colleagues. However, some constraints faced by the teachers were identified, which may undermine the gains of Lesson Study.

Key words: Teacher development, Lesson Study, EFL teaching, community college

1. INTRODUCTION

In Vietnam'scolleges, a strong demand exists for teachers to experience continuous, good-quality professional development in order to improve student learning and teacher instruction. Typically, experts are invited to deliver talks, workshops, or conferences with teachers who are only passive recipients of new ideas and knowledge. Several committed teachers will try to solely apply the experts' ideas with or without success; others will simply ignore them and continue their teaching approaches with which they are familiar. As a result, teacher professional development (PD) efforts are often criticized by educators for their lack of continuity and ability to produce effective change in teacher practice and student learning (Loucks – Horsley, Hewson, Love, & Stiles, 1998).

Lesson Study (LS) is a well-established Japanese approach to examiningclassroom practice. This model is believed to be an effective form of professional development which produces improvement of students' learning in many contexts in Asia, Europe and America (e.g., Chokshi & Fernandez, 2005; Lewis, Perry, Hurd, & O'Connell, 2006; Lewis & Tsuchida, 1998; Pang & Marton, 2003; Isoda, Stephens, Ohara, & Miyakawa, 2007; Lewis, 2011). Lewis (2011) stated LS is a systematic way of building teacher's knowledge together that has proved to have an impact on both teachers' and students' learning. In Viet Nam, LS is considered a new concept, although some projects have been carried out in some colleges and universities with regards to improving non-English subject pedagogy, research conducted in the field of English language teaching in a particular context as a community college is still limited. The present study was conducted to examine using LS for PD in order to improve the quality of LS practice implemented by a group of teachers of English in a community college in the Mekong Delta.

2. LESSON STUDYPROCESS

According to Cerbin and Kopp (2006)LS is a method to improve teaching and build knowledge that

has origins in Japanese elementary education. In Japanese Lesson Study programs, teachers work in small teams to plan, teach, observe, analyze, and refine individual class lessons, called research lessons. In this sense, LS is a cycle of instructional improvement in which teachers work together to formulate goals for student learning and long-term development, collaboratively plan a ‘‘research lesson’’ to bring to life these goals, conduct the lesson in a classroom, with one team member teaching and others gathering evidence on student learning and development, and reflect on the evidence gathered during the lesson in order to improve the lesson and instruction in general (Perry & Lewis, 2009, p. 366).

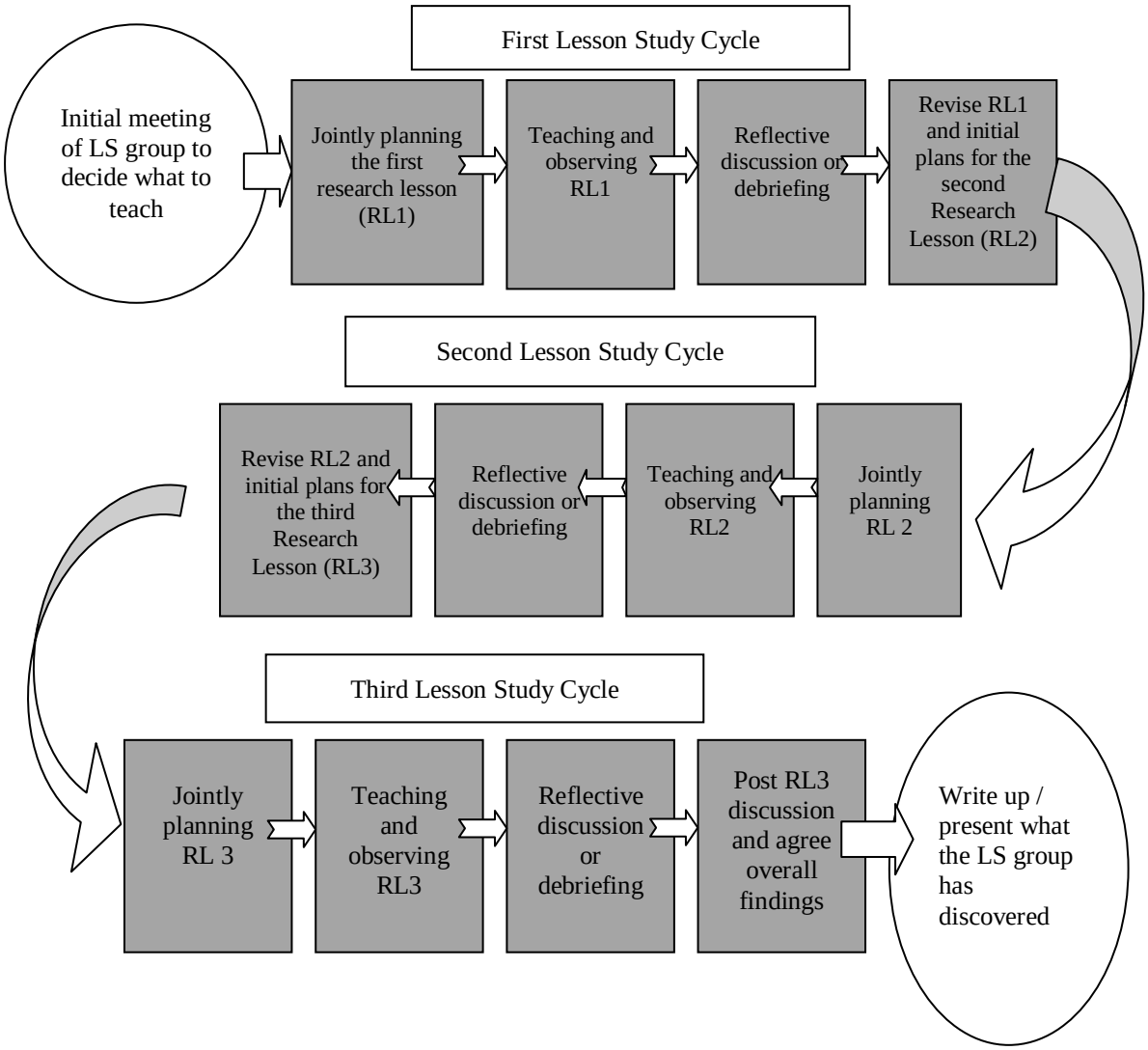

Fig 1. Cycle of Lesson Study adapted from Japanese Lesson Study process (Dudley, P., 2011, p.6)

LS is also defined as a collaborative-design-research framework which emphasizes teachers' leadership for learning and improving teaching, interaction between students in the classroom, and individual needs and differences (Matoba, Shibata, Reza, & Arani, 2007). The starting point of this approach is selection of a topic and goals for student learning in a module of work over a period of time, followed by an overall plan of development, includinga focus on a specific research lesson as an integrated part of an in-depth study.

In this study, LS is understood as a collaborative process that enables teachers with diverse expertise to work together preparing, teaching, observing and reflecting the research lesson (Figure 1).This process is illustrated in the following diagram:

3. RESEARCH ON LESSON STUDY

Lesson Study has a long history in Japan (Yoshida, 1999; Watanabe, 2002) and in recent years there has seen a steady growth in research outside Japan. LS has been implemented widely across Asia, but under several different monikers: in Hong Kong as Learning Study, in China as Action Education, and in many Asia-Pacific Economic Cooperation (APEC) member countries as LS (Fang & Lee, 2009). More recently, several researchers and projects have been interested in assessing the feasibility and effectiveness of introducing the LS approach in initial teacher education (Lee, 2008; Wakhid & Dian, 2010; and Fang & Lee, 2009).

In English education, Lee (2008) conducted a study on how a group of teachers adopted a LS approach and worked collaboratively so as to improve their class instruction on *wh*-question formation. The findings showed that the collaborative environment throughout the study enabled them to gain insights into how to improve their teaching strategies. LS enabled the teachers to take charge of their own professional development - they could put forward their own agendas and choose the object of learning for their study. LScreated a culture of peer learning and learning from actual classroom practice. It also provided opportunities for a free discussion of ideas, with participants able to challenge others' and their own way of thinking, and viewing learning from the student perspectives. However, the teachers' reflections also indicated some problems which may reduce the appeal of LS, including time constraints and pressure faced by many school teachers. Requiring teachers to stay behind after school for the LS meeting every week and doing paper work, on top of their already heavy teaching duties could be a burden.

In a different context, Wakhid & Dian (2010) conducted a research on the implementation of LS in English language learning in a private Senior High School in Malang - East Java - Indonesia.The results indicated that LS as a school project involved many people working directly in the learning and teaching process (teachers, headmaster, students) and those who did not relate to it directly (parents, experts). As a new perspective, Lesson Study becomes important, not only in the teaching and learning mathematics and sciences, but also in other subjects. What most important is to do it in the correct way, so that the result of the Lesson Study will be maximum and be able to contribute to the identification of what is going on during a class and to offer a solution for problems await while keeping good values recorded by observers. By applying Lesson Study, school-based or teachers' union-based one, teachers and students can get the benefit from a Lesson Study for the betterment of a subject teaching and learning.

Fang & Lee (2009) conducted a project on LS from 2006 to 2007 in order to respond therecenteducational reform in Singapore calling for improved instructionalpractices and school-basedcurriculum innovations tonurture engaged learners.The key findings revealed that the teacher participants had conflicting views towards lesson study. While they were satisfied with their participation and how lesson study enabled them to improve teaching and building community, many of them did not believe that all teachers should or would be able to participate in Lesson Study given their heavy teaching loads and the demand of resources. However, as the process continued, the teachers felt more confident in having their colleagues observe their lessons, and more teachers volunteered to teach the lessons designed by their teams. Most strikingly, LS groups became important sites for inducting and mentoring beginning teachers in the pilot school. Beginning teachers who were courageous enough to teach the research lessons found themselves acquiring deeper learning and faster growth than their other team members.

In general, these studies showed that the teachers were able to engage in the LS process and successfully bring about change in their practice that addressed individual learning needs. However, they

focus on improving instruction of school subjects such as Maths, English, Science etc., rather than proposing a LS model for professional development to the larger population of general education teachers. Moreover, various challenges that went against participants' existing belief on LS were ignored; successful cases of the projects were dominantly discussed instead.The study reported in this paper seeks to fill the gap in which using LS for professional development of teachers of English is still not emphasized.

4. LESSON STUDY IN VIETNAM

Lesson Study projects have been carried out in a few places as primary and secondary schools in Bac Giang province, a three-year project lasted from 2004 to 2007 and was supported by Japan International Cooperation Agency (JICA); Hue University in Hue, thestudy focuses on Mathematics education and Hau Giang Province in the Mekong Delta in collaboration with Can Tho University and Michigan State University.

All the projects mentioned above have shown good progress over time and work to move teaching from a more traditional focus on procedural knowledge and factual information towards a more constructivist view of teaching and learning. The students in such classrooms were beginning to learn concepts through discourse, collaboration, and applications to the real world. The number of teachers who participated in the projects increased and they took greater responsibility for implementation. As a result, greater attention has been focused on students' learning rather than just teaching performance. Each project has adapted its approach to the technical knowledge of experts supporting the project and the local setting. This suggests that there is no single "right" way to implement LS in Vietnam, but rather, the potential usefulness in implementing a LS program in Vietnam. However, these LS projects focus on teaching and learning non-English subjects such as Physics, Mathematics, Geography etc., in primary and lower secondary schools. Research of Lesson Study in English language teaching is scarce, and the contexts of research were not extended to higher level of education like college or university. Thus, an investigation on the opportunities as well as challenges of adopting Lesson Study in EFL teaching at college level is truly essential.

5. RESEARCH QUESTIONS

Aiming to investigate EFL teacher perceptions of using the Lesson Study for professional development of teachers in terms of feasibility, usefulness, challenge and to provide a tool for better practice of teacher PD at the college, the study seeks answers to the following questions:

1. How useful is the Lesson Study model as perceived by the EFL teachers at a community college?

2. What are feasibilities and challenges of Lesson Study implementation from the teachers' perspectives?

6. RESEARCH DESIGN

This research is an attempt to implement lesson study in a college context from which perceptions of EFL teachers in using the LS model for PD was elicited and examined. In this design, the qualitative methods of interview, reflective writing, and observation were used to collect relevant data for the study. This combination of methods were designed to validate the data and provide more detailed information about college EFL teachers' perceptions of LS for PD, which was also consistent with Tesch's (1990) systematic process of analyzing textual data utilized to segment the interview transcripts, field notes, and

written journal entries into coding categories that allowed for the emergence of themes and patterns in the data.

7. FINDINGS AND DISCUSSION

7.1. Participants' perceptions towards Lesson Study for PD

The findings from the data were consistent with previous research (Fernandez et al., 2002; Perry and Lewis, 2003; Rock & Wilson, 2005). It wasclearly indicated that LS model can serve as a means of teacher professional development with a positive impact on teacher practice of teaching process and on students' learning. The participants believed that LS embodies the key features of experiences that have a significant positive impact on teacher instructions, create opportunities for teacher to work collaboratively and reflect a wide range of key issues on every phase of the teaching and learning process. They believed their instructional practice would become more effective as a result of participation in the model.The data from the interview revealed,

"LS can be applied as a way for teacher development. It helps teachers practice group work skills, and learn teaching experiences from other teachers. Also, LS helps teachers get good lesson plans and improve instructional knowledge. LS can meet learners' needs because the lesson plans were carefully designed." (Participant 3)

"To me, this is a positive and effective approach for teacher development because it creates an environment for teacher to collaboratively work and mutually learn through discussion meetings and bilateral observations." (Participant 4)

In addition, the results also showed that LS cycle impacted teacher's ability to think about the effects on students' learning in multiple ways when they were engaged in this professional development tool that included planning, observing, reflecting and collaborating. As a result, the teachers were motivated to reconstruct lessons that address students' learning goals and blockage in learning. As with the findings above, the participants appeared to experience full benefits of professional growth as a result of involving in this process and LS was truly an appropriate professional development practice for a diverse range of contexts.

7.2. Participants' perceptions about benefits of Lesson Study

The data indicated that the teachers were aware of the value of LS in teacher growth. The benefits reported related to learning from colleagues, creating better lesson plans, meeting learners' goals, and dealing with scare of being observed.

In terms of learning from colleagues, the participants expressed appreciation that their colleagues' observation in which a wide range of evidence of students' learning along with teacher instruction was captured and collaboration in the research lesson cycle contribute directly to the rich source of critiques. They also added that their colleagues can offer them new points of view related to content knowledge, teaching techniques and instructional strategies based on real evidence from lesson observations. They said,

"This is also a chance for department teachers to meet, collaboratively work and mutually learn knowledge and experiences." (Participant 1, reflective writing).

"The most meaningful and impressive things to me is to get chances to design, teach and observe the same lesson with other teachers, which help me get more experiences from other colleagues in both designing and teaching." (Participant 4, reflective writing).

Such peer observations offered more feedbacks to detect and explore important teachable moments as well as activities which could otherwise go unnoticed. Lesson Study created the opportunities and offered a community to open the teachers' practice to scrutiny, and together with their community assist one another to think critically about their lessons, resulting in the teachers' instructional improvement (Lee, 2008; Lieberman, 2009).

Correspondently, the participants perceived that lesson plans should be regarded as a blueprint for teaching action, so creating qualified lesson plans plays a vital role inthe teachers' job. In the teaching context of Vietnam in general and in community college in specific, designing lesson plans is a compulsory activity for all of the teachers; however, almost all of the lesson plans at the current site were individually designed and taught, so the quality of these lesson plans is still doubted. The teachers believed that involving in the Lesson Study would help them design good lesson plans thanks to the reviewing cycle. In fact, all of the lesson plans taught through this process were carefully examined, taught, observed and revised by the whole group of teachers for many times based on ideas and suggestions from the collaborative group, especially from real evidences of observing phases capturing students' learning in actual classrooms, so mistakes, ineffective activities and teaching constraints in the imperfect lesson plans would be carefully analyzed and then adjusted (Cerbin and Kopp, 2006). This finding is a starting point to motivate teachers to learn and apply this tool because of their professional development in general and qualified lesson plans in specific.

Meeting learners' goals was the next benefit to emerge from the data. The participants affirmed that through lesson observations and post-lesson discussions, they received immediate and precious feedbacks that helped them understand their students' learning process and attitudes toward the lessons. Based on the feedbacks, they cooperatively revised worksheets, tasks and teaching strategies to provide clearer instruction for future lessons, to better impact learning, helping to achieve the learning targets. When the teachers provided the opportunities for students to make sense of what they were learning, they would be more engaged in the teaching process and make more learning achievements. Because the learning goal is considered the key point of lesson designs, the way students understand what they are learning has a vital position in their ability to succeed, and teachers should make this happen; in other words, we need to explore and embrace the instructional methods that build up students' existing knowledge to bring them to higher levels of learning effectiveness. The LS process is really an appropriate potential approach in enhancing teachers' practices to improve students' understanding of lessons and help students achieve their learning goals.

The final finding was that participation in the LS process can help the observed teachers overcome feelings of self-consciousness when being observed. The participants stated that in the present context, classroom observation is still not a frequent practice. Although a certain number of teachers were selected by the school to do this, many teachers wanted to reject it. The reason was that they were scared to be observed in their classes. However, through adopting LS process, the participants could overcome their anxiety and worry. They explained that this is because ownership of the study lessons belongs to all of the team members who devised the lesson plan and contribute in the whole process. In addition, LS also created the opportunity for the teachers to observe and critique their peer performances, so they gradually became accustomed to the observing cycle to defeat such a psychological problem. In other words, the LS

provided the teachers with a non-threatening teaching environment, illuminating that the focus of observation aims to evaluate the lesson design rather than evaluate teacher performance. It is focused on learning, not on judging (Chokshi & Fernandez, 2004).

7.3. Perceptions of feasibility and challenges of Lesson Study.

The strongest indicator was that the participants believed Lesson Study process effectively assisted them in improving their teaching practice by applying this process with a variety of purposes in the current context. According to these participants, Lesson Study can inspire them to cooperatively work with only one colleague, design effective activities which help interest students in learning process and experiment upon several certain subjects. However, the data from the interview also revealed that the participants faced some difficulties which cause hesitation in applying this tool.

Although the results of this study showed that the teachers found the whole process highly rewarding with regards to improving teaching effectiveness, the participants complained that LS was consuming much time and some revised activities may not suit all kinds of learners at the present site. First, time was considered the most dominant challenge in adopting LS as a school-based professional development tool because the LS process truly required the significant commitments and teachers' energy and time to complete a heavy workload cycle of study lessons. Like Lee's (2008) reported problems faced by Hong Kong teachers of English, one participant wrote, "*It is difficult to find a suitable period of time for all to join the group meetings, classroom observations, and even revising phase before the following cycle will be conducted".* In addition, it was also revealed that the college teacher spent much time preparing lessons, teaching every semester, dealing with their family and domestic work, so when participating in LS cycles, they had to take more responsibilities, whichprevented them from engaging in the process. The result also confirmed Rock and Wilsons' (2005) finding in an American elementary school that the process requires substantial time and commitment.

Another challenge reported was the question whether revised lessons suit a variety of of students. The teachers confirmed that although any revised activity based on visual evidences from observation notes may be better than an original one, it sometimes seemed less effective to apply in other classes.

In general, the two main problems above interfered much with the participants' use of LS for their professional development and reduced their willingness to apply it. Therefore, in order to handle difficulties preventing teachers' practice of this professional development process in the current context of the study, the participants suggested three solutions. First and foremost, the cycle of LS should be applied by peer colleagues and last during a whole school year or several semesters, so the teachers can arrange their own time to follow the cycle and lessen work pressures during the whole cycle. This suggestion was in congruence with Stigler and Hiebert's (1999) idea that the success of Lesson Study is determined by long-term improvement. It seems infeasible unless the school administrators and principals show their support in timetabling and providing staff professional development time (Lee, 2008). The school management has the responsibility to support as well as recognize teachers' effort in improving the atmosphere of learning and developing their instructional skills.

The second suggestion was that the teachers should feel freer and more encouraged to observe the students' learning in depth and select more vivid evidences from all actual happening rather than only focus on information which can answer the given questions. This suggestion is also advocated by previous research that at a time, when teachers feel pressured to teach particular curriculum, information about what students are actually learning is essential to instruction improvement and learning (Darlinf-

Hammond, 1997; Lewis, 2002a). Lastly, in terms of the revised lesson plans, it should be clear that the purpose of LS process is not to create a perfect model lesson for all of classes with mixed levels, so designing separate lessons for each different type of learners with multiple background level needs to be concerned. This process enables teachers to take a look back and evaluate properly their teaching in the present context in which the same lesson is taught again and again with learners of different styles and multiple background levels and the feedback tends to be superficial and focus on teaching procedures rather than students' learning process. Thisfinding isnoticeable in the present study.

8. CONCLUSION

The current research was conducted to investigate teachers' perceptions of using Lesson Study as a tool for teacher development in teaching English as a foreign language at a community college. The study also documented problems hindering teachers' use of teacher collaboration tools for PD. Its findings revealed that all of the participants in the study were aware of the importance and benefits of Lesson Study process for their PD. They agreed that Lesson Study process was useful for their PD, which helped them improve their profession and teaching performance. It was regarded as a form of learning community in which teachers can work together solving teaching problems as well as creating innovations in their instruction with supports from other colleagues. In addition, most teachers concurred that they perceived benefits related to learning from their colleagues; producing better lesson plans which focus on learners' goals and getting accustomed to being observed instructing by colleagues as a result of engaging in this process.

In terms of feasibility and challenges of applying the practice of Lesson Study at community college, the participants believed that Lesson Study is a powerful tool for teacher growth and they expressed their willingness to adopt it in different ways such as implementing the process for a longer period of time and conducting it with one colleague only. However, the barriers that could prevent the participants from engaging in LS were lack of time for collaborative planning and effectiveness of revised lessons for recycling with multiple types of learner. The most commonly cited difficulty in the interview data was a large block of time for pre- and post-lesson meetings because they felt that too much of their time would be dedicated to complete an overloaded work cycle as Lesson Study.

The quality of the practice of this process would improve if there should be some facilitating policies. Theseincluded having policies to support and encourage unwilling teachers to overcome their own concerns about Lesson Study; having a group structure of peer teachers so that the whole group could be engaged in deep conversations which enables the designed process to be more successful; and increasing the amount of time of implementing in order for more teachers to participate and promote the effectiveness of the practice.

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THE SOCIAL AND LINGUISTIC COMPOSITION IN BAC LIEU PROVINCE

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ABSTRACT

In the era of the open-door policy, the explosion of media and Vietnam on the way of international integration, we communicate and interact more and more with foreigners. These are favorable conditions for developing cross-culture, intersection and code-switching language. In the paper a survey was conducted on the intersections of languages which make contribution to enriching our mother tongue in Bac Lieu province as a miniature of Vietnam.

Key words: communicate, code-switching, intersection, language

1. INTRODUCTION

Language and society are intertwined because a society moves with language. When communication takes a proper process whereby meaning is generated, and a society moves with the pace of the language. (Anthony C. Oha)

The social study of language is a modern linguistic paradigm because it was the modern linguists who first acknowledged and accepted that language by its nature is totally a social phenomenon.

The present paper makes up a general report on an overall sociolinguistic investigation which concerns the linguistic situation in the province of Bac Lieu, South Vietnam. The readers will be provided with a general profile about the ethnic, social and linguistic situation. On the background of this information, the complex social and linguistic composition of Bac Lieu is to be grasped and evaluated.

In comparison to other places, slight differences in pronunciation, style and vocabulary between speakers that point at the geographical region, Bac Lieu, which the speaker comes from. Sociolinguistics investigates the way in which language changes, depending on the particular region of the country, Bac Lieu, which it is used in. One social and linguistic phenomenon, code- switching, which is the term given to the use of different varieties of language in different social situations, is studied in this paper.

2. BAC LIEU: GEOGRAPHIC-HISTORICAL BACKGROUND

Bac Lieu, a young coastal province, was first inhabited approximately two hundred years ago. With the total area of 2,484.96 square kilometres, Bac Lieu borders the East Sea on three sides, which enlarges it year after year at the speed of tens of square kilometres per year. The population is about 900,000 people among which the Vietnamese account for 90 percent, the Chinese 3.3 percent and the Cambodians (Khmer people) 6.4 percent.

Historically, Khmer people were the first inhabitants. Then the Vietnamese came and then so did the Chinese about over one hundred years ago. The distribution of the population in Bac Lieu like the one in other provinces is not logical. The Chinese majorly live near markets or commercial centres; most of the Vietnamese settle in the centres of culture, economy, education and administration; on the contrary, a

large number of the Khmer people live in the country villages.

Under the Saigon governments of the French colonialists and the US imperialists, the Khmer were treated badly. That is the reason why there were some Khmer riots in which these poor people rebelled and killed both the Vietnamese and the Chinese.

After the liberation of the South in 1975 all races live peacefully and fairly under the same roof. The minorities, in Vietnam in general and in Bac Lieu in particular, are taken care of with favourable policies. The Chinese and the Khmer are allowed to build schools to teach their own languages. Especially, a big boarding school was built for the minorities most of which are Khmer people. In addition, the open-door policy has been attracting a lot of foreigners to come to Bac Lieu to stay and work as tourists and businessmen such as Japanese people.

3. THE LANGUAGES IN BAC LIEU

Long time ago the Khmer language appeared in Bac Lieu and Khmer people, the native, with the Oc Eo civilization were the real owners of this land. The Khmer language is still seen inscribed in a lot of old temples, towers and pagodas. Khmer people often live in their own communities. Most of them earn their living by cultivating rice and vegetables and raising cattle and poultry. You happen to be in their communities and hear all voices in the Khmer language: from the radios, the cassette players, the televisions, from the people chatting, from the children playing and shouting, etc. Then, by mistake, you may think that you are in the country of Cambodia. Among their communities Khmer people communicate by their own language. The authorities always encourage them to learn Khmer by building schools, making the programmes in Khmer on the radio and television and the Khmer monks are obliged to learn Khmer and pray only in Khmer. From generation to generation, the Khmer language is learned orally rather than taught at school although people can learn Khmer in the pagodas and even in their own schools. Thus fewer and fewer people can read and write Khmer; they can only speak it. Instead, they voluntarily learn to write and read Vietnamese by which they can find promising opportunities in their life.

Kinh or major Vietnamese people went to settle in Bac Lieu over two hundred years ago. Gradually they have settled all over the province and form the most part of the population. The Vietnamese language is spoken and taught majorly everywhere. About over one hundred years ago Vietnamese letters based on Latin was invented by priest Alexander De Ross. To Vietnamese people, Vietnamese is the easiest language in the world because, after having learnt it for a month, they can read and write fluently all the Vietnamese words. This is the main reason why all the races in Vietnam voluntarily choose to learn Vietnamese in their education. All Vietnamese people go to school to learn in Vietnamese from kindergartens to colleges or universities. The Vietnamese language is the only official language in economic and political activities, all fields of sciences and social life of Vietnamese people. In different communities, Vietnamese is used for local communication. It is the Vietnamese language that enables people of more than sixty races to be close to each other and share the spirit and material values of Vietnam in which Bac Lieu is a miniature.

The first Chinese people put their steps on this land over one hundred years ago. Most of them live near the markets or business districts. The Chinese are deligent and excellent businessmen. That is the reason why they are often rich or well-to-do. Even though their population is only about 3 percent, the Chinese influence other communities greatly. Among their own communities they communicate by speaking and writing Chinese. It is obvious that they use the common language, Vietnamese, to

communicate with other communities. Because of the great influence of the Chinese civilization, the Chinese language are written and inscribed in all temples and pagodas in Bac Lieu. It is Chinese that is used in ceremonies and sacred services in the written forms. The Chinese build their own schools everywhere. They force their children to learn Chinese and Vietnamese simultaneously from the first grade to the fifth grade after which most of Chinese children stop learning Chinese and begin the sixth grade in Vietnamese.

Under the French colonialists, French was taught officially at school. Children were forced to learn only French. However, few of them could afford their education and they could learn further in Can Tho, Saigon or even in France. Most of them were poor and never dreamt of going to school. Under the influence of French education, a lot of old people of that time still remember some French words that they sometimes say to their grandchildren.

After the August Revolution, English gradually was taught at school more and more popularly. When American troops came to South Vietnam, the majority of students learned English and fewer and fewer learned French. As a result, English spread to everywhere in Bac Lieu.

From 1975 to about 1990, Russian was a mode in Bac Lieu. People, especially officials, plunged to learn it. At school students were also eager to learn it. They considered it something that could "polish" them. However, after learning it for a few years or even some months, they found it too difficult for them. Right after the collapse of the USSR, they forgot almost everything about Russian.

English has been taught in Bac Lieu since 1960s as a foreign language which was slightly declined after 1975. Since the mid 1990s, English has played a stronger and stronger role in the education of Bac Lieu. It is the open-door policy that helps English to be taught everywhere. More and more people learn English to look for good opportunities in life and to go overseas to study. Computers also make their considerable contribution to studying English. Finally, National English Project 2020 is a great stimulus that motivates all people to learn English to integrate into the world.

4. THE INTERSECTION OF THE LANGUAGES IN BAC LIEU

It is found that people in Bac Lieu often speak three languages: Vietnamese, Chinese and Khmer in their daily activities. Naturally, Vietnamese is the most popular; however, everywhere Chinese and Khmer can also be heard. Sometimes other languages, for example, English, may be used, especially when foreign people are visiting this land.

Among the three major languages: Vietnamese, Chinese and Khmer, there are a lot of common spoken words which are derived from geographical names (toponyms), names of specialities (foods), of customs and of traditions of each original culture.

The following table presents the intersection of the languages in Bac Lieu:

Common words	Transcription	Original language	Meaning
Bac Lieu	bak lju:	Chinese	Poor land
Bu Hoc	bu hok	Khmer	A kind of food
Ca Mau	Ka mau	Khmer	Small geyser

Common words	Transcription	Original language	Meaning
Cau Quay	kau wei	Vietnamese	Turning bridge
Cheo quay	ʧeo wei	Chinese	A popular frying cake
Che	ʧe	Chinese	Sister
Hia	hia	Chinese	Brother
Hu tiu	hu tju:	Chinese	A kind of vermicelli
In	in	Chinese	A kind of popular cake
Khot	kot	Vietnamese	A kind of popular cake
Luc	luk	Khmer	Khmer monk
Lung	lu **ŋ**	Khmer	Broad field
Soc	sok	Khmer	Hamlet
Tet	tet	Vietnamese	Vietnamese Lunar New Year
Thot not	**θok not**	Khmer	A kind of Khmer palm
Tiu	tju:	Chinese	A popular frying cake
Tra Kha	tra ka	Khmer	A toponym
Xeo	sel	Vietnamese	pancake

Code-switching is also a popular phenomenon in Bac Lieu nowadays, especially when the whole country has been integrating into the world. In daily activities, emails, messages, etc. appear more and more words of foreign origins. As a result, a lot of common words borrowed from other languages, especially European languages, are increasingly used among the communities in Bac Lieu.

Common borrowed words	Original words	Languages
An bum	Album	French
Bar	Bar	English
Bom	Bombe	French
Bon Se Vich	Bonsevich	Russian
Cara	Carat	French

Common borrowed words	Original words	Languages
Ca rem	Crème	French
Ca ri	Cury	Indian (Asia)
Cat xe	Cashé	French
CEO	CEO	English
Chat	Chat	English
Chip	chip	English
Cu lao	pulaw	Malaysian
CV	Cirriculum vitae	English
Email	Email	English
Fan	Fan	English
FIFA	FIFA	English
Game	Game	English
Glat not	Glasnot	Russian
Hello	Hello	English
Hai	Hi	English
Hot (boy, girl)	Hot (boy, girl)	English
Ki lo	Kilogram	French
Lapto	Laptop	English
Like	Like	English
Live show	Live show	English
Lit	litre	French
Li xang	license	French
Logic	Logique	French
MC	MC	English

Common borrowed words	Original words	Languages
Menu	Menu	English
Men se vich	Mensevich	Russian
Met	Metre	French
Mit ting	Meeting	English
No	No	English
OK	OK	English
Online	Online	English
Phim	Film	French
Pop	Pop (music)	English
Pro	Pro	English
Rock	Rock (music)	English
Sac	Charger	French
Sex	Sex	English
Shop	Shop	English
Show	Show	English
Sin gum	Chewing gum	English
So co la	Chocolate	French
So viet	Soviet	Russian
Soc	Shock	French
Teen	teen	English
Test	Test	English
Ti vi	TV	English
Tour	Tour	English
VIP	VIP	English

Common borrowed words	Original words	Languages
WTO	WTO	English
Xe tang	tank	English
Xi can dan	Scandal	French
Xi tret	Stress	English
Xi tin	Style	English
Yes	Yes	English

According to a survey conducted in Bac Lieu University in 2016, code-switching of language has been used by both monolingual and bilingual people as follows:

Frequency of using code-switching	Monolingual people		Bilingual people	
Always	2%	⇒ 22%	2%	⇒ 5%
Often	20%		3%	
Sometimes	52%		53%	
Seldom	25%		38%	
Never	1%		4%	

The survey shows the different rates of using code-switching in different places in Bac Lieu province:

Places where code-switching is used	Percentage
School	31,4%
Media	12.2%
Daily dialogs all over the province	50,4%
Other places: Parks Meetings Social networks Advertisements	6% (total) 1% 1% 3% 1%

5. THE TREND OF SWITCHING TO ENGLISH

Nowadays English becomes the language of international communication. It is the language of international business, research and science. The decree 422 dated in 1994 by the Prime Minister of Vietnam forces all senior officials to learn English. One additional is that English is the common language of ASEAN countries. Moreover, the National Foreign Languages Project 2020 has driven people to learn foraeign languages among which English is the vital language. At the present moment, in Bac Lieu, in particular, and in Vietnam, in general, all officials should learn English. Most of the companies and governmental agencies offer privilege to those who have English certificate in addition to their main qualifications in employing and recruiting new employees. Those who can not use English well can not use computers well. Learning English leads to a lot of opportunities in looking for jobs and studying overseas.

In many international forums like APEC 2017, beauty competitions, etc. and regional conferences like ASEAN Summit, it is English that is the only language to be used in contacts, discussions, contracts or treaties. It is possible to say that learning English is one of the promising components which will make Vietnam an Asian dragon in the near future. As teachers of English, we hope that Vietnamese people will soon be able to use English as well as European people do. We are sure that our dream will come true soon.

The fact that English will play an important role in communication in Vietnam, in general, and in Bac Lieu, in particular, is certainly true. Then English code-switching or English borrowing in the Vietnamese language will become more popular.

6. CONCLUSION

How to keep Bac Lieu identity and to develop this land simultaneously?

Everyone tries to reach the prosperity. It is no doubt that we can not reach the prosperity alone. We should always be helped by not only our community but also those all over the world. Among major languages in the world, English is the most important language that can make considerable contribution to the prosperity of Vietnam. Thanks to English, we can approach new technologies, new innovations and new inventions in any field of sciences. To solve the problem “how to keep Bac Lieu indentity and to develop this land simultaneously”, we should base on two grounds:

1) forcing people, especially children, to learn their own language in their education at school. Only mastering their mother tongue, can people learn and acquire other languages better.

2) It is easier for children to learn English than for older ones, so the most suitable place for children is the school in order to guarantee that English can “be acquired in fairly natural way rather than learned in later life as an additional skill” (cf. Goyvaerts 1973).

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USING LEARNING SPACE IN FLIPPED CLASSROOM TO DEVELOP STUDENTS' CAPACITY OF CREATIVE THINKING

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ABSTRACT

In this aticle we present out research on the possibilities of applying the model of "flipped classroom" in teaching the discipline of digital tecnology in a suitable learning space. Our analysis shows that the model of flipped classroom can be considered as a kind of classroom organization in integrated teaching and that it can be suitable to the current trend of modern teaching style.Our experiments and survey results indicate that the application of "flipped classroom" in teaching the discipline of digital technology in suitable learning space not only simulates students' interests, improve their learning efficiency but enables them to develop their capacity of creative thinking, lessens the pressure of class attendance whenever possible.

Key words: integrated teaching, learning space, skill, flipped classroom, capacity of creative thinking

1. INTRODUCTION

In 2007, Jonathan Bergman and Aaron Sams (2012), two teachers in Woodland Park invented a software to record the presentation on Powerpoint [1]. They recorded their live lecture and posted them in the internet so that their students who were not able to attend class could follow the lessons. From this time on, online lessons have become widespread and teachers used live videos for teaching and students did not attend classes, but instead watched the videos and receive the concepts. A moel of "Flipped classroom" came into being as a result.

In a traditional classroom, students listened to the teacher's lecture in the classroom and then teacher would did an exercise as a demo and then assigned homeworks to students, all basing on the main learning environments: in classroom and at home. In a flipped classroom, students are supposed to learn their lesson by watching the posted videos or by exploring any on line materials whenever it is possible to seek for knowledge. All classroom activities are for doing exercises, group disscussions under the teacher's guides. In stead of delivering lectures as in traditional classrooms, the teacher in flipped classrooms work as a manager who give questioning situations to students and assist students in solving these problems at request and finally systemize the essential knowledge for each lesson.

Many research projects the application of flipped classroom in teaching and teaching towards developing student's capacity of creative thinking have already been done and published. However, in this article the author focuses his applied research project on applying the model of flipped classrooms in associated with suitable learning space to develop students' capacity of creative thinking in teaching the discipline of digital technology.

2. CONTENTS

2.1. Literature review and nature of "flipped classroom"model

2.1.1. Learning space

'Space-whether physical or virtual-can have an impact on learning. It can bring people together; it can encourage exploration, collaboration, and discussion. Or, space can carry an unspoken message of silence and disconnectedness.' (Oblinger, 2006) [7]

A classroom is an important space and thus should not be seen as a unique entity but should be in association with other spaces. It is better for such a favourable learning condition as that of an associated learning space designed as in the figure 1 with one of the entity being the real space (for instance classrooms, theaters, libraries, offices, laboratories, homes, coffee shops) and other virtual space (like laptops, i-pads, smartphones, internet and computers connected to social networks) to be created for students and they are actually be able to learn in such environment.

Fig 1. A learning space mosaic

Physical learning spaces Virtual learning spaces

2.1.2. New learning compatible to IOT

In Technology Revolution 4.0, any entities are connected with information technology to form new interdiscipline, for example information technology in combination with banking turning to IT based banking, information technology and telecommunication to IT based telecommunication. In the new inter-discipline, one of the original entities may be eradicated like trational telecommuniction being replaced by IT based telecommunication and a new labor force in accordance with IT based telecommunication were generated.

The same nature is seen in the inter-discipline of IT based education, in which teaching and learning activities were "embedded" in an associated learning space. While traditional education activities were "confined" in such spaces and relationships as school-classroom, teacher-student, book-notebook, study-exam... then in IT based education teaching and learning activities are conducted in a learning space with

internet connection and operation of learning networks. In such learning environment, IT functions as both a tool and agent and at the same time as eco-environment for learning and education management activities to take place. Fish can live thanks to water environment. In the like manner, education in Technology Revolution 4.0 can be active because of internet based eco-environment.

A classroom in IOT society is a classroom with associated space, including the real space (real space (for instance classrooms, theaters, libraries, offices, laboratories, homes, coffee shops) and other virtual space (like laptops, i-pads, smartphones, internet..).

The once popular classroom with blackboard - white chalk and unmovable seats was replaced by a new learning environment with more suitable learning spaces. Learning spaces are designed to ensure an equal possiblities of learning opportunities in both real and virtual learning spaces because today students can study any time by the support of any available internet based mass media.

Thanks to the abundance of learning spaces as they are today, the model of 'flipped classrooms will be developed in a fast and organized manner. It is noticeable that, in the current context of IT and internet development, we can study no matter where we sit and no matter when we like provided that we have one of the devices: a laptop, a smartphone, an i-pads.

According to Chism (2006) [4], "learning scenarios occur whether we arrange the spaces or not. [But] We can facilitate deeper and richer learning when we design spaces with learning in mind." In reality there are significant constraints to designing the learning spaces we would prefer. Resource constraints limit the construction of new learning spaces. Pre-existing learning spaces may need considerable redesign but this also comes at considerable cost. However, it is also important to consider the cost of lost educational attainment, not just to individual students but to the nation, of maintaining poor quality learning space, or worse, of building new but unsuitable learning spaces. More challenges to the design of learning spaces occur whenever the space does not have learning as its primary purpose. Workplace learning, for example, will in many situations occur in spaces designed principally for production of goods and services, not learning.

2.1.2. The flipped classroom

The flipped classroom is just one example of how we might rethink learning spaces. This idea of the 'flipped classroom' appears to have originated around 2008 in a high school in the US. Flipped learning is a learning model that is different from the traditional learning style. The model suggests the "flipping" of teaching procedures, e.g listening to the lectures is done at homw while practising, application of theories, doing homework is done in classroom.

In a traditional classroom, teaching and learning procedures begin with the teacher getting ready for the lecture and students preparing and doing homework assigned in the previous class meetings. All the lectures are delivered in the class time allocation and if there were some time left, it would be allowed for practice. It means that delivering the lecture takes most of the time and the time for practice is quite humble. Regarding to this, many studies show that students are in the satge of "low level thinking" durin the lecture time, but in the stage of "high level thinking" during the practice time. It results to the fact that students find it hard to have deep thinking, to develop imagination and expand scope of knowledge when they are in the stage of "low level thinking" during the lecture time. The main point of a "flipped teaching" suggestion is to encrease the time for "high level thinking" stage and decrease the time for "low level thinking" stage.

Consequently, "flipped classroom" changes the roles of the teacher and students. The teachers come to

classroom not for delivering the lecture but chairing the discussions, exchanging and interacting with students, explaining the arised problems that students fail to solve. Similarly, students will shift their learning style to listening the teacher's video lectures via online means.

The suggestion of "flipped classroom" is originated from judging the nature of this kind of learning which aims at boosting students' acts and behavior towards knowledge and skills development, with the emphasis on the students' mutual interactions and combined learning environemnts so that there will be an increase in students' knowledge, from their initial level to the desired one. Teachers are supposed to creat suitable learning enviroments and use brainstorming methods to enhance students' konwledge seeking and acquisition process. Thanks to the development of e-learning together with the current constraints in teaching and learning that Vietnam is encounting, the model of "flipped classroom" has proved to be suitable to practical application because it creates favorable environments for the teaching and learning activities to work efficiently.

In addition, the model of "flipped classroom" itself has several benefits that help improve students' capacity to identify and solve learning problems as well as the ability to use information technology and telecommunication devices.

2.2. Capacity of creative thinking

New learning environment will shape the model of "flipped classroom" and enhance students' development of creative thinking capacities. Creative thinking capacities are a huge category, comprising complex concepts and theories but in the scope of this article, inly students' capacity of creative thinking in their studies is discussed.

2.2.1. Students' capacity of creative thining in their studies.

The capacity of creating thinking is reflected by the ability to perform new acts and behavior, create new things and at the same time by the ability to successfully solve learning problems and to flexibly handle problems basing on the current understandings.

Students' capacity of creative thinking is not an inborn characteristics but it is formed by the constant process of learning and experiencing. Each students' capacity of creative thinking is closely associated with his understandings, skills and techniques. Consequently, it is a must for teachers to help shape and develop students' capacity of creative thinking during their teaching time. The best way to create such capacity is to let students involve in the role of learning doers by expressing their active, automatic acts and behavior in taking up knowledge, skills and personal perfection of qualifications.

The capacity of creative thinking in studies is the ability to deal with learning situations, to flexibly apply what they learn in specific problems. Students' capacity of creative thinking in studies will be manipulated in the folowing situations:

+ Teacher gives a question or an exercise of much challenge but students can be able to analyze the question and solve it.

+ After finihsing one unit or chapter, students are able to cummarize it, make some certain comparisons or contrast with the those of the previous ones so as to generalize it, draw the relationship among the preceeding units or chapters.

+ If students meet a difficult question, students can be able to think of several solutions to the problem and then make a decision on which the best one will be.

+ Students are able to use what they have learned to explain or apply in practical life activities.

+ Students are determined to suggest new approaches to problem solving tasks, which have not been familiar with them and able to use arguments and reasons to defend their points of view and reject the wrong viewpoints or arguments.

+ Students are able to learn and do self studies from different sources, including their teachers, friends, mass media, modern technology, able to apply and renovate or update their understandings for better improvements.

Take it for example, students are able to apply theories in doing such practical tasks as "automatic controling circuit for a water pumping device", "circuit to control bells in competitions" after they have finished logic circuits.

Consequently, students' capacity of creative thinking in studies is formed during their learning process. It is, therefore, a must for teachers to shape and develop students' capacity of creative thinking during teaching time. If teachers wish to do these things successfully, they have to impersonalize themselves as learners who voluntarily and automatically seek for knowledge, develop capacity of creative thinking, perfecting personal qualifications.

2.2.2. The priciples for building a set of questions for students' out-of-classroom and in-classroom studies under the "flipped classroom" in order to develop their capacity of creative thinking [6]

In the model of flipped classroom, teachers give questions and students study them at home, students learn their lessons via video lectures or online lessons for knowledge reception. In classroom, teacher use the set of questions to stimulate students' brainstorming and gereating knowledge, developing lesson contents, at the same time encourage students to get engaged in discussions regarding to the core contents or ideas in a logical manner.

The questions used in the model of "flipped classroom" are not only used for checking students' extent of lesson comprehension but enable students to actively learn in their time. During in-class learning time, using questions is like a "bridge" that ensures the mutual interactions between teachers and students. Using questions help teachers not only check students' knowledge and skill but receive feedbacks for their adaptations of contents and teaching activities.

Example:

For the questions used out-of-class: used as a means to help students listen or read the lessons in advance to understand knowledge. Accordingly, the questions' coverage should be involved in the theories (stureture, working princinples, definitions...).

For the questions used in-class: Students come to classrooms for conducting discussions, doing homework, and solving difficult tasks. Consequently, the questions must elicit students to expand knowledge, associate what they learn with the practice, create new personal understandings (for example designing electronic circuits for uses of daily activities).

In a tradtional teaching method, a class observation is for evaluating how well the teacher conduct learning activities, what the characteristics of the activities are and how these activities are ordered. In the model of flipped classroom, a class observation is for evaluating how well students learn under the conditions prepared by their teachers, how much the questions are competible to the lesson contents and to the students' ability of receiption and comprehension. Additionally, to say whether the teaching hours

in a flipped classroom are successful or not, we must consider and count on the set of questions that the students have sent to their students for their self studies. All these steps and procedures will be in a close procedure with the questions being in a unified and cohesive relationship.

We can have a closer look at how the flipped classroom works via a class of literature teaching. Supposedly, the content of the lesson is a novel, and the teacher tells students to read the novel at home for the gist of it and analyze the themes conveyed in the novel by using the set of questions prepared by the teacher. During in-class teaching and learning time, the teacher spends time on conducting and guiding discussion activities to discover the literary emblems or meanings conveyed in these themes. Similarly, in the flipped classroom, the questions for students' homework to "*get to know the gist of the novel*" are, in term of their nature, different from the those used in class discussion "*for the discovery of the literary emblems and meanings of themes in the novel*".

2.3. The procedures for conducting a flipped classroom.

From [8], we can draw a figure of a flipped classroom as in that of figure 2 below. Basing on the figure, a specific procedure can be constructed as below.

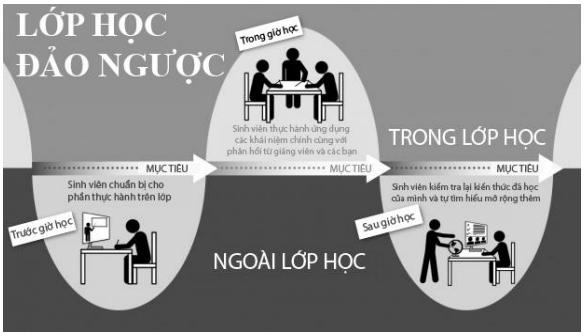

Fig 2. Steps to learn in a "flipped classroom" model

Step 1: Before the in-class learning

Teacher: creating a video lecture or giving instructions to students on exploring an available video lecture.

Whether a flipped classroom is successful or not depends on the teacher's level of professional epertise, pedagogical capacities and the ability and skills in information technology application. All these capacities are seen in how well they create a video lecture which is of scientific characteristics and of high suitablity to students' capacity. The teaching drama and lesson plan for a flipped classroom will surely be different from these of a tradtional classroom in term of the teaching and learning nature. The teacher's teaching drama ans lesson are of two elements: a video lecture and situations prescribing the teacher interacting with students in classroom.

There will be a well balance in term of the structure between the video lecture and the contents to be discussed in classroom. The teacher is adviced to constantly update latest information to the lecture and practical situations arising in classroom so that the later video lectures are informative.

Students: learn the video lectures in the manner of self-study and get ready for in-class discussions. Learning in flipped classroom is similar to student - centered mode of teaching; it is not the teacher whose job is to control students but the students actively learn the video lectures to build up their own understandings, opinions, and questions on the lecture contents. That is they have already been familar with some of the points in the lecture before they are in official lesson time.

Students must be good at using IT, searching for essential information from the internet, doing self-studies and planning their studies.

Step 2: In class learning

Teacher will chair the discussions, make exchanges of ideas to students and give evaluations to students. The teacher's main jobs are providing students with timely guidance on how they can solve a problem, necessary knowledge that students can not reach and introducing the most effective approaches to students for their problem solving tasks. Because the students' personal learning plans are different from class to class, the teacher's pedagogical skills and learning situations will be different.

The teacher's and students' main job: the teacher help students to deepen their knowledge while the students perform group work and spend time doing practice and thinkng drills.

Step 3: After in-class time.

When the class time is over, the teacher will continue giving guidance and help to students with their question solving if there are some tasks left unfinished in the class.

Studentshave to check their understandings and expand their knowledge.

Students can keep dairies or blogs and these tools help them to keep trace of what they have already achieved, of any notices they must be concerned, and what they should add in for the coming time.

After step three, teacher has to make a new video lecture or supply necessary information to the out-going lecture so that they can be suitable to the students' current comprehension and reception ability. Simultaenously, students return to step one to learn the teacher's new video lecture.

2.4. A pedagogical experiment of "flipped classroom" for the discipline of digital technology

2.4.1. Scientific principles for applying "flipped classroom" for the discipline of digital technology [10]

+ Digital technology is a discipline of much practical application and of many unique solutions to questions, from which teacher can encourage students to develop creative thinking capacity and problems sovling skills.

+ Questions on digital technology always attract the learners. As a result, teacher can design a lesson the contents of which compose of theories and practice so that students can check the theories for reality. Creating students' eagerness for study is a starting point, and a motivation enabling students to show their capacity of creative thinking.

+ Digital technology contains academic elements that suit several teaching methods such as conversations, realia, discussion to enhance students' capacity of creative thinking and eagerness for studies.

+ Digital technoloy also include modules that are applicable to project based learning style. Students can conduct some experiment following a teacher's given task to make a concrete item. Students are in active situation in which they have to make some discoveries, identify the problem and solve it in an independent manner.

+ Digital technology is a discipline that can be found in many universities' teaching cirricula so there

are many video lectures by experienced professors or lecturers. The teaching syllabi and contents imbued in digital technoloy are relatively homogenous. Therefore, these video lectures can be used a a source of reference for students. From the available learning materials, both teacher and students find it easy to select the appropriate ones, which helps decrease the teacher's time for delivering the theories in classroom and increase the time for introducing questioning situations and lead students to doing exercises or participating in group work and group discussion.

When students learn their lessons by video lecture, they can play the video several times, especially spend more time rewinding and watching the difficult contents for thorough understandings. In case they fail to understand something, they will automatically have questions for that and bring them to classroom for further discussions under the teacher's guidance and assistance.

2.4.2. Designing an integrated logic circuit

Designing an integrated logic circuit is an important content in the discipline of digital technology. In this section, we use the procedure for a flipped classroom showed as in 2.3 for designing an integrated logic circuit.

Step 1: Before in-class learning time

Teacher asks students to watch the video lecture prepaped by Lecturer Nguyen Phuong Quang, whose email address is quangnanh@yahoo.com, and is working in the Academic group of Industrial electonics, faculty of Electricity and Electronics, Ho Chi Minh University of Engineering Teacher Education, via http://huongnghiepviet.com/codientu/ki_thuat_cdt/dien_tu/vi_mach_so/index.htm by Nguyen Tien Dung, email vnnguyendung@gmail.com [11]. After study the theory and the example of a question, students can solve quesions of average difficulty as the example illustrated below.

Example 1: Design an integrated circuit to control a car, including three input ports DOOR, IGNITION, LIGHTS and an output port ALARM to help driver with steering the car by signalizing the alarming lights (The point to switch the circuit connection is ON: with the electric voltage being +5V and OFF being.....).

Condition: ALARM (A) is at high level when

IGNITION (I) is ON and the car door DOOR (D) is not closed

When LAMPS (L) is ON, IGNITION (I) is OFF

The solution is shown as in figure 3

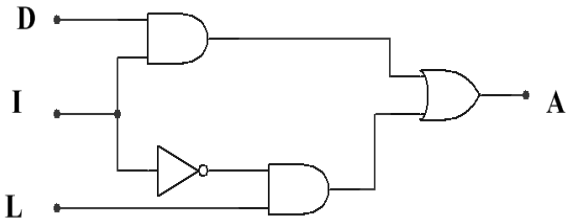

Fig 3. Chart of $A = DI + L\bar{I}$

Step 2: In-classroom learning time

Teacher will check students's for the old lesson

Teacher gives a question of average difficulty as showed in example 2 to check students' understandings after the time they had did some self-studies at home.

Example 2: Let a chart of circuit be given like that of figure 4, find value of function F at the output port?

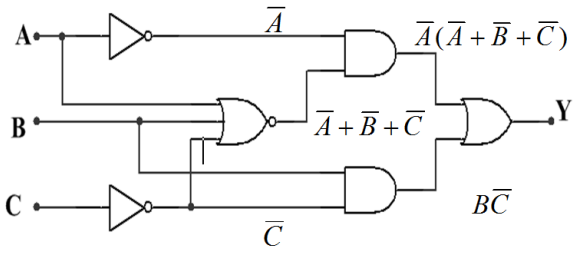

Fig 4. Chart of circuit in example 2

If students had already learned at home, they would have found the value of F easily

$$Y = B\overline{C} + \overline{A}(\overline{A} + \overline{B} + \overline{C})$$

Teacher gives a questioning situation and students have to work out the solution: Based on the known value of Y, simplify the circuit so that it has fewest ports.

This question is actually the simplification of an expression to enable students drill their skills of finding answers to a logic question basing on a known value of function. Students of everage level can find the solution.

The expression for output port

$$Y = B\overline{C} + \overline{A}(\overline{A} + \overline{B} + \overline{C})$$

We draw a series of expressions by using Boole

$$Y = B\overline{C} + \overline{A}(\overline{A} + \overline{B} + \overline{C})$$
$$Y = B\overline{C} + \overline{A}\overline{A} + \overline{A}\overline{B} + \overline{A}\overline{C}$$
$$Y = B\overline{C} + \overline{A} + \overline{A}\overline{B} + \overline{A}\overline{C}$$
$$Y = B\overline{C} + \overline{A}(1 + \overline{B} + \overline{C})$$
$$Y = B\overline{C} + \overline{A}$$

Based on the newly-withdrawn expression, a new circuit as figure 5 is formed.

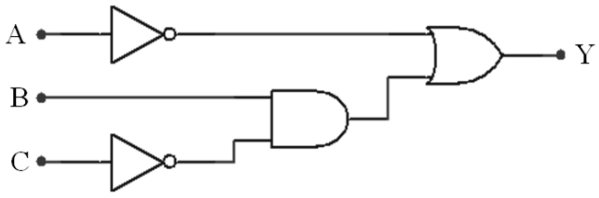

Fig 5. Chart of simplified circuit as in example 2

Teacher gives a difficult question that is not related to the theory and a model exercise

Example 3: Based on the circuit showed in figure 5, make a new circuit so that the function below is

done just by using one IC

$$Y = B\overline{C} + \overline{A}$$

The clues to solve this question have no relationship with the learned theories. This is out of the textbook and there is no similar model exercise. Students have to make out a new scheme or a new approach to the question but they may not know how to begin.

Due partly to no model example available, students have to think out and transform the question into a new versioned one with related clues. By our analysis, we realize that from the circuit showed in fgure 5, we must look up for an IC, find out an IC that contains port NOT, port AND and port OR if we wish the function will be solved. In reality, there is no IC containing such three ports but actually these ports are in three individual ICs. Here in this case, the questioning question is to consider whether the function $Y = B\overline{C} + \overline{A}$ could be turned to a new function so that within the function all ports are equally identical and the ports are fixed in an IC. This is the question we are supposed to solve.

If you want to do it, we have to to a mathematic technique in combination with De Morgan: convert the logics in the function Y two times as below".

$$Y = \overline{\overline{Y}} = \overline{\overline{B\overline{C} + \overline{A}}} = \overline{\overline{B\overline{C}}.\overline{\overline{A}}} = \overline{\overline{B\overline{C}}.A}$$

The chart is drawed as in the following figure

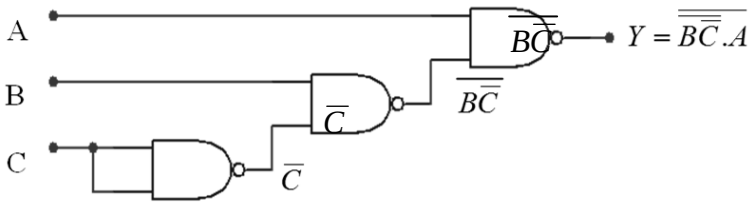

Fig 6. The chart of transformed circuit for example 3

Note: The exercise in this example is quite difficult because there is no model example for students to mimic but if there were a similar question (as in example 4, figure 7) then the solutions to the question would not matter because students can apply what they have learned from example 3.

Step 3: After in-class learning time

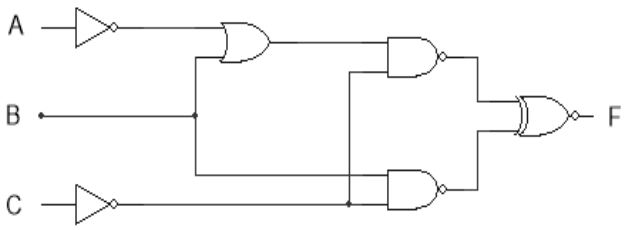

Fig 7. Circuit for example 4

The question given as homework as in example 4 must be more difficult than the question used as a small test at the primilinary step of example 2. The difference and difficulty in this question is to prove that F can be done via an only one logic port.

After step three, teacher has to return to step one and make a new video lecture or supply necessary information to the out-going lecture so that they can be suitable to the students' current comprehension

and reception ability. Simultaenously, students return to step one to learn the teacher's new video lecture.

In addition to using the teaching steps for flipped classroom as stated above, teacher is supposed to combine learning spaces appropriately. In this case, teacher can combine physical space and virtual space; students can use laptops, smartphones or virtual space to fullfil their learning tasks at anywhere: at home, in the uiversity library, in the park or at a coffee shop...for high efficiency.

2.5. An evaluation on the application of flipped classroom

2.5.1. Qualitative evaluation

Students' benefits: Because most of the in-class learning time is for discussions, students can be able to have a deeper understanding of the lesson, to relate the learned knowledge with the reality so it will arouse their eargerness for studies. In a traditional classroom, students must be silent and concéntrate on the lectura, Very little do they participate in the lessons or express their ability. Consequently, teacher can not know who has already prepared the lessons before hand, who can realy understand the lessons. In a flipped classroom, students must be hardworking so that they can "catch up with" the others. Vavious and suitable learning spaces and rich content and lively lectures will surely bring about hing interests to students, arouse their curiosity and enhance their creativeness.

Teacher's benefits: In a flipped classroom, video lectures of high quality will be able to used for similar clases or for the future clases. This is one advantage that using video lectura brings forth to them; teacher will not have to repeat the theories over and over again as the time passes. Furthermore, teacher can skip some of the theories that are easy for students as they believe. The teacher's major time is for doing research and writing out new questions for giving students correct assessment on their capacities.

2.5.2. Quantitative results

In order for ius to give a quantitative evaluation in pedagogical experiment, we did some processing of the data on the study results achieved by students in experimented class (KTCN15) and controled class (KHMT15).

The principles for choosing the two kinds of classes: we use two classes of students whose average scores won in the entrance exam are of equal value to guarantee that our result of study is enough persuasive.

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Diem DH	Control	41	15.415	2.1181	.3308
	Experiment	40	15.650	1.6220	.2565

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper

Diem DH	Equal variances assumed	5.301	**0.024**	-0.560	79	0.577	-0.2354	0.4199	-1.0712	0.6005
	Equal variances not assumed			-0.562	74.814	**0.576**	-0.2354	0.4186	-1.0692	0.5985

The statistics shows that:

In controled class, students got the average scores of 15,415 in the entrance exam with the deviation being 2.1181 and in experimented class, students got the average scores of 15.650 with the deviation being 1.6220.

With H_0, the results drawn from Lavene's test showed that: "there is no difference in variance of the scores between the students in two classes", with the reliabilty of 95% and Sig. = 0.024 < 0.05. The H_0 is dismissed. That is there is difference in variance of the scores between the students in two classes.

With H_0, the results drawn from t-test showed that: "there is no difference in the average scores between the students in two classes", with the reliabilty of 95% and Sig. = 0.576 > 0.05. The H_0 is approved. That is there is no difference in the average value of the scores between the students in two classes.

In order to check whether learning in flipped classroom is effective or not, we look at the difference in the scores in end-of –term exam won by students in experimented class and controled class.

Group Statistics					
	Group	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Diem HP	Control	41	5.593	2.0328	0.3175
	Experiment	40	6.538	1.9689	0.3113

Independent Samples Test										
		Levene's Test for Equality of Variances		**t-test for Equality of Means**						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
DiemHP	Equal variances assumed	0.468	**0.496**	-2.124	79	**0.037**	-0.9448	0.4448	-1.8302	-0.0594
	Equal variances not assumed			-2.125	78.996	0.037	-0.9448	0.4446	-1.8299	-0.0598

The statistics shows that:

In controled class, students got the average scores of 5.593 in the end-of-term exam with the deviation being 20328 and in experimented class, students got the average scores of 6.538 with the deviation being 1.9689.

With H_0, the results drawn from Lavene's test showed that: "there is no difference in variance of the scores in the end-of-term exam between the students in two classes", with the reliabilty of 95% and Sig. = 0.496 < 0.05. The H_0 is approved. That is there is no difference in variance of the scores between the students in two classes.

With H_0, the results drawn from t-test showed that: "there is no difference in the average scores of the end-of-term exam between the students in two classes", with the reliabilty of 95% and Sig. = 0.037 < 0.05. The H_0 is dismissed. That is there is difference in the average value of the scores in the end-of-term exam between the students in two classes. This points out that the average scores in the end-of-term exam won by students in experimented class being higher than that won by students in controled class bears the statistical meanings.

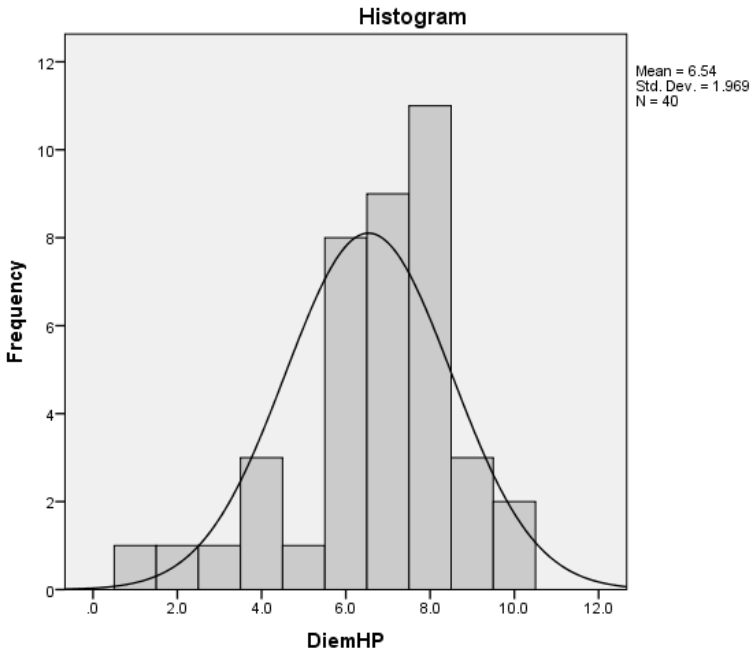

Fig 8. Distribution of scores in the end-of-term test won by students in experiemented class

3. CONCLUSION

The model of "flipped classroom" is the accumulated result of different research projects relating to traditional teaching methodology and computer based teaching methodology in combination with suitable application of learning spaces, which correspond to the demands of education renovation in the era of Revolution 4.0. Learning in a "flipped classroom", students can control their self-studies, can stop, rewind, watch the video lectures several times and discuss with friends. Students do not sit still and listen to the teacher's lecture but they will, instead, spend more time on cooperation activities, exchanges under the teacher's assistance. Because there is an increase in the allotted time for in-class discussions and exchanges, students can develop their skills of exchanging and expressing ideas. Students are in regular check and test so they know what they should accumulate in their self-study time. This model has been used in teaching the discipline of digital technology in Dong Thap

University, Vietnam. Our research results will contribute to the enhancement of students' autonomy and improvement of quality in thematic studies.

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