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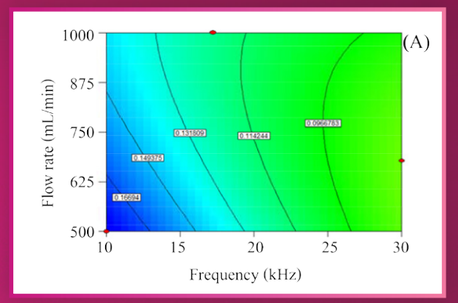

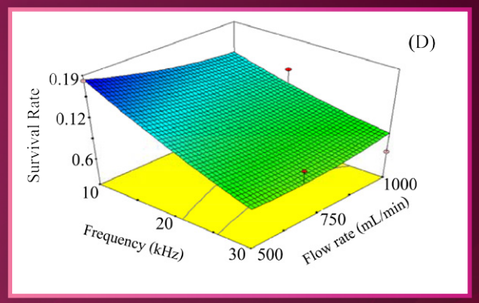

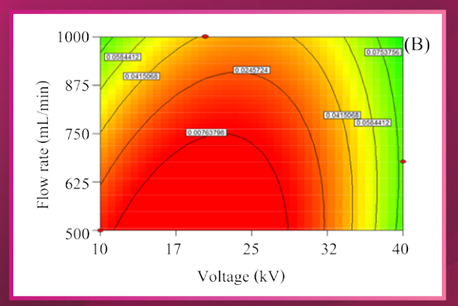

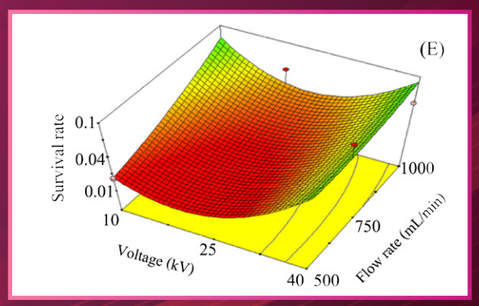

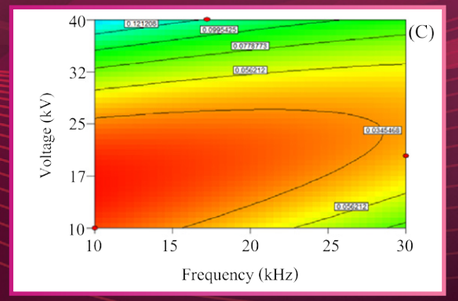

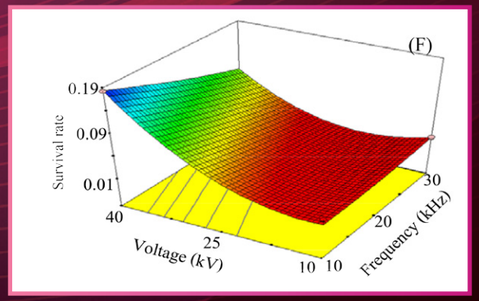

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The MSU Journal of Science and Technology is published quarterly and dedicated to the promotion and dissemination of scientific knowledge in the disciplines of Bioscience, Physical Science and Engineering Articles and research papers to be published in the Journal of Science and Technology Mahasarakham University will be subject to verification of academic luminaries both from within and outside the University to assure journal quality standards.

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Editor-in-Chief's message

The Mahasarakham University Journal of Science and Technology volume 35 issue 6 is the English language version of this series. It is composed of all original articles covering biological, physical and health sciences. Each article constitutes interesting and in-depth research, and I trust each reader will receive new knowledge and benefit from the information presented. Our journal is classified in group 1 of the Thai-Journal Citation Index (TCI) and as such, the editorial board and I would like to extend an invitation to all researchers to submit your manuscript for consideration and publication.

Assoc, Prof Dr. Worapol Aengwanich

Associate Editor

Cover photo explanation : Process Optimization for Microbial Reduction in Durian Juice by Using Pulsed Electric Field

Cover photo : Chaiwut Bourneow et al., 2559, 619-625.

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Original Articles

CONTENTS

Process Optimization for Microbial Reduction in Durian Juice by Using Pulsed Electric Field

Chaiwut Bourneow[1], Somyod Santimalai[2]

Received: 16 December 2015; Accepted: 30 March 2016

Abstract

Pulsed electric field (PEF) is an interesting non-thermal process for microbial reduction in liquid foods/materials. In this study, a PEF system was set up and characterized for some limitations in its use. The PEF system could generate a supply voltage in a range of 10-40 kV/cm with a frequency range of 10-30 kHz. The flow rate of the liquid food was in the range of 500-1000 mL/min with a continuous flow. The PEF was used for microbial reduction in durian juice. The process optimization was conducted by response surface methodology (RSM) for three parameters: voltage level, frequency of the PEF system and the flow rate of durian juice through a PEF chamber. It was found that the PEF system possessed the most effective functioning on microbial reduction at the voltage of 40 kV/cm at the frequency of 10 kHz. The optimum flow rate of durian juice was at 500 mL/min. The microbial content in the durian juice was reduced for 4.13 log CFU by the optimum condition. The results suggested that the set up PEF system and the obtained condition could be effectively used to reduce the microorganisms contaminating the tested foods.

Keywords: durian juice, microbial contamination, non-thermal processing, pulsed electric field (PEF), response surface methodology (RSM)

Introduction

Durian, the king of fruits in South East Asia, is an important tropical fruit in Thai agriculture with a unique characteristic of having a thorn-covered husk and strong odor[1]. Since 1999, more than 900,000 tons of durian have been produced by over 100,000 hectares of planted lands. Around 98% of total annual output of durian is domestically consumed while the rest is mainly exported to Hong Kong, Singapore, Taiwan and China[2]. Durian flesh is easily microbial deteriorated which leads to lose marketable value. Therefore, the processing of durian flesh is required to produce other products obtained from durian such as durian paste, durian ice-cream, freeze dried durian, and durian chips[3].

A microbial reaction process is necessary to improve the microbiological safety in food products. In several, instances the thermal processes such as pasteurization or sterilization have been done mainly to meet safety purposes. An adverse effect on sensory and nutritional qualities of the food products by those thermal processes is possible[4]. Therefore, many researchers have extended an effort to develop novel non-thermal processes, such as pulsed electric fields (PEF), ohmic heating, high pressure, membrane filtration, etc.[4,5,6]

PEF is an emerging processing technology that has demonstrated the potential to inactivate some vegetative cells of pathogenic bacteria and spoilage bacteria by using short bursts of electricity. PEF processing provides flesh-like safe foods with minimal loss in sensory qualities and nutritional quality[4,7]. In past decades, PEF has gained increasing interest in the mass transfer operation of food technology and biotechnology[8,9,10]

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especially in extraction of bioactive compounds[11,12], food shelf-life extension by sterilization and enzyme inactivation[13], maintaining physicochemical and nutritional quality of foods[12], and degradation of some pesticides contaminated in foods[14]. PEF has been used to reduce the microbial contamination in apple juice, coconut water, carrot-orange mixed juice, liquid eggs, mangosteen puree, milk, orange juice, and strawberry juice[7,11,13,15,17].

PEF processing is an application of external electric fields to induce the electroporation of cell membranes or membrane permeabilisation. The phenomenon enhances the diffusion of solutes inside the food systems. The electrical break down of a cell membrane is undergone by the exposure to a sufficiently intense electric field (above a critical value) in a short duration (milliseconds to microseconds). The PEF may also cause a sub-lethal injury in some microbial population, thus some of them can recover when they are in the optimal condition[16,17]. The membrane permeabilisation can be achieved at moderate electric fields (<10 kV/cm) and low specific energies (<10 kJ/kg)[18]. The lethality and the cell disruption are dependent to the microorganism and the environmental conditions[17]. Therefore, the effectiveness of the microbial inactivation also depends on the processing parameters applied that may cause either transiently or permanently permeability on the cytoplasmic membrane disintegration.[4] reported that the PEF treatment of 35 kV/cm and 300 msec could inactivate 5 $\log_{10}$ cycles of *Salmonella Typhi murium* STCC878 and *Escherichia coli* O517:H7 was reduced 2 $\log_{10}$ cycles and 4 $\log_{10}$ cycles at pH 3.5 and 5.5, respectively[4]. It is essential to know the influence of those factors individually and their concurrent effect in order to evaluate the potential of PEF technology in microbial elimination in food systems.

Therefore, this research aimed to optimize the PEF operation in microbial reduction in durian juice with emphases on three parameters: the pulse frequency, the supplied voltage and the flow rate of the durian juice. The response surface methodology (RSM) was used to design the treatment matrix for the process optimization.

Experimental

1. Raw Material

Frozen durian flesh was prepared from Mon Thong cultivar (*Durio zibetbinus* Murr.) obtained from the local market in Chanthaburi Province, Thailand. The sample (450-500 g) was separately frozen and kept in a polypropylene freeze bag at -20°C, until use.

2. Sample Preparation

Two-hundred grams of the frozen durian flesh was mixed with sterile water 250 mL. The sample was blended using a sterile wire blender (at a speed level 1) for 1 min. The sample was then filtered through a triple layer of sterile cloth-sheet and then kept in a sterile bottle embedded in ice to maintain the temperature of 0-4°C.

3. PEF system

The PEF equipment used in this investigation was designed and setup[15] The PEF system comprised a stainless steel chamber, a pulse generator and a pivotal system. The set up PEF has a capacity in the range of 10-30 kHz. The voltage is applied to the PEF chamber in the range of 10-40 kV. The voltage supply could also be determined by the space of the electrodes in the treatment chamber, the flow rate of fluid through the pipe was in the range of 500-100 L/min[15].

4. Experimental Design

The response surface methodology was used to evaluate the effect of the three treatment parameters at two levels (low-high) including pulse frequency (10-30 kHz), pulse intensity (10-40 kV) and flow rate of the fluid foods (500-1000 mL/min) on the responses of the survival of the microbial content and the rate of microbial reduction. The obtained data, after the sample treated with different conditions, were modeled with the following second order polynomial equation (1)[18]:

$$Y = \beta_0 + \sum_{i=1}^{k} \beta_i X_i + \sum_{i=1}^{k} \beta_{ii} X_i + \sum_{i>j}^{k} \beta_{ij} X_i X_j \qquad (1)$$

Where,

Y = the response variable to be modeled

X_i and X_j = the independent factors

β_0 = the intercept
β_i = the linear coefficient
k = the total number of independent factors

5. PEF-treatment on microbial reduction in durian juice

The sample was mixed with 3 L of the sterile water and then subjected to the PEF chamber as the condition assigned in the (Table 1). In a previous report on this PEF system, the PEF treatment should be run as a two-cycle run to provide the most effective result for microbial reduction. Therefore, all runs were performed as two-cycle runs. In addition, the PEF chamber and pivotal line were washed twice with 5 min circulation of 4 L hot water before running the next cycle.

6. Determination of microbial survival content

The samples were decimal diluted in sterile 0.85% NaCl before spreading on a plate to count agar (PCA) medium and then cultivated at 37°C for 12-24 h[19]. After that, the survival rate (equation 2) and the microbial reduction rate (equation 3) were calculated based on the model linearity.

$$\text{The survival rate} = \frac{1}{\sqrt{\eta}} = \frac{1}{\sqrt{TVC}} \quad (2)$$

The microbial reduction rate

$$= \mu_{red} = \frac{\left(\frac{TVC_0 - TVC_t}{TVC_0}\right)}{t} \quad (3)$$

Where η = Survival microbial content (CFU/mL)
μ_{red} = Rate of microbial reduction (min^{-1})
TVC = Total viable count (log CFU/mL)
TVC_0 = Total viable count of PEF-untreated sample (log CFU/mL)
TVC_t = Total viable count of PEF-treated sample (log CFU/mL)
t = treatment time (min)

7. Statistical analysis

The experiments were done in triplicate and the central composite design (CCD) and the corresponding analysis of the data were carried out by using the software package Design-Expert (Trial Version). The parameters of the models were tested in the regression and interaction at the statistical significance at *P<0.05*.

Results and Discussions

According to the results, there were two responses: the function inverse of the survival rate ($h^{-1/2}$) and the rate of microbial reduction (m_{red}). These were obtained from the total viable count (TVC) but had a different account of the treatment time (t). (Table 1) shows 16 runs by the treatment matrix of central composite design (CDD). By the statistical analysis, the survival rate was suggested to take a power of -0.5 to be fitted as linearity behavior (*F-value = 8.50*, *P = 0.0027*). The rate of reduction was calculated based on the treatment time, thus finding fitted linearity (*F-value = 6.54*, *P <0.0001*). By the fitted linear modeling, two models of the microbial survival (equation 4) and the microbial reduction rate (equation 5) were suggested.

The fitted equation of microbial survival:

$$\frac{}{\sqrt{\eta}} = 0.068 - 2.16\times10^{-3} f - 1.44\times10^{-3}\nu - 1.44\times10^{-4}\Phi - 1.87\times10^{-4} f\nu + 5.21\times10^{-6} f\Phi - 3.96\times10^{-6}\nu\Phi + 4.79\times10^{-5} f^2 + 2.26\times10^{-4}\nu^2 + 1.11\times10^{-7}\Phi^2 \quad (4)$$

The fitted equation of microbial reduction rate:

$$\mu_{red} = 9.47 - 0.44 f + 0.03\nu + 3.79\times10^{-3}\Phi - 4.12\times10^{-3} f\nu + 1.27\times10^{-4} f\Phi - 6.64\times10^{-5}\nu\Phi + 9.72\times10^{-3} f^2 + 3.61\times10^{-3}\nu^2 - 7.3\times10^{-6}\Phi^2 \quad (5)$$

Where

η = Survival microbial content (CFU/mL)

μ_{red} = Rate of microbial reduction (min^{-1})

f = Pulse frequency (kHz)

ν = Supplied voltage (kV/cm)

Φ = Flow rate of the sample (mL/min)

The model of microbial survival (equation 4) had lower reliability to use for the prediction of the PEF efficiency indicated by the statistical analysis (*Model, F-value = 10.93, P = 0.0044; LOF, F = 27.38, P = 0.0111*). The model of microbial reduction rate was fitted (*Model, F-value = 33.67, P = 0.0002; LOF, F-value =3.65, P = 0.1579*).

Table 1 Central composite design (CCD) matrix and responses for the microbial reduction in PEF-durian juice (predicted and experimental values).

Run	f (kHz)	ν (kV/cm)	Φ (ml/min)	Predicted value		Experimental value	
				Survival rate$^{-0.5}$	Reduction rate (min^{-1})	Survival rate$^{-0.5}$	Reduction rate (min^{-1})
1	10 (10)*	28 (30)*	800 (800)*	0.0310	6.09	0.0449	6.50
2	30 (30)*	40 (40)*	680 (700)*	0.1000	7.25	0.0737	7.05
3	10 (10)*	40 (40)*	500 (500)*	0.1700	10.87	0.1769	10.84
4	17 (20)*	40 (40)*	1000 (1000)*	0.1410	5.21	0.1160	5.04
5	10 (10)*	40 (40)*	500 (500)*	0.1700	10.87	0.1769	10.84
6	15 (15)*	18 (20)*	660 (700)*	0.0125	6.22	0.0037	5.44
7	30 (30)*	20 (20)*	1000 (1000)*	0.0600	3.71	0.0447	3.52
8	22 (25)*	29 (30)*	800 (800)*	0.0270	4.75	0.0289	4.84
9	30 (30)*	10 (10)*	500 (500)*	0.0100	5.85	0.0167	5.99
10	10 (10)*	10 (10)*	1000 (1000)*	0.0110	3.05	0.0258	3.39
11	22 (25)*	10 (10)*	800 (800)*	0.0125	3.89	0.0318	4.26
12	10 (10)*	10 (10)*	1000 (1000)*	0.0260	3.76	0.0258	3.39
13	30 (30)*	10 (10)*	500 (500)*	0.0125	6.21	0.0167	5.99
14	30 (30)*	40 (40)*	1000 (1000)*	0.0600	4.48	0.0883	4.71
15	10 (10)*	10 (10)*	500 (500)*	0.0156	6.59	0.0057	6.66
16	22 (25)*	28 (30)*	500 (500)*	0.0310	5.82	0.0225	6.17

Remark: (*) asterisks represented to the measured values in the experiments

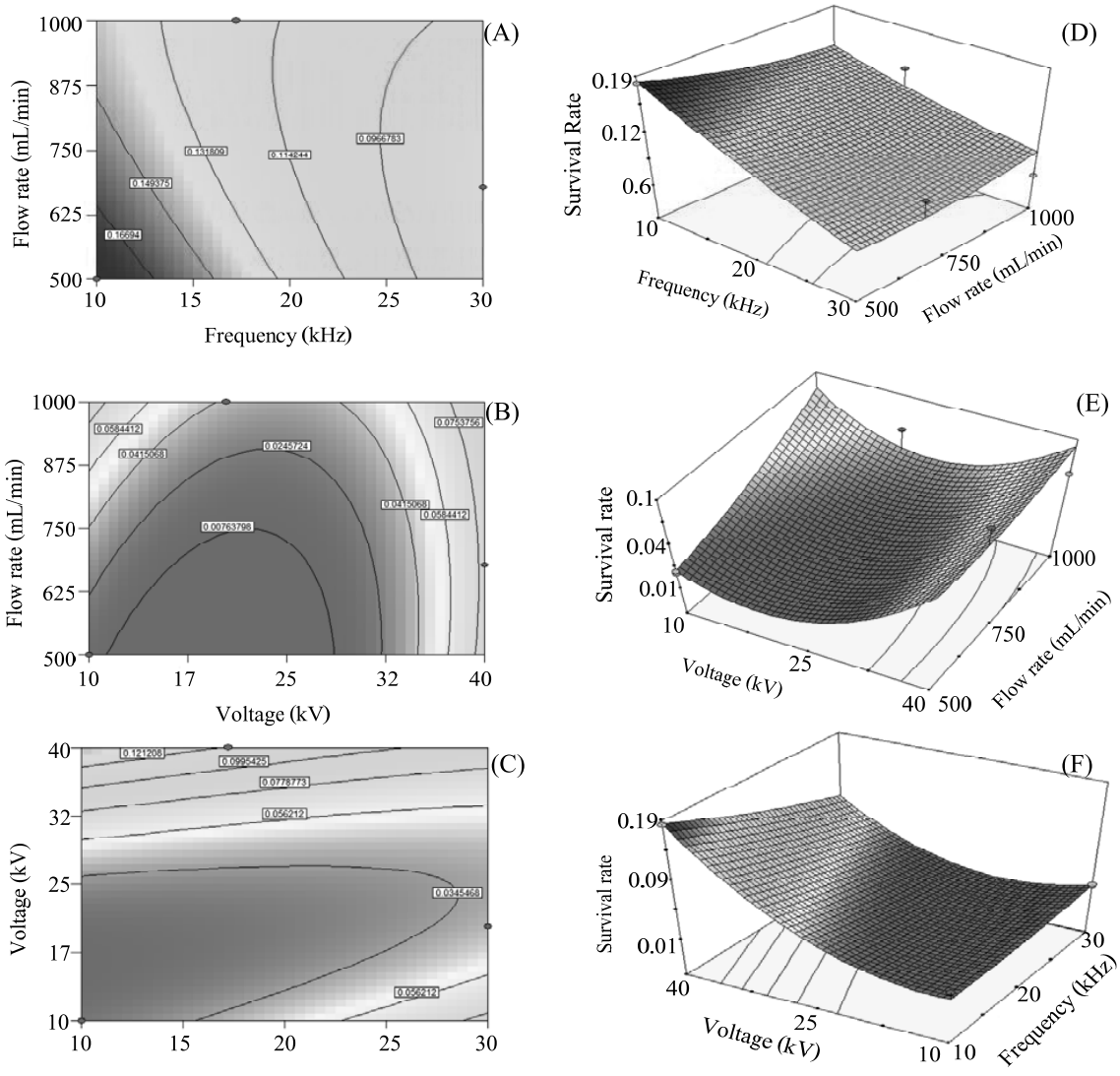

Figure 1 Contour plots (A-C) and response surfaces of the tested parameters (D-F) on microbial survival

From the microbial reduction rate model, it could be implied that the voltage frequency was a domoinant parameter on microbial reduction in the durian juice. The interaction of frequency and voltage supply had a concurrent enhancing on the PEF to reduce microbial content in the liquid foods. The results are similar to the findings of Elez-Martinez et al. (2005) that the increasing of pulse frequency caused decreasing in the PEF effect on microbial reduction[20].

Conclusion

The voltage frequency was a major parameter on the microbial reduction in durian juice. In addition, the voltage supply and the frequency use are concurrent in microbial reduction. In this study, the optimal condition for microbial reduction in durian juice was at 40 kV/cm with 10 kHz and the flow rate of 500 mL/min with the microbial reduction rate of 10.84 min^{-1}.

Acknowledgement

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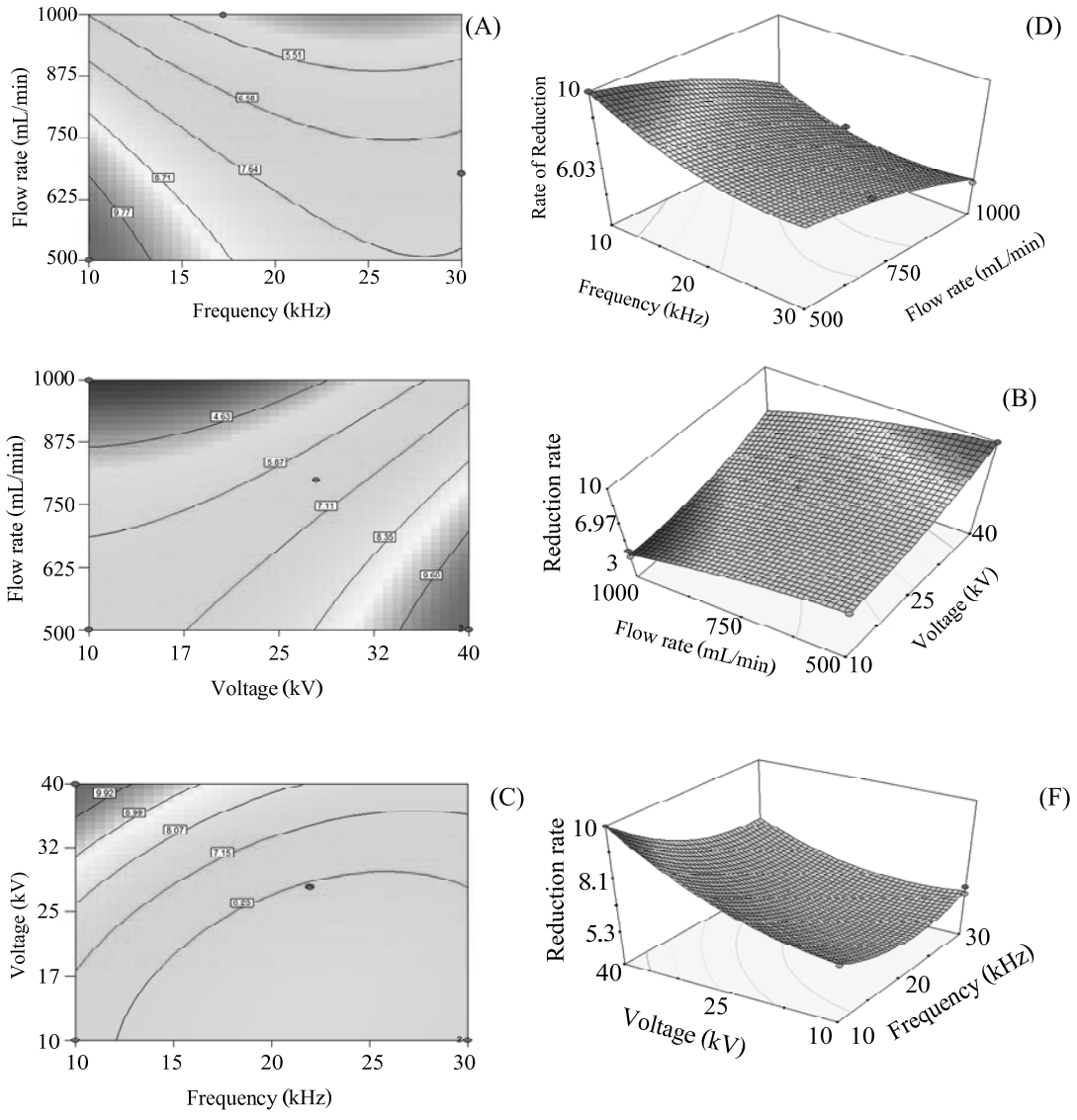

Figure 2 Contour plots (A-C) and response surfaces of the tested parameters (D-F) on the microbial reduction rate

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NIR Enhancement of a LSU Dryer for Maize

Chanat Vipattnaporn[1], Suphan Yangyuen[1], Juckamas Laohavanich[1]

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Abstract

In the drying process of maize grains with mixed flow of plant drying, enterprises have faced problems at the outset of the drying process due to a long time required for drying high moisture grains. This research aims to develop the use of near-infrared radiation added to the mixed flow drying system, which will help increase the rate of heat exchange to reduce the grain's moisture faster. The experiment was divided into two parts 1) the principle of heating by near-infrared radiation and grains transporter and 2) the installation of the device and the testing of actual work in the factory. The zigzag pattern of the device was a developed track for the grains to turn and run through 3000 watts of near-infrared radiation power from 4 infrared lamps installed above the transport rail for longer operation time. And the installation of vibration motors could enhance a better flow in the case of high moisture maize. The zigzag tray could be installed parallel to the exit part that was connected to the bottom of bucket conveyor. The results of conducting experiments in two harvesting seasons on drying maize grains at initial moisture content of 30% wb, showed that the drying time was reduced to about 18 percent. The cost reduction in the drying cycle was about 934.54 baht per round and a breakeven point was 42 days

Keywords: maize, hot air, near infrared radiation, LSU dryer

Introduction

Maize is one of the crops important to both domestic production and export. Maize varieties are grown in countries with hot climates and are suitable for the climate in Thailand. Maize can be grown 2 times a year and can be harvested at 110 to 120 days of age[1]. In the rainy season from September to October high humidity endangers the quality of the seed corn. Rapid deterioration caused by a fungus produces aflatoxin. As a result, the quality does not meet the standard of corn production. Therefore, the post-harvest drying prior to storage is an important step in preventing the growth of fungus and microorganisms that destroy the grain quality. The proper moisture before storage is estimated at no more than 14.5 percent wet basis. In general, farmers get used to dry corn spread on the ground because it is convenient and economical but often problems are encountered during the rainy season. Drying by this method has been used instead of corn grain dryers to dry the seeds spread on the ground. The entrepreneur uses dried corn for animal feed. The mixed-flow dryers, or LSU dryer, experienced a time problem when drying corn grain with high moisture content in the first drying period. It was taking longer to dry. The cost of wasted energy increased. The researcher became interested in studying near infrared radiation with unique properties such as the ability to transfer heat directly to the material, inexpensive and could be applied with other drying techniques. This is a preliminary study.

Experimental set up

Near infrared radiation equipment was designed and built for installation with the LSU dryer. The main components include a conveyor zigzag tray to enhance the vibration

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motors ability to increase the heating period from the near infrared radiation. The near infrared radiation heating power of 3 kW from 4 lamps above the zigzag tray were set at a distance of 150 mm, which is suitable for the drying maize[1,2]. The equipment was installed between a dryer tank and bucket conveyor (Figure 1) to test the performance of the unit. This method was compared with the LSU drying system which was the original hot air drying system. The results of the study included measuring the moisture content, temperature and color value of maize grain temperature. The test was three replications of two harvesting seasons.

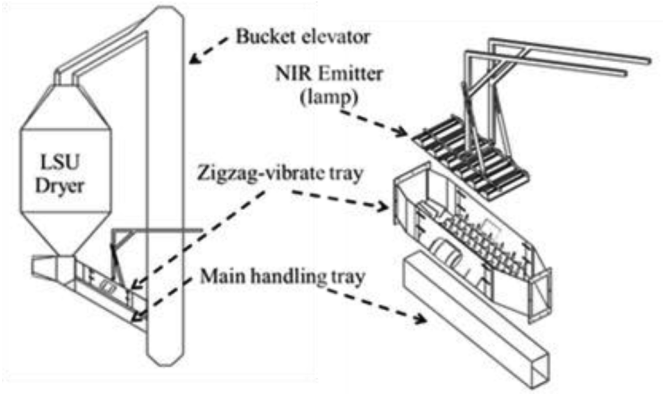

Figure 1 The installation of the near infrared radiation device with LSU dryer system

Results and Discussions

The results of near-infrared radiation equipped with LSU dryers were reported. This was a test comparison between the normal drying processes and drying with the enhancement of heat exchanging with near-infrared radiation. The results also indicated the moisture content, temperature and color values of the maize grains. The initial moisture content of corn was 30 percent wet basis. The changing moisture content of the corn grain drying system was enhanced by near-infrared radiation, and the drying period is likely to decline more than in the early part of the drying process (Figure 2). This is due to the heat exchange characteristic of infrared radiation which directly affects the maize grain.

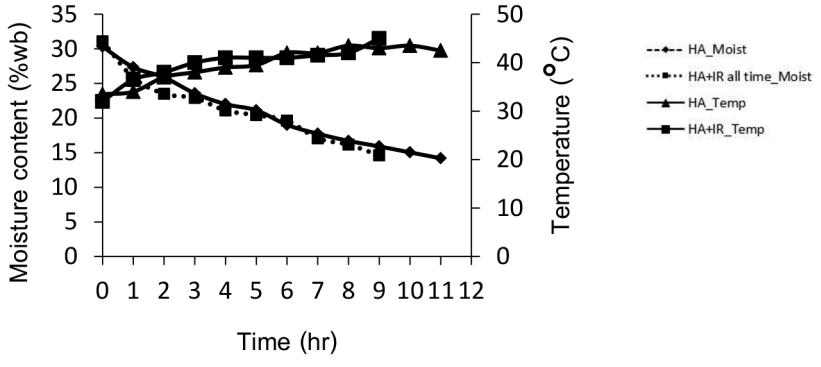

Figure 2 Moisture and temperature changing of the maize grain by near-infrared radiation all the drying time

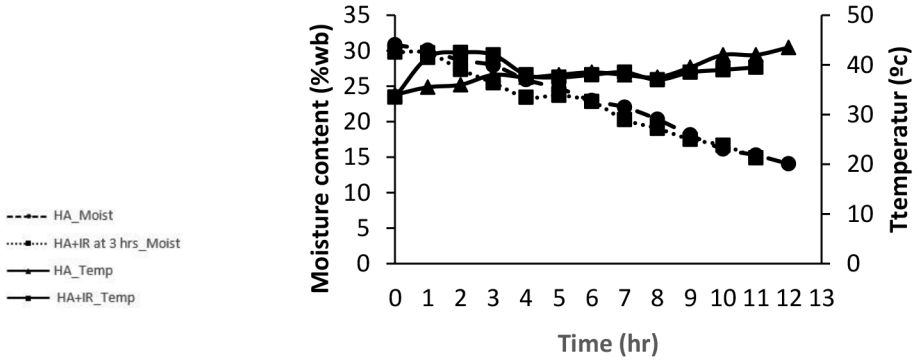

Figure 3 Moisture and temperature changing of the maize grain by near-infrared radiation for 3 hours

The study found that a heat exchanger with near-infrared radiation could shorten the drying time. The long decline could be compared with the cost of energy from the burning of corn. The comparison shows the cost of system operation and the enhancement of the heat exchanging with near-infrared radiation (Table 1).

Table 1 Cost of operation compared to enhancement of heat exchanging with near-infrared

Drying System	Cost(Baht/Cycle)		Sum(Baht)
	Electric charge	Cob cost	
Regular System	1,326.36	5,000	6,326.36
Enhanced NIR System	1,391.82	4,000	5,391.82
Variation	-65.46	+1,000	+934.54

The color values of maize grain after drying was compared by different drying methods. There was no significantly difference at 95% (Table 2).

Table 2 The average color values of maize grain of three drying conditions

Experimental conditions	Color Values		
	L*	a*	b*
After drying with HA + NIR (all time)	58.85±2.00[a]	17.90±1.80[b]	35.28±3.10[c]
After drying with HA+NIR (at 3 hrs)	59.57±2.52[a]	18.2±1.38[b]	37.28±0.17[c]
After drying with regular system HA	58.32±0.83[a]	18.13±0.90[b]	36.24±0.92[c]

Note - HA : Hot Air, NIR : Near Infrared Radiation

Conclusion

Application of near-infrared radiation for pre-heating maize was developed. The prototype set was installed with the LSU dryer at Tah Yong Limited Partnership. Then, The results of conducting experiments in two harvesting seasons on drying maize grains at initial moisture content of 30%wb, showed that the drying time was reduced to about 18 percent. The cost reduction in the drying cycle was about 934.54 baht per round and a breakeven point was 42 days

Acknowledgement

Thanks to the Faculty of Engineering All Rights Reserved Providing support for research.

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More Efficient Rooftop Ventilation Wind Generators with Topping Vertical Blades

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Abstract

This paper presents a technique for improving the efficiency of an electrical generation system. Specifically, a rooftop ventilation wind generator using topping vertical blades is presented. A conventional 22-inch rooftop ventilator with 12 copper coils and 15 Neodymium magnetic sheets was investigated. The proposed ventilation wind generator had 4 vertical blades on its top and was tested with wind speeds of 2.4, 2.8 and 3.4 m/s. The experimental results show that the proposed generator can generate higher output rms phase voltages of 0.96, 1.48 and 1.90 V at rotational speeds of 37, 52 and 62 rpm compared to conventional generators of 0.70, 1.06 and 1.39 V at the rotation speeds of 26, 38 and 45 rpm, which is a 37-40% improvement in output voltage and a 36-42% improvement in rotational speed.

Keywords: ventilator wind generators, vertical blades, wind energy

Introduction

Using rooftop ventilators is one of the least expensive ways to dispose of heat from buildings to the outside air[1]. Most conventional rooftop ventilators utilize the concept of temperature difference between inside and outside buildings in coordination with the natural wind flow to cause their rotation and thus dispose of the indoor heat. Rotation of parts of rooftop ventilators therefore leads to the possibility of electricity generation based on Faraday's law of induction. Permanent magnetic sheets could be mounted on the rotating parts of the ventilators to provide a constant magnetic field and when these magnetic fields are managed to move across closed-loop inductive coils, electricity can be generated[2]. These kinds of ventilators are known as rooftop ventilation wind generators (RVWGs). There are few alternative technologies available for RVWGs[3-5].

This paper proposes an alternative method to increase the electricity generation efficiency of RVWG, which is by installing vertical turbine blades on the top of the ventilators. The experimental results obtained from the proposed RVWG show that the proposed RVWG can increase amount of electricity by approximately 37-40% compared to conventional RVWGs, as well as provide greater capability of heat exhausting with a higher rotating speed of approximately 36-42% compared to conventional RVWGs. Structure and operation principle of the proposed wind generator are detailed in Section 2 and Section 3. The experimental results obtained from the proposed wind generator are presented and discussed in Section 4; following by the conclusions in Section 5.

Structure of the Proposed Rooftop Ventilation Wind Generator

(Figure 1a) shows the overall structure of the proposed rooftop ventilation wind generator (RVWG). The proposed RVWG consists of 4 components: a ventilator, copper coils, permanent magnetic sheets and vertical blades. A conventional aluminum ventilator with the most popular diameter of 22 inches was used (Figure 1b). Twelve sets of copper coils with 170 turns per coil, 24 degrees apart from each other (Figure 1c) were installed around the circular base of the ventilator. Fifteen sets of Neodymium permanent magnetic sheets were installed

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on the moving part of the ventilator, which were designed to rotate across all the copper coils angularly with the air gap between the magnetic sheets and coils of 1 cm (Figure. 1d). The magnetic sheets with the width, length and thickness of 2, 5 and 1 cm were used. Four vertical blades with dimensions shown in (Figure 1e) were additionally installed on the top of the ventilator.

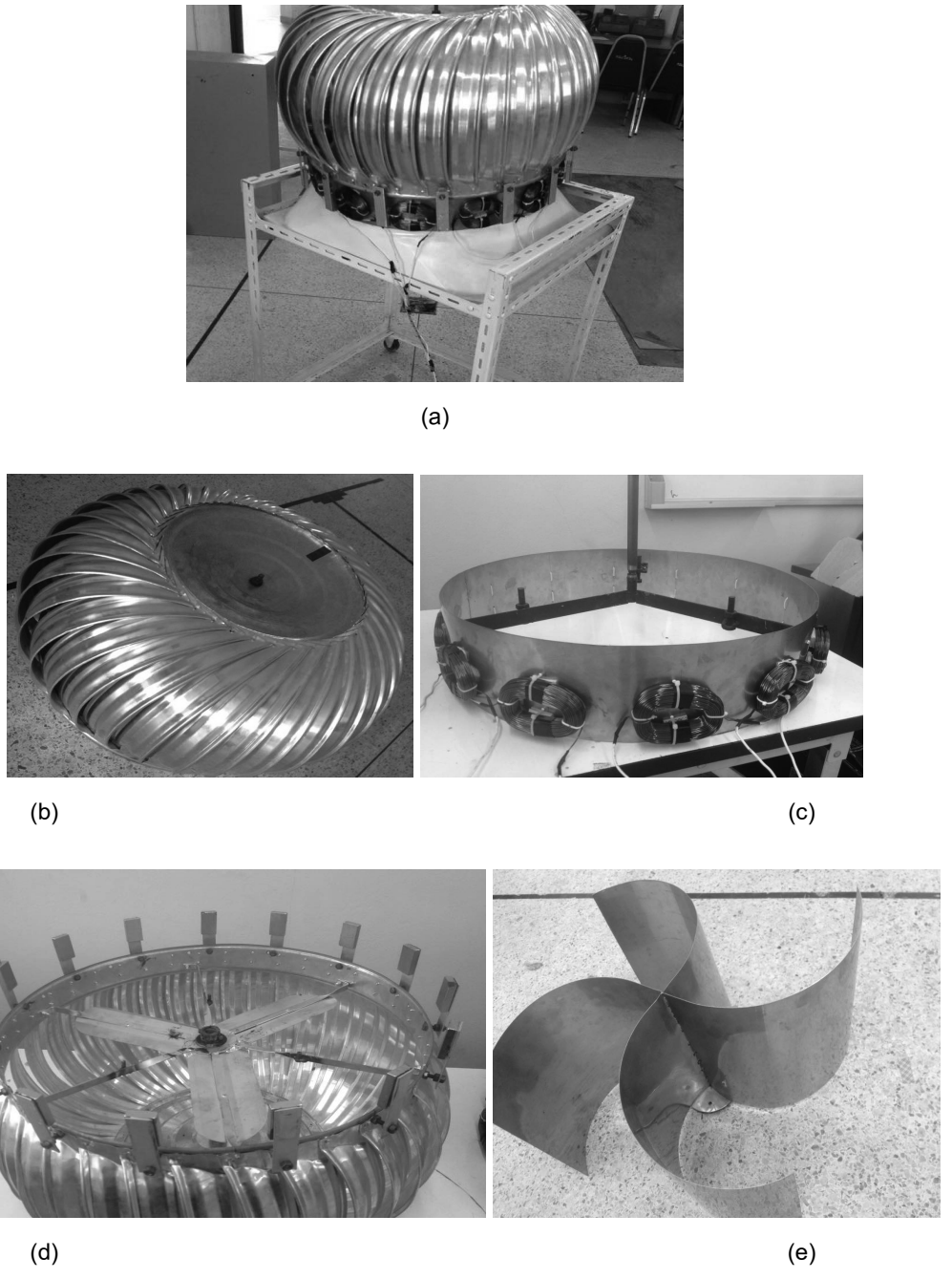

Figure 1 Structure of the proposed rooftop ventilation wind generator: (a) overall structure; (b) a ventilator; (c) copper coils; (d) permanent magnetic sheets; (e) vertical blades

Operation Principle of the Proposed Rooftop Ventilation Wind Generator

Operation principle of the proposed rooftop ventilation wind generator can be described by referring to (Figure 1a-e). A conventional, low cost aluminum ventilator was used, which had functionality to dispose of the hot air inside the building to the outside as well as provide rotational movement for the magnetic sheets that

were mounted on the edge of the moving part of the ventilator. The moving magnetic sheets generated magnetic fields and conducted electrons inside the closed-loop copper coils to move and finally generated electricity based on Faraday's low of induction. The additional vertical blades were installed on the top of the ventilator, which helped to increase rotation speed of the ventilator by increasing the attacking surface area for both wind from hot air and natural wind. Four vertical blades were used to allow all directions of wind (i.e. North, East, South and West) to rotate the blades easily even with very low wind speed.

Results and Discussions

(Figure 2) shows photographs of the experimental test systems. The conventional rooftop ventilation wind generator (RVWG) shown in (Figure 2a) was tested with the wind speeds of 2.4, 2.8 and 3.4 m/s generated from a fixed-position electric fan. The output rms voltage and speed of the RVWG then were measured and used for analysis and conclusions. Similarly, the proposed RVWG with additional vertical blades was tested with same input wind speeds and same test conditions as shown in (Figure 2b) The experimental results in terms of output voltage and rotational speed were examined.

(a) (b)

Figure 2 Photographs of the experimental test systems: (a) testing the conventional RVWG and (b) testing the proposed RVWG

1. Output Voltage

(Figure 3) shows compared results of the output voltage waveforms generated from the conventional RVWG (Figure 3a, c and e) and the proposed RVWG (Figure 3b, d and f) when testing with the wind speeds of 2.4, 2.8 and 3.4, respectively. The measured parametersfrom (Figure 3a-f) were reproduced in (Table 1). It can be seen that the output phase voltage levels of the proposed RVWG increase approximately 37-40% compared to the conventional RVWG.

Table 1 Measured output phase voltage at different wind speeds

Parameter	Conventional RVWG			Proposed RVWG (%change)		
	2.4 m/s	2.8 m/s	3.4 m/s	2.4 m/s	2.8 m/s	3.4 m/s
$V_{peak\text{-}peak}$(volt)	2.24	3.44	4.44	3.24 (+44.6%)	4.52 (+31.4%)	5.72 (+28.8%)
V_{rms} (volt)	0.70	1.06	1.39	0.96 (+37.1%)	1.48 (+ 39.6%)	1.90 (+36.7%)

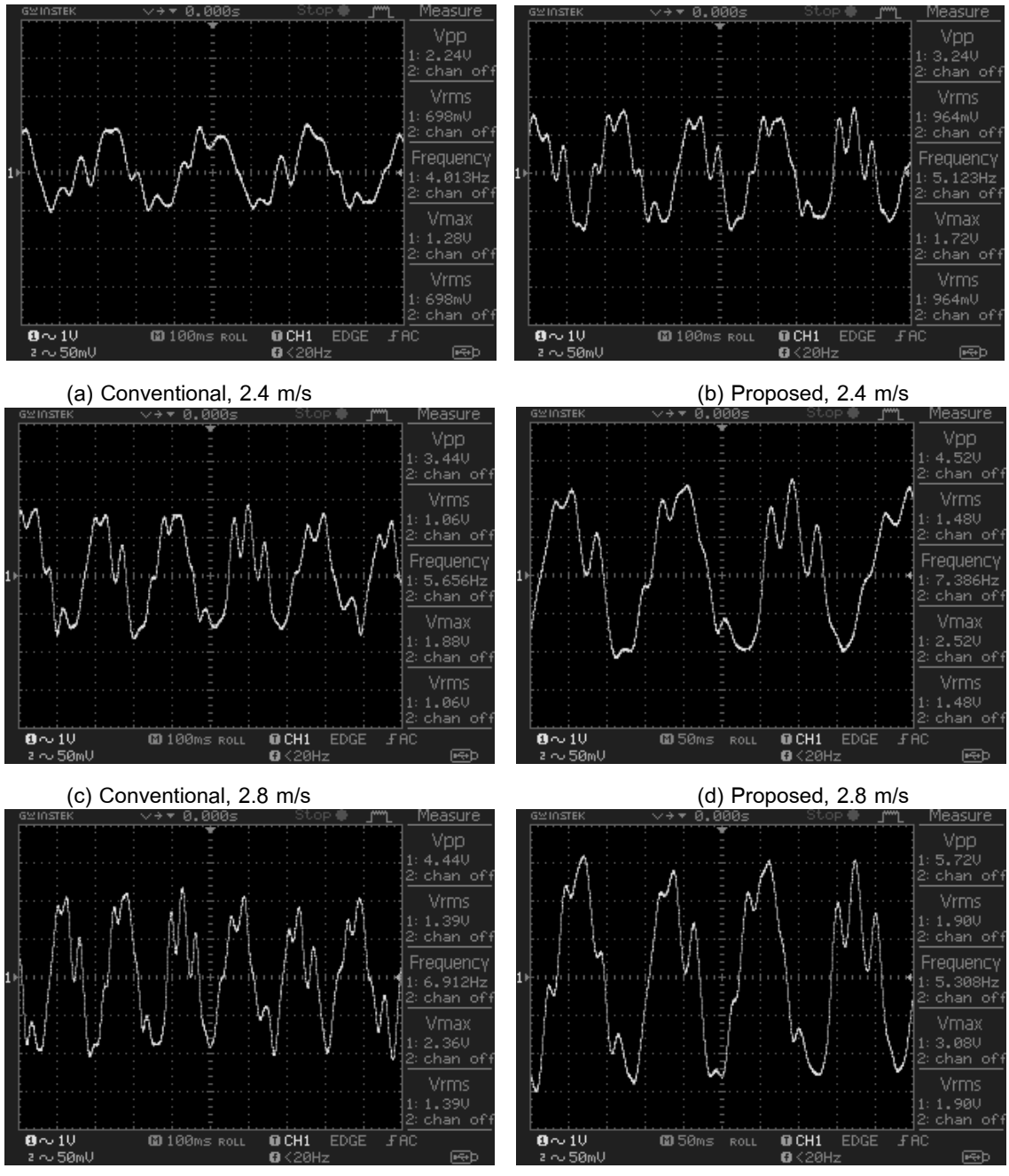

Figure 3 Output phase voltage waveforms: (a), (c) and (e) from conventional RVWG and (b), (d) and (f) from the proposed RVWG when testing with wind speed of 2.4, 2.8 and 3.4 m/s, respectively

2. Rotational Speed

(Table 2) shows measured rotational speeds of the rooftop ventilation wind generator (RVWG) for both the conventional RVWG and the proposed RVWG. The results show that adding vertical blades to the conventional RVWG could help to increase rotational speed approximately 36-42%. This would reflect the improved capability of exhausting the heat of the proposed RVWG compared to the conventional RVWG.

Table 2: Measured rotational speed of the conventional and proposed RVWG at different wind speeds

Parameter	Conventional RVWG			Proposed RVWG (%change)		
	2.4 m/s	2.8 m/s	3.4 m/s	2.4 m/s	2.8 m/s	3.4 m/s
Rotational Speed (m/s)	26	38	45	37 (+42.3%)	52 (+36.8%)	62 (+37.8%)

Conclusions

A more efficient rooftop ventilation wind generator using topping vertical blades has been proposed. Details of structure and operation principle of the proposed generator have been described. The experimental results in terms of generated output phase voltage and rotational speed obtained from both conventional and proposed generators have been presented and compared. The results show that output voltage and rotational speed of the proposed generators, when applied wind speeds of 2.4, 2.8 and 3.4 m/s, has been improved by approximately 37-40% and 36-42% compared to the conventional rooftop ventilation wind generator.

Acknowledgement

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Causal Relationship Model of EQ and MQ and Environmental Education

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Abstract

The objective was to propose a structural model Emotional Quotient (EQ), Moral Quotient (MQ) and Environmental Education (EE) affecting environmental behavior for global warming alleviation through inspiration of public consciousness. The population was 37,101 undergraduate students of Mahasarakham University in the second semester of academic year 2013. The Multi-stage simple random sampling technique was employed to collect the sample for 400 undergraduate students. The research instrument was a questionnaire, and it was used for data collecting. LISREL was used for model verification. Results illustrated that the structural model confirmatory factors of Emotional Quotient (EQ), Moral Quotient (MQ) and Environmental Education (EE) were able to explain the variation of endogenous factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) to cause Environmental Behaviors for Global Warming Alleviation (BEH) with 96.00 percent. IPC had the most effect to BEH with 0.69. Consequently, confirmatory factors of Environmental Education (EE), Emotional Quotient (EQ), and Moral Quotient (MQ), were able to explain the variation of confirmatory factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) with 88.00 percent. EE was the effect to IPC with 0.49.

Keywords: model EQ, MQ, environmental education affecting, environmental behavior

Introduction

The rapid growth of global population is a critical environmental problem because people need natural resources for daily living. Moreover, numerous scientists have indicated that human activity is the foremost factor of environmental deprivation and natural resources devastation. It results in degradation of environmental quality and waste accumulation. However, human activities, primarily clearing of forests and the burning of fossil fuels have intensified the natural greenhouse effect to cause global warming[7,32,11,18]

Emotional quotient (EQ) or emotional intelligence quotient is a measurement of a person's ability to observe his or her emotions, to cope with pressures and difficulty. EQ is the capability to assess the concern conditions and connections with other peoples. There various style of EQ test varies according to different interest, but it is hypothesized as questionable or self-reported data. However, the EQ test highlights intensely on problem solving design to determine the ability of the responder to comprehend, and control emotions within themselves and others. High scores indicate high awareness of general social norms. Measurements of people's EQs are used in many situations. Generally, this idea is very well established in the business world, where many businesses use EQ tests to help their employees determine and measure their emotional responses to different situations. Therefore, EQ tests are often used in business to identify strengths and weaknesses in employees so that these employees can learn skills to improve certain aspects of their EQ. EQ is also inherent ability and learned behavior.[5,9,2,1]

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Moral Quotient (MQ) is comparable to environmental ethics. Morality distinguishes from intentions, decisions, and performances between those that are good or right and those that are bad or wrong. A system of morality is relative with a particular philosophy, religion, and culture. Therefore, morality may also be entirely the same with "goodness" or "rightness.".[3,8,14,34] A moral code is the Golden Rule which insists that, "One should treat others as one would like others to treat oneself." MQ is an ability to effectively react to difficulties by noticing from his or her response with a wide range of difficult events. In contrast, groups in the most firm occupations frequently score below the comprehensive mean. However, it is revealed that people are likely to choose occupations based on their MQ.[13]

Environmental Education (EE) is an essential concept for supporting sustainable development via developing the people competence to concentrate on environment and development issues. It should particularly be conducted by means of the education system whether formal, informal, non-formal or lifelong education in order to raise awareness, to change attitude, to cultivate the consciousness, to take responsibility and to practice skill for achieving better environmental behavior based on inspiration of public mind or public consciousness. The principles of EE are congruent to Sustainable Development (SD) in terms of increasing environmental knowledge and understanding, changing people's attitudes and awareness, to have appropriate value and skill to take responsibilty for environmental conservation behavior through inspiration of public mind and for effective public participation. Additionally, to reach the success of EE and SD, it should manage with attention on the dynamics of both the physical/biological and socio-economic environment and human development, should be integrated in all disciplines with effective means of communication.[35,18,19,20,21,22,23,24,25,26]

Thiengkamol discovered, from various researches on inspiration of public consciousness or public mind, and she concluded that it might occur from one' insight with or without any action or it might occur from one's impression on role model, event, environment and media perception. It is different from motivation because inspiration needs no rewards. Inspiration of public consciousness or public mind, especially, for natural resources and environment conservation, one doesn't receive any incentive, respect or gratefulness for one's act for natural resources and environment conservation.[15,16,18,19,21,22,25,26,27,28,29,30]

It is not obviously seen that the research about EQ, MQ, EE affects environmental behavior for global warming alleviation through inspiration of public consciousness including person as role model, impressive event, impressive environment, and media perception [22,23,12,6] when it compared with other aspects of relating factors affecting environmental behavior for global warming alleviation.

Therefore, this research was designed to study all factors relating to the above/ It alone would be able to develop a model of environmental behaviors for global warming alleviation that is affected by EQ, MQ and EE through inspiration of public consciousness.

Objective

The objective was to propose a structural model of EQ, MQ and EE affecting environmental behavior for global warming alleviation through inspiration of public consciousness.

Methodology

The research design was implemented in steps as follows:

1. The population was 37,101 undergraduate students of the second semester in academic year 2013 at Mahasarakham University. Multi-stage random sampling was employed to collect 400 students from different faculties of Mahasarakham University.

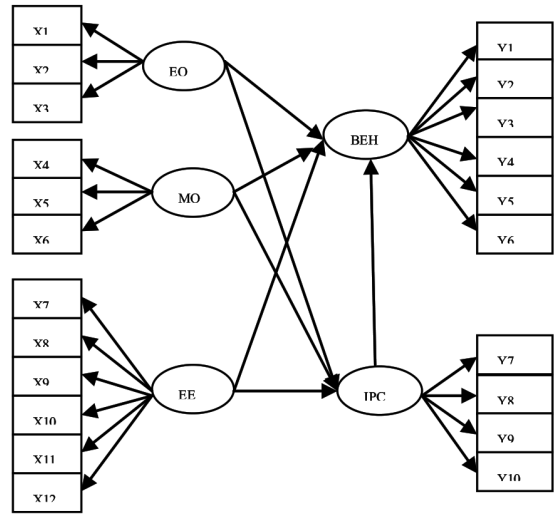
2. The research instrument was a questionnaire, and it was used for data collection. The content and structural validity were determined by Item Objective Congruent (IOC) with 5 experts in the aspects of environmental education, psychology, social science and social research methodology. The reliability was done by collecting the sample group from 50 undergraduate students of Rajabhat Mahasarakham University which is nearby Mahasarakham University. The reliability was

determined by Cronbach's Alpha. The reliabilities of Moral Quotient (MQ), Emotional Quotient (EQ), Moral Quotient (MQ), Environmental Education (EE) Inspiration of Public Consciousness (IPC), Behaviors for Global Warming Alleviation (BEH), and the whole questionnaire were 0.919, 0.877, 0.972, 0.977, 0.964 and 0.967 respectively.

3. The descriptive statistics used were frequency, percentage, mean and standard deviation. The inferential statistics used was LISREL by considering on Chi-Square value differs from zero with no statistical significant at 0.05 level or Chi-Square/df value with lesser or equal to 5, P-value with no statistical significant at 0.05 level and RMSEA (Root Mean Square Error Approximation) value with lesser than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00.

Conceptual Framework

The exogenous latent variables of Intelligence quotient (IQ), Adversity Quotient (AQ) and Environmental Education (EE) had direct and indirect effects to Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors for Global Warming Alleviation (BEH). IQ was measured by Conceptual Creation (X1), Talent Expression (X2), Relationship Perception (X3), AQ was measured by Personal Challenge (X4), Family Challenge (X5), and Social Challenge (X6). EE was measured by Knowledge and Understanding (X7), Environmental Awareness (X8), Environmental Participation (X11), and Environmental Evaluation (X12). The endogenous latent variable of BEH was measured by Consumption Behavior (Y1), Energy Conservation Behavior (Y2), Recycling Behavior (Y3), Waste Management Behavior (Y4), Traveling Behavior (Y5), Knowledge Transferring Behavior (Y6) and IPC was measured by Person as Role Model (Y7), Impressive Event (Y8), Impressive Environment (Y9), and Media Receiving (Y10).



Results

1. Results of Effect among Variables in the Model in Terms of Direct Effect

1) Confirmatory factors of Emotional Quotient (EQ), had a direct effect on the Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors for Global Warm 0.32 and 0.28. Moreover, model Emotional Quotient (EQ), had a indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant level of 0.01 with effect of 0.22.

2) Confirmatory factors of Moral Quotient (MQ) had a direct effect on Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of 0.01 with effect of 0.33 and 0.29. Moreover, confirmatory factors in aspect of Moral Quotient (MQ) had indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of 0.01 with effect of 0.23.

3) Confirmatory factors of Environmental Education (EE) had a direct effect on Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors for Global Warming Alleviation (BEH) with a statistically significant level of 0.01 with effect of 0.49 and 0.42. Moreover, confirmatory factors in aspect of Environmental Education (EE) had indirect effect to Behaviors for Global Warming Alleviation

(BEH) with no statistically significant at level of 0.01 with effect of 0.34.

4) Confirmatory factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) had direct effect Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of 0.01 with effect of 0.69.

5) Considering the structural model confirmatory factors of Moral Quotient (MQ) Emotional Quotient (EQ), and Environmental Education (EE) they were able to explain the variation of endogenous factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) to cause Environmental Behaviors for Global Warming Alleviation (BEH) with 96.00 percent as follows in Equation (1).

$$BEH = 0.29*MQ+0.28*EQ +0.42*EE+ 0.69 *IPC..... (1)$$
$$(R^2 =0.96)$$

Equation (1) factors that had the most effect to Environmental Behaviors for Global Warming Alleviation (BEH) were Inspiration of Public Consciousness (IPC) with an effect of 0.69, and subsequences were Environmental Education (EE), Moral Quotient (MQ) and Emotional Quotient (EQ) with effect of 0.42, 0.29, and 0.28 respectively. These were able to explain the variation of Environmental Behaviors for Global Warming Alleviation (BEH) with 96.00 percent.

Consequently, confirmatory factors of Environmental Education (EE), Emotional Quotient (EQ), and Moral Quotient (MQ), were able to explain the variation of confirmatory factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) with 88.00 percent. Therefore, the equation can be written as follows Equation (2).

$$IPC = 0.49*EE+0.33*MQ + 0.32*EQ ..... (2)$$
$$(R^2 = 0.88)$$

Equation (2) factors that had the most effect to Inspiration of Public Consciousness for Environmental Conservation (IPC) was Environmental Education (EE) with an effect of 0.49, subsequences were Moral Quotient (MQ) and Emotional Quotient (EQ), with an effect of 0.33 and 0.32. These were able to explain the variation of Inspiration of Public Consciousness for Environmental Conservation (IPC) with 88.00 percent.

Table 1 Direct and Indirect Effect of EQ, MQ and EE Affecting BEH through IPC

Causal variable	Result variables					
	IPC			BEH		
	TE	IE	DE	TE	IE	DE
EQ	0.32** (0.065)	-	0.32** (0.065)	0.50** (0.035)	0.22** (0.031)	0.28** (0.034)
MQ	0.33* (0.061)	-	0.33** (0.061	0.52** (0.040)	0.23** (0.029)	0.29** (0.042)
EE	0.49** (0.044)	-	0.49** (0.044)	0.76** (0.064)	0.34** (0.032)	0.42** (0.061)
IPC	-	-	-	0.69** (0.055)	-	0.69** (0.055)
χ^2 = 286.76; df = 181			CN = 245.81		χ^2/df = 1.590	
GFI = 0.94; AGFI = 0.91			RMSEA = 0.003		RMR = 0.0048	

TE: Total Effect, IE: Indirect Effect, DE: Direct Effect

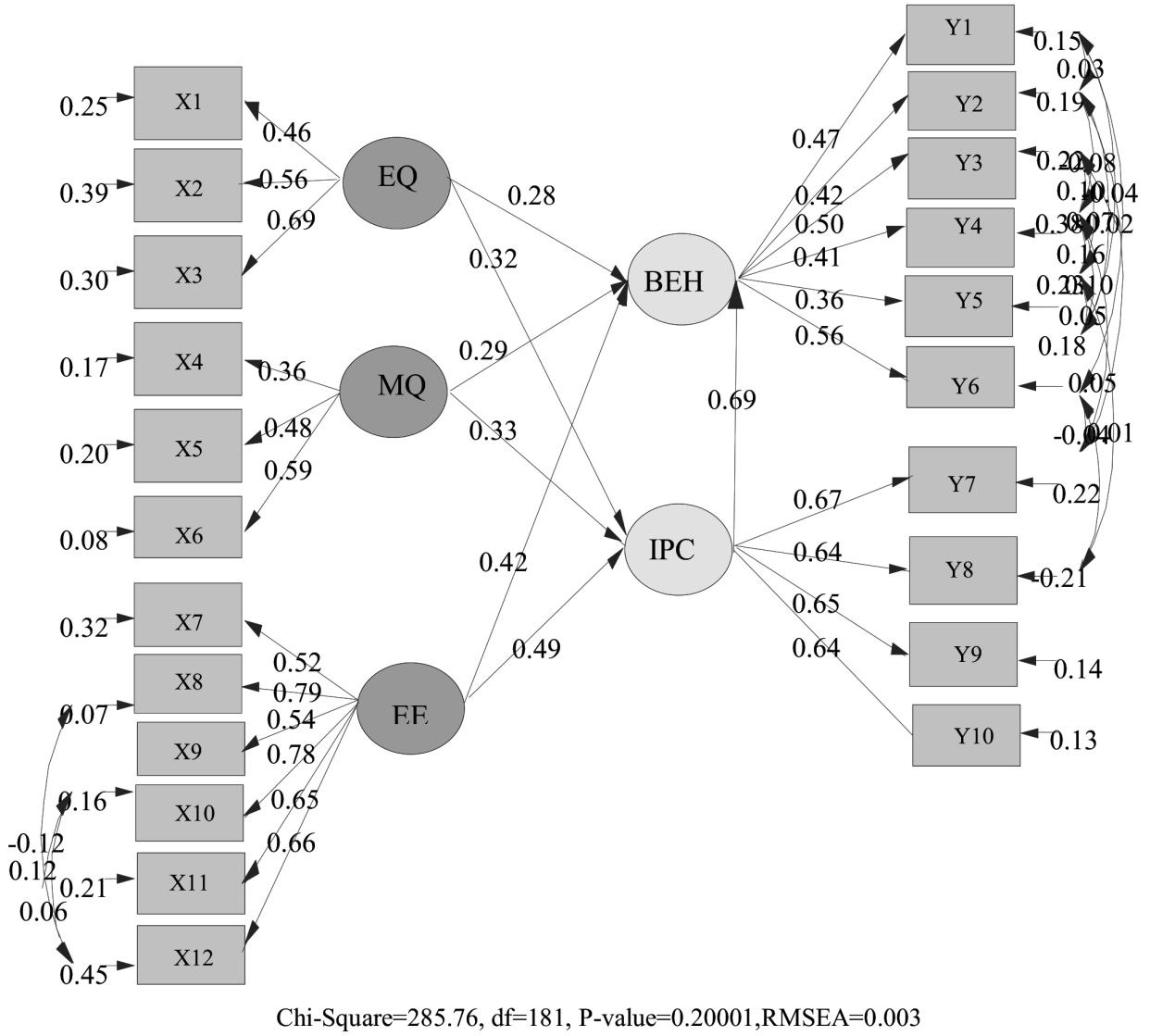


Figure 1 Model of Direct and Indirect Effect of EQ, MQ and EE through IPC Affecting BEH

Discussion

The results revealed that confirmatory factors of Emotional Quotient (EQ) had a direct effect on Environmental Behaviors for Global Warming Alleviation (BEH) and were statistically significant at level of 0.01 with an effect of 0.28, and had an indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with a statistically significant level of 0.01 with effect of 0.22. Furthermore, Emotional Quotient (EQ) had a direct effect to Inspiration of Public Consciousness (IPC) with statistically significant at level of 0.01 with effect of 0.32

Therefore, it is evident that Emotional Quotient (EQ) composed of Emotional Realization (X1), Emotional Control (X2) and Performance and Decision Making (X3) affect Environmental Behavior for Global Warming Alleviation (BEH) through Inspiration of Public Consciousness (IPC) composed of Person as Role Model (Y7), Impressive Event (Y8), Impressive Environment (Y9), and Media Receiving (Y10). Therefore the results of this study are harmonious to various studies of Thiengkamol and her colleagues (Thiengkamol, 2011i; Thiengkamol, 2011j; Thiengkamol, 2012c; Thiengkamol, 2012d; Thiengkamol, 2012e; Donkonchum, et al., 2012a; Gonggool, et al., 2012b; Morrasri, et al, 2012b; Ruboon, et al., 2012a; Udonboon, et al, 2012b; Waewthaisong, et al., 2012a) .

Simultaneously, the results revealed that confirmatory factors of Moral Quotient (MQ) had a direct effect on Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of 0.01 with effect of 0.29, and had indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistical significance at level of 0.01 with effect of 0.23. In addition, Moral Quotient (MQ) had a direct effect to Inspiration of Public Consciousness (IPC) with statistically significant at level of 0.01 with effect of 0.33.

Therefore, it is clearly seen that Moral Quotient (MQ) composing of Personal Ethics (X4), Personal Ethics (X5) and Social Norm (X6) affecting Environmental Behavior for Global Warming Alleviation (BEH) through Inspiration of Public Consciousness (IPC) composing of Person as Role Model (Y7), Impressive Event (Y8), Impressive Environment (Y9), and Media Receiving (Y10), therefore the results of this study are harmonious to various studies of Thiengkamol and her colleagues[22,23,25,26,27,4,6,10,12,31]

The exogenous factors of Emotional Quotient (EQ), Moral Quotient (MQ) and Environmental Education (EE) were able to explain the variation of endogenous factors of Inspiration of Public Consciousness (IPC) to caused Environmental Behaviors for Global Warming Alleviation (BEH) with 96.00 percent.

Moreover, Environmental Education (EE) had a direct effect to Environmental Behaviors for Global Warming Alleviation (BEH) with a statistically significant level of 0.01 with effect of 0.42, and had an indirect effect to Environmental Behaviors for Global Warming Alleviation (BEH) with statistically significant at level of 0.01 with effect of 0.34. Furthermore, Environmental Education (EE) had direct effect to Inspiration of Public Consciousness (IPC) with statistically significant at level of 0.01 with effect of 0.49.

Therefore, it is clearly seen that Environmental Education (EE) composing of Knowledge and Understanding (X7), Environmental Awareness (X8), Environmental Attitude (X9), Environmental Skill (X10), Environmental Participation (X11), and Environmental Evaluation (X12) affecting Environmental Behavior for Global Warming Alleviation (BEH) through Inspiration of Public Consciousness (IPC) composing of Person as Role Model (Y7), Impressive Event (Y8), Impressive Environment (Y9), and Media Receiving (Y10). Therefore the results of this study are harmonious to various studies of Thiengkamol and her colleagues[22,23,25,26,27,4,6,10,12,31]

The model of EQ, MQ and EE affecting BEH through IPC was verified. The proposed model was fitted with all observed variables according to criteria of Chi-Square value differs from zero with no statistical significant at 0.05 level or Chi-Square/df value with lesser or equal to 5, P-value with no statistical significant at 0.05 level and RMSEA (Root Mean Square Error Approximation) value with lesser than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00.

Therefore, it might be concluded that EQ, MQ and EE play a very important role to create the environmental behavior of consumption, energy conservation, waste management, travelling behavior, recycling behavior, and knowledge transferring and supporting for environmental conservation. Therefore the Four Nobel Truths should be reintroduced again in school. However, EQ and MQ are significant factors for undergraduate students to adopting environmental conservation behavior for global warming alleviation through public consciousness to meet sustainable development. These results were congruent to concepts proposed by Thiengkamol[15,16,18,19]

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Development of a Model on Health Care for the Hepatitis B Virus Patients through Thai Traditional Medicine

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Abstract

Thai Traditional Medicines arise from an outstanding effort of educational research and development on drugs and medical improvements. Knowledge of Thai Traditional Medicine is to know the old cultural practices which remain today to essentially benefit the modern world of health care. Development of the health care process through Thai traditional medicine is seen as an essential alternative medicine for curing people of many symptoms. Such an illness being identified as an ordinary liver disease in the former time has now become more meaningful since alternative Thai traditional medicines has been able to help analyze whether the symptom is the ordinary liver disease or being of other virus symptom, or whether it is the Hepatitis B Virus. This developmental process in curing the Hepatitis B Virus patient through Thai traditional medicines is done through a research study aimed at finding the appropriate way or process for curing the patients who are suffering and being infected by the Hepatitis B Virus. This qualitative research is implemented with an aim to discover the best practices in administering the appropriate plans for the performances of 3 particular types of health care centers in relation to their different potentialities and identities. These 3 selected types of health care centers comprise (1) Thai traditional medicines in the hospital, (2) Thai traditional medicines in the private health clinic, (3) Thai traditional medicines conducted by the personnel of local wisdom. According to the research findings, the caring process of Thai traditional medicines in every selected health care center is found to have some particular things in common. For example, the conduct of symptom diagnosis is done through the records inquiries on the patients' sickness from the past to the actual time. Besides, the observations of patients' mental and emotional states as well as body contact are also conducted in order to examine and diagnose the symptom. Following the diagnosis of the symptom, the herbal medicines are advised for curing the symptom. In terms of the general hospitals, the integration of Thai traditional medicines and the modern medicines are used for curing, while the general traditional medicines clinic will concentrate on Thai traditional medicines as the main role but still broadly open for any new sciences and technological knowledge as the alternative development process for caring. In terms of personnel or teachers who represent local wisdom, their health caring will be concentrated essentially on the local way of practices or ancient scriptures medicine. Besides, other significant factors in Thai traditional medicines caring are seen depending on 4 administering and management processes comprising personnel management, venue management, material equipment, and financial management.

Keywords: Thai traditional medicines, patients' health caring process, curing through Thai traditional medicines**,** caring Process for the Hepatitis B Virus Patients through Thai Traditional Medicine

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Introduction

In Thai society, folk medicines in former times existed through the efforts of educational development in terms of medicine management for healing and health care. It could be described as cultural heritage, but indeed the use of folk medicine remains even today in a significant part of the civilized world.[1] Thai traditional medicine is another form of the health care process being classified as intellectual knowledge management and skills of Thai local wisdom. This knowledge will be used to benefit problem solving in terms of treatment and prevention of the sickness of oneself and his/her own community through self-help or self-reliance. This is appropriately seen as a balance of people's life style development and their environment from generation to generation. The local wisdom of Thai traditional medicines is also seen as the holistic valuable culture that concentrates on building up the integration of one's health physically, mentally, socially and environmentally. In other words, Thai traditional medicine is seen as an integration of the health caring processes.[2]

As foreseen by the Ministry of Public Health, 1-2 million people have the Hepatitis B Virus infection and it is certain that in future time approximately 2.5 - 3 million people may die of liver cancer. From this statistic, the Hepatitis B Virus is seen to be the vital cause of cirrhosis and liver cancer. At present, modern medicine has not yet found the appropriate treatment to cure all symptoms of cirrhosis, but only treat them according to their symptom since most of cirrhosis patients come to the hospital with a swollen belly. To cure this symptom, most modern medicine hospitals tend to dehydrate the water by drilling the abdomen of the patient. This method may cause relapsing into a symptoms slump and the patient may possibly die of bacterial infection.[3]

Thai traditional medicines and Thai herbs are the alternative curing process for the people who have financial problem or those who have been impacted by the liver disease as well as those who are suffering from the Hepatitis B Virus symptom and are hopeless in healing by any types of medicines or modern medicine. According to several scriptures that describe the process of healing the liver disease, most those scriptures mentioned only how to cure or discard the symptoms having occurred in and caused by the liver. For example, the symptoms of a bruised liver, liver abscess and liver infection. That way of curing liver disease was regarded as the old fashioned cultural practice of health caring in the former time in which the conduct of recording and following up of the symptom were unseen and were not relevant to the today living that several appropriate technologies can be equipped for recording and diagnosing the symptom.[4] Therefore, when the physician in the former time mentioned only that the liver contracted some disease; however, without any diagnosis what type of disease the liver has got due to the lack of equipment for examination. Sciences and technological equipment in the present day can help identify what particular kind of liver disease and how much the patient is suffering. Therefore, it should be recommended that the curing process through the conduct of Thai traditional medicines can be done more effectively if there is possible integrations among the processes of checking-up or examination, process of caring and healing, process of follow-up and communication between physicians and patients, a process of well-administering and management of health care centers.

To make the curing process of Hepatitis B Virus patients more meaningful, Thai traditional medicine should be the best alternative in which the appropriate plan on the conventional processes of curing should be considered. In so doing, the administration and management should be appropriately done so as to be in compliance with the capacity and identity of the particular health centers since each of which has performed different ways of Thai traditional medicine curing. In support of the present lifestyle of the people in terms of their health caring, the alternative way of doing this should be considered in terms of integrating the outstanding strengths of every health care center and developing it into a new model of conceptual knowledge. This may be done by means of conserving the Thai wisdom and extending development of knowledge through the application of sciences and technology into the symptom diagnosis, curing and caring

as well as following up of the results. In so doing, it may help in terms of preventing the Hepatitis B Virus symptoms from developing or turning to be the cirrhosis symptom and, finally, the liver cancer. This new conceptual knowledge may help release the risk of all types of loss, such as the loss of quality of life, loss of expenses for curing each particular symptom which might be increased depending on the state of seriousness. This may also help decrease the expenses of health care of the whole country as well as becoming an alternative way of curing the patients and improving their quality of lives. Above all, this should be the most effective way in developing the reliability and credibility of Thai traditional medicine as a whole.

This study was taken in the form of Qualitative Research with 2 particular aims: (1) To study the present condition and problems as well as recommendations regarding health caring processes for the Hepatitis B Virus Patients through the use of Thai traditional medicines; (2); To develop the model on health caring process for curing the Hepatitis B Virus Patients through the use of Thai traditional medicine.

Experimental

1. Raw Material

The research activities comprise the collection of all needed information from both printed matters and field survey. The research instruments and raw materials being used are;

1. Participatory observation and non-participatory observation
2. Unstructured interview and structure interview
3. Focuses group discussion
4. Workshop

2. Sample Preparation

The research sampling is done through the selection of 3 target groups in which comprises 6 selected venues; two hospitals, two Thai traditional health caring clinics, and two local wisdom personnel of Thai traditional medicine. The accuracy of collected information is verified by using Triangulation Technique, while the data analysis is done according to the objectives being set forth. The result outcomes of the study will be presented in the form of descriptive analysis.

Results and Discussions

1. The outcomes of the study found that Thai traditional medicine at the aforementioned 6 selected venues have shown similarly a remarkable feature in terms of symptom diagnosis of the patients, in which historical background questionings are done in more details from their past to the present stages. Observations have been made on mental and emotional aspects of the patients and also touching of their bodies may be done in order to examine their symptoms so that curing by concentrating on traditional medicines can be done. In terms of the results from the targeted hospital, it is found that some hospitals intend to integrate the use of Thai traditional medicine together with the modern medicine, while in health care centers of Thai traditional medicine have rather concentrated mainly on Thai traditional medicine but at the same time provided the opportunity for scientific knowledge and new technological know-how to take the role in developing health caring processes. However, in terms of health caring performed by the local-wisdom personnel it is found that they concentrate mainly and significantly on curing through the old custom or traditional practices by using old-fashioned scriptures and local way of doing. Apart from the above-mentioned information, the studies also find that other significant factors in health care practices through Thai traditional medicine depends on 4 significant processes and types of administering: personnel management, place or venue management, equipment or material management, and financial management. In regards to the present condition, problems and suggestions on the health care process for Hepatitis B virus patients through Thai traditional medicine, it is found that the program lacks several significant factors in terms of states of readiness. For example; lack of efficient personnel experienced in herbal medicines, lack of knowledge in terms of integration of herbal medicine with the modern medicine, lack of strong support from the government sector and lack of adequate budget or financial support. Therefore, it is

recommended that concrete or substantial development should be done in terms of best-practices on health caring processes so as to be in compliance with the present life style of the people. Besides, this will help the budget by reducing import of high cost medicines from overseas.

Research found that Thai traditional medicine was first developed through cooperative efforts among 3 concerned sectors, of which included some government organizations, private business sectors and support of local wisdom services. The cooperation was found being incompliance with a theory on Cultural Diffusion in which Dr. Songkoon Chantachon.[5] had referred a statement of France Boas' opinion that "Cultural Diffusion is the significant process in which one cultural practice is recognized or disseminated into another culture and this application has been adapted to conform to the new culture". In his opinion, the significant factors of success in terms of attending health caring of the patients were the management process such as knowledge and skills management of health personnel, health venue, equipment and financial support, all of which had to be adequate and the service should be of good quality. His said opinion was seen being coincide with the idea of Siriporn Pongsriviroj.[6] who cited that the administrative management was the most significant need that made all working performances more successful according to the target goal. Management needed to involve both states of art and science in locating various resources to supplement the task of administration so as to be in accordance with the objectives and goal that set forth effectively. These notifications were coincidently conformed to the statement made by medical doctor Chatchai Sawasdichai. who once gave his statement "… The management or administration is seen as the most important factor in working performances of both Thai traditional medicines clinic and modern medicine hospital. The staff personnel should have the ability in coordinating with all groups of personnel who are commander, subordinator, colleagues and every concerned sector...". The research findings showed that the identities of Thai traditional medicine was the holistic health caring process in which it put most significance to health caring of the patients both physically and mentally as well as socially. According to the results from of 6 target venues, it was found that different ways of health caring might have caused by different educational backgrounds been, thereby causing different identities of healing and health caring in the target places. It was found that all target places had adapted their process of symptom diagnosis, process of the treatment and the follow-up process, in which lots of developments had occurred appropriately in terms of health caring process performed by each target venue. Every Thai traditional medicine had the same point of view in which the most significance was placed onto the patients not only healing their symptom, but their mental as well. For example; Rawewan, the outstanding Thai traditional medicines doctor who always stickled to 4 principles of health treatment and caring which were (1) knowing well about causes and symptom of sickness, (2) the patients had ability to heal themselves by nature, (3) when the symptom had gone or recovered, the sickness or symptom would not return any more, (4) The recovered patients should have the abilities to help others who had got the same symptom. These 4 principles of treatments seemed to be in accordance with the opinion of Pender.[7] who gave the meaning of Health Protective Behavior in terms of individual action in which it happened repeatedly and regularly which contributed to having good health. This action was found to help healing the symptom of the patient himself and protect him from any sickness. This was proved to be incompliance with the opinions of Malee Arnakul and Bussakorn Metakul.[8] who stressed that the sickness could not be separated from the body, and holistic health caring was seen as the people's life style.

2. In development of health caring process for Hepatitis B virus patients through Thai traditional medicines, the researcher had found that the processes in healing and caring the patients through Thai traditional medicines might need 2 principal processes, one of which was the need of treatment process and the other one was the management process. In terms of treatment and caring process the researcher recom-

mended 3 implementing steps which included the following: Step 1 - doing diagnosis of the Hepatitis B virus. Step 2 – attending health caring of the patients. Step 3 – undertaking follow-up and evaluation.

Every step of the treatment and caring processes should be done in terms of holistic care taking through physical, mental and social dimensions as well as keeping the balance of the four substantial elements of the nature that include the earth, water, wind and fire, and this should be done in parallel with the provision of herbs and food, and should seriously follow the advice regarding prohibited food. Diagnosis of blood test was also important as same as the suggestion on self caring and amount of drug to be taken. All of this advice was to support the patients in order to stimulate their feelings so that they would be impressed on being attended by Thai traditional medicines. In addition, more support should be done in terms of sharing the space or room for social network on line in order to share the benefits of knowledge and information on Thai traditional medicines. The relevant chart which identified the whole management system is seen as significant and effective to the treatment process of Thai traditional medicines.

This research finding found that the focus point of health caring processes of 6 target health caring centers should be divided into 3 different channels: (1) Integration of Thai traditional medicines into modern medicines as presented by medical doctor Chatchai Sawasdichai[9] that health caring through the integration of Thai traditional medicines with modern medicines should be recognized since it would make better recovering of the sickness successfully because it was the holistic caring of physical, mental, family and society, (2) The integration of Thai traditional medicines with sciences and nutrition knowledge, (3) Thai traditional medicines and modern medicines had brought about knowledge and methods of sciences and technology into the health caring process which was found to be very useful for the patients. In addition, other findings of the research show that it should be very appropriate to undertake the selection of strengths or strong points from different systems into the application of health caring in which it might refer as “Multiple Appearance Medicines”. This was incompliance with Komart Chung Satiensub and Yongsak Tuntipidok[10]. Besides, this study had as well intended to find an appropriate way to develop the outstanding process on health caring for the Hapatitis B Virus patients through Thai traditional medicines, and this intention was found to be in accordance with Steiner[11] and Keeve[12] who stated that “Forming is the way to identify the concepts that are systematically concerned and are inter-related in order to point out what is presented, how is the presentation, what is obtained, what should be explained about the existing condition, and what has brought about the discovery of new things”.

Conclusion

This research study is regarded as the model for the health caring processes through the application of Thai traditional medicine which has presently been integrated into modern medicines and has developed into an appropriate model for health caring processes by undertaking the progressive method of sciences and technology into use of health caring system. This effective model of health caring is seen as the alternative channel for patients as well as for promoting development of Thai public health. This appropriate model is regarded as the best practices which continues to develop the local wisdom of Thai traditional medicine, above all, can pave the way to economize the financial costs on public health of the country. This research is academic information that can be used as the issue for development of patients caring process in Thai traditional medicine, public health personnel, modern medicine, alternative medicines and other concerned personnel who take care of Hepatitis B Virus patients. This research can be the guidelines for treatment and caring of the Hepatitis B Virus patients through Thai traditional medicines. It can as well be used for creating more benefit in terms of raising economic value of the country through the use of herbal medicines and Thai traditional medicines for health caring and diseases prevention. This can help decrease the costs of importing medicines from overseas as well. According to the benefit of this research study, it can finally be concluded

as follows:

This research study is related to the Thai traditional medicine integrating with modern sciences and technological knowledge in which it can be applied to the use of development process for health caring of other un-severe patients.

The research study is related to development of herbal medicine in terms of its quality, production, packaging, and source of medicines as well as locations of planting the herbs that may respond to the desirable needs of today's society.

The research study describes the benefit of forest conservation and develops herbs growing for promoting the attention of having good quality of raw materials and decreasing the import of herbs as well as increasing the forestry areas in order to build the balance of the nature.

The research study introduces an appropriate process of administering the integrated working development among the local wisdom personnel, the Thai traditional medicine and the modern medicine in order to benefit more experiences and skills of best practices of the concerned health caring sectors including state hospitals. This model is aimed to develop future effective performances of Thai traditional medicine.

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Causal Relationship Model of IQ, AQ and Four Noble Truths

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Abstract

The population was 37,101 undergraduate student of Mahasarakham University in the second semester of academic year of 2012. The Multi-stage simple random sampling technique was employed to collect the sample for 400 undergraduate students. The research instrument was a questionnaire and it was used of data collecting. Structural Equation model (SEM) was used for model verification. The objective was to propose the structural model of Intelligence Quotient (IQ), Adversity Quotient (AQ) and Four Noble Truths (FNT) affecting environmental behavior via inspiration of public consciousness. The results revealed that when considering structural model confirmatory factors Intelligence Quotient (IQ), Adversity Quotient (AQ) and Four Noble Truths (FNT) were able to explain the variation of endogenous factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) to cause Environmental Behaviors (BEH) with 86.00 percent and IPC was the highest effect to BEH with 0.54. Furthermore, confirmatory factors of Four Noble Truths (FNT), Intelligence Quotient (IQ), and Adversity Quotient (AQ), were able to explain the variation of confirmatory factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) with 70.00 percent and FNT was the highest effect to IPC with 0.38.

Keywords: model, IQ, AQ, four noble truths, environmental behavior

Introduction

The intelligence quotient (IQ) questioned that people's intelligence originates from parents genetic heredity or condition of family nurturing. Some believe it is directly connected to biological parental intelligence quotient (IQ). However, the heritability of IQ has been investigated for more than a century, but it couldn't conclude which one is more influential. The diversity of ideas proposes that it depends on heritability and the mechanisms of inheritance[15,14,3,2,30,6]. Afterward, Dickens and Flynn established a model for numerous doubtful conclusions regarding IQ. In their model, an environmental motivation can have numerous effects on IQ including adults, but this effect also decays over time except the stimulus persistence. The model could be modified to embrace possible factors, like nutrition during early childhood that may cause stable effects. Consequently, IQ adjustment can be elucidated by a generally motivating environment for all people. The study involved that IQ scores do have high predictive strength for individual differences in school completion. They confirm the predictive validity of IQ for adult professional status, while variables such as education and family conditions have been statistically controlled. They recommended that individual variations in intelligence are remarkably influenced by both genetics and environment but it is still not known that which one has the foremost power.[4]

Adversity Quotient (AQ) is the capability to resolve problems and difficult tasks with intention to discover a method to alter the catastrophe. Pone who has good AQ will be a courageous person, has patience and good intentions lack easy failure, therefore in general, the person with this characteristic frequently accomplishes victory.

People who devote themselves to accomplishment will be inspirited and have self-esteem because their

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insight has the power of problem solving and they believe that they can overcome the problem via continuous resolution and comprehension. A robust influence is a good struggle to lead them to success in their lives. AQ is the mainly reasonable and generally utilized technique.

Furthermore, people with superior AQ will be optimistic and they will change difficulties into opportunities. The elementary constituent of human competency is to manage how people must face life difficulties, or adversity. People with strong authentication are able to respond to life troubles: for instance, frustrations, irritations, and obstructions, even the most unacceptable trouble. That is the major role for all human efforts.[18,20,21,22,5]

The teachings of Buddhism, Four Noble Truths are regarded as important to get over life's problems. These embrace 1) life means suffering, 2) the source of suffering is attachment, 3) the termination of suffering is attainable and 4) the path to the cessation of suffering (Middle Path or Eightfold Path). Taking into account on the first principle of life means suffering, refers to living with suffering for the reason that the people are not perfect and neither is the world stable. At some stage in people lifetime, they inevitably have to tolerate physical suffering such as tiredness, old age, pain, sickness, injury, and ultimately death; and they have to tolerate psychological distress like as sadness, fear, disappointment, dissatisfaction, and misery. Even though, there is also positive experiences in life that people recognize as pleasure such as ease, comfort and happiness but it is just for a while, not permanent or forever because life entirety is inadequate and incomplete, since the world is impermanent subject. Therefore humans are never able to maintain everlastingly what they try for, and just as happy minutes pass by, they themselves and their loved ones will pass away one day, too.[17]

The trail to the suffering eradication is the fourth noble truth through the middle path to finish the suffering. It is a regular mean of self-development that is explained in more detail with the Eightfold Path. The middle way is between the two extremes of excessive self-petty and extreme self-dignity; finally it directs to the end of the cycle of rebirth. The final quality separates it from other paths that are only "wandering on the wheel of appropriate", because these do not have a final object. The mean to finish suffering can expand over many lifetimes. Wishing, unawareness, illusions, and its effects will progressively fade away, however the progress is made on the path. Noble Eightfold Path regards to right view, right intention, right speech, right action or behavior, right livelihood, right effort, right mindfulness and right concentration or meditation.[7]

Thiengkamol declared that if one is really understands Four Noble Truths, one would live with adequacy way of life by practicing their daily activities with cautious methods for pro-environmental behavior and natural resources maximization utilization containing of food consumption, energy conservation, waste management, recycling behavior, traveling behaviors and environmental knowledge transferring for others. Consequently, they also have concern for every step of living with right view, right thought, right speech, right behavior, right livelihood, right effort, right mindfulness, and right meditation. However, Thai people are generally Buddhists since the economic development together with consumerism pattern has caused them to be in the trap of an economic crisis since 1992 because of the 7th National Development Plan that the government accentuated for economic growth while environmental quality has been degraded unavoidably. Afterward, they realized the importance of sufficiency based on Middle Path of Four Noble Truths which has been their root of way of life for one thousand years. They reflect on their origin of Buddhist Principle of Four Noble Truths to use it to meet sustainable development.[12,11,12,23]

Moreover, Sufficiency Economy Philosophy has been remarked by His Majesty King Bhumibol Adulyadej during his 58 years on the throne. This philosophy is a guideline of human living behavior of all classes starting from the family to the community to the Thai nation. It is able to be applied for local and nation development and administration. This philosophy is also indistinguishable from "Middle Path" of Four Noble Truths to finish live suffering for Buddhist people. Sufficiency refers moderation and rationality, accompanied by creating a practical

immune system against shocks from the outside or from the inside. All plans and every step of their action must be conducted based intelligence, thoughtfulness, extreme care and body of knowledge. The spiritual underpinning of all people in the nation, predominantly state officials, scholars, and business people must be constructed for all levels, therefore the moral integrity and honesty must be cultivated, and consequently they must effort for the appropriate wisdom to live with broadmindedness, carefulness, intelligence, and reflection. Finally, it should maintain the balance of physical, social, economic, environmental, and cultural changes of inside and from the outside world.

Environmental issues were generally unaware as inessential subject by people. Afterward, the beginning of the year 2011, Thai peoples have affected by the phenomenon in summer, they met with terrible cold weather. This made them aware on disaster of climate change or global warming.[13]

The inspiration to have public consciousness or public mind is a significant factor that has been proved by different studies of Thiengkamol and her colleagues. It was proposed by Thiengkamol that public mind inspiration arises from insight; therefore it is dissimilar from motivation because inspiration needs no rewards, admirations, and complements. Particularly, for pro-environmental behavior, it needs inspiration of public consciousness or public mind for environmental conservation and natural resources conservation because people who are devoted to conserve the environment will not require any admiration, rewards, money or incentives to do it, but they may be inspired by role model or idle, or impressive events, environment, and media receiving such as movies, book, magazine, and internet.[7,16,9,1]

Currently, it is very seldom and there is no research that is holistically integrative conducted on intelligence quotient, adversity quotient, and Four Noble Truths affecting environmental behavior via inspiration of public consciousness. This research was designed to study by regarding all factors as mentioned above to attain a new body of knowledge to inspire the the young generation of undergraduate student to be a pro-environmentalist to practice as good idle for their generation and future generation.

Objective

The objective was to propose a structural model of Intelligence Quotient (IQ), Adversity Quotient (AQ), and Four Noble Truths (FNT) affecting environmental behavior via inspiration of public consciousness.

Methodology

The research design was implemented in steps as follows:

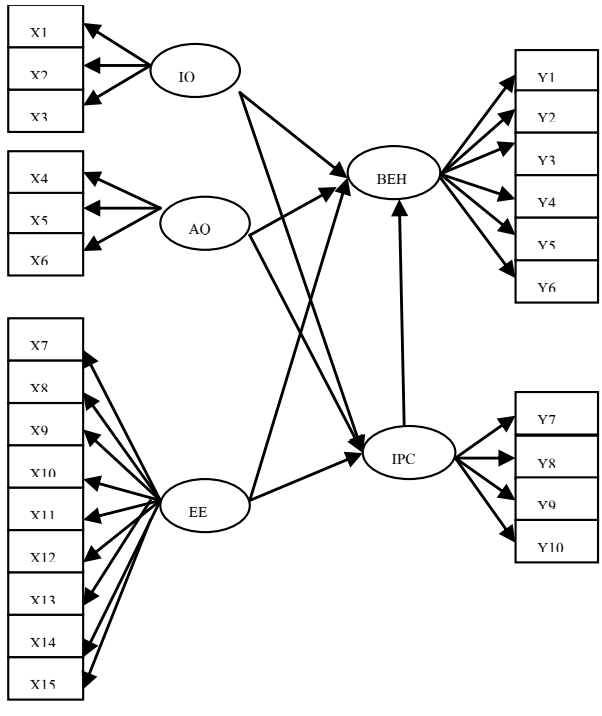
1. The population was 37,101 undergraduate students of the second semester inacademic year 2012 of Mahasarakham University. The Multi-stage random sampling was employed to collect 400 students from different faculties of Mahasarakham University.

2. The research instrument was a questionnaire, and it was used for data collecting. The content and structural validity were determined by Item Objective Congruent (IOC) with 5 experts in the aspects of environmental education, psychology, social science and social research methodology. The reliability was done by collecting the sample group from 50 undergraduate students of Rajabhat Mahasarakham University which is nearby Mahasarakham University. The reliability was determined by Cronbach's Alpha. The reliability of Intelligence Quotient (IQ), Adversity Quotient (AQ), FNT (Four Noble Truths) Inspiration of Public Consciousness (IPC), Behaviors for Global Warming Alleviation (BEH), and the whole questionnaire were 0.785, 0.919, 0.972, 0.977, 0.928 and 0.952 respectively.

3. The descriptive statistics used were frequency, percentage, mean and standard deviation. The inferential statistics used was LISREL by considering on Chi-Square value differs from zero with no statistical significant at 0.05 level or Chi-Square/df value with lesser or equal to 5, P-value with no statistical significant at 0.05 level and RMSEA (Root Mean Square Error Approximation) value with lesser than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00.

Conceptual Framework

The exogenous latent variables of Intelligence quotient (IQ), Adversity Quotient (AQ) and Four Noble Truths (FNT) had direct and indirect effects to Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors for Global Warming Alleviation (BEH). IQ was measured by Conceptual Creation (X1), Talent Expression (X2), Relationship Perception (X3), AQ was measured by Personal Challenge (X4), Family Challenge (X5), and Social Challenge (X6). FNT was measured by Holistic View FNT (X7), Middle Path 1: Right View (X8 Middle Path 2: Right Thought (X9), Middle Path 3: Right Speech (X10), Middle Path 4: Right Behavior (X11), Middle Path 5: Right Livelihood (X12), Middle Path 6: Right Effort (X13), Middle Path 7: Right Mindfulness (X14), and Middle Path 8: Right Meditation (X15). The endogenous latent variable of BEH was measured by Consumption Behavior (Y1), Energy Conservation Behavior (Y2), Recycling Behavior (Y3), Waste Management Behavior (Y4), Traveling Behavior (Y5), Knowledge Transferring Behavior (Y6) and IPC was measured by Person as Role Model (Y7), Impressive Event (Y8), Impressive Environment (Y9), and Media Receiving (Y10).



Results

1. Results of Effect among Variables in Model in Terms of Direct Effect

1) Confirmatory factors of Intelligence Quotient (IQ) had direct effect to Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors (BEH) with statistically significant at level of 0.01with effect 0.18 and 0.16. Moreover, Intelligence Quotient (IQ) had indirect effect to Environmental Behaviors (BEH) with statistically significant at level of 0.05 with effect of 0.10. IQ had the total effect to BEH with 0.26.

2) Confirmatory factors of Adversity Quotient (AQ) had direct effect to Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors (BEH) with statistically significant at level of 0.01 with effect of 0.27 and 0.26. Moreover, confirmatory factors in aspect of Adversity Quotient (AQ) had indirect effect to Environmental Behaviors (BEH) with statistically significant at level of 0.01 with effect of 0.15. AQ had the total effect to BEH with 0.41.

3) Confirmatory factors of Four Noble Truths (FNT) had direct effect to Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors (BEH) with statistically significant at level of 0.01 with effect of 0.38 and 0.30. Moreover, confirmatory factors in aspect of Four Noble Truths (FNT) had indirect effect to Environmental Behaviors (BEH) with statistically significant at level of 0.01 with effect of 0.21. FNT had the total effect to BEH with 0.51.

4) Confirmatory factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) had direct effect Environmental Behaviors (BEH) with statistically significant at level of 0.01 with effect of 0.54.

5) Considering on structural model confirmatory factors Intelligence Quotient (IQ), Moral Quotient (MQ) and Four Noble Truths (FNT) were able to explain the variation of endogenous factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) to cause Environmental Behaviors (BEH) with 86.00 percent as following in Equation (1).

$$BEH = 0.16*IQ+0.26*AQ +0.30*FNT+ 0.54*IPC..... (1)$$
$$(R^2 =0.86)$$

Equation (1) factors that had the most effect to Environmental Behaviors (BEH) was Inspiration of Public Consciousness for Environmental Conservation (IPC) with effect of 0.54 and subsequences were Four Noble Truths (FNT), Adversity Quotient (AQ) and Intelligence Quotient (IQ) with effect of 0.30, 0.26, and 0.16 respectively. These were able to explain the variation of Environmental Behaviors for Global Warming Alleviation (BEH) with 86.00 percent.

Consequently, confirmatory factors of Four Noble Truths (FNT), Intelligence Quotient (IQ), and Adversity Quotient (AQ), were able to explain the variation of confirmatory factors of Inspiration of Public Consciousness for Environmental Conservation (IPC) with 70.00 percent. Therefore, the equation can be written as following Equation (2).

$$IPC = 0.38*FNT+0.27*AQ + 0.18*IQ ..... (2)$$
$$(R^2 = 0.70)$$

Equation (2) factors that had the most effect to Inspiration of Public Consciousness for Environmental Conservation (IPC) was Four Noble Truths (FNT) with effect of 0.38, and subsequences were Adversity Quotient (AQ) and Intelligence Quotient (IQ) with effect of 0.27 and 0.18. These were able to explain the variation of Inspiration of Public Consciousness for Environmental Conservation (IPC) with 70.00 percent.

The results of exogenous variables had effect to endogenous variables with direct and indirect effects are demonstrated in (Figure 1) and (Table 1).

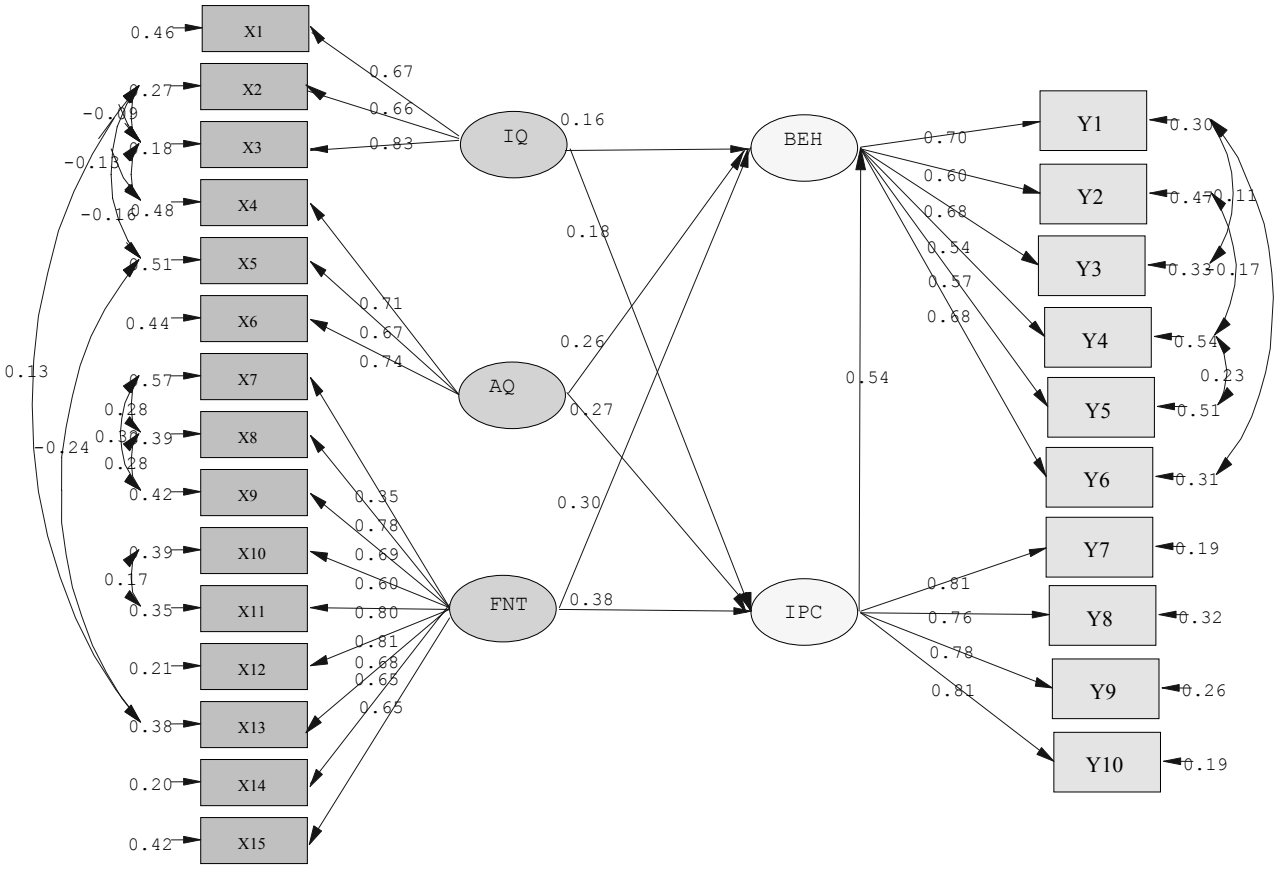


Figure 1 Model of Direct and Indirect Effect of IQ, AQ and FNT Affecting via IPC to BEH

Table 1 Direct and Indirect Effect of IQ, AQ and FNT Affecting BEH through IPC

Causal variable	Result variables					
	IPC			BEH		
	TE	IE	DE	TE	IE	DE
IQ	0.18* (0.055)	-	0.18* (0.055)	0.26* (0.037)	0.10* (0.032)	0.16* (0.044)
AQ	0.27* (0.042)	-	0.27* (0.042)	0.41** (0.045)	0.15** (0.030)	0.26* (0.034)
FNT	0.38** (0.065)	-	0.38** (0.065)	0.51** (0.065)	0.21** (0.033)	0.30** (0.054)
IPC	-	-	-	0.54** (0.042)	-	0.54** (0.042)
χ^2= 253.76; df = 156			CN = 239.23		$\chi^{2/}$df= 1.627	
GFI = 0.94; AGFI = 0.91			RMSEA = 0.007		RMR = 0.0049	

TE: Total Effect, IE: Indirect Effect, DE: Direct Effect

Discussion

The findings indicated that Intelligence Quotient (IQ), Adversity Quotient (AQ), and Four Noble Truths (FNT) had direct effect to Environmental Behaviors (BEH) at a statistically significant level of 0.01 with effect of 0.16, 0.26 and 0.30.

Considering, the observed variable of Talent Expression (X2) was the highest correlation for Intelligence Quotient (IQ) with 0.60, Family Challenge (X5) was the highest correlation for Adversity Quotient (AQ) with 0.76 and Middle Path 5: Right Livelihood (X12) was the highest correlation for Four Noble Truths (FNT) with 0.86.

Regarding Intelligence Quotient (IQ) contained Conceptual Creation (X1), Talent Expression (X2) and Relationship Perception (X3) were able to predict Intelligence Quotient (IQ) with effect of 0.27, 0.60 and 0.34 and had direct affecting Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors (BEH) with highly with statistically significant at level of 0.01 with effect of 0.18 and 0.16.

However, Adversity Quotient (AQ) comprised of Personal Challenge (X4), Family Challenge (X5), and Social Challenge (X6) were able to predict Adversity Quotient (AQ) with effect of 0.44, 0.76 and 0.65 and had direct affecting Inspiration of Public Consciousness for Environmental Conservation (IPC) and Environmental Behaviors (BEH) at a statistically significant level of 0.01 with effect of 0.27 and 0.26. Moreover, Inspiration of Consciousness for Environmental Conservation (IPC) also had direct influencing to Environmental Behaviors (BEH) with highly statistically significant at level of 0.01 with effect of 0.54. Simultaneously, when considering prediction of correlation of observed variables of Impressive Environment (Y9), Impressive Event (Y8), Media Receiving (Y10), and Person as Role Model (Y7) rather high level with 0.92, 0.76, 0.76, and 0.70 respectively.

Concurrently, the result also indicated that Four Noble Truths (FNT) composed of the Holistic View FNT (X7), Middle Path 1: Right View (X8), Middle Path 2: Right Thought (X9), Middle Path 3: Right Speech (X10), Middle Path 4: Right Behavior (X11), Middle Path 5: Right Livelihood (X12), Middle Path 6: Right Effort (X13), Middle Path 7: Right Mindfulness (X14) and Middle Path 8: Right Meditation (X15) had direct affecting Inspiration of Public Consciousness (IPC) and Environmental Behaviors (BEH) with highly with statistically significant at level of 0.01 with effect of 0.38 and 0.30 respectively.

It might be concluded that the Adversity Quotient (AQ) and Four Noble Truths (FNT) composed are the significant exogenous latent variable that affect Environmental Behaviors (BEH) via Inspiration of Public Consciousness for Environmental Conservation (IPC) and Inspiration of Public Consciousness for Environmental Conservation (IPC) is the most essential variable to cause the Environmental Behaviors (BEH). Therefore whatever environmental behavior happens, it needs to inspire the people to realize their responsibilities to have pro-environmental behavior with their perception for person as role model, impressive event, impressive environment and various media receiving. These were congruent to Thiengkamol concept her different studies of Thiengkamol and her colleagues[7,8,16,9,1,19] that the results illustrated that Intelligence Quotient (IQ), Adversity Quotient (AQ), and Four Noble truths (FTN) affecting via inspiration of public mind or public consciousness to perform better environmental behaviors whether consumption behavior, energy conservation, recycling behavior, waste management, traveling behavior and knowledge transferring and supporting for environmental conservation when they had real practice through environmental conservation with inspiration of public mind or public consciousness.

Particularly, Four Noble Truths Principle is the fundamental belief of Thai people as the national religion for more than thousand years. Furthermore its concept is relevant to the concept of sustainable development based on the reason of living with sufficiency way. Even though in recent decades, the Ministry of Education has withdrawn it from the curriculum of all levels of education, as such, the Four Noble Truths have faded from the young generations. It is urgent that the Ministry of Education should introduce the Four Noble Truths into curriculum again since the middle path concept or the eight folds in this principle is practical for everyone in the world to perform their daily life activities with concepts of pro-environmental behavior.

Conclusion

However, it might be concluded whether IQ, AQ, and FNT, and IPC latent variables are play important roles to cause environmental behaviors of consumption behavior, energy conservation, recycling behavior, waste management, traveling behavior and knowledge transferring and supporting for environmental conservation through PM. Therefore, the model of IQ, AQ, and FNT affecting via IPC to BEH was verified the proposed model was fitted with all observed variables according to criteria of Chi-Square value differs from zero with no statistical significance at .001 level or Chi-Square/df value with lesser or equal to 5, RMSEA (Root Mean Square Error Approximation) value with lesser than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.90-1.00.

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Drying Characteristics of Paddy Dried by Thermosyphon Heat Pipe Heat Exchanger

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Abstract

It is well known that drying is an important method for avoiding the chemical and biochemical deterioration of paddy. Moisture reduction using solar drying is the most widely used method due to a low cost operation. However, it takes a very long time for the operation and an unstable climate may cause operation limitations, resulting in the quality of paddy. The Thermosyphon heat pipe heat exchanger is an alternative device applied in this study. The objective was to study the paddy drying characteristics of San-Pah-Tong 1 with average initial moisture content of 34.57% (wet basis) dried to final moisture content of 14% (wet basis). The layer thickness of paddy was 5, 10 and 15 centimeters. The results showed that the paddy drying using a Thermosyphon heat exchanger provided 3.5 times higher in average drying rate than that using open sun. The layer thickness of 5 centimeters was found to be shorter in drying time than 10 and 15 centimeters. Different mathematical models namely Henderson and Pabis, Midilli et al., Page, Modified Page and Logarithmic models were used for the modeling of the drying kinetics. The best mathematical model was determined using R^2 coefficient, root mean square error (RMSE) and chi-square ($\chi 2$) as criteria. It was found that the Logarithmic equation was the best model for describing the drying behavior in all cases. The effective moisture diffusivity evaluated by using Fick's diffusion equation was in the rage of 2.11×10^{-8} - 1.37×10^{-7} m^2/s.

Keywords: Drying characteristics, Thermosyphon, Heat exchanger, Paddy dried

Introduction

Paddy is one of the most important crops in the world. According to FAO report[1], global paddy production yielded about 745 million tons in 2013. After harvesting, paddy still contains high moisture content (19-26% wet basis)[2,3] that can cause nutritional losses and microbial growth during storage. To prevent quality deterioration paddy needs to be dried until a safe moisture level of 14% wet basis or below[4].The reduction of moisture is one of the oldest techniques for food preservation. Mechanical and thermal methods are two basic methods to remove moisture in a solid material[5]. Open sun drying is usually used to reduce moisture content of paddy. This method is a low-cost method and easy to operate. Nevertheless, it depends on the weather condition and consumes time. To overcome these problems hot air drying using Thermosyphon heat pipe heat exchanger was proposed in this study. This method has been reported to require shorter drying time than open sun drying leading to better product quality[6]. Thermosyphon heat pipe is one type of heat exchange device that has no external power requirements. Heat exchangers with heat pipe units possess many advantages such as high heat recovery effectiveness, high compactness, no moving parts, light weight, relative economy, pressure tightness, complete separation of hot and cold fluids, and high reliability[7]. Heat pipe heat exchanger has been extensively applied in many industries[8]. Thermosyphon heat pipes operate by using the heat transfer principle of latent heat of working fluid contained inside heat pipe.

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High temperature heat source caused working fluid evaporation. The working fluid of gas was condensed to be condensate by transferring heat to an area that had low temperature, which was the heat sink. Typical operation of heat pipe could be explained as follows. After the heat pipe receives heat at the evaporator section, the inside saturated working fluid evaporates to become vapor gas and then flows upward to the condenser section where there is a lower temperature. The working fluid transfers heat out by condensation and then the condensate returns downward to the evaporator section by gravity force to receive heat at evaporator section again. The operation, thus, acted as a cycle. Because of the high latent heat inside working the fluid, the heat pipe could be operated by transferring heat from one end to the other end although it had small difference temperature of the evaporator section and condenser section. He heat transfer capability of Thermosyphon heat pipe depends on several factors such as aspect ratio, length of heat pipe, type or material used to make the heat pipe, conditions of heat pipe setting, type of working fluid, temperature of heat source and temperature of heat sink[9].

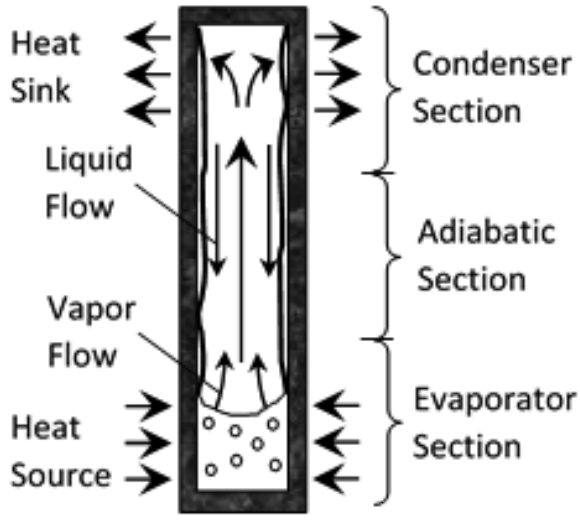

Figure 1 A schematic of the Thermosyphon[10]

In order to the clarify knowledge from the past study of Thermosyphon heat pipe heat exchanger and to apply on paddy drying, it is important to study the applied Thermosyphon heat pipe heat exchanger to reduce moisture content of paddy. This work therefore was aimed at investigating drying characteristics of paddy San-Pah-Tong 1 dried by hot air drying using Thermosyphon heat pipe heat exchanger drying method.

Experimental

1. Sample preparation

After harvesting of paddy (San-Pah-Tong 1) with average initial moisture content of 34.57%, (wet basis) paddy were then packed in zip bag and kept at 4°C until the time of experiment.

2. Heat Exchanger drying method

In this research a Thermosyphon heat pipe heat exchanger with seamless steel was designed and constructed as shown in (Figure 2) Thermosyphon heat pipe heat exchanger consists of a number of individual Thermosyphons or gravity-assisted wick less heat pipes. Distilled water was used as the working fluid with a filling ratio of 50% of the evaporator section length and consisted of 53 tubes that were 1.1 m long, had a 25 mm inside diameter and a 30 mm outside diameter. The tubes were arranged in 7 rows. The evaporator and condenser sections of the Thermosyphon heat exchanger had a length of 500 mm and its central adiabatic section had a length of 100 mm. The parameters are shown in (Table 1).

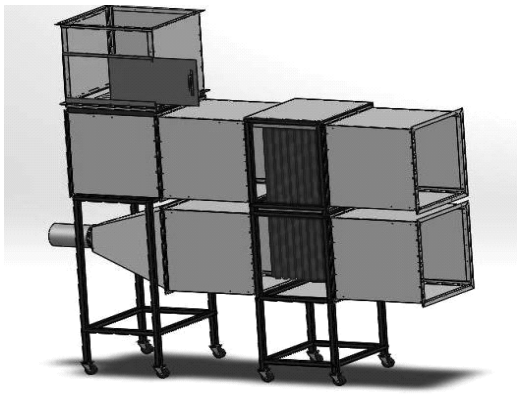

Figure 2 Hot air dryer using Thermosyphon heat pipe heat exchanger

Hot air dryer using a Thermosyphon heat pipe heat exchanger was used for drying paddy. The dryer consists of hot air tube blower set and drying chamber (Figure 2). The drying chamber is constructed of polycarbonate sheets with dimensions of 0.5 m wide × 0.5 m long × 0.5 m high. The dryer was combined with a set of Thermosyphon heat pipe heat exchanger. The paddy (San-Pah-Tong 1) was spread in a thin layer on screen trays with the dimension of 0.5 m wide × 0.5 m long × 0.2 high. The thickness of paddy was varied at 5, 10 and 15 cm. The drying temperature was controlled at 45±5°C for the whole drying period. During each experiment the sample was taken out every hour to determine its moisture content. The temperature of samples was also measured continuously using type-K thermocouples, which were inserted in the bed of the paddy.

Table 1 Parameters.

Parameters	Description
Dimensions of tube	D_o=30 mm, D_i= 25 mm and L_{tubes}=1100
Thermosyphon arrangement	Staggered, SL=55 mm and ST=55 mm
Number of rows	nL=7, nT= 8
Total of tube	N=53
Material	Seamless steel tube
Working fluid	Water
Paddy variety	San-Pah-Tong 1
Rice thickness	5 , 10 and 15 cm
Temperature of Drying chamber	45±5°C
Initial moisture content of paddy	34.57% wet basis
Final moisture content of paddy	14% wet basis

3. Open sun drying method

The paddy was placed in a tray with the varied thickness of paddy at 5, 10 and 15 cm. The sample was exposed to the sun for 12 h. During each experiment the sample was taken out every 5 h to determine its moisture content. The temperature of samples was also measured continuously using type-K thermocouples, which were inserted in the bed of the paddy.

4. Mathematical modeling

The moisture ratio (MR) of the paddy was defined as follows: $$MR= \frac{M_t-M_e}{M_i-M_e} \quad (1)$$

Where M_t, M_i and M_e are the moisture content at any time of drying (kg water/kg dry mass), initial moisture content (kg water/ kg dry mass) and equilibrium moisture content, respectively. The experimental data at different thicknesses of paddy were fitted into 5 thin-layer drying models that commonly used in most food and biological materials as shown in (Table 2).

Table 2 Mathematical models applied the moisture ratio

Model name	Model	Ref.
1. Henderson and Pabis	$MR = a\ exp\ (-kt)$	[11]
2. Midilli et al.	$MR = a\ \exp(-kt)+bt$	[12]
3. Page	$MR = \exp(-kt^n)$	[13]
4. Modified Page	$MR = \exp((-kt)^n)$	[14]
5. Logarithmic	MR = a exp(-kt)+c	[15]

5. Correlation coefficients and error analyses

The determination of coefficients (R^2), reduced chi-square (χ^2) and root mean square error (RMSE) were used to evaluate the goodness fit. These parameters were calculated as follows:

where N is the number of observations, z is the number of constants, $MR_{i,exp}$ and $MR_{i,pre}$ are the experimental and predicted moisture ratios, respectively.

6. Determination of effective moisture diffusivity

The drying characteristics of agricultural products in a falling rate period can be described by using Fick's second law of diffusion equation. The paddy is determined to be a sphere. Negligible shrinkage, constant diffusion coefficients and temperature during drying are assumed as follows:

In the case where t is large and R is small, terms in series where n>1 are negligible and Eq. (5) can be further simplified to

The effective moisture diffusivity is determined by plotting the experimental drying data in terms of ln (MR) versus drying time. A plot of ln (MR) versus drying time gives straight line with a slope as follows:

Results and Discussion

1. Drying characteristics of paddy

The average initial moisture content of the samples (San-Pah-Tong 1) prior to drying was approximately 34.57 (wet basis). Figure 3 shows the drying curves of the samples undergoing hot air drying using a Thermosyphon heat pipe heat exchanger and open sun drying at various thicknesses of paddy. It was observed that hot air drying using the Thermosyphon heat pipe heat exchanger exhibited higher drying rate than open sun drying, as expected. Drying at higher temperatures led to higher moisture diffusivity values and larger driving force for heat and mass transfer than at lower temperatures. Time needed to reach the desired moisture content of less than 14% wet basis is shown in (Table 3). The results showed that the paddy drying using Thermosyphon heat pipe heat exchanger provided 3.5 times higher in average drying rate than that using open sun. The layer thickness of 5 centimeters was found to be shorter in drying time than 10 and 15 centimeters. In addition, the results showed that hot air drying using Thermosyphon heat pipe heat exchanger took shorter drying time than open sun drying. Moreover, increase in thickness of paddy led to longer drying time, as expected.

Table 3 Time to dry samples to the final moisture content of less than 14% wet basis

Drying method	Layer thickness (cm)	Drying rates (g/hr)
Thermosyphon heat pipe heat exchanger	5	0.26
	10	0.24
	15	0.17
Open sun	5	0.09
	10	0.07
	15	0.04

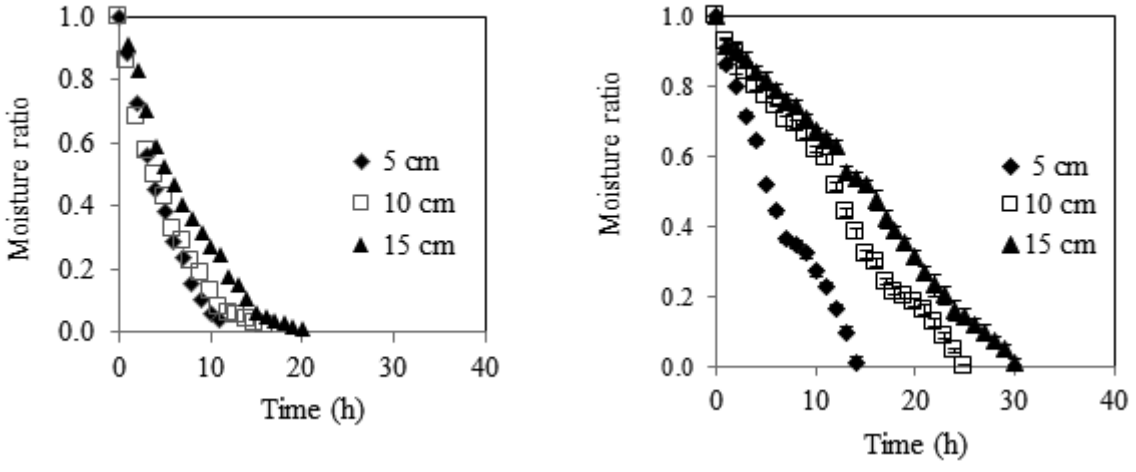

Figure 3 Drying curves of paddy dried by (a) hot air drying using Thermosyphon heat pipe heat exchanger and (b) open sun drying

2. Mathematical modeling of drying curves

Drying curves of the paddy under hot air using heat pipe heat exchanger was fitted with five different moisture ratio models shown in (Table 2). The statistical results of the different models, including the drying model coefficients and the comparison criteria used to evaluate goodness of fit, namely, R^2, χ^2 and RSME, are summarized in (Table 4). It can be seen that, the R^2 values for the models were in the range of 0.993-0.999, $\chi 2$ values were varied between 0.0002 and 0.004 and, and RMSE values between 0.014 and 0.044. By comparing the criteria values among five drying models, it can be seen that Logarithmic was the best descriptive model for drying methods, since it exhibited the highest average value of R^2, the lowest average values of $\chi 2$ and RMSE. Thus, it was selected to represent the drying charac teristics of paddy.

3. Determination of effective moisture diffusivities

The values of the effective moisture diffusivity values are calculated using Eq.6 and 7 and were found to range between 2.11×10^{-8} m^2/s and 1.37×10^{-7} m^2/s (shown in Table 5). The effective moisture diffusivity was affected by drying method and thickness of paddy. It was observed that the increase in Deff in paddy affected the thickness of paddy increased. Similar results have previously been reported. Rasouli et al.[16] and Yardfon et al.[17], for example, found that higher thickness of samples resulted in larger effective moisture diffusivity.

Table 4 Statistical results obtained from different drying models

Model name	Drying method	Thickness	Drying Constants	R^2	χ^2	RSME
1.Henderson and Pabis	Thermosyphon	5 cm	k=0.220, a=1.059	0.994	0.0016	0.037
		10 cm	k=0.195, a=1.027	0.997	0.0007	0.025
		15 cm	k=0.145, a=1.058	0.994	0.0014	0.035
2.Midilli et al.	Thermosyphon	5 cm	k = 0.228, n=0.894, a=1.126, b= -0.011	0.996	0.0021	0.037
		10 cm	k = 0.169, n=1.017, a=1.004, b= -0.003	0.998	0.0003	0.014
		15 cm	k = 0.130, n=0.972, a=1.051, b= -0.005	0.998	0.004	0.019
3. Page	Thermosyphon	5 cm	k=0.132, n=1.271	0.998	0.0003	0.017
		10 cm	k=0.151, n=1.121	0.998	0.0004	0.019
		15 cm	k=0.085, n=1.219	0.997	0.0006	0.023
4. Modified Page	Thermosyphon	5 cm	k=0.183, n=1.129	0.993	0.0021	0.044
		10 cm	k=0.152, n=1.245	0.996	0.0008	0.026
		15 cm	k=0.138, n=0.987	0.993	0.0018	0.041
5.Logarithmic	Thermosyphon	5 cm	k=0.146, a=1.242 c=-0.220	0.999	0.0003	0.015
		10 cm	k=0.161, a=1.079 c=-0.077	0.998	0.0002	0.014
		15 cm	k=0.104, a=1.167 c=-0.150	0.998	0.0003	0.017

Table 5 Effective moisture diffusivity values of paddy

Drying method	Layer thickness (cm)	D_{eff} (m^2/s)
Hot air using Thermosyphon heat pipe heat exchanger	5	2.11×10^{-8}
	10	7.09×10^{-8}
	15	1.37×10^{-7}

Conclusion

The experiments were performed to determine drying characteristics of paddy cv. San-Pah-Tong 1 dried by hot air drying using a Thermosyphon heat pipe heat exchanger and open sun drying method. According to the statistical analysis applied to all models, it can be concluded that among these models, Logarithmic gave the best results. In addition the drying method, thickness of paddy had a significant influence on the drying rate. Hot air drying using Thermosyphon heat pipe heat exchanger required shorter drying time than open sun drying since drying rate of hot air drying was higher than that of open sun drying. Increase in thickness of paddy resulted in decreased drying rate and needed longer drying time to reach the final moisture content. Moreover, drying method and thickness of paddy affected the effective moisture diffusivity values of paddy. Studies on physical and nutritional properties of the paddy after drying are suggested as a future work.

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Imaging Red Light Runners

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Abstract

Traffic lights are routinely ignored by Thai drivers, so we designed a system that allows a single camera attached to a simple PC to monitor a controlled intersection and sends images of vehicles violating traffic lights to a police post further down the road. This allows police to instantly stop motorists, fine them if appropriate but, more importantly, educate them on the importance of following road rules - for the benefit of all drivers. We demonstrated that our system performs with two types of cheap, consumer cameras: it is simple to setup, does not rely upon accurate intersection delineation and can be deployed on intersections that are not well marked. It can view red light runners from the side or rear view thus the only constraint on the camera position is the ability to view the whole intersection and at least one controlling traffic light.

Keywords: visual object tracking, traffic safety

Introduction

Thailand has a very high rate of road accidents: it has been ranked as high as third in the world on a per head of population basic by statistics from the World Health Organization[1]. Road traffic accident have many causes: statistics from the Thai Traffic Police rank the causes of the accident as

1. Highway speeding,
2. Tailgating,
3. Unsafe overtaking and
4. Running a red light[2].

Although running red lights only causes _ 10% of accidents in Thailand, this represents _ 2000 deaths (and many more accidents) annually[2]. However, this problem is international: Retting et al. reports that in the US, 260,000 crashes and 750 fatalities annually were attributed to red light running[3]. Crashes involving red light runners have greater impact than other crashes causing occupant injuries in 45% of crashes, compared to 30% in other crashes[4]. Internationally, the economic and social cost of road accidents remains high, even in countries with much lower per capita accident rates than Thailand. For example, in Victoria, Australia, with only 5.4 fatalities per 100,000 head of population, the economic cost is estimated at $ A4 billion perannum[5] in a total population of 5.8 million (2014 census), thus the cost in Thailand with 17 fatalities per 100,000[1] the economic cost must be significantly greater. This makes no account of the social cost of deaths and injuries. Despite some campaigns from several sources in Thailand, the accident rate is not decreasing. Thus any system which increases awareness of road hazards will have enormous benefit for the country.

Previous work

Many systems have been developed to monitor traffic violations. Early systems were usually attached to the traffic light control systems, e.g. Abbas and Li used a combination of a PC104 which takes data from the traffic cabinet and cameras storing images with a commercial video capture loop[6]. Other systems, mostly involving cameras linked to traffic cabinets and inductive loop detectors, have been surveyed by Yung and Lai[7]. Washburn and Courage used a commercial video

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recorder with some sensors on the light power cables. Signals from these sensors were encoded on the audio channel of the recorder for later outline

Analysis: the acquired data was used for traffic analysis and was not used for enforcement or education of drivers themselves[8]. Many of these use camera and image processing techniques to assist law enforcement and improve safety as well as improve traffic flow. Klubsuwan et al. used image processing alone to detect traffic light violations without the help of other systems[9]. They correctly detected 80% violations. Several commercial systems are also now available, but they are mainly suited to the well-controlled intersections in western countries[10]. One full system developed in Thailand has been reported, but does not appear to have been widely adopted: cost may be a factor as it includes license plate detection[11].

1. Extent of the problem

To confirm the extent of the problem of running red lights locally, we made a simple count of the rate of red traffic light violations. On one major highway T-junction in Mahasarakham (a small city in NE Thailand, pop 250,000), we counted the number of vehicles going through traffic lights in light traffic conditions (12 noon on a Sunday): in a one hour period, with 26 light changes (one for each of 3 directions), we noted 79 cars and trucks and 28 motorcycles that did not stop for a traffic light over the three intersections in the T-junction, ie on average one car or truck for every light change and one motorcycle every three changes. This showed that traffic lights are routinely ignored locally and that an automated system that assisted police to detect and educate drivers could make a significant impact on accidents and their cost. We also hypothesized that educating drivers to obey one road rule might encourage them to follow other rules also and reduce accidents from other causes too.

Our system

Our system consists of a single camera attached to a PC which was positioned to monitor a controlled intersection. It monitors the traffic lights themselves and does not require assistance from the traffic controlling hardware and associated road loops. When it detects a red light violation - a vehicle moving through the intersection when the light is red - it captures images of the offending vehicle and transmits a set of images to a police post which can be several hundred meters down the road. This component of the system was designed to follow the very common current Thai police practice of establishing partial road blocks to check vehicles, thus it will require minimal changes to current practices. Our design is also easily adapted to a variety of situations: it can be set up in a few minutes at a new intersection. It just requires a suitable position for a camera mount and a casing for the PC and battery[1]. The wireless connection needs a line-of-sight link to the monitor post, say 500m away[2].

1. Operation

1.1 Setup

Traffic Light Detection initially, the operator needs to place the camera in a stable location so that it can view the intersection and at least one light controlling it. The software detects traffic light candidates which can be anywhere in the field of view and asks the operator to indicate when the correct light has been detected[3]. Steps in the light detection algorithm are:

1. Identify `red' areas by comparing high intensities in the red channel of the image with intensities in the other two channels. Typical traffic scenes contain large white areas which show high red intensities, so these are eliminated. Unfortunately, scenes often contain several red patches (red cars seem to be very popular!), so we did not attempt to fully automatically identify lights: previous efforts, e.g. Sooksatra and Kondo[12], found less than 90% correct detections in fairly ideal conditions, as might be expected due to the likeli-hood of round and red objects appearing in a typical scene[4]. traffic light, false color optical flow map (green indicates highest speed), flow map contour

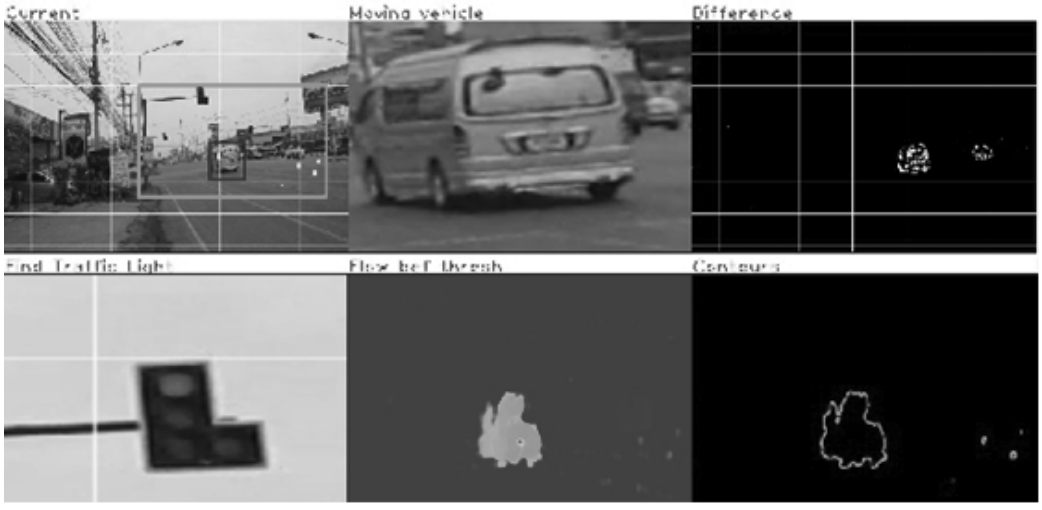

Figure 1 Screen shot after detecting a red light runner using 1280 720 pixel small consumer camera (Canon IXUS 155) Top row: marked up intersection image, vehicle passing red light, difference image; Bottom row:

2. Select red light candidates by shape and size.

3. Present candidates to the operator, one-by-one

4. Terminate when the operator accepts a candidate or repeat on another image.

Traffic Light Detection The operator then identifies the `forbidden region' - the area which must not be entered after the light has turned red. Observation showed that many intersections were poorly marked - with markings absent or badly worn - and therefore likely to defeat an automated system. However, an operator can quickly (two mouse clicks) identify the forbidden region - see blue outline in the top left of (Figure 1).

Link to monitor post Then the operator aligns the link between the intersection camera and the monitoring post computer. A reasonable height above ground for the antennae at both ends will ensure trouble-free transmission. Even in quite crowded city areas, transmitters and receivers about 2-3m or more above ground will suffice. Software will verify that significant bandwidth to transmit images of the red light runners is available[5].

1.2 Automatic Monitoring In monitor mode, the program uses optical flow to detect moving objects in the exclusion zone when the traffic light is red. Candidate algorithms for this are frame differences and optical flow.

1.3 Frame differences This is very fast and meets any real-time constraints, but is susceptible to interference from moving objects (trees are a particular concern, but even traffic lights are affected by the wind. Some examples may be seen in the top panel of (Figure 2) which shows trees and power wires clearly showing up - `speckle' in the Top row: marked up intersection image, vehicle passing red light, difference image; Bottom row: traffic light, false color optical flow map (green indicates highest speed), flow map contour

background. Even the `pick up' appearing as a large white area in the difference map is a complex shape with several black `holes'. So the difference images need considerable intelligent processing to remove noise and non-vehicle movements and we rejected it in favor of optical flow techniques. Although it is not used for primary vehicle movement detection, occasional system artefacts (probably mainly vibrations in the camera base) cause poor frame-to-frame registration, affecting optical flow, which detects anything moving in the scene, and leads to poor discrimination between moving and background objects. So we simply reject frames which are poorly registered: typically more than 30 frames are captured for a red light runner, so this has negligible effect on overall detection.

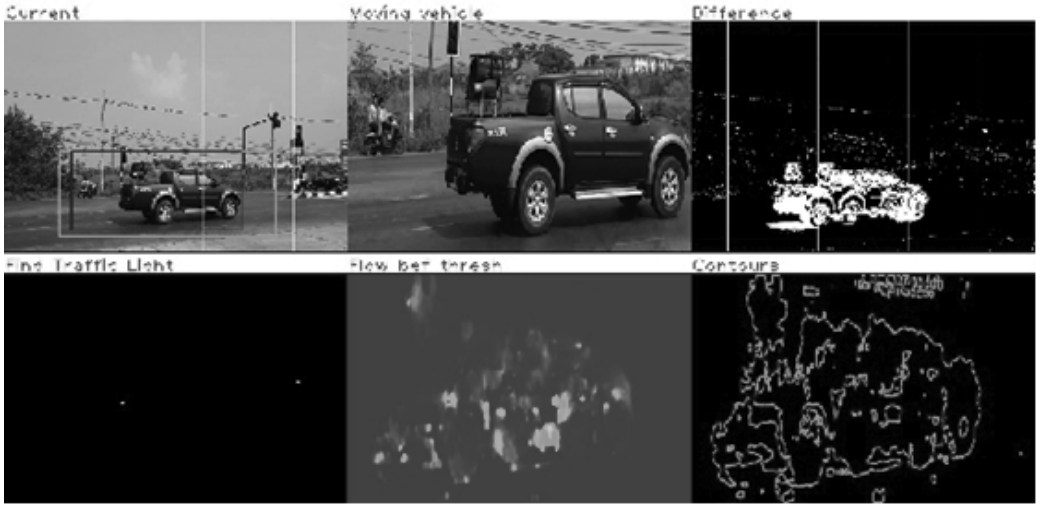

Figure 2 Screen shot after detecting a red light runner using hand held 1900 _ 1080 pixel cell phone camera (Samsung Galaxy Grand Prime)

1.4 Optical flow

Optical flow is unfortunately computationally complex on the high resolution images that are now available. Selection of the forbidden region assists by reducing the area that must be processed. Optical flow images also allow the speed and direction of the moving vehicle to be determined, allowing rejection of vehicles stopped unintentionally in the forbidden region, e.g. blocked by other traffic. We used the Farneback optical flow routine from the Open CV library[13]. In separate trials, we have used the total linear variation algorithm (from Open CV[14]) which produces slightly better results but is approximately three time slower. On the bottom middle panel of (Figure 1), a false color map showing which pixels are moving from frame to frame.

Greenish colours encode faster moving pixels. A contour is drawn around the fast moving pixels: small areas are rejected (wind or vibration generated noise) and regions large to represent a vehicle (or motorcycle - the commonest offenders are some intersections) and an image of the offending vehicle extracted from the current scene image for transmission to a monitoring post. For the higher resolution images of (Figure 2), the optical flow algorithm fails to cleanly assign every pixel of the vehicle to a uniform velocity (as seen in the lower middle false colour image of Figure 2), but the moving vehicle is sufficiently correctly identified to allow a complete and clear image of the red light runner (upper middle panel of Figure 2).

Results

Preliminary results for our system have been tested with several video cameras - including one in a cell-phone - have shown that the system reliably detects red light runners. A screen shot from the running program is shown in (Figure 1). Using a Canon IXUS 155 camera (1280_720 pixel resolution), clear images of the red light runner were obtained in typically 300 _ 230 pixel colour images which can easily identify a vehicle. These _ 24 Kbyte images are rapidly transmitted to a monitor post which can capture a short video of the runner.

False detections from low moving and small objects and noise were readily eliminated. Currently the system is being tested using IP links over the cell-phone network, which may prove satisfactory (and considerably cheaper!) in the long run: we note that a red light runner travelling at 60 km/hour needs 30 s to reach a monitoring station 500m down the road and a communications latency of much less than that is readily achieved. A frame rate as low as 10 fps requires a bandwidth of _ 0:25 MB/s to capture 30 frames of a red light runner at 60 km/hour: so a clear picture can still be obtained if many frames are dropped. There is also considerable potential to use higher resolution images but seemingly no need to increase frame rates.

We observed that automatic number plate recognition (as provided in the Smart Vision Technology

system[11]) would require higher resolution and also restrict position of the camera to be almost directly behind the moving vehicle, but there are only weak constraints of the current system: it can be rapidly set up and only needs a clear view of the intersection and a controlling traffic light. We have tested it successfully from several viewpoints in different intersections.

Conclusions

This work was designed to develop a simple and robust system that was suited to Thai conditions and procedures. It is characterized by a flexible fast setup and thus can be readily redeployed to a new location. Rapid movement may be a key factor in the electiveness of this system: fixed red light camera locations are widely publicized in several countries, mitigating their electiveness, but the wide availability of rapidly deployed systems may substantially enhance electiveness. Tests at several intersections with different camera capabilities have suggested that the system has significant potential to detect traffic light violations in less than ideal conditions with simple set-up procedures and contribute to the serious problems referred to in the introduction that currently exist on all Thai roads. We thus see strong justification for further work to improve its robustness and reliability.

Future work

Robust estimation of the object shape and size from optical flow data needs further study. Further tests in a variety of weakly controlled environments, e.g. partially visible traffic lights, and situations where several competing traffic flows can be observed. Although the system is designed to provide traffic light violations to a human operator and therefore occasional failures are tolerable, confidence and effectiveness of the systems will be improved if its correct behavior is known - and approaches 100%. Statistical analysis of detection accuracy is also required: we have not yet investigated situations where several vehicles run the red light at the same time.

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Causal Relationship Model of Ecological Footprint Integrated with Environmental Education

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Abstract

This research was quantitative research with a survey approach. A questionnaire was used as an instrument for gathering data from a population of 36,009 upper secondary school students under Secondary Service Area Office 28 (Sisaket-Yasothon) in academic year 2014. Cluster Random Sampling technique was implemented to collect 400 upper secondary school students as the sample group. Structural Equation model (SEM) was used for model confirmation. Research results demonstrated that Ecological Footprint (EF), Environmental Education (EE), and Environmental Conservation Inspiration (INS) were able to explicate the variation of cause Environmental Conservation Behavior for Global Warming Alleviation (EnB) with 92.00 percent. EF had the most effect to EnB with 0.69, Subsequences were EE, and INS with 0.48 and 0.40. Additionally, EF and EE were able to explicate the variation of INS with 78.00 percent, and EF had the most effect to INS with 0.36. Subsequence was EE with 0.30. The causal relationship model of EF and EE influencing EnB through INS was confirmed the proposed model and it was fitted with all observed variables in line with criteria of Chi-Square/df value with less or equal to 1.647 and it was less than or equaled to 5.00 ($\chi^2/df \leq 500$). RMSEA (Root Mean Square Error Approximation) equaled to 0.045 (RMSEA <0.05) and RMR (Root Mean Square Residual) equaled to 0.047 (RMR <0.05) including index level of model congruent value of Goodness of Fit Index (GFI) equaled to 0.94, and Adjust Goodness of Fit Index (AGFI) equaled to 0.91 which are between 0.90-1.00.

Keywords: model, ecological footprint, environmental education

Introduction

Ecological Footprint (EF) is a measurement of humanities reliance on natural resources. Moreover, EF measures the amount of productive land and water necessary for the production of goods including waste accumulation from the population's activity. EF is a distinctive group of uniqueness, actions, etc., that leave a trace and serve as methods of classification, such as the quantity of productive land suited for average of each person (in the world, a country, etc) for food, water, transport, housing, waste management, and other purposes. The simplest way to define ecological footprint would be classify it as the impact of human activities measured in terms of the area of biologically productive land and water requisite to produce the goods consumed and to absorb the wastes produced. Basically, it is the quantity of the environment required to produce the goods and services needed to maintain a particular lifestyle.[8,22]

The EF is rooted in the fact that all renewable resources come from the earth. It accounts for the flows of energy and matter to and from any defined economy and converts these into the corresponding land/water area

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required for nature to support these flows. The Ecological Footprint is defined as “the area of productive land and water ecosystems required producing the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located.”1 It compares actual throughput of renewable resources relative to what is annually renewed. Non-renewable resources are not assessed, as by definition their use is not sustainable.

Environmental Education of The Intergovernmental Conference highlighted the Environmental Education functions on preservation and improvement the global environment and required to supply the agenda and directions for environmental education. Environmental education is a learning process that makes human gain more awareness and knowledge on the environment, developing the essential skills and expertise, and cultivating attitudes, and promise for decision making and taking responsibility. Environmental education covers the fundamental component of environmental, knowledge and understanding, awareness for environmental problems, having proper attitude for performing appropriate behavior through repeated practice for environmental conservation with skill and correct decision making with responsibility and participation in environment projects and activities.[25]

Thiengkamol affirmed that the inspiration of public consciousness or public mind requires no admiration or complement or incentive. Particularly in natural resources and environment conservation, it happens from insight of someone, whilst its occurrence might come from the pleasure in a person as role model or idle, events, situation, environment, media perceiving such movie watching, book and magazine reading, and internet using. In addition, several researches were carried out by her and her colleagues, these have also proved that inspiration of public consciousness or public mind are a critical factor for environmental conservation in diverse environmental management with the integration of the environmental education concept.[2,3]

The goal of this study was to apply the EF knowledge and EE for the students to conserve the natural resources and environment via inspiration of public consciousness or public mind. Knowledge and understanding of EF and EE would lead them to be concerned that the ecological capacity has limitations whilst the population growth has increased rapidly because various factors support this growth. A factor such as better medical technology is progress, thus the people have better health. However, there is the problem of a new disease arising from the environmental problems of pollutions. Therefore, understanding the EF would help younger generations to realize the importance of ecological balance and to challenge them to change their environmental behavior of consumption, energy conservation, waste management, recycling, traveling and environmental knowledge transferring. The new generations would be our hope to cure and maintain the ecological system with their public consciousness to meet sustainable development.

Objective

The objective of this research was to develop a causal relationship model of an ecological footprint and environmental education of upper secondary school students under Secondary Service Area Office 28 (Sisaket-Yasothon) in the Northeastern region, Thailand.

Methodology

The research method was conducted following these steps:

1. Population and Sample

Population was 36,009 upper secondary school students under Secondary Service Area Office 28 (Sisaket-Yasothon) of Northeastern region of Thailand in second semester of academic year 2014.

Sample was 400 upper secondary school students that gathered with Cluster Random Sampling technique.

2. Research tool

The content and structural validity of a questionnaire were proved by Item Objective Congruent (IOC) from 5 experts in the fields of ecology, environmental education, social science and social research methodology.

The reliability was tried out by conducting a sample group from 40 upper secondary school students who had the same characteristics with sample group. The reliability was determined by Cronbach's Alpha formula: the ecological footprint composing 42 items, environmental education composing 42 items, environmental conservation inspiration composing 35 items, and environmental conservation behavior for global warming alleviation composing 42 items. The whole questionnaire consisted 161items. Their reliabilities were 0.816, 0.804, 0.954, 0.957 and 0.938 respectively.

3. Data Collection

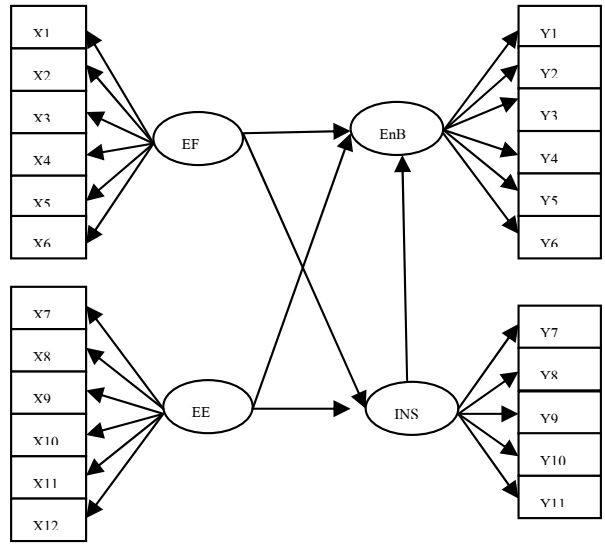
The Cluster Random Sampling technique was employed for data collecting of 400 upper secondary school students under Secondary Service Area Office 28 (Sisaket-Yasothon) of Northeastern region of Thailand. The research instrument was a questionnaire, and it was used for data gathering.

4. Data Analysis

The descriptive statistics were frequency, percentage, mean and standard deviation. Structural Equation Model (SEM) was used for model confirmation with LISREL version 8.30 by considering on Chi- Square value had no statistically significant at level of 0.01 or Chi-Square/df value with less or equal to 5, RMSEA (Root Mean Square Error Approximation) and RMR (Root Mean Square Residual) values with less than 0.05 including index level of model congruent value, GFI (Goodness of Fit Index) and index level of model congruent value, AGFI (Adjust Goodness of Fit Index) between 0.9-1.00.

Conceptual Framework

The exogenous latent variables of Ecological Footprint (EF) and Environmental Education (EE) had direct and indirect effects to Environmental Conservation Inspiration (INS) and Environmental Conservation Behavior for Global Warming Alleviation (EnB). EF was measured by Ecological Footprint for Shelter (X1), Ecological Footprint for Food (X2), Ecological Footprint for Transportation (X3), Ecological Footprint for Cloth (X4), Ecological Footprint for Medicine (X5), and Ecological Footprint for Housing (X6). EE was measured by Environmental Awareness (X7), Environmental Attitude (X8), Environmental Skill (X9), Environmental Participation (X10), Environmental Responsibility (X11) and Environmental Decision (X12). The endogenous latent variable of EnB was measured by Consumption Behavior (Y1), Energy Conservation Behavior (Y2), Waste Management Behavior (Y3), Recycling Behavior (Y4), Traveling Behavior (Y5), Environmental Knowledge Transferring Behavior (Y6) and INS was measured by Self-Public Mind (Y7), Role Model Impression (Y8), Event Impression (Y9), Environment Impression (Y10), and Media Reception (Y11).



Results

1. Results of Effect among Variables in the Model in Terms of Direct and Indirect Effect

Ecological Footprint (EF), Environmental Education (EE) and Environmental Conservation Inspiration (INS) had effect on Environmental Conservation Behavior for Global Warming Alleviation (EnB) as follows.

1) Confirmatory factors of EF had direct effect on INS with statistically significant at level of 0.05 with effect of 0.36. EF had direct effect on EnB with statistically significance at a level of 0.01 with effect of 0.69 and indirect effect on EnB with statistical significant at level of 0.05 with effect of 0.14.

2) Confirmatory factors of EE had direct effect on INS with statistical significant at level of 0.05 with effect of 0.33. EE had direct effect on EnB with

statistical significant at level of 0.01 with an effect of 0.48 and indirect effect to EnB with statistical significant at level of 0.05 with effect of 0.13.

3) Confirmatory factors of INS had direct effect on EnB with statistical significant at level of 0.01 with effect of 0.40.

Considering on structural model confirmatory factors of component analysis of EF, EE and INS had effect to EnB with effect of 92.00 %. The structural equation can be written as the following in equation (1).

$$EnB = 0.40*INS + 0.69*EF + 0.48*EE \quad (1)$$
$$(R^2 = 0.92)$$

Equation (1) factors that had the most effect to EnB was EF with 0.69, subsequences were EE, and INS with effect of 0.48 and 0.40, these were able to explicate the variation of EnB with 92.00 percent.

Considering on confirmatory factors INS of upper secondary school students, it demonstrated that EF had the most effect on INS with 0.36. Subsequence was EE with 0.33, these were able to explicate the variation of INS with 78.00%. The structural equation can be written as follows.

$$INS=0.36*EF + 0.33*EE \quad (2)$$
$$(R^2 = 0.78)$$

Equation (2) factors that had the most effect to INS were EF, and subsequence was EE, these were able to explain the variation of Environmental Conservation Inspiration (INS) with 78.00 percent.

The results of exogenous variables had effect to endogenous variables with direct and indirect effects were demonstrated in (Figure 1) and (Table 1).

Discussion

The results indicated that understanding the concept of Ecological Footprint (EF) was predicted by 6 observed variables of Ecological Footprint for Cloth (X4), Ecological Footprint for Transportation (X3), Ecological Footprint for Shelter (X1), Ecological Footprint for Medicine (X5), Ecological Footprint for Housing (X6) and Ecological Footprint for Food (X2) with predicting power of 0.83, 0.74, 0.65, 0.64, 0.60, and 0.28 respectively. Moreover, it also had direct effect to Environmental Conservation Behavior for Global Warming Alleviation (EnB) with effect of 0.69, which is a rather high effect, thus it is obviously seen that EF plays an important role to change the environmental conservation behaviors for global warming alleviation that was predicted by Environmental Knowledge Transferring Behavior (Y6), Energy Conservation Behavior (Y2), Waste Management Behavior (Y3), Traveling Behavior (Y5), Recycling Behavior (Y4), and Consumption Behavior (Y1) with prediction power of 0.71, 0.62, 0.62, 0.61, 0.56, and 0.51 respectively. Another essential exogenous variable was Environmental Education (EE) which had direct and indirect effects on EnB with 0.48 and 0.13 and it also was predicted by observed variables of Environmental Skill (X9), Environmental Decision (X12), Environmental Awareness (X7), Environmental Responsibility (X11), Environmental Attitude (X8) and Environmental Participation (X10) with prediction power of 0.89, 0.60, 0.48, 0.47, 0.37 and 0.32 respectively. The findings verified that EF and EE are vital factors that are able to be applied for challenging pro-environmental behaviors of upper secondary school students to act as critical change agents to transfer their environmental knowledge to their friends, family members, and others in society as well including explicit their Energy Conservation Behavior, Waste Management Behavior, Traveling Behavior, Recycling Behavior, and Consumption Behavior as good role model for others too. The results were in the line with Thiengkamol and her colleagues that EE had direct and indirect effect to environmental conservation behaviors for global warming alleviation.

Additionally, Environmental Conservation Inspiration (INS) had direct effect to EnB with effect of 0.40 whereas considering on prediction of correlation of observed variables of Event Impression (Y9), Media Reception (Y11), Environment Impression (Y10), Role Model Impression (Y8), and Self-Public Mind (Y7). These were congruent to different studies of Thiengkamol and her colleagues that the results illustrated that Inspiration of Public Consciousness or public mind influencing pro-environmental

behaviors whether consumption behavior, energy conservation, waste management behavior, recycling behavior, traveling behavior and knowledge transferring and supporting for environmental conservation and so on.

Thus, this research results should be established to inspire upper secondary school students to take action in playing a role as environmental educators to transfer their environmental knowledge and understanding with public mind to devote for environmental conservation behavior as new generations who take care for ecological balance and maintain environmental quality to meet life quality for achieving sustainable development based on EF and EE concept considerations.

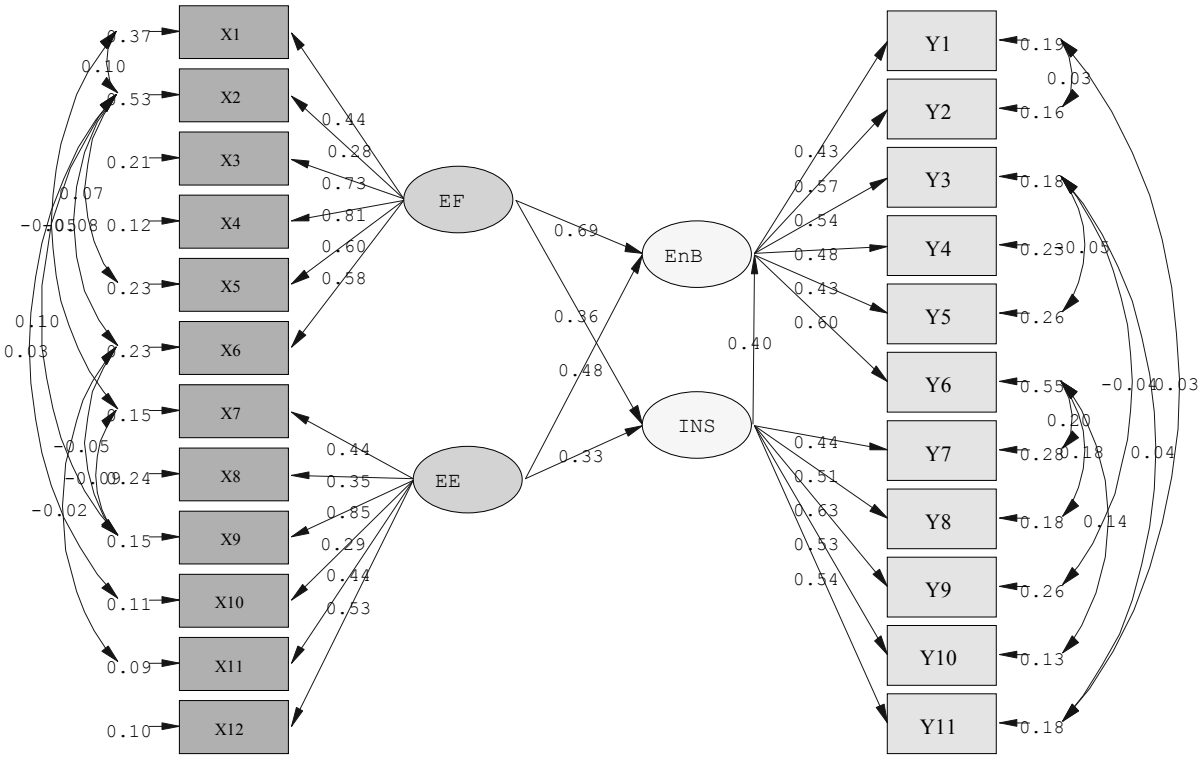


Figure 1 Model of Direct and Indirect Effect of EF and EE Affecting EnB through INS

Table 1 Direct and Indirect Effect of EF and EE Affecting EnB through INS

Causal variable	Result variables					
	INS			EnB		
	TE	IE	DE	TE	IE	DE
EF	0.36* (0.059)	-	0.36* (0.059)	0.83** (0.075)	0.14* (0.033)	0.69** (0.074)
EE	0.33* (0.059)	-	0.33* (0.16)	0.61** (0.065)	0.13* (0.013)	0.48** (0.069)
INS	-	-	-	0.40** (0.043)	-	0.40** (0.043)
χ^2= 263.50; df = 160			CN = 234.28		χ^2/df= 1.647	
GFI = 0.94; AGFI = 0.91			RMSEA = 0.045		RMR = 0.047	

TE: Total Effect, IE: Indirect Effect, DE: Direct Effect

Conclusion

Nevertheless, it might be summarized that latent variables that can be observed from observed variables are influenced through Environmental Conservation Inspiration (INS) composed of Self-Public Mind (Y7), Role Model Impression (Y8), Event Impression (Y9), Environment Impression (Y10), Media Reception (Y11) to Environmental Conservation Behavior for Global Warming Alleviation (EnB) that included behavior of appropriate consumption, energy conservation, waste management, recycling, travelling and knowledge transferring. Thus, the model of EF and EE influencing via INS to cause EnB was verified the proposed model was fitted with all observed variables according to criteria of Chi-Square/df value with less or equal to 5 ( ). RMSEA (Root Mean Square Error Approximation) equaled to 0.049 (RMSEA < 0.05) and RMR (Root Mean Square Residual) equaled to 0.017 (RMR < 0.05) including index level of model congruent value of Goodness of Fit Index (GFI) equaled to 0.95, and Adjust Goodness of Fit Index (AGFI) equaled to 0.92 which are between 0.90-1.00.

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Acute and Sub-Acute Toxicity Studies of Hawm Nil Brown Rice Kefir Powder

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Abstract

The present study was designed to determine acute and sub-acute toxicities of Hawm Nil brown rice kefir powder (HNKP) in male Wistar rats. In this acute toxicity study, HNKP at doses of 1,000, 2,000 and 4,000 mg/kg were once administered to the rats orally. Symptoms of toxicity and mortality were observed within 24 h and over a further period for 14 days. The results showed that all the doses of HNKP did not produce mortality or symptoms of toxicity. HNKP at a dose of 1,000 mg/kg produced the best body weight gain, food intake and FCR. Moreover, blood biochemistry including TP, Alb, Glob, BS, BUN, CREA, UA, TB, AST, ALT, and ALP, cholesterol, hematological values including WBC, RBC, Hb, Hct, MCH, MCHC, MCV, and Plt, and relative organ weight (ROW) of the rats received all the doses of HNKP did not differ from those in controls. In a sub-acute toxicity study, HNKP at the doses of 500, 1,000 and 2,000 mg/kg were given orally to the rats every 2 days for 14 days. Again, the result showed that all the doses did not produce mortality or symptom of toxicity. HNKP at a dose of 500 mg/kg produced the best body weight gain, food intake and FCR. Furthermore, the rats that received HNKP at this dose had blood biochemistry, cholesterol, hematological values, and ROW close to those in controls. However, the rats received high doses of HNKP (1,000 and 2,000 mg/kg) and long term application altered Alb, Glob, BS, BUN, UA, AST, and ALP levels. These results indicate that long term and high dose application of HNKP can affect renal and hepatic functions (p<0.05). In addition, TG and HDL of the rats that received HNKP were significantly (p<0.05) less than those in controls. Interestingly, the rats that received HNKP had fewer neutrophils while lymphocytes were significantly higher than that in controls (p<0.05). These findings indicate that Hawm Nil brown rice kefir powder had no acute and sub-acute toxicities. However, long term application at high doses (1,000 and 2,000 mg/kg) of HNKP may cause hepatic and renal dysfunctions. Its activity on decreasing neutrophils and increasing lymphocytes resulted in increased globulin leads to improve immunomodulatory activity.

Keywords: Hawm Nil rice, rice kefir, acute toxicity, sub-acute toxicity, kefir powder

Introduction

Kefir is a fermented milk product. It contains lactic acid bacteria, yeasts and acetic acid bacteria that produce jelly-like grain. Kefir grain is white or lightly yellow, gelatinous irregular masses and sized between 0.3-3.5 cm. diameter[1-2]. Both bacteria and yeasts are surrounded by a water-soluble branched glucogalactan called kefiran[1]. Kefir has been reported to possess antibacterial[3-7], antifungal[7], antitumor[8], antioxidant[5, 9-11], anti-allergic[12], antineoplastic and pro-digestive[13-14], antidiabetic[15-16], and immunomodulatory activities[17-18]. Moreover, it is important to anti-inflammatory activity on the liver[19], lung[12, 16, 20] and colon[21]. Kefir can modulate the intestinal mucosa immune response. It induced the helper T cell type 2 response by increasing the number of immunoglobulin A, interleukins type 4, 6 and 10 cells, and induced simultaneously the production of pro-inflammatory cytokines (IFN γ and TNFα) but without tissue damage[17-18]. It can also improve lactose digestion and tolerance[22]. Fermented milk from kefir has high antioxidant activity and reduces the accu-

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mulation of reactive oxygen species (ROS) including superoxide ($O2^{-}$), hydrogen peroxide (H_2O_2) and nitric oxide ($NO\cdot$)[23]. In addition, kefir has high nutritional value as a source of proteins and calcium. It has a long tradition of being regarded as good for health in many countries[24]. Kefir can be considered as a probiotic resource, as it produces good activities for health.

Recently, the γ-aminobutyric acid (GABA), α-tocopherol, γ-tocopherol and total phenolics compounds (TPC) it is reported, has been found in Hawm Nil rice [25-26]. Moreover, total phenolic content and total anthocyanin content are found in Hawm Nil rice (Black) more than in white and red colored rice[27-28]. In addition, it exerts high levels of antioxidant activity[28]. Kefir from rice milk has higher antioxidant activity than cow's milk[5]. The antioxidants were higher in Kefir produced from plants as a result of the phenolic compounds presence in the plants[29].

A toxicity study of medicines or plant products should be carried out to see whether they are safe for human application. The present study was therefore designed to determine acute and sub-acute toxicity of Hawm Nil brown rice kefir powder in the rats.

Materials and methods

1. Hawm Nil brown rice, fermentation and kefir powder preparation

1.1 Hawm Nil brown rice: Hawm Nil brown rice harvested during the year 2013-2014 from Selaphum, Roi Et province, Thailand was used in this study. The rice was dried, weighed, soaked in distilled water (1:5, W:V) at 25°C for 2 h and thoroughly ground by using a blender and filtrated to obtain rice milk. The rice milk was pasteurized at 70°C for 15 min and then directly cooled at 4°C.

1.2 Hawm Nil brown rice fermentation: A 0.2 g freeze-dried Kefir grain was inoculated into 250 mL flask with 200 mL of Lactobacilli de Man, Rogosa, and Sharpe (MRS) broth and incubated under anaerobic conditions; the flask was put into a 5L anaerobic jar. After that the sample jars were kept at 30°C for 24 h, and then centrifugation (1000×g, 15 min at 4°C) to obtain the cells. The cells were washed and re-suspended in sterile saline solution (0.85% NaCl) and then diluted with sterile 0.85% NaCl (1:10; V:V). Subculture, kefir starter was inoculated into fresh milk (20:200; V:V) and incubated under aerobic conditions at 30°C for 48 h to obtain activated kefir grain. Then activate kefir grain were cultured and fermented by inoculating into Hawm Nil brown rice milk adding with 2.5% sucrose (100:1,000, V:V) and incubated under anaerobic conditions at 30°C for 24 h to get the final pH of about 4.8-4.9.

1.3 Hawm Nil brown rice kefir powder (HNKP) preparation: the Hawm Nil brown rice milk kefir was freeze-dried and powdered. The kefir powder was kept at -20°C until used.

2. Animals

Forty-eight male Wistar rats weighing 280-300 g were purchased from the National Laboratory Animal Center, Mahidol University, Thailand. The rats were kept in an animal laboratory and acclimated for 7 days in environmental conditions (22-25°C, 50%-55% humidity and under a 12-hour light/dark cycle). The rats were fed with a standard diet (Perfect Companion Group Co., Ltd.) and water *ad libitum*. All experimental protocols were maintained in accordance with the Guidelines of Committee Care and Use of Laboratory Animal Research, National Research Council of Thailand and advice of the Institutional Animal Care and Use Committee, Mahasarakham University, Thailand.

3. Acute toxicity study

Rats were weighed and divided randomly into four groups with 6 rats in each; group 1; rats received phosphate buffered saline (PBS) (control group), group 2, 3 and 4; rats received HNKP 1,000, 2,000 and 4,000 mg/kg respectively[30]. The doses of HNKP were once administered to the rats orally. Symptom of Toxicity (seizures, vomiting, diarrhea, and nausea) and rat mortality were observed within 24 h and over a further period for 14 days. Body weight and food intake were recorded daily. On day 14, the rats were fasted overnight, weighed and sacrificed by overdoses of chloroform. Blood sample was collected from the rat heart to determine blood biochemistry and hematological values. Visceral organs including liver, lung, heart, kidney and spleen were removed and weighed.

4. Sub-acute toxicity study

The rats were randomly divided into four groups with 6 rats in each; group 1; rats received PBS (control group), group 2, 3 and 4; rats received HNKP 500, 1,000 and 2,000 mg/kg respectively[31]. HNKP was given orally to the rats every 2 days for 14 days. Symptoms of toxicity were observed within 14 days. Body weight and food intake were recorded daily. At the end of experiments, the rats were fasted, weighed and then euthanasia by overdose of chloroform. Blood samples were collected from the rat hearts to determine blood biochemistry values and hematological values. Visceral organs including liver, lung, heart, kidney and spleen were removed and weighed.

5. Relative organ weight and feed conversion ratio

The relative organ weight (ROW) of each animal was calculated using the following equation;

$$\mathrm{ROW} = \frac{\text{Absolute organ weight (g)}}{\text{Body weight of rat (g)}} x100 \qquad (1)$$

The feed conversion ratio (FCR) of each animal was calculated as follow;

$$\mathrm{FCR} = \frac{\text{Food intake (g)}}{\text{Body weight gain (g)}} \qquad (2)$$

6. Determination of blood biochemistry and hematological values

Blood samples were put into heparinized and non-heparinized tubes. Blood was centrifuged at 1500 g for 10 min to separate serum. The serum from the non-heparinized blood was assayed for biochemistry including total protein (TP), blood sugar (BS), blood urea nitrogen (BUN), creatinine (Crea), uric acid (UA), cholesterol (CHO), triglycerides (TG), high density lipoprotein (HDL), low density lipoprotein (LDL), albumin (Alb), globulin (Glob), total bilirubin (TB), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP).

Heparinized blood was used for hematological analysis. Hematological analysis included red blood cell (RBC) count, white blood cell (WBC) count, hematocrit (Hct), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), platelets (Plt), neutrophils (Neu), and lymphocytes (Lym).

7. Statistical analysis

The results were presented as mean±SEM and analyzed using one-way ANOVA. The differences among means were detected by using the Duncan's Multiple Range Test and values of p£0.05 were consi dered statistically significant.

Results and Discussion

1. Acute toxicity

1.1 Symptoms of toxicity, body weight gain, food intake and FCR

All the doses of HNKP did not produce any symptom of toxicity and mortality of the rats during 14 days. HNKP at a dose of 1,000 mg/kg produced the best body weight gain, food intake and FCR (Fig.1A–1C). Moreover, the rats received HNKP at a dose of 1,000 mg/kg had hepatic and renal functions (Table 1), lipid profile (CHO, TG, HDL and LDL) (Table 2), hematological values (Table 3), and ROW (data not shown) close to those in controls. However, the rats received all the doses of HNKP had neutrophils less than while lymphocytes were higher than that in controls (p<0.05) (Table 3).

These findings indicate that HNKP has no acute toxicity on rats. Its activity on decreasing neutrophils and increasing lymphocytes resulting in increased globulin leads to improve immunomodulatory activity[17-18].

1.2 Blood biochemistry and ROW

Since, AST, ALT and ALP enzymes are involved in hepatic function and TB, TP, Alb, Glob, BS, BUN, CREA, and UA are involved in renal function[32]. The results from acute toxicity study revealed that TB, TP, Alb, Glob, BS; BUN, CREA, UA, AST, ALT, and ALP enzymes in the rats received all the doses of HNKP did not differ from those in controls (Table 1), suggesting that HNKP had no effect on hepatic and renal functions.

Hyperlipidemia is well known as one of the major risk factors for atherosclerosis which leads to coronary artery disease (CAD)[33]. The total cholesterol

was increased in the rats received HNKP at the doses of 2,000 and 4,000 mg/kg. However, TG, HDL and LDL were not altered in the rats treated with all the doses of HNKP compared to those in controls. These data indicate that HNKP has an effect on total cholesterol but not on TG, HDL and LDL (Table 2). The ROW in the rats treated with HNKP did not differ from that in controls.

1.3 Hematological values

(Table 3), WBC, RBC, Hb, Hct, MCV, MCH, MCHC, and Plt in the rats received HNKP did not differ from those in controls. Interestingly, the rats that received all the doses of HNKP had significantly less neutrophils while lymphocytes were significantly higher than that in controls (p<0.05), consistent with globulin increased. Since the total WBC count did not change, this result suggests that HNKP acts in opposite way in the differentiation of hematopoietic cells by suppressing neutrophils and stimulating lymphocytes. According to previous reports, kefir induced the helper T-lymphocytes type 2 proliferations by increasing the number of immunoglobulin A (IgA), interleukins type 4, 6 and 10 cells[17-18], in agreement with the increase of lymphocyte and globulin in this study.

Table 1 Blood biochemistry in rats treated with HNKP and PBS from acute toxicity study (mean±SEM).

Blood biochemistry	PBS	HNKP (mg/kg)		
		1,000	2,000	4,000
BS (mg/dl)	182.33±23.55	176.67±38.09	214.83±21.09	235.33±25.04
BUN (mg/dl)	20.17±0.48	19.75±0.37	19.63±0.33	20.62±0.51
CREA (mg/dl)	0.91±0.03	0.88±0.02	0.85±0.02	0.87±0.02
UA (mg/dl)	3.91±0.55	3.72±0.31	3.65±0.31	4.12±0.07
TP (g/dl)	5.65±0.11	5.47±0.17	5.47±0.12	5.63±0.02
Alb (g/dl)	3.47±0.04	3.45±0.08	3.48±0.07	3.47±0.03
Glob (g/dl)	2.20± 0.06	2.25±0.06	2.18±0.05	2.17±0.04
TB (mg/dl)	0.11±0.01	0.09±0.01	0.09±0.00	0.09±0.00
AST (U/L)	147.67±3.95	143.83±4.80	152.83±1.08	143.50±2.79
ALT (U/L)	39.33±1.17	38.17±2.21	35.00±0.68	37.50±0.96
ALP (U/L)	124.33±3.06	118.67±3.01	123.00±2.31	126.00±5.39

TP = total serum protein; Alb = albumin; Glob = globulin; BS= blood sugar; BUN = blood urea nitrogen; CREA = creatinine; UA= uric acid; TB= total bilirubin; AST = serum aspartate aminotransferase; ALT = serum alanine aminotransferase; ALP = alkaline phosphatase.

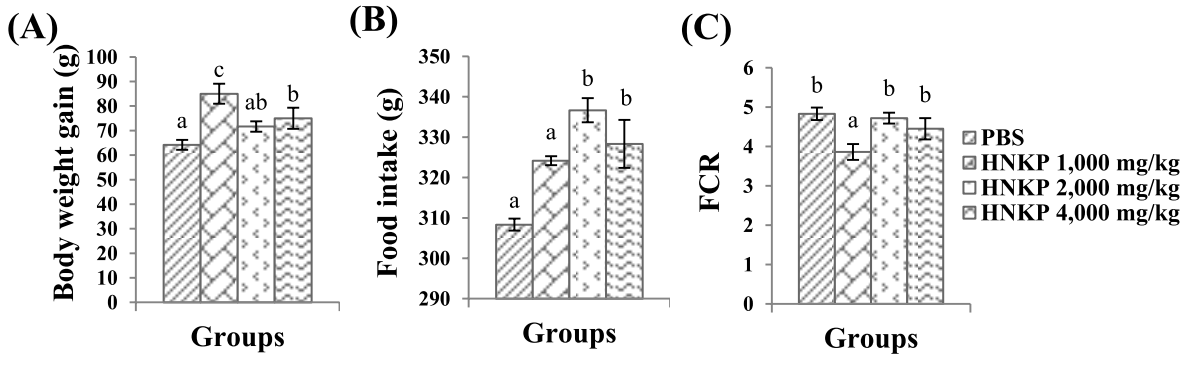

Figure 1 Body weight gain (A), food intake (B) and FCR (C) in rats treated with HNKP and PBS from acute toxicity study at the end experiment (mean±SEM). Mean values with different letters are significantly different, Duncan's test at p< 0.05.

Table 2 Cholesterol (CHO), triglycerides (TG), high density lipoprotein (HDL) and low density lipoprotein (LDL) in rats treated with HNKP and PBS from acute toxicity study (mean±SEM).

Lipid profiles	PBS	HNKP (mg/kg)		
		1,000	2,000	4,000
CHO (mg/dl)	53.67±1.28[a]	56.50±1.91[ab]	58.67±0.88[b]	58.67±1.63[b]
TG (mg/dl)	130.00±2.62	127.33±4.14	123.50±3.64	123.17±4.73
HDL (mg/dl)	16.48±0.27	16.57±0.55	17.10±0.57	16.62±0.29
LDL (mg/dl)	32.50±2.11	32.00±0.68	32.17±0.98	35.33±0.88

Mean values within each row with different superscripts are significantly different, Duncan's test at $p<0.05$.

Table 3 Hematological values in rats treated with HNKP and PBS from acute toxicity study (mean±SEM).

Hematological values	PBS	HNKP (mg/kg)		
		1,000	2,000	4,000
WBC (10^3 cell/mm^3)	5.93±0.16	5.55±0.23	5.93±0.22	5.40±0.27
RBC (10^6 cell/mm^3)	8.87±0.13	8.76±0.21	9.00±0.12	8.99±0.05
Hb (g/dl)	17.07±0.40	16.30±0.21	16.35±0.32	16.28±0.28
Hct (%)	53.83±0.87	52.67±1.31	51.83±1.14	51.50±0.22
MCV (fl)	58.33±0.88	59.33±0.21	57.67±1.56	59.67±0.42
MCH (pg)	19.60±0.08	19.53±0.10	19.65±0.26	19.95±0.08
MCHC (g/dl)	32.33±0.34	32.55±0.21	33.07±0.46	33.13±0.18
Plt (10^3 cell/mm^3)	943.17±27.15	904.50±13.18	883.00±23.23	924.83±17.63
Neu (%)	8.50±0.22[c]	6.17±0.17[b]	2.50±0.43[a]	2.33±0.33[a]
Lym (%)	91.00±1.21[a]	94.00±0.26[b]	97.00±1.21[c]	97.83±0.31[c]

Mean values within each row with different superscripts are significantly different, Duncan's test at $p< 0.05$. WBC = white blood cells; RBC = red blood cells; Hb = hemoglobin; Hct = hematocrit; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; Plt = platelets; Neu = neutrophils; Lym = lymphocytes.

Table 4 Blood biochemistry in rat treated with HNKP and PBS from sub-acute toxicity (mean±SEM).

Blood biochemistry	PBS	HNKP (mg/kg)		
		500	1,000	2,000
BS (mg/dl)	207.67±11.25[c]	156.50±19.70[b]	128.67±9.30[b]	85.50±7.64[a]
BUN (mg/dl)	20.45±1.12[c]	19.27±0.71[bc]	17.53±0.55[ab]	16.47±0.27[a]
CREA (mg/dl)	0.82±0.03	0.90±0.07	0.78±0.03	0.83±0.03
UA (mg/dl)	2.65±0.34[b]	2.62±0.28[b]	1.65±0.25[a]	1.48±0.19[a]
TP (g/dl)	5.72±0.13	5.63±0.15	5.43±0.08	5.73±0.18
Alb (g/dl)	3.28±0.06[b]	2.72±0.05[a]	2.67±0.03[a]	2.67±0.05[a]
Glob (g/dl)	2.48±0.09[a]	2.73±0.05[b]	2.73±0.08[b]	3.02±0.06[c]
TB (mg/dl)	0.07±0.02[ab]	0.05±0.01[a]	0.05±0.01[a]	0.13±0.02[b]
AST (U/L)	104.00±1.53[a]	140.00±3.18[b]	151.67±5.16[c]	157.33±4.58[c]
ALT (U/L)	49.17±1.66	47.33±1.41	50.33±1.33	53.83±3.70
ALP (U/L)	132.83±4.66[b]	119.83±6.82[ab]	116.67±3.37[a]	112.67±3.25[a]

Mean values within each row with different superscripts are significantly different, Duncan's test at $p< 0.05$ (N=6). TP = total serum protein; Alb = albumin; Glob = globulin; BS= blood sugar; BUN = blood urea nitrogen; CREA = creatinine; UA= uric acid; TB= total bilirubin; AST = serum aspartate aminotransferase; ALT = serum alanine aminotransferase; ALP = alkaline phosphatase.

Table 5 CHO, TG, HDL and LDL in rats treated with HNKP and PBS from sub-acute toxicity study (mean±SEM).

Lipid profiles	PBS	HNKP (mg/kg)		
		500	1,000	2,000
CHO (mg/dl)	54.50±5.42	46.50±1.43	48.17±3.38	49.33±3.02
TG (mg/dl)	152.00±4.20[b]	109.00±4.56[a]	100.67±7.05[a]	94.33±4.62[a]
HDL (mg/dl)	22.55±1.04[b]	18.42±0.42[a]	16.93±0.84[a]	17.48±1.44[a]
LDL (mg/dl)	29.17±1.01	31.83±1.90	33.67±2.93	31.33±2.17

Mean values within each row with different superscripts are significantly different, Duncan's test at $p< 0.05$.

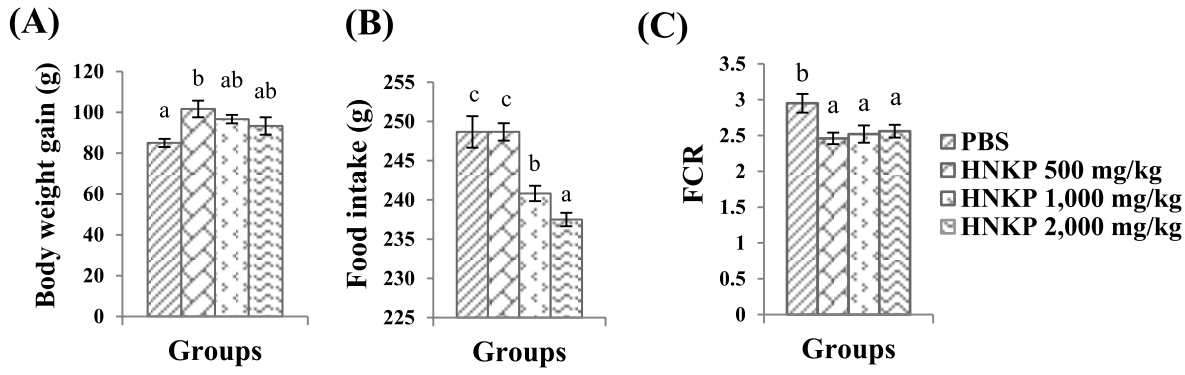

Figure 2 Body weight gain (A), food intake (B) and FCR (C) in rats treated with HNKP and PBS from sub-acute toxicity study at the end experiment (mean±SEM). Mean values with different letters are significantly different, Duncan's test at $p< 0.05$.

Table 6 Hematological values in rats treated with HNKP and PBS from sub-acute toxicity study (mean±SEM).

Hematological values	PBS	HNKP (mg/kg)		
		500	1,000	2,000
WBC (10^3 cell/mm^3)	6.42±0.28	5.77±0.43	6.50±0.26	5.60±0.40
RBC (10^6 cell/mm^3)	8.76±0.13	8.38±0.14	8.63±0.41	8.13±0.18
Hb (g/dl)	17.52±0.23	16.70±0.35	16.88±0.44	16.32±0.47
Hct (%)	53.33±0.76	51.00±0.68	50.67±1.38	50.67±1.36
MCV (fl)	59.33±0.49	59.50±0.43	59.33±0.42	59.33±0.33
MCH (pg)	19.98±0.28	19.90±0.17	19.80±0.27	20.05±0.26
MCHC (g/dl)	33.72±0.35	33.43±0.28	33.37±0.47	33.75±0.36
Plt (10^3 cell/mm^3)	923.17±24.11	887.33±24.78	893.67±42.25	905.67±46.40
Neu (%)	8.83±1.01[b]	7.33±1.54[ab]	5.83±0.94[ab]	4.83±1.05[a]
Lym (%)	90.83±1.25[a]	91.83±1.87[ab]	95.17±0.87[bc]	96.33±0.71[c]

Mean values within each row with different superscripts are significantly different, Duncan's test at $p< 0.05$. WBC = white blood cells; RBC = red blood cells; Hb = hemoglobin; Hct = hematocrit; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; Plt = platelets; Neu = neutrophils; Lym = lymphocytes.

2. Sub-acute toxicity

2.1 Symptoms of toxicity, body weight gain, food intake and FCR

Again, the results showed that all the doses of HNKP did not produce any symptom of toxicity and mortality of the rats. HNKP at a dose of 500 mg/kg produced the best body weight gain, food intake and FCR (Figure 2A-2C). However, all the doses of HNKP had FCR better than that in controls (p<0.05). Kefir has been widely used in clinical practice to promote growth[13-14,24], and may be a source of nutritional compounds. Hawm Nil rice exerts high levels of antioxidant and phytochemical activities than white and red rice[25-28]. Thus, HNKP is suitable for further development as therapeutic agents for growth promotion.

2.2 Blood biochemistry and ROW

The results of this study showed the rats received HNKP at a dose of 500 mg/kg had hepatic and renal functions close to those in controls. Furthermore, the rats received high doses of HNKP (1,000 and 2,000 mg/kg) and long term were altered of Alb, Glob, BS, BUN, UA, AST, and ALP levels. These results indicate that long term and high doses application of HNKP can effect on renal and hepatic functions (p<0.05) (Table 4). The serum AST and ALP activities are widely used as sensitive markers of possible tissue damage, particularly liver toxicity[34]. Moreover, the triglycerides and HLD of the rats received kefir powder were significant less than that in controls (p<0.05). The decreasing of TG and HLD on rats received HNKP may be cause from hepatic function changing. However, the ROW in the rats treated with HNKP did not differ from that in controls (data not shown).

2.3 Hematological values

In line with the acute toxicity study, WBC, RBC, Hb, Hct, MCV, MCH, MCHC, and Plt in the rats that received HNKP did not differ from those in controls (Table 6). Nevertheless, the rats received all the doses of HNKP had neutrophils significant less than while lymphocytes were significant higher than that in controls (p<0.05). These results confirmed the non-toxicity of the application of Hawm Nil brown rice kefir powder at the doses less than 4,000 mg/kg.

Conclusions

HNKP has no acute and sub-acute toxicities when a dose less than 4,000 mg/kg is administered orally once, or a dose less than 500 mg/kg is administrated every 2 days for 14 days. In long term application, the powder at doses higher than 1,000 mg/kg may cause hepatic and renal functions as it produces Alb, BS, BUN, UA, and ALP levels decreasing while Glob and AST levels increase compared to those in controls. Furthermore, its activity on decreasing neutrophils and increasing lymphocytes resulting in increased globulin leads to improve immunomodulatory activity.

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Development of a Bike Trail as a Tourist Attraction in the Area of the Community Forest of Ban Nonhinphueng

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Abstract

A study of ways to develop a of bike trail as a tourist attraction in the area of the community forest of Ban Nonhingphueng, Tambon Dongbang, Amphoe Prachantakam, Prachinburi province was conducted. The study was to investigate tourists' opinions about a bike trail as a tourist attraction in the community. It was found that the tourists having no experience participating in this kind of activity tend to be more satisfied than the experienced ones. With the recommendation provided, ways of development based on a service marketing strategy, such as product varieties, uniqueness, pattern and need conformation, clear signs of tourist attraction and activity trail, increasing garbage dump spot and public relation channel, sale promotion inducing more buying, notifying activity sequence throughout the activity based on the tourists participating in life styles and learning experience with the community in more environmental friendly way, were proposed.

Keywords: development, prototype tourist, service market, creative tourism

Introduction

Based on an evaluation of, Tumbon Dongbang, Amphoe Prachantakam, Prachinburi province conducted by Faculty of Technology and Industrial Management joint with Raks Thai Foundation, a bike trail is proposed as an attraction in the area of the community forest in order to support an ecosystem tourist attraction which beneficially consumes the community's natural resources, develops sustainable careers and provides income for the community. In order to realize whether the trail is appropriate, the prototype activity should be held. Therefore, the researcher joined with Raks Thai Foundation and provided the prototype activity "Ride to the forest, Pick vegetables, and Visit community enterprise" to be aware of the tourists' opinions toward the bike trail in the area of community tourist attraction and to further improve and develop ways of sustainability.

Experimental

1. Tools and population

Questionnaires with a check list form based on Likert's scale and content analysis were mainly used to collect data whereas an interview was used to store data. The population was from the 50 prototype tourists participating in activity provided on 28th February 2015

2. Statistics used in this research

2.1 Significance level at 0.05

2.2 Descriptive statistics such as demographic data in check list form, frequency, percentage, rating scale with data exposing the satisfaction level of prototype activity participation, means, standard deviation, content analysis related to opinions and recommendation showing from highest to lowest.

2.3 Analytical statistics based on t-test (t) is to find the relation between variables of participating in

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riding bike activity for tourism and satisfaction of participating in prototype activity

2.4 Analysis of the average. Evaluating the level of satisfaction.

Average	**Interpretation**
4.51-5.00	Highest
3.51-4.50	High
2.50-3.50	Moderate
1.51-2.49	Low
1.00-1.50	Least

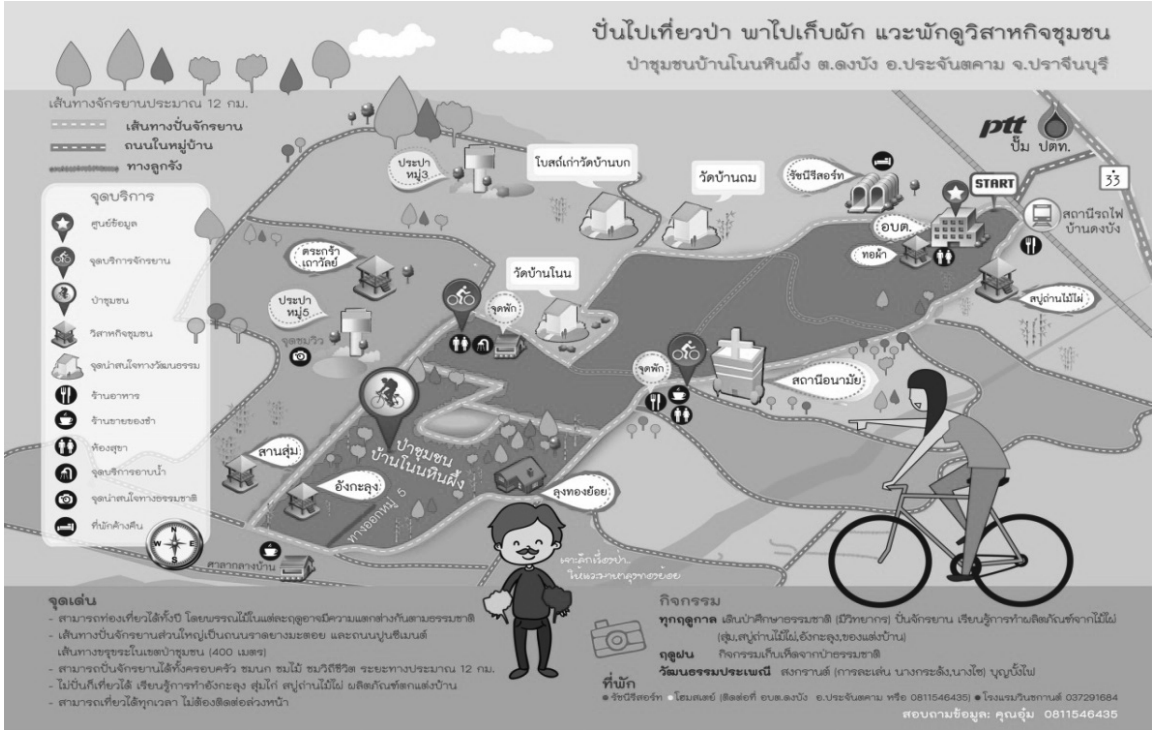

Figure 1 description of bike trail for tourism in the community [1]

Results and Discussions

1. Analysis of general status of the respondents

Table 1 Analysis of general status of the respondents

	Male	**More than 45 years**	**Income/month lower than 15,000 baht**	**state enterprise officers**	**Experiencing of similar activity**	**Experiencing of riding a bike for tourism of mere 5 years**
Number	37	31	24	16	35	29
Percentage	74.00	32.00	48.00	32.00	70.00	58.00

According to table 1, the prototype tourists have the following general status as male, age more than 45 years old, income less than 15,000 baht a month, having a career of state enterprise officers, experience of riding a bike for tourism, and experience of riding a bike for tourism of more 5 years.

2. Data analysis of satisfaction of participating in prototype activity and variable relation related to participating in bike activity for tourism and satisfaction of participating in a prototype activity

According to satisfaction of participating in prototype activity in every aspect, mean is 3.52 indicating high level of satisfaction of participating in prototype activity; data of each aspect can be analyzed and categorized as the (table 2-8) shown.

Table 2 Data analysis showing satisfaction level and relation between product variables

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Appropriateness of activity	3.76	0.72	High	-1.483	3.53	3.86	0.15
Difference of activity type	3.64	0.75	High	0.573	3.73	3.60	0.57
Various kinds of activity	3.72	0.73	High	0.054	3.80	3.69	0.62
Total aspects of product	3.71	0.61	High	-0.134	3.69	3.71	0.89

According to (Table 2), the prototype tourists have high level of satisfaction to products of prototype activity in every aspect; however, if it is categorized by experience of participating in riding a bike activity for tourism, the satisfaction level is significantly indifferent at 0.05.

Table 3 Data analysis of satisfaction and relation between price variables

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Appropriateness of activity fee	3.26	1.45	Moderate	0.654	3.47	3.17	0.52
Appropriateness of distributed product	3.48	0.95	Moderate	-1.271	3.13	3.63	0.22
Value acquired by activity participation	4.08	0.72	High	-0.508	4.00	4.11	0.61
Total aspects of price	3.61	0.79	High	-0.428	3.53	3.64	0.67

According to (Table 3), the prototype tourists have high level of satisfaction to the cost of prototype activity; however, the appropriateness of activity fee and price of product distributed has a moderate level of satisfaction. Nevertheless, if it is categorized by the experience of participating in riding a bike activity for tourism, the satisfaction level is significantly indifferent at 0.05.

Table 4 Data analysis of satisfaction and relation between place variables

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Convenient access to activity	3.86	1.03	High	0.030	3.87	3.86	0.98
Safety of trail and activity participation	3.96	0.73	High	-0.513	3.87	4.00	0.61
Clarity of directional signs and tourist attraction spots	3.48	1.11	Moderate	-1.248	3.13	3.63	0.23
Total aspects of place	**3.77**	**0.77**	**High**	**-0.871**	**3.62**	**3.83**	**0.39**

According to (Table 4), the prototype tourists have overall high level of satisfaction to place of prototype activity; however, the clear signs and tourist attraction spots have moderate satisfaction. Nevertheless, if it is categorized by the experience of participating in riding a bike activity for tourism, the satisfaction level is significantly indifferent at 0.05.

Table 5 Data analysis of satisfaction and relation between promotion variables

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Appropriateness of advertising and public relation	3.24	1.33	Moderate	-2.877	2.47	3.57	0.01*
Frequency of activity notification	2.86	1.36	Moderate	-3.203	2.00	3.23	0.00*
Appropriateness of sale promotion such as discount, exchange, give-out, and give in addition	3.14	1.36	Moderate	-1.165	2.80	3.29	0.25
Total aspects of promotion	**3.08**	**1.25**	**Moderate**	**-2.576**	**2.42**	**3.36**	**0.01***

According to (Table 5), the prototype tourists have an overall high level of satisfaction to promotion of prototype activity; however, if it is categorized by the experience of participating in riding a bike activity for tourism, the satisfaction level of only one aspect of appropriateness of a sale promotion such as a discount, exchange, give-out, and give in addition, is significantly indifferent. Nevertheless, there is significant difference between the inexperienced tourists in riding a bike activity for tourism having tendency to have more satisfaction than the experienced tourists in riding a bike activity for tourism at 0.05.

Table 6 Data analysis of satisfaction and relation between personnel variable

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Appropriateness of manners and courtesy by the service provider.	3.70	1.49	High	-1.450	3.13	3.94	0.16
Full of Knowledge, skill and experience throughout the activity.	3.60	1.38	High	-1.142	3.20	3.77	0.27
Assistance in fixing all kinds of problem throughout the activity session.	3.54	1.47	High	-1.805	2.87	3.83	0.09
Total aspects of personnel	**3.61**	**1.39**	**High**	**-1.548**	**3.07**	**3.85**	**0.14**

According to (Table 6), the prototype tourists have a overall high level of satisfaction of personnel toward prototype activity; however, if it is categorized by the experience of participating in riding a bike activity for tourism, the satisfaction level of prototype activity participation is significantly indifferent at 0.05 level.

Table 7 Data analysis of satisfaction and relation between creation and presentation of physical evidence variable

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Appropriateness of activity duration	3.40	1.41	Moderate	-1.688	2.80	3.66	0.11
Quickness of service provided throughout activity	3.36	1.45	Moderate	-1.596	2.87	3.57	0.12
Appropriateness of tourist attraction and activity pattern	3.50	1.46	High	-1.901	2.80	3.80	0.07
Creation and physical evidence presentation	**3.42**	**1.36**	**Moderate**	**-1.769**	**2.82**	**3.68**	**0.09**

According to (Table 7), the prototype tourists have a overall moderate level of satisfaction of creation and presentation of physical evidence to the prototype activity; however, the appropriateness of tourist attraction and activity pattern has high level of satisfaction. Nevertheless, if it is categorized by the experience of participating in riding a bike activity for tourism, the satisfaction level of prototype activity is significantly indifferent at 0.05

Table 8 Data analysis of satisfaction and relation between process variable

Prototype activities	Data related to satisfaction level			Relation of riding a bike experience and satisfaction			
	Mean	S.D.	Satisfaction	t	Mean Exp.	Mean Inexp.	Sig
Appropriateness of step of activity participation	3.42	1.30	Moderate	-2.041	2.87	3.66	0.05*
Appropriateness of practical procedure throughout activity	3.32	1.41	Moderate	-1.646	2.73	3.57	0.12
Appropriateness of link between community tourism and nature	3.60	1.40	High	-1.804	3.07	3.83	0.08
Total aspects of process	3.45	1.30	Moderate	-1.755	2.89	3.69	0.10

According to (Table 8), the prototype tourists have overall a moderate level of satisfaction of process toward prototype activity; however, the appropriateness causing the link between community tourist attraction and nature have high level of satisfaction. Nevertheless, if it is categorized by the experience of participating in riding a bike activity for tourism, the satisfaction level of prototype activity of all three aspects is significantly indifferent. However, the significantly different aspect found that the inexperienced tourists riding a bike activity for tourism have more satisfaction level than the experienced ones at 0.05.

Table 9 Data analysis related to opinions and recommendations

Recommendations	Amount
Product	
Distributed clothes should be more colorful or occasional.	6
Various products should be more; samples are not enough.	4
Price	
It is proper.	8
Place	
Directional signs should be added throughout the bike trail.	10
There are not enough garbage bins.	8
Shady construction should be added in every spot and construction maintenance should be regularly done for the tourists' convenience and pleasure.	4
Community forests should be conserved and expanded to the surrounding community.	3
Promotion	
Public relation should be more.	6
Personnel	
They are friendly, helpful, and impressive.	3
Creation and presentation of physical evidence	
There is continuous presentation of public relation of activity through social network and TOT webpage or provincial webpage and activity provision.	4
Process	
Suitable.	3

4. Discussion

The marketing principle of the service market was applied to cover all aspects: product, price, place, promotion, personnel, creation and presentation of physical evidence. The process and creative tourism principle, a tourism pattern, enables the tourists or visitors to develop or use their own potential or others creative skills by participating in with determination and purposefulness of ways and learning experience which the people in the community always do; the tourists only volunteer or take part in.

Except for the study of the provision of prototype trail activity there are other studies with similar results. Panya and his colleges[4] conducted a research revealing adventurous tourism management by using mountain bikes within the community, and it was found that not only more kinds of activities at the tourist attraction induced more tourists to take community tours but also the community is entitled to participate in their own career promotion and arrange their own community story. These similar results also appeared in the research conducted by the Office of Economic and Social Development Board of North-East[5] A way of ecosystem tourism promotion by bike at Buddism Forest of Khoa Eto Waterfall Park, Prachinburi[6] shows that the environment is not influenced by the pattern of activity provision.

5. Recommendation

The community should develop products with more variety and unique design. However, the activity fee of 300 baht with one free t-shirt would be more appro priate if the pattern and need conformation is met. Moreover, clear directional signs and activity trails, garbage dumping spots, more public relation channels and sale promotion to induce more product buying, and sequence notification of activity process to enhance clear understanding throughout the program should be added.

Conclusion

The community should develop an activity pattern, product, and tourists' needs and community conformation to enhance the tourists' impression and specify the niche of new tourists who have never experienced this kind of activity since the description shows that the inexperienced tourists tend to have greater satisfaction than others.

Acknowledgement

Our appreciation and thanks to the Raks Thai Foundation for their cooperation in terms of budget support of prototype activity provision.

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Effect of Calcination Time on Physical and Chemical Properties of CaO- catalyst Derived from Industrial-eggshell Wastes

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Abstract

In this study, eggshell wastes from a hatchery industrial plant were carefully-calcined under air-atmosphere at 800 ºC in the range of 1 to 4 hours. Then both physical and chemical properties of calcium oxide derived from calcination of eggshell wastes were systematically characterized by XRF, XRD, SEM, particle size analyzer and gas adsorption experiment. The XRF results and the XRD patterns indicate that all calcination times completely transformed the eggshell wastes to be a crystalline calcium oxide phase with about 98 % w purity of calcium oxide. The SEM characterization results indicate rod-liked porous surface on the obtained calcium oxide and size of surface pore are slightly increased with increasing of calcination times. The Langmuir surface area of the obtained calcium oxides was determined by N_2 adsorption experiment at -195 °C. This experiment showed that the surface area of the obtained calcium oxides is rapidly decreased from 14.9 to 2.0 m^2/g with increasing of calcination times from 1 to 4 hour. These results indicate that calcination time is one of the factors determining both physical and chemical properties of calcium oxide. Additionally, this present study also provides a new optimum condition to produce calcium oxide from industrial-eggshell wastes with both physical and chemical properties comparable to commercial calcium oxide.

Keywords: Calcium oxide, Catalyst, Eggshell

Introduction

In Thailand, large hatchery farms generate eggshell wastes (about 6.6 tons per annum) and this waste normally goes to landfill site. This waste management scheme leads to several environmental concerns e.g. landfill leachate, odor and methane emission from landfill. Furthermore, landfill site normally cause a crucial conflict between hatchery farms and their neighbors. So, large amount of eggshell wastes have to be managed properly. Recently, eggshell has been extensively studied as a starting material for preparing low-cost calcium oxide. This is because calcium oxide is normally used as an environmentally-friendly heterogeneous catalyst in a wide range of processes, e.g. chemical synthesis, petrochemical industry and biodiesel production process. In addition, calcium oxide can be separated from product and can be regenerated\reused in several cycles of production process. Currently, researchers reported that high purity of calcium oxide can be produced from eggshells due to it contain with high content of $CaCO_3$. Thermal decomposition of eggshell above 700 °C is a facile method to decompose eggshell in to carbon dioxide and calcium oxide. Several synthesis conditions on thermal decomposition of eggshell at different temperatures and under different atmospheric conditions were reported. However, the effect of calcination time on surface properties of

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calcium oxide has not been clearly reported. In this work, the effect of calcination time on physical and chemical properties of CaO-catalyst derived from Industrial-Eggshell wastes was investigated in order to find the optimum condition to produce calcium oxide from industrial-eggshell wastes.

Experimental

1. Raw Material

Chicken eggshell wastes used in this study was obtained from one of the largest hatchery farms in Nakon Ratchasima province, Thailand. The eggshell wastes were rinsed with water to remove dirt and other impurities and were dried in an oven at 105 ºC for 24 hour. The egg-shell membranes were separated manually. Then, the eggshell wastes were crushed in to powder with Panasonic MX-AC400 crushing machine followed by screening through a set of sieves to get a grain size lower than 425 micrometer.

2. Sample Preparation and Characterization

Calcium Oxides (CaO) were prepared by a thermal decomposition method. The eggshell powders were calcined in muffle furnace from room temperature to 800 °C with a heating rate of 50 °C/min. Furnace temperature was maintained at 800 °C for 1 to 4 hour under air atmosphere. Then, the furnace was left to cool down to 120 °C before calcined eggshell wastes were taken to desiccator. All calcined eggshell samples were kept in the vacuum desiccator to avoid the sample reacting with moisture and carbon dioxide in the atmosphere. Crystal structures and elemental composition of the calcined eggshells were determined by X-ray diffractometer (XRD – PW 3040/60 X'PERT PRO Console) with Cu-K radiation and X-ray fluorescence analyzer (XRF-Bruker S4 Explorer), respectively. Surface morphology of calcined eggshells were investigated by scanning electron microscopy (SEM – LEO 1455VP). Particle size diameter of the samples was analyzed by laser diffraction particle size analyzers (Beckman Coulter LS 230). In addition, Langmuir surface area of the samples was measured by N_2 adsorption/desorption isotherm at -195 °C (Micro meritics-TriStar II 3020).

Results and Discussions

1. Effect of calcination time on chemical properties of CaO derived from industrial- eggshell waste

XRD patterns and their major peaks of both calcined eggshells from various temperatures and commercial calcium carbonate are presented in (Figure 1) and (Table 1), respectively. The XRD pattern of commercial calcium oxide match with peak data collected from Joint Committee on Powder Diffraction Standards (JCPDS). This indicated that crystal phase of commercial calcium oxide is in both calcite and aragonite form. The XRD patterns and peaks obtained from calcined eggshells are similar to calcium oxide data collected by JCPDS. The results of XRF showed that CaO was the most abundant component in eggshell wastes (68.2 % w). (Table 2) shows the eggshell wastes also contained small amounts of Mg, P_2O_5, Na_2O, SO_3, and K_2O. However, high purity of CaO (about 98.0 % w) can be obtained after eggshell wastes were calcined at 800 °C at various times. Both XRD and XRF results showed that calcined eggshells at 800 °C from 1 to 4 hour, thermally decomposed calcium carbonate in eggshells to carbon dioxide and calcium oxide.

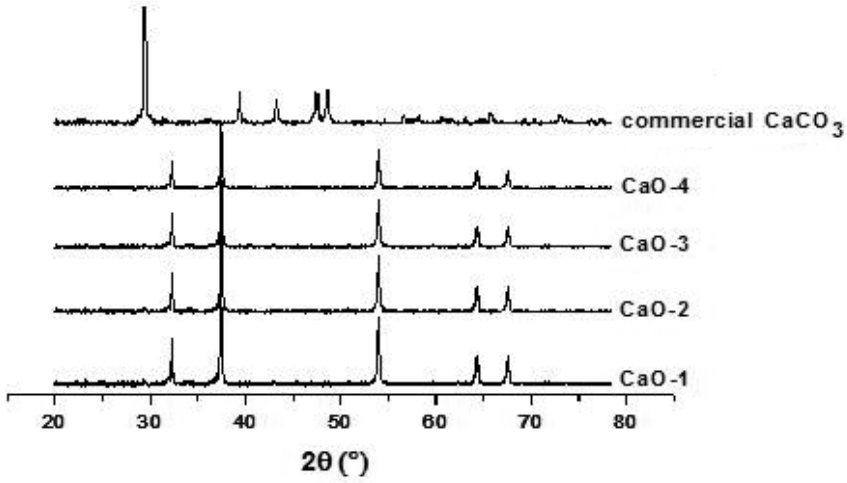

Figure 1 XRD patterns of commercial $CaCO_3$ and calcined eggshell waste at 800 ˚C for 1 to 4 hr

Table 1 Major diffraction peaks of commercial CaO and calcined eggshell waste collected by XRD technique.

Sample	Decomposition temperature	Compound	2θ
JCPDS data [1]	-	$CaCO_3$	29.4° 39.4° 43.2° 47.4° 48.5°
		CaO	32.2° 37.3° 58.3° 64.1° 67.3°
Egg-shell wastes[2]	800 °C 2h	CaO	32.3° 37.42° 53.92° 64.22° 67.42°
Egg-shell wastes	As received	$CaCO_3$	29.4° 39.5° 43.2° 47.6° 48.6°
(this study)	800 °C 1h	CaO	32.2° 37.4° 53.9° 64.2° 67.4°
	800 °C 2h	CaO	32.2° 37.4° 53.9° 64.2° 67.4°
	800 °C 3h	CaO	32.2° 37.4° 53.9° 64.2° 67.4°
	800 °C 4h	CaO	32.2° 37.4° 53.9° 64.2° 67.4°

Table 2 Chemical composition of the samples determined by X-ray fluorescence spectrophotometer.

Element (%w)	CaO-1	CaO-2	CaO-3	CaO-4	CaO [3]	Eggshell
CaO	97.9	98.0	97.9	97.9	97.42	68.2
MgO	0.977	0.984	1.01	1.01	1.63	0.459
P_2O_5	0.543	0.530	0.579	0.532	0.52	0.396
Na_2O	0.223	0.162	0.171	0.161	-	0.103
SO_3	0.111	0.107	0.116	0.120	0.26	0.105
K_2O	0.065	0.034	0.045	0.036	0.08	0.0622

2. Effect of calcination time on physical properties of CaO derived from industrial-eggshell wastes

(Figure 2-3) shows SEM photographs of eggshell and calcined eggshell wastes, respectively. It expressed the rough surface of eggshell with some small pores while calcined eggshell waste obtained from different calcination times showed similar micromorphology of rod-liked or dumbbell shaped. This rod-liked shape occurred during thermal decomposition of carbonate contained in eggshell

and this rod-liked shape possibly provides higher surface area than original eggshell waste.

Particle size diameter of the samples is shown in (Figure 4). Initially, particle size diameter of crushed eggshell waste was about 248.4 micron but particle size diameter of the sample gradually reduced to 59.82, 13.43, 13.75, 12.87 micron for CaO-1 to CaO-4, respectively. This indicated that particle size diameter of the sample decreased with increasing of calcination time.

The Langmuir surface areas of CaO derived from different calcination time were shown in (Figure 5). It appeared that surface area of the sample significantly increased about 5.7 times after the eggshell sample was calcined at 800 °C for 1 hour. However, the surface area of the calcined samples significantly decreased from 14.9 m^2/g to 2.0 m^2/g with increasing calcination time from 1 to 4 hour. Additionally, the surface area of calcined eggshell waste at 800 °C for 1 hour is remarkably higher than surface area of commercial calcium oxide.[4]

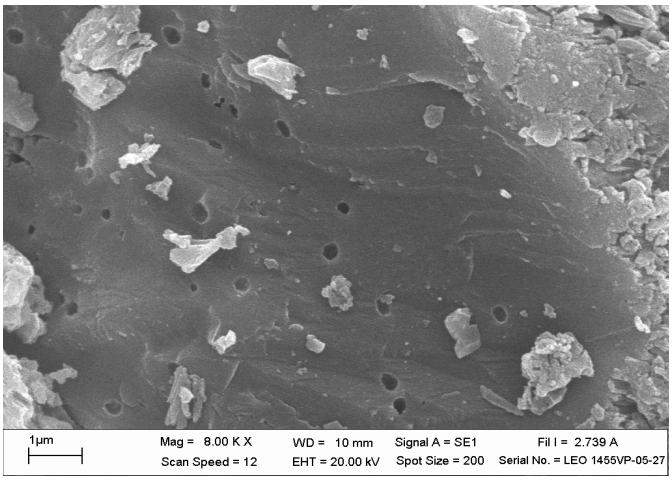

Figure 2 SEM photograph of eggshell waste with 8,000x magnification.

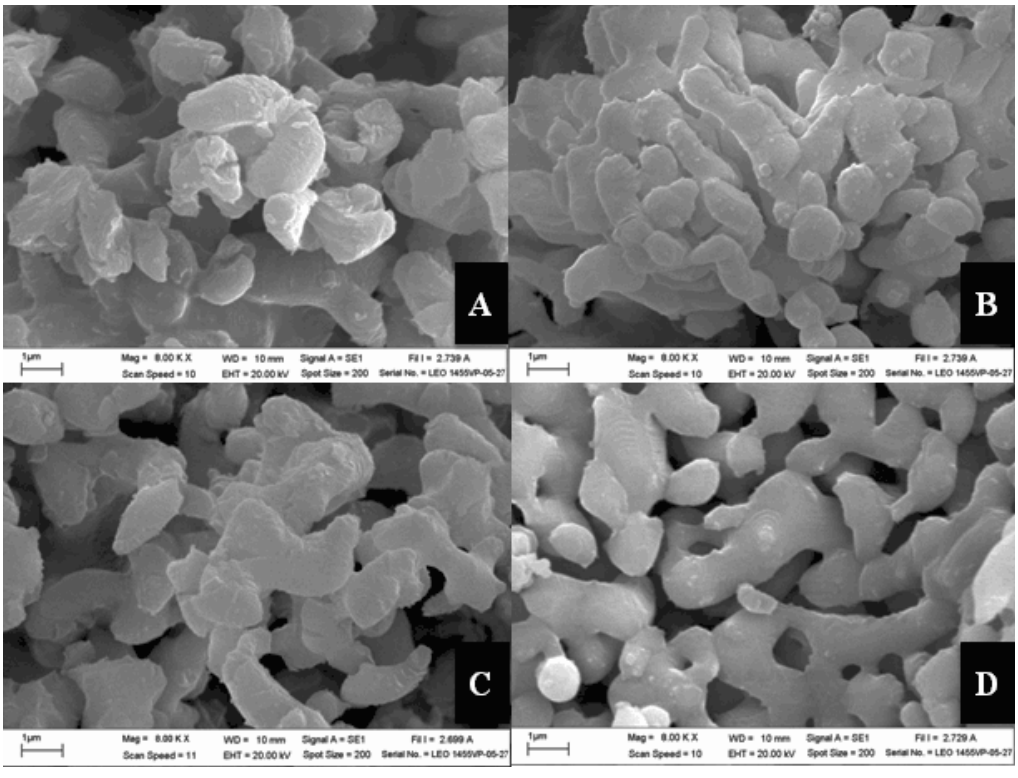

Figure 3 SEM photographs of calcined eggshell wastes at 800 °C for 1 to 4 h with 8,000x magnification, CaO-1 (A), CaO-2 (B), CaO-3 (C) and CaO-4 (D)

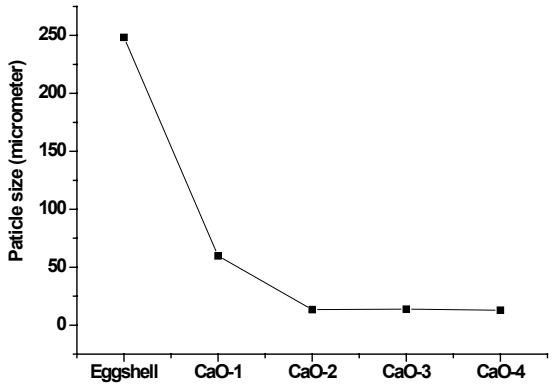

Figure 4 Particle size diameter of samples obtained from various calcination conditions.

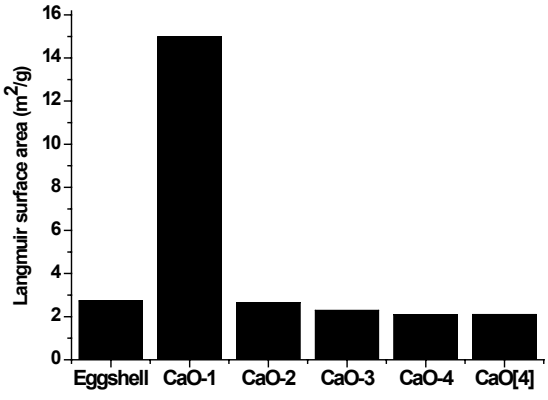

Figure 5 Langmuir surface area of various samples.

Conclusion

In this work, effect of different calcination times on both chemical and physical characteristics of calcium dioxide derived from eggshell wastes was reported. The results indicated that both particle size and surface area decrease with increasing calcination time. In terms of energy conservation, calcination of industrial-eggshell wastes at 800 ºC for 1 hour is enough to produce high purity of calcium oxide. In addition, high surface area of calcium oxide can also obtained at this optimum calcination temperature and time. This study also indicated that both physical and chemical properties of calcium oxide obtained from eggshell waste were comparable to commercial calcium oxide.

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Heat Transmission of Double-Pane Windows with Horizontal Slats for Thailand

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Abstract

An automated blind can provide energy saving and improve comfort. To obtain these benefits a computer program that is able to calculate interior illuminance, heat gain, glare discomfort and thermal comfort has been developed. The thermal performance of the window system was investigated. From the study it was found that installing a venetian blind in between the double-pane glass window causes a significant reduction in heat gain compared to the plain glass window. The heat gain through the window system in the shortwave part of the radiation was analyzed. The slat reflectance, slat angle and solar profile angle have the major effect on the shortwave part of solar heat gain coefficient. The blind using a lower value of slat reflectance has a lower shortwave part of solar heat gain coefficient. The effective solar heat gain coefficient (SHGC) and the effective overall heat transfer coefficient (U) for the double-pane glassed window with enclosed horizontal slats was developed. These SHGC and U value can be used with the equation to calculate the Overall Thermal Transfer Value (OTTV) of Thailand's building energy code to evaluate a building that use the double-pane glassed window with enclosed venetian blind.

Keywords: automated blind, solar heat gain coefficient, overall heat transfer coefficient

Introduction

Venetian blinds are popular shading devices used in commercial buildings. Blinds facilitate daylight into buildings by blocking excessive light while views are still possible. Utilization of daylight increases worker satisfaction and productivity. For tropical climate or summer conditions daylight is highly available and buildings are cooling load dominated. Daylight can be used to replace electric light; reduce electricity consumption for lighting and cooling system. However heat gain due to solar radiation is an important part of cooling load in Thailand.

Solar Heat Gain Coefficient (SHGC) measures how much heat from the sun is blocked. It is the fraction of incident irradiance that enters through the window and becomes heat gain. It includes both the directly transmitted portion and the absorbed and reemitted portion[1,2]. The SHGC and the U values are significant factors for rating of fenestration[2] and also used for building design and rating[3,4].

The results of Klems and Warner[5] confirmed that the SHGC for fenestrations incorporating venetian blinds depends strongly on the incident direction of beam solar radiation. Using a single value of SHGC to characterize window with blind systems would lead to nonsensical energy choices. However, the study was conducted only at few slat angles.

Therefore, in this study an investigation of thermal performance of the window system was evaluated and the effective SHGC and the effective U values were developed and analyzed in detail based on weather of Thailand.

Thermal Performance of Venetian Blind Window System

The heat transfer through venetian blind window system can be written as[6]

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$$q = SHGC \times I + U \times \Delta T \quad (1)$$

Where q is the heat gain (W/m^2). SHGC is the solar heat gain coefficient. U is the overall heat transfer coefficient (W/(m^2-K)). ΔT is the temperature difference between the indoor and outdoor condition (K). I is the incident solar radiation (W/m^2). The solar heat gain coefficient for a venetian blind window system can be divided into the solar heat gain coefficient in the shortwave part and the solar heat gain coefficient in the longwave part.

In this analysis the effect of the slat reflectance, slat angle and solar profile angle on the SHGC of the direct solar radiation of the system of glass window and blind are investigated. The solar profile angle is the relationship between the solar altitude angle and the solar azimuth angle. The solar profile angle can be written as

$$\phi_s = \tan^{-1}\left(\frac{\tan(\alpha_s)}{\cos(\gamma_s - \gamma_w)}\right) \quad (2)$$

Where ϕ_s is the solar profile angle, α_s is the solar altitude angle. γ_s is the solar azimuth angle. γ_w is the window azimuth angle. The solar heat gain coefficient (SHGC) and the solar heat gain coefficient in the short-wave part (ShW SHGC) for the fenestration system are calculated from the developed mathematical model as presented in[7].

(Figures 1 to 3) show the variations of SHGC for venetian blind at 0°, 45° and -45°, respectively. The SHGC of the single pane clear glass window is also shown for comparison. The results show that the SHGC of the clear glass window and window with venetian blind are dependent on the solar profile angle. The dotted lines in (Figure 1-3) represent the shortwave transmittance for the direct radiation indicated as solar heat gain coefficient in the shortwave part (ShW SHGC). The differences between the solid and dotted lines in (Figure 1 to 3) are the values of longwave transmittance for the direct radiation, which are shown as the values of the solar heat gain coefficient in the long wave part.

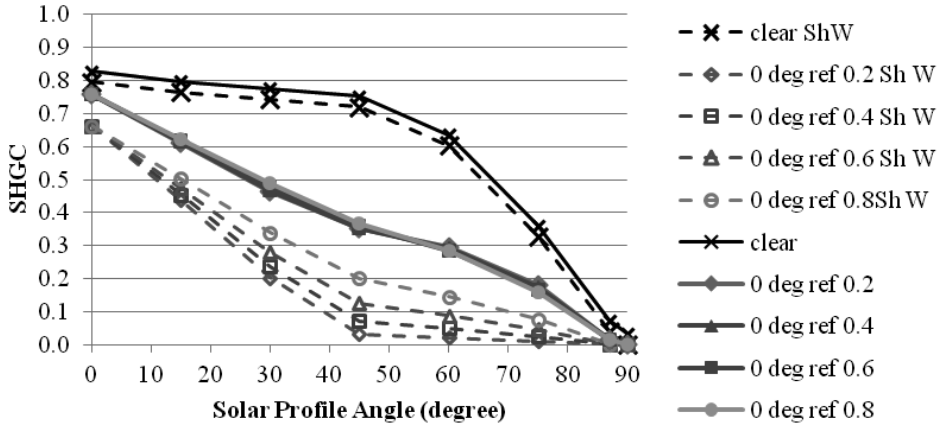

Figure 1 SHGC and ShW SHGC of the window with the blind in different slat reflectances when the slat is set at 0°. ref = slat reflectance. Clear = clear glass window.

From the results the SHGC values of clear glass pane are higher than the window with blinds. For a single pane clear glass window, the values of solar heat gain coefficient in the shortwave part are dominant and the values of longwave part of SHGC are small when it is compared to the window with blind. The ShW SHGC is high when the slat is in the position that the slats are able to reflect radiation into the room. In any case, the values of ShW SHGC are low at the low slat reflectance values because the slat can reflect lower ration into the room.

The effect of slat reflectance on SHGC is low when the slat is in the position that solar radiation is not incident on the slat or at the slat position that most of the solar radiation is blocked by the slat.

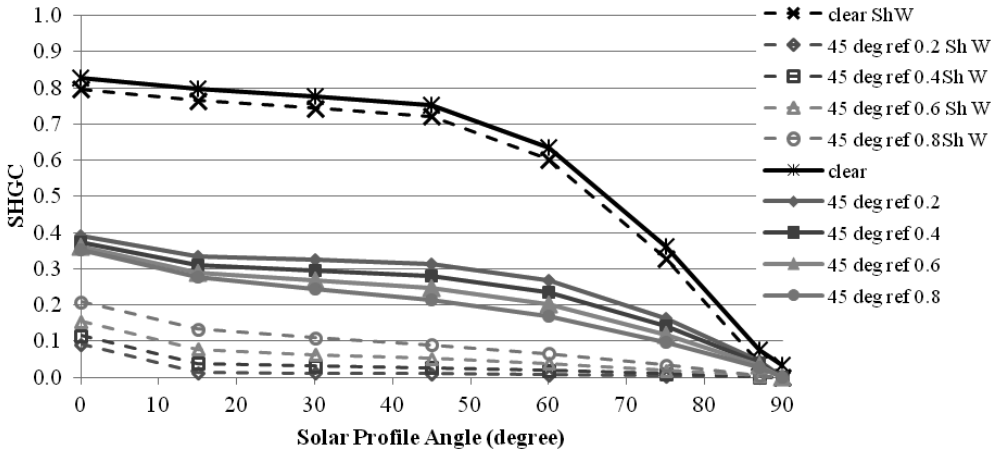

Figure 2 SHGC and ShW SHGC of the window with blind in different slat reflectances when the slat is set at 45°. ref = slat reflectance. Clear = clear glass window.

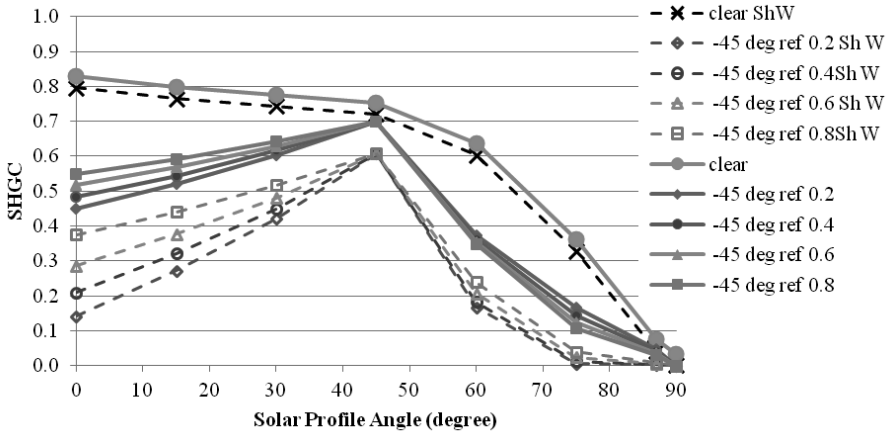

Figure 3 SHGC and ShW SHGC of the window with blind in different slat reflectances when the slat is set at -45°. ref = slat reflectance. Clear = clear glass window.

Effective SHGC and Effective U-value

The one year weather data of Bangkok were used for the simulation. Wind speed was set as 1.5 m/s. The type of window system used in this section was double glazing window filled with air in the gap using green glass as exterior window and clear glass as interior window with venetian blind in between. The properties of glazing are summarized in (Table 1 and 2). For simulation the configuration of the room is as shown in (Figure 4). The walls, roof and ceiling are well insulated.

Thermal properties of glass pane and blind slat are shown in (Table 1). Thermal properties include thermal conductivity (k), specific heat capacity (c_p), density (ρ) and thickness. (Table 2) shows properties of glass panes, and blinds including transmittance (τ), absorptance (α) and reflectance (ρ) as solar and visible properties and also emissivity (ε). The properties of the front and back sides of the glass are the same.

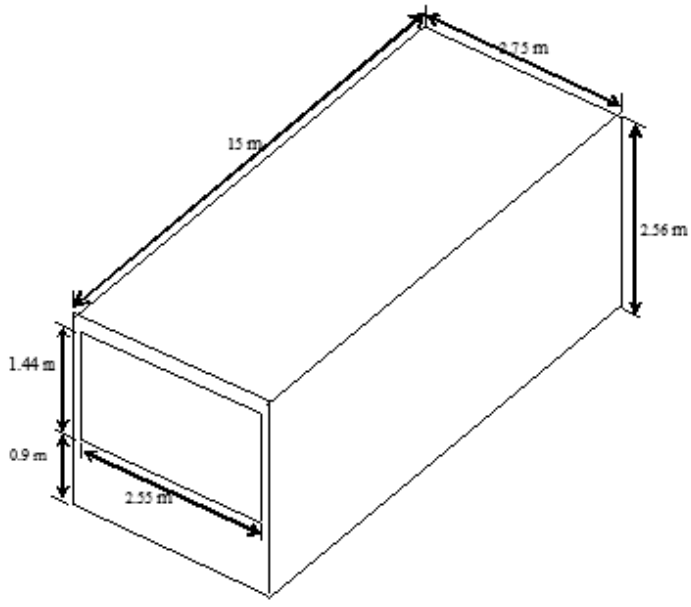

Figure 4 Building configuration

Table 1 Thermal properties of glass panes and blind slat

Material	k W/m.K	c_p kJ/kg.K	ρ kg/m^3	Thickness m
Glass pane	1.05	0.840	2500	0.006
Blind slat	-	0.870	2700	0.001

Table 2 Solar and visible properties of glass panes and blind slat

Section	τ	α	ρ	ε
Clear glass (solar)	0.80	0.13	0.07	0.85
Clear glass (visible)	0.80	0.12	0.08	-
Green glass (solar)	0.26	0.68	0.06	0.85
Green glass (visible)	0.67	0.21	0.12	-
Blind slat(solar)	0	0.316	0.684	0.316
Blind slat (visible)	0	0.266	0.774	-

The blind chosen for this study was a 50 mm venetian blind. The distance between the two glass panes was 100 mm. Figure 5 shows the position of the blind when the slat angle (β) is positive. (Figure 5) also illustrates slat width and distance between each slat (slat separation) which are 0.05 m and 0.042 m, respectively.

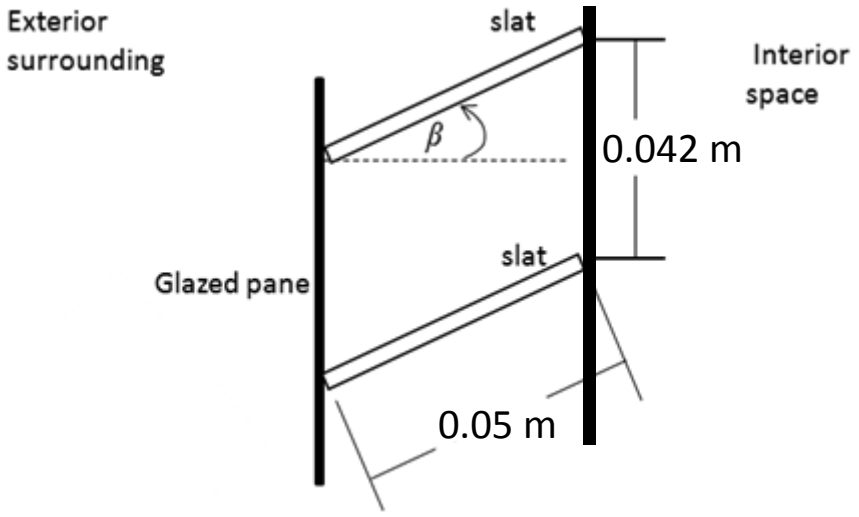

Figure 5 Side view of two adjacent slats

The developed computer program was used to calculate heat transfer through a double-pane window with a blind. The values of monthly average of the window heat gain are shown in (Figure 6). At high degrees of blind angles such as -50, -60, 50, and 60 degree, heat gain through window reduces because the blind slats are almost close and beam radiation cannot penetrate through the gaps between blind slats. It was found that there are higher values of heat gain through the window system in the cases of negative slat angles when comparing to the cases of positive slat angles. When blind angles are negative, there are higher chances that blind slats tilt parallel to the direction of beam solar radiation so higher heat passes through the window system.

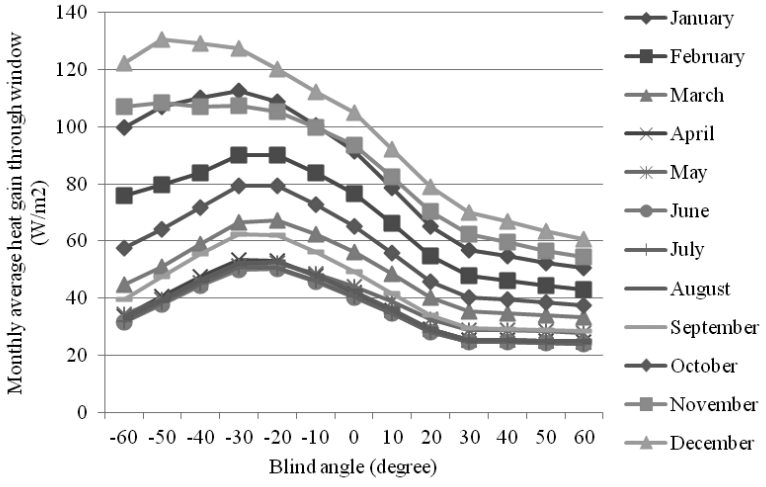

Fig. 6. Monthly average heat gain through window (south orientation)

The effective SHGC and U-value are calculated by using Equation 1 divided by the solar radiation incident on window in vertical direction (*I*):

$$\frac{q}{I} = SHGC + U \times \frac{\Delta T}{I} \quad (3)$$

(Figure 7) shows the plot of the ratio between heat gain through window and the solar radiation incident on window in vertical direction and the ratio between the temperature difference between the indoor and outdoor air and the solar radiation incident on window. Each dot in the graph represents the data at a particular hour. The

slope of the data in (Figure 7) is the U-value and the intercept of the graph is the SHGC. One set of data in the case of 0 degree blind angles in October is shown as an example. Each graph provides the SHGC and the U-value for a particular month and a particular slat angle.

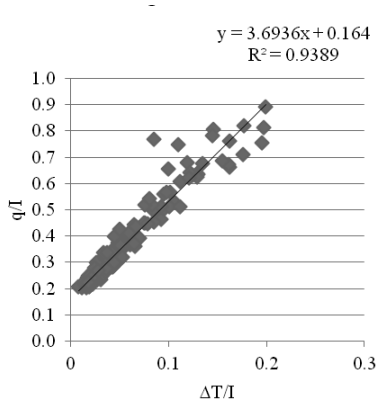

Figure 7 q/I and DT/I in October at 0 degree slat angle

The effective SHGC values and the effective U-value of each month and each blind angle are shown in (Figure 8 and 9), respectively. The results are analyzed for the data during the daytime (8 a.m. to 7 p.m.) and the profile angles are in the range of 22-90 degree. The yearly average profile angle during daytime is 63 degree. It is found that the results are high when the blind angles are negative which are in an agreement with the results show in (Figure 1 to 3).

When blind angles are negative, the shortwave part of SHGC is dominant. When blind angles are positive, the longwave part of SHGC is dominant because most of the solar radiation is blocked by the slat.

During the daytime (8 a.m. to 7 p.m.), an average temperature difference between the indoor and outdoor conditions is 7.3 °C when the indoor temperature is set as 25°C. When slat angles are positive, the effective U-values are highest at 0° blind slat angle and decrease when the blind angle increases. As the blind closes, increasingly it blocks the direct exchange of longwave radiation between the glass panes. This is probably the dominant effect that causes the decrease in U-value as the blind is closed.

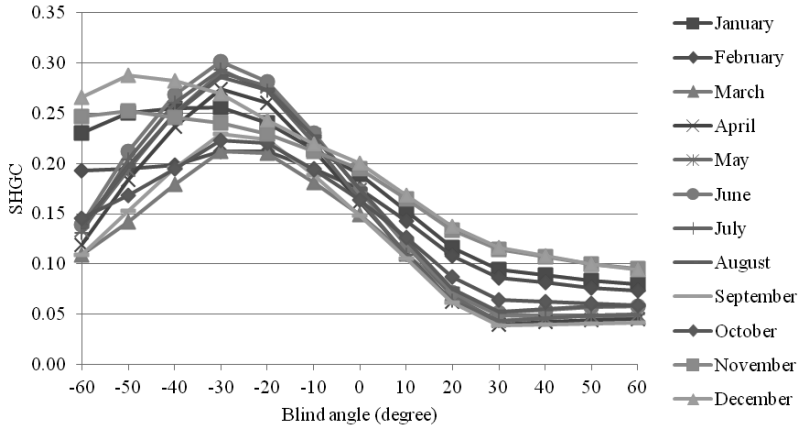

Figure 8 The monthly effective SHGC of the double-pane window with blind

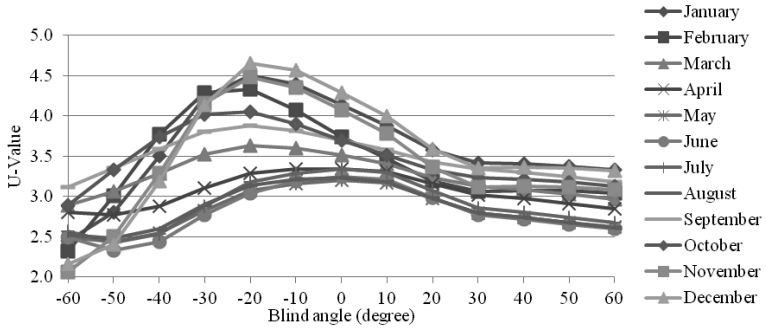

Figure 9 The monthly effective U-value of the double-pane window with blind

Applications of Effective SHGC and U-value

The results of the effective SHGC and the effective U-value in the previous section can be used to calculate the heat gain through the window (W/m^2) by Equation 1. The case of January 1st when blind angle is -30° is selected as an example. The effective SHGC and the effective U-value for January are 0.256 and 4.233, respectively. The room air temperature is set as 25°C. The ambient air temperature and solar radiation incident on window on the selected day are shown in (Figure 10). The heat transfer through the window on the selected day is shown in (Figure 11). The heat transfer through the window is calculated by the computer program based on the heat balance equation and the radiative exchange equation is also shown in (Figure 11) as dotted line. The results from Equation 1 show good agreement with the results from the computer simulation program at maximum 7.8% error.

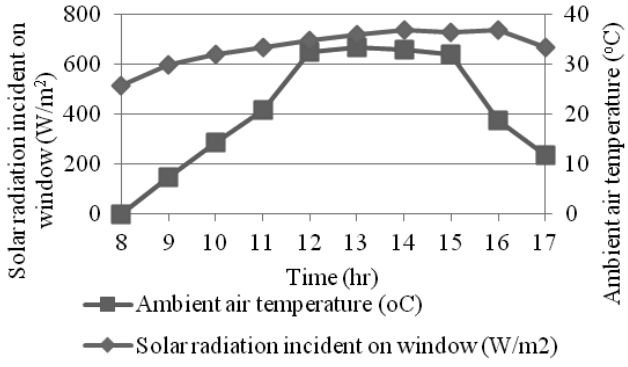

Figure 10 Ambient air temperature and solar radiation incident on window of the example date

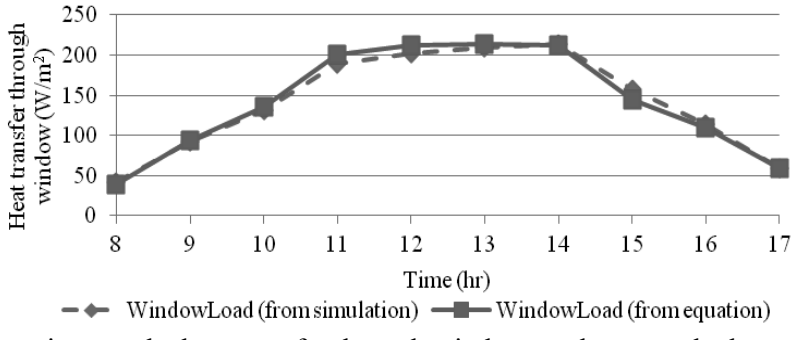

Figure 11 The heat transfer through window on the example date

The effective SHGC and the effective U-value in (Figure 8 and 9) can also be used for calculation of the Overall Thermal Transfer Value (OTTV) in the building energy code of Thailand. The terms of the total thermal transmittance (U_f) and the solar heat gain coefficient (SHGC) of the OTTV equation can be calculated when double-pane windows with venetian blind are used.

Conclusion

The SHGC and U-value for calculation of heat transfer through window systems was developed.

The directly transmitted portion of Solar Heat Gain Coefficient (SHGC) and the SHGC that includes the both directly transmitted portion and absorbed and reemitted portion of SHGC were analyzed. The results show that the SHGC are dependent on the solar profile angle and blind reflectance. The monthly effective SHGC values and the monthly effective U-value of white aluminum blind are developed. The heat transfer through window estimated from the developed effective SHGC and effective U-value show well agreement with the heat transfer through window calculated by the computer program that

based on the heat balance equation and the radiative exchange equation at maximum 7.8% error. These SHGC and U value can be used to calculate the Overall Thermal Transfer Value (OTTV) of Thailand's building energy code for a building that use the double-pane glassed window with enclosed venetian blind.

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