

Rajamangala University of Technology  
**PHRA NAKHON**



Foods, Crafts,  
**Fashion & Textiles**  
Trends

# Academic Treatise

The 1<sup>st</sup> RMUTP International Conference:  
Green Trends in Foods, Crafts, Fashion & Textiles  
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**Academic Treatise** “The 1<sup>st</sup> RMUTP International Conference: Green Trends in Foods,  
Crafts, Fashion & Textiles”

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## PREFACE

The Academic Treatise “The 1<sup>st</sup> RMUTP International Conference: Green Trends in Foods, Crafts, Fashion & Textiles” aims to collect and distribute academic papers from oral and poster presentation approved to be presented in the 1<sup>st</sup> RMUTP International Conference: Green Trends in Foods, Crafts, Fashion & Textiles held on 13-14 July 2009 at Novotel Hotel Bangkok.

We hope that this book will be useful as a reference to other related research and study. Please accept our apology for any mistake in this book. Thank you.

International Affairs Division  
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# Oral Presentation

# Phosphonic Acid Functionalization of Hyperbranched Polyamidoamine Grafted Ultrafine Silica to Prepare the Flame Retardant for Cotton Fabric

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## Abstract

Grafting of hyperbranched polyamidoamine (PAMAM) dendrimer onto ultrafine silica followed by the introduction of phosphonic acid groups onto branch ends was carried out. First, an initiating site was incorporated into silica surface by reacting the silica silanol group with 3-aminopropyltriethoxysilane, producing amino-functionalized silica. The free amine group content was controlled by varying ratios of methanol to water in the hydrolysis step of sol-gel reaction. Then grafting of PAMAM was performed by repetitive reactions between Michael addition of silica amino groups to methyl acrylate and amidation of the resulting terminal methyl ester groups with ethylenediamine. Amino group content in each generation was determined. This was found to be significantly lower than theoretical value due to unavoidable side reactions. After the G3.0 hyperbranched PAMAM grafted onto silica was synthesized, phosphonic acids functionalization of the terminal amino groups by the Mannich type reaction was carried out. The phosphorylated hyperbranched PAMAM grafted silica was achieved and its application on cotton fabric to produce phosphonated cellulose was studied.

**Keywords:** polyamidoamine, flame retardant, textile finishing, grafted silica

## 1. Introduction

Polyamidoamine (PAMAM) dendrimers, the starburst polymers with a plurality of terminal functional groups have attracted considerable interest due to their novel functionalities such as nanoscopic containers, delivery devices, ultrafine colloid stabilizers and nanocomposite materials [1-8]. Surface modifications of terminal groups with different functionalities such as acetamide, hydroxyl, carboxyl or quaternized PAMAM dendrimers further increase the versatile applicability of these materials[9-13]. Focused on nanoparticle fillers such as carbon black and silica, these materials are widely used for rubber and plastics. A good uniform dispersion of extremely fine particle size for most of their applications is important. However, these nanoparticles by nature are found in micron sized aggregate whose performance is inferior to those of the nanometer sized form. This problem of nanoparticles having a strong tendency to agglomerate is solved by surface modification[14-17]. The grafting of PAMAM dendrimer onto inorganic particle's surface is one possibility[18-20]. The grafted dendrimer effectively prevents agglomerate formation, resulting in the stability of ultrafine nanoparticles in the colloidal state or dispersibility in the polymer matrix. Nanometer-sized fillers are expected to exhibit the attractive interaction with polymer matrix at very low filler content, resulting in an improved performance of nanocomposite materials. Another interesting effect is that the PAMAM attached on inorganic particles leads to hybrid materials with special characteristics particularly high performance chelating agents[21] and nanoreactors in which metal nanoparticles are stabilized[22]. Other interesting performance concerned with nanocomposites includes reduced gas permeability, increased solvent resistance and reduced flammability. In this study, this type of nanoparticle was specially designed to impart its flame retardancy performance on cotton cellulose. When considering flame retardants for cellulose and cellulose derivatives, phosphorus-based flame compounds have been a major interest because of their environmentally friendly products and their low toxicity, as well as, their low evolution of smoke in fire. These compounds will promote dehydration and char formation.

## 2. Experimental

### 2.1 Materials and reagents

Fumed silica (AEROSIL 200) was purchased from JJ Degussa (Thailand), Co., Ltd. Methyl acrylate (MA), ethylenediamine (EDA), and 3-aminopropyltriethoxysilane (APTES) from Fluka were used without purification. Phosphorus acid was purchased from Aldrich and formaldehyde was obtained from Fluka. Toluene and methanol were distilled before use. Dicyandiamide as a catalyst for

the phosphonic acid and cellulose reaction was bought from Fluka. Dyed knitted industrial cotton fabric was obtained from textile dyeing factory.

## 2.2 Incorporation of amino groups onto ultrafine silica particle

The attachment of amino groups onto the silica surface was achieved by the condensation reaction between surface silanol groups and 3-aminopropyltriethoxysilane. Into a 600 ml flask, 15.0 g of fumed silica and 500 ml of 10% v/v toluene solution of 3-aminopropyltriethoxysilane were charged, and the fumed silica particles were homogenously dispersed by a magnetic stirrer for 30 minutes. Then 50 ml of methanol: water (4:1 or 2:1) was added to the mixture and stirred for 72 hours. After that, the modified silica particles were filtrated and extracted with toluene for 24 hours using soxhlet extractor to remove unreacted 3-aminopropyltriethoxysilane. The APTES treated silica was dried in an oven at 60<sup>0</sup>C for 24 hours and stored in autodehumidity desiccators

## 2.3 Grafting of hyperbranched polyamidoamine dendrimer from silica surface

The Michael addition was carried out as follows: a 1,000 ml flask containing 20.0 g APTES treated silica was added drop by drop with 600 ml of methanol having methyl acrylate with the concentration of 10 times higher than the amino content found in treated silica. The mixture was stirred at room temperature for 48 hours. The methanol and unreacted methyl acrylate were evaporated by reduced pressure evaporator. The amidation of terminal ester groups from the Michael addition step was carried out as follows: the whole amount (34 g) of ester terminated silica obtained from Michael addition step was put into a 1000 ml round bottom flask. Then, 500 ml of methanol was added. A solution containing 45 ml of EDA and 100 ml of methanol was added. The mixture was vigorously stirred at room temperature for 72 hours. The solvent and unreacted EDA were removed by a rotary evaporator performing at the temperature no higher than 40<sup>0</sup>C. The propagation for second and third generations was carried out by repeating the two step reactions, Michael addition and amidation.

## 2.4 Phosphorylation of hyperbranched PAMAM grafted silica

Hyperbranched PAMAM grafted silica (0.2 mole) and crystalline phosphorous acid (0.4 mole) were dissolved in 200 ml of water and concentrated hydrochloric acid (0.6 mole). The mixture was heated to reflux in a three-necked flask fitted with thermometer, condenser and dropping funnel. In the course of ca 1 hour, 40% aqueous formaldehyde solution (0.8 mole) was added by drops, and the reaction was kept at the reflux temperature for an additional hour. The water was evaporated at low



temperature using a rotary evaporator. The concentrated solution was neutralized with concentrated ammonia solution. Finally, the concentrated solution was precipitated in methanol to get yellowish solid gel-like product.

### **2.5 Fixation of phosphorylated hyperbranched PAMAM grafted silica on cotton fabric**

Knitted Cotton fabrics were treated with a solution containing 30% w/w phosphorylated hyperbranched PAMAM grafted silica, 30% w/w urea and 20 g/l dicyandiamide as a catalyst. The application was performed using a pad mangle set a pressure nip at 80 percent wet pick up. The padded fabric was dried at 100°C for 5 min and cured at 170 °C for 3 min to allow the covalent reaction, leading to phosphonated cellulose produced. The treated fabric was washed-off to remove unfixed agents. Then thermal property of the treated fabric was analyzed using TGA analysis.

### **2.6 Determination of amino group content on hyperbranched PAMAM grafted silica**

The amino group content of hyperbranched PAMAM grafted silica was determined by titration technique. Into a 125 ml flask, 0.1000 g of grafted silica and 25 ml of 0.01 M hydrochloric acid aqueous solution were charged. The mixture was stirred at room temperature for 2 hours. Then, the mixture was filtrated and titrated with a standardized aqueous solution of sodium hydroxide using phenolphthalein as an indicator.

### **2.7 Determination of percent grafting**

The weight of PAMAM grafted onto the silica surface was determined by weight loss measurement. PAMAM grafted silica was burnt out at 800<sup>0</sup>C using TGA (Mettler Toledo STARe System DCS822e Module). The percentage of grafting was calculated from the difference between percentage of determined original weight of PAMAM grafted silica sample and the percent residual silica.

### **2.8 Characterizations**

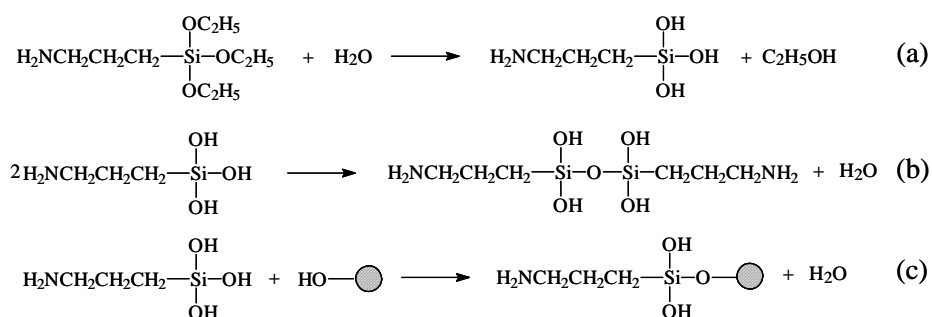
The morphology of hyperbranched PAMAM grafted silica was observed by scanning electron microscopy (JEOL JSM-5410LV) operated at 15 kv accelerating voltage. The particle size distribution was analyzed using laser light scattering (Mastersizer 2000). FTIR spectroscopy taken on KBr pellet samples was recorded on a Nicolet Impact 400D spectrophotometer. <sup>1</sup>H NMR spectra of the samples were recorded on Bruker DPX-300 spectrometer. TGA was performed using Mettler Toledo STARe System DCS822e Module.

### 3. Results and discussion

#### 3.1 Introduction of amino groups onto the silica surface

The treatment of silica with APTES resulted in silica particle containing amino groups on the surface which acted as the initiator sites for PAMAM grafting. The condensation reaction is base-catalyzed and APTES amine groups are self-catalyzed component. The mechanism involved the hydrolysis of APTES triethoxy groups by water, yielding silanol groups. Then condensation reaction between APTES silanol group and silica silanol group took place on silica surface as shown in Figure

1. The amount of water present in the system significantly influenced the hydrolysis reaction of triethoxy groups and the condensation reaction on silica surface [23].



**Figure 1.** Chemical equation of hydrolysis reaction from alkoxysilanes (a) and self condensation reaction (b) or (c) condensation reaction between APTES and silica.

The rate of hydrolysis and condensation reaction was controlled by using a mixture of water and methanol. In this study, the methanol to water ratios of 4: 1 and 2: 1 were used. The measured amino contents on silica plotted against reaction times are shown in Figure 2. The amino group content increases with an increase in the amount of water and reaction time. Water was consumed to convert APTES triethoxy groups to silanol groups (hydrolysis reaction). The amount of water, hence, determined the rate of hydrolysis. Consequently, the more silanol groups produced the higher the rate of subsequent silanol condensation reaction. Amino-functionalized silica for PAMAM grafting was prepared as follows: a 2:1 ratio of methanol to water was used and the surface functionalization of silica particles was allowed to occur for three days.

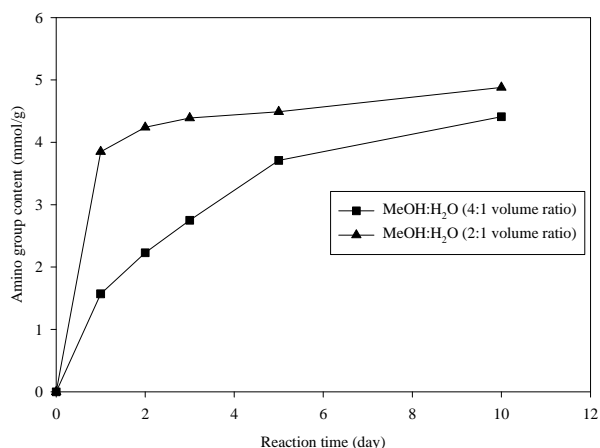


Figure 2 Amino group content measured on APTES treated silica versus reaction time

Figure 3 compares FTIR spectra between APTES grafted silica, virgin silica and APTES. Silica which is an inorganic substance in nature exhibits the strong absorption band of siloxane (Si-O-Si) bonding at  $\sim 1,200\text{ cm}^{-1}$  and the silanol OH band in the range of  $3,200\text{--}3,400\text{ cm}^{-1}$ . When considering the APTES silica, organo-functionalized silica, its spectrum exhibits new absorption frequencies at  $2932\text{ cm}^{-1}$  and  $1640\text{ cm}^{-1}$ . These bands are associated to C-H stretching and primary amine ( $\text{-NH}_2$ ) stretching absorptions, respectively. Also, these bands are found corresponding with the absorption characteristics of APTES spectrum. These results indicate that APTES was incorporated into silica particles. The silica surface modification is further confirmed by change observed in spectrum pattern in the region of silanol OH band ( $3200\text{--}3400\text{ cm}^{-1}$ ) due to new inter-hydrogen bonding interaction among APTES silica particles.

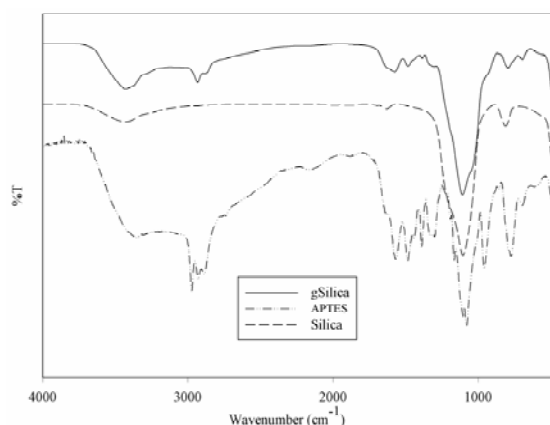


Figure 3 FTIR spectra of silica, APTES and APTES grafted silica

### 3.2 Grafting of hyperbranched PAMAM from silica surface

Grafting of hyperbranched PAMAM onto the surface of amino-functionalized silica was carried out by repeating two processes, Michael addition and amidation which were used in the same

manner as in the synthesis of PAMAM dendrimers [24]. FTIR results are shown in Figure 4. In the Michael addition step, the terminal methyl ester group of G0.5, G1.5 and G2.5 products shows a strong and distinguishable band at  $1740\text{ cm}^{-1}$ . This peak completely disappears from the spectra of G1 and G2 as a result of the amidation reaction. In this step, the terminal amine group was produced, corresponding to the appearance of the strong absorption intensity of the N-H band in the region of  $3000 - 3350\text{ cm}^{-1}$ . Its absorption intensity significantly increases with an increase in PAMAM generation, reflecting that the terminal amine groups also significantly increases. Focused on G3.0 hyperbranched PAMAM grafted silica, the absorption peaks at  $1649\text{ cm}^{-1}$  and  $1568\text{ cm}^{-1}$  are characteristics of C=O stretching and N-H bending. The absorption peaks at  $3281\text{ cm}^{-1}$  and  $3086\text{ cm}^{-1}$  correspond to N-H antisymmetric stretching and N-H symmetric stretching of primary amine, respectively. In accordance, the C-H band at  $2900\text{ cm}^{-1}$  which shows up strongly in the spectra of G0.5 and G1.5 becomes less dominant due to suppressing influence by the surrounding N-H band.

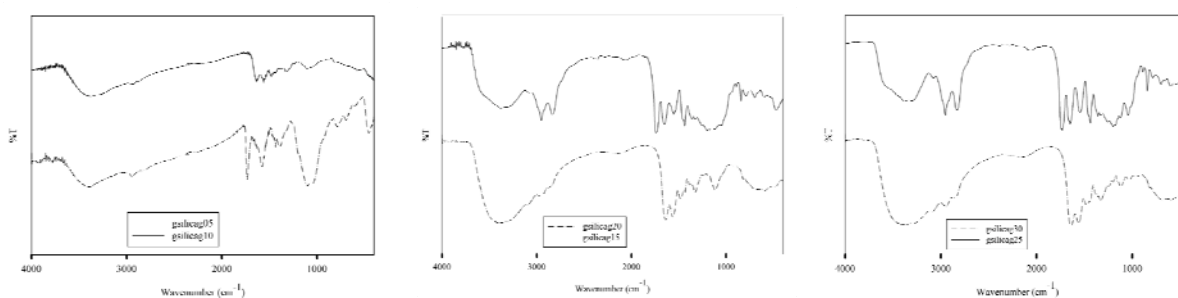


Figure 4 FTIR spectra of G0.5 – G3.0 hyperbranched PAMAM grafted silicas.

From the TGA analysis, percent graftings were calculated and their results are also given in Figure 5. The percent grafting increases when PAMAM generation grows as a result of PAMAM propagation from the silica surface amine groups. The amino group contents were expected to increase in a similar manner to percent grafting.

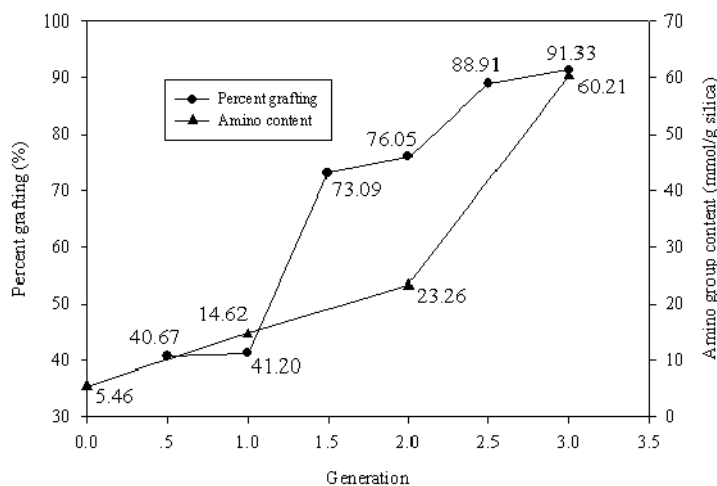


Figure 5 Percent grafting of PAMAM on silica surface and amino group content

### 3.3 SEM analysis and particle Size Analysis

By nature, the as-received fumed silica nanoparticles powder aggregated and formed micron-sized nanoclusters. Typically, physical interaction among nanoparticles is too strong to separate them by mechanical agitation means into individual particles due to its large surface area characteristic. In this study, the effect of hyperbranched PAMAM dendrimer grafted onto silica surface on particle disaggregation and its stability was examined using SEM and particle size analysis. SEM images are shown in Figure 6. As found in SEM, as-received fumed silica particles are tightly packed and adhered together in agglomerate form. After grafting, changes in particle distribution behavior as well as the agglomerate size were observed and the results are also shown in Figure 7. The results indicate that hyperbranched PAMAM grafting onto silica has been proven to be successful in dispersing particle agglomeration. This achievement was due to the steric role of grafted hyperbranched PAMAM. Figure 7 shows the particle size distribution comparison between as-received fumed silica and hyperbranched PAMAM graft silica. As can be seen, the particle sizes before treatment are in an average size of ~100 microns and then after modification the particle sizes decrease to ~100 nanometers.

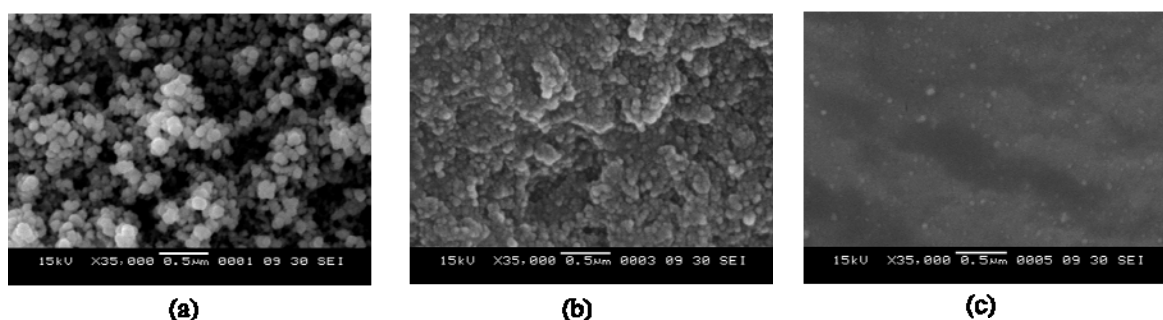
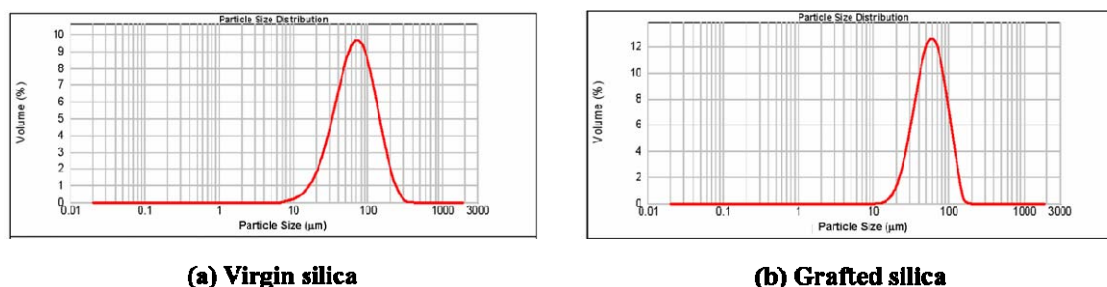


Figure 6 The SEM images of (a) silica, (b) G0.5 PAMAM grafted silica and (c) G1.0 PAMAM grafted silica.



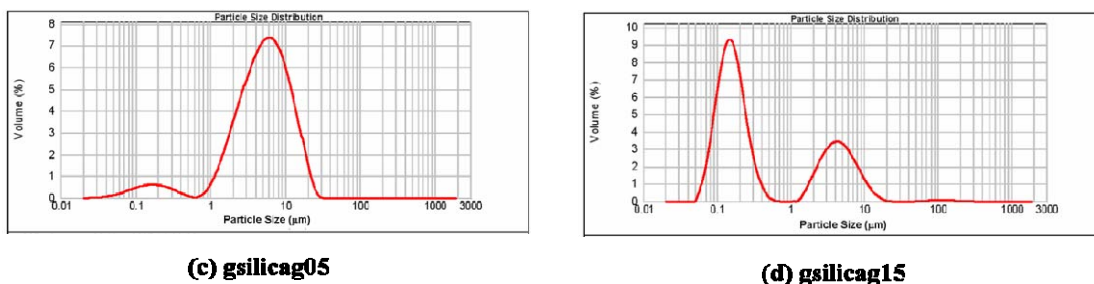


Figure 7 The particle size distribution of (a) virgin silica, (b) grafted silica, (c) G0.5 PAMAM grafted silica and (d) G1.5 PAMAM grafted silica.

### 3.4 Phosphorylation of hyperbranched PAMAM grafted silica

The reaction products were characterized using FTIR analysis and FTIR spectra are shown in Figure 8 (a). When considering the spectrum of the phosphonic acid functionalized silica, new peaks are observed, indicating change occurring in the structure of hyperbranched PAMAM grafted silica. The presence of phosphonic acid moiety is correspondent to the absorption bands at  $1182\text{ cm}^{-1}$ ,  $1078\text{ cm}^{-1}$ ,  $923\text{ cm}^{-1}$  which are the characteristic peaks of (P=O), (P-OH) and (P-O) groups, respectively[25 – 28]. A very broad band extending from  $3,600\text{ cm}^{-1}$  to as low as  $2,500\text{ cm}^{-1}$  is also observed, attributing to the absorption characteristic of the phosphonic acid hydroxyl group (OH). It is noticed that N-H stretching band at  $3500\text{ cm}^{-1}$  in hyperbranched PAMAM grafted silica markedly decreases, reflecting its consumption by Mannich reaction.  $^1\text{H}$  NMR analysis was also performed. In the  $^1\text{H}$  NMR spectrum of phosphonic acids functionalized PAMAM grafted silica in Figure 9 (b), signals indicate the presence of C(1)-H<sub>2</sub> and C(2)-H<sub>2</sub> groups and a methylene group adjacent to phosphorous nucleus are found at 3.6 and 3.7 ppm, respectively.

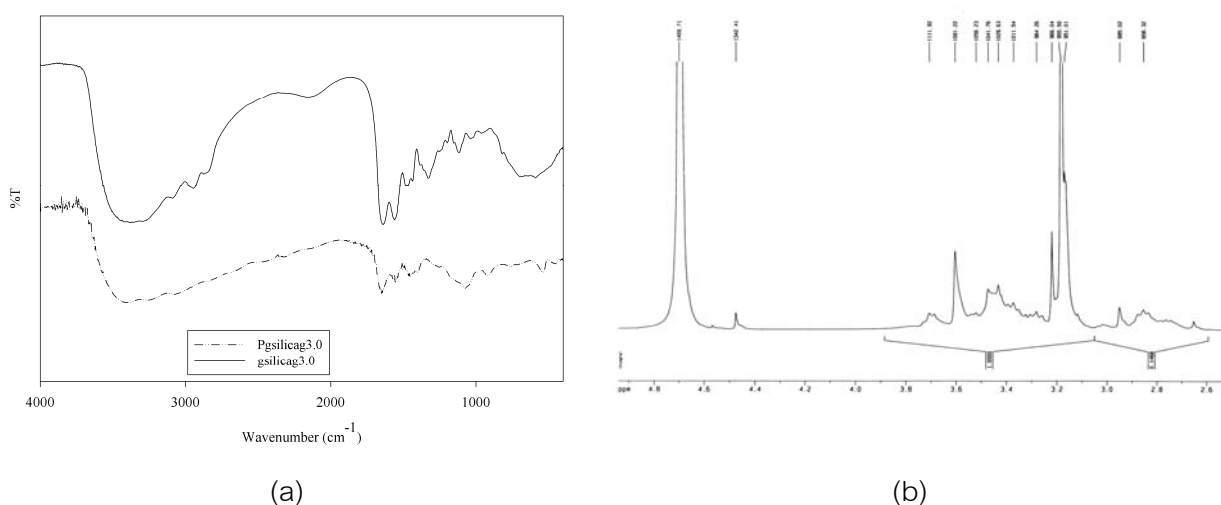


Figure 8 (a) FTIR spectra of hyperbranched PAMAM grafted silica (gsilica 3.0) and phosphorylated hyperbranched PAMAM grafted silica(Pgsilica 3.0), (b)  $^1\text{H}$  NMR spectrum of phosphorylated hyperbranched PAMAM grafted silica

### 3.5 Flame retardancy effect testing

Phosphorylated hyperbranched PAMAM grafted silica potentially offered powerful chelating action and flame retardancy properties. Treatment of cotton with phosphorylated hyperbranched PAMAM grafted silica was expected to render cotton fire resistant. The treated cotton fabric was subject to vertical burning test (Figure 9). Its burning behavior was compared with those of untreated cotton. As observed, the cotton fabric treated with phosphorylated hyperbranched PAMAM grafted silica exhibited fire retardancy property.

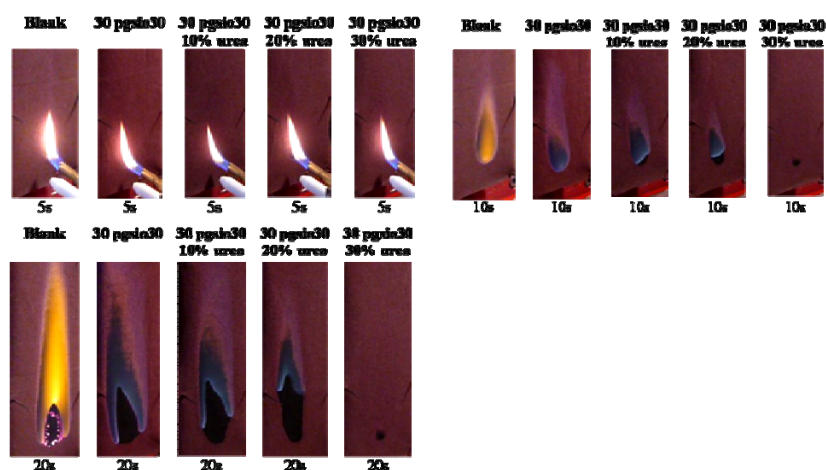


Figure 9 Vertical flammability test of 30 % phosphorylated hyperbranched PAMAM grafted silica treated cotton fabric at various concentrations of urea.

TGA thermograms shown in Figure 10 present the decomposition temperature of treated and untreated cotton fabrics. The untreated fabric starts to decompose at about 300°C, continues to reach the 100% weight loss at 350°C [29]. In case of treated fabric, the temperature of degradation begins at the relatively lower temperature of 290°C. The pyrolysis of flame retardant finished cotton fabric has lower decomposition temperature because of a catalytic dehydration of cellulose by the flame retardant, leading to char forming on fabric surface. The decline of degradation temperature is due to the fact that the phosphorous compounds react with C<sub>6</sub> hydroxyl of the cellulose anhydroglucose unit, blocking the formation of levoglucosan (source of fuel). Then, it will reduce the amount of fuel to the flame and promote char formation. Moreover, its structure contains nitrogen atoms which act synergistically with phosphorus [30]. It is known that nitrogen enhances the electrophilicity of phosphorous thereby making a stronger Lewis acid and also promoting the phosphorylation reaction with C(6) hydroxyl group of anhydroglucose unit.

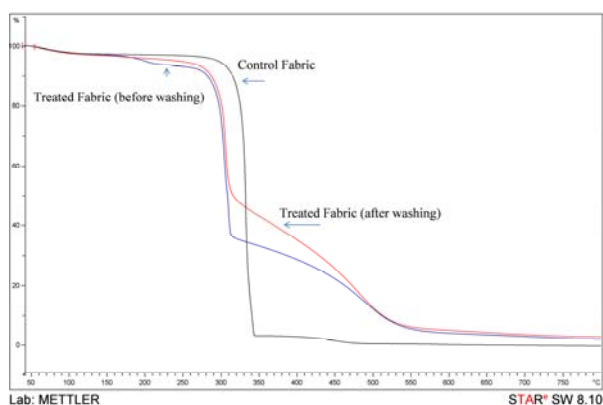


Figure 10. TGA thermograms of treated and untreated cotton fabrics.

#### 4. Conclusions

The grafting of hyperbranched PAMAM dendrimer onto amino groups functionalized silica was successfully achieved by repetitive reactions between Michael addition of silica amino group to methyl acrylate and amidation of the resulting terminal methyl ester group with ethylenediamine. A series of silicas grafted with hyperbranched PAMAM dendrimer up to generation 3 were produced. Percent grafting calculated from TGA results were 41.21, 76.05 and 91.33 for G1.0, G2.0, and G3.0, respectively. The amino group contents of G1.0, G2.0, and G3.0 were 14.62, 23.26, and 60.21 mmol/g silica, respectively, showing an increasing trend which is the same manner as the percent grafting. It was found that grafted hyperbranched PAMAM caused the steric role in dispersing particle agglomeration. The agglomerate size before grafting averaged ~100 microns and after grafting the particle size significantly decreased to a range of ~ 10 nanometer. The phosphorylation of the hyperbranched PAMAM dendrimer terminal amino groups was successfully achieved by Mannich type reaction. The phosphorylated products containing the phosphonic acids exhibited flame retardancy when applied onto flammable cotton fabric.

#### Acknowledgements

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## Preparation of Ceria Fibers Via Electrospinning Process

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### Abstract

Electrospinning is an interesting technique with various potential applications. CeO<sub>2</sub> fibers production was achieved via this technique. In this work, the prepared condition and the fiber morphology were investigated and described. The optimum condition was 15 kV, 7 cm in distance between needle tip and ground collector, 50 wt% of i-propanol in the co-solvent. The obtained fibers were continuous with a diameter of 900 nm. The smooth electrospun fibers produced were dried for one hour, and then calcined at 450 °C for 3 hours. The calcined fibers were reduced to 600 nm and cracked on the fibers. They were ceria fibers, what verified by EDX, and XRD pattern. They had high specific surface area to volume ratio, and monolith fibers, which is applied for catalytic applications.

**Key words:** CeO<sub>2</sub>, co-solvent, surface tension, viscosity, electrospinning

## 1. Introduction

Electrospinning technology is a simple and low cost method for making ultra fine polymer [1,2,3], cellulose [4] and metal oxide fibers [5,6,7]. Ultra fine fibers have diameters ranging from 10  $\mu\text{m}$  down to 10 nm by forcing a polymer melt or solution through a spinnerette with an electric field. A polymer fiber is formed during the process of electrospinning from the charged jet of a polymer solution with a suitable viscosity. It is stretched because of the electrostatic repulsion between the charges on the surface. The small diameter of the fibers allows fast mass exchange and the solvent usually evaporates before deposition on the fiber collector. The diameter and the morphology of the fibers are influenced by the solution concentration, viscosity, conductivity, the solvent surface tension, and the strength of the applied electric field. These fibers had great surface area per unit mass so that non-woven fabrics of these nanofibers can be used in various applications. The superfine fibers produced by electrospinning are randomly collected onto thin non-woven fiber mats that behave like micro-porous membranes [8]. The great benefit of this process, what ceria fibers may employed to utilize as catalytic system.

## 2. Experimental

### 2.1 Materials

Cerium (III) nitrate hexahydrate ( $\text{CeNO}_3 \cdot 6\text{H}_2\text{O}$ , 99 %) and Polyvinyl alcohol ( $(\text{CH}_2\text{CHOH})_n$ , Mw 30,000-70,000, 95 %) from Aldrich Chemicals and iso-propanol ( $(\text{CH}_3)_2\text{CHOH}$ , 99%) from Fisher Chemicals were used without further purification.

### 2.2 Preparation of ceria fibers

Cerium nitrate (1.0 M) was dissolved and stirred continuously. Subsequently, 30 % w/w of PVA was slowly added into the precursor solution, stirring vigorously until a viscous and clear solution was obtained.

The solution was placed into a glass syringe with a 2 mm diameter metal needle. The tip was connected to a DC high voltage generator (15 kV). A grounded aluminum sheet was used as a collector. The electrospun fibers were ejected in a web form onto the collector, then dried at 80 °C for 1 hour and Ceria/PVA fibers were transform to ceria fibers via calcination process at 450 °C for 3 hours [8].

## 2.3 Characterization

The viscosity of the solution was measured using a viscometer. The fiber morphology was determined using a scanning electron microscope with energy dispersive X-ray spectroscopy mode (JSM-5600 LV, JEOL). The element identification of the ceria fiber was confirmed by using an X-ray diffractometer (PW1830/40, Phillips) with 20 kV (CuK $\alpha$  radiation,  $\lambda=1.54060$  Å).

## 3. Results and discussion

### 3.1 Fiber morphology

Firstly, the solution was prepared by pure water. The factors were distance between needle tip; 5 cm to 10 cm, and fiber morphology. There found the jammed fibers on the ground collector at the whole distance. The fiber characterizations displayed in figure 1.

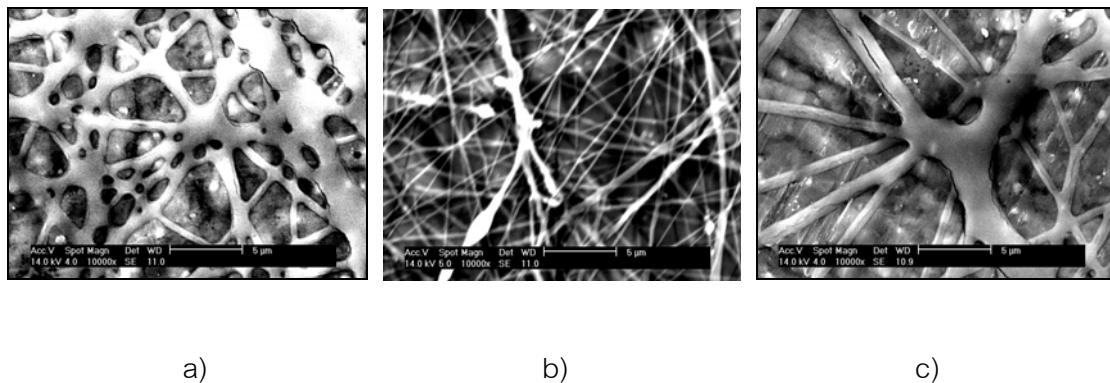


Fig. 1 the fiber characterization by effect of distance

a) 5 cm    b) 7 cm    c) 10 cm

In figure 1, the jammed electrospun fibers were obtained, which water had slowly vaporization effect. The water vaporization had an effluent to draw fibers. Moreover, the distance was a significant key for controlling the fibers shape. At 7 cm distance was sufficient distance to draw fibers and good quality in shape for extended study.

The second, the jammed effect were reduced, what co-solvent was preferred to answer this trouble. The co-solvent was mixture solution between water and i-propanol. I-proanal was an alternative choice due to great vaporized than water. The improvement fibers found in figure 2.

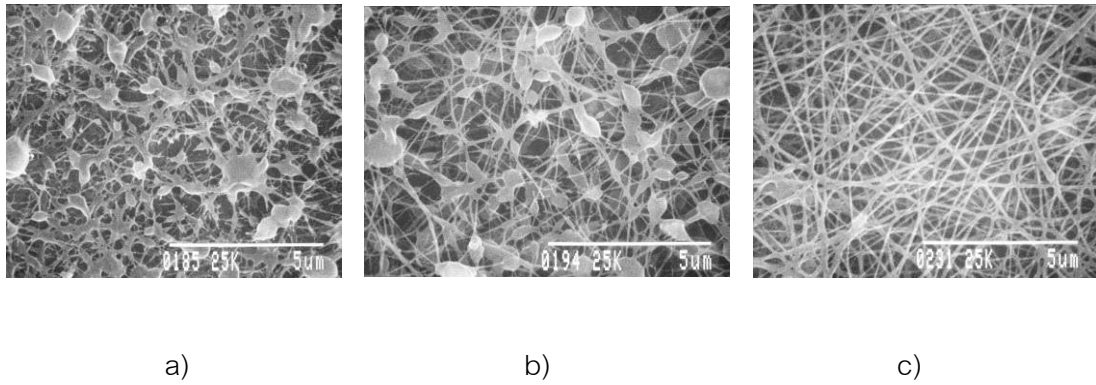


Fig. 2 SEM micrographs of obtained fibers

a) 10 wt. i-propanol      b) 30 wt. i-propanol      c) 50 wt. i-propanol

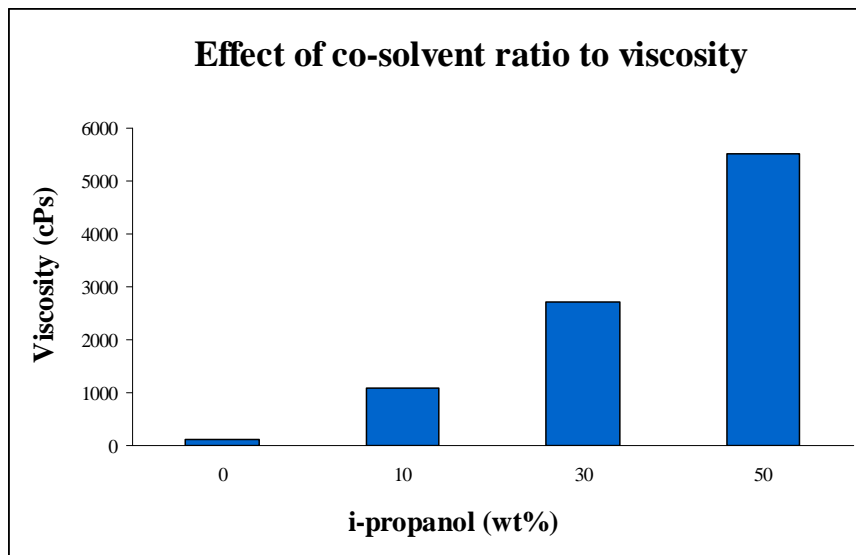


Fig.3 Effect of co-solvent ratio to viscosity

The transformation of electrospinning fibers was conducted by surface tension and viscosity. Namely, these parameters can influence to the characteristic of bead on the fibers. The surface tension of water and i-propanol are 72.3 mN/m and 22.3 mN/m, respectively [10]. The co-solvent had lower surface tension than water due to the mixing effect. The generated fibers were smooth and continuous when reduce the surface tension showed in SEM picture as Fig.2. SEM is primarily used to study the surface, or near face, structure of bulk specimens. The solvent was modified by varying the weight percent of i-propanol from 10 to 50, when the consequence showed in Fig. 2 a), b), and c). The first, 10 % weight of i-propanol appeared as enlarged droplets on the aluminum collector, some polymer solution could stretch to fiber form. When co-solvent solution percentage increased, the droplets were

transformed. The beads gradually disappeared till the smooth fiber occurred at 50 percentage co-solvent.

Therefore, the viscosity of the solution also has an effect on the electrospinning and the fiber morphology. When the viscosity of the solution was too low, electrospinning occurred and particles were formed as shown in Figure 2 (a). The viscosity of the mixture depends on the PVA solubility which can be explained by the dielectric constant of a solvent. The dielectric constant is a relative measure of polarity. Water has a dielectric constant of 80 (high polarity), while i-propanol has a dielectric constant of 20 (semi-polar), and PVA has a dielectric constant of 2 (low polarity) at 20°C [11]. This implies that PVA can dissolve in i-propanol better than in water. Thus, the addition of i-propanol into the co-solvent will enhance the solubility of the PVA and increase the viscosity of the solution.

Moreover, the viscosity of the solution also has an effect on the electrospinning and the fiber morphology. When the viscosity of the solution was too low, electrospinning occurred and particles were formed as shown in Figure 2 a. This is confirmed by the result presented in figure 3.

### 3.2 SEM/EDX

The SEM images in Figures 4a) and 4b) show the morphology of the cerium oxide fibers before and after calcination at 450°C for 3 hours. The generated fibers had a diameter of 900 nm before and a diameter of 600 nm after calcination.

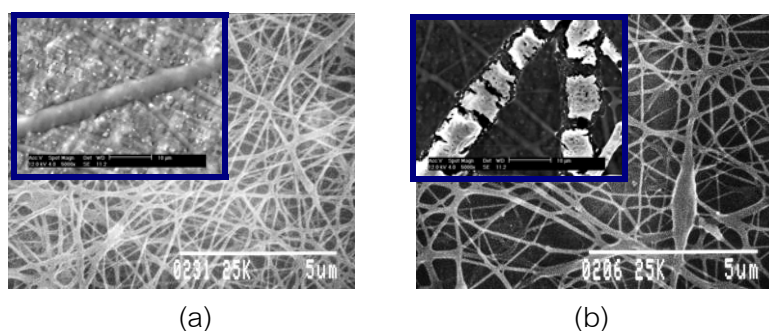


Fig.4 SEM images of electrospun fibers (50 wt. i-propanol)

(a) before calcination b) after calcination

Energy Dispersive Spectrometer (EDS) has been a great advance in the suite of analytical techniques available for rapid qualitative analysis. However, there are some serious limitations to be considered as it is impossible to detect elements lighter than sodium with a standard detector.

The composition of elements (pretreatment and after calcination at 450°C) are displayed in Table 1. The totals refer to atom percentage (% atom) of the elements in the system. The pretreatment comprised of  $(\text{CH}_2\text{CHOH})_n$ ,  $\text{CeNO}_3$ ,  $\text{H}_2\text{O}$  and  $\text{CH}_3\text{CH}_2\text{CHOH}$ . The percentages of C, N, O and Ce are shown, but hydrogen was smaller than sodium so it could not be detected.

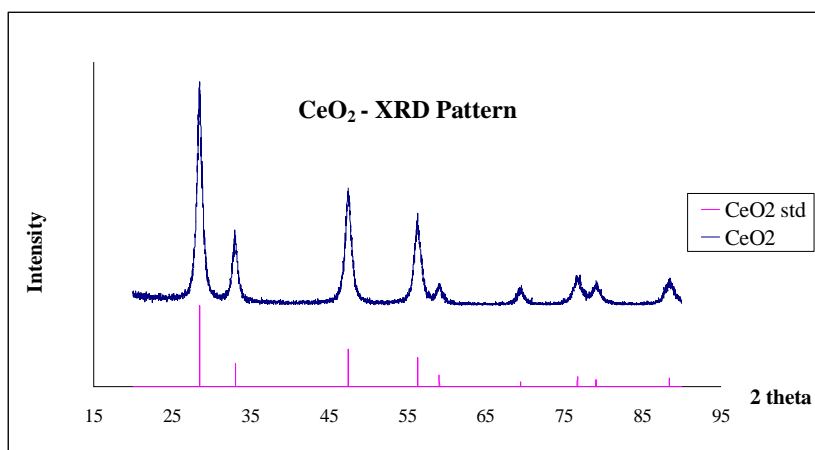
**Table 1 Elemental composition of the fibers (before and after calcination)**

Element	C (%)	N (%)	O (%)	Ce (%)
Before	18.44	19.48	55.29	6.79
After	1.50	12.25	57.92	28.31

Moreover, the low percentage of carbon in the calcinated fibers implies that it went into the ash of the residual polyvinyl alcohol. Some nitrate compound still remained in the process, however, oxygen and cerium had the highest percentages. The calcination process was a heat treatment to effect phase transformations. It induced the calcination process that transformed the polyvinyl alcohol/cerium nitrate composite fibers to  $\text{CeO}_2$  fibers. The percentages of cerium and oxygen were 28.31 and 57.92, respectively. The yield proportion was approximately 1:2 and there was a strong possibility that it was  $\text{CeO}_2$ .

### 3.3 X-ray diffraction (XRD)

The crystalline structure of ceria had been investigated by many researchers. X-ray diffractometry (XRD) is mainly used for the identification of compounds by their diffraction patterns. It has been shown that a single crystal with a particular set of atomic planes oriented toward the X-ray beam diffracts X-rays at an angle  $\theta$  determined by the distance between the planes.



**Fig.5 XRD pattern of ceria synthesizer**

Figure 5 shows the crystalline phase present after calcination treatment. The diffraction method is ideally suited for characterization and identification of polycrystalline phases. The same substance always gives the same pattern. The results here displayed sharp and intense peaks corresponding to CeO<sub>2</sub> as matched with the database in JCPDS (file number: 81-0792). Thus, it was almost certain that the product was CeO<sub>2</sub> confirming the earlier EDS verification.

#### 4. Conclusions

Ceria (CeO<sub>2</sub>) fiber was successfully prepared by an electrospinning technique. The factors relevant were the solution properties of the solvent as vaporization, viscosity, polarity, and distance between tip and ground collector had a prominent influence on the electrospinning process. The addition of the co-solvent, i-propanol, reduced the surface tension of the feed solution and thereby promoted the polyvinyl alcohol solubility. Smooth fibers were produced with 50 wt% i-propanol. The CeO<sub>2</sub> fibers obtained after the calcination at 450°C for 3 hours had an average diameter of 600 nm. The EDS and XRD results verified the formation of CeO<sub>2</sub>.

#### 5. Acknowledgements

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# The Development of Mudmee Pattern : The Case Study of Silhouette of Prasat Si Khoraphum Using in Clothing Design

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## Abstract

The aims of this study are as follows 1.) to develop a new woven Mud Mee pattern which inspired by optical art integrated with the silhouette of Prasat Si Khoraphom in Surin province 2.) to use the developed Mud Mee pattern to improve clothing design influenced from 1960s fashion 3.) to test the satisfaction level of the finished Mud Mee clothes from the sample group. There are 7 textile professionals including pattern designers, textile artists, Mud Mee textile specialists, and 4 fashion designers as supervisors in screening the patterns and designs. The sample group was selected from the staffs who work in Rajaphat Surindra University, and Rajamangala University of Technology Northeast (Surin Campus). The tools used in this research were the fabric pattern sketches inspired by optical art integrated with the silhouette of Prasat Si Khoraphum, the 1960 fashion clothing design sketches , and the satisfaction survey. The statistical package for the social science program was used to find mean and percentage. This study found that the most selected designs from 7 textile professionals were Pra Sart Moom Soong pattern, Phasom Phasarn Nammatham pattern, and Barai Sai Nam pattern. There were 9 jacket sketches that had been selected. The level of satisfaction on the clothing design from 1960 era of 213 women staff who work in Rajabhat Surindra University and Rajamangala University of Technology Northeast (Surin Campus) showed that the Phrasat Moom Soong pattern gained the highest level of satisfaction (4.78) The Barai Sainam pattern was the most aesthetics pattern (4.70). Finally, the sample group satisfied the color and pattern of Phasom Phasan Nammatham the most (4.73). In Chon-Phoa group, the most aesthetic jacket patterns were Phrasat Moom Soong (4.67), and Phasom Phasrn Nammatham(4.70). While the Bari Sainam pattern appeared to have the highest level of correlation between pattern and clothing design (4.74). In the uniform group, the most aesthetic 1960 jacket patterns were Phrasat Moom Soong (4.74), and Phasom Phasrn Nammatham(4.71). While the Bari Sainam pattern appeared to has the highest level of correlation between pattern and clothing design (4.73). In Art and Fashion group, highest level of correlation between pattern and clothing designs for each pattern were Phrasat Moom Soong pattern (4.67), Bari Sainam pattern (4.69), and Phasom Phasrn Nammatham (4.70).

**Keywords** : Prasat Si Khoraphom, optical art, clothing design influenced from 1960s fashion.

## Introduction

### Statement of the Problem

The hand-woven silk that is made of local materials in Thailand becomes more popular in these days than in the past. People usually use them to make clothes or dresses for wearing in their every day life and also in many special occasions. For that reason, the design of clothes using Thai Silk is now more creative and diversified to satisfy all needs. This research focuses on this change and chooses to study the pattern of Mudmee Silk in Surin province. The weaving pattern has been influenced by the Cambodian of Phnom Penh and Phra Tabong, for example, portrait, animal and architecture designs. This kind of pattern doesn't change much since it has been carried on from generation to generation. As a result, any products that are developed by using these patterns have a conservative image, not contemporary or up-to-date. This research, therefore, tries to offer the new pattern which is inspired by the silhouette of Prasat Si Khoraphum stone castle. This castle is situated in Si Khoraphum district and also one of the most famous tourist attractions in Surin. Above the entrance of the main prang is a lintel depicts the dancing god - Shiva in Nataraja - which is still in good condition and the most complete in Thailand. Apart from that, Absorn Angel sculptures on the main prang door is the same as of Angkor Wat .For these special characteristics of Prasat Si Khoraphum stone castle, the researcher use it as an inspiration to create the new pattern on Mudmee silk. What brought the outstanding uniqueness to this Prasat Si Khoraphum is that the silhouette of the castle is reduced in size of the corner in descending order from the roof top. This kind of pattern is similar to the Illusion Art or Optical Art which use the descending line and form to create the illusion when seeing by the eyes. Combining the castle silhouette and optical illusion art, comes a new weaving pattern of Mudmee silk. Then using this new design to develop clothes in style of 1960s, that was when the optical art first originated and had inspired many fashions (Joe Houston,2007) Also it was the time when the local fabric had been popularly used which is consistent with the use of local Thai silk nowadays.

In conclusion, this research offers the idea of developing Thai silk by using Mudmee silk of Surin province. The weaving pattern is created from the Prasat Si Khoraphum e silhouette integrating

with the Optical Illusion Art and then becoming the clothe design of 1960s style. The purpose is to develop new weaving pattern, and to promote the cultural heritage of Surin province.

### **Objectives of the study**

1. To develop the weaving pattern of Mudmee silk by using Prasat Si Khoraphum silhouette and the optical art as an inspiration.
2. To use Mudmee silk in Prasat Si Khoraphum silhouette combining with the optical art weaving pattern to design the clothes in the fashion of 1960s.
3. To evaluate the overall satisfaction of the target group on the 1960s' fashion made of Mudmee silk in the pattern of Prasat Si Khoraphum silhouette combining with the optical art.

### **Scope of the study**

1. Study on the weaving pattern of Mudmee silk in Surin province.
2. Study on the Prasat Si khoraphum in Surin province, emphasizing on the silhouette of the castle.
3. Study on the Optical Illusion Art.
4. Study on the fashion in the 1960s, focus on the lady coat.
5. To evaluate the overall satisfaction on the 1960s' fashion which made of Mudmee silk in the pattern of Prasat Si khoraphum silhouette combining with the optical art, the target group is the 117 female personnel of Surin Rajabhat University and 96 female personnel of Rajamangala University of Technology Isan - Surin Campus.

## **Research Method**

### **Instruments**

- 1) The Sketch of Mudmee silk pattern of Prasat Si Khoraphum silhouette combining with the optical illusion art.

The collection and analysis of the primary data from the Prasat Si Khoraphum in Surin, the unofficial interview with the Khmer ancient architecture expert and the secondary data from the academic document have become 5 prototype sketch patterns. These are then used to design 50 Mudmee silk patterns, separated in 5 categories as follow:

- Phrasat Moom Soong            10 patterns
- Phrasat Nammadham           10 patterns
- Phrasat Rekhakanit            10 patterns
- Phrasat Thai Prayuk            10 patterns
- Ruam Phrasat                    10 patterns

Then the textile design and silk weaving expert selected the pattern that is consistent with the objectives of this study which finally left only 30 patterns:

- Phrasat Moom Soong            10 patterns
- Phrasat Nammadham           10 patterns
- Phrasat Rekhakanit           10 patterns

2) Designs from each group has been chosen to make real textiles.

3) The lady's coat of 1960s fashion using Mudmee silk with the selected patterns of Phrasat Si khoraphum combining with the optical illusion art are 27 sketches altogether.

4) From the 30 sketches of weaving pattern selected results in 63 designs of lady's coat for female personnel of Surin Rajabhat University and Rajamangala University of Technology Isan - Surin Campus. Again, the expert considered the sketches and selected only 27 designs that are consistent with the objectives. According to the data in 1960s, 27 designs can be categorized as below:

- The design inspired by the tribe (Tribe group) 9 designs
- The design inspired by the uniform (Uniform group) 9 designs
- The design inspired by art, fashion and important events (Art group) 9 designs

5) Designs from each group with 3 different patterns had been chosen to make real coats.

### **The Questionnaire**

1) The interview guideline framework for interviewing of the experts with open-ended questions that required the opinion on the sketch of Mudmee silk weaving patterns.

2) The questionnaire with closed-ended questions that required evaluating of satisfaction.

### **Population and Sampling group**

1) Population

The population using in this research can be separated into 3 groups; textile design and Mudmee silk weaving experts, fashion design experts and satisfaction evaluation group which are female personnel from the educational institutes in Surin province.

## 2) Sampling group

2.1) Textile design and Mudmee silk weaving expert: 7 samples are chosen by using purposive sampling method which consider knowledge, expertise and working experience in the field related to textile design and Mudmee silk weaving.

2.2) Fashion design expert: 5 samples are chosen by using purposive sampling method which consider knowledge, expertise and working experience in the field related to fashion design.

2.3) Satisfaction evaluation group: The samples which are chosen by both purposive sampling and accident sampling, consists of

- Female personnel of Surin Rajabhat University which are teachers, staffs and employees 117 samples

- Female personnel of Rajamangala University of Technology Isan - Surin Campus which are teachers, staffs and employees 96 samples. There are 225 samples altogether

## Data Collection

The researcher studied general background and information related to the objectives of the research through the document study.

### 1) Pattern Design

1.1) Researcher used the silhouette of the Prasat Si khoraphum as the inspiration, and then gathered the information from the location, local museum, and the Fine Arts Department.

1.2) Researcher did more study on Optical Illusion Art (Op Art) through conducting the interview of the pattern designer from Anita Silk, the Op Art expert.

1.3) Researcher studied the Mud Mee weaving techniques through observation and interview of the Mud Mee textile specialist from Rajamangala University of Technology Isant (Surin Campus).

2) **Clothing Design** Researcher did the study on clothing style in 1960 period from many documents.

### **Data Analysis**

1) The information and data from the interview, observation, and questionnaire were analyzed and divided into 2 parts.

2) The Mud Mee Pattern Sketches and Jacket

3) The developed Mud Mee pattern designs which inspired by silhouette of the Prasat Si khoraphum.

4) Result of the silhouette the Prasat Si khoraphum blended with Optical Art

5) The finished Mud Mee cloth inspired by silhouette the Prasat Si khoraphum and Optical Art in 1960s clothing design

### **Satisfaction Survey Data**

The data had been gathered from 213 women age 22-60 years old who love to wear silk clothes through the questionnaires. Researcher used the quantitative method to analyzed the data to find the average level of satisfaction of the sixty period costumes style which made from new designed Mud Mee fabric.

The levels of satisfaction are as follows:

Average score 4.50-5.00 means most satisfaction

Average score 3.26-4.00 means satisfaction

Average score 2.51-3.25 means moderate satisfaction

Average score 1.76-2.50 means less satisfaction

Average score 1.00-1.75 means no satisfaction

### **Summary and Recommendations**

This study found that the most selected designs from 7 textiles professionals were Pra Sart Moom Soong pattern, Phasom Phasarn Nammatam pattern, and Barai Sai Nam pattern. There were 9 jacket sketches that had been selected.

The level of satisfaction on the clothing design from 1960 era of 213 women staff who work in Rajabhat Surindra University and Rajamangala University of Technology Isan (Surin Campus) showed that the Phrasat Moom Soong pattern gained the highest level of satisfaction (4.78) The Barai Sainam pattern was the most aesthetics pattern (4.70). Finally, the sample group satisfied the color and pattern of Phasom Phasan Nammatham the most (4.73).



Picture 1-3 The real textile 3 pattern

In Chon-Phoa group, the most aesthetic jacket pattern were Phrasat Moom Soong (4.67), and Phasom Phasrn Nammatham(4.70). While the Bari Sainam pattern appeared to have the highest level of correlation between pattern and clothing design (4.74).



Picture 4-6 Chon-Phoa group

In the Uniform group, the most aesthetic 1960 jackets pattern were Phrasat Moom Soong (4.74), and Phasom Phasrn Nammatham(4.71). While the Bari Sainam pattern appeared to have the highest level of correlation between pattern and clothing design (4.73).





(7-9)

Picture 7-9 Uniform group

In Art and Fashion group, highest level of correlation between pattern and clothing designs for each pattern were Phrasat Moom Soong pattern (4.67), Bari Sainam pattern (4.69), and Phasom Phasm Nammatham (4.70).



(10-12)

Picture 10-12 Art and Fashion group

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# The Comparative Study of Tie-Dye Methods for Pattern Design Development of Tie-Dye Products

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## Abstract

The purposes of this research were 1) To compare to the distinctly motifs of Tie-dye methods: binding technique, folding technique and stitching technique. 2) To compare the dyeing results of the characteristics of cotton, linen, and rayon in geometrics patterns design group and naturalistic patterns design group. There are 8 motifs were used; quadrangle, triangle, circle, heart form, flower, leaf, butterfly, and worm. The research Instruments were used; 1) tie-dye fabrics dyed in 3 tie-dye methods. The tie-dye methods were bind, fold, and stitch amount of 120 pieces 2) The assessment for 15 connoisseurs (connoisseurship model). Data was analyzed by the statistical package for the social science program and using mean, percentage, standard deviation, one-way ANOVA (Scheffe), and chi-square.

The results of the study were found that binding technique was at mean 4.20 including stitching technique at mean 4.10 and folding technique at mean 3.69. The best technique was binding technique because this technique could produce products in a large quantity. The stitching technique was aesthetic, elegant and valuable. The folding technique could produce many patterns in one time.

Binding technique, folding technique and stitching technique on cotton were much suitable in tie-dye method and capability of techniques. Binding technique and stitching technique on cotton were much suitable in pattern design and overall image of fabric dyed. Binding technique and stitching technique on linen were much suitable in 5 parts. Folding technique on linen were much especial suitable in tie-dye method and capability of techniques. Binding technique and stitching technique on rayon were much suitable in 5 parts. Folding technique on rayon were much especial suitable in 5 parts except overall image of fabric dyed. Comparison of three kinds of fabric and two pattern groups were that geometrics and naturalistic patterns on cotton, linen, and rayon fabrics had average the best in binding technique. To compare tie-dye techniques and fabrics and pattern groups had different for some parts statistically significant at level of .05

This study was the experimental methods of tie-dye and 3 kinds of fabrics; cotton, linen, and rayon. The method of dyed in the study was vat dye (Indigo dye), the result found that the best fabric absorption dyed was rayon, the second best fabric absorption dyed was cotton and linen. The vat

dye in different kinds of fabric were dyed at the same quantity. They were dyed in the nearly different shade. Rayon was the best dye than another kind. Cotton and linen were dyed as the same shade.

**Key words** : Tie-Dye Methods, fabrics, patterns design

## Preface

Handicraft market in this time, Thai hand-made product are well-know in domestic and aboard. Since a few years, handicraft product, hand-made products were increase demand. To consist of this situation, we are confront with the global warming, so many people turn back to care about friendly environment products. Fabric product, which is one of human element factor, is on the top of export ranking. There were the Thai Textile & Clothing Statistics Report on September 2008, Natural Materials garment had the highest export cost. Being unfortunately, learning process fundamental of folk wisdom was learned by experience learning and observation learning. Besides, it was instructed by word to mouth. The affect of the knowledge source will disappear provided that we are not record it in text. As tie-dye method that makes motifs on the fabric by several materials to be resist. There are many techniques such as fold, bind, stitch, twist, spin, clip etc., all over called Tie-dye. In the past, tie-dye was just craft that made in family or in hamlet and community. Nowadays, it is not only in home but it is a handiwork that makes it widely. Tie-dye make people in community to have income and it become export product and have order in every month. Furthermore, last year on runway, there were a lot of designer used tie-dye technique on their design such as DOLCE & GABBANA in Collection Pre-fall 08 ,NINA RICCI in collection Resort 08, and EMMA COOK in collection London Fashion Week Autumn/Winter 08 (Online Available: [www.style.com](http://www.style.com)). Moreover, Thai designer who use tie-dye technique on his design is Nagara and Thakoon. As above, Tie-dye methods have many techniques, some technique was used for along time and in this time, it is still used. Some technique is not famous to use because it is very complicated, hard and spend time to make. Although, the manufacturer is trying to design many motifs for matching with buyers but the motif name is yet repeated. It makes confusion to call the name and explain the details of the motif. About the beauty of motifs depend on tie-dye techniques that makes motif have different characteristics. Though, Tie-dye methods in each technique, which uses to make motifs have identities, so it has an affect on motif to present. The Important thing is the selection fabric, it will enhance techniques and motifs, is one of main component. The researcher realize to the importance of Tie-dye methods so the researcher would like to compare Tie-dye methods; binding technique, folding technique and stitching technique. The result of this study is the knowledge to develop Tie-dye technique and pass on to public sector, privet sector and anyone would like to know about Tie-dye.

## Objectives

- 1) To compare to the distinctly motifs of Tie-dye methods: binding technique, folding technique and stitching technique.
- 2) To compare to the dyeing results of the characteristics of cotton, linen, and rayon in geometrics patterns design group and naturalistic patterns design group.

## Limitation

- 1) To study and compare to tie-dye methods; Binding technique, folding technique and stitching technique.
- 2) Three different kinds of fabric dyed; cotton, linen, and rayon that all go through preparing fabric in scouring process.
- 3) The Colour dyeing in Vat dye (Indigo)
- 4) For this research was presented by 2 pattern design groups; geometrics and naturalistic patterns. There are 8 motifs were used; quadrangle, triangle, circle, heart form, flower, leaf, butterfly, and worm.

## Procedure

- 1) Tools of experiment
  - 1.1) Materials are rubber band, C-clamps, spun thread, motif blocks, motif papers, Vat (Indigo), caustic soda, soda ash, soaping, wetting agent, sodium hydrosulphite and salt
  - 1.2) Fabrics are cotton, linen, and rayon. The tie-dye methods were bind, fold, and stitch amount of 120 pieces
  - 1.3) The suitable assessment for 15 connoisseurs
- 2) To select techniques, fabrics, and pattern groups
  - 2.1) To study and select 3 Tie-dye methods



Binding technique



folding technique



stitching technique.

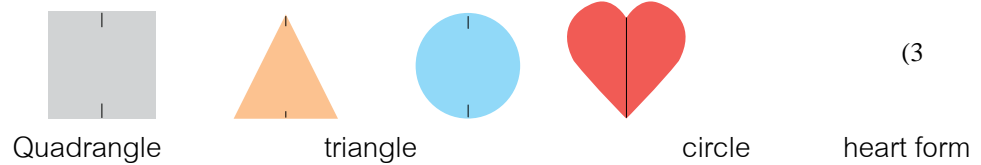
(1

2.2) To study and select three different kinds of fabrics and The scale of samples is 30 x 30 cm.

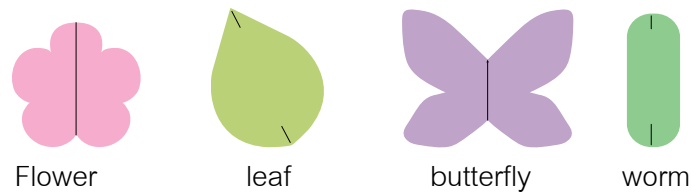


(2)

2.3) To select 2 pattern design groups; geometrics and naturalistic patterns. There are 8 motifs were used; quadrangle, triangle, circle, heart form, flower, leaf, butterfly, and worm.



(3)



(4)

3) Experiment process to compare

3.1) To experiment Tie-dye in 3 Tie-dye methods, 3 fabrics and 2 pattern design groups

3.2) Preparing fabrics in scouring process

3.3) To arrange motif blocks and motif papers

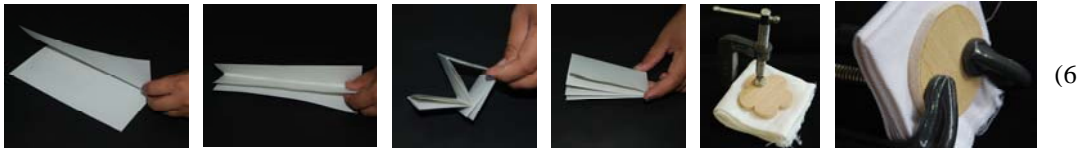
3.4 To Mark and to draw the motifs on the fabrics

3.5) To bind the fabric in fan style, bind on the line mark and bind on the area in crossed style.



(5)

3.6) To fold in quadrangle form, motif block cover like sandwich form and take the C-clamp to clamp.



3.7) To stitch in running stitch by hand, pull strings, be tied by spun thread till the ends.



3.8) Dyeing process

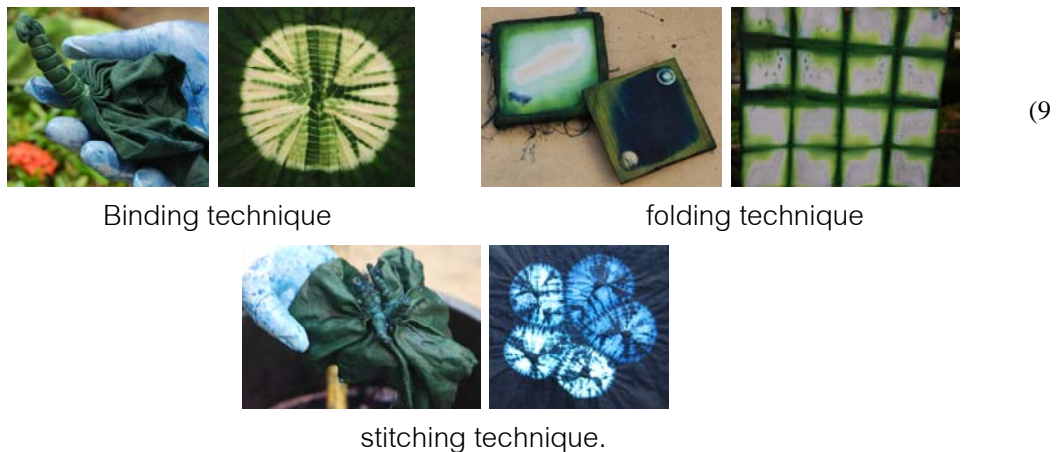
3.9) To prepare stock vat (Indigo) dye



Measure the dye powder and put it into the measuring cups. Add a small amount of measured quantity of water. Add the Caustic soda to the water. Carefully mix the sodium hydrosulphite powder slowly onto the surface of it. Last, add the Indigo to the vat and put salt into it.

3.10) To put wet-out fabrics into the vat, after that 10 minutes later carefully put salt again into the vat and mix. Mix again in every 10 minutes.

3.11) Dyeing for 2 hours, take the fabrics dyed comes into contact with the air it will start to oxidize



Binding technique

folding technique

stitching technique.

3.12) Turning the indigo dye from greenish-yellow back to its deep blue state.



(10)



(11)

Sample Product

4) Making the suitable assessment for 15 connoisseurs by connoisseurship model. In this study, there were comparative in 5 parts as follows

- 4.1) tie-dye method
- 4.2) pattern design
- 4.3) colour of fabric dyed
- 4.4) overall image of fabric dyed
- 4.5) capability of techniques

5) Data were analyzed by the statistical package for the social science program and using mean, percentage, standard deviation, one-way ANOVA, and chi-square.

### Results

The results of the study were that binding technique had mean 4.20, the second, the stitching technique had mean 4.10 and the last, the folding technique had mean 3.69. For the result of the tie-dye technique suitability comparative ranking for mass-product, the best technique is binding technique because this technique was fast for made mass order. The second was stitching technique because this technique was look aesthetic, elegant and valuable, and the last was folding technique because this technique was fast for made many patterns in one time.



Tables 1 Average Mean from the suitable assessment in 5 parts

<i>Tie-dye Method</i>	<i>Max</i>	<i>Min</i>	$\bar{x}$	<i>S.D</i>	<b>Suitable level</b>
Binding Technique	5	2	4.20	.680	much
Folding Technique	5	1	3.69	.921	much
Stitching Technique	5	2	4.16	.702	much
Totel			4.02	.809	much

Tables 2 The result of Ranking Tie-dye methods that suitable for Mass Product

<b>Value</b>	<b>Binding Technique</b>	<b>Folding Technique</b>	<b>Stitching Technique</b>
Value (a)	3	2	1(b)

(a) Median

(b) All values

Binding technique, Folding technique and Stitching technique on Cotton were much suitable in tie-dye method and capability of techniques. Binding technique and Stitching technique on Cotton were much suitable in pattern design and overall image of fabric dyed. Binding technique and Stitching technique on Linen were much suitable in 5 parts. Folding technique on Linen were much suitable especial in tie-dye method and also capability of techniques. Binding technique and Stitching technique on Rayon were much suitable in 5 parts. Folding technique on Rayon were much especial suitable in 5 parts except in a part of overall image of fabric dyed. Comparison of three kinds of fabric and two pattern groups were that cotton, linen, and rayon fabrics in geometrics and naturalistic patterns in binding technique had average the best. Comparison of three kinds of fabric and two pattern groups had different and were insignificantly. To compare two pattern groups on Cotton had suitable in the high level and suitable in three tie-dye methods, To compare tie-dye techniques and fabrics and pattern groups had different for some parts statistically significant at level of .05

### Recommendations for Future Research

- 1) It is recommended that Vat dyeing if you desire colour the best than capability Indigo dye, you can put the turkey red oil (as a mordant) into the vat before dyeing.
- 2) It is recommended that comparisons another Tie-dye methods which have different resist materials
- 3) It is recommended that comparisons Tie-dye methods and dyeing more 1 colour.
- 4) It is recommended that comparisons between Tie-dye method and Tie-dye method in another pattern design groups.
- 5) It is recommended that studying motivation and problem factor of another kind of dyeing
- 6) It is recommended that to study the probability of Tie-dye method developing for improvement to Industry level.

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# The Study on Knowledge, Attitude and Consumption Behavior about Healthy Food of High School Teachers in Nontaburi Province

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## Abstract

The objectives of this research were 1) to study the knowledge about healthy food; 2) to study the attitude towards consumption of healthy food; 3) to study the relationship between the individual of personal factor and health factor, and 4) to study relationship between knowledge and attitude towards of healthy food of high school teacher in Nonthaburi that influenced their behaviors. Questionnaires were used as a tool for collecting the data, and the data was analyzed by using percentage, mean, standard deviation, t-test, f-test, and Pearson correlation (r).

Most of the responders of this research were female. Age group was between 51-60 years old. Height group was between 151-160 centimeters. Weight group was between 51-60 kilograms. The majority of their salaries were between 28,001-33,000 Baht. The level of personnel sickness was low. The level of understanding of how to consume healthy food was high. The attitude of consuming healthy food was high level. But the behavior of consuming healthy food was mostly at moderate level.

According to the study of relationship between the individual of personal factor and health care factor, the results were: there was relationship between sex and behavior of consuming healthy food, statistically significant at the .05 level. Moreover, the study of relationship between the knowledge and attitude of consuming healthy food of high school teacher showed that it had an impact on their behavior which was statically significant at the .05 level.

**Keyword:** knowledge, attitude, behavior of healthy food, high school

## Introduction

According to the objective of development in human life under regulation plan number 10 of economy and society improvement 2007 – 2011, it considered that Thai population would be developed in their physical conditions, minds, knowledge and capacities, working skills, and securities. This would cover in every group target. Increasing potential, their families, communities, and societies would be strength. Moreover, the level of sickness such as heart attracts, hypertension, diabetes, brain, and cancer would be decreasing. In term of success, the number of labor available would increase, and the cost of medical care would decrease by following.

According of observation of Ministry of Public Health, Doctor Narong Aengkasuvapala (2008) presented 2 over 3 of Thai population with 40 -59 years old; they were impacted with fat in blood vessel, gain weight, and fatness. These would be the result from too much eating, strain, and less exercise. These would cover over people in working group that always had three and more additional meals. Therefore, having more meals in every single day without any exercise would be affected to be risky to have those sickness on the top.

Long time ago, vegetable and herb became the majorities in Thai food component for Thai people. To have brown rice with Thai dishes, protein, carbohydrate, vitamin, and fat would be nutrients that the eaters would receive after their meals. But in this century, many people have no time to make their own meals, and they still ignore to have some health food or study the health education for their healthy.

According to this study, it considered to the knowledge, attitude, and behavior of food consuming for health. Because having right of knowledge and directional attitude would bring to the right direction of behavior in food consuming; therefore, this research would be an implement for improving healthy for Thai people in the future.

The objectives of this research were ; 1) to study the knowledge about healthy food;2) to study the attitude towards consumption of healthy food;3) to study the relationship between the individual of personal factor and health factor, and 4) to study relationship between knowledge and attitude towards of healthy food of high school teacher at Nonthaburi that impacted their behaviors.

### Hypothesis:

1. There are different patterns of the respondent to consume food for healthy if they are different genders.

2. There is a relationship between the pattern of the respondents to consume food for healthy and age
3. There are different patterns of the respondent to consume food for healthy if they have different marriage background.
4. Different educational backgrounds would have different patterns of having meals for healthy.
5. There are different patterns of the respondent to consume food for healthy if they have different salaries.
6. There are different patterns of the respondent to consume food for healthy if they have different personal sickness.
7. There is a relationship between the pattern of the respondents to consume food for healthy and understanding of healthy food.
8. There is a relationship between the pattern of respondents to consume food for healthy and attitude of healthy food consuming.

**Process:**

To study this research, survey became a process for collecting the data about the attitude and behavior of food consuming of high school teachers at Nonthaburi.

**Sampling:**

Samplings were 340 high school teachers at Nonthaburi province

**Data Collection:**

The instruments for studying this research was the set of questionnaire, and it would be divided by 4 parts:

**Part 1:** The question would focus on personal and the respondents' sanitations. Those questions were gender, age, marriageable background, education background, salary, and congenital diseases. Open-ended and check list were types of question on the questionnaire.

**Part 2:** The question would focus on understanding how to have food for health. The multiple choices became the type of the question on questionnaire.

**Part 3:** Attitude of consuming food for health would be measurement. In term of this part, likert scale type or asking agreement would be a question on questionnaire.

**Part 4:** The frequency of food consuming for healthy would be the data for collecting. The question would focus on how often the respondents would have food that concerns for health. Rating scale

would be type of question on this questionnaire.

#### **Data Collecting:**

The using data would be collected by the researcher, all of the data would be asked for the respondents to be corporate. One high school teacher would be asked per one school. The researcher would take one month for collecting data by starting on March 2 – March 31, 2009

#### **Data Analysis:**

After, finish collecting the data, coding and analysis the data by using computer would be the next process for getting information. The researcher called the statistic analysis. In term of amount, percentage, mean, standard deviation, T-test, F-test, and Pearson Correlation would be the statistic answer for analysis.

### **Result**

#### **Personal data:**

The majority of the respondents were female. The age group of the respondent was between 51 – 60 years old. Height group was between 151 – 160 centimeters. And the weight group was between 51 – 60 kilograms. The most respondents were marriages, and their education degrees were bachelor's degrees. The salary group was between 28,001 – 33,000 Baht. The level of personal sickness is low.

#### **Health food:**

Grouping the respondents about how they concerned about health food could be divided into three groups. The most respondents had knowledge about health food very well were in the first group, and the score was between 12 – 15 points. Second group of the respondents who knew about health food, but not very well, and the score was between 8 – 11 points. And the last group of the respondent who did not know well about the health food and the score was between 0 – 7 points.

#### **The attitude:**

The respondents had good attitudes about how they consumed health food. The first result presented that the respondents believed to receive 5 main nutrients and workout would make them healthy. The second belief was consuming fruit and vegetable helped for good excretory system and cancer stopping. Moreover, having brown rice, the respondent would have more benefit than having white rice. Finally, media were unable to influence on the respondents' decisions to choose or consume food.

## Consuming food for health:

The level of the behavior of respondents to have food for healthy was meddles. The result presented not to drink alcohol in the highest average level. The second was not to have salted food and drinking water 6 – 8 glasses per day was a good idea. Having soybean milk or milk was a lowest average level.

## The result of hypothesis:

**Hypothesis 1:** There are different patterns of the respondents to consume food for healthy within different gender. The result is gender has a relationship with the pattern of the respondents to consume food for healthy.

**Hypothesis 2:** There is a relationship between age and pattern of the respondents to consume food for healthy. The result is rejection; there is no relationship between age and pattern of the respondents to consumer food for healthy.

**Hypothesis 3:** There are different patterns of respondents to consume food for healthy within different marriage backgrounds. The result is rejection; there is no relationship between the pattern of respondents to consume food for healthy and marriage background.

**Hypothesis 4:** There are different patterns of respondents to consume food for healthy within different education backgrounds. The result is rejection; there is no relationship between the pattern of respondents to consume food for healthy and education background.

**Hypothesis 5:** There are different patterns of respondents to consume food for healthy within different salary earning. The result is rejection; there is no relationship between the pattern of respondents to consume food for healthy and salary earning.

**Hypothesis 6:** There are different patterns of respondents to consume food for healthy within different congenital diseases. The result is rejection; there is no relationship between the pattern of respondents to consume food for healthy and personal sickness.

**Hypothesis 7:** There are different patterns of respondents to consume food for healthy within different the understanding of how to have the healthy food. The result is acceptable; there is relationship between the pattern of respondents to consume food for healthy and the understanding of how to have healthy food.

**Hypothesis 8:** There are different patterns of respondents to consume food for healthy within different attitude of consuming food for healthy. The result is acceptable; there is a relationship for between the pattern of respondents to consume food for healthy and the attitude of consuming food healthy.

## Suggestion

According to study this research, attitude and behavior of food consuming for healthy for high school teachers at Nonthaburi, the researcher has few suggestions by:

### Suggestion for practicing

1. In term of result, the majority of the respondents were female. They had knowledge background and attitude about consuming food for healthy very good; on the other hands, their patterns of consuming food for healthy was on middle. Therefore, they did not concern much in choosing some food for their health. The most respondents believed in wrong direction that they did not need milk, but having coffee or tea instead. They should be educated by suggesting milk was giving more benefit in every gender and age, and they could have it everyday. In addition, educating them knew how to have food in the right way and food would be another suggestion form researcher.

2. The respondents should concern about food consuming because it would be easy to teach their students when they practiced good in having food. That meant they would be good example for their students. The respondents would encourage their students by educating them understood in food consuming for healthy, and their students would earn benefit in future.

3 .The research should be presented to the department that might concern. The objective was to educate the public how to consume food for healthy. That meant food consuming was very important. This would influence someone who was not interested had a second thought to concern about his or her healthy.

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## Traditional Knowledge Based Ecotourism in Bali

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### Abstract

The global tourism industry has been slow to respond to major environmental changes and critical conservation needs of the 21<sup>st</sup>. The Balinese industry is no exception. It is poorly equipped to deal with environmental change. But it is critical that it does so. The industry is dependent on a high quality and sustain environment. It is time for the industry to invest in skill and competencies to underpin sound environmental management.

As the famous tourist destination in the world, Bali tries to create traditional knowledge based ecotourism concerning with the government planning in 2009 about creative economic, because by these activities, ecological, cultural, and economic sustainable can be expected.

**Keywords:** traditional, knowledge, ecotourism and sustainable.

## I. Introduction

Tourism industry is one of “T” in global issues in the 3<sup>rd</sup> millennium. The other T are: Transportation, Telecommunication, and Technology. For Indonesia, especially Bali, the tourism industry is the only priority sectors which can compete in globalization. Because of the various unique Balinese culture are considered to be a famous tourist attraction in the world. Concerned with this condition Balinese government from the beginning introduces tourism as “Cultural Tourism” with the soul of Hindu Religion.

According to Gareth Shaw and Allan M. William (1997) in Ardika (2003) that in tourism activities there are ten (10) cultural elements which become tourist attractions those are:

1. Handicraft
2. Tradition
3. The history of a place
4. Architecture
5. Local/traditional food
6. Arts and music
7. The way of life of the society
8. Religion
9. language
10. Local/traditional costume

These cultural elements seem very relevant with the type of tourism which is developed in Bali that is cultural tourism. Moreover, Bali is one of a prominent tourist destination in the world. The main reason of tourist to choose Bali as a destination is because of cultural uniqueness (>67%) (Dalem, 2001). Among the important factors in defining tourism sustainable in Bali, other than culture is everlasting environment.

## II. Environment and Tourism in Bali

### A. Environment in traditional knowledge view point

Balinese thinks of the environment as “*manic ring cacupu*”(fetus in a womb). Any damages to fetal environment, will expose fetus to die. Therefore, if not willing to cause the

succeeding generation to live in a seriously deteriorated environment, it is obligatory for us to preserve environment (Dalem, undated).

Good environment management in Baali applies the philosophy of *Tri Hita Karana* that refers to a harmonious relationship to pursue happiness and welfare of man with God (*Parahyangan*), with fellow being (*Pawongan*) and with his environment (*Palemahan*).

The success of *Parahyangan* relationship is observable from the man's will to observe God's teaching with increasingly sincere devotion, not from extravagant religious ceremonies that can not prevent man from sinfulness.

In a *Pawongan* relationship man is suppose to cultivate humanity and positive values in interacting with his fellow, such as: *Tat Twam Asi* (you are me), *Bhineka Tunggal Ika* (Unity in Diversity) and *Desa, Kala Patra* (to act in accordance with time place, and circumstance).

In *Palemahan* relationship are reflected in spatial use that highlights the concept of *ri Mandala* (Upper, middle, and lower zone). Beside that in this relationship we also appreciate our environment by giving ceremonies such as:

*Tumpek Kandang* (ceremony for the creatures/animals)

*Tumpek Uduh* (ceremony for plants)

*Tumpek Landep* (ceremony for every human working instruments which the materials mde of iron, include today's sophisticated technology instrument such as: car, motorbike, computer, laptop, refrigerator, TV, etc

Balinese attention to the environment also can be seen from some experts' opinions, there are:

1. Gregor Krauss (1988: 15) said that Balinese people "*reverence in the face of surrounding nature*"

2. Covarobias (1936:13) said that Bali is the only one tribe who is so harmony replace themselves in environment, and no other race gives the impression of living on such close touch with nature, creates such as feeling of harmony between the people and its surrounding. He continued that Balinese people "*regulate every act of their lives so that it shall be in harmony with the natural forces*"(1936:260)

3. DeZoete & Walter Spies (1973:2) who had come to Bali since 1927 and become pioneer of Balinese arts, also said that *“the Balinese is so perfectly in harmony with his surroundings* (Pitana 1999:67).

## **B. Environment and tourism**

Operationally, Bali tourism development tend to 6 cases which are disharmony with the concept, there are:

1. The limitation of resources
2. The environment pressure
3. The unbalance economic
4. Cultural disturbance
5. The weakness of management
6. Weakness in financial,(the result of BTB questioner in 1999).

The environment pressure in Bali is in serious condition, because Bali is a small island with wide approximately 560,000 ha and a high land conservation development, so the existence of opened land and rice fields tend to more and more narrow. These conditions will reduce/lose the tourism attraction which is source from natural scenery such as terrace rice field, hill natural views, and the flora and fauna attraction. The boundaries of village called “bengang” (green belt) also eroded.

The prospect of Balinese tourism in future is depend on the ability of Bali to protect the uniqueness of the attraction beside the safety and comfortable condition.

## **III. Issues in Future**

In future environment issues are more and more important concerned with the desire of community with healthy and everlasting environment. Since the advancement of science and technologies begun, more people realize that the World can be this small. We can realize that any activities in one place can cause impacts in other part of this earth, from economical, social up to environmental issues.

The global environment crisis is also caused by tourism activities. Nonetheless, tourism also will be disturbance if the global environment damage and carrying capacity collapsed. Nowadays, it is clear that how and where we should develop the tourism. Tourism is not only for economic benefit, but it also keeps ecosystem and to rich the life and fertilizes human life qualities.

One form of tourism which has gained much attention in recent years is **ecotourism**, the sub-component of alternative tourism. Although there are several definitions of this term, there is general agreement that in ecotourism the physical environment is the focus of the touristic activity.

The common issues seen by tourism society in Bali which are care about environment in future are: autonomy in Indonesia, globalization, and free trade. By regency autonomy, it gives the more chances to the regencies in managing buildings, and it is expected to minimize conflicts among the regencies, because in ecotourism implementation we should refer to Korten's opinion (1986:5 in Pitana:1999) in community based management that are:

**Local variety** means, local life variety or different life need a different management system, it can not be given a similar treatment and the local community knows a lot about the local condition.

**Local Resources** means traditional resources belong to the local community and need local management because they have the nearest moral relationship with the resources.

**Local Accountability** means, local management is usually more accountable because their direct activities will influence their life directly.

Moreover, viewed as a form of alternative tourism, the emphasis of ecotourism development should be on small-scale, locally owned activities (Weaver 1991, in Cater 1997). This has three important repercussions for beleaguered third world economies.

**Firstly** the facilities in terms of infrastructure and superstructure are simpler and less expensive than those demanded by conventional mass tourism.

**Secondly**, locally owned and operate businesses are not enmeshed in the need to conform to the operate Western identity of the multinational tourism concerns, and, therefore, can have a much higher input of local products, materials and labor. This not only has greater multiplier effects throughout the local economy, but also reduces import leakages and remittances from expatriate labor which result from large-scale, foreign-owned, operations.

**Thirdly**, the profits made should accrue locally instead of following back to the parent country. In the capital-scare situation of most Third World countries, this is a particularly attractive prospect (Cater 1997).

Concerning the 10 cultural element which become tourists' attraction, so the suitable ecotourism develop in Bali is *Traditional Knowledge Base Ecotourism* (is under the communal system of common proprietary and common use with the perpetual desire to always be that way) (Greeners, 2007:35).

Even though it is a "new concept" in Bali, some expectations can be relied upon these activities because of the following reason:

*1. It creates jobs and applicable in economic crisis situation*

Based on ecotourism concept, the activities should involve and supported by local community (Anonymous, 1997, Sunarta, 1998 in Dalem, 2002), at least the people around the ecotourism destination. Besides that, some of these activities do not require high capital because use local materials, local labors with their traditional knowledge, and small-scale local management.

*2. It benefits the local community*

Another important issue related to ecotourism is economical aspects enjoyed by the local community around the ecotourism destination area (Sudarto, 1998, in Dalem, 1998). There has been commonly believe that many people around "mass tourism developed areas" especially in Bali, are only marginally benefited out of the projects (Anonymous, undated). In ecotourism concept, public involvement in the projects is important. Beside that it should bring benefits to local communities (Anonymous, 1997).

In Monkey Forest, Padangtegal, Ubud, the management efforts to return the benefits of the tourism object to the local community by some activities such as: give contribution to the every pass away community, contribution to the village building, give loan with soft interest, etc. (Harmini,2005).

*3. It is a tool for the nature conservation*

Ecotourism projects should follow the environmental and tourism rules or law so that the people use the resources in a sustainable way (Anonymous, 1997). Beside that `education value` leading to

appreciate nature to promotes conservation (Ceballos-Lascurain, 1993) is also very important in ecotourism.

#### 4. *It conserves cultural diversity and minimize conflicts*

One of the ecotourism principal is that it should not damage the cultural and religious values of the people in ecotourism areas (Wiana,1999). The ecotourism projects should be based on local social cultural background and should not contradict the local people`s culture (Anonymous, 1997; Kleden, 1996 in Dalem 1998). As a result, conflict could be minimized, and cultural diversity can be maintained.

All visitors when watching white egrets at Petulu Village, Ubud-Bali, for example, “should” be given an explanation not only the ecology of the egret but also what the local believes of the creatures so that the visitors also being expected not to disturb the animals (Boemer, 1992 in Dalem, 1998).

The local community may make a special ceremony such as *Tumpek Kandang* and *Tumpek Uduh* (Sudibya, 1998) to respect animal and the plants in their surroundings. Visitors and outsider should respect the local attitudes and the local way of treating their environments. By traditional knowledge based ecotourism, ecological, economical, and cultural sustainable can be perpetually made.

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# Poster Presentation

# The Study of Nutrition Knowledge, Consumption Behavior, and Nutritional Status of Kluaynamthai Bangkok Personnel

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## Abstract

This research aimed to study the qualification of Kluaynamthai Hospital's (KLH) personnel in three aspects; nutrition knowledge, consuming behavior, and nutritional status. The research also studied on the relationship of the three aspects. The Stratified Random Sample method was used. Questionnaires and the 2008 annual check up information were used to gather the data from 236 samples. The data were analyzed by using frequency, percentile, mean, and standard deviation. The analysis of test score was done by a statistical method (Chi-square) with a 0.01-0.05 significant level. The study revealed that 65.68 % of Kluaynamthai Hospital's personnel had excellent nutrition knowledge and 26.69 %, 6.78%, 0.42% and 0.42% had nutrition knowledge at good, average, meet criteria and under criteria, respectively. The average of 2.91 of the group had good consuming behavior, and the frequency of good consuming behavior at 2.69 or 91.95 % of the group's consuming behavior was less affected by mass media. 49.58% of the group had normal nutrition status while 35.59% and 14.58 % had over nutrition and below nutritional status respectively. The study of the relationship between the nutrition knowledge and the consuming behavior revealed that there was the significant relationship between the two variables at significant level of 0.05.

**Key words** : Nutrition Status, Consumption, Behavior Nutritional status, Personnel

## Introduction

Because of an economic, political, cultural, social had been changing, technology, and data and information, the people in urban society today must take their efforts to adapt and change their ways and life style for better situation. Each family does not much time and to concentrate their health, including bad behavior of consumption such as; eaten junk foods, lack of 5 nutrient foods balance consumption, consume over or less than health needs, and bad habit to eat a meal . They cause an illness such as gastric disease, malnutrition disease, obesity disease, diabetes, hypertension, etc.

Nutritional knowledge and food consumption of personnel is very important because impacts on food-related behavior and human consumption conditions. Specially, an over- consumption problem and chronic diseases are the crucial issues of mental illness and early-dead. The nutritional problem is occurred because people lack of valid information which deliver to inappropriate behavior of consumers.

People in working age, should focus on food consumption together with an exercise in regularly. It's impact good healthy without sickness and disease and work effectively as well. Working age people is a group that tries to build their families. They should focus on food consumption in the right figure proportions and avoid to impact on overweight, obesity and malnutrition.

Good nutrition makes the human minds stronger, emotional platform maturity, fresh & bright, vigor, enthusiastic and defend against discourage. Specially, they are able to adapt themselves to society and/or the environment easily. A rapid growth of their EQ is quickly than the person who takes the poor nutrition and it's impact with their work effectively

Hospitals are institutions that provide patient care under the plan of medical care direction. In the hospital will include personnel with specific knowledge in many areas. To provide services to patients correctly. The staff in hospital should be a good health Knowledge of nutrition & nutritional conditions. With the reason, these people are became the important source to transfer knowledge to those who have been treated directly. Result in a treated healthy.

The research personnel of a private hospital. They are interested to make a research the Kluay Nam Thai Bangkok Hospital. A total of 600 employees who work regularly in the working age between 22-60 years old, divided into 4 working groups area of Department of medicine, Nursing of medical support, Department personnel offices, Location of care and safety. In overall of health after provided annually physical examination of employees year 2551, the statistic have shown that the good nutrition, health status 51.25%, 23.75% fat in the blood, high nutritional condition than in the blood

sugar condition 13.75% , 11.25% higher in respectively.

A research who is an employee of Kluay Nam Thai Hospital. He expected to all employee have a good health and have a knowledge of food consumption with appropriately. He pay attention to study and educate the nutrition foods knowledge, including personal foods consumption behavior and define the guideline for promote good nutritional conditions and prevention for their good health.

Objectives of this research are :

(1) To study the knowledge of nutrition of people Kluaynamthai Hospital .

(2) To study the behavior of food consumption Kluaynamthai Hospital .

(3) To study the state of nutrition of bookmarks similar Kluaynamthai Hospital.

(4) To study the relationship between knowledge of nutrition. Food consumption behavior and nutritional conditions of hospital personnel of Kluaynamthai Hospital.

## Research Method

### 2.1 Tools Used

Questionnaire is a tool that provided for researching about nutrition in food consumption behavior, which affects the nutritional status of hospital personnel. It's sponsored by the research studies textbooks and related research. The researchers divide the questionnaire into two (2) areas.

**Part 1** Survey data are as gender, age, religion, status, basic education all of the family income per month. Characteristics questionnaire as a check list (Check list).

**Part 2** There are 30 questions in the questionnaire asking about nutrition knowledge. They are divided into two sections.

Section 1: knowledge about buying/ 15

Section 2: knowledge about food consumption and nutrition/ 15 questions

**Part 3** Survey of consumer behavior/a total of 35 food questions are divided into 3 sections

Section: 1 consumer habits questionnaire/ 12 questions

Section; 2 questionnaire about food consumption frequency/ 13 questions

Characteristics of questionnaire at parts 1 and 2 have a value rating scale (Rating scales) is in 4 level of frequency practices, Often ,Do rarely and Never do. Parts 3, the questionnaire is asking about media influences on food consumption behavior. Ten questions are yes/no questions.

### 2.1.1 Tools Creation

1) Document research and education related to nutritional conditions. Behavior, food consumption and factors related to personnel in private hospitals.

2) Learn how to create guidelines and questionnaire from the book and various documents.

3) Take the data to establish a conceptual framework covered content research.

4) To create a query in nutrition knowledge and food consumption behaviors. The covers meet the objectives.

5) To propose the idea questionnaire for being reviewed and approved by an advisory board.

6) The questionnaire is reviewed by the Advisory Board. The accuracy of content is approved by three experts (Content Validity) (Siri Virgo, 2549).

### 2.1.2 The Confidence Scale.

A revised questionnaire is completed by personnel of Kluaynamthai Hospital. Branch of Kluaynamthai Hospital have 2 branches and Kluaynamthai clinics have 11 clinics. Manner similar to the sample 30 peoples to analyze the results obtained find Confidence of The questionnaire by Alpha Coefficient of Conbach.

## 2.2 Approach

This research is a survey research study. (Survey research) This is intended to study the knowledge of nutrition food consumption behavior and nutritional conditions personnel of Kluaynamthai Hospital.

Research conducted by, respectively:

1.1 Population

1.2 Representative sample

Data collection

Data analysis

### 2.2.2 Population and Sampling

#### Population

Population used in this study is 600 personnel of Kluaynamthai Hospital.

## Sample

Population used in this study is hospital personnel Kluaynamthai Hospital in working age between 22-60 years. They are splited into 4 working groups as Department of Medicine and Nursing, Medical Support, Department Personnel Offices, and Place of care and safety. Amount 236 people from Stratified Random sample.

1. Determine the size of the sample is representative of the population. Use the table of Krejcie and Morgan (politely, 2550: Referral from Krejcie and Morgan.1997).

2. Share Kluaynamthai Hospital by employees of the hospital operations and calculate the number of samples in each group ,The proportion of the population size in each ratio uses the following formula (a Chidchanok, 2548).

$$\text{Number of samples in each group} = \frac{\text{Sample size} \times \text{Population in all parties}}{\text{Total population}} \quad (1)$$

### Calculation the Sample

1) Department of Medicine and Nursing employs a total of 280 people which present the number of sample 2.110 people.

2) Medical Support employs a total of 156 people which represent a total of samples 4.61 people.

3) Department Personnel Offices employs a total of 122 people which represent a total of samples 4.48 people.

4) Place of Care and Safety employs a total of 42 people which represent a total of samples 9.17 peoples.

3. To select people from each sample by simple random sample by the lot number of the sample, as shown Table 1

**Table 1** Number of people and a population sample of work by the standard of Kluaynamthai Hospital

Group	Population (people)	Sample
Department of Medicine and Nursing	280	110
medical support	156	61
Department personnel offices	122	48
Place of care and safety	42	17
<b>Total</b>	<b>600</b>	<b>236</b>

### 2.3 Data collection

1. Do the research approval letter from Chairman Kluaynamthai Hospital.
2. Coordinate with HR staff. Ask them to distribute the list of test samples and random details and explain how to understand people with data collection.
3. The research is surveyed by observing people's behavior while in the hospital itself to collect the data of the research.
4. Verify and complete data to analyze in the next step.

### 2.4 Data Analysis

In this study, the study has set the process data as

1. Data collected from the respondents. Spatial analysis uses descriptive statistics. Statistics to evaluate include: Frequency, Percentage, and mean.
2. Analyze of test knowledge of nutrition and food consumption behaviors to find mean, Percentage, and Standard deviation values.
3. Assessment of nutritional status personnel assessed by using weight (Kg) and height (cm), then evaluate the body mass index (BMI) data from health examination of Kluaynamthai Hospital.
4. Analyze the relationship between knowledge of nutrition and food consumption behavior, nutrition conditions of personnel Kuay Num Thai hospital using statistical Chi-square.

## The Results of Data Analysis

### 1. To study the knowledge of nutrition of personnel of Kluaynamthai Hospital

Personnel of Kluaynamthai Hospital personnel knowledge on nutrition is very positive, representing 65.68 percent . Subordinate in a good medium, through minimum criteria, and lower than standard is 26.69%, 6.78%, 0.42 %and 0.42%, respectively. The analysis is summarized at 2.

#### Part 1 knowledge about buying food

Personnel of Kluaynamthai Hospital have most of the nutrition knowledge about buying food in a very good level. Secondary 79.66% Subordinate in the medium, good, through the minimum criteria, and Criteria below is 11.44%, 7.20%, 0.85% and 0.85%, respectively.

#### Part 2 knowledge about food consumption and nutrition

Personnel of Kluaynamthai Hospital have most of the nutrition knowledge about Consumptive food and nutrition in a very good level at 72.46% Subordinate levels , Median , Through the minimum criteria , and Criteria below is 13.56, 12.29, 1.27 and 0.42 respectively.

### 2. To study the behavior of people consuming food of personnel of Kluaynamthai Hospital

Information about food consumption behaviors Summary results of the analysis is at 3

#### Part 1 Consumer habits

The behavior of consumers about food consumption habits in the overall levels is equal to the average 2.91. It found that the behavior of a class action, include The rinse before eating is equal to the average 3.43, including the subordinate eating half-cooked, Food waste is more like fruit, vegetables, drinking water 6-8 glasses per day, Helping end eating 3 day cold morning, drink 1 bottle of sparkling water a day, eating all those full 5 days, eating of sweet / salty arrange / organize it. In the food and punctually. Is equal to the average 3.40, 3.34, 3.18, 3.14, 2.99, 2.84, 2.82 and 2.70, respectively.

The behavior of a class action, including a pretty day drinking milk box 1 or box 2 is equal to the average 2.47, including any subordinate eating dinner over helping others. In the food-like repeated. It is equal to the average 2.36 and 2.25, respectively.

#### Part 2 Frequency of food consumption

Practices associated with food consumption behavior in the frequency of food consumption in overall levels is equal to 2.69, based on the average in each type of food found at a food frequency behavior in food consumption levels are good foods and vegetables. It is equal to the



average 2.92. Subordinate foods include sweets foods, Meat foods, and food starch is equal to the average 2.84, 2.82 and 2.63, respectively.

The type of food on a behavior, food consumption levels are pretty include Canned foods is equal to the average 2.46 , subordinate the fried foods is equal to the average 2.43 .

**Part 3** from the media to influence food consumption behavior

Most of Personnel of Kluaynamthai Hospital food consumption behavior were influenced by media. In low levels representing 91.95 percent, subordinate influence food consumption behavior in a fairly, Much, Medium, and Most is 4.66%, 1.69%, 1.27% and 0.42%, respectively.

**3. To study the nutritional status of personnel of Kluaynamthai Hospital Bangkok hospital.**

Personnel of Kluaynamthai Hospital are the largest normal nutritional conditions, representing 49.58 percent. Secondary to nutritional conditions has exceeded the standard, And substandard Representing 35.59% and 14.83% respectively.

**4. To study the relationship between knowledge of nutrition. Food consumption behavior and Nutritional conditions of personnel of Kuay Num Thai Bangkok hospital.**

**Hypotheses 1** in knowledge about nutrition, food buying People's Kluaynamthai Hospital did not find relationship with nutritional conditions.

**Hypotheses 2** knowledge about nutrition in food consumption and nutrition People's Kluaynamthai Hospital did not find relationship with nutritional conditions.

**Hypotheses 3** Behavior of consumers about food consumption habits of people Kluaynamthai Hospital had found that relationships with nutritional conditions. A statistically significant level at 0.05 .

**Hypotheses 4** Behavior regarding food consumption frequency of food consumption in humans Kuay Num Thai Bangkok Hospital not found relationship with nutritional conditions.

**Hypotheses 5** Food consumption behavior of media influence on the behavior of food consumption of bookmarks similar Kuay Num Thai Bangkok Hospital did not find relationship with nutritional conditions.

**Discussion of the research**

This research intends to study the current state of knowledge about nutrition and food consumption behavior. And nutritional conditions of hospital personnel Kluaynamthai Hospital based on the research found.

## 1. The Basis of Data Samples.

Selected sample of hospital personnel Kluaynamthai Hospital . The share of the work 4. Department of Medicine, and is nursing Employing a total of 280 people, medical support, employs a total of 156 people, office personnel employs a total of 122 people, places and maintain a total of 42 people including security personnel. All of 600 people selected sample total number of 236 people is likely to be a sample that covers the distribution of sufficient data in the study.

## 2. Knowledge about How to Buy Food and Knowledge about Food Consumption and Nutrition

### 2.1 Knowledge about buying food.

Hospital Shopping considering economics as a basis to 47.03 percent, which is an incorrect understanding. Due to economic conditions have changed many people now turn to consideration of a major expense. Forget to consider the value of nutrition that the body should be and quantity of food sufficient for the needs of the body (Thep, 2550), buying food ready cooked stored in normal room temperature. Nearly 55.08 percent of the time people understand the issue of food-storage errors. Think that food can be stored and cooked at normal room temperature. The main food sanitation are sold in the shopping malls. Must be available in the chilled cabinet temperatures below 7 degrees Celsius thermometer notice from the chilled cabinet noted the mall that day month, production on the label. Should buy the new product. Do not buy food to cook with because it produces more than 3 days may be a rotten easy, however when buying food and cooking to prepare the assembly should immediately because cooking food component through various processes. ago to reduce putrid and increase the number of pathogens. (Department of Food Sanitation Division Ministry of Public, in 2548, buying cooked food from restaurants that have successfully prepare table 60 cm high from the ground up from the study found. Personnel have knowledge of food sanitation standards or requirements for food restaurant Representing 69.92% of all the people. The Food Sanitation for the main restaurant outside tables outside to prepare - to prepare a high from the floor at least 60 cm table is made of materials with smooth surface. Easy to clean, such as Stan-Four mega etc. (Food Sanitation Division, Department of Water and Health, 2550).

### 2.2 Knowledge about food consumption.

This research shows that The majority of hospital employees Kluaynamthai Hospital personnel's knowledge about food consumption levels very well. Representing 72.46 per cent and secondary level is down. Representing 13.56 per cent and by the knowledge of nutrition to consumers

about food and nutrition is more of a question will see that With any questions. Bleeding as a mark left by the teeth showing symptoms of the disease lack of vitamin C. All the answers were 229 people, representing 97.03 per cent is the highest level of education and knowledge in food consumption. At the same time, the question is who is the least understood. That is the question. Sausage and a fat dressing. Is a question in the negative. It is sausage and salad dressing are not very many fat volumes to understand this in a number of 78 people representing 33.05 per cent, much less considered because most people are understanding that this is incorrect. Volume 5-inch chicken sausage with an energy of 115 kilo calory dressing 1 tablespoon water to condense energy 100 kilocalorie (Ministry of Public Health Division, Department of Nutrition, 2532).

### 3. Food Consumption Behavior.

#### 3.1 Consumer behavior in food consumption habits.

Good food is helping all 3 eating all those 5 drinking water clean enough. Eating foods and vegetables. Is consistent with the research (Pornrimol, 2544), but have found some of the consumption habits of the class is pretty drink per day or 1 box 2 boxes of milk because the protein is an important mineral calcium. phosphorus and vitamins. Especially vitamin B 2 milk helps bones and teeth healthy. Slow decay of the bones. And cause tissue. Act normal elderly adults should drink 1-2 glasses milk per day. milk of cow are nutritious. Is necessary and important nutrients essential to health. Fresh milk is the best fresh milk does not taste sweet to taste, reduce obesity and dental caries risk (Anuthin, 2549) and eating dinner over helping others. Most people focus on eating dinner over helping others. Due to the potion morning rush to work and not eating. Or lunch time is not full of food. Result is to make dinner feel hungry faster or more hungry. Combined with the urgency of not eating. Time to eat in a somewhat Family dining with a friend sent it to eat dinner and other than helping the body use. The food is correct. Is eating breakfast every day. Amount of energy to distribute food to fit the needs of the body. Also helps the body. Not hungry in the afternoon and evening. And helps to control eating dinner less Eat enough to fill each potion. Consumers and not be too much. Natural food timber Should select natural food timber And should eat dinner from time to sleep at least 4 hours (Suthep, 2550) to eat like a replay. Most consumers tend to prefer dining repeated due primarily focused favor forget to think. Value of nutrition that the body should be. This is how very wrong. Principles of food is correct. 5 foods to eat all those volumes of each of those should be in moderation and eat a variety of selection. To receive nutrients. Complete as a body will want to eat. Conditions have resulted good nutrition (Doungporn, 2546).

### 3.2 Frequency of Food Consumption.

Research found that the frequency of food consumption overall. Levels. 2.69 is considered equal to the average behavior of food consumption. Is eating a variety of food which does not overlap too much with the information that consumers have a tendency to eat like a pretty level when repeated on the classification issue is the consumer, will have some of that score. For example, type in a so-so seafood. Foods other than rice flour. Fried foods. R for type finish. And drink coffee category. Research reflects that hospital personnel Eating foods that average at least 2 - 4 times per week. If a future eating disorder is continued or increased may affect the risk of obesity prevalence. Fat in the blood. High blood pressure. Vascular diseases and diabetes. Consistent with the research (Boonta, 2543) If you continue to keep exercising regularly. Control and modify behavior with food consumption to fit the needs of the body. Or with the appropriate activity in each day. Can reduce the risk of disease is different (Office of Health and Social Security Administration Mahidol University, 2552).

### 3.3 The influence of media on behavior, food consumption,

Research found that Influenced by media affect food consumption behavior with hospital personnel. Kluaynamthai Hospital in a 91.95% less when the classification is the study of a sample found on the beliefs of nutrients that enter the products that benefit the body. And hearing the announcement of the price if the price is not expensive to meet the needs will choose to purchase it so influenced by the media affect food consumption behavior is less risk to the health nutrition Kluaynamthai Hospital . Bangkok 4th nutrition conditions. Personnel in Kluaynamthai Hospital of a total of 600 people who regularly work in ages. Working age group between 22-60 years to work out a division of the Department of 4 nurses and doctors. Support Medical Department personnel offices. And location of care and safety. Look at the overall health of people find that nutritional conditions are 49.58% normal nutritional conditions than standard nutritional conditions and substandard Representing 35.59% and 14.83 respectively.

The research found the practice of nutrition knowledge. In buying food and knowledge about nutrition and food consumption do not correlate with nutritional conditions. However, a remark that Who have knowledge in the minimum criteria of 100% will result in people with normal nutritional conditions. And 50% over standard 50% knowledge 100% of average people has resulted in substandard conditions. 12.50% have normal nutritional conditions. 37.50% more than standard nutritional conditions. 50% knowledge level from 100% resulted in people with substandard conditions. 22.22% have normal nutritional conditions. 41.27% more than standard nutritional conditions. 36.51%

very good level of knowledge resulting from 100% to people with substandard conditions. 12.26% have normal nutritional conditions. 54.19% more than standard nutritional conditions. Representing 33.55 per cent.

Therefore, the overall analysis found that the practice known as indirect boost the nutritional status is If people have knowledge, through medium and low criteria will have problems in nutritional conditions than people with good knowledge. Knowledge but do not correlate directly to alleviate the problem of nutritional conditions.

Of food consumption behavior study of hospital personnel Kluaynamthai. Bangkok has a relationship with a state nutrition. Found that the behavior of consumers about food consumption habits of people Kluaynamthai is associated with nutritional conditions. With statistical significance at the .05 because of the consumption habits. Likely to be conversant in the food and cause a consumption habits. And make the choice of dining category. Initiate behavior as well as food consumption. This is consistent with studies (Charoen-Sri: in 2548, กัลยา: 2541, Somsri: 2531, Kamala: 2531, to Malin: 2537) is the consumption habits are important factors that will affect the nutritional health of hospital personnel Kluaynamthai . Bangkok Meet the benchmarks set (Department of Health, 2546).

Based on the research relationships between food consumption behaviors associated with the frequency of food consumption in humans Kluaynamthai hospital Found that people with the frequency of food consumption by 100% is pretty substandard nutritional conditions. 20.41% normal nutritional conditions. 46.94% 32.65 outsized and nutrition conditions of the people on the consumption level of good health is 100 percent lower than the standard diet. 13.37% normal nutritional conditions. Representing 50.27% and 36.36 so outsized nutritional conditions of the relationship between food consumption behaviors associated with the frequency of food consumption in humans Kluaynamtai hospital. Bangkok The relationship of nutrition, health nutrition personnel conditions. In addition to depending on food consumption behavior. Also depends on exercise. And other factors such as genetics and devour nutrients in the body.

Research on food consumption behavior from the media to influence food consumption behavior of hospital personnel Kluaynamthai has a relationship with a state nutrition. The analysis found. The influence of media on behavior, food consumption level of 100% less nutrition conditions are substandard. 15.67% normal nutritional conditions. 49.31% 35.02 outsized and nutrition conditions of the influence of media on behavior, food consumption levels from 100% moderately substandard nutritional conditions. 5.26% normal nutritional conditions. Representing 52.63% and 42.11 so outsized

nutritional conditions of the relationship between food consumption behaviors associated with the media to influence food consumption behavior of hospital personnel Kluaynamthai has no relationship with nutritional status of people.

However in this research. Get to know the knowledge of nutrition. Behavior, food consumption and nutritional status of hospital personnel that a sufficient knowledge of nutrition? The food consumption behavior? Used as a way to encourage people with appropriate consumer behavior. And control conditions such as poor nutrition, the nutritional conditions in excess of Conditions, high blood sugar. High cholesterol in the blood. 5 Suggestions 1 should be studied factors and personal factors, behavior and practices in private hospitals. As is Changing the way the lives and lifestyles different from the past. To provide information to the format of nutrition education is consistent with the factors that affect food consumption behavior. 2 should make a comparative study of nutritional knowledge. Food consumption behavior. Between nutrition and health. Government hospitals and private hospitals in the same area. That is different? And any factors that correlate?

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## Nutritional Quality of Fish Mixed with Algae Tofu

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### ***Abstract***

Fish mixed with algae tofu (FAT) was developed to increase the nutrition and to valuate the tufu. FAT was an alternative for healthy consumers. It was prepared from soybean (500 g), mackerel (75 g), algae (25 g), egg albumin powder (7.5g), potato starch ( 5 g),  $MgSO_4$  (25 g), salt (7.5 g), pepper (2.5 g), sugar (5 g), and water (2,500 g). Then they were fried at 150 °C for 1 min. The chemical quality of FAT had moisture, carbohydrate, protein, fat, ash, fiber and calcium were 75.37%, 6.06%, 15.46%, 1.42%, 1.61%, 1.99%, and 1.56 mg/100 g., respectively. The microbial counts were less than 10 CFU/g



## Equipment and methods

### Equipment

#### 1. Materials in production

##### *1.1 Raw material in production*

1.1.1 Soy bean (type Chiang Mai 60)

1.1.2 Fish (Japanese Threadfin Bream, Purple-Spotted Big eye, Mackerel)

1.1.3 Algae (Porphyra)

1.1.4 Soy bean oil

1.1.5.Salt

1.1.6 Pepper

1.1.7 Sugar

1.1.8 Potato starch

1.1.9.Egg albumin powder

##### 1.2 Chemical

1.2.1 Magnesium sulfate

##### 1.3 Equipment in production

1.3.1 Manufacturing soy milk

1.3.2 Centrifuge

1.3.3 Mixer

1.3.4 Electric deep fryer

1.3.5 Vacuum packaging Machine

1.3.6 Wood type for a tofu

1.3.7 Some whites

1.3.8 Bag vacuum

#### 2. The quality analysis equipment

##### 2.1 Quality equipment in the chemical analysis

2.1.1 Hot air oven

2.1.2 Desecrator cabinet

2.1.3 Kjeidahl protein and nitrogen determination

2.1.4 Rapid distillations for NH<sub>3</sub>, Alcohol, SO<sub>2</sub>, Phenol and Cyanide

2.1.5 Soxhlet fat determination Rapid and traditional

2.1.6 Furnance

2.2.The microbial quality analysis tools.

2.2.1 Autoclave

2.2.2 Incubator

2.2.3 Petrifilm Aerobic Count Plate and Petrifilm Yeast and Mold

2.2.4 Tube Mixer

### Methods

Fish mixed with algae tofu (FAT) was prepared from previous directions. Fried and not fried FAT were analyzed by chemical and microbiological quality. The chemical and microbiological quality of commercial tofu (Plain tofu and Fish tofu in market) was compared with FAT.



Fig. 1. Fish mixed Algae Tofu ( left is raw and right is fried)

## Results and Discussion

Table of Fish mixed with algae tofu, Chemical quality and Microorganisms quality.

Factor of product quality	Plain tofu	Fish tofu in market	Fish mixed with algae tofu	
			Raw	Fried
Chemical quality				
Moisture	70.9 <sup>(3)</sup>	76.32 <sup>(1)</sup>	75.37 <sup>(1)</sup>	60.00 <sup>(1)</sup>
Carbohydrate	6.0 <sup>(3)</sup>	6.68 <sup>(1)</sup>	6.06 <sup>(1)</sup>	15.46 <sup>(1)</sup>
Protein	12.5 <sup>(3)</sup>	13.08 <sup>(1)</sup>	13.55 <sup>(1)</sup>	17.98 <sup>(1)</sup>
Fat	8.1 <sup>(3)</sup>	0.15 <sup>(1)</sup>	1.42 <sup>(1)</sup>	2.24 <sup>(1)</sup>
Ash	— <sup>(3)</sup>	1.69 <sup>(1)</sup>	1.61 <sup>(1)</sup>	2.53 <sup>(1)</sup>
Crude fiber	— <sup>(3)</sup>	2.08 <sup>(1)</sup>	1.99 <sup>(1)</sup>	1.79 <sup>(1)</sup>
Calcium	1.88 <sup>(3)</sup>	0.97 <sup>(1)</sup>	1.56 <sup>(1)</sup>	1.38 <sup>(1)</sup>
Microorganisms quality				
Total plate count (CFU/g)		<10 <sup>(2)</sup>	<10 <sup>(1)</sup>	<10 <sup>(1)</sup>
Yeast and mold (CFU/g)		<10 <sup>(2)</sup>	<10 <sup>(1)</sup>	<10 <sup>(1)</sup>
E.coli		— <sup>(1)</sup>	— <sup>(1)</sup>	— <sup>(1)</sup>

Source: <sup>(1)</sup> Analyzed for Physical, Nutritional and Microorganisms

<sup>(2)</sup> Nutrition label of Fish mixed tofu in market

<sup>(3)</sup> Nutritional quality table. (1987)

From this experiment, the moisture and fibers of FAT (fried and not fried) were reduced. The increased concentration of albumin powder (egg white powder or dried egg white), potato starch, and other ingredient were affected to the quantity of carbohydrate, protein, fat, and ash (Table 1). The sensory test of the commercial tofu and FAT showed difference. The commercial tofu had texture, elasticity, smoothy, tasty, and fish smelly more than FAT. The sweetly and nutty of FAT were less than the commercial tofu. Therefore, FAT was the suitable product for the healthy consumers.

The total microbial counts of FAT was less than  $5 \times 10^4$  CFU/g. Standards of industry of soft tofu and Soy Bean Paste were recommend. The total microbial counts were not more than  $5 \times 10^4$  and

$1 \times 10^2$  CFU/g, respectively. Thus, FAT was a safety product which was developed as an alternative for healthy consumers.

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**Keywords:** tofu, fish and algae

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# Knowledge, Awareness and Practice about Food and Nutrition of Adolescence in Muang District, Prachinburi Province

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## Abstract

The research aimed to: 1. study and compare food and nutrition knowledge of adolescence by looking at gender and level of education. 2. study and compare the awareness of food and nutrition by comparing gender and level of education. 3. study and compare the practice of food and nutrition by comparing gender and level of education. 4. study the relationship between knowledge, awareness, and practice of food and nutrition of the adolescence in Muang District, Prachinburi Province. Tests and questionnaires were used to gather the data from 346 samples. The Stratified Random Sampling was used. The data were analyzed by using percentile, mean, standard deviation, t-test, one way analysis of variance and Pearson's Product Moment correlation at 0.01 - 0.05 significant level. The study found that

1. 71.4% of the samples were female and 41.0% of the samples were high school graduates.

2. The sampling adolescence had good knowledge of food and nutrition. Different gender had significantly different level of food and nutrition knowledge at 0.01 while different level of study had no different level of food and nutrition knowledge.

3. The sampling adolescence had food and nutrition awareness at high level. Different gender had significantly different level of food and nutrition awareness at 0.01 while different level of study had no different level of food and nutrition awareness.

4. The sample group had good food and nutrition practice at moderate level, with no difference between gender and level of study.

5. There was a positive relationship between food and nutrition knowledge, awareness, and practice of the adolescence at 0.05. The relationship between knowledge and awareness was moderate and the relationship between knowledge and practice was low.

**Key words:** Knowledge, Awareness, Practice, Food and Nutrition, Adolescence, level of education, Prachinburi

## Introduction

Currently people tend to live in town and it causes changing in their life. Urgent life causes their value change. And consumerism causes to over nutrition. These will lead to various diseases as diabetes, and obesity hypertension. Coronary Artery Disease and cancer, are the cause of illness and death of people in primordial. (Ministry of Health, 2003) and Plan of National Economic and Social Development No. 10 year 2007 through 2011 (Office of National Economic and Social Development, 2006) contains information that people get sick of the overall reduction from 1,809.6 per thousand population in the year 2002 is 1,798.1 per thousand population in the year 2004 But illness is a preventable disease trends continue to increase, during the year 2004 there were the highest rate of patients with high blood pressure 18.4% , diabetes 14.2%, heart disease 13.4%, and cancer 4 % respectively. It causes many people are not aware of health care. Their behaviors in consuming are unhealthy. With The Tenth National Economic and Social Development Plan (A.D. 2007 – 2011) (Office of National Economic and Social Development, 2006) has set objectives for social development and is one of the accessories. Create a balance between health services promoting prevention treatment and recovery performance and create security in life and property. The main goal is the average age of people expect a higher than 80 years together with the lower rates of illness increase with disease prevention in the top 5 cardiovascular disease is high blood pressure, diabetes, vascular disease and brain cancer led to the increase image production and reduce labor expenses in the long term health of individuals.

The happiness of life depends on the practice of food and nutrition. The words that "You are what you eat ", which is to demonstrate the relationship of food to the nutritional conditions and health of each people. Because of the human body is perfect healthy or irregularity all that is associated with eating food (Siripan, in 2004). So health care to the body healthy. One of the important things is eating. Age each person must be needs vary food by age group and food needs to change the physical condition especially among school age children and an adolescent is the age at which the body is growing. Need to eat all those 5 each and those for various kinds and food for all 3 portions (Ministry of Health, 2003).

The growth of teenagers is rapidly developing. They prefer independence and decide by themselves. And the current advertising influence to the role of teenagers. These things all affect to eating behavior such as consumerism. Fast food and instant food is very popular among teenagers, it shows teenagers will have the unhealthiness. Moreover, they usually skip breakfast because some wake up late, and some are on diet. If they often do this thing, it will cause of dietary deficiency.

In addition, teenagers do not eat on time and they misbehave on nutrition care. (Op Chay, 1999) Therefore, teenagers should be well-advised on good nutritional consumption. And they should be promoted to play sport or exercise regularly and enough rest. If teenagers have good nutrition, it will be helpful their physical development and protects them from chronic disease (Department of Health, 2000).

Prachinburi Province Health Office (2007) has summarized the results of monitoring growing of students in Muang district, Prachinburi province that students in kindergarten class in the number of 418 weight less than 6.7% age criteria skinniness start bloated 7.66% 18.8% primary education level in the number of weight less than 1,833 people age criteria meager 5.73% 6.76% 21.71% obese begin in Number of high school weighing less than 6,235 people age criteria meager 1.91% 3.70% 8.10% obese begin to see that students in the district town, Prachinburi Province. Start conditions are conditions higher than obese and lean conditions, age, and weight less than standard. All levels in obese and start conditions are likely higher level of kindergarten (18.18%) to primary education (21.71%) starting conditions are likely reduced in obese high school (8.10%), this condition may result from Start children into teenagers. Make up the body quickly, or may result from the child's knowledge and awareness of their food and nutrition practices. For this reason the research is interested in learning the knowledge and awareness of their food and nutrition practices of adolescents in Muang district, Prachinburi province. Approach is to encourage youths to happiness is good health.

### **Research method**

The research of knowledge, awareness and practice about food and nutrition of adolescence in Muang District, Prachinburi province. The researcher proceed in this way:

#### **Population and Sample**

##### **Population**

Populations used in this research are the students who belong to boundary of educational pursuits, Prachinburi province open for the high school grade 10 and above for 4 locations. It contain all of 3,188 students according to table no.1

##### **Sample Group**

Population used in this research are the students who belong to boundary of educational pursuits, Prachinburi province open for the high school grade 10 and above for 346 students from the Stratified Random Sampling as the following process :

Step 1: Fix the size of sample group and use the table of Krejcie & Morgan, 1970. Size of the Sample Group of 346 peoples.

Step 2: Divide the students of each school by calculating the proportion of the sample group in each school. Compare the proportion according to table no.1

Step 3: The Simple random (Simple Random Sampling) by drawing the sample number.

Table 1 show amount of the populations and sample of groups.

Name of school	Population	Number of sample group
Prajin Radsadon Umrong School	1,797	195
Prajin Kanlayanee School	1,269	138
Thairatviittaya 7 School	97	10
Adual Sadsanakij sukxa Sahool	25	3
Total	3,188	346

#### Tools used in research

Research tools used in this experiment and a questionnaire that including 4 parts:

Part 1: General information of respondents. Characteristics questionnaire as a check list and open - ended questions.

Part 2: Knowledge of food and nutrition test. Quiz answers are selected option 4 choose.

Part 3: Food and nutrition awareness test. Survey estimates a rating Scale is a 5 level especially agree, agree, not sure, disagree, and especially disagree.

Part 4: The questionnaires of food and nutrition practice are rating scales with 4 levels:

Regularly means the practice 5 - 7 days a week.

Quite often means the 3 - 4 days per week.

Rarely means the practice 1 - 2 days per week.

Never means no action.

#### Finding quality tools

Knowledge of nutrition and food quality test analysis tools by:



**Reliability** knowledge of food and nutrition test and the rating system is answer the wrong answer to points 1 to 0 score confidence scale by using a formula  $20(KR - 20)$ , and the manual de Richardson (Kuder - Richardson) have values, beliefs, confidence test knowledge of food and nutrition equals 0.85.

**Difficulty** analysis evaluation questionnaire by the difficulty of easily determine the ratio between the numbers of respondents in each of the test is to test how people respond. Easy difficulty has a value between 0.13 to 0.95.

**Discrimination** Diagnostic evaluation of classification authority by the coefficient for Conbach's alpha between the scores of the entire score. Distinguish between the power values from 0.36 to 0.66 since the food and nutrition awareness. Questionnaire and conduct food and nutrition. Reliability for the coefficient of Conbach's alpha questionnaire awareness of nutrition and food costs have confidence 0.84 Survey and conduct nutrition and food costs have confidence 0.66.

#### **Data analysis**

The research provides a test Questionnaires and received back complete check of the answers and then proceeds with data analysis computer. Steps are as follows:

- 1) General data of respondents explained by the frequency and percentage values.
- 2) Analyze the level of knowledge. Awareness and practices of food and nutrition. The average value and standard deviation.
- 3) Comparative analysis of average differences in knowledge and awareness of food and nutrition practices. As independent variables t - test for gender and One Way Analysis of Variance for variable levels. And a pair test by Scheffe 'Mothod.
- 4) Find relation between awareness and awareness of food and nutrition practices by the Pearson's Product Moment Correlation.

#### **Conclusion**

This research studied the knowledge and awareness of their food and nutrition practices. Teenagers in the city's districts, Prachinburi Province and the results of this research as follows:

#### **General information of sample**

Most of teenagers sample number of 247 people are female 71.4% secondary level education in years the number of 142 people aged between 41.0% from 16 to 17 years a total of 185 people is 53.4 per cent cumulative average learning effect between 2:00 - 2:50. 93% 26.9 Number of people get to school each day from 51 to 60 baht a total of 35.0% of 121 people, most teenagers lived with

parents 82.7% number of people 286 adolescents received the knowledge of food and nutrition from their families, school and medias. Level similar number is 243 people, 230 people and 216 people respectively 27.1%, 25.6 and 24.1 respectively.

#### **Food and nutrition knowledge of adolescent in the district town, Prachinburi Province**

Teenagers in Muang district, Prachinburi Province had knowledge of food and nutrition in the overall positive both female and male, with average 75.83%, 77.43 and 71.77 levels, respectively. Teenagers in Muang districts, Prachinburi Province in secondary school at levels 4, 5 and 6 had knowledge of food and nutrition in the average scores of 74.43%, 74.37%, and 77.83%, respectively.

#### **Food and nutrition knowledge of adolescent in the district town, Prachinburi Province**

Teenagers in Muang district, Prachinburi province was aware of food and nutrition in a large Overall both female and male. The average of awareness in female is 4.27 and 4.15 in male. All levels had the awareness in high level. The secondary-level 4-year average awareness level of 4.27 to 5 year high school level is 4.14 and the average awareness level of 6-year secondary education awareness 4.26 average.

#### **Conduct food and nutrition of adolescents in the district town, Prachinburi Province**

Teenagers in the city districts, Prachinburi province to conduct a food and nutrition in the overall average 2.75 was equal to the average male in the conduct of food and nutrition, the average female was equal to 2.78 and the conduct of food and nutrition as the average level of 2.74. Adolescents with conduct food and nutrition in the overall average in both year levels, secondary 4, 5 and 6 with a 4-year secondary education levels 2.77 was equal to the average level of 5-year secondary education is equal to 2.76 and the average level of 6-year secondary education was equal to the average 2.72.

#### **Testing hypotheses**

Hypothesis test results found that

1) Different gender of teenagers in the city districts, Prachinburi province had difference of knowledge in food and nutrition with statistical significance at 0.01.

2.) Different level of teenagers in the city districts, Prachinburi province had no difference of knowledge in food and nutrition with statistical significance at 0.01. And different gender of teenagers had difference of awareness in food and nutrition with statistical significance at 0.01.

3) Different levels of teenagers in the city districts, Prachinburi province had no difference of awareness in food and nutrition. And different gender of teenagers had no difference of practice in food and nutrition.

4) Different levels of teenagers in the city districts, Prachinburi province had no difference of practice in food and nutrition. And there was positive correlation in awareness and practice of food and nutrition with statistical significance at 0.05. Moreover, there was correlation between knowledge and awareness at the moderate level ( $r = 0.34$ ) and knowledge, awareness, and practice of teenagers had correlation at the low level ( $r = 0.21$  and  $r = 0.13$ , respectively).

### Discussing

From the study of knowledge and awareness of their food and nutrition practices. Teenagers in the city's districts, Prachinburi Province. The discussion of the research:

#### **The study of food and nutrition knowledge of adolescents in the district town, Prachinburi Province**

The study found that teenagers in the city districts, Prachinburi province with knowledge of food and nutrition levels. The average score was 75.83% because the teens may be interested in that age range is curious things. Moreover, recent knowledge of food and nutrition from a variety from families with teenagers in schools and media had the most knowledge about the health benefits of food. Eating foods with excessive fat requirements would cause obesity. Eating fruits and vegetables were vitamin and mineral fibers. To help purge the skin and maintenance of which would be seen that the basic knowledge that teens know already. But teenagers have found that knowledge levels were low on food sources of iron. And most teenagers did not know the 6 types of nutrients include protein, fat carbohydrates vitamins minerals and water that the water is not Teen nutrients so that the knowledge of food and nutrition knowledge and repeated. Teens will have to take the correct knowledge to perform in food consumption accurately.

Comparison of knowledge between male and female adolescents found that female had more food knowledge than males with statistical significance at the 0.01. Because female adolescent were interested in themselves, fond of dressing up and careful diet. Thus resulting in further education scale of food knowledge and nutrition than in males. Consistent with studies of the Chayanit (2000) studied on consumer behavior, health food, high school education of students. Nawamintharachinuthit Satriwitaya 2 Elementary Education Department Bangkok found that most students had good knowledge in class and students with different sexual knowledge and attitude about food, a different statistical significance at 0.05. The comparison of food and nutrition knowledge between levels found

that adolescent in secondary level at 4 years, 5 and 6 with knowledge of nutrition and food did not vary. Because adolescent in all levels of knowledge of food received and nutrition from the nearby school and may receive more knowledge from the self-study or supported from family.

#### **Awareness of Food and nutrition knowledge of adolescents in the district town. Prachinburi Province**

The study found that teenagers in the city districts, Prachinburi province were aware of food and nutrition in the overall level. Because adolescent had knowledge of food and nutrition in the overall level. Thus allowing more teenagers were aware. Adolescent were aware of the levels in most drinking water was clean, healthy drinking more sparkling water, drinking and driving causes an accident. Teenagers should gain 5 groups of nutrition, each group to eat vary group that adolescents may be more aware because of the widely promoted by both government and private sector such as the campaign does not drive drunk. Project and Thai children not eat a sweet. Part of the teenagers had little awareness. The level of awareness in many average and is eating dry seeds, beans, eggs or various kinds of food valued close to the expensive meat, eat fritter make pimply teens and frozen foods no food value. That adolescent are less aware of this. May be because adolescents consume media pretentious than real. Mouth and eating indulgence regardless of results. Comparison of food and nutrition knowledge of adolescents in the district town, Prachinburi Province between females and males found that the differences between a statistical significance at 0.01 by the female adolescent were aware of food and nutrition than male adolescents. Because female adolescent were interested on food and nutrition than the male. The comparison of food and nutrition knowledge between levels found that adolescent in secondary level at 4 years, 5 and 6 were aware of nutrition and food did not vary because adolescents in all levels of knowledge in a similar level. And adolescent in all levels had almost the same comprehension in nutrition and food.

#### **The practice of food And nutrition of adolescent in the district town, Prachinburi Province**

The study found that teens from the district town, Prachinburi Province conduct a food and nutrition in the overall average. From comparisons between female and male, and a comparison between the 4-year secondary level, 5 and 6 found that the conduct of nutrition and food did not vary. The food and low in nutrition is eating a very sweet drink, eating sweets crunchy crispy eating fried food and lack of exercise. The practice of food Nutrition and this may affect nutritional status of adolescents. So should encourage adolescents to comply with food Nutrition and correctly.

## Relationship between knowledge awareness and conduct food and nutrition of adolescents in the district town. Prachinburi Province

The results found that knowledge and awareness of food and nutrition are interrelated in a moderate ( $r = 0.34$ ) because adolescent had the knowledge level. Resulting in as much knowledge. This is consistent with Good (Good, 1973) recognizes the practice occurs when a person has been fueled by stimulation or touch the stimulus Cause of the cognitive stimulation and the understanding of stimulation as a thought. To learn the knowledge and awareness is realized when it will happen.

By studying the correlation between knowledge and practice and awareness found that relationship is found in low because most teenagers food consumption taking into account taste. And comfort is primary. Also present in the food business with a variety of how to increase the incentive to customers by advertising through various media which will affect food consumption behavior of adolescents. For this reason, it was the relationship between knowledge and practice and awareness. Correlate with lower levels consistent with studies of the glory of Sirinya (2000) studied of knowledge attitude and practices regarding food consumption of secondary school students. Schools under the Department of General Education Bangkok found in practice with the knowledge about food consumption. Correlate with relatively low levels and consistent with the study of Wanrude (2001) who studied of knowledge attitude and practices regarding food consumption of secondary school students in school opportunity. Bangkok found under the bar and know about the consumption of food students are positively related. Correlate with relatively low levels. And consistent with studies of help (2002) who studied on knowledge attitudes and behavior, food consumption at the end of high school students. Schools under the Department of General Education Bangkok found in practice to know the behavior, food consumption, Attitudes and behavior are related to the positive is statistically significant at 0.01 level, but not consistent with the study of the Chayanit (2000) who studied of health behaviors associated with consumption of food students high school education. Nawamintharachinuthit Satriwitaya 2 Elementary Education Department Bangkok found that the relationship between knowledge about the consumption of food students. No relationship of positive and inconsistent with Chidchanok (2005) study. Food consumption behavior of students in professional schools of Panichiyakarn Sukhothai found knowledge about food consumption did not correlate with food consumption behavior.

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# The Study of Instant Pad Thai Powder Processing

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## Abstract

This paper aimed to study the process of making instant Pad Thai powder by Spray Drying method. The appropriate temperature of hot gas and the quantity of Maltodextrin in processing instant Pad Thai powder by Spray Drying method were studied. Factorial in Completely Randomized Design (CRD) was used. The study found that the appropriate quantity of Maltodextrin was 20% and the appropriate temperature for in and out hot gas was 150/90 °C. The color variation of the finishing instant Pad Thai powder was as follow: Bright colors L\* 88.32 Red a\* 0.99 Yellow b\* 8.26. The color variation after cooking the product was: Bright colors L\* 30.73 Red a\* 3.08 Yellow b\* 8.25. aw 0.22. The moisture of the powder was 1.24. Then, the consumer satisfaction was studied by using 3 types of Pad Thai Noodles; Pad Thai Noodles with Instant pad Thai Powder, Pad Thai Noodles with regular Pad Thai sauce, and Pad Thai Noodles sold in general market. Randomized Complete Block Design, RCBD was used. The study of the consumer satisfaction revealed that there was no difference between pad Thai Noodles made with Instant Pad Thai Powder and Pad Thai Noodles made with regular Pad Thai sauce at the statistical significance ( $p > 0.05$ ). The testers rated the overall taste of Pad Thai Noodles at 7.57. Next, the researcher studied the expiration period of Instant Pad Thai Powder by packing the product in double vacuum foil and storage the product at 4 different temperatures 30, 35, 45, and 55 degree Celsius. Then the product was studied to evaluate the physical, chemical, microorganism, and sensory property. The product kept at 55 °C was the most different of the four storage products at  $p \leq 0.05$  with the highest level of consumer satisfaction at color = 7.33, smell = 7.30, taste = 7.90, texture = 7.57 and total = 7.40. The amount of microorganism, yeast, and fungus were at the safe level to consume.

**Key words :** Instant Pad Thai Powder Spray Drying Pad Thai Noodle



## Introduction

Thai Food has been known as one of the Thai identities and well accepted all around the world. This also indicates to long history of collected attainment of Thai people. The subject of cooking would be the best way to conserve the quality and nutrition value of the food. And the subject of preparation is tended to focus on harmonious of tastes and aroma . The punctiliousness on choices of ingredients of the food is very attractive , and the flavor is excellent . The government supports Thai Food export, opening of Thai restaurants abroad and Thai Food materials export. Various kinds of Thai Food are popular around the world such as Green Curry, Tom Yum Koong (Shrimp spicy soup), Hot dishes, Pad Thai noodle, etc. Pad Thai noodle, or Pad Thai in panatelas, has been selected as one of the best dishes by Thai people. Later, it became the national food that is well known by foreigners worldwide, indicated by survey result of the best international Thai dishes in 1999 by the office of the National Culture Commission (the journal of the national research council of Thailand, 2003).

Pad Thai noodle has a unique taste as different from other kind of noodle meals internationally. The mellow taste of Pad Thai comes from major ingredients such as Thai noodles, thick tofu, fermented turnip (Chai Powe), red onion, dried salted prawn, egg and seasonings compounded of tamarind juice, fish sauce, coconut sugar, vinegar and salt. To cook Pad Thai, melt and mix all seasonings together to make Pad Thai sauce. Then, fry red onion and follow with salted turnip in a pan. Stir Thai noodles and add a little bit of water to soften the noodle. Then add the prepared Pad Thai sauce together with thick tofu, dried salted prawn, egg and bean sprouts. Now, Pad Thai cooking is finished. In foreign countries, it is quite inconvenient to find fresh ingredients and materials to make original Pad Thai.

Aforementioned, the author of this research is interested to study methods of producing Pad Thai noodle sauce in the form of instant powder, which is convenient for everyone's usage including Thai restaurants in foreign countries.

The purpose of this research was to: (1) To study temperature of hot wind and the proper quantity of Molto dextrin used in spray drying the Pad Thai sauce. (2) To study and compare Pad Thai powder to the original Pad Thai sauce and the locally sold Pad Thai. (3) To study shelf life of Pad Thai powder.

## Experiment process

### Study Temperature of Hot Wind and the Proper Quantity of Molto dextrin to Spray Drying the Pad Thai Powder.

Base on the Pad Thai noodle sauce which is accepted from the experiment in Germany and United Kingdom as the formula basis. The composition in Pad Thai noodle sauce are tamarind juice, coconut sugar, sugar, vinegar, fish sauce and salt. There has been an adjustment to use natural color sugar instead of granulated bleached sugar. The was of Molto dextrin in this formula is to crystallize the product. Then, prepare the composition of the basic formula Pad Thai noodle sauce which are tamarind juice, fish sauce, vinegar, salt and Molto dextrin except the natural color sugar. Fiber-dry the natural color sugar under the experimental design of "Factorial in Completely Randomized Design (CRD)" method. The first factor to study in Spray drying by using Molto dextrin is studying to the 3 levels of proper quantity of Molto dextrin which are the percentages of 15, 20 and 25. The second factor is studying the proper temperature in Spray drying process. There are 2 levels of temperature which are the beginning hot wind temperature  $130 \pm 10$  Celsius degrees, the terminated hot wind temperature  $80 \pm 5$  Celsius degrees and the beginning hot wind temperature  $150 \pm 10$  Celsius degrees, the terminated hot wind temperature  $90 \pm 5$  Celsius degrees. Then, mix the Spray drying Pad Thai flavoring powder with natural color sugar. And restore to former form by thawing in boiled water in the calculated ratio. After that, analyze physical quality which are color, water activity ( $a_w$ ), and calculate percentage of yield, and analyze chemical of which are humidity (%) and the amount quantity total soluble solid ( $^{\circ}$  Brix)

### The Study of Consumer's Acceptance, Comparing All 3 Products which are Instant Pad Thai Powder, the Original Pad Thai Sauce and the Accepted Locally Sale Pad Thai Sauce.

After the Spray drying of basic formula of Pad Thai noodle composition and the studying of sensory evaluation, Pad Thai powder, the original Pad Thai sauce and the accepted locally sold Pad Thai flavoring product was compared. The ratio of Pad Thai powder after restore the form was 92 grams and Pad Thai noodle 80 grams, stirred into 3 kinds of Pad Thai. Then, plan the Randomized Complete Block Design, (RCBD). The usage of 3 kinds of Pad Thai noodle which had been analyzed the attributer in color, flavor, taste, texture and overall liking by tasting the meal and rate to 9-point Hedonic scale. 30 evaluators tasted samples trice. The result was analyzed for varying facts (Analysis of Variance, ANOVA) and analyze the difference of the varying facts by Duncan's New Multiple Range Test (DMRT) theory.

## **Study Shelf Life of Instant Pad Thai Powder.**

Study the Shelf life of Instant Pad Thai Powder that has been accepted by testers for Shelf life Study by packing in a vacuum bag and pack again inside a foil bag. 4 different levels of temperature of storage are 30, 35, 45 and 55 Celsius degrees. Then, analyze the physical quality which are color and examine the changing of  $a_w$ . Chemical analysis consists of examination of the change of humidity and the amount of total soluble solid ( $^{\circ}$  Brix). Microbiological quality analysis examine the amount of the total plate count, yeast and Molds. The sensory evaluation was conducted by stirring Instant Pad Thai Powder together after restoring the form with Pad Thai noodles. This experiment used 30 evaluators who are the food expertise teachers to evaluation in color, flavors, taste, texture and overall liking. The test is also divided into 9-point Hedonic scale. And analyze the vary facts from the result (Analysis of Variance, ANOVA). And analyze the difference of average facts by Duncan's New Multiple Range Test method. These were tested every 2 weeks for 12 weeks.

### **Data Analysis Result and Result Discussion.**

**Temperature Study of Hot Wind and the Proper Quantity of Molto dextrin to Spray Drying the Instant Pad Thai Powder**, indicate that when hot wind by incoming and outgoing increased from 130/80 to 150/90 degrees Celsius, and the quantity of Molto dextrin increased from 15, 20 and 25% respectively, effected to  $a_w$  and humidity decrease (%). The rates of  $a_w$  decreased from 0.265 to 0.240, 0.230 to 0.202 and 0.249 to 0.233 consecutively. Meanwhile, the rates of humidity (%) decreased from 1.71 to 1.11, 1.50 to 1.40 and 1.35 to 1.24 respectively. Anyhow, the rate of Yield percentage was increasing when the level of Moltodextrin and the temperature during the drying was higher. The high temperature caused the Instant Pad Thai Powder to good conditioning level and there was no powder left in the spray drying machine. And this used a short time to make. As for the color of the original formula of Pad Instant Pad Thai Powder restore to former form, the study of hot wind and the proper quantity of Molto dextrin to Spray drying the the Instant Pad Thai Powder, founded the quantity of Molto dextrin at 20% and the incoming and outgoing hot wind temperature at 150/90 Celsius degrees.  $a_w$  rate and humidity were in low level. The results were appropriated for producing the Instant Pad Thai Powder. Moreover, the observation of the Spray drying indicates that the incoming and outgoing hot wind temperature at 150/90 Celsius degrees in 1 hour, produce Instant Pad Thai Powder constantly and less leftover in the machine which caused only a small loss of the product. Thereby, the level of Molto dextrin at 20% and the incoming and outgoing hot wind

temperature at 150/90 Celsius degrees were selected . In order to spray drying the Instant Pad Thai Powder which gives the best physical and chemical quality including Yield percentage.

**Results of the Study of Consumer Acceptance by Comparing 3 Products which are the Developed Instant Pad Thai Powder, the Basic Formula Pad Thai Noodle Sauce and the Accepted Locally Sold Pad Thai Sauce.**

Table 1 The mean scores of satisfaction in general qualification of cooked Pad Thai noodle by 3 kinds of products.

Qualification	Pad Thai noodle cooked by 3 kinds of products.		
	Developed formula	Basic formula	Local formula
Color	6.87 ± 1.07 <sup>b</sup>	6.60 ± 0.94 <sup>b</sup>	<b>7.50 ± 1.04<sup>a</sup></b>
Flavour	7.53 ± 0.95 <sup>a</sup>	<b>7.70 ± 0.86<sup>a</sup></b>	7.00 ± 0.84 <sup>b</sup>
Taste	<b>7.63 ± 1.05<sup>a</sup></b>	7.57 ± 0.93 <sup>a</sup>	6.70 ± 1.16 <sup>b</sup>
Texture	7.57 ± 0.83 <sup>a</sup>	<b>7.67 ± 0.82<sup>a</sup></b>	7.17 ± 1.09 <sup>b</sup>
Overall liking	<b>7.63 ± 1.08<sup>a</sup></b>	<b>7.63 ± 1.03<sup>a</sup></b>	7.27 ± 1.16 <sup>a</sup>

\*Values within rows followed by a different letter are significant ( $p \leq 0.05$ ).

After the research indicates that the mean scores of Overall liking of the kinds of products have no difference in statistical significance ( $p \leq 0.05$ ). As for the mean scores of satisfaction in color, flavour, taste and texture of the developed Instant Pad Thai Powder and the basic formula Pad Thai noodle sauce have no difference statistically ( $p \leq 0.05$ ). These also indicate that the evaluators accepted the developed Instant Pad Thai Powder as being the same as the basic formula Pad Thai sauce. Because the consumers concur Pad Thai that is cooked by the developed Instant Pad Thai Powder as the same as the basic formula Pad Thai noodle sauce. Therefore, the researcher kept the developed Instant Pad Thai Powder for further study in shelf life.

## Results of the Study of Shelf Life of Instant Pad Thai Powder.

Table 2 Results of the study of chemical quality factor in humidity (%) of Instant Pad Thai Powder, when kept in 4 different levels of temperature for 12 weeks.

Shelf life duration (Weeks)	Humidity (%)			
	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
0	1.40 ± 0.00	1.40 ± 0.00	1.40 ± 0.00	1.40 ± 0.00
2	0.71 ± 0.01	0.64 ± 0.03	0.54 ± 0.03	0.54 ± 0.02
4	0.77 ± 0.02	0.69 ± 0.01	0.60 ± 0.01	0.58 ± 0.01
6	0.80 ± 0.02	0.75 ± 0.04	0.67 ± 0.02	0.62 ± 0.03
8	0.87 ± 0.03	0.81 ± 0.01	0.69 ± 0.01	0.68 ± 0.01
10	0.89 ± 0.01	0.87 ± 0.02	0.71 ± 0.01	0.70 ± 0.01
12	0.92 ± 0.02	0.90 ± 0.01	0.77 ± 0.02	0.83 ± 0.01

The numbers indicated that there were humidity (%) changes of Instant Pad Thai Powder which had been kept in 4 different levels of temperature. When the Shelf life duration of 12 weeks, the humidity in Instant Pad Thai Powder had increased each week. But the humidity (%) of the Pad Thai noodle flavoring powder quantity was less than the criterion which was under the percentage of 13 of the weight at the standard of community instant Kanom Jin (Thai rice noodle) sauce product.

Table 3 Results of the Study of Chemical Quality Factor in Total Soluble Solid Quantity (°Brix) of the Instant Pad Thai Powder, when Kept in 4 Different Levels of Temperature for 12 Weeks.

Shelf life duration (Weeks)	The amount total soluble solid (° Brix)			
	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
0	47.2 ± 0.25	47.2 ± 0.25	47.2 ± 0.25	47.2 ± 0.25
2	48.2 ± 0.25	48.3 ± 0.25	48.2 ± 0.26	48.3 ± 0.26
4	48.3 ± 0.29	48.3 ± 0.15	48.5 ± 0.32	48.1 ± 0.10
6	49.3 ± 0.15	49.10 ± 0.10	49.50 ± 0.20	49.27 ± 0.21
8	49.1 ± 0.17	49.2 ± 0.15	50.3 ± 0.20	51.6 ± 0.12
10	49.7 ± 0.15	50.3 ± 0.20	51.7 ± 0.15	51.9 ± 0.10
12	50.5 ± 0.15	50.9 ± 0.15	51.9 ± 0.10	52.3 ± 0.21

The numbers indicated that there were amount of total soluble solid ( $^{\circ}$  Brix) changed of the Instant Pad Thai Powder which had been kept in 4 different levels of temperature. The amount of total soluble solid was increasing in each week.

Table 4 Results of the study of physical quality factor in free water activity ( $a_w$ ) of the Instant Pad Thai Powder, when kept in 4 different levels of temperature for 12 weeks.

Shelf life duration (Weeks)	water activity ( $a_w$ )			
	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
0	0.19 ± 0.00	0.19 ± 0.00	0.19 ± 0.00	0.19 ± 0.00
2	0.27 ± 0.02	0.26 ± 0.01	0.21 ± 0.01	0.22 ± 0.01
4	0.29 ± 0.01	0.28 ± 0.01	0.26 ± 0.02	0.26 ± 0.02
6	0.30 ± 0.01	0.31 ± 0.01	0.28 ± 0.01	0.29 ± 0.01
8	0.32 ± 0.02	0.32 ± 0.01	0.29 ± 0.01	0.30 ± 0.10
10	0.32 ± 0.01	0.34 ± 0.01	0.31 ± 0.01	0.32 ± 0.02
12	0.32 ± 0.01	0.34 ± 0.01	0.33 ± 0.01	0.34 ± 0.02

The numbers indicated that when keeping the Instant Pad Thai Powder in 4 different levels of temperature for 12 weeks, the free water quantity ( $a_w$ ) was increasing each week. Therefore, the Instant Pad Thai Powder had lower than the criterion of 0.6 at the standard of community instant Kanom Jin (Thai rice noodle) sauce product.

From the study of microbiological quality factor indicated that the longer of shelf life duration, more of yeast amount would increase from the 12 weeks of shelf life. The estimated quantity was less than 10 CFU/g which was not over the standard of the community dried chili paste product had fixed as maximum 100 CFU/g. Synopsis, the developed Instant Pad Thai Powder that had been kept for 12 weeks was safe and harmless to consumers.

And from the study of microbiological quality factor indicated that the changing in amount of microorganism of the Instant Pad Thai Powder in 4 levels of temperature, the longer of shelf life duration quantity was increasing in each week. But the level was under the standard of the community dried chili paste product had fixed as maximum  $1 \times 10^3$  Colonies per 1 gram of example. Synopsis, the developed Instant Pad Thai Powder that had been kept for 12 weeks is safe and harmless to consumers.

Table 5 The Mean Scores of Satisfaction in the Instant Pad Thai Powder Product Acceptance after the beginning of Shelf life Duration.

Qualification	Instant Pad Thai Powder				
	Controlled Example Set	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
Color	7.67 ± 0.48 <sup>a</sup>	6.23 ± 0.68 <sup>c</sup>	6.40 ± 0.72 <sup>c</sup>	7.00 ± 0.64 <sup>b</sup>	7.50 ± 0.52 <sup>a</sup>
Flavor	7.27 ± 0.64 <sup>a</sup>	6.47 ± 0.68 <sup>b</sup>	6.17 ± 0.91 <sup>b</sup>	6.30 ± 0.84 <sup>b</sup>	6.57 ± 0.57 <sup>b</sup>
Taste	7.33 ± 0.61 <sup>a</sup>	6.33 ± 0.76 <sup>b</sup>	6.30 ± 0.95 <sup>b</sup>	6.47 ± 0.63 <sup>b</sup>	6.97 ± 0.85 <sup>a</sup>
Texture	7.03 ± 0.85 <sup>a</sup>	6.43 ± 0.90 <sup>b</sup>	6.47 ± 0.78 <sup>b</sup>	6.33 ± 0.88 <sup>b</sup>	6.50 ± 0.63 <sup>b</sup>
Overall liking	7.63 ± 0.61 <sup>a</sup>	6.53 ± 0.63 <sup>cd</sup>	6.40 ± 0.67 <sup>d</sup>	6.83 ± 0.59 <sup>bc</sup>	7.13 ± 0.51 <sup>b</sup>

\*Values within rows followed by a different letter are significant ( $p \leq 0.05$ ).

The numbers indicated that the consumers accepted the controlled Instant Pad Thai Powder example set and that had been kept in 55 Celsius degrees the most. Because when it was kept under high temperature, the product would turn up more brown color. And the scent of the flavor would be more obvious similar to the cooked Pad Thai noodle sauce.

Table 6 The Mean Scores of Satisfaction in the Instant Pad Thai Powder Product Acceptance after 4 Weeks of Shelf Life Duration Study.

Qualification	Instant Pad Thai Powder				
	Controlled Example Set	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
Color	7.47 ± 0.78 <sup>a</sup>	6.03 ± 0.89 <sup>b</sup>	5.97 ± 0.89 <sup>b</sup>	6.00 ± 0.98 <sup>b</sup>	7.17 ± 0.65 <sup>a</sup>
Flavor	7.27 ± 0.61 <sup>a</sup>	6.47 ± 0.63 <sup>b</sup>	6.53 ± 0.78 <sup>b</sup>	6.63 ± 0.61 <sup>b</sup>	7.57 ± 0.63 <sup>a</sup>
Taste	7.47 ± 0.51 <sup>a</sup>	6.23 ± 0.68 <sup>c</sup>	6.40 ± 0.72 <sup>c</sup>	6.77 ± 0.43 <sup>b</sup>	7.43 ± 0.50 <sup>a</sup>
Texture	7.47 ± 0.63 <sup>a</sup>	5.90 ± 0.71 <sup>c</sup>	6.03 ± 0.56 <sup>c</sup>	6.13 ± 0.63 <sup>c</sup>	6.97 ± 0.32 <sup>b</sup>
Overall liking	8.10 ± 0.66 <sup>a</sup>	6.73 ± 0.45 <sup>c</sup>	6.80 ± 0.41 <sup>c</sup>	6.87 ± 0.51 <sup>c</sup>	7.53 ± 0.57 <sup>b</sup>

\*Values within rows followed by a different letter are significant ( $p \leq 0.05$ ).

The numbers indicate that the consumers accepted the controlled Instant Pad Thai Powder example set and that has been kept in 55 Celsius degrees the most. Because when the Instant Pad Thai Powder was kept at 55 Celsius degrees, hence to high temperature, the product would turn up

more brown color than the first week of the shelf life duration. And the flavour of the sugar would be more obvious similar to the cooked Pad Thai noodle sauce.

Table 7 The Mean Scores of Satisfaction in the Instant Pad Thai Powder Product Acceptance after 8 Weeks of Shelf Life Duration Study.

Qualification	Instant Pad Thai Powder				
	Controlled Example Set	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
Color	7.20 ± 0.96 <sup>b</sup>	6.33 ± 0.88 <sup>cd</sup>	6.07 ± 0.78 <sup>d</sup>	6.73 ± 0.83 <sup>c</sup>	7.70 ± 1.14 <sup>a</sup>
Flavor	7.13 ± 1.17 <sup>a</sup>	6.73 ± 0.58 <sup>ab</sup>	6.33 ± 0.76 <sup>b</sup>	6.50 ± 0.94 <sup>b</sup>	7.00 ± 0.98 <sup>a</sup>
Taste	7.80 ± 0.92 <sup>a</sup>	6.47 ± 0.68 <sup>c</sup>	6.43 ± 0.68 <sup>c</sup>	6.63 ± 0.67 <sup>c</sup>	7.17 ± 0.70 <sup>b</sup>
Texture	7.47 ± 0.82 <sup>a</sup>	6.27 ± 0.74 <sup>c</sup>	6.20 ± 0.61 <sup>c</sup>	6.87 ± 0.78 <sup>b</sup>	7.03 ± 0.49 <sup>b</sup>
Overall liking	7.40 ± 0.56 <sup>a</sup>	6.40 ± 0.86 <sup>c</sup>	6.33 ± 0.71 <sup>c</sup>	6.90 ± 0.71 <sup>b</sup>	7.27 ± 0.83 <sup>ab</sup>

\*Values within rows followed by a different letter are significant ( $p \leq 0.05$ ).

The numbers indicated that the consumers accepted the controlled Instant Pad Thai Powder example set and that has been kept in 55 Celsius degrees the most. Because when the Instant Pad Thai Powder was kept at 55 Celsius degrees, hence to high temperature, the product would turn up more brown color than the 4th week of the shelf life duration. And the flavour of the sugar would be more obvious similar to the cooked Pad Thai noodle sauce.

Table 8 The Mean Scores of Satisfaction in the Instant Pad Thai Powder Product Acceptance after 12 Weeks of Shelf Life Duration Study.

Qualification	Instant Pad Thai Powder				
	Controlled Example Set	30 Celsius degrees	35 Celsius degrees	45 Celsius degrees	55 Celsius degrees
Color	6.93 ± 1.11 <sup>ab</sup>	6.47 ± 0.51 <sup>c</sup>	6.53 ± 0.57 <sup>c</sup>	7.23 ± 0.83 <sup>a</sup>	7.33 ± 0.71 <sup>a</sup>
Flavor	6.83 ± 0.99 <sup>b</sup>	6.67 ± 0.66 <sup>b</sup>	6.67 ± 0.48 <sup>b</sup>	6.93 ± 1.05 <sup>ab</sup>	7.30 ± 0.84 <sup>a</sup>
Taste	7.07 ± 1.01 <sup>b</sup>	6.83 ± 0.53 <sup>b</sup>	6.73 ± 0.45 <sup>b</sup>	7.57 ± 0.73 <sup>a</sup>	7.90 ± 0.61 <sup>a</sup>
Texture	7.00 ± 1.08 <sup>bc</sup>	6.57 ± 0.68 <sup>d</sup>	6.80 ± 0.55 <sup>cd</sup>	7.37 ± 0.72 <sup>ab</sup>	7.57 ± 0.50 <sup>a</sup>
Overall liking	6.87 ± 1.17 <sup>bc</sup>	6.73 ± 0.58 <sup>c</sup>	6.63 ± 0.56 <sup>c</sup>	7.23 ± 0.73 <sup>ab</sup>	7.40 ± 0.56 <sup>a</sup>

\*Values within rows followed by a different letter are significant ( $p \leq 0.05$ ).



The numbers indicated that the consumers accepted the most the controlled Instant Pad Thai Powder example set which had been kept in 55 Celsius degrees. Because when the Instant Pad Thai Powder was kept at 55 Celsius degrees, hence to high temperature, the product would turn up more brown color than the 8th week of the shelf life duration. And the flavour of the sugar would be more obvious similar to the cooked Pad Thai noodle sauce.

### Experiment conclusion

Results of the study about temperature and the proper quantity of Molto Dextrin for the Instant Pad Thai Powder by Spray Drying method were 20% of Molto Dextrin, and the incoming and outgoing of hot wind temperature at 150/90 degree Celsius. The results of consumer acceptance research by comparing among 3 kinds of products indicated that the Pad Thai noodle flavoring powder could be substituted for the basic formula of Pad Thai noodle sauce. The consumers could hardly distinguish the difference except for little less flavor. The result of chemical quality changing which were humidity (%) and the amount of total soluble solid ( $^{\circ}$  Brix), the conserved Instant Pad Thai Powder within 4 different levels of temperature which were 30, 35, 45 and 55 degree Celsius for 12 weeks, were lower than the standard rate and safe for consumption. The study of physical quality changing which were color of the Instant Pad Thai Powder before restore to form, color of the Pad Thai noodle flavoring powder and after restore to form color and the amount of water activity ( $a_w$ ) that has been kept in 4 different levels of temperature which were 30, 35, 45 and 55 degree Celsius for 12 weeks, were lower than the standard rate referred to community instant Kanom Jin (Thai rice noodle) sauce product. The study in microorganism quality changing of Instant Pad Thai Powder that has been kept in 4 different levels of temperature which were 30, 35, 45 and 55 Celsius degrees for 12 weeks, indicated that the amount of microbe was lower than the criterion, referred to instant Kanom Jin (Thai rice noodle) sauce product. Therefore, Instant Pad Thai Powder stored in 4 different levels of temperature which were 30, 35, 45 and 55 degree Celsius could be kept up to 12 weeks.

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# Effects of Fat Substitute on Survived Probiotic Bacteria in Yoghurt Ice Cream

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## Abstract

The objective of this research was to compare amounts of fat substitutes supplied in the industries in order to determine their ability to encapsulate probiotic microbes in the production of yoghurt ice cream to ensure maximum survived probiotic microbes. In this research, two fat substitutes, Purity SM 100 and CRYSTAL tex™ 648, were used to substitute skim milk in the standard formulas in order to study numbers of survived probiotic microbes and to test the sensory acceptance. For the sensory acceptance, it was found that the probiotic yoghurt ice cream containing 20% Purity SM100 is acceptable at the maximum significance ( $p \leq 0.05$ ) because its flavor and taste was better than other samples as well as the best overrun with statistical significant differences ( $p \leq 0.05$ ). However, by addition of both fat substitutes at different concentrations, pH values of probiotic yoghurt ice cream products did not have statistical significant differences ( $p \geq 0.05$ ). When *Lactobacillus acidophilus*, *Bifidobacterium*, and *Streptococcus thermophilus* microbial starters were added into the probiotic yoghurt ice cream using both fat substitutes in place of skim milk at ratios of 10%, 15%, and 20%, respectively, under a storage condition of -20°C for 4 weeks, it was found that types and amounts of fat substitutes affected the surviving rate of probiotic microbes in the product with a statistical significance ( $p \leq 0.05$ ). The addition of fat substitutes, Purity SM100 and CRYSTAL tex™ 648, at all concentration levels made probiotic microbes survived in the product, which illustrated that both fat substitutes used in above experiments could encapsulate probiotic microbe cells. The survived probiotic microbes were in the range of  $10^7 - 10^8$  CFU/ml in comparison to the probiotic yoghurt ice cream with the standard formula without the addition of fat substitutes that has survived probiotic microbes of only  $10^6$  CFU/ml.

**Key words :** Fat Substitutue, Probiotic Bacteria, Yoghurt Ice Cream

## Introduction

Probiotic is the microorganism which exists mostly in the products that processed from the fermented milk. The probiotic in the products contributes in the digestive system of a human, in addition it will help to make the alimentary canal work normally, it help to decrease a chance in infecting with the alimentary canal. But most yogurt ice cream often have a quantity of probiotic lower than 10<sup>6</sup> CFU/g. Moreover it has saturated fat very much as a kind of lauric acid and myristic acid. The research was to study the processing of products from yogurt ice cream by emphasizing at the quantity of probiotic microorganisms existed in yogurt by taking the fat replacer to use as wrapper on probiotic microorganisms to have most survival quantity, and it was an option for the consumers who took care of health.

## Experimental Method

### 1. The study for a period of time on yogurt preparation for using as the composition in the probiotic yoghurt ice cream

Prepare the yoghurt from ready made microorganism for producing the yogurt (The East Asiatic (Thailand) PLC) by using the quantity of microorganism in the milk in table 1 and the process in Figure 1 Take this yoghurt to measure the pH, the total dissolved solids, and the quantity of lactic acid for every hours until the yoghurt has constant quantity of lactic acid, and applied it as the components of yogurt ice cream formula.

Table 1 Comparison of the ratio of the microorganism and the quantity of milk

Amount of milk to be inoculated	1,250 l / 500 gal	2,500 l / 1,000 gal	5,000 l / 2,000 gal	10,000 l / 4,000 gal
Amount of DVS culture	250 g	500 g	1,000 g	2,000 g

Source : The East Asiatic (Thailand) PLC

### 2. The study of standard formula of yoghurt ice cream

The study of standard formula of yogurt ice cream by taking both standard formulas in the table 2 to produce the ice cream, and bring them to test the sensory attribute : color , smell , smoothness and overall liking, used 30 examiners, by the method of scoring in 9 levels of preference (9 Point Hedonic scale), and took the results to analyze the variance and the difference of the vary facts.

Table 2 Standard formula of yoghurt ice cream

Ingredient	Quantity of Composition	
	1	2
Sugar	150	110
Whipping Cream	200	200
Whey Powder	30	70
Stabilizer	5	5
Water	300	465
Yoghurt	400	370

Source : 1. Somjit Sukapat, 2541

2. Wannaporn Jitjumrean, 2547

### 3. Study the type of fat substitute in the Probiotic Yoghurt Ice Cream

Take the yoghurt ice cream formula that can develop to study the type and the type of the fat replacer, for example , Purity SM100 and CRYSTAL tex™648 by planning the factorial experiment: First factor : they were two types of fat replacer, for example, Purity SM100 and CRYSTAL tex™648, the second factor was as follows: the quantity of fat replacer in 3 levels, for example , 10, 15 and 20 of the quantity of the whey of the powdered milk, and take the produced ice cream to measure the quality as follows:

#### 3.1 The physical quality analysis

3.1.1 Leavening rate according to the method (Marshall and Arbuckle,1996)

3.1.2 Dissolved rate according to the method (Geilman and Schmidt, 1992)

#### 3.2 The chemical quality analysis

3.2.1 Measure the pH with the pH meter

3.2.2 Analyze the quantity of fat according to the method of AOAC 2000

#### 3.3 Analysis of the microbial quality

3.3.1 Quantitative analysis of S.thermophilus (Dave and Shas, 1996)

3.3.2 Quantitative analysis of L.acidophilus (Dave and Shas, 1996)

3.3.3 Quantitative analysis of B.bifidum (Dave and Shas, 1996)

3.3.4 Sensory quality analysis

#### 4. Quantitative study of lactic acid bacteria during keeping the probiotic yoghurt ice cream

Take the yogurt ice cream to put in the plastic cup, close the lid and kept at -20°C and took a random to test the quantity of lactic acid bacteria in ice cream products every weeks for one month in order to check the amount of microorganisms remaining in the products.

#### Results of data analysis and discussion

##### 1. A study for a period of time on yoghurt preparation for using as the composition in ice cream products

###### Probiotic Yoghurt

From producing the yoghurt and adding *S.thermophilus*, *L.acidophilus*, *B.bifidum* in the compounds of yoghurt, then the yoghurt was ripen at 40°C, which was the appropriate temperature for the progress of the microbe that used as the yogurt microbe, and measured the pH value, the total dissolved solids, and the percentage of lactic acid of yoghurt for every one hour until the percentage of lactic acid in the yoghurt was equal to 0.90 - 0.97. It was found that, in the first three hours the pH value inclined to be stable and the pH value started to decrease from 6.60 to 3.23 but it has started to decrease quickly since the fourth hour. Because at the first period the microorganism in yoghurt that has just grew up was *S. thermophilus* only which this microorganism could digest the protein and nitrogen from a source of nitrogen that was not the protein.

Besides, *S. thermophilus* was able to build lactic acid, acetic acid and formic as well. It made pH value, in the products decreased (Shihata and Shah, 2000) In the part of *L.acidophilus* and *B. bifidum* were microorganisms that had to use amino acid and peptides which *S. thermophilus* built as food in the growth so it made both kind of these microorganisms built lactic acid with *S. thermophilus*. It made the pH value started to decrease quickly since the fifth hour. When the pH value decreased lower than 5, it made *B. bifidum* which did not resist to acid and died slowly. It made the pH value not decreased quickly, the percentage of lactic when it ended the period of fermentation time at 0.97. The percentage of lactic acid increased quickly since the third hour to the seventh hour. Because the microorganism began to digest the lactose sugar in milk to lactic acid which caused the total dissolved solids in yogurt started to decrease until 6 °Brix. When it analyzed the protein and fat quantity in the products, it was found that the example of yoghurt had 3.04 protein quantities and 3.20 fat quantities.

## 2. The study of standard formula of yoghurt ice cream

Choose two amounts of yoghurt ice cream formula for applying to choose as the standard formula in making the probiotic yogurt ice cream. From the sensory test with the consumers, it was found that the consumers accepted the first ice cream formula. From statistical analysis, it was found that the quality of color, taste, flavour, and texture, there was not statistical difference ( $p \leq 0.05$ ) but there was obvious difference at the total preference of the consumer. Therefore, the researcher chose to use the first yoghurt ice cream formula as standard formula in probiotic yoghurt ice cream development. For the first formula, it had more quantity of yoghurt for using as the compositions than the second formula, therefore it made more special flavor of yoghurt, which it caused the first formula received the total preference scores more than the second formula.

Table 3 The average preference scores of choosing the ice cream standard formula

Samples	Sensory Characteristics				
	Taste	Color	Flavour	Texture	Total Preference
First formula	8.03±0.78	8.13±0.68	8.03±0.80	8.03±0.71	8.25±0.63
Second Formula	8.08±0.72	8.20 ±0.66	7.95±0.67	8.05±0.72	7.93±0.55

## 3. The study of the type of the fat replacer in the probiotic yoghurt ice cream

Prepared seven samples of yoghurt ice cream as follows: ICE01, ICE02, ICE03, ICE04, ICE05, ICE06, and the control sample, and took them to analyze the physical quality, the chemical quality, the microbiological quality and the sensory quality. The results of the experiment were as follows:

Table 4 The results of statistical analysis in the physical aspect of the probiotic yoghurt ice cream

Type of Fat Replacer	Factor	
	Dissolving Rates	Percentage of Leavening
ICE01	21.50 <sup>a</sup> ±0.707	95.37 <sup>bc</sup> ±0.077
ICE02	15.50 <sup>bc</sup> ±0.707	95.85 <sup>a</sup> ±0.070
ICE03	13.00 <sup>c</sup> ±1.414	96.04 <sup>a</sup> ±0.014
ICE04	18.50 <sup>ab</sup> ±0.707	94.52 <sup>d</sup> ±0.050

Table 4 The results of statistical analysis in the physical aspect of the probiotic yoghurt ice cream  
(to be continued)

Type of Fat Replacer	Factor	
	Dissolving Rates	Percentage of Leavening
ICE05	16.00 <sup>ab</sup> ±0.000	95.05 <sup>c</sup> ±0.028
ICE06	15.00 <sup>bc</sup> ±1.414	95.50 <sup>b</sup> ±0.028
Control	20.50 <sup>a</sup> ±0.707	94.43 <sup>c</sup> ±0.156

**Note :** a - b , the different alphabets in the horizon means the average which there are statistical differences ( $p \leq 0.05$ ) , \* Values within column followed by a different letter are significantly.

From the study of the type of the fat replacer in the probiotic yoghurt ice cream, it made ice cream had dissolving rates, and percentage of leavening. There was statistical difference ( $p \leq 0.05$ ) as shown in Table 4. In the aspect of dissolving of the probiotic yoghurt ice cream, which added the Purity SM100 at 10% , there was statistical difference ( $p < 0.05$ ) with ICE04. It had shown that adding the Purity SM100 and CRYSTAL tex<sup>TM</sup> 648 at 10% , it did not help in dissolving of the probiotic yoghurt ice cream, but adding both types of the fat replacer at 15% and 20 % in the yogurt, it would help the samples of probiotic yoghurt ice cream dissolved slowly in the room temperature , including having high percentage of leavening. This experimental results corresponded with the experiment of Pelan(1997) said that dissolving rate would have relations with the percentage of leavening. That was when the percentage of dissolution decreased, the percentage of leavening would rise as shown in Table 4, it has shown that the samples of probiotic yoghurt ice cream that had percentage of dissolution approximately , it would have percentage of leavening approximately too.

From the comparative ratio of the Purity SM100 and CRYSTAL tex<sup>TM</sup> 648 when it compared with the Control samples, it showed that both kinds of substances made the dissolving rate in yoghurt ice cream better. When it compared with each one, it has shown that CRYSTAL tex<sup>TM</sup> 648 was able to help the ice cream dissolved slowly at room temperature. When 10% CRYSTAL tex<sup>TM</sup> 648 were used, it would make the dissolving rate better equal to using the Purity SM100 at 15% and 20%.

From the analysis of percentage of leavening, it showed that percentage of leavening in the samples in the section of 94-96% from Table 4 when it compared both kinds of fat replacer adding in the ice cream. It would affect the percentage of leavening in the products of both kinds of substance, there was statistical difference ( $p \leq 0.05$ ). It was considered that both substances had properties on



stability aims, and being emulsifier alike, but the Purity SM100 caused the ice cream which was added this fat replacer had higher percentage of leavening. Because this kind of this substance entered, it would make aeration cell in yogurt ice cream had small-sized, it made the air kept in the yoghurt ice cream better than adding CRYSTAL tex™ 648. Although it was added in the same ratio, the results of Goff (2003) said that the substance that had property as emulsifier, and the substance which provided the stability would help the fat grain catch with the air and it could leavened better. If we want to use CRYSTAL tex™ 648 in the products, as a result, we had to add this substance in the increasing quantity for one time on order to get the characteristics of good dissolution and leavening the same as adding Purity SM100.

The type and the quantity of both fat replacers, for example, Purity SM100 and CRYSTAL tex™ 648, in the quantity of 10, 15 and 20%, indicated that the probiotic yoghurt ice cream had significant difference in pH values ( $p \leq 0.05$ ). The pH values were at 4.6-4.8 which were lesser than the ice cream formula of the control sample which had highest pH value but it was still at pH value that the probiotic microorganism could grow up.

Table 5 The analysis results in sensory testing of the probiotic yoghurt ice cream samples

Samples	Sensory Characteristics				
	Taste	Color	Flavour	Texture	Total Preference
ICE01	7.78 <sup>b</sup>	8.05 <sup>a</sup>	6.83 <sup>cd</sup>	6.38 <sup>b</sup>	6.93 <sup>c</sup>
ICE02	7.73 <sup>b</sup>	8.07 <sup>a</sup>	7.23 <sup>bc</sup>	6.93 <sup>a</sup>	7.52 <sup>b</sup>
ICE03	8.03 <sup>a</sup>	8.02 <sup>a</sup>	8.03 <sup>a</sup>	6.93 <sup>a</sup>	8.03 <sup>a</sup>
ICE04	7.95 <sup>a</sup>	8.13 <sup>a</sup>	6.40 <sup>d</sup>	6.38 <sup>b</sup>	6.93 <sup>c</sup>
ICE05	7.95 <sup>a</sup>	8.13 <sup>a</sup>	7.12 <sup>c</sup>	6.93 <sup>a</sup>	7.50 <sup>b</sup>
ICE06	8.03 <sup>a</sup>	7.98 <sup>a</sup>	7.70 <sup>ab</sup>	6.93 <sup>a</sup>	7.70 <sup>ab</sup>

**Note :** a - b, the different alphabets in the horizon means the average which there are statistical differences ( $p \leq 0.05$ ), \* Values within column followed by a different letter are significantly.

From the study of yoghurt ice cream by adding two types of fat replacers, they were Purity SM100 and CRYSTAL tex™ 648 at 10, 15 and 20 percentage of a quantity, the results of this study in Table 5 were as follows: the aspect of color factor of the probiotic yoghurt ice cream showed that there were no significant differences ( $p \geq 0.05$ ), in the part of taste, flavour, texture and total preference of yoghurt ice cream that used both types of fat replacers had significant difference ( $p \leq 0.05$ ). It was found that yoghurt ice cream which have added CRYSTAL tex™ 648 gave better flavour. In the part of

taste, it was shown that in every samples had significant difference ( $p \leq 0.05$ ) in the sample ICE03 added 20% Purity SM100, it was most accepted. In the aspect of texture, the examiner accepted the sample added the substances at 15-20% from the table 5 : the samples ICE02, ICE03, ICE05 , and ICE06 had significant difference ( $p \leq 0.05$ ). With the samples ICE01 and ICE04 added the fat replacer at 10%, in the part of total preference the probiotic yoghurt ice cream that was accepted most from the examiner was ICE03 which was added 20% Purity SM100 in the ice cream. Because this example gave the feeling of yogurt taste, including the feeling of smooth on the tongue more than other examples so there was significant difference ( $p \leq 0.05$  with other examples. It summarized that the example of probiotic yoghurt ice cream that was accepted in the aspect of sensory from the consumers most was ICE03. From the analysis of fat and protein quantity in the example ICE03, it was found that protein quantity in the products was equal to 13.97 and the fat quantity was equal to 10.13.

#### 4. The study of lactic acid bacteria quantity between keeping the probiotic yogurt ice cream

The study results on the quantity of probiotic microorganism used as the yoghurt microbe in the yoghurt products. When the ice cream has been spun with the ice-cream maker for 20 minutes and the **lactic acid bacteria quantity was analyzed**: *S.thermophilus*, *L.acidophilus* and *B.bifidum* were kept at  $-20^{\circ}\text{C}$  for 4 weeks in order to check the amount of probiotic microorganisms remaining in the products. When it was compared with the probiotic microorganism, it would analyze the quantity of probiotic microorganism after the ice cream has already spun (Table 6)

From the table, it was indicated that every ice cream samples had initial microorganisms during  $10^9 - 10^{10}$  CFU/ml excepted the ice cream formula of the Control sample. At the beginning it had microorganism quantity , *B.bifidum*, in lesser quantity than other examples: there were microorganism quantity during  $10^8$  CFU/ml. But when it was analyzed statistics, it was shown that the microorganism quantity in every samples had no significant difference ( $p \geq 0.05$ ). In the part of checking the microorganism, *E.Coli*, which was used as the indicator of cleanness of the processing procedure, the analysis results did not find *E.Coli* microorganism.

Table 6 The quantity of probiotic microorganism in the products in the fourth week

Samples	Quantity of Microorganism			
	Lactic Acid			
	Bacteria	<i>S.thermophilus</i>	<i>L.acidophilus</i>	<i>B.bifidum</i>
Control 1	80 x 10 <sup>5c</sup>	1 x 10 <sup>6c</sup>	39 x 10 <sup>6b</sup>	45x 10 <sup>6</sup>
ICE01	40 x 10 <sup>7c</sup>	15 x 10 <sup>8a</sup>	49 x 10 <sup>7b</sup>	50x 10 <sup>6</sup>
ICE02	90 x 10 <sup>7c</sup>	17 x 10 <sup>8a</sup>	70 x 10 <sup>7b</sup>	90 x 10 <sup>7</sup>
ICE03	49 x 10 <sup>8a</sup>	14 x 10 <sup>8ab</sup>	90 x 10 <sup>8a</sup>	65 x 10 <sup>7</sup>
ICE04	40 x 10 <sup>7c</sup>	65 x 10 <sup>7ab</sup>	47 x 10 <sup>7b</sup>	55 x 10 <sup>6</sup>
ICE05	30 x 10 <sup>8b</sup>	75 x 10 <sup>7ab</sup>	88 x 10 <sup>8a</sup>	55 x 10 <sup>7</sup>
ICE06	55 x 10 <sup>8a</sup>	10 x 10 <sup>8bc</sup>	88 x 10 <sup>8a</sup>	40 x 10 <sup>7</sup>

**Note** : a - b , the different alphabets in the horizon means the average which there are statistical differences

( $p \leq 0.05$ ) , \* Values within column followed by a different letter are significantly

Changing the quantity of yoghurt microbe, and probiotic microorganism, Lactic Acid Bacteria, *S.thermophilus*, *L.acidophilus*, and *B.bifidum* when they have been kept at -20°C for four weeks. It was found that the microorganism quantity inclined to decrease during keeping. Making a comparison between the table 7, 8, 9 and 10 which were microorganism quantities in the first, second, third and fourth weeks, respectively with the table 6, which the microorganism quantities were analyzed after the procedure of spinning ice cream.

*S.thermophilus* in the examples tended to decline since the zero week which *S.thermophilus* would begin to decrease the quantity quickly down in the third to fourth week by decreasing from 10<sup>10</sup> CFU/ml to 10<sup>7</sup>- 10<sup>8</sup> CFU/ml of all samples which added the fat replacer, Purity SM 100 and CRYSTAL tex<sup>TM</sup> 648 , in the last week, the samples that added Purity SM 100 at 15 percentage of a quantity.

It contributed to cover most microorganism cell, *S.thermophilus*, following with the sample that added Purity SM100 at 20 and 10 percentage of a quantity, respectively. In the part of fat relacer, CRYSTAL tex<sup>TM</sup> 648, the quantity that helped to cover most cell of *S.thermophilus*, that was fat replacer at 20 percentage of a quantity. But when the amount of cell microorganism, *S.thermophilus*, as taken to analyze statistics, it was found that the remaining microorganism quantity of every examples had no significant difference ( $p \geq 0.05$ ).

*L.acidophilus* tended to decline between keeping it, but during the first and second weeks the amounts of *L.acidophilus* increased a little, and decreased continuously. At the end of the last week,

it was found that ICE03, which added the fat replacer, Purity SM 100 at 20 percentage of a quantity, was the example that left most amount of *L.acidophilus*. In the part of ICE05 and ICE 06, which added CRYSTAL tex™648 at 20 and 15 percentage of a quantity, respectively, having the amount of *L.acidophilus* at  $10^8$  CFU/ml. ICE 04 which added CRYSTAL tex™648 at 10 percentage of a quantity remaining microorganism quantity at least. When it was analyzed statistics, it was found that ICE03, ICE05 and ICE06 had significant difference ( $p \geq 0.05$ ) with the samples ICE01, ICE02, ICE04, and the Control.

*B.bifidum* tended to decrease continuously, but it decreased quickly during the third and fourth weeks, ICE 02 had quantity of *B.bifidum* remaining most. Following with ICE 03 from table 10, It was indicated that adding the fat replacer, Purity SM 100, and CRYSTAL tex™648 at 10 percentage of a quantity which had an effect on *B.bifidum*, remaining at  $10^6$  CFU/ml. In the part of adding Purity SM 100 and CRYSTAL tex™648 at 15 and 20 percentage of a quantity which had an effect on *B.bifidum*, remaining at  $10^7$  CFU/ml.

Decreasing the amount quickly, it caused from the microorganism cell was pierced by the ice crystal as it was kept for a long time, and the water of ice cream which became ice. So it could not take the nutrient to the microorganism cell (Dave and Shah, 1997). But *S.thermophilus*, *L.acidophilus* and *B.bifidum* had cell wall as gram positive, which was the characteristics of the microorganism that resisted freezing. Therefore, keeping the probiotic yogurt ice cream at  $-20^\circ\text{C}$ , it made the quantity reduction of probiotic microorganism occurred very slowly (Adams and Moss, 2000)

From the above experiment, it was indicated that both Purity SM 100 and CRYSTAL tex™648 used as the fat replacer in the yoghurt ice cream products. They had properties in covering the probiotic microorganism in ice cream products when it compared with the yoghurt ice cream formula in the control sample which did not add any fat replacer in the ice cream. The control formula would have remaining microorganism remains during  $10^5 - 10^6$  CFU/ml. In the part of other ice cream formula that added the fat replacer in the ice cream, the microorganism quantity would be left during  $10^7 - 10^8$  CFU/ml. If making the comparison on the quantity microorganism remaining in the sample that added Purity SM 100 and CRYSTAL tex™648, it was found that the remaining microorganism was not different. But using Purity SM 100 would be accepted by more consumers, they would find that it was soft and helped to pull the taste of yoghurt ice cream better than the ice cream which added CRYSTAL tex™648.

## Discussion and Conclusion

1. The period of time on fermenting yogurt which was appropriate was 7 hours, by ripening at 40°C. It would make yoghurt had a quantity of lactic acid bacteria at 0.90-0.97 percentage by using the yoghurt microbe and mixed with *Lactobacillus acidophilus*, *Bifidobacterium* and *Streptococcus thermophilus*.

2. The fat replacer which was appropriate for using with the formula of making yoghurt ice cream. It was Purity SM 100, by using it in stead of the whey at 20 percentage of a quantity. Purity SM 100 would help to cover the cell of probiotic microorganism in the yoghurt ice cream products in order to have the amount of surviving microorganism more than using CRYSTAL tex™ 648. That was making the microorganism quantity, remaining during  $10^7$ -  $10^8$  CFU/ml and more than the production in the normal formula that did not add any fat replacer in the ice cream, by remaining the probiotic microorganism only  $10^7$ -  $10^8$  CFU/ml.

3. The formula of probiotic yoghurt ice cream that was accepted in the sensory aspect from most consumers was ICE03, which added Purity SM 100 in the ice cream at 20 percentage of a quantity. As a result of the flavour, taste, texture and total preference which were better, including the ice cream was soft better than using CRYSTAL tex™ 648. But CRYSTAL tex™ 648 is one of the good kind of fat replacer because it has a property in replacing the fat and it has the property in helping to cover the microorganism cell in order to have the amount of microorganism remaining survived as using Purity SM100. Although they were left in the a little quantity but they could make the consumers to receive the benefit in the aspect of probiotics better than consuming the yoghurt ice cream that did not add Purity SM 100 and CRYSTAL tex™ 648.

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The East Asiatic (Thailand) PLC

## Low Calorie Soy Milk Product Fortified with Beta-Carotene

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### Abstract

The purposes of the study on low calorie soy milk product fortified with beta-carotene were 1) to study the suitable content of carrot, which was one source of beta-carotene, and sugar 2) to study the physical and chemical quality of the product 3) to study shelf- life of the product and 4) to investigate the product acceptance. Standard soy milk formula was studied and fortified with 3 levels of carrot and reduced 4 levels of sugar content. The 3x4 factorial Design was used to experiment and 9-points hedonic scale was used for sensory evaluation from 30 panelists.

The results were found as follows:

1. For the content of carrot and sugar, the panelists had the acceptance of carrot with 2000 gram and 65% of sugar reduction. The use of carrot and sugar had significant ( $p < 0.05$ ) effects on over all liking and milk's taste.

2. For the physical quality, it was found that  $L^*$  value was 6.50,  $a^*$  value was 20.13,  $b^*$  value was 10.44, viscosity was 27.80 centipoint, total soluble solid was  $11.33 \pm 0.01$  degree Brix and ph was 6.55. For the chemical quality, 100 gram of soy milk fortified with beta-carotene contained 37.45 kcal energy, 2.48 g protein, 0.01 g fat, 6.86 g carbohydrate and 3.18 ml beta- carotene.

3. For shelf-life study, it was found that the product did not change when kept in the temperature of 7 degree Celsius for 0-10 days except for 11-14 days. Total bacteria count was  $4.8 \times 10^3$  CFU/cm<sup>3</sup> when compared to Thai Community Product Standard (529/2547), it should be found lower than  $1 \times 10^4$  colony/ 1 cm<sup>3</sup>. It was evidently found that low calorie soy milk fortified with beta-carotene was safety for consumer when kept for 14 days.

4. For the product acceptance, it was found that 93% of the consumer satisfied the product price of 10 baht per 200 ml consumption.

Key words: Soy Milk, Beta-Carotene, Low Calorie

## Introduction

### Research Problems

Soy milk or soybean milk is a healthy and popular beverage which is high in protein, linoleic acid, phospholipids acid in lecithin which helps increasing HDL cholesterol, phytoestrogen which is estrogen hormone-like chemicals naturally found in plants especially in soy bean and it is naturally lactose free but it contains sucrose sugar which is another alternative for people who are allergic to cow's milk or have diarrhea. Therefore, soy milk is suitable to be a food supplementary because of its cheap price. Carrot is a source of beta-carotene which is a precursor of vitamin A and antioxidant compounds which prevent oxidation reactions, degenerative eye diseases maintain skin health and reduce heart diseases and coronary risk. Nowadays, beta-carotene substances synthesized with chemical processes, bacteria, fungi, yeast and algae increases cancer risk. Carrot juice is another beverage which is risk of bacteria contamination. Also, sugar-sweetened beverage is a risk of being overweight and high energy.

### Research Objectives

1. To study the suitable content of carrot and sugar in low calorie soy milk product fortified with beta-carotene.
2. To study the physical and chemical quality of low calorie soy milk product fortified with beta-carotene.
3. To study shelf- life of the product
4. To investigate the product acceptance.

### Methodology

1. Study 3 of original formulae of soy milk and evaluate sensory testing by 9-points hedonic scale with 30 panelists, who are expert in the art of food and drink, from Food and Nutrition Department and Food Science and Nutrition Department, Faculty of Home Economics technology, Rajamangala University of Technology Phra Nakhon. Carrot supplement and sugar reduction were added in the acceptable original formula in order to increase beta-carotene and reduce energy in soy milk.

2. Study carrot supplement and sugar reduction in soy milk to increase beta-carotene and reduce energy by adding 3 levels of carrot content; 1200, 1600, and 2000 gram of standard formula and adding 4 levels of sugar content; 65%, 75%, 85%, and 95%. 3x4 factorial Design was used to experiment



### 3. Study the product quality

#### 3.1 Study the physical quality of soy milk for 3 formula in the following aspects;

- 3.1.1 Measurement of color quality
- 3.1.2 Measurement of viscosity value
- 3.1.3 Measurement of the soluble solids
- 3.1.4 Measurement of ph value

#### 3.2 Study the nutritive value of low calorie soy milk fortified with beta-carotene in the following aspects;

- 3.2.1 Energy content analysis
- 3.2.2 Protein content analysis
- 3.2.3 Carbohydrate content analysis
- 3.2.4 Fat content analysis
- 3.2.5 Beta- carotene content analysis

4. Study shelf-life of the product which was kept in the temperature of 7 degree Celsius and bacteria counts after stored for 2, 4, 6, 8, 9, 10, 11, 12, 13, 14 days to study the change in total bacteria counts

5. Study the product acceptance from the consumers by using 100 of questionnaires dividing into 4 parts of general information, behavior and attitude information, nutrition information and product acceptance information. Data were analyzed by frequency and percentage.

6. Data analysis was done by ANOVA and compare means of 3 formulae of product by Duncan's new multiple range test (DMRT) and statistical significance level set at 0.05

### Results of the Study

1. The acceptable formula of soy milk was from Thailand Institute of Scientific and Technological Research. The sensory evaluation of the panelist for overall liking, color, smell, taste and texture was 7.40, 7.70, 7.17, 6.87 and 7.27 respectively. The product ingredients were 500 gram of hulled soybean (8.33%), 5000 gram of water (83.34%) and 500 gram of sugar (8.33%)

2. For the study of carrot supplement and sugar reduction in soy milk to increase beta-carotene and reduce energy, it was found that the panelists had the acceptance of carrot with 2000 gram and 65% of sugar reduction. The sensory evaluation for the overall liking, taste and texture was 8.10, 8.10 and 7.60 respectively. The product ingredients were 500 gram of hulled soybean (6.51%), 5000 gram of water (65.15%), 2000 gram of carrot (26.06%) and 175 gram of sugar (2.28%).

### 3. The study of product quality

#### 3.1 The study of physical quality

3.1.1 For the physical quality, it was found that L\* value was 17.55, a\* value was 13.38, b\* was 29.79, viscosity value was 17.33 centipoise, total soluble solid was 14.83 degree Brix and pH was 6.77.

3.1.2 For the study of carrot supplement and sugar reduction in soy milk to increase beta-carotene and reduce energy, it was found that the panelists had the acceptance of carrot with 2000 gram and 65% of sugar reduction. L\* value was 6.50, a\* value was 20.13, b\* was 11.33 and pH was 6.55

3.2 From the study the nutritive value of low calorie soy milk fortified with beta-carotene, it was found that the panelist had the acceptance of ingredients consisting of 500 gram of hulled soybean, 5000 gram of water, 2000 gram of carrot and 175 gram of sugar. Nutritive value was composed of 37.45 kcal of energy, 90.28 gram of moisture, 2.48 gram of protein, 0.01 gram of fat, 6.86 gram of carbohydrate, 0.37 gram of ash and 3.18 milligram of beta-carotene.

4. For the study shelf-life of the product kept in the temperature of 7 degree Celsius and stored for 0-10 days, it was found that the product did not change except for 11-14 days. Total bacteria count was  $4.8 \times 10^3$  CFU/cm<sup>3</sup> when compared to Thai Community Product Standard (529/2547), it should be found lower than  $1 \times 10^4$  colony/ 1 cm.<sup>3</sup> It was evidently found that low calorie soy milk fortified with beta-carotene was safety for consumer when kept for 14 days.

5. For the product acceptance from 100 of consumers, it was found that most of the consumers were knowledgeable in nutrition, the consumer had the acceptance on the low calorie product fortified with beta-carotene, the overall liking was at the medium level and the consumer satisfied the product price of 10 baht per 200 ml consumption.

### Results and Discussion

Low calorie soy milk fortified with beta-carotene product not only reduced sugar of 65% but also lowered the fat and energy. However, it affects beta-carotene digestion. Therefore, this product should be a food supplementary. When kept for days, it is precipitated. For industry production, hydrochloride may be used to prevent the precipitation or stick with "Shake before drinking" on label package.

## Recommendation

1. Soy milk fortified with beta-carotene product in this study contains lower fat and serves low energy when compared to standard one, so it affects beta-carotene digestion. Therefore, this product should be a food supplementary.

2. When soy milk fortified with beta-carotene product is kept for days, it is precipitated and uninteresting. For the further study, suspendible composition should be used to prevent the precipitation of soybean fortified with beta-carotene.

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## Development of Thai Style Handmade Paper from Sugar Cane Leaves for Handicraft and Package

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### Abstract

The objectives of this work are to develop the technique of making paper from sugar cane leaves, to make the prototype products made from the developed paper, and then transfer the technology to the selected groups. The study included 5 steps: (1) select the target group of 60 people from sugar cane farmers, community enterprise group, and general public in Lopburi province, (2) make the prototype products and present to public, (3) prepare the tools for transferring the technology, (4) transfer the developed technology, and (5) evaluation and statistical analysis including frequency, percentage, mean, and standard deviation.

The general information of the 60 trained people can be summarized as follows: 80.00 % is female, 26.67 % is 31-40 years old, and 40.00 % is sugar cane farmer. The objectives, content, activities, and training method were evaluated to be the best suitable. The structure of the course was found to be the most suitable. More over, the materials, training documents, and place were rated to be the most suitable to the best suitable.

## Introduction

Thailand is one of the world leading country of sugar export. There are plenty areas of sugar cane plantation, especially in the central part of the country. After harvesting process, there are a lot of wasted sugar cane leaves left over. Usually, the farmer burns the leaves at the field. This creates a lot of CO<sub>2</sub> emission, which will affect on the global warming. Therefore, this work is proposing a solution to solve this problem by utilizing the wasted sugar cane leaves as a raw material for making paper and then using it to produce handicrafts and packages.

The objectives of this work were to develop the technique to make paper from sugar cane leaves and to make prototype handicraft and packaging products using the obtained paper. Consequently, the developed technique was transferred to the selected groups, especially the sugar cane farmers.

## Experimental

The sugar cane leaves were dried and then boiled with sodium hydroxide solution (30 % w/w) at 100 °C, 5 hours. The obtained pulp was then bleached with hydrogen peroxide (8 % w/w), sodium silicate (2 % w/w), magnesium sulphate (0.05 % w/w), and sodium hydroxide (1.5 % w/w) at 100 °C, 2 hours. Next, the bleached pulp was mixed with *Broussonetia papyrifera* pulp (70:30) and dispersed with an aid of U-ramin PN-S (0.05 % w/w) as disperser. The formed sheet was 72 x 84 cm. having a density of  $90 \pm 5 \text{ g/m}^2$ . After drying, it was coated with konjac solution (0.5 % w/w) and then dried again. The physical properties of the paper were tested following standard methods. The designed art works were printed on the paper. Subsequently, the selected prototype products were made.

The training course was designed including techniques for making paper from sugar cane leaves and selected paper products. The target groups of 60 people totally were small and micro community enterprise and farmers in Taluang Distric, Lopburi Province. The training was conducted at T. N. Sugar Plant (Wangkanai Group) Lopburi for 3 days (6 hours per day).

## Results and Discussion

The obtained yield of pulp from sugar cane leaves was 45.40 % of dried leaves. After bleaching, the pulp had the brightness close to that of unbleached *Broussonetia papyrifera* pulp. The fold strength, tensile strength, tearing strength, smoothness, bursting strength, and brightness of formed paper were 109.66 times, 20.88 N.m/g, 31.38 mN.m<sup>2</sup>/g, 0.93 seconds, 1.74 kPa.m<sup>2</sup>/g, and 58.23 %, respectively.

In addition, it was found that the paper could adsorb the printing ink very well during the printing process. Three products: baskets, lampshade, and drawer set were chosen to be developed as prototypes using the obtained paper. The pictures of finished products are shown in Fig. 1-3.



Figure 1 Baskets



Figure 2 Lampshade



Figure 3 Drawer set

Finally, the developed technology was digested into simple training materials starting from the paper making to how to make the finishing products. Then, it was transferred to the target group that are 60 people selected from the small and micro community enterprise and farmers in Taluang Distric, Lopburi Province. Most of them are female (80 %), 31-40 year old (26.7 %) and sugar cane farmers (40 %). The training was conducted at T. N. Sugar Plant (Wangkanai Group) Lopburi for 3 days (6 hours per day). The trainees were asked to evaluate the curriculum in all aspects. It can be summarized in Table 1.

Table 1 Evaluation result on the training course

Aspect	Level of Satisfaction
Structure of the curriculum	high
Objectives of the curriculum	highest
Content of the curriculum	highest
Activities	highest
Training method	highest
Training materials	high - highest
Training documents	high - highest
Place	high - highest

In term of criteria of product, which they concern, it was found that the most concern was function following by image of the product. It should be noted that the color and texture of the sugar cane leaf paper are quite unique and make it be suitable for handicraft. However, the product design is also important.



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# The Development of Indian Women Dresses of Punjabi Style Made by Weaving Cotton Fabric from the North-eastern Part of Thailand

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## Abstract

The purpose of this research was to study the development of Indian women dresses of Punjabi style made by weaving cotton fabric from the north-eastern part of Thailand. The sampling group was 250 Indian women who live in Bangkok selected by Quota Sampling and analyzed by SPSS.

The research result found that the sampling group of people was married and under 30 years old were undergraduate degree or equal level. They were house wives with average income of 15,001-20,000 baht per month. Most of them were born and lived in Thailand. They liked to use north-eastern Thailand cotton handmade dresses which could be affordable in Pahurat, the Central of Bangkok. The reason why Indian women bought this kind of fabric and turned it into Indian Women dresses of Punjabi style because it was suitable and could be worn in many social occasions.

The analysis result found that the five different kinds of north-eastern Thailand handmade weaving cotton fabric including their colors and designs could affect to the satisfaction of the development of Indian Women dresses of Punjabi style. The satisfaction in types of fabrics differed at the statistical significance level of .05. The satisfaction in touching surfaces of fabrics did not differ at the statistical significance level of .05.

**Keywords:** North East Thailand handmade weaving cotton fabric, Indian Women dresses of Punjabi

## Introduction

Of four necessities for human being, clothes are very important for their living. They are fabric clothing materials woven to have worn for a long time.<sup>(1)</sup> So, weaving is a job of art handed down from generation to generation which made such a fabric natively women important for a way of life and at the same time it creates tradition for the native. Nowadays, it is not made only for use of oneself and family but also for development to be a career and get income suitable for the living cost. By taking the clothing materials to be woven to produce clothes as a family industry,<sup>(2)</sup> especially the hand-woven cotton fabrics of the north-eastern region, it makes the value added. In doing so, this brought to the products quality development in producing process, alteration and packing design. For the products of women's fabrics already made, its market served is minor; but in majority its market is found in the area of its own production and in some places near Thailand. Due to small numbers of those products exported to sell in the foreign countries, it will be highly possible if development in styles or fashions of producing women's clothes is improved by using the hand-woven cotton fabrics in the north-eastern region of Thailand to properly match with the need or fashionability of each country; and that will be their promotion and make Thai cloth fabric well known in public and there can also be more trend in exporting Thai clothing material fabrics to foreign countries.

India is the country well related to Thailand for a long time since the historic periods of Sukhothai-Ayudhya. The record of China showed vividly that in the period of Sukhothai, these were kinds of clothing materials being used as valuable garments for the kings and high officials. Apart from these clothing materials, in the styles of dressing at that time, Thai people both men and women would keep their hair long hung together as a lock, wrap around their heads with a cotton fabric, wear gown with long sleeves made of cotton and wear shorter garment like dressing of Indian people wear white garments and long-sleeved shirts, and have long hair with cloth wrapping around their heads; but women wear Saris or pleated shirts or trousers and wrap their heads with cloth. Manners of wearing and covering are prepared by wrapping the body like that of the monk.<sup>(3)</sup> Now, we can see a lot of Indian people coming to live in Thailand. Most of them stay at the garments markets-Pahurat and Sampeng and sell many kinds of garments/cloths there. They have their own identity in dressing. Men wear Kurtas and Churidars but women wear Sulvakamiti or Punjabi styles which are popular in modern Indian.<sup>(4)</sup> And this style – Sulvakamiti dress is widely popular for Indian

women. It is the style that they have worn to go for work, to school, the temple and to other places in every part of the country.<sup>(5)</sup>

As mentioned above, Indian has had a good relationship with Thailand for a long time; and there were Indian women or Thai ones with Indian lineage living in Thailand who still wore the Indian dress-an original fashion to be popular for their wearing in general-Punjabi dress style.<sup>(6)</sup> And if development of the style of Indian women's dresses are made to design by use of the hand-woven cotton fabric of the north-eastern region in Thailand, it will be a way in promotion and create more tendency to export Thai fabrics and clothing materials. In fact, such a hand-woven cotton fabric of the north-eastern region in Thailand is suitable for making Indian women's dress in Punjabi style. This is because it has its gentle surface to be touched; and it can also be comfortably worn, absorb moisture and perspiration and ventilate heat well. Besides, its pattern/stripe has similarity to the hand-woven cotton fabric in India which such a weave with hands of both Thai and Indian have a prominence in weaving of Mudmi cotton fabric. Moreover, its feature of unique and individual hand-woven fabric can indicate relationship of social characteristics and a community race in the tradition.<sup>(7)</sup>

Therefore, in order to promote and develop the product styles of clothes and garments made of the hand-woven cotton fabrics of the north-eastern region, there was a study of this research on: The development of Indian Women dresses of Punjabi style made by weaving cotton fabric from the north-eastern part of Thailand. Its purposes were to develop the Indian women's dresses of Punjabi style by using the hand-woven cotton fabrics of the north-eastern part to be designed for making the women's dresses, using a style obtained from the Indian women's dresses of Punjabi style as its basis and to study satisfaction of Indian women or Thai ones with their Indian lineage effective to development of the Indian women's dresses of Punjabi style which can respond of Punjabi style which can respond to the consumers' needs and make Thai fabrics materials more known to both Indian people living in Thailand and those who made journeys from India to Thailand and vice versa, including to people from other countries.

### **Procedures**

The Development of Indian Women dresses of Punjabi style made by weaving cotton fabric from the north-eastern part of Thailand was a survey research from 250 Indian or Thai - Indian women from 5 places. There were 50 people in each place. They were selected with purposive

sampling and quota sampling.

The tools used in this research were sample of 5 models of hand-woven cotton fabrics from the north-eastern part of Thailand. Each model contains of 3 patterns, a total of 15 samples and some questionnaires about satisfaction of such samplings.

### 1. Sample model

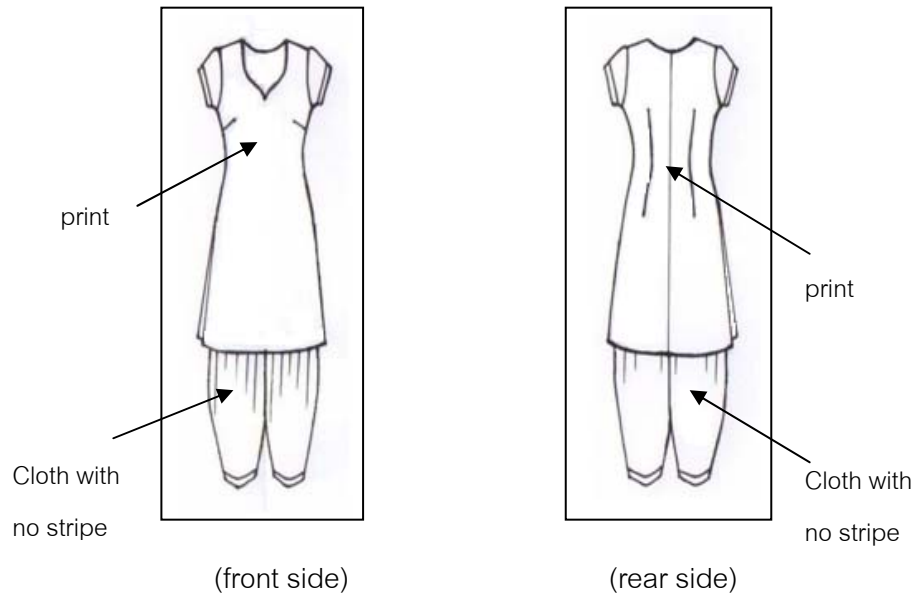


Figure 1 : Sample model – blouse and trousers

2. 5 types of hand – woven cotton fabrics from the north – eastern part, each has 3 prints.

The first type is Mudmi cotton fabrics indigo and fermented with mud.



Sample 1



Sample 2



Sample 3

The second type is Mudmi cotton fabrics dyed indigo, fermented with mud and inserted with braid.



Sample 1



Sample 2



Sample 3

The Third type is Khid cotton fabric.



Sample 1



Sample 2



Sample 3

The Fourth type is cloth with tabular stripes.



Sample 1



Sample 2



Sample 3

The fifth type is cotton fabric with Kled Tao stripes (ancient ones).



Sample 1



Sample 2



Sample 3

In its data collection, the researcher gave out the questionnaires about satisfaction to the samplings in several places and took them back to have proceeded. The data were analyzed by using frequency, percentage, mean and comparative analysis to find difference of mean of satisfaction in development of Indian women's dresses of Punjabi style made by weaving cotton fabrics from the north – eastern part to experiment its assumption by a method of T – test.

Its results presentation consisted of frequency table, percentage, mean and standard deviation. And when the statistical results were obtained, their methods were used to have presented :

1. Narration given to show the data table

## 2. Description given to explain and conclude

### Results of Experimentation

Basic data and those on using the hand – woven cotton fabrics from the north – eastern part :

The majority of the samplings have marriage status and most of them are under 30 years of age being 21.2 percent; and in the second, they have their 50 – 55 years of age being 20.0 percent. Bachelor degree or equivalent is their education, their occupation is the most housewife being 42.0 percent and in the second, they make their living by private career being 32.0 percent. Their average income per month is Baht 15,000 to 20,000. And the majority of women have lived in Thailand since they were born. Such the samplings know the hand – woven cotton fabrics from the north – eastern part of Thailand. They are interested and used to use them, especially by making a blouse. The place where they like to shop such hand – woven cotton fabrics is Pahurat. Their season for buying them is personal liking. And the majority of those women agree with use of the hand – woven cotton fabrics from the north – eastern part to make Indian women’s dresses of Punjabi style because they are suitable for being able to wear for the social parties on various occasions. Results of satisfaction in development of Indian women’s dresses of Punjabi style obtained from those samplings who answered the questionnaires.

The results obtaining from studying the satisfaction in development of Indian women’s dresses of Punjabi style by using the hand – woven cotton fabrics from the north – eastern part of Thailand were found as follows :

- In their types, the fifth type with Kled Tao stripes (ancient ones) had mean and its highest satisfaction being at a high level.

- In their touching surfaces, the first type of a sample 2 had mean and its highest satisfaction being at a high level and the third type of a sample 2 had mean and its highest satisfaction being at a high level.

- In their patterns/stripes, the third type of a sample 2 had mean and its highest satisfaction being at a high level.

- In their other sides, as compared with the satisfaction criteria of such type of the said cotton fabrics, the total mean was found as below :

- The first type of Mudmi cotton fabric dyed indigo, fermented with mud in a sample 3 had mean and its highest satisfaction being at a medium level.

- The second type of Mudmi cotton fabric dyed indigo, fermented with mud and inserted with braid in a sample 3 had mean and its satisfaction being at a medium level.

- The third type of Knid cotton fabrics in a sample 2 had mean and its highest satisfaction being at a high level.

- The fourth type of clothes with tabular stripes in a sample 2 had mean and its highest satisfaction being at a medium level.

- The fifth type of cotton fabric with kled Tao stripes (ancient ones) in a sample 2 had mean and its satisfaction being at a medium level.

Upon consideration in general from mean and satisfaction level of the samplings in development of Indian women's dresses of Punjabi style by using the hand – woven cotton fabrics in five types, mean and their satisfaction were found to be at a medium level.

In their studies, assumption experiment results were obtained :

- In the first assumption, five types of hand – woven cotton fabrics the north – eastern part were in relation with satisfaction in different types of the said cotton fabrics. And five different types of hand – woven cotton fabrics from the north – eastern part effective to satisfaction in types of fabrics differed at the statistical significance level of .05 .

- In the second assumption, five types of hand – woven cotton fabrics from the north – eastern part were in relation with satisfaction in different touching surfaces. And five different types of hand – woven cotton fabrics from the north – eastern part effective to satisfaction in touching surfaces of fabrics did not differ at the statistical significance level of .05.

- In the third assumption, five types of hand – woven cotton fabrics from the north – eastern part were in relation with satisfaction in different colours of fabrics differed at the statistical significance level of .05.

- In the fourth assumption, five types of hand – woven cotton fabrics from the north – eastern part were in relation with satisfaction in different patterns/stripes of fabrics. And five different types of hand – woven cotton fabrics from the north – eastern part effective to satisfaction in patterns/stripes of fabrics differed at the statistical significance level of .05.



### Conclusion of the Experiment Results

The development of Indian women's dresses of Punjabi style made by weaving cotton fabric from the north – eastern part could indicate that there was still a way in development of Indian dresses of Punjabi style by using the hand – woven cotton fabrics from the north – eastern part to be designed to make the dresses for men based on the Punjabi style.

We could see different characteristics of hand – woven cotton fabrics from each type their touching surfaces, colors and their patterns/stripes. So, in order to bring about their diversities, the viewpoints have been used to develop the products in making them better or the best – new fashions/features in several ways such as models and materials replaced by novelty as well as by changeability of new looks. Apart from these, such new materials are changed, altered and adjusted suitably from original ones such as their colors and shapes. And these is some information on the products as media to make the consumers known and understood and to create good images for them. This would be recognized by a lot of people targeted, including their targets set and their demand of using the products. So, after having seen the models or characteristics of each dress and after having touched the fabrics/clothing materials of each type,<sup>(9)</sup> the majority of Indian women and Thai ones with Indian lineage are interested and agree to have used Indian women's dresses of Punjabi style by using the hand – woven cotton fabrics from the north – eastern part of Thailand as considered important and able to respond to the consumers' needs.

### Suggestion for Future

1. A comparative study of satisfaction among many groups of consumers should be made.

A study of needs between Indian people living in Thailand and Indian ones living in India is effective to development of Indian women's dresses of Punjabi style by using the hand – woven cotton fabric from the north – eastern part.

2. A more study of satisfaction in other kinds of products, clothes and dresses – Sari, an evening dress, a casual wear/dress, Other national sets of clothes and so on.

3. The same study of features should be made but there should be change and adjustment of using other fabrics with various colors to have developed them as Indian women's dresses.

4. A study of relationship should be made between fundamentals, such as ages, educational levels, careers, income, etc. and satisfaction in Indian women's dresses of Punjabi style by having used the hand-woven cotton fabrics from the north-eastern part.

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# Silk Degumming with Dried Latex of *Carica Papaya* Linn

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## Abstract

Degumming process is a fundamental finishing process for silk yarn and silk fabric. The main objective is scouring the substrate such as silk gum (sericin), wax and some impurities from silk fiber. The principle of degumming process is breaking the peptide linkage of amino acid in sericin structure into a small molecule, which is soluble in water. The hydrolysis reaction performed by acid and alkaline, but they have a big problem on the surface area of silk. Proteolytic enzyme be used to solve this problem but it has some disadvantages such as it was using a specific condition and expensive. For this reason, this research chooses papain enzyme form dried latex of *Carica papaya* Linn. to degum the raw silk. The efficiency of degumming process was evaluated by determination of tensile strength and staining test with direct dyes (C.I. Direct Red 80). The result was revealed; the appropriate conditions for silk degumming with dried *Carica papaya* Linn.'s latex be recommended as follows: the amount of dried latex solution of 4 % owf at 75 degree Celsius for 30 minutes, in this condition was not harm to strength and fiber surface. The degummed fibers still had lustrous, soft and smooth surface.

Keywords : degumming, sericin, papain

## 1. Introduction

Silk is a protein fiber that consists with 2 main parts called fibroin (fiber part approximately 62.5 – 67.0 %) and silk gum called sericin (approximately 23. – 27.5 %). Sericin acts as an adhesive for the twin fibroin filaments and conceals the unique luster of fibroin. Sericin contains some impurities such as waxes, fats and pigments. Thus, need to remove sericin (degum) that cover on the fiber surface in order to obtain a luster, soft handle and the other desired properties for further process. Principle of silk degumming process is increasing the silk gum solubility by breaking the peptide linkage of sericin structure into small molecule such as amino acid and its oligomer with hydrolysis reaction. Silk degumming can be performed by various methods such as using alkaline and synthetic detergent. However, alkaline condition are harmful to silk fiber because silk has poor resistance to alkaline. Nowadays, proteolytic enzyme be used to solve this problem but it has some disadvantages about specific condition and high costs. For this reason, this research chooses papain prepared from dried latex of *Carica papaya* Linn. as proteolytic enzyme to degum the raw silk instead of conventional degumming agent. Thus, the main purpose of this work is to study about silk degumming with dry latex of papaya and its affective factor such as concentration and condition (temperature and time).

## 2. Experimental

### 2.1 Materials

*Bombyx mori* silk was selected as a material for degumming process with papain enzyme prepared from dried latex of *Carica papaya* Linn. Papain is obtained by cutting the skin of the mature papaya (approximately 2 - 3 months of age) 1/8 inch deep, then collecting the latex which flows from the cuts and left in the sun to evaporate some water. After that the latex was dried in the oven at 55 °C until the latex is crumbly and ground into a white powder. Hirus Supra Red 3BL 140% (C.I. Direct Red 80) donated by Phisit Intergroup. ECE Phosphate Reference Detergent FBA free (Union TSL Co., Ltd.) used soap for degumming. All other chemicals were of commercial grade and purchased from A.N.Y. Product Co., Ltd.

### 2.2 Degumming process

#### - *Silk degumming with dried papaya's latex*

Raw silk was degummed by using degumming liquor with various concentrations of dried latex of papaya fruit. Degumming liquor was comprised papaya's dried latex ranges 0%, 1%, 2%, 3%, and 4 % owf respectively. The liquor ratio of raw silk to degumming liquor was 1 : 25 (g : ml).

Specimens were degummed at the temperature ranges 55, 65, 75 and 85 and time 10, 20, 30 and 40 minutes, then rinsed with cool and hot water and dried at 60 °C

*- Silk degumming with soap and Sodium carbonate*

Specimens were subjected to degum in a boiled alkaline solution containing 12 % owf soap and 6 %owf sodium carbonate for 60 minutes at a liquor ratio of 1 : 30 (g : ml). Degummed silks were rinsed with cool and hot water and dried at 60 °C

### 2.3 Determination of tensile strength

Tensile strength of degummed silks fibers were performed according to TIS 121 Part 8-2518 (1975) : Method of test for textiles Part 8 Breaking load and extension of yarns and threads. A single fiber was measured at a gauge length of 200 mm on a tensile strength tester (Lloyd Instruments LR5K, Intro Enterprise Co., Ltd.)

### 2.4 Staining test with direct dyes

Hirus Supra Red 3BL 140% (C.I. Direct Red 80) was used to evaluate the remaining of sericin after degumming. The degummed silk samples were dyed in an dye liquor comprised Hirus Supra Red 3BL 140% 1 g/L with a liquor ratio of 1 : 200 (degummed silk : dye liquor) at 100 °C for 2 minutes. The color strength of dyed samples (K/S values) was measured by a spectrophotometer (Color Quest XE) under illuminant D65 with a 10<sup>0</sup> standard observer. Color strength was calculated from the reflectance values using Kubelka-Munk equation as follows

$$K/S = \frac{(1-R)^2}{2R} \quad (1)$$

Where R is the decimal fraction of the reflection of the dye fabric, K is the absorption coefficient and S is scattering coefficient.

### 2.5 Fiber surface morphology analysis

Scanning electron microscope (SEM) was used to study surface morphology of degummed silk. The samples were coated with gold by sputtering at room temperature. Scanning electron micrographs of fibers were taken by scanning electron microscope (JSM-5410LV). The instrument was operated at 15 kv.

### 3. Results and discussion

#### 3.1 Fiber strength

The tensile strength of silk fiber can be indicating the results of degumming method because sericin act as reinforcement material for silk fiber when its was removed, the strength of fiber will also decreased. Several factors especially the amount of dried latex, was found to influence on tensile strength of degummed silk. Concentration of papaya's dried latex in degumming liquor related to efficiency of silk degumming due to papaya's latex was consist of papain enzyme that has ability to digest protein compound. At the high amount of dried latex and prolong degumming time, it would lead to the higher result in silk degumming. The tensile strength of silk fiber tend to be decrease when the amount of dry latex was increased and its become constant, when concentration of dry latex reach to 4 %owf. The average strength was 4.28 N

Considered the effect of temperature shows the tensile strength of silk fibers tend to be decrease when degumming temperature was increased. When the degumming temperature increased from 55, 65, 75 and 85 °C, the average tensile strength of fibers were 6.28 5.85 5.63 and 5.27 N respectively. The reduction in tensile strength was probably because of enzyme activity of papain. Effect of Temperature Papain has a temperature optimum range of 65 to 80 °C and temperatures above 90 °C rapidly inactivate the enzyme.

For the effect of degumming time to tensile strength of silk fiber, it was found slightly decreased in strength when degumming time increased from 10, 20, 30 and 40 minutes.

#### 3.2 Result of staining test with direct dyes

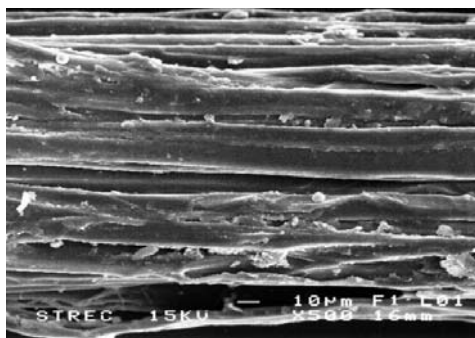
For the staining test by dyeing with C.I. Direct Red 80, raw silk was stained dark red color as a result of a large quantity of sericin present in the fibers. Soap and Sodium carbonate degummed silk at 100 °C appeared pale pink. Meanwhile, papain degummed silks were appeared pink. This indicating that there was a small amount of sericin remaining. Considered at the effect of temperature, time and amount of dried latex on the degumming efficiency by using K/S value was found color strength of silk fibers decreased when the temperature and time increased, except at 85 °C was increased. K/S value of raw silk, silk degummed with soap + sodium carbonate and papain degummed silks (55 – 85 °C) were 2.516, 0.163, 1.921, 0.279, 0.181 and 0.279 respectively.

Form the study variable result was revealed; the appropriate conditions for silk degumming with dried latex of *Carica payapa* Linn. was recommended as follows : the amount of dry latex solution of 4 % owf at 75 °C for 30 minutes at neutral condition

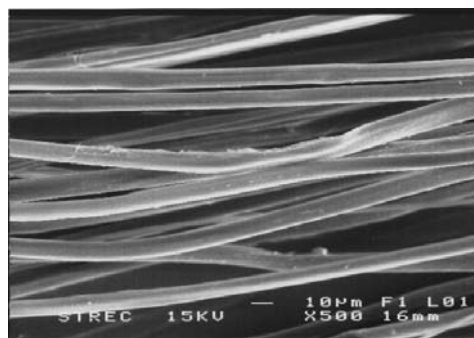
### 3.3 Fiber surface morphological

Different surface morphology and fiber damage of the raw silk fiber and degummed silk at various conditions were observed among the SEM micrographs of the fibers. Micrograph a in Figure 1 shows the surface characteristic of raw silk fiber that covered with large amount of sericin on fibroin. In micrograph b was shown surface of degummed silk fiber with soap and sodium carbonate at 100 °C, in this condition could almost completely remove sericin but some damage was observed on the fibers surface.

Micrograph c, d, e and f exhibited surface of silk fiber degumming with with 4% owf of dried latex solution at various temperature when the degumming time was 30 minutes. Degumming with papain enzyme 55 °C is not suitable condition because large amount of sericin still remained on fiber surface. The efficiency of silk degumming with papain enzyme was increased when increased temperature to 65 and 75 °C this condition could almost remove silk gum out off fiber surface (exhibited in micrograph d and e). At In 85 °C, degumming efficiency as same as 65 and 75 °C However, some damage was observed and fibrillation of some fibroin threads occurred. (exhibited in micrograph f).



(a) raw silk



(b) Soap + Na<sub>2</sub>CO<sub>3</sub>

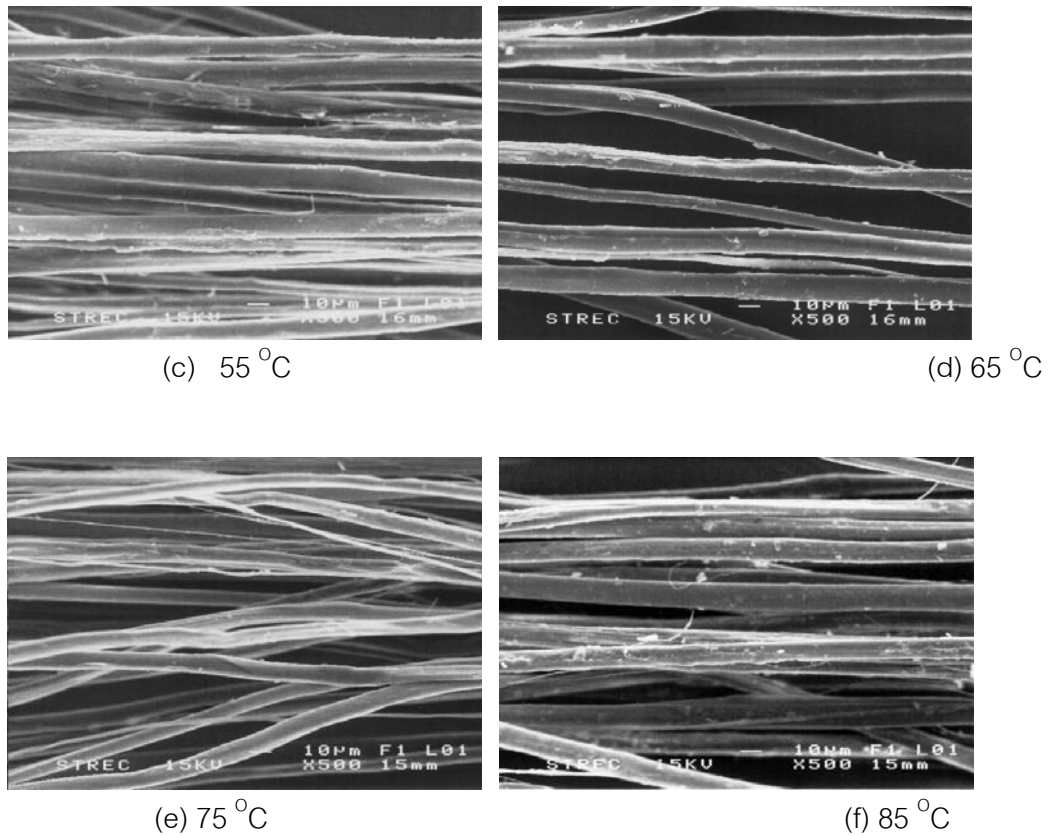


Figure 1 Scanning Electron Micrograph of degummed silk fiber

When comparison in appearance of fiber derived from 2 methods (Conventional degumming process with soap +  $\text{Na}_2\text{CO}_3$  and degumming with dried latex 4 % owf at 75 °C) was found silk fibers obtained form conventional method has high bulky and some fiber was entangled with each other. Some fibril was observed on silk fiber of some threads occurred.



Figure 2 Appearance of silk fiber

#### 4. Conclusions

Form the study about silk degumming wth dried latex of *Carica payapa* Linn. The appropriate conditions result was recommended as follows : the amount of dry latex solution of 4 % owf at 75 °C



for 30 minutes at neutral condition. In this condition was not harm to strength and fiber surface. The degummed fibers still had lustrous, soft and smooth surface. Result of staining test with direct dyes was appeared pink, indicating that there was a small amount of sericin remaining. This process can be used in stead of conventional degumming method with low cost and do not harm to environmental.

## 5. Acknowledgements

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# The Development of Fancy Yarn from Banana and Cotton Fiber Blend

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## Abstract

The research of development Fancy yarn from Banana fiber and cotton fiber blend was conducted to seek Ratio of Banana fiber and cotton fiber for making sliver by ROLLER CARD. It was found that blending banana fiber and cotton fiber at 20: 30, 30: 40, 40: 60 and 50: 50 was able to be spun as sliver. Due to the quantity of Banana fiber, there were quantity of yarn less than or equal with cotton fiber it made both fibers cling together. In the parts of the suitable sliver laying direction to contain to the GAREBO YARN TUBE was found that the suitable laying direction to contain into the GAREBO YARN TUBE could make sliver easily draw and continue spinning yarn. About Ratio and weight of sliver in GAREBO YARN TUBE that was affect to Fancy yarn spinning as SLUB YARN was found that the qualification of thread for seeking yarn twist, yarn strength and Elongation (Percentage) of Banana Fiber : cotton Fiber 20:80 was found that the weight of Sliver 20 grams have yarn twist (turn/inches) mean 10.8 (newton) of sliver 40 grams mean 6.27 and Elongation (Percentage) of sliver 30 grams mean 4.45. Banana Fiber : cotton Fiber 30:70 was found that the weight of Sliver 30 grams have yarn twist (turn/inches) mean 10.9 (newton) of sliver 30 grams mean 7.68 and Elongation (Percentage) of sliver 30 grams mean 4.93. Banana Fiber : cotton Fiber 40:60 was found that the weight of Sliver 40 grams have yarn twist (turn/inches) mean 10.5 (newton) of sliver 20 grams mean 6.20 and Elongation (Percentage) of sliver 40 grams mean 4.76. Banana Fiber : cotton Fiber 50:50 was found that the weight of Sliver 20 and 40 grams have yarn twist (turn/inches) mean 10.9 (newton) of sliver 30 grams mean 6.07 and Elongation (Percentage) of sliver 20 grams mean 5.09. Banana Fiber : cotton Fiber 60:40 was found that the weight of Sliver 20 grams have yarn twist (turn/inches) mean 11.2 (newton) of sliver 40 grams mean 5.34 and Elongation (Percentage) of sliver 40 grams mean 4.57.

**Keywords** : Banana fiber , Cotton fiber , Fancy yarn

## Preface

Spinning Industry or Thread Production is the Middle Step of Textile Industry that concern to thread Production made from natural Fibers and Synthesis fiber especially making Thread from Natural Fibers. They are materials to use in Textile Industry which created several kind of Products such as to use in weaving , Home Textile and Apparel (Boonchai and others,1998)

Types of Fiber can separate 2 Types is man-made; Fiber modified from Natural Polymer, inorganic Fiber, Synthesis Fiber and Natural yarn that can classify follow source of Fiber ; animals and plant. In the present, have develop paint fiber to thread for fabric such as Bamboo textile clothes Mangosteen fiber clothes pine apple fiber fabric Hemp fiber (Banana and others,2008). Now, there is Banana Fiber in Industry Production. Getting Banana Fiber 12% Rayon 23% and Polyester 65% blend to produce as thread and textile but the identity of fabric was not present the Clearly identities of Banana Fiber.

So the researcher is interested in Banana Fiber and Cotton Fiber Blend. For seeking the suitable ratio to produce as thread in the sort of fancy yarn and to study Sliver put into GAREBO YARN TUBE.

## Objective

1. To study Ratio of Banana Fiber and cotton Fiber Blend.
2. To study the sliver laying direction contain in the GAREBO YARN TUBE.
3. To study Ratio and weight of sliver in GAREBO YARN TUBE that are affect to fancy yarn spinning as SLUB YARN.

## Limitations

In this research, Study and experiment only the Fancy yarn in SLUB YARN.

## Equipment and Experimentation

### 4.1 Tools

4.1.1 ROLLER CARD

4.1.2 GAREBO

4.1.3 TWIST TESTER (yarn twist (turn/inche) tesing)

4.1.4 USTER TENSORAPID 3 V6.1 (Yarn strength and Elongation)

### 4.2 To study Ratio of Banana fiber and cotton fiber Blend

#### 4.2.1 Providing Banana yarn

Separation Banana fiber started by Banana Fiber Separating Machine, which produced by Rajamangala University of Technology Phra Nakhon, can speedily separate fiber and sponge in acceptable level. There are separated Methods as follows.

1. Banana was cut the bunch of Banana ages 8-10 months.
2. Take outside of shells Banana amount 5-6 Shells.
3. Halving by longside of shells and cut width 3-4 inches.
4. shells cut and put into Banana fiber separating Machine with turning upside down and put into (sponge overturned) machine for cutting sponge and tissues out
5. Taking Shells passed separated sponge and tissues to comb by fiber comb while fiber is still wet for cleaning. And keeping only fiber.
6. Cut Banana fiber 2 inches put into ROLLER CARD for making fiber scattered to cleaning fiber in order to throw tissues away.
7. Banana Fiber pass 1 time by ROLLER CARD and then blend cotton in order to both fiber blend and spin to be sliver

4.2.2 Ratio of Banana fiber and cotton fiber, this research to know about Ratio of Banana fiber that can blend cotton fiber and spin sliver with different Ratio as follow.

BANANA : COTTON

20 : 80

30 : 70

40 : 60

50 : 50

60 : 40

4.3 To study of the laying direction of Sliver to GAREBO yarn Tube. To cut Sliver 30 cm put down 6 row amount 3 levels. Sliver as above and take the wooden bar diameter 1 cm and long 50-60 cm, it was used to roll sliver for putting in wooden tube to GAREBO YARN TUBE. There are the laying direction of Sliver as follow.

#### 4.3.1 The crosswise laying in GAREBO yarn TUBE.



Fig.1 The crosswise laying

#### 4.3.2 The longwise in GAREBO yarn TUBE.



Fig.2 The longwise laying

#### 4.3.3 The angle 45 degree laying in GAREBO yarn TUBE.



Fig.3 The angle 45 degree laying

4.4 To Study Ratio and weight of Sliver in GAREBO yarn TUBE. That are affect to Fancy yarn spinning as SLUB YARN. Planning experiment in 5x3 factorial Design and 50 tested repeats. From the factor is composed of 2 Factors as follow.

4.4.1 First factor: Ratio of Banana Fiber and Cotton Fiber (A) in different Scale is 20 : 80, 30 : 70, 40 : 60, 50 : 50 and 60 : 40.

4.4.2 Second factor: Weight of Sliver (B) in GAREBO yarn Tube to spin Fancy yarn as SLUB YARN. There are to allot to contain Sliver in 3 levels as 20 grams 30 grams and 40 grams.

### Analyze

#### 5.1 The result of Ratio of Banana fiber and cotton fiber blend.

The characteristics of fibers as Sliver With Roller Card were found that The blending between Banana fiber and cotton fiber Ratio 20 : 30, 30 : 40, 40:60 and 50 : 50 can spin sliver. Due to Banana fiber there are quantity of yarn less than or equal with cotton fiber, it made both fibers can cling together. Blending Ratio 60 : 40 was found that it can not spin sliver because there are Banana fiber more than cotton, it made hard probable cling together and flimsier in process.

#### 5.2 The Result of the Sliver directions into GAREBO yarn Tube.

5.2.1 The experiments were found that the crosswise laying of sliver in GAREBO yarn tube have overlay and tum tube circle. It made while drawed sliver on the top of the tube, hard to draw and involve together with another Sliver so Thread had Large node scale and stuck some parts or tightly

twist too much, it can not draw to be. Threa Sometimes Thread is out large size all over line. Thus, the crosswise laying can not produce because. It was large too much to produce as textile.



Fig.4 Present about spinning fancy yarn as SLUB YARN

5.2.2 The result of experimental of the longwise laying was found that.

The Fancy yarn spinning as SLUB YARN in GAREBO can easy draw thread and continues spin yarn. Thread is small and tightly and loose of thread some parts. It made puff thread that was to be characteristic of Fancy yarn as SLUB YARN.



Fig.5 showing about spinning Fancy yarn as SLUB YARN in the longwise laying in GAREBO yarn Tube.

5.2.3 The result of experimental of the angle 45 degree laying was found that the fancy yarn spinning as SLUB YARN can little draw because sliver, which was angle 45 degree in Tube Tare firmly in the middle but the top and the end of tube was loose. It made Sliver easy to be off the GAREBO yarn Tube while it was in spinning process.

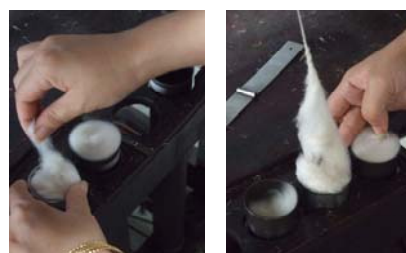


Fig. 6 showing about spinning Fancy yarn as SLUB YARN in angle 45 degree laying in GAREBO yarn Tube.

5.3 The result of Ratio and weight of Sliver contain in GAREBO yarn tube, having effect to spinning Fancy yarn in SLUB yarn. There are 15 Samples thread and test the qualifications of threads about yarn Twist, Yarn strength and Percentage of elongation. Showing in Table 2 about the result of qualification yarn testing.

**Table 2** The result of the qualification yarn testing about yarn twist, Yarn strength and Percentage of elongation

Samples thread	Weight of Sliver	Yarn Twist (Turn/inches)	Tensile (Newton)	Elongation
1. BANANA 20% : COTTON 80%	20 grams	10.8	3.26	3.95
2. BANANA 20% : COTTON 80%	30 grams	9.8	5.52	4.45
3. BANANA 20% : COTTON 80%	40 grams	10.5	6.27	4.42
4. BANANA 30% : COTTON 70%	20 grams	10.8	3.95	3.93
5. BANANA 30% : COTTON 70%	30 grams	10.9	7.68	4.93
6. BANANA 30% : COTTON 70%	40 grams	10.0	4.26	4.12
7. BANANA 40% : COTTON 60%	20 grams	9.9	6.20	4.62
8. BANANA 40% : COTTON 60%	30 grams	10.3	4.77	4.27
9. BANANA 40% : COTTON 60%	40 grams	10.5	4.59	4.76
10. BANANA 50% : COTTON 50%	20 grams	10.9	5.94	5.09
11. BANANA 50% : COTTON 50%	30 grams	10.3	6.07	4.50
12. BANANA 50% : COTTON 50%	40 grams	10.9	3.34	3.77
13. BANANA 60% : COTTON 40%	20 grams	11.2	5.28	4.20
14. BANANA 60% : COTTON 40%	30 grams	10.3	4.27	4.22
15. BANANA 60% : COTTON 40%	40 grams	10.3	5.34	4.57

## Conclusion

### 6.1 The Research of Ratio and Weight of Banana Fiber : Cotton Fiber.

The Study of Ratio and weight of Banana fiber : cotton fiber that were spun sliver by Roller card were found that blending between Banana fiber and cotton fiber Ratio ; 20 : 30, 30 : 40, 40 : 60, and 50 : 50 can spin sliver. Due to Banana fiber, there are quantity of yarn less than or equal with cotton fiber, it made both fiber can cling together.

### 6.2 The research of the laying direction of sliver to GAREBO yarn Tube.

The result of the laying direction of sliver to GAREBO Yarn Tube was found that the most suitable Sliver laying direction is longwise because it was laid tidy and was not overlay. Able to easy draw and to flow spinning.

6.3 The result of Ratio and weight of sliver contain in GAREBO yarn tube, having effect to spinning Fancy yarn in SLUB yarn

The result performed by Physical Properties Testing about yarn twist, yarn strength and Percentage of Elongation were found that

6.3.1) Banana Fiber and Cotton Fiber have ratio at 20 : 80 was found that sliver have weight 20 grams, there are yarn twist (turn/inches) 10.8, Tensile(Newton) was found that the weight of sliver at 40 grams that effect to tensile 6.27. And Elongation (Percentage) was found that Sliver have weight 30 grams that effect to elongate 4.45

6.3.2) Banana Fiber and Cotton Fiber have ratio at 30 : 70 was found that sliver have weight 30 grams, there are yarn twist (turn/inches) 10.9, Tensile(Newton) was found that the weight of sliver at 30 grams that effect to tensile 7.68. And Elongation (Percentage) was found that Sliver have weight 30 grams that effect to elongate 4.93

6.3.3) Banana Fiber and Cotton Fiber have ratio at 40 : 60 was found that sliver have weight 40 grams, there are yarn twist (turn/inches) 10.5, Tensile(Newton) was found that the weight of sliver at 20 grams that effect to tensile 6.20. And Elongation (Percentage) was found that Sliver have weight 40 grams that effect to elongate 4.76

6.3.4) Banana Fiber and Cotton Fiber have ratio at 50 : 50 was found that sliver have weight 20 grams and 40 grams, there are yarn twist (turn/inches) 10.9, Tensile(Newton) was found that the weight of sliver at 30 grams that effect to tensile 6.07. And Elongation (Percentage) was found that Sliver have weight 20 grams that effect to elongate 5.09

6.3.5) Banana Fiber and Cotton Fiber have ratio at 60 : 40 was found that sliver have weight 20 grams, there are yarn twist (turn/inches) 11.2, Tensile(Newton) was found that the weight of sliver at 40 grams that effect to tensile 5.34. And Elongation (Percentage) was found that Sliver have weight 40 grams that effect to elongate 4.57

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# The Development for Product of Local Folk-weaving Material by the Weaving Group of Paihoochang Banglen, District, Nakhon Pathom Province

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## Abstract

The objective of the study was to examine the opinions toward 5 products made of local folk material, Paihoochang Banglen district, Nakhon Pathom Province which were facial tissue boxes, hanging hand towels, bolster cushions, bags, tablecloths and to study the basic background of the customers who appreciated with handicraft. The research considered the styles, sizes, practical uses and attractiveness on different products. The 200 evaluators were accidentally sample from those interested in model handicraft presented in 4 department stores of Nakhon Pathom. The statistic analysis was done by using the computer program. The finding indicated that most of the evaluators were female who were about 31 – 40 years of age, single and graduated in Bachelor degree level. Their occupations were running private business with over 20,000 baht income per month. The purpose for buying products was the souvenirs. The motivation for buying was the practical use. The result of customer satisfaction affected handicraft product from local folk weaving showed that the average highest satisfaction in styles of product was the hanging hand towels B. The satisfaction of sizes of product showed the average highest were the hanging hand towels A, B. The satisfaction of practical use of product showed the average highest was the hanging hand towels A.

**Keywords:** local folk-weaving material

## Preface

Thai local folk-weaving, there are all regions in Thailand, is one of the essential factors for life in progress with Human civilization. Patterns which are present on fabric, show that the individual and culture. Changing period comes to be a part of economy and social, was affect to lifestyle, cultural and folk's belief of man. The effect of changing is the way of folk handiwork that have to adjust become modernization. Nakhon Pathom is one of many provinces that there are local folk belief of weaving. It is folk handiwork that start to go together with tradition and Thais Song Dum which wear especially black clothes, so it was called in many different words such as Laos-Song, Song Dam, or Thai-Song that all is the same meaning and specific in their lifestyles. (panida,1981) Thais Song Dum lineage in Nakhon Pathom province are still keep on some common traditions but some had incline to disappear by materialism especially West civilization. Able to see Thais Song Dum young people when girls went to work and wear Thai sarong but now, they wear skirt and pants all over spoken language which they was not to use dialect. Almost the next generation, Thais Song Dum immigrates came into metropolitan but in village had only old generation and once in a while the young people came back to meet their oldness. It is affect to the inheritance of tradition, that is identity of Thais Song Dum perhaps to be lose though folklore which they believe it and can being a group to abandon, by the next generation. Thus, goodness, aesthetic and culture are the unique of Thais Song Dum were not in times. Thais Song Dum is still weaving to use in tradition and brief ritual to be composed of Teang-Moo stripe fabric and black, yellow, orange, green, red and white plain fabrics. Nowadays, Thais Song Dum weaving is decrease because of social situation. Nevertheless, there are the preservationist and inheritor of weaving in order to disappear. Folk-weaving was reserved by the weaving group of Paihoochang Banglen district, although they are not use cotton and silk anymore but they used artificial silk rather than real silk and cotton because artificial silk is low-cost and easier than authentic. Moreover, Thais Song Dum wove fabric for ritual and yet to making modern clothes, it was several weaving styles such as Mud-Mee patterns weaving, Gold and Silver ornamental braid fabrics, and dobby fabric. Hence, The researcher is interested to develop for product of local folk-weaving material by the weaving group of Paihoochang Banglen distrist, Nakhon Pathom province to produce for value-added prices and also to promote of revenue and to create powerful of community to stable economy.

## Objectives

1) To create prototypes as facial tissue boxes, hanging hand towels, bolster cushion, bags and tablecloths made of local folk-weaving material by the weaving group of Paihoochang Banglen district, Nakhon Pathom province

2) To study the basic background of customers to folk-weaving prototypes in parts of overall images, styles, sizes, utilization that is composed of facial tissue boxes, hanging hand towels, bolster cushion, bags and tablecloths made of local folk-weaving material by the weaving group of Paihoochang Banglen district, Nakhon Pathom province

## Limitations

1) In this research prototypes made of local folk-weaving material were assessed by the customers at the places around Nakhon Pathom province.

2) Fabrics of prototypes is Teang-Moo stripe fabric and Khan decorated with silver and gold braid stripe fabric.

3) The study is development for product local folk-weaving material by the weaving group of Paihoochang Banglen district, Nakhon Pathom province with prototypes, which are not clothes, as 5 products 3 styles in each product. There are total 15 prototypes.

## Procedures

The research is research and development: R&D “The development for product of local folk-weaving material by the weaving group of Paihoochang Banglen district, Nakhon Pathom province

## Equipments

Prototypes as facial tissue boxes, hanging hand towels, bolster cushion, bags and tablecloths made of local folk-weaving material (Teang-Moo stripe fabric and Khan fabric decorated with silver and gold stripe fabric) by the weaving group of Paihoochang Banglen district, Nakhon Pathom province

1) to study the information of local folk-weaving material by the weaving group of Paihoochang Banglen district, Nakhon Pathom province to develop as prototypes

1.1) to study the characteristics of Thai Song Dum weaving about How to weaving, Patterns, Uses to be guideline to develop as fabric products.

1.2) the characteristic of product development from local folk-weaving in present times and the other information.

2) to design products made of local folk-weaving material by the weaving group of Paihoochang Banglen district, Nakhon Pathom province is composed of facial tissue boxes, hanging hand towels, bolster cushion, bags and tablecloths.

2.1) design products by Teang-Moo and Khan fabric decorated with silver and gold stripe fabric with 15 sketches 5 products 9 styles in each products. There are 45 sketches by casuals wear idea.

2.2) from 45 sketches to 3 styles in each products total 15 sketches to produce as prototypes were selected by 5 specialists with questionnaire.



Fig. 1. Facial Tissue Boxes



Fig. 2. Bolster Cushions



Fig. 3. Bags



Fig. 4. Hanging Hand Towels



Fig. 5. Tablecloths

3) to create prototypes

3.1) to make patterns of facial tissue boxes and hanging hand towels, by condensing woman clothes size M and ratio 1:4

3.2) to make patterns of bolster cushion size 16 x 16 inches, bags size 14 x 14 inches and circle tablecloths have diameter 24 inches.

4) data acquisition

4.1) prototypes made of local folk-weaving material were assess by the customers at the places are around Nakhon Pathom province.

4.2) prototypes were show in 4 Tesco Lotus department stores of Nakhon Pathom province for the assessment sampling.

5) Analyze

5.1) the statistic analysis was done by using the computer program.

5.2) to gather and completely checking of the questionnaire about basic background of sampling in percentage, arithmetic mean and standard deviation.

5.3) the opinion data of local folk-weaving that used as 5 prototypes 3 styles in each products total 15 prototypes to analyze data.

5.3.1) showing in tables

5.3.2) present the opinion by mean in each products

### Population and Sampling

The research selected estimated products sampling by accidental sampling from the customer who appreciated with handicraft by the weaving group of Paihoochang Banglen distrist, Nakhon Pathom province. The 200 evaluators were accidentally sample from those interested in model handicraft presented in 4 department stores of Nakhon Pathom and selected purposive sampling in each department stores as follow

- 1) Tesco Lotus Department store Nakhon Pathom Branch amount 50 persons.
- 2) Tesco Lotus Department store Nakhon Chai-Sri Branch amount 50 persons.
- 3) Tesco Lotus Department store Sam Pran Branch amount 50 persons.
- 4) Tesco Lotus Department store Kamphangsaan Branch amount 50 persons.

Total 200 persons

## Results

Table 1 Mean and standard Deviation of Style

Products	Type s	$\bar{x}$	S.D.
Facial tissue Boxes	A	4.19	0.82
	B	4.13	0.69
	C	4.02	0.78
Hanging Hand Towels	A	4.20	0.78
	B	4.12	0.78
	C	3.98	0.83
Bolster cushions	A	4.12	0.89
	B	4.07	0.76
	C	3.97	0.88
Bags	A	4.07	0.93
	B	4.05	0.78
	C	4.01	0.90
Tablecloths	A	4.15	0.93
	B	3.95	0.78
	C	3.85	0.85
<b>Total</b>		<b>4.06</b>	<b>0.59</b>

Table 2 Mean and standard Deviation of Size

Products	Type s	$\bar{x}$	S.D.
Facial tissue Boxes	A	4.05	0.75
	B	4.06	0.78
	C	4.03	0.79
Hanging Hand Towels	A	4.12	0.71
	B	4.12	0.74
	C	4.05	0.74



Table 2 Mean and standard Deviation of Size (to be continued)

Products	Type s	$\bar{x}$	S.D.
Bolster cushions	A	3.93	0.80
	B	3.91	0.82
	C	3.91	0.79
Bags	A	3.86	0.80
	B	3.88	0.79
	C	3.86	0.82
Tablecloths	A	3.73	0.91
	B	3.82	0.92
	C	3.78	0.94
<b>Total</b>		<b>3.94</b>	<b>0.67</b>

Table 3 Mean and standard Deviation of Utilization

Products	Type s	$\bar{x}$	S.D.
Facial tissue Boxes	A	4.22	0.67
	B	4.21	0.65
	C	4.17	0.71
Hanging Hand Towels	A	4.26	0.64
	B	4.23	0.64
	C	4.20	0.70
Bolster cushions	A	4.10	0.72
	B	4.10	0.73
	C	4.10	0.71
Bags	A	4.18	0.70
	B	4.17	0.69
	C	4.15	0.71
Tablecloths	A	4.04	0.76
	B	4.01	0.76
	C	4.03	0.75
<b>Total</b>		<b>4.15</b>	<b>0.60</b>

Table 4 Mean and standard Deviation of overall image

Products	Type s	$\bar{x}$	S.D.
Facial tissue Boxes	A	4.28	0.68
	B	4.23	0.66
	C	4.16	0.71
Hanging Hand Towels	A	4.23	0.66
	B	4.25	0.74
	C	4.21	0.75
Bolster cushions	A	4.26	0.69
	B	4.23	0.67
	C	4.21	0.72
Bags	A	4.21	0.70
	B	4.19	0.70
	C	4.21	0.71
Tablecloths	A	4.18	0.74
	B	4.16	0.71
	C	4.08	0.75
<b>Total</b>		<b>4.20</b>	<b>0.57</b>

The finding indicated that most of the evaluator were female who were about 31 – 40 years of age, single and graduated in Bachelor degree level. Their occupations were running private business with over 20,000 baht income per month. The purpose for buying products was the souvenirs. The motivation for buying was the practical use. The result of customer satisfaction affected handicraft products from local folk weaving showed that the average highest satisfaction in styles of product was the hanging hand towels B. The satisfaction of sizes of product showed the average highest were the hanging hand towels A, B. The satisfaction of practical use of product showed the average highest was the hanging hand towels A.



Fig. 1. Hanging Hand Towels A



Fig. 2. Hanging Hand Towels B

#### Recommendations for future Research

- 1) It is recommended that development for product of local folk-weaving material by the other weaving group of Paihoochang Banglen district, Nakhon Pathom province.
- 2) It is recommended that development for product of local folk-weaving material by the other weaving group of other district in Nakhon Pathom province.
- 3) It is recommended that development for product of local folk-weaving material by the other weaving group of other province.
- 4) It is recommended that development another products.
- 5) It is recommended that to research with another ages in order to cover demand other customer groups.

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