Application of Rice as a Material in Lifestyle Product Design

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ABSTRACT

This research aims to study the rice grains' properties as they influence graphic and texture features for material selection, product transformation experiments, and product design. The procedures have been divided into three steps. Firstly, the literature has been reviewed about rice grains' physical properties, utilities, and values. Secondly, the experiment of product transformation has been conducted. Finally, the design for a product prototype has been created. After the experiment, it was found that Thai jasmine rice no. 105 is the most appropriate material for product transformation owing to its physical properties: long grains with obvious rice germ and an appropriate translucent level. Resin is the most suitable adhesive agent because of its strength, flexibility before being set, ability to mix with multicolor, and short production period. In terms of the technical process, forming the product can be done horizontally or in a bending form. Molding and design have been done through a computer program, which was a great assistance in arranging the rice grains into a designated form with standard acceptance. Not only did this process add the value to the rice, but it also introduced a new product to the market and created the most benefit from the by-product.

Keywords: Rice, Material, Lifestyle Product Design

Introduction

Materials are the main elements in product design. Nowadays, the designers focus on the material properties which are major concerns in their minds (form follows material). Each material has its own underlying story. Thailand possesses several natural resources that can be transformed into more alternative products. The combination between materials and design can reflect creativity and ignite new items that are beyond expectations. Meanwhile, the trend of natural preservation becomes an inspiration for designers to apply their creative ideas to the available materials. *(Niamsap, N. 2008)*

Rice is one of Thailand's agricultural products and plays an important role in the economic system. Rice can be consumed as a daily diet and can be processed into various value-added products: cosmetic and skincare, etc. The quality of rice grains and the production process need to meet the standard and be well accepted in the transformation procedure. The results can be varied according to

the local areas because there are 12 types of rice in Thailand which are Thai Jasmine Rice 105, Thai Jasmine Rice Tung Kula, Thai Sticky Rice Gor Khor 6, Thai Sticky Rice Khao Wong Kalasin, Thai Sticky Rice Kheow Ngu, Thai Black Sticky Rice or Black Glutinous Rice, Khao Leuang Patew Chumphon, Khao Jek Chuey Sao Hai, Brown Rice, Riceberry Rice, Red Cargo Rice, and Sangyod Muang Phattthalung Rice. Rice products are divided into two groups: daily diet and by-product. According to the daily diet, rice is the main source of carbohydrate for Thai people, making it a valuable gem of Thai cuisine because rice can be developed into assorted menus. The by-product from rice has been derived from the rice milling process resulting in broken rice, small broken rice bran, and husk with different quantities depending on the milling manufacturer's size. After the milling process, there will be 48% of rice, 25% of husk, 17% of small broken grains, and 10% of raw bran. The number of rice grains and by-products will be larger if they are milled by the gigantic milling factories, leading to the development of by-products to add value and reduce the operation cost of rice milling *(Rice Products, 2017)*.

The new experience is applied to creativity in some context, there can be some meaningfully interesting ideas taken place. Besides, the cultural richness with faith, belief, relaxing lifestyle, and humor, contributed to the uniqueness of Thai innovation. Some innovations have been created to solve problems, while others have been obtained from local wisdom and process. Since high technology has become part of people's daily lives, the definition of 'Made in Thailand' in the 21st century needs to be revised to investigate, understand, and search for an answer which can meet the consumers' needs. Knowledge accumulation is might not important as knowledge with local wisdom application which can be more beneficial to consumers. *(Thamtheerasathian, A. and Charoenrakpanya, C., 2017)*

Therefore, the products and materials transformed from rice grains have corresponded to the Bio-Circular-Green Economy which can help develop the overall economic system. By this, it means bio-economy can enrich the value of the bioresource relating to a circular economy which optimizes the recycling process under the concept of a green economy which develops income level, society, and environmental preservation based on the advantages of the biodiversity and culture of the country. This can be a method to add value and optimize the local materials and resources and can be another alternative for the communities or any units from government or private organizations to transform the primary resource into new commercial products.

Research objectives

1. To study the rice grain properties influencing graphic and texture features for material selection in product design.
2. To experiment with product transformation and molding for rice grains.
3. To introduce a new product designed for rice grains.

Research scope

To initiate commercial lifestyle products based on graphic and texture of rice grain transformation, molding, and product design.

Research methodology

There are three steps in this research methodology.

1. Research the physical properties and benefits of rice grains by visual context.
2. Experiment with molding and transformation process from rice grains to be materials for the product design.
3. Design the prototype following these three steps.

Step 1: Survey, gather and analyze information

1.1. Review the related information in books, articles, journals, and research.

1.2. Arrange field surveys and gather qualitative data about the physical features of rice by taking photos and scribing.

Step 2: Try out and transform rice grains

2.1. Transforming and molding the rice grains into material suiting for product design.

2.2. After the experiment, the result will be further applied to the design.

Step 3: Design the product

3.1. Create product outlines that will be developed into prototypes.

3.2. Create the prototype.

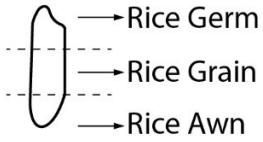
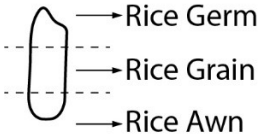
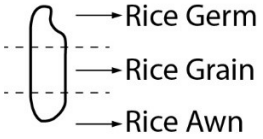
3.3. Conclude the process.

Findings

Part 1: After gathering rice information, it is found that 12 popular Thai rice types can be generated into four categories: Thai Jasmine Rice, Sticky Rice, White Rice, and Healthy Rice. Firstly, Thai Jasmine Rice originated in Thailand with pandan fragrance, consists of Thai Jasmine Rice 105 and Thai Jasmine Rice Tung Kula. Secondly, Sticky Rice, grown in the Northeastern region, is the best one in Thailand such as Thai Sticky Rice Gor Khor 6, Thai Sticky Rice Khao Wong Kalasin, Thai Sticky Rice Kheow

Ngu, and Thai Black Sticky Rice or Black Glutinous Rice. Next, white grain rice is grown around Thailand such as Khao Leuang Patew Chumphon and Khao Jek Chuey Sao Hai. Finally, healthy rice is the whole grain form with multivitamins such as Brown Rice, Riceberry Rice, Red Cargo Rice, and Sangyod Muang Phattthalung Rice. Each type of rice is different in shapes, colors, and translucent levels which can be demonstrated in Table 1.

Table 1. Properties of 12 kinds of Thai Rice

Types	Colors	Shapes	Translucency
Jasmine Rice			
1. Jasmine Rice 105	White or Off-White Color	Long grain with a small awn and a noticeable germ. 	Translucent
2. Thai Jasmine Rice Tung Kula	Off- white color	Long grain with a noticeable germ but no awn 	Translucent
ticky Rice			
3. Thai Sticky Rice Gor Khor 6	White or Off-White Color	Long grain with a little awn and a noticeable germ 	Semi-Translucent

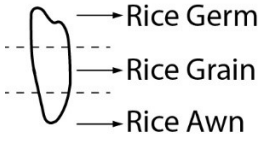
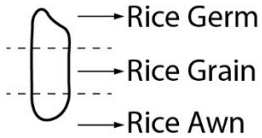
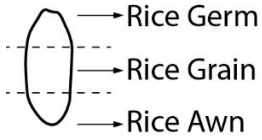
		Long grain with awn and germ	
4. Thai Sticky Rice Khao Wong Kalasin	Cream color		Semi-Translucent

Table 1 Properties of 12 kinds of Thai Rice (continued)

Types	Colors	Rice Features	Translucency
5. Thai Sticky Rice Kheow Ngu	White	Slim and small grain with a germ but no awn. 	Semi-Translucent
6. Thai Black Sticky Rice	Black	Fat grain with a small germ and an awn 	Opaque
White Grains			
7. Khao Leuang Patew Chumphon	Light yellow	Long grain with a little awn and a noticeable germ	Translucent

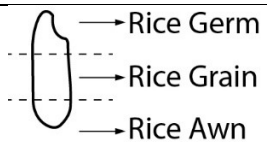
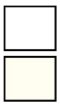
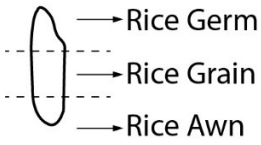
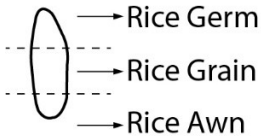
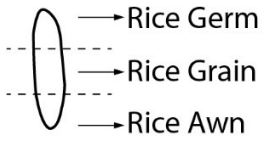
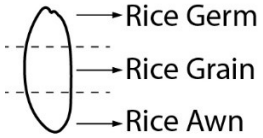
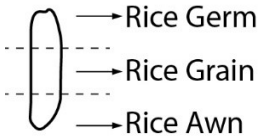
			
8. Khao Jek Chuey Sao Hai	White and Off-White 	Long grain with a little awn and a noticeable germ 	Translucent
Healthy Rice			
9. Brown Rice	Off- White and Light Yellow 	Small and slim grain without awn and germ 	Semi-Translucent

Table 1 Properties of 12 kinds of Thai Rice (continued)

Types	Colors	Rice Features	Translucency
10. Riceberry Rice	Dark purple	Long grain with awn but no germ 	Opaque
11. Red Cargo Rice	Red	Fat grain with awn and small germ 	Semi-Translucent
12. Sangyod Muang Phattthalung Rice	Red	Slim and long grain with awn and a small germ 	Semi-Translucent

According to table 1, the different physical features of rice can be categorized by three criteria: color, shape, and translucence.

1. In terms of color, there are six different shades. The white and off-white colors can be found in Thai Jasmine Rice 105, Thai Sticky Rice Gor Khor 6, Thai Sticky Rice Khao Wong Kalasin, Thai Sticky Rice Kheow Ngu, and Khao Jek Chuey Sao Hai. The cream and light yellow colors can be found in Thai Jasmine Rice Tung Kula, Khao Leuang Patew Chumphon, and brown rice. The red color can be found in Red Cargo Rice and Sangyod Muang Phattthalung Rice. The purple color can be found in Riceberry Rice. The black color can be found in Thai Black Sticky Rice.

2. The grain shapes can be generated into two forms: long and fat grains. The long-grain shape can be found in Thai Jasmine Rice 105, Thai Jasmine Rice Tung Kula, Thai Sticky Rice Gor Khor 6, Thai Sticky Rice Khao Wong Kalasin, Thai Sticky Rice Kheow Ngu, Khao Leuang Patew Chumphon, Khao Jek Chuey Sao Hai, Sangyod Muang Phattthalung Rice, brown rice, and Riceberry Rice. The fat grain shape can be found in Thai Black Sticky Rice and Red Carco Rice. Apart from grain shapes, rice germ is the attribute that makes the rice grain look unique. The rice grains with a noticeable germ consist of Thai Jasmine Rice 105, Thai Jasmine Rice Tung Kula, Thai Sticky Rice Gor Khor 6, Thai Sticky Rice Khao Wong Kalasin, Thai Sticky Rice Kheow Ngu, Khao Leuang Patew Chumphon, and Khao Jek Chuey Sao Hai.

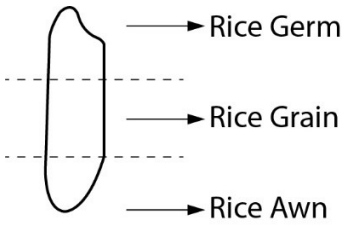


Figure 1. The Rice Germ Feature

1. There are three levels of rice opacity: translucent, semi-translucent, and opaque.
    a. The translucent rice grain allows the light to get through by half and it is unable to see the back of the rice grain clearly. Four translucent grains consist of Thai Jasmine Rice 105, Thai Jasmine Rice Tung Kula, Khao Leuang Patew Chumphon, and Khao Jek Chuey Sao Hai.
    b. The semi-translucent rice grain allows very little light to get through. Only the edge of the grain can be seen through such as Thai Sticky Rice Gor Khor 6, Thai Sticky Rice Khao Wong Kalasin, Thai Sticky Rice Kheow Ngu, brown rice, Red Cargo Rice, and Sangyod Muang Phattthalung Rice.
    c. The opaque rice grains do not allow the light to travel through which are Thai Black Sticky Rice and Riceberry Rice.

Part 2: The experiment and application of rice grain is the process to draw the physical and translucent attributes into the design. The processes are listed as follows.

1. Try out the three adhesive agents: Darma Gum (organic substance), Latex Glue mixed with rice bran (organic and synthetic substances), and Resin (synthetic substance), on molding and stabilizing the materials. The processes were listed as follows.
    a. Align Thai Jasmine Rice 105 on the tray (15*15*1 cm.).

b. Pour the different adhesive agents in three different trays until they reach a similar level as the rice grain and let it sit at room temperature.
c. After the rice grain pad is set, polish its surface with a sandpaper polishing machine until the shape of the grains appears.
d. Analyze the strength, flexibility, bending, color, and length producing period attributes among the three different adhesive agents as can be seen in table 2.

Table 2. The result of the three adhesive agent experiments.

Adhesive agents	Result				
	Mechanical Properties			Color /Attractiveness	length of producing time (hours)
	Strength	Flexibility	Bendable		
Darma Gum(A)	x	☐	☐	Unclear color tone	20
Latex Glue with rice bran(B)	☐	☐	☐	Unclear color tone	24
Resin (C)	☐	☐	☐	Variegated color tones	4

According to table 2, it is found that latex glue with rice bran and resin is better adhered to than darma gum owing to its strength, flexibility, and bendability. Nonetheless, the color portrayed on the materials and the length of producing time is different. Resin gave more vivid color with more variegated tones and took a shorter producing time (four hours) than the others. The rice pad with latex mixed with rice bran gave an unclear color tone because of the dark color tone of rice bran. The outcome of the combination between the rice grains and latex glue with rice bran took a longer producing period (24 hours). Darma gum is the adhesive agent that gives flexibility and bendability attributes but lacks strength and bright color tone due to its darker color than the material. It also took 20 hours to finish the process.

A. Darma Gum B. Rice Bran with Latex Glue C .Resin

Figure 2. The outcomes of the rice pads adhered to by the three agents: Darma Gum, Rice Bran with Latex Glue, and Resin.

2. Design and translucent test

Resin is the most suitable agent because of its strength, flexibility, bending, and color tone attributes. As well as this, resin requires the least producing time of all. The procedures can be listed as follows.

2.1. Align the rice grains according to the design in a 15 x 5 x 1 cm. tray.

2.2. Pour Resin into the tray and let it sit at room temperature for two hours.

2.3. Polish the surface of the material with a sandpaper polishing machine until the rice grain reveals.

2.4. Test the translucent level by putting the standard 6.5 watts LED light bulb with Non-directional light behind the material.

Figure 3. Translucency of the material adhered by resin.

Part 3: Product Design

According to the analysis in the first step, it can be concluded that the appropriate rice grain to be used was Thai Jasmine Rice 105 owing to its translucent level and long grain with a noticeable germ. According to the adhesive agent, it is found that resin is the most appropriate one. The design processes can be generated as follows.

1. Concept Design Creation

As rice is the main dish representing the Thainess, the concept design of this research has been inspired by 'Natural Abundance'. The researcher has adopted the natural forms: rice grain, water, fish, leaf, flower, butterfly, cloud, and bird, into the table set products and lighting equipment to reflect the plentiful natural resource in Thailand. Moreover, Thai identity can be expressed through the design and products as can be seen in figure 4.

Figure 4. Concept and Design Pattern

2. Production procedures

2.1. The patterns have been designed with the computer program (figure5).

Figure 5. Pattern Design with the computer program

2.2. Place the patterns obtained on the model and align the rice grains according to the patterns (figure 6).

A. Vertical Alignment

B. Bent Alignment

Figure 6. The vertical and bent alignments of rice grains

2.3. Pour resin into the model on top of the grains. The level of resin poured must be at the same level as the grains and let it sit at room temperature for two hours.

2.4. Polish the surface of the products with a sandpaper polishing machine.

3. Prototypes of Rice Grain Products:

3.1. Placemat with floral and butterfly pattern (figure 7)

3.2. Coaster with ripple and fish pattern (figure 8)

3.3. Fruit Tray with leafy pattern (figure 9)

3.4. Floral vase with the ear of rice pattern (figure 10)

3.5. Lamp with cloud and bird pattern (figure 11)

Figure 7. Placemat

Figure 8. Coaster

Figure 9. Fruit Tray

Figure 10. Floral Vase

Figure 11. Lamp

Conclusions and Discussion

The research results can be categorized into two parts: materials and techniques.

1. The appropriate materials for this product design are Thai Jasmine Rice 105 and resin.

1.1. Thai Jasmine Rice 105 is suitable for this design because of its physical features: long grain with noticeable germ and translucency. The rice grain partly allows the light to travel through.

1.2. Resin is the most suitable adhesive agent among the three agents because of its strength, flexibility, short time consumption, and bendability before solidifying. Moreover, it can be mixed with multicolor tones.

2. In terms of techniques, the material can be formed in vertical or bending formation by a mold. The pattern can be created with a computer program that facilitates the grain alignment process and standardized the products.

Discussion of Research Result

Apart from rice grain properties, and product application studied in this research, the identity of Thai rice grains has portrayed the abundance of Thai nature. The translucent property has been applied to produce graphic and texture of the lamp to shine the outstanding property of rice grain. These experiment and product transformed processes can be a value-plus to the local product and another way to optimize the natural resource as can be seen in figure 12. Not only is this research applied to the rice grains, but this can also apply to another local product that possesses a similar quality as well.

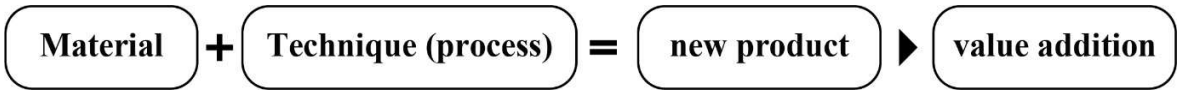


Figure 12. The Conclusion of the Design Concept Diagram

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