Development of Natural Facial Mask for Skincare from Local Materials

Channarong Siri and Wassanai Wattanutchariya*

Advanced Manufacturing Technology Research Centre (AMTech), Department of Industrial Engineering, Faculty of Engineering, Chiang Mai University, Chiang Mai 50200, Thailand.

*Corresponding author e-mail: wassanai@eng.cmu.ac.th, 1channarong_s@cmu.ac.th

Abstract. This research aims to develop a natural facial mask from local materials. The latter are natural materials which could be found locally. In this study, we have selected local materials such as silk fibroin, mulberry, and chitosan. Silk fibroin is active ingredient in the prototype because of its high antioxidant activity. On the other hand, the mulberry extract is antioxidant and antibacterial activity in the facial mask. In the meantime, chitosan could be extracted from local materials such as squid pen and shrimp shells. Chitosan was chosen to be material of the facial mask to nourish good mechanical properties of the mask’s structure. The research has developed the natural facial mask with the product design technique. Also, this study integrates consumer’s requirements and quality function deployment (QFD) to transform consumer’s needs into technical design specifications. The result show that the consumer’s requirements which obtain high score are certification standard, ability to release substances, and skin adhesion. Therefore, consumer’s preferences and technical specifications helped to achieve the prototype. The prototype was developed and evaluated according to consumer’s satisfactions. The result of consumer satisfactions is natural products and skin adhesion. Nevertheless, consumers suggest further improvement in term of color, odor, thickness, and durability of the product.

1. Introduction

Nowadays, healthcare and beauty are becoming increasingly important in everyday life. Cosmetic products are widely used for skincare to enhance beautiful look on both facial appearance and body parts. Cosmetics market expands with a high growth rate. In addition, the herbal cosmetics market costs high value income because the ingredients are imported from abroad, causing consumers to spend high amount of expenses. The entrepreneurs are trying to expand their customer base by purchasing domestic raw materials instead of importing products from abroad. The ingredients are mostly from vegetables, fruits, and grains. In most cosmetics, there are ingredients chemically produced, which may have adverse effects on the consumers while safety is one of their most concerns. In the present, we bring materials from natural extracts used in cosmetics to replace the use of chemicals. So that, “Cosmeceuticals” is a term of combination between cosmetic and medicinal properties. These two equities share the same medicinal benefits and contain many natural active ingredients such as vitamins and antioxidants. Therefore, cosmeceuticals are used for skin rejuvenation. Otherwise, skin care products are created to maintain beauty, most of which are antioxidant activity, antimicrobial activity, wrinkles reduction, make skin radiant, helps skin smooth, add moisture to the skin, skin rejuvenation and old-skin exfoliation. Face mask is an alternative for
consumers who need to take care of their facial appearance and gain facial rejuvenation. The facial mask sheet is very popular among people of all ages, both men and women. In addition, this beauty method is quite practical, available in every store, portable, and very refreshing. The mask offers many different recipes and ingredients, which conform to the purposes of consumers such as skin nourishment. In Thailand, there are plenty of ingredients with a variety of materials that can be developed as a cosmeceutical. Silk and mulberry are native plants and can be easily produced. There are great numbers of business of silk and mulberry. From the process of these businesses, it will leave some residues which seem to be useless. For example, silk from the cocoon of *Bombyx mori* consists of fibroin and sericin [1]. Furthermore, silk fibroin is a biomaterial which contains good antioxidant properties, biocompatibility, biodegradation, absorption properties, and good mechanical properties. Moreover, mulberry also has antioxidant and antibacterial properties due to its phenolic compounds, such as flavonoids and anthocyanins [2]. In addition, chitosan can be synthesized from squid pen and shrimp shell. Chitosan is a local material which has a good mechanical properties, antimicrobial activity, anti-inflammatory activity, biocompatibility, biodegradability, nontoxicity, and good absorption properties [3-4]. With all reasons stated, this research manipulates local materials including silk fibroin, mulberry, and chitosan to develop a prototype facial mask for skincare that is non-toxic and non-irritating.

The objective of this research is to synthesize, extract local materials and to analyse the properties to meet consumer’s demands. Then, this research aims to develop a facial mask with QFD to meet the needs of consumers. Finally, this research shall evaluate the satisfaction to get a prototype that meets the requirements.

2. Materials and methods

This research has studied local materials to develop a facial mask for skin care by product design techniques. Afterwards, QFD was applied to transform the consumer’s needs to the technical requirement. Thus, the prototype was produced and evaluated for the needs of consumers.

2.1. Local materials preparation

For the first process, raw cocoons were cut into small pieces and degummed for 30 minutes with a Na2CO3 solution. Then, filter out the solution. Next, the small pieces were boiled with DI water for 10 minutes and then filter out the water [5], repeat twice. After that, the degummed silk were dried in an oven drying at 37°C for 12 hours and dissolved in a solution of CaCl2:CH3CH2OH:H2O with mole ratio of 1 : 2 : 8 [6-8] at 70°C and applied to water bath at 70°C for 7 hours. Afterward, the solution was dialyzed in a cellulose tube in DI water for 3 days. Then, the silk fibroin was centrifuged at 2000 rpm for 10 minutes. Next, silk fibroin extract was frozen at -20°C and -80°C and then be processed lyophilization. The second process commenced by washing and drying mulberry leaves in an oven drying at 60°C for 48 hours. The dried leaves were crushed and extracted with water at 45°C for 3 hours and filtered by cheesecloth. The extract was centrifuged and filtered with filter paper. Next, the mulberry extract was evaporated with rotary evaporators at 45°C [2]. And finally, for the third process, squid pen chitosan was purchased from Taming Enterprises Co., Ltd, Thailand. Chitosan was soaked in lactic acid solution until the latter became homogeneous [9].

2.2. Consumer survey

The interviews were conducted to evaluate consumers’ needs. The raw data was collected from consumers with a set of questionnaires concerning the facial mask product. Consumers’ answers were converted to the consumers’ needs and categorizing with the affinity diagram. Then, the latter was manipulated as a questionnaire online.

2.3. Quality function deployment

QFD was applied for product design and development. The QFD consists of four phases. This research was operated under the first phase which called “the House of Quality (HOQ”)”. Its main purpose is to convert customers’ requirements into technical requirements. The HOQ consists of five major components: (A) customer requirement, (B) technical requirement, (C) relationship matrix, (D) Co-
relationships and (E) Column weights as shown in figure 1. HOQ was employed to transform consumer requirements into technical requirements [10]. It was used to assess the needs of consumers and to improve the product [11]. HOQ assists the facial mask to meet consumers’ needs by defining the relationship of consumer’s demand with the technical specifications of the product. Information from online questionnaires was also utilized in the form of HOQ. An analysis of the common relationship of consumer’s demand with the technical characteristics of the product shall reveal what features are important and which one needs to be developed to meet the needs of most consumers.

![Figure 1. House of Quality (HOQ)](image)

2.4. Develop prototype products
The prototype product characteristics was inquired by the questionnaires, by the results of HOQ before examining and by evaluation. The prototype was tested by cytotoxicity to ensure that the product is nontoxic.

2.5. Consumer Satisfaction Assessment
The prototype was evaluated by consumers to assess the level of satisfaction on it, by using sensory evaluation and by focusing on group questionnaires.

3. Results and discussion

3.1. Material characterization
The local materials were tested to verify their characterization. The silk fibroin extract was analyzed by Fourier transform infrared spectrometer (FTIR). The result reveals that the extract substance has a real fibroin. The mulberry extract was tested by DPPH assay, this test found that the compounds contain antioxidant activity.

3.2. Consumer survey
From an in-depth interview to gather information on consumer’s needs, the result is adapted for facial mask production. The research divided consumer’s needs into three groups, using the tree diagram as shown in figure 2.
3.3. House of Quality
HOQ is used to transform customer requirements into technical requirements. The research utilizes the HOQ to identify the most important technical requirements of the facial mask product. According to figure 4, the technical requirement with highest scores are the ability to release substance, skin adhesion, and certification standard. The results indicate that all three technical specifications should be used for product development.

3.4. Prototype of natural facial mask
The prototype of local material was developed according to the technical requirements and formed by lyophilization as shown in figure 3. The prototype was designed as an eye mask for testing. The size is 60×30 millimetres and has a thickness of 3 millimetres. The prototype from the local materials was tested by cytotoxicity and found to be non-toxic.

3.5. Evaluation of consumer satisfaction
The result of the focus group assessment reveals that most consumers are satisfied with a product made from natural materials which contains a quality of good skin adhesion. The consumers affirm that they feel safe to try the product and the price is acceptable. However, consumers are also concerned about the colour, odour, thickness, and durability of the product. There are suggestions on how to improve the product such as the colour, it should be light brown or white to augment the friendly appearance to customer. Therefore, we have explained about the prototype that the colour is derived from the nature of mulberry, which is the main component of the product. In addition, the prototype odour is a natural extract which smells unpleasantly to the consumer. Hence, the process and technique should be improved to prevent further odour. The thickness of the prototype is too thick. Consumers suggest that the layer should be thinner to fit more precisely to the facial skin. For the durability of the prototype, it is recommended that the freeze-drying forming technique and proportion of mixture should improve the proportion of mixture, so that shall render prototype to be more durable and consistent with the need of consumers.
**Physical abilities**

- Odor/smell: No pungent smell (3.66)
- Excess amount of Essence: Excess amount of Essence (3.69)
- Skincare: Slight or possible (3.38)

**Safety standards**

- Meet standard: Meet standard (4.51)

**Pharmacological abilities**

- Skin Resurfacing: Skin Resurfacing (4.77)
- Moisturizing: Moisturizing (4.14)

**Usability**

- Close to the face: Close to the face (4.47)
- Not tear easily: Moderate relationship (3.69)
- Duration of use reasonable: Moderate relationship (4.11)

**Target Value**

- Tensile strength: ++
- Tear strength: -
- Cost of product: -

**Movement of Target Value**

- ↑ Large the better
- ○ Target the best
- ↓ Smaller the better

**Figure 4. House of Quality (HOQ) for natural facial mask.**

**4. Conclusion**

In this study, the active ingredient was extracted from local materials. In the test, silk fibroin and mulberry extracts contain antioxidant and antibacterial activity. The study of consumer’s demands applies QFD techniques to develop the prototype of a natural facial mask. The technical requirements that consumers demand primarily are certification standard, ability to release substances, and skin adhesion. These are the technical requirements which led to the development of the prototype. The results of the prototype approach to sensory evaluation among consumers who tried facial mask, we found that the consumers were satisfied with the product at the moderate level. The consumers were satisfied with natural materials and skin adhesion. In addition, the results of the cytotoxicity assay affirmed that the product was initially standard in terms of non-toxicity to skin cells. However, consumers suggest further improvement in term of color, odor, thickness, and durability of the...
prototype. From interviews and consumer suggest, the researchers shall develop and improve the prototype in the next generation of products to better meet the needs of consumers.

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