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Application of Design Thinking and Chemical Analysis of the Taro Chip Industry in Several Taro Chip Industries in Padang Panjang City

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A B S T R A C T

Taro is an important source of carbohydrates, providing 23.7 g per 100 g of raw taro, but its potential use has not been fully realized, one option for its utilization is to produce taro chips. This research aims to use design thinking methodology to create an innovative product development strategy aligned with market demand. The research strategy is to improve the business through design thinking techniques. According to the survey results, the packaging used is in the form of a standing pouch, which features a naturally random shape of taro chips and a citrus leaf balado flavor variant on the chips created through design thinking. Chemical analysis of the taro chips revealed a moisture content of 5.08%, ash of 1.62%, protein of 3.08%, fat of 26.67%, and carbohydrate of 63.56%, following the SNI 01-4305-1996 standard.

Contribution to Sustainable Development Goals (SDGs)

SDG 2: Zero hunger

SDG 3: Good Health and Well-being

SDG 8: Decent Work and Economic Growth

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. Research background

Taro (*Colocasia esculenta* L. Schott) is a tuber-producing plant and can be consumed. The chemical composition of taro tubers in 100g is Mineral elements contained in raw taro nutritional content of taro consists of water (73g), energy (98 kcal), protein (1.9 g), fat (0.2 g), carbohydrates (23.7 g), ca (28 mg), p (61 mg), fe (1.0 mg%), vitamin a (20 si/100g), vitamin b (0.13 mg), vitamin c (4 mg) [1].

One type of taro processing business is taro chips. The taro chips industry sector is an expansion of processed taro products that utilize local resources in the form of taro tubers and has growth prospects because it can increase population income. Taro chips are one of the most popular processed foods in Indonesia, especially in West Sumatra..

Taro chips industry players must continue to innovate to meet increasing consumer expectations, thus encouraging them to

assess and improve more effective strategies. One method that can be applied in this endeavor is design thinking, which focuses on thoroughly understanding user needs and generating creative solutions. [2].

By utilizing design thinking methods, industry players are expected to gain a deeper understanding of consumer preferences and react to market demands more effectively. Design thinking centers not only on the product but also on the innovation process, which emphasizes teamwork, experimentation, and testing to develop more attractive and high-quality taro chip products. Given the aforementioned statements, it is important to explore the design thinking methodology and chemical analysis of taro chips.

1.2. Literature Review

1.2.1. Taro

Taro is a nutritious food choice that offers many health benefits. Taro tubers are rich in protein, low in fat, and rich in carbohydrates, vitamins, and minerals. Taro has high levels of



calcium oxalate which is harmful and has antinutritional properties. If consumed in excessive amounts, this substance can cause itching in the mouth, burning, and skin irritation. Raw calcium oxalate levels can be reduced through various methods, including heating techniques such as boiling and steaming. Individual practices remove calcium oxalate through simple methods such as soaking in running water or soaking in a mixture of salt and lime juice.

One category of the taro processing industry is taro chips. The taro chip production industry is a diversification of processed taro products that use local resources in the form of taro tubers and have the potential to be developed because it can increase community income. Taro chips are one of the most popular processed foods in Indonesia, especially in West Sumatra. Taro chips are not just a snack; they also show the potential of local natural resources that can be utilized effectively.

This food is known not only for its distinctive and delicious taste but also for its great nutritional benefits. As public awareness about the importance of healthy and natural food increases, the demand for taro chip products continues to rise. Padang Panjang City, known as the center of taro chip manufacturing, has significant opportunities to advance this sector. The presence of this industry not only supports the local economy but also helps maintain the culture and traditions associated with taro processing [3].

1.2.2. *Design Thinking*

According to Ref. [4], design thinking is a tool used in problem-solving, problem design, and problem forming. Design thinking is a pattern of thinking that not only solves a problem, but can shape and design a problem such as increasing customer satisfaction, or finding the right innovation by using five sequential stages. Every process in design thinking is human-centered or centered on humans or in the context of business innovation are customers and consumers who are the end users of the products and services produced.

The design thinking process combines three elements, namely: users (humans as users), technology as a facilitator of innovation, and the business itself as a place where innovation is implemented. The key to the process is to empathize with the user or user (end consumer) to find unmet needs by understanding beliefs, values, motivations, behaviors, constraints, benefits, and challenges. It is also to conceptualize innovative solutions.

1.3. *Objective*

This study aims to use a design thinking approach to formulate innovative and market-friendly product development strategies and determine the value of chemical content contained in taro chips.

2. MATERIALS AND METHODS

2.1. *Research Location*

The research was conducted in Padang Panjang City, West Sumatra Province. The research focused on Sigando Village, Koto Panjang Village, and Silaing Atas Village as the center of the taro chip industry. The research location was chosen intentionally or through purposive sampling, researchers consider that this village is the center of taro chips.

2.2. *Materials and Methods*

The materials used in this study include taro tubers obtained from Padang Panjang Market, cooking oil, salt, red chili, and garlic. The tools used in this research are questionnaire forms, office stationery, stoves, woks, bamboo sticks, plastic buckets, basins, tuber slicers, tuber peelers, scales, plastic, blenders, wooden spoons, and sealer

2.3. *Research Design*

The researcher will explore business development strategies through the application of design thinking phases which include five steps: 1) Empathy, 2) Defining, 3) Ideation, 4) Prototype, 5) Testing. The process of collecting data by sending questionnaires to taro chip customers from industrial centers that offer significant value based on the results of the business feasibility assessment. In this phase, the research is qualitative and descriptive.

2.4. *Research Procedure*

The research method used is a descriptive qualitative approach, which emphasizes the collection and analysis of descriptive data [5]. In this research, the main approach adopted is a descriptive qualitative method to understand the business environment of the taro chips industry and evaluate the application of design thinking in business growth, because this method offers a thorough understanding of the obstacles faced by the industry and facilitates an in-depth investigation of the use of design thinking. Data was collected through interviews, observations, and literature reviews. Interviews were conducted with industry owners to gain clearer insight into the obstacles they face, the marketing tactics they have implemented, and their hopes for business growth. Additionally, a literature review was conducted to gain comprehensive insight into the idea of design thinking, its application in business growth, and its role as a marketing instrument.

The collected data was analyzed using a qualitative approach, including thematic grouping and data coding to identify relevant patterns and findings. The results of the analysis will be used to understand the challenges faced by the taro chips industry in Padang Panjang City in using marketing tools, as well as designing appropriate solutions using the concept of design thinking. This design thinking method focuses attention on human needs, where identifying individual or group needs is a key factor in achieving business success [6]. Design thinking can help businesses get ideas and solve problems [7].

2.5. *Analysis Method*

The analysis observed in this study such as moisture content using the oven method, ash content using the method of soaking, protein content using the micro Kjeldahl method, fat content using the Soxhlet method, and carbohydrate content using the differentiation method.

3. RESULTS AND DISCUSSION

3.1. *Application of design thinking method to taro chips*

This design thinking method is usually used to solve user-centered problems. The design thinking method is implemented by presenting ideas in the form of solving problems and needs of

each user and creating them, adjusting to user needs, implementing designs by paying attention to some of them, understanding problems, and seeing the needs and challenges of the business being run [8].

Preliminary studies were carried out by observation, distributing questionnaires, and interviews. Observation activities are carried out to observe the shape of the product, and the packaging used by the taro chip industry to its buyers. Then the preliminary study continued with the distribution of questionnaires to a total of 120 taro chip buyers in four taro chip industries. Based on the distribution of this questionnaire, it was found that 85 out of 120 respondents expressed boredom with the shape and taste (original) of taro chips produced by four industries, then there was concern regarding environmental problems with the packaging used to package taro chips and the lack of information on taro chip packaging. So it can be concluded that there are respondents' concerns regarding the use of packaging used today and the use of packaging in question refers to the use of plastic packaging.

3.1.1. Phase Empathy

At this stage, data collection was carried out on the target taro chip industry. The target taro chip industry consists of taro chip industry owners and consumers. The data collection activities carried out were exploratory interviews. The exploratory interview is an interview method that begins with general questions to find out the characteristics and practices of taro chip business actors and consumers in carrying out an activity [9].

The journey taken by taro chip industry players in processing consumer orders begins with the stage of selecting the packaging to be used. At this stage, industry players try to choose the size that suits the available portions and look for examples of suitable packaging to wrap their food. In addition, in choosing this packaging, industry players lack references regarding environmentally friendly packaging materials so they often ignore environmentally friendly aspects in choosing packaging. In addition, in the process of purchasing the selected packaging, industry players seek and obtain packaging that follows what is available on the market.

3.1.2. Phase Define

This phase is carried out to define the problems and challenges that become the basis for the emergence of an idea. After identifying what problems the user is currently facing. The next stage is to determine the main problems faced by Micro, Small, and Medium Enterprises (MSMEs). This stage is a very important part, where a designer must describe and analyze the core of the problem in detail so that the right solution can be found in the next stage [10]. This is done to determine user needs. For this reason, what must be done is to determine the problem to be solved [11].

At this stage, the needs required by the target user are identified and clarified. Identification of needs is carried out based on the results of exploratory interviews conducted at the Empathize Stage. The identified needs are then explained further in the form of a point of view. The point of view summarizes an explanation of who the target user being researched is, what the needs of the target user are, and what knowledge has been gained based on the results of the empathy that has been carried out. As can be seen in Table 1, two points of view have been identified. The first point of view is for the owner of the taro chips industry,

the second point of view is for buyers of taro chips. Based on the defined point of view, it can be seen that different needs are identified. The taro chips industry requires safe packaging to package food. Apart from that, the taro chips industry also requires packaging that is the right size for the portions provided

Table 1. Point of view

Point of View 1	
User	Owner of the taro chips industry in Padang Panjang
Needs	Packaging with a size that fits the portion provided and is tight and safe to pack taro chips
Insight	Packaging that is practical for consumption, easy, and safe when consumed
Point of View 2	
User	Buyers who purchase taro chips
Needs	Packaging that can be a container for taro chips directly and tightly and safely to pack, with materials that are environmentally friendly and reusable and have new flavors of taro chips and new forms of chips produced.
Insight	To be able to consume food under safe conditions and be able to consume food and beverages practically while paying attention to the environmental aspects of the packaging, and enjoy new flavors of taro chips and shapes.

Current packaging still pays little attention to its packaging design in terms of visual appeal and functional appeal which results in a lack of consumer interest in the market. The old packaging design made by the taro chips industry has not met the requirements of a packaging design that has attractiveness so improvements need to be made because it is considered less attractive in terms of visuals such as the use of colors, font types, the use of images on the packaging and the layout of the labels used..

3.1.3. Phase Ideation

The third phase is where the process that produces the solution occurs. In this phase, it is expected to start thinking "outside the box". Starting with identifying new solutions based on the problem statement generated from the define phase. If there is stagnation, then the perspective on the problem should be changed [12].

This stage is a stage carried out in the process of finding solutions that can answer the needs that have been identified in the previous stage. At this ideate stage, the search for ideas is carried out with the Brainwriting process, the results of which are arranged based on priorities using a 2x2 matrix and selected using dot voting and continued with the benchmarking process to find ideas again before proceeding to the prototyping stage. The brainwriting process involves 4 owners of the taro chips industry, 4 buyers, and one person who acts as a designer. The ideas generated from this brainwriting process can be seen in Tables 2 and 3.

Table 2. Packaging Brainwriting Ideas

Materials
1. Paper-based packaging
2. Plastic-coated packaging on the inside
3. Aluminum and paper-based packaging
Shape
1. Bowl-shaped packaging
2. Standing Pouch packaging
Innovation
1. Packaging with a zip and lock system on the lid
2. Stackable packaging
3. Providing recycling steps on the packaging

Table 3. Brainwriting Result Idea Taste and Shape of Taro Chips

Flavor
1. Cheese taro chips
2. Balado taro chips
3. Balado taro chips with lime leaves
Shape of chips
1. Spiral
2. Random

3.1.4. Prototype Phase

A prototype is a tangible result of an idea that can be seen as a physical object and is able to interact more intensely with the

human senses, not only in the visual aspect alone [10]. At this stage, the initial design of the product is made to identify errors or deficiencies and look for new opportunities that may exist. To do this, the initial design will be tested by users to get the right feedback, which will help improve the design [13].

Prototype, After going through the previous three stages, namely the empathize, define and ideate stages, at this stage, the prototype design of the packaging design to be made begins. Several things will be discussed at this stage, namely using visual strategies such as packaging design style, packaging shape, packaging typography, packaging color and illustrations on the taro chip product packaging. And at this stage, execution and validation are also carried out through group discussions with the taro chip business owner. This prototype was tested together with the taro chip business owner himself. So when there is input, improvements will be made to the prototype so that it produces a maximum prototype.

The prototype that was designed is divided into three large parts. The first part is a prototype regarding the packaging material for taro chips. The second part is a prototype of a sticker that can be attached to the packaging. The third part is a prototype of a new form of taro chips that will be promoted and the fourth part is a variation of the taste of orange balado taro chips. The packaging design can be seen in Figure 1.

**Figure 1.** Taro chips packaging design

The initial prototype is related to packaging materials. The material used for taro chip packaging is aluminum. Aluminum packaging consists of packaging made of aluminum foil or aluminum foil. Aluminum packaging has many uses, such as Food and beverage packaging: Aluminum foil is used to wrap food and beverages that require special protection, such as maintaining taste or crispiness.

This packaging material offers the benefit of creating a simple and sophisticated impression at the same time because it looks

more attractive than other plastic options. Furthermore, for the packaging design, the researcher made it by making a label sticker which will then be attached to the packaging. For the packaging design, the researcher made a packaging label sticker which will be attached to the packaging, similar to the initial prototype.

There is a development of the taro chips logo in the new packaging design which is attached to the side of the packaging. There is an additional photo of the taro chips product. The use of this photo is intended to provide information to consumers about

the contents of the product and its appeal. The following is the result of the square-shaped taro chips logo design shown in Figure 2.

Creating a new packaging design that is simpler, attractive, and functional packaging design is one of the key factors in influencing consumer purchasing decisions. The Padang Panjang taro chips industry can be improved by developing a simpler and more modern packaging design.

3.1.5. Testing

The fifth or final stage of design thinking is to conduct user testing. In the final stage of the design thinking process, designers will conduct trials to obtain feedback to improve existing solutions and make the product even better. User feedback is

useful for identifying the advantages and disadvantages of the product so that improvements can be made [13]. In this testing stage, designers can make changes and improvements to eliminate problem solutions and gain the deepest possible understanding of the product and its users.

3.2. Chemical Analysis of Taro Chips

Taro chips resulting from design thinking need to be chemically analyzed to determine the nutritional content of the taro chips produced. The analysis carried out is the analysis of water content, ash content, protein content, fat content, and carbohydrate content. The analysis was carried out at the Vahana Scientific Laboratory in Padang City, West Sumatra



Figure 2. Taro Chips Packaging Sticker/Logo

Table 4. Chemical Analysis of Taro Chips Resulting from Design Thinking

Parameter	Average \pm SD
Water content (%)	5.08 \pm 0.61
Ash content (%)	1.62 \pm 0.36
Protein content (%)	3.08 \pm 0.12
Fat content (%)	26.67 \pm 0.17
Carbohydrate content (%)	63.56 \pm 0.30

Water is an essential element in taro chips because it can affect the sensory characteristics of the chips. Water is a medium for biochemical reactions, including producing free fatty acids, protein degradation, and hydrolysis [14]. [15] showed that the water content in food ingredients affects the overall water content. The findings from the variance analysis presented in Table 4 show that the water content of taro chips is 5.08%. This occurs because the taro chip production process involves around 10-15 minutes of frying. The thickness of the taro tuber slices will affect the water content of the taro chips and is directly related to

the temperature and time of the frying process. Excessive water content not only affects sensory quality but also affects the shelf life of the chips [16]. Ash is an inorganic residue resulting from the combustion or oxidation of organic compounds found in food ingredients. Ash content is included in the proximate analysis of food ingredients, which aims to assess the product's nutritional value, especially to measure the mineral content [17]. The results of the variance analysis of taro chips showed an ash content of 1.62%. The ash content of the taro chips produced meets the SNI quality standards for cassava/taro chips. SNI 01-4305-1996 is not more than 2.5%. The higher the ash content in the food material obtained, the higher the mineral content. The ash content reflects the level of cleanliness of a product because it can indicate the presence of mineral or metal contamination that is not soluble in acid [17].

The frying method causes a significant decrease in nutritional value because the high temperature used during frying can damage nutrients such as protein. The results of the analysis in Table 4 show that taro chips have a protein content of 3.08%. The

cooking method can reduce the protein content in food ingredients, and higher temperatures can accelerate the protein denaturation process [18], which causes a decrease in the protein content in the ingredients [19]. In addition, the length of the frying process can affect the protein content; as the frying time increases, the protein content decreases [20].

According to the findings of the fat content analysis in Table 4 above, taro chips contain 26.67% fat. The increase in fat content in fruit chips is due to the absorption of cooking oil during the frying process and the duration of frying, which causes an increase in the fat content in the chips. This is in line with research [20], because the fat content in taro chips in all treatments varies slightly, ranging from 24.97% to 25.80%. When frying, oil will be absorbed into the ingredients, meaning that the higher the temperature and the longer the frying time, the more water will evaporate and cavities will be formed that can be filled with oil as a frying medium [21]. Based on the results of the carbohydrate analysis shown in Table 4, taro chips contain 63.56% carbohydrates. The carbohydrate content is influenced by a decrease in water content, ash content, fat content, and protein content, meaning that carbohydrate content depends on the reduction factor. This is in line with research [20] which shows that the increase in carbohydrate content in chips can be caused by the loss of water content in the chips, causing the concentration and increase in carbohydrates to be higher.

4. CONCLUSION

From the design thinking results, it was found that HDPE plastic packaging was replaced with aluminum foil standing pouch windows, the shape of taro chips changed from round to irregular, and flavor innovation produced spicy taro chips with the addition of lime leaves. By combining various flavor choices and perfecting the packaging design of taro chip products, sales can be boosted and customer satisfaction can be increased. Based on chemical analysis, taro chips containing 5.08% water, 1.62% ash, 3.08% protein, 26.67% fat, and 63.56% carbohydrates meet the SNI 01-4305-1996 standards.

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