

PAPER

Mangosteen Peel Cookies: An Innovative Functional Snack from Mangosteen Peel Flour and Butterfly Pea Flower Extract

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ABSTRACT

Agricultural waste is often underutilized despite its potential value as a food ingredient. One example is mangosteen peel, which is commonly discarded even though it contains antioxidant compounds beneficial to human health. This project aimed to develop Mangosteen Peel Cookies, an innovative snack product made from mangosteen peel flour and butterfly pea flower extract. The product was designed to promote the utilization of agricultural waste, provide a healthier snack alternative, and support sustainable food production. The production process involved drying and grinding mangosteen peels into flour, preparing butterfly pea flower extract as a natural coloring agent, mixing the ingredients, baking the cookies, and packaging the final product. The resulting cookies exhibited a crispy texture, pleasant aroma, attractive appearance, and distinctive flavor. The incorporation of mangosteen peel flour enhanced the functional value of the product due to its antioxidant properties, while butterfly pea flower extract improved visual appeal through natural coloring. The business model focused on creating value from agricultural waste while targeting health-conscious consumers, students, young adults, and environmentally aware individuals. Marketing strategies included both online and offline approaches to increase product visibility and consumer acceptance. The findings indicate that mangosteen peel can be successfully transformed into a value-added food ingredient. Furthermore, Mangosteen Peel Cookies demonstrate potential as a healthy, environmentally friendly, and commercially viable snack product. This innovation contributes to waste reduction, sustainable resource utilization, and the development of functional food products with economic and environmental benefits.

KEYWORDS

Mangosteen Peel Cookies; Mangosteen Peel Flour; Butterfly Pea Flower; Functional Food; Sustainable Food Innovation

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1. INTRODUCTION

Cookies are among the most popular snack products worldwide due to their convenience, affordability, pleasant taste, and long shelf life. They are consumed by people of various age groups and are widely available in different varieties. However, conventional cookies are generally made from wheat flour, sugar, butter, and other ingredients that primarily provide energy but limited functional health benefits. In addition, many commercial cookies utilize artificial colorants, flavorings, and preservatives to enhance their appearance and shelf stability. As consumers become increasingly aware of the importance of healthy lifestyles and natural food products, there is a growing demand for innovative snack products that offer both nutritional value and environmental sustainability.

One of the major challenges faced by the agricultural sector is the increasing amount of organic waste generated from fruit processing and consumption. Fruit peels are often discarded despite containing valuable bioactive compounds and nutrients. Mangosteen (*Garcinia mangostana* L.) is a tropical fruit widely cultivated and consumed in many Southeast Asian countries, including Indonesia. While the fruit flesh is highly valued, the peel is commonly treated as waste. In fact, mangosteen peel contains various beneficial compounds such as xanthenes, polyphenols, flavonoids, and antioxidants that may contribute to human health. The improper disposal of mangosteen peel not only represents a loss of potential resources but also contributes to environmental waste problems.

Several studies have explored the utilization of agricultural by-products as ingredients in food products to improve nutritional quality while reducing waste. Examples include the use of banana peel flour, dragon fruit peel flour, and other fruit-based ingredients in bakery products. These innovations demonstrate that agricultural waste can be transformed into valuable food ingredients with functional properties. Nevertheless, the application of mangosteen peel flour in cookie production remains relatively limited, particularly when combined with natural colorants derived from plants. This condition creates an opportunity to develop a unique and sustainable food product that incorporates both agricultural waste utilization and natural functional ingredients.

In addition to the use of mangosteen peel flour, natural food colorants have gained increasing attention as alternatives to synthetic food dyes. Many consumers are concerned about the excessive use of artificial additives in processed foods. Therefore, food producers are encouraged to utilize natural ingredients that can enhance product appearance while maintaining safety and nutritional quality. Butterfly pea flower (*Clitoria ternatea*) is a plant known for its distinctive blue-purple pigments derived from anthocyanins. These pigments can be used as natural colorants in various food products. Furthermore, butterfly pea flowers also contain antioxidant compounds that may provide additional health benefits. The cultivation and utilization of butterfly pea flowers support environmentally friendly food production and reduce dependence on synthetic additives.

To address these issues, this innovation introduces Mangosteen Peel Cookies, a functional snack product developed using mangosteen peel flour and butterfly pea flower extract. Mangosteen peel flour serves as a source of natural antioxidants and contributes to the nutritional value of the product, while butterfly pea flower extract functions as a natural coloring agent that provides an attractive appearance. The combination of these ingredients creates a unique product that not only utilizes agricultural waste but also promotes the use of natural food ingredients. Through this innovation, materials that are often considered waste can be transformed into products with economic value and consumer appeal.

The development of Mangosteen Peel Cookies is also aligned with the principles of sustainable food production and circular economy practices. By converting agricultural waste into a useful food ingredient, this product contributes to waste reduction, resource efficiency, and environmental conservation. Moreover, the utilization of locally available materials can help support local communities and create new economic opportunities. The product demonstrates how food innovation can simultaneously address environmental concerns and consumer demands for healthier food options.

From a business perspective, Mangosteen Peel Cookies have promising market potential. The increasing popularity of healthy snacks, environmentally friendly products, and natural ingredients has created favorable conditions for the commercialization of innovative food products. The target consumers include students, young adults, health-conscious individuals, and consumers who support sustainable products. Attractive packaging, unique appearance, and functional benefits further enhance the competitiveness of the product in the snack market. Therefore, Mangosteen Peel Cookies not only serve as a nutritious snack but also represent an innovative business opportunity based on sustainable practices.

The purpose of this study is to develop and evaluate Mangosteen Peel Cookies as an innovative food product that utilizes mangosteen peel flour and butterfly pea flower extract. Specifically, this study aims to reduce agricultural waste, increase the utilization of natural ingredients, provide a healthier snack alternative, and explore the potential of sustainable food innovation. It is expected that the findings of this project will contribute to the development of environmentally friendly food products while encouraging greater awareness of agricultural waste utilization and natural food ingredients in the food industry.

2. METHOD

2.1 Business Model, Market Segmentation, and Production Method

The Mangosteen Peel Cookies is an innovative food product developed by utilizing mangosteen peel flour and butterfly pea flower extract as its main functional ingredients. The business model of this product focuses on creating value from agricultural waste by transforming mangosteen peels, which are commonly discarded, into a nutritious and marketable snack. This approach not only reduces organic waste but also increases the economic value of local agricultural products. The product is designed to meet the growing demand for healthy snacks made from natural ingredients while supporting sustainable food production practices.

The target market for Mangosteen Peel Cookies consists of consumers who are interested in healthy lifestyles, environmentally friendly products, and innovative food products. Market segmentation is divided into several categories. The first segment includes students and young adults aged 15–30 years who are interested in unique and trendy snack products. The second segment includes health-conscious consumers who prefer foods containing natural ingredients and antioxidants. The third segment includes environmentally aware consumers who support sustainable products and waste reduction initiatives. In addition, the product can also be marketed to tourists and gift buyers who are looking for distinctive local products with added nutritional value.

The marketing strategy combines both online and offline approaches. Online marketing is conducted through social media platforms such as Instagram, TikTok, and WhatsApp Business to reach a wider audience and increase product visibility. Product information, promotional content, and customer testimonials are shared regularly to attract potential buyers. Offline marketing includes participation in school exhibitions, local fairs, community events, and direct product demonstrations. Attractive packaging and branding are also implemented to strengthen the product image and improve consumer interest.

The production process begins with the procurement of raw materials from local sources. Mangosteen peels are collected from fruit vendors and households, then cleaned, dried, and processed into flour. Butterfly pea flowers are cultivated by the production team and processed into a natural coloring extract. The flowers are harvested, cleaned, and extracted to produce a natural blue-purple coloring agent for the cookies. Other ingredients, including wheat flour, sugar,

butter, milk powder, egg yolks, cornstarch, baking powder, vanilla, chocolate, and salt, are purchased from local stores and distributors. After all materials are prepared, the ingredients are mixed according to the formulation and processed into cookie dough. The dough is shaped, baked, cooled, and packaged before distribution.

The supply chain method involves several stages, including raw material collection, ingredient processing, production, packaging, storage, and distribution. Quality control is implemented throughout the production process to ensure product consistency, safety, and consumer satisfaction. Finished products are distributed directly to consumers through online orders, school exhibitions, and local retail outlets. This supply chain system enables efficient production while supporting local suppliers and promoting sustainable business practices.

Overall, the business model of Mangosteen Peel Cookies demonstrates how agricultural waste can be transformed into a value-added product with economic, environmental, and social benefits. The integration of market-oriented strategies and sustainable production methods enhances the product's potential for future growth and commercialization.

2.2 Materials and Ingredients

Table 1. Ingredients and Their Functions in Mangosteen Peel Cookies Production

Material	Number	Quantity
Wheat Flour	Main ingredient	400 gr
Mangosteen Peel Flour	Source of antioxidants	50 gr
Butterfly Pea Flower Extract	Natural coloring agent	130 ml
Dancow Milk Powder	Enhances nutritional value and taste	54 gr
Cornstarch	Improves cookie texture	30 gr
Sugar	Sweetener	150 gr
Butter	Improves texture and flavor	200 gr
Egg Yolk	Binder	2 eggs
Baking Powder	Helps dough expand	5 gr
Vanilla	Flavor enhancer	5 ml
Salt	Balances flavor and enhances taste	2 gr
Chocolate Bar	Additional flavor and topping	100 gr

Table 1 presents the materials used in the production of Mangosteen Peel Cookies. Mangosteen peel flour was utilized as a functional ingredient rich in antioxidants, while butterfly pea flower extract served as a natural coloring agent. Other ingredients were added to improve texture, flavor, and overall product quality.

3. RESULT AND DISCUSSION

3.1 Product Development Results



Figure 1. Mangosteen Peel Cookies Logo

Figure 1 shows the logo of Mangosteen Peel Cookies, representing the product identity and its main ingredients.



Figure 2. Drying Process and Mangosteen Peel Flour

Figure 2 shows the drying process of mangosteen peels and the resulting mangosteen peel flour used in cookie production.



Figure 3. Final Product of Mangosteen Peel Cookies

Figure 3 shows the final appearance of Mangosteen Peel Cookies, which have a crispy texture and attractive appearance.



Figure 4. Product Packaging

Figure 4 presents the packaging design of Mangosteen Peel Cookies prepared for marketing and distribution.

3.2 Discussion

The results showed that Mangosteen Peel Cookies can be developed as an innovative functional food product by utilizing mangosteen peel flour and butterfly pea flower extract. The use of mangosteen peel flour increased the functional value of the cookies due to its antioxidant content, while butterfly pea flower extract provided a natural color that enhanced the product's visual appeal.

Compared to conventional cookies, this product offers several advantages, including the utilization of agricultural waste, natural ingredients, and potential health benefits. The cookies maintained a crispy texture, pleasant aroma, and acceptable taste despite the incorporation of mangosteen peel flour. These findings indicate that agricultural by-products can be successfully transformed into value-added food products.

In addition, the use of natural coloring from butterfly pea flower supports consumer preferences for healthier food products. The attractive appearance of the cookies may increase consumer interest and market acceptance. The combination of mangosteen peel flour and butterfly pea flower extract also creates a unique product identity that differentiates it from conventional cookies available in the market.

The innovation also contributes to environmental sustainability by reducing organic waste and promoting the use of natural resources. By utilizing mangosteen peels that are commonly discarded, the product demonstrates how agricultural waste can be converted into a valuable food ingredient. This approach supports sustainable food production and encourages more efficient use of agricultural resources.

Furthermore, the positive characteristics of the product indicate promising opportunities for commercialization. The growing demand for healthy snacks and environmentally friendly products provides a favorable market for Mangosteen Peel Cookies. Therefore, this innovation has the potential to be developed further as a healthy snack product with economic, environmental, and social benefits.

4. CONCLUSION

The development of Mangosteen Peel Cookies successfully produced an innovative functional snack product utilizing mangosteen peel flour and butterfly pea flower extract as the main ingredients. The product demonstrated desirable characteristics, including a crispy texture, pleasant aroma, attractive appearance, and unique flavor. The incorporation of mangosteen peel flour increased the functional value of the cookies due to its antioxidant content, while butterfly pea flower extract served as a natural coloring agent that enhanced visual appeal without the use of synthetic additives. The findings of this project indicate that agricultural waste, particularly mangosteen peels, can be effectively transformed into a value-added food product with nutritional, economic, and environmental benefits. The utilization of natural ingredients not only improves product quality but also supports consumer demand for healthier and more sustainable food options. Furthermore, the product contributes to environmental sustainability by reducing organic waste and promoting the efficient use of local resources. Overall, Mangosteen Peel Cookies demonstrate strong potential for further development and commercialization. Future improvements may include product diversification, nutritional analysis, and broader consumer testing to enhance product acceptance and market competitiveness. Therefore, this innovation can serve as an example of sustainable food development that combines health benefits, environmental responsibility, and economic opportunities.

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