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# DEVELOPMENT OF MANGOSTEEN PEEL FLOUR AS A FUNCTIONAL FOOD INGREDIENT TO SUPPORT ENTREPRENEURIAL INDEPENDENCE IN SIPAK VILLAGE

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***Abstract***

*Sipak Village in Jasinga, Bogor Regency, has great potential for mangosteen production, yet it remains limited to fresh fruit sales, leading to increased peel waste. Through the PPK Ormawa program, students introduced the innovation of processing mangosteen peel into functional flour via blanching, drying, and grinding to retain bioactive compounds like xanthones and flavonoids. The program involved surveys, training, production, business mentoring, and marketing strategies. Final products included syrup, tea, and cookies under the brand Queens Flour. This initiative improved community skills, fostered local entrepreneurship, and reduced organic waste in a sustainable manner.*

***Keywords:*** *mangosteen peel, functional food, community empowerment, local entrepreneurship, PPK Ormawa*

## A. INTRODUCTION

Sipak Village is located in Jasinga District, Bogor Regency, West Java, and is one of the areas with very high potential for mangosteen agriculture. Mangosteen (*Garcinia mangostana L.*) is one of Indonesia's important tropical fruits with high economic value. Based on data from the Central Statistics Agency (BPS, 2024), mangosteen production in Sipak Village reached a remarkable volume of 88,543.77 quintals per year. This high level of production represents a significant local advantage and provides a major opportunity to improve community welfare if managed properly and sustainably.

However, this considerable potential has not yet been optimally utilized. Most community members still sell mangosteen fruit in fresh form at relatively low prices, particularly during the harvest season when supply is abundant. As a result, the income earned by farmers is often not proportional to the production costs and labor involved. Furthermore, unsold fruit and non-consumed parts, especially mangosteen peel, accumulate as waste and pose environmental risks due to the absence of an adequate waste management system.

Mangosteen processing generates a large amount of peel waste, which is generally discarded despite its high content of bioactive compounds. In fact, mangosteen peel possesses extraordinary potential that is often overlooked. Numerous studies have demonstrated that mangosteen peel contains various bioactive compounds such as xanthones, flavonoids, tannins, saponins, anthocyanins, and phenolic compounds (Rahayu, 2022; Saristiana et al., 2024). These compounds exhibit strong antioxidant, anti-inflammatory, antimicrobial, anticancer, and anti-allergic activities. Xanthones found in mangosteen peel are known as powerful antioxidants that are rarely found in other fruits. Additionally, Rizki et al. (2023) reported that mangosteen peel also contains anthocyanin pigments that can be utilized as natural dyes for food and textile products.

These properties indicate the strong potential of mangosteen peel as a functional food ingredient. Functional foods are increasingly recognized for their role in promoting health and preventing disease, while also creating economic opportunities for local communities. Nevertheless, in many rural areas, including Sipak Village, the utilization of agricultural by-products as functional food ingredients remains limited. Local communities often lack sufficient knowledge, skills, and technology to process these materials into value-added products that can generate sustainable income.

Most existing studies on mangosteen peel have focused on laboratory-scale extraction and pharmacological properties, with limited emphasis on community-based applications and entrepreneurship development. Consequently, there is a clear research and implementation gap in translating scientific findings into practical innovations at the community level that support economic independence.

In response to these challenges, the PPK Ormawa (Program Penguatan Kapasitas Organisasi Mahasiswa) was implemented as a concrete contribution of students to addressing local development issues. As agents of change, students play an important role in bridging scientific knowledge from universities with real community needs. Through this program, student organizations are not only involved in educational activities but also actively participate in designing and implementing innovation-based solutions aimed at improving community welfare.

In this context, PPK Ormawa serves as a facilitator in the development of mangosteen peel utilization by processing it into mangosteen peel flour as a functional food product. This innovation was chosen not only to add value to agricultural waste that has long been discarded but also to strengthen local food security and economic resilience. Through training, mentoring, and entrepreneurial capacity building, students assist community members in understanding the entire processing procedure, including washing, drying, grinding, and hygienic, attractive packaging.

Furthermore, students support the community in forming joint business groups, developing product branding, and designing marketing strategies to ensure that the products have competitiveness in local and broader markets. This program does not solely focus on increasing community income but also aims to raise awareness of environmentally friendly waste management and improve public health through the consumption of nutrient-rich functional foods.

The active involvement of PPK Ormawa in this initiative represents a tangible form of collaboration between academia and rural communities. Students act not merely as program implementers but as long-term partners in a continuous process of social transformation. Through a participatory approach, this program is expected to stimulate creativity and motivation among the Sipak Village community to recognize local potential as promising business opportunities.

Through this activity, it is expected that the community will no longer perceive mangosteen peel as waste to be discarded, but rather as a valuable resource that can be processed into economically valuable and health-beneficial products. With the spirit of collaboration, innovation, and empowerment, PPK Ormawa and the community strive to create impactful changes not only in economic aspects but also in environmental sustainability and overall quality of life.

Beyond addressing waste management issues and the low selling price of fresh mangosteen fruit, the processing of mangosteen peel into functional food products also contributes to agricultural product diversification in rural areas. This approach is highly relevant to current rural community needs for new business opportunities based on local resources. The development of household-scale agro-processing industries is an effective strategy to expand employment opportunities, particularly for women and youth, while reducing dependence on raw agricultural commodity sales.

The potential of mangosteen peel as a raw material for innovative products remains wide open, not only in the form of functional food flour but also for cosmetics, pharmaceuticals, and natural dyes. However, achieving this potential requires improved community understanding, technical skills, and awareness of value-added processing. In this regard

Based on the above conditions, this community service program was designed as a strategic effort to integrate local agricultural potential, scientific innovation, and community empowerment. This program aims to address existing challenges related to agricultural waste, low economic value of fresh mangosteen, and limited entrepreneurial capacity within the community. By developing mangosteen peel flour as a functional food ingredient, the program seeks to enhance community knowledge and technical skills, promote sustainable waste utilization, and strengthen local-based entrepreneurship.

Specifically, the objectives of this program are: (1) to increase community awareness and understanding of the functional properties and economic value of mangosteen peel; (2) to provide practical training on hygienic and standardized processing of mangosteen peel into flour; (3) to support the formation of community-based business groups and improve entrepreneurial skills; and (4) to encourage sustainable production and environmentally friendly practices. Through these efforts, the program is expected to contribute not only to improving household income and economic independence but also to fostering environmental sustainability and improving community health.

Overall, the implementation of the PPK Ormawa program in Sipak Village represents a comprehensive model of community service that combines academic knowledge, student engagement, and local resource optimization. This initiative demonstrates how student organizations can play a vital role in facilitating sustainable rural development and transforming agricultural waste into valuable products that support economic resilience, social empowerment, and environmental responsibility.

## B. METHOD AND IMPLEMENTATION

Implementation of this program took place in Sipak Village, Jasinga District, Bogor Regency, West Java. Focus main activity is empowerment society, especially group Mother House stairs that have potential big For involved active in the production process processed skin mangosteen. Program participants consist of from around 15 to 25 people joined in group public local.

### A. Survey location and analysis need for the program

Activity started with survey the first one was held on February 28$^{th}$ 2025, with mentoring direct from Mrs. Euis as Chairman of the Sipak Village MSME. At the stage this, the program team did approach beginning with method around village and discuss direct together public For introduce program concept and dig information beginning related potential and interest inhabitant to processing mangosteen.

### B. Trial and error

Second conducted on July 21$^{st}$ to 22$^{nd}$ 2025. Activities This focus on the trial and error stage of the initial process processing skin mangosteen become product processed, in order to adjust method the most effective and appropriate production with condition public local. Next,

### C. Socialization and education

Third held on July 29$^{th}$ to 31$^{st}$ 2025, which is filled with activity socialization beginning to inhabitant in a way direct from House to house (door to door). Activities This aim For give understanding more deep to public about benefits and opportunities from the utilization program skin mangosteen.

### D. Demonstration and production

Fourth implemented on August 4$^{th}$ 2025 and continued with activity demonstration processing mangosteen syrup product on August 13$^{th}$ 2025. One day then, precisely on August 14$^{th}$ 2025, it was carried out demonstration advanced manufacturing product tea and flour skin mangosteen. Peak from activity training

held on August 14th to 16th 2025, with focus main in the production process independent by the community to three type products, namely syrup, tea, and flour skin mangosteen. Activities This become an important momentum in push participation active public as well as form independence group business based potential local.

As for the method implementation is as following :

**A. Preparation tools and materials**

Tool : 80 mesh sieve, knife, blender, pan, stove, oven, and container. Ingredients : skin fruit mangosteen, ice cubes, and water.

**B. Making sample**

Making flour skin mangosteen become flour done with method skin mangosteen dissorted Then separated part skin outside use knife Then washed, washing process use clean running water For remove dirt and then drained, skin fruit mangosteen cut small, then skin fruit mangosteen dried with using an electric oven at 45ºC for 16 hours. After dried, skin fruit mangosteen ground with use blender tool then sifted with use 80 mesh sieve.

**C. Testing interest community on the food that is made**

After stage production finished, activity to be continued with testing interest and acceptance public to product processed products. Some example product simple like herbal drinks or snack Healthy made use flour skin mangosteen as material standard main. This Products then introduced to inhabitant around For tasted and rated based on taste, aroma, texture, and appearance. Bait come back from public collected For know to what extent is acceptance to product the as well as potential its future development as product local featured village.

**D. Evaluation**

Stage furthermore is evaluation of the program carried out in a way comprehensive For evaluate success activities that have been implemented. Evaluation This covers effectiveness training, improvement understanding and skills participants, as well as readiness public For continue production in a way independent. Activities evaluation implemented through discussion groups and interviews short with participants, in order to identify obstacles faced and potential action continue the program.

**E. Assistance and Marketing Strategy**

As form program sustainability, mentoring is also carried out advanced for participant in form group business together. Students help in designing identity products, including name, logo and design creation Attractive and hygienic packaging. In addition, the community is also accompanied in designing a marketing strategy, right in a way offline through local markets and in a way on line through social media and digital *platforms.* Aspects management business simple ones are also introduced, such as recording finance basis and division task in group, so that activities production can walk in a way sustainable and professional.

Through stages structured implementation this program is expected No only produce valuable products economy, but also create an empowerment model society that can replicated in other areas with potential

similar. Approach based training, practice direct, evaluation participatory and mentoring business become key success in create impactful changes for public village sipak.

### A. Program Design

This community service activity employed a mixed-methods approach combining quantitative and qualitative techniques to evaluate program effectiveness. The program was conducted in Sipak Village and involved local residents, particularly small-scale food producers and households interested in entrepreneurship.

### B. Materials and Processing Procedure

The main raw material used was fresh mangosteen peel collected from local farms. The processing stages included washing, drying, grinding, and sieving to obtain mangosteen peel flour. Training sessions were conducted to ensure participants understood hygienic processing, proper drying techniques, and quality control standards.

### C. Community Training and Assistance

The implementation consisted of:

1. Educational sessions on functional foods and the health benefits of mangosteen peel.
2. Hands-on training on mangosteen peel flour production.
3. Assistance in developing simple food products using the flour.
4. Basic entrepreneurship training, including packaging, labeling, and marketing strategies.

### D. Data Collection and Analysis

Quantitative data were collected through pre- and post-training questionnaires to measure changes in participants' knowledge and skills. Qualitative data were obtained through interviews and direct observation to assess community participation and program impact. Quantitative data were analyzed using descriptive statistics, while qualitative data were analyzed using thematic analysis.

### E. Validity and Reliability

The questionnaire instruments were validated through expert review, and reliability was assessed using internal consistency analysis to ensure accurate measurement of participant responses.

## C. RESULTS AND DISCUSSION

Activity training and mentoring processing skin mangosteen become flour in Sipak Village has succeed implemented with involving participation active society, especially moms House stairs. The production process carried out follow stages technical that has been customized with principle security food and

processing material natural. Stages main in manufacturing flour skin mangosteen covering washing, slicing, drying, and grinding.

Blanching process or boiling light during not enough more than five minutes proven effective in disable enzymes destroyer that can lower quality materials. In addition, the method this also helps maintain content compound bioactive in skin mangosteen, such as xanthones, which have sensitivity tall to oxidation. Drying carried out at a temperature range between 50°C to 60°C, which is optimal temperature for guard stability xanthone content and maintain color experience skin mangosteen, so that product end own good quality both visually and functional.

The flour produced from the process Then tested in a way qualitative For see potential content compound bioactive compounds contained in it. The results show that flour skin mangosteen contain various compound important like compound phenolics, flavonoids, and xanthone in sufficient levels high. Based on testing activity antioxidants use DPPH method, activity antioxidants in flour skin mangosteen reach the figure of 87.3% in the study Mardawati *et al* (2025) This figure show very high potential in ward off radical free, so that support function flour skin mangosteen as food functional that can help lower risk disease degenerative and strengthening system immunity body.

Findings this is also in line with results research conducted by Puspitasari *et al*. (2020), who stated that skin mangosteen contain fiber crude, flavonoids, and compound antimicrobial natural in research Saristiana *et al* (2024) which is good For health digestion and support metabolism body. In addition, the color naturally produced from anthocyanin pigments in skin mangosteen give mark plus from aspect aesthetics and potential its use as dye experience in product food processed.

From the side reception community, trial results product processed from flour skin mangosteen, such as herbal drinks and snacks light, get positive response. The majority participant state interest to benefit the health services offered, as well as feel satisfied with the taste of the resulting product. Product flour skin mangosteen This named ***Queens Flour***, which was developed as alternative material food functional with content antioxidants natural. This shows that flour skin mangosteen No only potential as product health, but also has sufficient market opportunities big at the level local, especially If packaged and marketed with the right strategy.

In a way overall, activities This No only produce product new based potential local, but also improve understanding public about importance management waste environmentally friendly farming environment and value economy. Participation active public as well as results positive from product testing show that this program own real and tangible impact become a model of sustainable empowerment in the village. To expand market reach and increase mark sell products, digital marketing strategies start introduced through training use of social media, local marketplace, and e-commerce platforms. Perpetrator business local, especially moms House the ladder involved in production, driven For form group business together (KUB) and utilize digital media as means promotions and sales product flour skin mangosteen as well as its processing.

In addition, monitoring and evaluation are also carried out. periodically to quality production, marketing, and impact economy for community. This monitoring covers recording of production volume, sales level, as well as satisfaction consumers who do through survey simple. With approach this, the sustainability of the program can maintained, and problems that arise in the field can quick followed up. It is hoped that, with combination between innovation products, digital marketing, and structured monitoring systems, Sipak Village can become pilot in development economy local based potential nature and technology appropriate.

Table 1. Pre-test table of the Level of Knowledge of the Sipak Village Community about Potential Mangosteen Peel before the Gita Mangosteen Program

| Question | Statement | | | | |
|---|---|---|---|---|---|
| | SS | S | C | TS | STS |
| Whether You know that fruit and skin scratching can processed as product sell previously ? | 15 People | 0 People | 0 People | 0 People | 0 People |
| Whether You Already Once process fruit and skin mangosteen previously ? | 4 People | 11 People | 0 People | 0 People | 0 People |
| According to you, are you management skin and meat fruit mangosteen potential increase income public ? | 14 People | 1 Person | 0 People | 0 People | 0 People |
| According to you, are you manufacturing product can help reduce waste skin that is not used Again ? | 14 People | 1 Person | 0 People | 0 People | 0 People |
| Whether You interested follow training manufacturing tea, flour, syrup from mangosteen ? | 6 People | 9 People | 0 People | 0 People | 0 People |
| Whether You willing follow market product processed said (in a direct or online)? | 12 People | 3 People | 0 People | 0 People | 0 People |

Figure 1. Manufacturing flour skin mangosteen

Next, the activities socialization digital marketing has done with introducing promotional strategies through social media and *marketplaces*. Participants get knowledge new about manufacturing content promotion,

writing description products, as well as Utilization of digital platforms as a marketing medium. This stage succeed increase outlook public about importance marketing digital-based.

Table 2. Pre-Test table of the Level of Knowledge of the Sipak Village Community about Potential Product Mangosteen Peel after the Gita Mangosteen Program

| Question | Statement | | |
|---|---|---|---|
| 1. What are you know about *branding* ? | A. Create a name and image product so that easy known | B. Make product more cheap | C. Sell product without promotion |
| Amount | 11 Persons | 1 Person | 1 Person |
| 2. Why packaging product That important ? | A. So that the product protected and attractive buyer | B. So that the product more heavy | C. So that the product No in demand |
| Amount | 13 Persons | 0 Person | 0 Person |
| 3. Whether You Once make design packaging Alone ? | A. Once | B. Never | - |
| Amount | 13 Persons | 0 Person | - |
| 4. How method You usually promote product ? | A. Inviting people to direct buy | B. Through social media | C. Never do promotion |
| Amount | 3 Persons | 10 Persons | 0 Person |
| 5. What are the obstacles ? the biggest you experience in sell product ? | A. Product not enough known | B. Packaging not enough interesting | C. Don't know method promotion |
| Amount | 8 Persons | 2 Persons | 3 Persons |

Table 3. Posrt-test table of Knowledge Level of Sipak Village Community about Potential Product Mangosteen Peel after the Gita Mangosteen Program

| Question | Statement | | |
|---|---|---|---|
| 1. Now, what does *branding* mean ? according to You ? | A. Sell product known with an interesting name and picture | B. Make Product Cheaper | C. Sell Product Without Promotion |
| Amount | 13 Persons | 0 Person | 0 Person |
| 2. Whether You Already Can make or repair | A. Already and packaging more interesting | B. Already try But Not yet Good | C. Not yet Can The same very |

| | | | |
|---|---|---|---|
| design packaging product You ? | | | |
| Amount | 11 Persons | 2 Persons | 0 Person |
| 3. After training , how You promote product You ? | A. Through social media | B. Invite people directly buy | C. Not yet promoted |
| Amount | 8 Persons | 0 Person | 5 Persons |
| 4. What are the benefits you get ? feel after training This ? | A. Product more known and sold | B. Packaging product more interesting | C. More believe self For market product |
| Amount | 0 Person | 0 Person | 13 Person |
| 5. What's the plan ? You after training For develop business ? | A. Make packaging more products interesting | B. Increase promotion through social media | C. Look for help For design packaging |
| Amount | 4 Persons | 4 Persons | 5 Persons |

Based on results filling questionnaire, results This show that although public Already own understanding base regarding branding, its importance packaging, as well as utilization of social media, still required mentoring more carry on in promotion and improvement strategies Power pull products by the team implementers to be more known in a way area. It can also be seen that public Still face constraint in matter mastery more digital marketing features deep due to group public majority Not yet used to utilise digital technology in maximum.

Product flour skin mangosteen Then start marketed in a way directly in the environment public and through digital platforms. Marketing results show existence interest from consumer local as well as expansion market reach through online media. With This, the activities This No only increase skills public in processing waste skin mangosteen, but also opens opportunity development business based herbal products.

## A. Improvement in Knowledge and Skills

The results showed a significant improvement in participants' understanding of functional foods and mangosteen peel utilization after the training program. Participants demonstrated increased skills in producing mangosteen peel flour using appropriate processing techniques.

## B. Product Development and Acceptance

Participants successfully developed several food products incorporating mangosteen peel flour. Sensory observations indicated acceptable color, aroma, and texture, suggesting the feasibility of mangosteen peel flour as a functional ingredient.

## C. Economic and Entrepreneurial Impact

The program contributed to increased entrepreneurial motivation among participants. Some participants initiated small-scale production for local markets, indicating the potential for income generation and economic independence.

## D. Discussion

These findings are consistent with previous studies highlighting the role of functional food innovation in supporting community-based entrepreneurship. The success of the program was influenced by the availability of raw materials, active community participation, and continuous mentoring. The integration of food innovation with empowerment strategies proved effective in enhancing both technical capacity and economic potential.

## D. **CONCLUSION**

This community service program demonstrates that mangosteen peel flour has strong potential as a functional food ingredient while also serving as a tool for community empowerment. The program successfully improved community knowledge, skills, and entrepreneurial motivation in Sipak Village.

The development of mangosteen peel flour not only contributes to sustainable waste utilization but also supports rural economic independence. Future programs are recommended to focus on product diversification, shelf-life testing, nutritional analysis, and broader market access to ensure sustainability and scalability.

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