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EMPOWERMENT OF THE BISIMO ETAIKENA FARMER GROUP IN PROCESSING BANANA PEEL WASTE INTO *NATA DE MUSA*

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Abstract

Nata is a food product from a fermentation process like banana peels. The requirement for making Nata products. Generally, the basic ingredients must have a fairly high glucose (carbohydrate) content. Banana peel is a waste material (banana fruit waste) which is quite a lot. Banana peel waste contains high levels of nutrients, especially vitamins, and minerals, so that it can be used as food raw material. Banana peel waste is good enough to be used as a substrate for making nata de Musa; judging from the nutritional content, it has a fairly high carbohydrate content. This empowerment activity is carried out through the Beginner's Community Service Program (PMP) for Fiscal Year 2023, funded by the Directorate of Research, Technology, and Community Services (DRTPM). This activity took place in Wamena City, Jayawijaya Regency, Papua Highlands Province, from July to August 2023, with the participation of 20 farmers. This community service initiative uses the Community Based Research (CBR) methodology for training and mentoring, specifically the Forum Group Discussion (FGD) technique. The results of this community service activity show a great opportunity to develop and continue as a community micro and medium business with processed banana skin waste products.

Keywords: Banana Peel Waste, Empowerment, Independent Economy, Nata de Musa, Processed Food

INTRODUCTION

Banana peel is a waste material (banana fruit waste) which is quite a lot. Banana peel waste contains high levels of nutrients, especially vitamins, and minerals, so that it can be used as food raw material. Apart from being used as a raw material, it also improves the nutritional content when processed into food. One of the processed foods from banana peels is crackers. The process, which needs to be more difficult, makes it easier for village people to practice it themselves. So that the banana skin which was not originally used becomes of the sale value and has a value of benefits (Hartono & Janu, 2013).

Banana is a fruit plant widely cultivated and consumed in tropical and subtropical regions. The average banana consumption is 12 kg per capita, making it the world's main food crop after rice, wheat, and maize. World banana production has steadily increased over the past

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20 years, from about 70 million tons in 1999 to around 117 million tons in 2019. Bananas are mostly produced in Asia, Latin America, and Africa (Fig. 1). In 2019, the prominent producer of bananas was India, followed by China, India, Brazil, and Ecuador (Faostat, 2020).

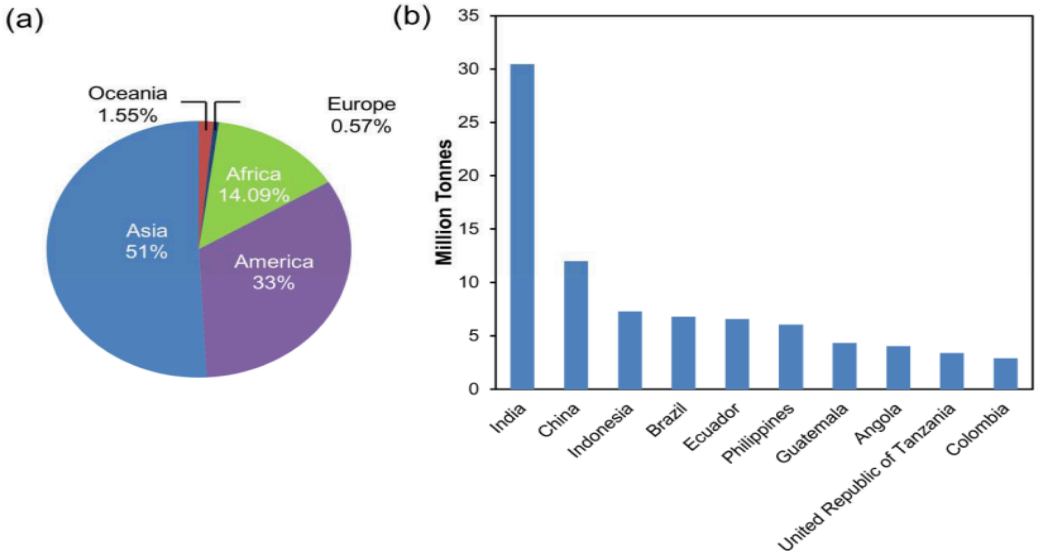

Figure 1. (a) Data on the percentage of banana production by region and (b) the top 10 largest banana-producing countries (FAOSTAT, 2020)

Since bananas are an important crop worldwide, plantations generate tons of residue after each harvest season and during processing to get banana pulp. The precipitate may include leaves, pseudostems, stalks, and inflorescences, but it is 35%–50% of the total fruit mass (without banana peels) (Gomes et al., 2020). Banana peels are usually disposed of into the environment without any processing. In Wamena today, many fried food sellers flood urban streets. It is due to the high public interest in fried foods such as bananas. Processed food in the form of fried bananas is a favorite of people in their daily activities, but the skin is not wasted and only becomes waste that impacts the environment and health (Tuhuteru et al., 2023). In some cases, banana peels can and have been used as organic fertilizer and animal feed due to their low tannin and high fiber content (Pereira & Maraschino, 2014; Wanimbo, 2022; Inrianti et al., 2018). Approximately 36 million tonnes of banana peels are produced annually, and their current endpoint is associated with adverse environmental impacts and economic losses (Gomes et al., 2020).

Every day several tons of banana peel waste is generated in fruit markets and household waste, causing an unpleasant odor due to the anaerobic digestion of biomass, which produces gases that disturb the natural balance of the air. Although ripe bananas are consumed unprocessed, large quantities are processed industrially into banana flour, chips, and other processed goods, generating large amounts of banana peel waste (Figure 2). Previously, the food manufacturing industry disposed of banana peels in landfills. The agricultural industry will benefit financially from converting banana peels into valuable products (Zaini *et al.*, 2022).

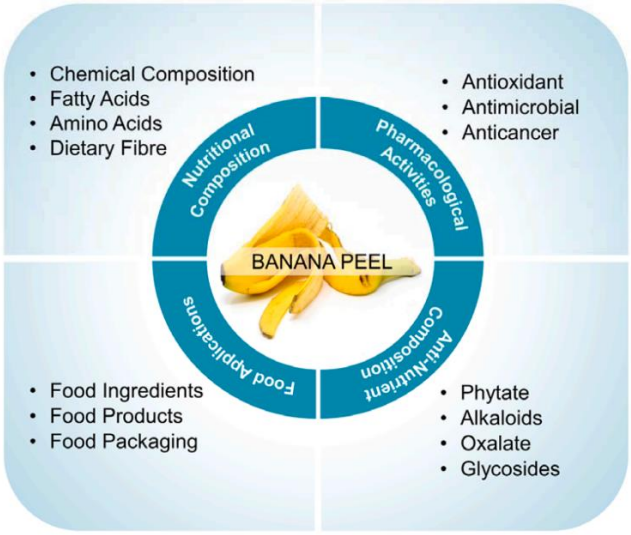

Figure 2. Graphic outline of the content and role of banana peels

The utilization of fruit peels in nutritional supplementation mainly depends on their chemical composition. Like its pulp, banana peel contains rich organic content (lipids, fiber, carbohydrates, and proteins) as the main source of many bioactive compounds with various functions (Zaini et al., 2022). Banana peels contain high carbohydrates, around 18.5% (Munadjim, 1988), so they can be used as raw materials for making various food products, including manufacturing alcoholic beverages, nata, and crackers (Hartono & Janu, 2013). Banana peel is a raw cracker material that is very easy to obtain, unlike other fruits in a certain season. Banana peel waste is quite good for use as a substrate for making nata de musa; judging from the nutritional content, it has a fairly high carbohydrate content, namely 18.50 g in 100 g of material (Suripto, 2018). The nutrients in banana peels include 1.28% sucrose sugar, various mineral sources, including Mg^{2+} (3.54 gr/l), and growth-promoting factors, which are compounds that can increase the growth of bacteria-producing bananas. Nata (*Acetobacter xylinum*). *Acetobacter xylinum* will utilize sucrose sugar in banana peels as an energy source and a carbon source to form metabolite compounds, including cellulose which forms nata de musa. Compounds supporting growth (growth-promoting factors) will increase microbial growth, while minerals in the substrate will help increase the activity of kinase enzymes in Acetobacter xylinum cell metabolism to produce cellulose (Kirana et al., 2014).

Nata is a food product from a fermentation process like banana peels. The requirement for making Nata products. Generally, the basic ingredients must have a fairly high glucose (carbohydrate) content. Data can be formed with glucose (carbohydrates) (Suryani et al., 2005; Wardi & Fendri, 2018).

Based on the background stated above, through Community Service activities, it is hoped that it can assist farmers in understanding advanced processed products from banana peels which are known to contain good nutrition for the health of the body; besides that, it is also good for the environment with good management. For this reason, implementing this PKM activity aims to increase farmers' knowledge and skills in Wamena City, processing banana peel waste into nata (nata de musa) products and increasing the selling value of processed banana skins.

IMPLEMENTATION METHOD

This empowerment activity is carried out through the Beginner's Community Service Program (PMP) for Fiscal Year 2023, funded by the Directorate of Research, Technology and Community Services (DRTCS). This activity took place in Wamena City, Jayawijaya Regency, Papua Highlands Province, from July to August 2023, with the participation of 20 farmers. The activity location was deliberately chosen because local farmers needed activities to develop and increase human resources through processing banana peel waste into nata de musa.

This community service initiative uses the Community Based Research (CBR) methodology for training and mentoring, specifically the Forum Group Discussion (FGD) technique. FGDs were conducted with the community to find alternative solutions to their problems (Harini et al., 2023).

The CBR method is a community-based study that aims to provide support, strength, and active contribution to the empowerment process to create value that benefits society (International Collaboration for Participatory Health Research) (Hanafi et al., 2015; Septiani et al., 2022). The CBR method is a participatory method developed to encourage collaboration between implementers and respondents, to receive and develop perfect findings, and to become a method for translating research findings into practical changes (Miskiyah et al., 2023).

This method is used to improve the quality of farmers in Wamena City by carrying out community service activities, namely training in making nata de musa from banana peel waste. The stages in the elaboration of the methods for implementing training and mentoring activities in question consist of the following:

1) Survey and Riset Stage

This empowerment activity begins with a site survey and continues with licensing. Then coordination was carried out with the head of the Bisimo Etaikena Farmer Group regarding the details of the service activities in the form of discussions that focused on discussions starting from preparation for implementation, increasing resource requirements, distributing the materials needed to the heads of farmers groups, and socializing activities.

2) Counseling or Socialization Stage

The socialization activity was carried out for one day, which began with a discussion and explanation about the processing of banana peel waste, the content of banana peels, and the benefits of banana peels for health, especially as a basic ingredient for making nata de musa.

3) FGD Stage (Foccus Group Discuccions)

The FGD was carried out after the socialization about the processing of banana peel waste, the content of banana peels, and the benefits of banana peels for health, especially as a basic ingredient for making nata de musa, was held, which was carried out on the same day or according to an agreement with partners. The FGD aims to broaden horizons and increase community knowledge and skills by exploring the material presented by resource persons during socialization.

4) Stage of Training and Assistance Making *nata de musa*

In this stage, nata de musa is made, which begins with preparing the tools and materials. This stage was carried out with the farmer groups who were present, and at this stage, the

implementing team explained in practical terms the utilization of banana peel waste into products that have economic value and meet health requirements. The stages of making nata de musa taught in this stage are: The process of processing banana peels starts from collecting banana peel waste from the production process of processing bananas into fried foods. All banana peels can be used because the chemical content is almost the same for banana peels. The stages of processing banana peels into Nata de Musa are as follows:

- Wash and cut the banana peel, then puree it with a blender with a 2:1 composition. Then filter it using a cloth filter.
- Boil banana peel extract in a saucepan, then add 75 grams of sugar per liter.
- Measure the pH of the banana peel extract. If the pH is above 4 – 4.5, add vinegar or glacial acetic acid until the pH becomes 4 – 4.5. Then filter it using a sieve.
- Put the banana peel extract into a plastic tray, basin, or another container, then cover it with clean paper, give a description, and store it in a safe place.
- After the temperature reaches 30o – 40o C, add 165 ml/liter of seed fluid and nutrients as germinated water substitutes for Urea and ZA (with a certain ratio).
- After 10-15 days, a white layer will form on the surface of the banana peel extract. Lift the layer. Be careful not to contaminate the undercoat; this liquid can be used as seed in later production processes.
- Soak the white layer (nata) for 2-3 days to remove the acid. Every day, the soaking water must be replaced with new water.
- Discard the layer/thin film attached to the bottom of the white layer earlier, then cut the white layer obtained according to the desired shape, then wash it clean.
- Then drain.

  Boil the nata until the sour smell disappears (flavors can be added), then cut into pieces and pack.

5) Monitoring and Evaluation Stages

Monitoring and evaluation have been carried out since the activity ended by monitoring the implementation of the sustainability of banana peel waste processing in partner groups and monitoring the performance of members in continuing the program after it was initiated at the beginning. This activity will also be carried out by providing questionnaires to be answered by all participants regarding the activities carried out. In addition, at the end of each program, an evaluation is carried out by giving questionnaires and interviews to find out the responses and understanding of each participant from the PKM implementation carried out by the Team. The evaluation is expressed in the following indicators:

Table 1. Program Implementation Indicators

No.	Indikator	Before	After
1.	Partners understand what is meant by processed food, especially those that come from waste, and have good nutrition for health	10 %	70 %
2.	Partners understand the process of processing banana peel waste into nata de musa and the tools and supporting materials used.	15 %	75 %
3.	The number of partners who improve the mindset towards processing banana peel waste as a form of local food diversification.	20 %	70%
4.	Become an economically independent partner by processing banana peel waste into *nata de musa* as a food ingredient for processed bananas that can increase family income.	10 %	50 %
5.	Partners can understand the nutritional content of the *nata de musa* and the level of product hygiene	10 %	70 %

The activities to be carried out consist of mentoring and setting up institutions related to sustainable production marketing, practices/demos carried out in the process of making nata de musa can be grouped into five stages, namely: the practice of cooking and mixing of auxiliary ingredients, storage in containers, stage planting seeds, the ripening (fermentation) stage and the harvest and post-harvest stages (Palupi et al., 2020). The stages of the implementation of activities are as follows:

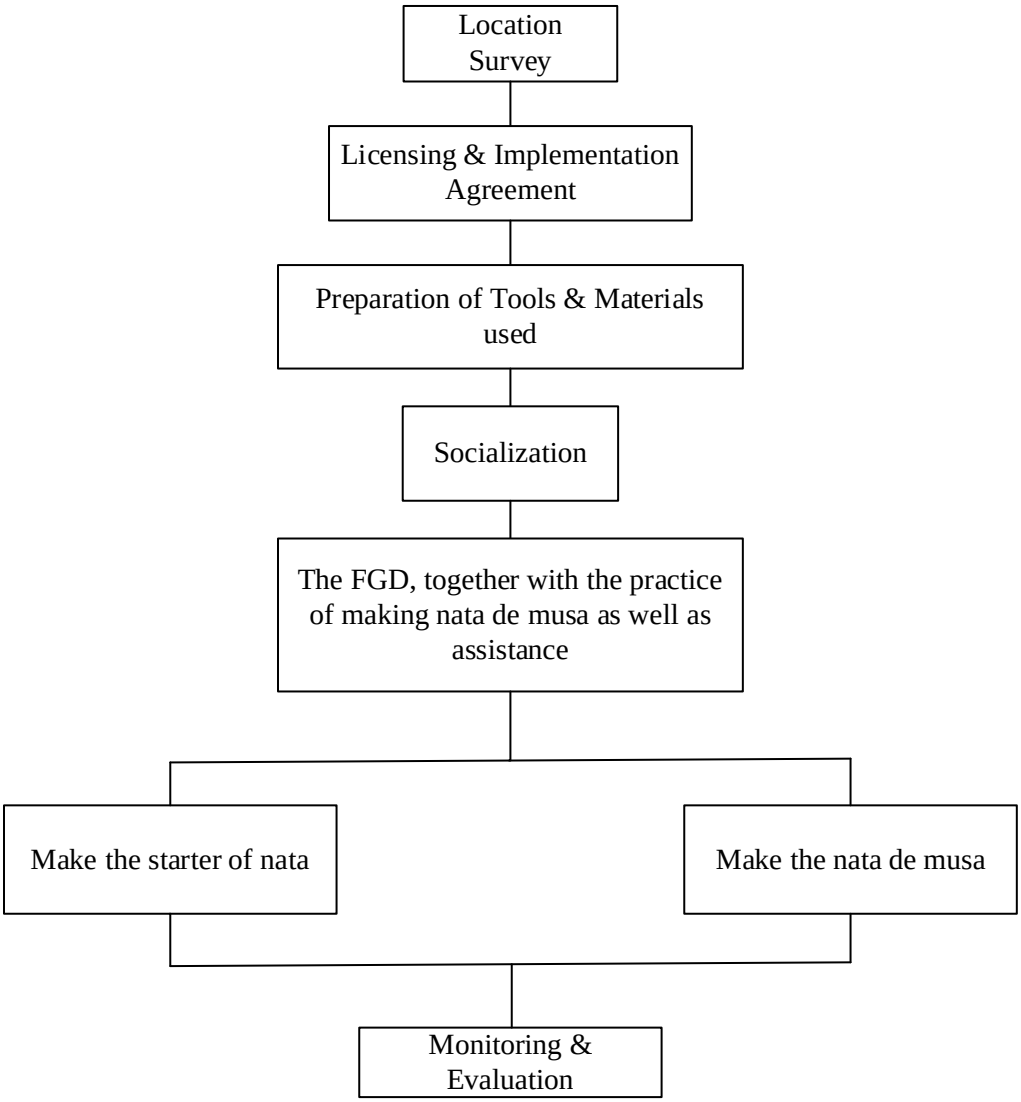

Figure 3. Stages of Activity Implementation

RESULTS AND DISCUSSION

The results of implementing this PKM activity show the community's enthusiasm for participating in the socialization activities. It can be seen from the number of participants than invitees. In addition, this community service program is carried out to provide knowledge and skills in assisting in making nata de musa. It is due to support the knowledge and skills of the community in processing banana peel waste into nutritious secondary food. In its implementation, this community service program is carried out in three stages, namely:

1) Preparation Stage

   The preparation stage is to prepare the tools and materials used in the activity; it also prepares the building or room that will be used as the place for the activity. This stage is carried out after the licensing process is carried out. The materials used consist of banana peel waste obtained from a fried food seller in Wamena City and as many as five plastic sacks, which will then be crushed and used for making nata de musa. Apart from that, there are also starter materials that have been made or purchased along with ZA.

Figure 4. Main Ingredients in Making Nata de Musa (Banana Peel (Left), starter, and ZA (Right))

2) Implementation Stage

This stage consists of outreach, FGD, and training and assistance in making *nata de musa*.

a. Socialization and FGD

Ini merupakan tahapan dimana proses sosialisasi dilangsungkan dengan materi sosialisasi pengolahan limbah kulit pisang, kandungan kulit pisang dan manfaat kulit pisang bagi kesehatan terutama sebagai bahan dasar pembuatan *nata de musa*. Tampak bahwa tahapan sosialisasi dilakukan di dua tempat berbeda yakni di halaman rumah, dan seiring berjalan diminta untuk dapat menuju rumah Ketua Kelompok Tani yang harus melewati lahan pertanian warga.

Figure 5. Socialization Process of Ongoing Activities (Left) Before starting the socialization, the FGD occurred (Right)

When the socialization took place, the FGD stage was also continued. This aims to determine the level of knowledge of farmers before and when given the material. In addition, this stage is also interspersed with the help of questionnaires related to farmers' understanding of processed food made from banana peels.

b. Training and Assistance Stage

This stage is the final session of the implementation of socialization. Training and mentoring took place simultaneously, namely training in making starters and assistance in making nata de musa with local farmers in Wamena City.

Figure 6. Starter and Nata de Musa Making Training Process

3) Evaluation Stage

At this evaluation stage, the community service implementation team evaluates the responses that have been given or shown by farmers during the activity. The assessment was carried out based on responses or responses from farmers, such as questions posed by participants, including

1. how banana peels can be consumed even though they are waste,
2. What is contained in banana peels that makes them nutritious and good for health?
3. How long will it take to store pineapple starter if it is hard to find one on sale?
4. Can it be processed into other foods besides nata?

The questions raised raised the team spirit in this service activity.

To motivate farmers and as a form of appreciation for the response during the socialization, the dedication team gave door prizes in the form of starter shops, pouches, and data sheets ready to be marketed or consumed.

After the evaluation process takes place, the presentation expected by the implementation team as a form of achievement for the implementation of this community service activity is:

Table 2. Activity Success Indicators

No.	Indicators	Before	After	
			%	Quantities
1.	Partners understand what is meant by processed food, especially those that come from waste, and have good nutrition for health	10 %	100 %	40
2.	Partners understand the process of processing banana peel waste into nata de musa and the tools and supporting materials used.	15 %	85 %	34
3.	The number of partners who improve the mindset towards processing banana peel waste as a form of local food diversification.	20 %	50 %	20
4.	Become an economically independent partner by processing banana peel waste into *nata de musa* as a food ingredient for processed bananas that can increase family income.	10 %	50 %	20
5.	Partners can understand the nutritional content of the *nata de musa* and the level of product hygiene	10 %	45 %	18

The results of the activity were said to be successful because they were able to achieve the goals set at the beginning, namely: evidenced by increasing the understanding and skills of farmers during the activity and until the end of the activity and intending to continue it as a home business by 20 farmers.

The achievement of implementing this activity is following the set targets: 1. 100% increase in local food diversification from banana peel waste. 2. 100% reduction in odor pollution caused by banana peel waste in the Middle City of Wamena. 3. The establishment of an independent economic business through food processing made from banana peel waste which currently needs to be widely used 4. Five farmers understand and process banana peel waste into nata de musa and are willing to develop it.

CONCLUSION

The implementation of these activities resulted in the conclusion that processing banana peel waste into nata de musa is easy to do even though it takes a long time because you have to wait two weeks in storage until nata is formed. Then, socialization activities and training in making the starter and nata de musa were carried out according to a predetermined plan. It is evidenced by the level of achievement of implementation indicators in the field, where the percentage of partners who understand what is meant by processed food, especially those originating from waste and having good nutrition for health, is 10% and reaches 100% after the activities are carried out (a total of 40 farmers understand), as well as the percentage of partners who understand the process of processing banana peel waste into nata de musa and the supporting tools and materials used increased from 15% to 85% (34 farmers), from 50% to 85% (21 farmers). The number of partners who improve the mindset towards processing banana peel waste as a form of local food diversification is 50% (20 farmers), an increase from

only 20%. The team then agreed on the results to continue the mentoring process to fully integrate it as a community small business to increase family income. Thus, this business has a great opportunity to develop and be continued by community service providers and people with the potential to develop it.

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