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Optimization of Pedada Mangrove Fruit as a Mangrove Processed Product to Enhance Mangrove Forest Utilization

Ni'matus Sholihah*, Fadhil Muhammad Tarmidzi, Jefri Pandu Hidayat, Gevbry Ranti Ramadhani Simamora, Siti Munfarida, and Amalia Nur Kumalaningrim
Food Technology/Food Science, Food Technology and Maritime Affairs, Institut Teknologi Kalimantan, Balikpapan, Indonesia
*nimatus.sholihah@lecturer.itk.ac.id

Abstract: Mangrove forests are a unique ecosystem and are important in providing life support for coastal communities. The community group (Kelompok Kariangau Lestari) is a community in Kariangau RT 02 Village that has yet to receive intensive training or socialization regarding the diversification of mangrove derivative products. Mangrove plants are not used properly, so they are only left to grow wild around residential areas. The settlement around the mangrove is used as a tourist attraction, namely Jembatan Panjang Mangrove Kariangau. Still, this tourist attraction is not optimal because the long bridge is the only attraction, and the bridge has been damaged, so there is no longer a source of income for residents. Therefore, this community service activity aims to train community groups to utilize mangrove fruit as a processed food product to attract tourism to the Jembatan Panjang Mangrove Kariangau and increase residents' income. This activity began with observing the condition of the mangrove forest and holding discussions with the local community regarding efforts to increase mangrove forest productivity. In this activity, minimizing processing tools was also carried out to make processed food products and determine the right formulation for processed food products. The evaluation was carried out in two discussions, namely product evaluation, with the result that residents could accept the product as consumers, and activity evaluation, with the result that residents felt this activity was very useful for increasing the current use of mangrove plants.
Keywords: Crackers, Mangrove, Pedada, Syrup

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INTRODUCTION

After the enactment of Law No. 3 of 2022 concerning the State Capital (IKN), the idea of relocating the capital of the Republic of Indonesia is no longer merely a concept. President Joko Widodo proposed the areas of Penajam Paser Utara and Kutai Kartanegara as the new capital. Moreover, the environmental area of Penajam Paser Utara, which has been designated as the IKN region, consists mostly of forested areas. Teluk Balikpapan is one of the regions comprising coastal areas and mangrove forests within the IKN territory (DLH Balikpapan, 2015). Teluk Balikpapan,

with a water area of 16,000 hectares (Warsidi & Endayani, 2017), plays a vital and strategic role as a support for ecosystem balance in the IKN area through its surrounding river basins, which are mangrove forests. Based on delineation maps, the Mangrove Ecosystem Zone (EM), according to Mayor Regulation No. 22 of 2021, covers an area of 1,597.55 hectares in Sub-BWP Kariangau. Among the extensive mangrove ecosystems, approximately 3.05 hectares are located in the Kariangau Village area along the Samratulangi Road coastline.

Mangrove forests are unique ecosystems capable of adapting to various marine, estuarine, and surrounding environmental conditions. They are among the ecosystems with high commercial value and productivity on Earth (Jadin & Rousseau, 2022). Warsidi & Endayani (2017) identified 20 mangrove species in Balikpapan, including Rhizophora apiculata, Rhizophora mucronata, Sonneratia alba, Acrostichum aureum, Ardisia sp., Avicennia marina, Bruguiera gymnorhiza, Ceriops tagal, Dillenia suffruticosa, Dysoxylum sp., Flagellaria sp., Glochidion littorale, Guioa sp., Heritiera littoralis, Lumnitzera littorea, Nypa fruticans, Pandanus odoratissima, Pouteria sp., Xylocarpus granatum, and Cerbera. Biodiversity depends on the environment, climate type, altitude, and other plant growth factors (Ainiyah et al., 2017; Imaniar et al., 2017; Kurniasih, 2019). One of the dominant coastal forests in the Balikpapan region, specifically in the Kariangau Village area, is the mangrove forest, which has the potential to serve as a model for bioprospecting for both local and city residents of Balikpapan.

The role of mangroves is crucial, and they serve as a lifeline for coastal communities, providing wood, fruit, and other resources. The dominant species of mangroves in Indonesia is Avicennia marina (Forsk.) Vierh. (Avicenniaceae), commonly abbreviated as AM (Jha et al., 2021). Its fruit can be used to create various products beneficial to human life, such as syrup, coffee, and other derivative products. AMFP (Avicennia marina Fruit Polysaccharides) also has the potential to serve as bacterial food (prebiotics) and as a raw material for pharmaceutical industries based on herbal medicines (Yuan et al., 2022).

So far, the Community Group (Kariangau Lestari Group) has yet to receive training or socialization related to diversifying mangrove derivative products. Therefore, it is necessary to provide training to enhance the community's ability by diversifying mangrove derivative products. However, information on the utilization of mangrove resources still needs to be improved, although the community is aware that mangroves are rich in potential and can be utilized to create globally competitive products. The residents of Kariangau Village RT 02 prefer other jobs rather than utilizing the potential of mangroves through appropriate technology. This poses a threat to the extinction of the mangrove ecosystem.

There is a need for special attention to raise awareness about the importance of preserving and maintaining mangrove forests. Increasing the awareness of RT 02 residents is the most crucial factor for community groups to manage the potential of mangrove forests effectively. Empowerment initiatives fostering mutual reinforcement and community benefits can be established through instructing and coaching local groups on harnessing mangrove fruit for processed food items.

Increasing community awareness to preserve mangrove vegetation has the potential to strengthen the community's economy through training, mangrove product development, and marketing.

These activities can continue, making Kariangau Village a flagship eco-tourism destination in the Balikpapan region.

METHOD

This community service activity is carried out in collaboration with the Kariangau Srikandi and Lestari Community Groups. The activity began in May and lasted until November 2023 as the initial phase of community service, with plans for continued sustainability. The activity involves four stages:

1. The initial stage involves conducting a preliminary study through field observations of the existing mangrove forest conditions in Kariangau.
2. The second stage involves discussions with the local community regarding their efforts to conserve and enhance the productivity of the mangrove forest.
3. The third stage involves developing minimal processing tools for producing processed food products and determining the appropriate formulation for processed food products made from mangrove fruits.
4. The final stage includes an educational program demonstrating the production of processed mangrove products. Activities such as equipment usage simulations and product manufacturing are conducted through training sessions or demonstrations.
5. The activities are evaluated using a questionnaire containing questions about the evaluation of the produced products, focusing on consumer acceptance and questions about the benefits of the conducted activities.

RESULT AND DISCUSSION

Community service activities are directly related to the main partner, the community. These activities aim to provide solutions to issues faced by the community. The objective is to offer added value to the community by enhancing their knowledge of mangrove fruits and their market value. The activities consist of several stages:

1. **Field observation**: This activity is conducted to assess the potential of natural and human resources around the Kariangau mangrove forest. The field observation results indicate that the mangrove vegetation consists primarily of Pedada, Api-api, and Nipah. Participatory observation methods are employed, involving researchers directly engaging in the activities of the empowered community. Researchers observe and participate in daily activities, interact with community members, and record their experiences and observations (Puspitasari, 2023).

   The predominant plant species around residential areas is Api-api, while other species are found in the water. The potential human resources for mangrove plant care include the women's group Srikandi Lestari, who typically stay at home and have ample time to engage in mangrove plant cultivation activities. The partner location features the Mangrove Long Bridge Kariangau tourist attraction, as shown in Figure 1.

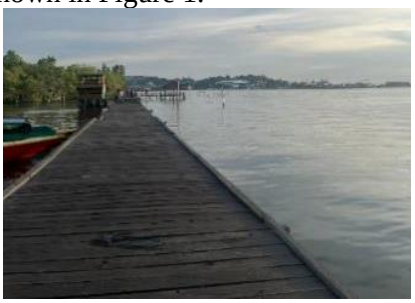

Figure 1 The location of the mangrove forest

2. **Activity Formulation**: Field observations have yielded much information regarding how much the surrounding communities have utilized mangrove plants for food processing. Thus far, communities have only been aware of the potential

of Pedada mangrove fruits for making mangrove syrup. However, their knowledge of other processed products and how to select mangrove fruits for processing could be more extensive. This presents a new opportunity to create derivative products from mangrove fruit syrup and enhance community understanding of the potential of pedada fruits. Therefore, it is formulated to create derivative products from mangrove fruit syrup, including fruit drinks, candies, and crackers. To optimize the mangrove syrup processing already mastered by the community, we developed a minimal processing tool for packaging mangrove syrup.

3. **Design of the Tool**: The minimal processing tool is designed to expedite the cooling process of cooked mangrove fruit syrup, allowing for quicker packaging into bottles, as shown in Figure 2. Shortening the packaging time will improve product shelf life by reducing product exposure to the surrounding air, thereby minimizing microbial contamination. The greatest risk in food processing is the presence of pathogenic microorganisms resulting from food contamination during processing or cross-contamination through containers or utensils. Optimal conditions for pathogenic microorganisms in cooked food can lead to microbial multiplication within 1-2 hours (Agshani, 2019).

(a) (b) (c)

Figure 2 (a) Minimal processing tool design; (b) Tool manufacturing process; (c) Minimal processing tool

4. **Determination of Mangrove Processed Product Formulation**: The next step is to determine the formulation of ingredients for processing mangrove fruit into processed products, such as mangrove syrup. This is because the syrup serves as the base for derivative products, and, based on community experience, the syrup made by the community tends to have a sour taste, making it less enjoyable. Therefore, determining a good formulation is a solution to this issue.

The formulation of mangrove fruit syrup starts with selecting raw materials, specifically ripe Pedada mangrove fruits, identified by their sweet aroma. Next, the fruits are peeled, revealing their green outer skin. Pedada fruit is characterized by its green colour, pleasant aroma, and sour taste. It is round, with the base wrapped in flower petals (Salsabila, 2022).

The second step involves washing the fruits to remove any sap. The third step is boiling the Pedada fruits with a fruit-to-water ratio of 2:1,

followed by straining to remove fruit residue. The final step in making mangrove syrup is adding sugar at a ratio of 1:1 with the boiled water, as shown in Figure 3. The syrup is sweetened with natural sugar to make it more palatable and acts as a natural preservative (Damayanti, 2023).

(a) (b)

Figure 3 (a) Peeling of fruit skin; (b) Fruit residue filtration

4. **Production of Derivative Products from Mangrove Syrup**: The mangrove syrup produced is then used to create other derivative mangrove products to enhance the diversification of mangrove fruit-processed products. The syrup has a thick texture, a yellow colour, and a sour aroma (Salsabila, 2022).

The first product to be made is a mangrove fruit drink made from diluted mangrove fruit syrup to create a ready-to-drink mangrove fruit beverage, as illustrated in Figure 4. The second derivative product is mangrove fruit candies, which are made by adding mangrove fruit syrup to a gelling agent such as gelatin, which is then cooled to form candies. The final product is the production of mangrove crackers, made from the residue of mangrove fruit syrup mixed with binding agents such as tapioca flour and wheat flour and flavouring agents for making crackers.

(a) (b) (c) (d)

Figure 4 (a) Mangrove syrup; (b) Fruit drink; (c) Mangrove candies; (d) Mangrove crackers

5. **Socialization and Simulation of Mangrove Fruit Processed Products**: Ten women from the Srikandi Lestari women's group attended this activity, which took place at House RT 02. The socialisation activity began with understanding the various types of mangrove fruits and the derivative products that can be processed from

mangrove plants. The subsequent activity involved a simulation of making mangrove-processed products, such as candies and crackers, as shown in Figure 5.

(a) (b) (c)

Figure 5 (a) Socialization; (b) Crackers Making Simulation; (c) Discussion Session

The evaluation of the activity was conducted using a questionnaire, which addressed questions related to the acceptability of the products made by consumers, the ease of replicating the production process, and the benefits of this activity for the mangrove community. As reflected in the questionnaire responses, the discussion results indicated that the residents found the activity highly beneficial for increasing the utilization of mangrove plants. Moreover, the products were well-received in taste, appearance, and packaging.

CONCLUSION

The community service activity conducted with the Kariangau Lestari Group in RT 02, Kariangau Village, focuses on processing mangrove fruits into candies and crackers. A minimal processing tool was developed to expedite the cooling process, allowing quicker packaging into bottles. The production includes making mangrove fruit syrup, mangrove fruit candies using gelatin as a gelling agent, and mangrove crackers made from the residue of mangrove fruit syrup mixed with tapioca flour, wheat flour, and flavouring agents. These products, once socialized, are expected to serve as a model for bioprospecting opportunities for both the local community and the city of Balikpapan.

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