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Utilization of Grinding Machine Technology to Improve Shrimp Paste Production Capacity in Kecamatan Medan Belawan

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Abstract. Located in Kelurahan Belawan I, Kecamatan Medan Belawan, Kampung Nelayan Lingkungan XII is a coastal area where the community primarily engages in fishing, boat rental services, and producing shrimp paste (terasi) from small shrimp (udang rebon). Observations and discussions with Kelompok Usaha Lestari, a local group dedicated to shrimp paste production, revealed that traditional methods, such as using mortars and pestles, are still prevalent. This manual process significantly limits production capacity and results in inconsistent product quality that deteriorates quickly over time. This Community Partnership Program (PKM) aims to address these issues by improving production efficiency and enhancing product quality through the integration of appropriate technology. The initiative includes the provision of a grinding machine tailored for processing small shrimp, training on product standardization, and continuous guidance to ensure effective use of the technology. The implementation of this technological solution has proven effective in increasing production capacity and ensuring higher consistency and quality of the shrimp paste. These improvements enable Kelompok Usaha Lestari to compete more effectively in the market and contribute to their long-term economic sustainability.

Keywords: shrimp paste, grinding machine, technology, production capacity.

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1. Introduction

The coastal area of Medan Belawan holds significant potential in the fisheries sector, making it a central hub for maritime economic activities in North Sumatra. Among the communities in Kampung Nelayan Lingkungan XII, residents rely heavily on fishing as their primary source of income, especially from catching marine resources such as small shrimp and various fish species. However, their economic activities are not limited to fishing alone. Women in these households actively contribute by processing small shrimp into *terasi* (shrimp paste), a fermented product highly demanded in local markets and with significant potential for broader distribution. *Terasi*, an essential ingredient in cooking, enhances food flavor and is deeply rooted in culinary traditions [4].

Fig. 1. Manual and Traditional Mortar Used for Shrimp Paste Ingredients

Despite its high demand, the production of *terasi* in this area still relies heavily on traditional methods as shown in Figure 1. Using simple tools like mortars and pestles, the process is manual, labor-intensive, and time-consuming. This approach limits daily production capacity, with each session yielding only 0.5 to 1 kilogram of shrimp paste. Additionally, the products are often inconsistently textured and poorly packaged, typically wrapped in basic paper, which shortens their shelf life. Variability in shrimp size, combined with manual crushing techniques, further impacts product quality. During storage, larger shrimp fragments degrade faster, affecting overall freshness [6][7].

Another significant challenge is market competition. Locally produced *terasi* struggles to compete with products from other regions that utilize modern processing technologies, offering higher production volumes and more consistent quality. These limitations in production capacity, product uniformity, and storage life hinder the competitiveness of the products made by Kelompok Usaha Lestari in wider markets.

To address these challenges, the Community Partnership Program (PKM) from Universitas Negeri Medan introduced modern technological solutions, including a shrimp grinding machine designed specifically for improving efficiency and product quality. By adopting this technology, local shrimp paste producers aim to increase production capacity, achieve consistent quality, and extend product shelf life, enabling them to compete more effectively in regional and national markets [2].

2. Method

A. : **Stage 1: Problem Identification**

The program began with field observations and discussions with the Kelompok Usaha Lestari in Kampung Nelayan Lingkungan XII, Kelurahan Belawan I. Through these interactions, the team identified the primary challenges faced by the group, including limited production capacity and inconsistent product quality. Traditional tools like mortars and pestles required significant manual effort and time, restricting daily output and leaving little room for market expansion. These limitations, coupled with non-uniform textures and packaging, created barriers to reaching broader markets. This stage served as the foundation for designing targeted solutions to address the identified issues effectively.

B. Stage 2: Design and Procurement of the Grinding Machine

Following the problem identification, the team developed and procured a shrimp grinding machine tailored to the group's needs. The machine was constructed from high-quality, corrosion-resistant materials, ensuring durability in the humid coastal environment [5]. Designed for electric operation, the machine significantly increased production capacity, processing 2-3 kilograms of shrimp per minute compared to the 0.5-1 kilogram achievable through manual methods. Beyond its speed, the machine ensured a finer, more consistent texture for the shrimp paste. This homogeneity not only improved product quality but also enhanced its storage capabilities, making it less susceptible to spoilage [8]. The increased efficiency allowed group members to allocate time and energy to other value-added activities, such as packaging and marketing.

C. Stage 3: Training and Education

Once the machine was operational, the PKM team conducted hands-on training sessions for the group.

Members were taught to operate the machine efficiently and maintain it properly. The training also included lessons on product standardization, focusing on achieving consistent texture, flavor, and aroma. Furthermore, the group received guidance on advanced packaging techniques to extend shelf life and enhance market appeal. The training sessions emphasized practical applications, ensuring that participants could confidently integrate the machine and new practices into their daily operations.

Fig. 2. Manual and Traditional Mortar Used for Shrimp Paste Ingredients

3. Findings

The application of the shrimp grinding machine brought substantial improvements to the operations of Kelompok Usaha Lestari, addressing key challenges related to production capacity, product quality, and market competitiveness. These improvements are discussed in detail below:

D. Increased Production Capacity

Before the implementation of the grinding machine, production was limited to 0.5–1 kilogram of shrimp paste per minute due to the manual processing methods. This severely restricted the group's ability to meet increasing market demands. With the introduction of the grinding machine, production capacity more than doubled, reaching 2–3 kilograms per minute. This significant increase allowed the group to produce larger quantities of shrimp paste within a shorter time frame, ensuring they could cater to more significant market demands without overburdening their labor resources. The efficiency of the machine also freed up time for group members, enabling them to focus on other critical aspects of the business, such as packaging, marketing, and exploring new sales channels. By optimizing their time and resources, the group experienced a more sustainable and scalable production model.

E. Enhanced Product Quality

A critical aspect of the group's challenges was the inconsistent quality of the shrimp paste produced using traditional methods. Manual processing often resulted in uneven textures, with larger fragments of shrimp remaining in the paste [1]. This not only affected the product's aesthetic and sensory appeal but also reduced its overall market value. The grinding machine introduced a standardized process, ensuring a finer and more uniform texture. By achieving consistency in texture, the shrimp paste now aligns better with consumer preferences for high-quality products. The improved homogeneity also enhanced the flavor distribution, creating a more balanced taste profile. This consistency is a vital factor in building consumer trust and establishing the product as a reliable choice in the competitive market.

F. Improved Shelf Life and Storage

Another notable improvement was the extension of the product's shelf life. Prior to the implementation of the grinding machine, the shrimp paste had a shelf life of approximately 1–2 months due to uneven particle sizes and poor packaging. Larger fragments within the paste were prone to faster spoilage, significantly limiting storage options and market reach. With the grinding machine, the texture became finer, allowing for better compression and sealing during packaging. This resulted in a longer shelf life of 4–6 months. The extended shelf life not only reduced product waste but also provided opportunities to expand the distribution of the product beyond local markets. Retailers and consumers benefited from the improved storage stability, which added value to the product in the eyes of buyers.

G. Economic Benefits

The economic impact of the grinding machine was evident in the increased monthly revenue for Kelompok Usaha Lestari. Prior to adopting the technology, the group's revenue was approximately IDR 3,000,000 per month. After the machine's implementation, revenue increased to an estimated IDR 6,500,000 per month. This dramatic improvement highlights the direct correlation between production capacity, product quality, and marketability. The higher revenue enabled the group to reinvest in their operations, explore new market opportunities, and improve the livelihoods of their members. The increased income also allowed the group to consider additional ventures, such as upgrading packaging materials or marketing their products to more diverse markets.

H. Consumer Satisfaction

A consumer satisfaction survey conducted after the adoption of the grinding machine revealed a significant increase in positive feedback. Consumers praised the improved texture and consistent flavor of the shrimp paste, noting that the product now meets or exceeds the quality of similar products available in the market. The enhanced satisfaction directly contributed to repeat purchases and word-of-mouth referrals, which further supported the group's economic growth.

I. Broader Implications

The success of this initiative demonstrates the value of integrating appropriate technology into small-scale production systems [3]. Beyond immediate benefits to production and quality, the grinding machine has positioned Kelompok Usaha Lestari as a competitive player in the shrimp paste market. This case study highlights the potential for similar technological interventions to uplift other small and medium enterprises (SMEs) in rural and coastal areas. The results also underscore the importance of training and education in ensuring the successful adoption of new technologies. Through hands-on training, the group gained the skills and confidence to operate and maintain the machine, ensuring its long-term utility. Moreover, the standardization of production processes provided a foundation for future improvements and scaling.

TABLE I: Summary of Impacts from the Implementation of the Shrimp Grinding Machine

Parameter	Before Implementation	After Implementation	Impact
Production Capacity	0.5–1 kg/minute	2–3 kg/minute	Capacity more than doubled, enabling larger market reach.
Product Texture and Quality	Inconsistent texture, uneven quality	Smooth and consistent texture	Improved product appeal and competitiveness.
Shelf Life	1–2 months	4–6 months	Extended shelf life reduces waste and improves distribution.
Monthly Revenue	IDR 3,000,000	IDR 6,500,000	Increased income strengthens economic sustainability.
Consumer Satisfaction	Moderate, with complaints about quality	High, with positive feedback	Enhanced trust and increased repeat purchases.

4. Conclusion

The introduction of the shrimp grinding machine has proven to be an effective solution for addressing the production challenges faced by Kelompok Usaha Lestari. By improving efficiency, enhancing product quality, and extending shelf life, the technology has enabled the group to meet higher market demands and expand their economic opportunities. These findings highlight the transformative potential of appropriate technology in supporting small-scale producers. Future initiatives could focus on integrating automation into other aspects of production and exploring more advanced marketing strategies to further expand market reach and sustainability.

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