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Application of Temperature-Controlled Petis (Shrimp Paste) Mixer Machine to Increase the Effectiveness of the Production Process of Petis Sidoarjo Micro, Small and Medium-Sized Enterprises (MSME)

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ABSTRACT

This paper focuses on Petis Sidoarjo's micro, small and medium-sized enterprise (MSME) 's production process of mussel paste (petis Kupang). The conventional, human-labored production process causes the cooking and stirring processes to spend 5 hours per production process. As a result, the employees get exhausted quickly because they produce the paste manually using a wooden stick. Also, the stove temperature is unstable. Therefore, workers need to check the temperature frequently to prevent the shrimp paste from overcooking. Therefore, the current community service program (PKM) proposes the use of a shrimp paste mixer machine. The implementation method consists of designing, manufacturing, assembly, machine testing, machine handover, machine operation, and maintenance training, periodic monitoring, financial management training, and regular monitoring. The results showed that accelerating the cooking and stirring processes using an electric motor drive reduced more production session time (from 5 hours to 3 hours). In addition, the project helped to improve the workers' safety and health. Also, controlling and adjusting the stove temperature can keep the paste from overcooking and saves LPG consumption.

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1. INTRODUCTION

Sidoarjo regency (East Java province) is an area with rapid economic development. Many micro, small, and medium-sized enterprises (MSMEs) – such as petis Kupang (mussel paste) production - have been developed due to the potentials and adequate human resources in the Sidoarjo regency.

Petis (shrimp paste) is a component of Indonesian cuisine made from the by-products of cooking soup (usually from fish, mussel, or shrimp) cooked until the liquid becomes thick like a denser sauce. The caramelized shell sugar is added to give a sweet taste and dark brown color.

Balongdowo Village, located in Candi district, Sidoarjo, is famous for petis Kupang (mussel paste) production. There have been at least ten MSMEs producing petis Kupang. The current PKM program partnered with a petis Kupang MSME owned by Muhammad Abdul Rochim. Rochim's MSME produces about 10 kg of mussel paste daily. He occasionally gets more orders during fasting months (Ramadhan) and from wedding organizers. The paste is usually served in Kupang lontong and rujak cingur and as condiments. Rochim's mussel paste price ranges from IDR 25,000 to 30,000 per kg, and his average daily income is IDR 500,000. Rochim has run the MSME using family management for five years with an initial capital of about IDR 5,000,000. He employed three workers with junior high school educational backgrounds.

Our pre-observation indicated that the production process of mussel paste in Rochim's MSME uses conventional equipment, including a wood stove which requires 15 minutes to get the needed temperature and a frying pan (to be filled with dough of sugar and mussel broth, cooked until boiling and stirred for about one hour). Cassava flour is added into the pan after the dough boiling, and the dough is stirred continuously for four hours using a wooden stick until it is evenly cooked. The cooked paste is ready to pack.

Moreover, our preliminary interview with the MSME partner indicated some obstacles in the mussel paste production process. First, the production process was carried out conventionally using human labor. Second, the cooking and stirring time required in one production process was relatively long (5 hours). Third, workers required extra effort to process and stir the paste using a wooden stick continuously. Lastly, workers had to check the unstable stove temperature regularly to avoid overcooking.

The current project aims to manifest and implement a shrimp paste mixer machine in the MSME partner's business to increase the production process. The project also intends to design an easy-to-operating mussel paste mixer machine to increase the MSME partner's production capacity (from 10 kg/day to 20 kg/day). In addition, the project also aims to increase the effectiveness of the cooking and stirring processes by shortening the process to 3 hours per production.

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2. LITERATURE REVIEW

A new business can be considered productive if the business can be carried out efficiently and effectively or use the minimum possible resources with the most accurate results possible. Increasing a business' productivity can be done by increasing the efficiency and effectiveness of the business. (Sutantra, 2011). Haryono et al. (2015) listed two ways that entrepreneurs can take to increase productivity and efficiency and the effectiveness of their business, namely (1) increasing employees' skills and (2) updating their production equipment. However, small entrepreneurs rarely use the second method due to limited capital and knowledge. Generally, small entrepreneurs may not be able to access the latest information, especially those related to the development of increasingly sophisticated production equipment. In contrast, big (professional) entrepreneurs on average prefer to upgrade their production equipment to increase the efficiency and effectiveness of their business. (Biegel, 2012).

Ahmadi (2011) stated that in general, the production problems faced by Indonesian small and medium enterprises (SMEs) are not suitable to solve through the application/use of sophisticated technology machines. These problems are more suitable to be solved by applying an efficient technology (Teknologi tepat guna or TTG). Moreover, the investment costs for implementing TTG are relatively cheap, and the mastery of technology does not require too high knowledge.

A control system is a system that can start, regulate, or stop a process to get the desired output (Johnson, 2013). An automatic control system works automatically (without using human power), while a semi-automatic control system works with a bit of human assistance. According to Ogata (2014), the control system is divided into open-loop and closed-loop control systems. An open-loop control system is a control system where the input variable will directly affect the output produced without comparing the output result with the reference value or setpoint that has been set in control equipment. Meanwhile, a closed-loop control system has an output variable that is continuously measured by a sensor (measurement), and the measurement results are compared with the reference quantity (setpoint) to produce the desired output. The control system used in this shrimp paste mixer machine project is equipped with temperature control using a closed-loop control system.

3. METHODS

Five main steps were performed to develop a shrimp paste mixer machine, including:

a. Preparation and design stage which includes:
   1) on-site needs survey,
   2) making a detailed drawing,
   3) identification and procurement of materials and equipment required in the manufacturing process.

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b. Manufacturing and assembly stage which includes:
   1) the manufacturing process of shrimp paste mixer machine,
   2) the assembly process of all shrimp paste mixer components.
c. Trial stage, consisting of:
   1) function test
   2) test engine performance on partners, and
   3) revisions and improvements.
d. Handover and training stage, including:
   1) handover of the shrimp paste mixer machine,
   2) training on the operation of the shrimp paste mixer machine,
   3) training on the maintenance of shrimp paste mixer machine, and
   4) training on work safety.
e. Periodic monitoring stage

4. FINDINGS AND DISCUSSION

The results of the study are presented below.

4.1 The design of shrimp paste mixer machine

The team has designed the shrimp paste mixer machine based on the prior discussion with the MSME partner, as shown in Figure 1. below.

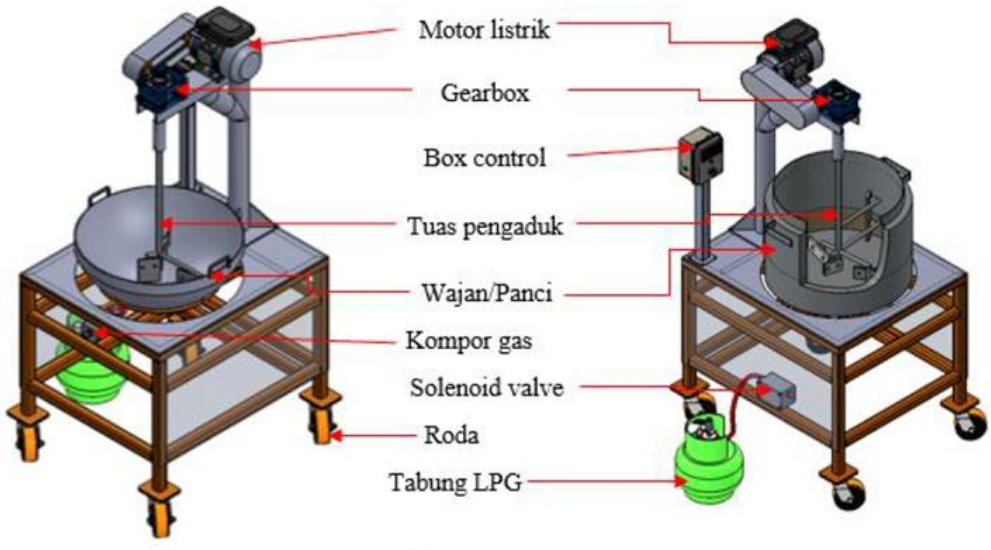

Figure 1. The design of the shrimp paste mixer machine

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4.2 The Results of Manufacture and Assembly of Shrimp Paste Mixer Machine

The following step after designing the machine was manufacturing and assembling the machine, as shown in Figure 2 below.

Figure 2. The temperature-controlled shrimp paste mixer machine

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Table 1. Specification of shrimp paste mixer machine

No.	Machine specification	Information
1	Dimension	85 Cm x 70 am x 136cm
2	Max Capacity	20 litters/ process
3	Activator	electric motor 0,5 HP
4	Material	stainless steel and mild steel
5	Control system	Automatic

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4.3 Function test and trial of shrimp paste mixer machine

Function test and trial of the machine were performed to see if all components can function appropriately before being implemented on the MSME partner's business. The result of the function test and trial are shown in the following Table 2.

Table 2. The results of the function test of the shrimp paste mixer machine

No	Components	Information
1.	Frame system	Good (the machine could stand firmly and prop up all machine components)
2.	Transmission system	Good (electric motor could move stirring axis properly through gears, chain, and gearbox
3.	Electric system	Good (no cut off solder or wire joints, all components requiring electricity source could function adequately)
4.	Stirring system	Good (the machine could mix shrimp paste dough from the beginning to the end with an adjustable loop according to the needs.
5.	Temperature control system	Good (the temperature of paste dough can be controlled as needed with 5ºC tolerance)

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4.4 The implementation of shrimp paste mixer machine

The function test and trial of the machine showed that the machine quality is feasible to be implemented to the MSME partner, as shown in figure 3.

Figure 3.
The implementation of shrimp paste mixer machine in MSME partner's business

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The implementation result of the machine in the MSME partner is shown in Table 3.

Table 3. The implementation result of shrimp paste mixer machine in MSME partner

No	Description	Before PKM	After PKM
1.	The time of the cooking and mixing process	5 hours	3 hours
2.	Mixing method	Using a wooden stick and human labor	Using mixing lever driven by electric motor 0,5 HP
3.	The temperature of the stove flame	Not controllable, must be monitored continuously	The temperature is controllable and adjustable; no continuous monitoring required
4.	Production capacity	10 kg/day	20 kg/day
5.	Product quality	Good display of shrimp paste	Better display of shrimp paste; the paste can attract the consumers

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5. CONCLUSIONS AND SUGGESTION

The application of the temperature-controlled shrimp paste mixer machine can increase the effectiveness of the MSME partner's production processes in several ways. First, it shortens the cooking and stirring processes from 5 hours to 3 hours. Second, the electric motor-driven stirring process makes employees' tasks easier so they do not easily get exhausted. Finally, controlling and adjusting the stove temperature as needed can avoid overcooking and reduce LPG consumption.

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