Study of Pressure Cooker Application in Milkfish Processing Industry to Increase Productivity and Quality

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Abstract: The purpose of this activity is to develop and implement cooking equipment in the small industry of making milkfish soft thorn in the city of Semarang. The equipment is to increase productivity and quality. The development of tools is carried out in several stages, they are designing stage, calculation of strengths, making tools, testing, refinement of tools, and tool application to figure out if the tool work well. A set of soft thorn milkfish cooking equipment has been made. It has special operating method as well as several advantages. Some advantages of this tool are that the tool is more fuel-efficient, it has greater production capacity, and it yields better quality milkfish which is higher protein content, better texture, and free of damage. In addition, the use of this new tool can increase the profits of soft thorn milkfish producers.

1 INTRODUCTION

Soft thorn milkfish or better known as bandeng presto (presto milkfish) is a typical gift of Semarang City, where the market share of this product is widely open. It is not only for Central Java people, but also for people throughout Indonesia and even international costumers (who were mostly tourists). Bandeng presto is not only sold in shops or souvenir centers (Pandanaran Street Semarang) but is also widely sold in traditional markets.

Milkfish includes milky white hard-fleshed and fleshy fish. The structure of the meat is solid with many fine spines between the flesh, especially around the tail. The nutritional value of milkfish is quite high. Every 100 grams of milkfish contains 129 kcal of energy, 20 g of protein, 4.8 g of fat, 150 mg of phosphorus, 20 mg of calcium, 2 mg of iron, 150 SI of vitamin A, and 0.05 mg of viamin B. Based on the nutritional composition then milkfish are clas-sified as high-protein and low-fat fish (Saparinto, 2006: 11).

Milkfish content, especially Omega 3, is higher than the content of Omega 3 salmon which is an imported fish. Milkfish is one type of fish that has a specific taste, and has been known in Indonesia and even abroad. According to the research of the Fisheries Quality Research and Development Center (1996), milkfish has 14.2% omega-3, it exceeds omega-3 substance in salmon which is only 2.6%, tuna fish (0.2%) and sardines or mackerel fish (3.9%) (http://www.naqsdna.com).

For presto milkfish, other protein factors must also be considered. The quality of soft thorn milkfish can be seen from the following five parameters:

Table 1: Soft Thorn Milkfish Quality Criteria.

Parameters	Remarks
Visualisation	the fish is intact and un-broken, smooth, un-injured, clean, un-contaminated with outside or strange matters and there is no deposits of fat, salt and other impurities.
Color	it has specific color, brilliant, un-moldy and slimy.
Smell/Odor	It has specific odor such as boiled fish, savory and fresh fish without a rancid, sour, stale or rotten odor.
Taste	It should be savory, specific, thorny milkfish, soft and not too salty, salty taste evenly distributed, no foreign flavor.
Texture	Compact, solid, quite dry, not runny, invisible

Source: Saparinto, 2006: 51.

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Milkfish, that has been processed into soft thorn milkfish (bandeng presto), will have several values more; 1) If it is stored, the fish has a long endurance, 2) the thorn becomes soft, it makes easy serving, and 3) the price will increase compared to the previous original milkfish (Suhaeni, 2007: 12).

Both modern and traditional class-presto milkfish run by small industries in Semarang City. For "modern" presto milkfish business owners, there are almost no significant obstacles. Every day the turnover is tens of millions of rupiah, and generally owned by entrepreneurs with large capital and has been established for decades. On the contrary, most of the traditional presto milkfish producers by small businesses (UMKM) in Semarang, the condition is that good.

In Semarang city, presto milkfish industry is spread out in 14 districts and 25 villages. Total investment value reaches IDR 515,200,000, thus the total production value reaches IDR 907,600,000, with a total workforce of 141 people (Semarang City Office of Industry and Trade Data, 2012). One of the centers of presto milkfish industry in the city of Semarang is in Krobokan Village, West Semarang Subdistrict, and currently is a member of the Community-Based Self-Help Group (KSM) "Soft Thorn Milkfish". Although their existence has existed since the 1990s, but the establishment of a business group in the KSM "Soft Thorn Milkfish" started in 2004, led by Mr. Petrus Sugiyanto.

Presto milkfish which is produced by small entrepreneurs is cheaper than presto milkfish which is sold at the center of souvenirs along Pandanaran Street Semarang. Presto Milkfish should made by small entrepreneurs in Krobokan and other areas of Semarang City shoud be more competitive, however, the reality shows un-satisfying condition. Production development or business turnover is stagnant, and this is a problem with many aspects, such as aspects of production, technology used, product quality, packaging, marketing management and other aspects that need to be solved.

The existence and condition of KSM "Soft Thorn Milkfish" in Krobokan is a representation of small thorn milkfish businessmen scattered in other sub district in Semarang and number of dozens of business units. The number of workers involved in the presto milkfish manufacturing business is between 2 to 4 people. Based on the scale, this business includes home industry (with workers under 4 people). However, seeing its business turnover and market opportunities, this milkfish processing business has a long chain and involves a lot of labor (ranging from fish farmers to marketing personnel) so that it greatly influences people's economic activities. Therefore, any solutions to the problems faced by small-scale milkfish processing entrepreneurs, are necessary to affect the economic activities of the people at large stage.

Based on surveys and observations in the field, the problems faced by presto milkfish small-scale entrepreneurs can be divided into three aspects, they are: production, quality, and business management or marketing where these three aspects are interrelated. In this paper, the problem is limited to aspects of production, namely appropriate technology (TTG) for making presto milkfish.

According to Sonhaji (2012), appropriate technology is often called intermediate technology (intermediate technology), because it must be in the midst of the extreme ends of primitive technology and advanced technology. This technology must be small-scale, simpler and cheaper, and easier to implement, but must be better than primitive technology. In addition, in the selection of appropriate technology, it is necessary to pay attention to several criteria, including: a) technology chosen must be able to meet real needs, which can be directly utilized and enjoyed by the local community, b) the technology is initiated, it gains participation, increases employment opportunities, and increases the income of the local community, and d) th technology must be able to increase productivity, add value and quality of production, increase the quantity and quality of human resources, and promote innovation and creativity of the local community, e) The technology can optimally improve natural resources, the equipment should be easily handled and maintained by the local community.

Based on the above criteria, the development of presto milkfish cooking equipment that will be applied in the community includes part of appropriate technology (TTG). In this activity begins with the design or design of the TTG. The design is designed so that the tool can function as expected. As stated by Hurst (2006: 4), engineering design is all activity to build and define solutions to problems that cannot be solved before or in a different way than before. Engineering designers use the intellectual ability to apply scientific knowledge and ensure its products are in line with market needs.

Meanwhile, according to the Presidential Instruction of the Republic of Indonesia Number 3 of 2001 concerning Guidelines for Implementing and Developing Appropriate Technology, the definition of Appropriate Technology is technology that is appropriate to the needs of the people, it also can answer community problems, it does not damage the

environment, and can be easily utilized by the community and generate added value from economic aspects and environmental aspects.

So far, small businesses still use the technology of simply making presto milkfish. The tools used in the form of presto pans are purchased from stores with a maximum capacity of 5 kg of raw milkfish. To cook the presto milkfish, it uses an LPG gas stove (a small portion still uses kerosene) with a cooking time of 3 hours. If you cook 40 kg of milkfish, it takes 8 stoves or 8 cooking processes. This method is very inefficient because it is wasteful of fuel, it takes a long time, and takes a lot of space. In addition, with a small diameter pan (30 cm) and without a shelf, the milkfish is damaged and flattened. Therefore, it is necessary to immediately find a solution to overcome the problems faced by this milkfish producer.

Figure 1: Conventional Presto Pan: Production Capacity is 5 kg without shelf.

By observing problems faced by presto milkfish producers, in this study will work on designed and appropriate technology which is useful for modern presto milkfish makers. This tool is a development of presto milkfish maker LTHPC (Low Temperature High Pressure Cooker) which was previously made by the implementing team.

Some of the advantages of presto milkfish making tools that will be applied later are: 1) it has higher productivity: in one process it is able to cook up to 40 kg of milkfish, while the partner industry can only cook 5 kg in each pan so they have to cook for about 8 times); 2) it saves time: since the tool only takes 90 to 120 minutes, while the old method takes 3 hours or 180 minutes, obviously it is more efficient; 3) it is fuel saving (BBM): because the cooking process is faster, less fuel is needed so the production costs are smaller; 4) it leads to cost-effectiveness: because of high productivity, faster time, and more economical fuel economy, production costs decrease and profit margins increase; 5) it has higher quality: 0% damage level, no milkfish damaged by bending or flattening, because the diameter of the presto pan is 55 cm and in the preparation of milkfish made up of shelves.

2 METHODS

In designing a product, there are several methods, including the methods of French, Pahl & Beitz, VDI, and Ullman. Each method has a different phase or stage. Generally, same stages or phases are almost the same (Harsokoesoemo, 2004). The stages are: 1) problem and needs analysis, 2) design of product concepts, 3) preparation of product technical specifications, 4) product manufacturing, 5) product trials, and 6) product improvements.

The implementation team of this activity was selected from various disciplines to support the success of the activities. In addition to the support of human resources (HR), this activity is also supported by laboratory facilities as well as sufficient work-shops from the Department of Mechanical Engineering, Semarang State University.

In this activity presto cooking equipment will be developed with a design like picture 1. In this presto cooker there is a temperature control device. Temperature Controller is connected to a gas flow regulating valve, which regulates the flame, where if the desired temperature is reached, the stove flame will shrink automatically.

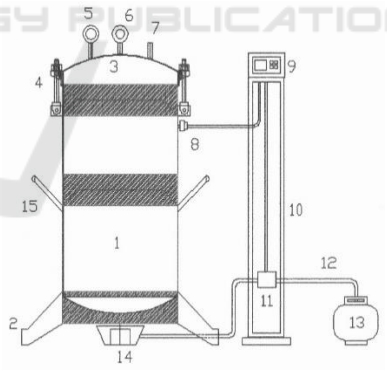

Figure 2: Pressure Cooker Design.

Remarks:

1. Presto pan/body tube
2. Tube feet.
3. Cap
4. Locking bolts
5. Thermometer
6. Manometer
7. Safety valve
8. Thermocouple
9. Control panel
14. LPG Gas Stove
15. Tube Holder

10. Pole control panel
11. Solenoid valve
12. LPG gas hose.
13. LPG gas cylinders

Conversely, if the temperature drops below what is desired, then the flame of the stove will enlarge automatically and the temperature will rise again. With this system will make it easier for operators and fuel consumption to be more controlled or more economical.

After the tool is made according to the design drawings, the next step is to test the use of the tool. The purpose of this trial is to test the effectiveness of the device whether it is in accordance with the desired goals or not. If there are deficiencies in terms of construction or workings, the tool can still be refined before it is actually implemented. In addition, the trial aims to obtain data as a material for further analysis so that it has an accountable basis.

3 RESULTS AND DISCUSSIONS

In this activity a set of milkfish presto cooking utensils has been produced with the following technical specifications:

Height: 80 cm
Diameter: 55 Cm
Pot Material: Stainless Steel (SS 304)
Pan Thickness: 3 mm
Capacity: 40-50 kg of fresh milkfish
Number of Shelves: 10 Shelves
Fuel: LPG
Cooking time: 1.5 - 2 hours
LPG consumption: 1 - 1.5 kg / process

A set of soft thorn milkfish cooking equipment consists of: (1) presto pans / tubes, (2) milkfish shelves, (3) temperature control, (4) LPG stoves, and (5) LPG gas cylinders. Inside the tube is designed a special shelf several layers so that milkfish are not flattened. This is not in the previous cooking tools, so most milkfish produced by traditional milkfish entrepreneurs are flat and bent.

Figure 3: Pressure Cooker with New Design.

Figure 4: The Milkfish are layered in the shelves.

The soft thorn milkfish cooking equipment produced is equipped with temperature control which aims to regulate the high and low heating temperatures that correlate with fuel consumption. Temperature Controller is connected to a gas flow regulating valve, which regulates the flame, where if the desired temperature is reached, the stove flame will shrink automatically (not to death). Conversely, if the temperature drops below what is desired, then the flame of the stove will enlarge automatically and the temperature will rise again. With this system will make it easier for operators / cookers and fuel consumption to be more controlled / more economical.

After the design of the finished equipment, the next step is to test the use of tools to make presto milkfish. Trials involve experienced presto milkfish entrepreneurs in the hope of assessing the quality of milkfish produced more valid.

Table 2: The Result of Trial I in Making Soft Thorn Milkfish.

Temperature	Pressure	Cooking Duration	LPG Consumption	Results
105-110º C	1,5 atm	120 min	1 kg	Soft thorn Milkfish good texture, tekstur bagus, unflattened or undamage.

Based on the first trial that has been done, the results can be said to be good and satisfying. This is according to Mr. Petrus Sugiyanto as a milkfish entrepreneur who has decades of experience. According to him, who also uses milkfish presto LTHPC, this result is better than previously thought.

After the implementation team tested the tool and succeeded, the next step was to conduct a second trial as well as to socialize the use of tools to KSM members "Soft Thornfish Milkfish". In this activity the participants were explained about the functions and benefits of the tools, the advantages they have, as well as the operational technical use of the tools. In this activity, the implementation team carried out the practice of making milkfish from the beginning to the end, starting from the preparation of raw materials, arranging milkfish, operating the equipment, until the milkfish was well-cooked.

The results of the milkfish manufacturing in the second trial can be seen in table 3 below.

Table 3: The Result of Trial II in Making Soft Thorn Milkfish.

Temperature	Pressure	Cooking Duration	LPG Consumtion	Result
100º C	1,7 atm	120 min	1,8 kg	Soft thorn Milkfish, good texture, undamaged.

Based on the trial results of making soft thorn milkfish above, the quality from both trials were good. Both methods yielded soft thorn milkfish, good texture, and unbroken fish. Yet, in both trials, the consumption of LPG has different in amount. The second trial needed more fuel. It was because there was a difference in temperature control setting. In the first trial, the temperature setting was done twice. At the first stage, the temperature was set to a maximum of 110ºC. After heating reached a temperature of 110ºC, the temperature control was set again, then the temperature was set to a maximum of 100ºC. This was done based on the assumption that after the fire stove decreased, the temperature in the pan would drop. In order to reduce the temperature that has no effect to the temperature control, or lessen stove flame (which can increase LPG consumption), the temperature control setting should have been made lower, for instance 10º C up to 100º C.

After it reaches the temperature of 110º C, the fire decreases and the temperature drops to 105ºC. However, because the temperature drop is still above the set temperature (100º C), the stove flame remains small, and the consumption of LPG fuel remains low.

Different things occur during the second trial where the temperature setting is only done once, for instance, the temperature is set to a maximum of 100ºC. As a result, when the flame of the stove decreases, the temperature drops below 100º C. Because the temperature below is set (100º C), temperature control works , the gas flow regulating valve opens so that the flame of the stove enlarges again and of course it requires greater consumption of LPG gas as well. When the flame increases, the temperature rises above 100º C (101º C) and the fire shrinks again. But this does not last long and the stove burns again. This small and enlarged flame condition occurs repeatedly to maintain the temperature at 100ºC. The effect is that the fuel consumption becomes large.

Based on the trial results and the socialization that have been carried out, it can be said that the purpose of this study has been achieved. However, the development of tool design needs to be carried out continuously in order to meet the needs of presto milkfish entrepreneurs or producers, as well as tools that can function more effectively and efficiently.

During the socialization there were several inputs from the participants, for example about the size of the presto pan. They suggested to create smaller pan for first-step-entrepreneurs whose production was still in a small quantity. This is a good input for the implementing team. The follow-up-step is the modification and dissemination of the tool. The size of the presto pan can be varied, for example the size for the capacity of 20, 30, 40, and 50 kg. Thus the user has a lot of capacity choices, adjusting to the production capacity and budget to buy the equipment.

From the user side, there are also opportunities to develop technical aspects of milkfish cooking process. This is solely to get the best, effective and efficient results. For example in regulating the amount of temperature, pressure and cooking time.

From the previous trial, to reach a temperature of 100º C and a pressure of 1.5 atm, it only takes about 20 minutes. Then when the fire decreases, the temperature only drops around 5º C and the pressure is relatively constant. In the previous experiments, after 2 hours of cooking time, the milkfish cooking process was complete, the stove was immediately turned off and the pressured air discharge valve was immediately opened, and the milkfish was taken.

Seeing the above conditions, even though the stove has been turned off, the temperature and pressure are still relatively high. This actually can still be utilized in the process of cooking milkfish. For further study, it is necessary to carry out another trial in one condition that the ignition duration is only 1.5 hours, but the opening of the air valve is longer, for example 2 hours or more. If the trial yields good results, surely this can be a new innovation. Thus, it can be ascertained that the consumption of LPG fuel is more efficient than the previous process.

Additionally, this milkfish cooking equipment can actually be used to cook any food ingredients, not just presto milkfish. Processed foods other than milkfish such as presto chicken (soft bone chicken) and presto nuts. Entrepreneurs can do other innovations, such as making presto food from other ingredients, such as ducks, crabs, eels, catfish and various other foods.

The results of this activity were felt to be truly beneficial by the presto milkfish businessman. This can be seen from the comparison of new tools with the old tools used so far. With old tools, 3 kg LPG for 4 x cooking process (@ 3 hours) x 5 kg = 20 kg milkfish. While with milkfish cooking products development results: 3 kg LPG for 3 x cooking process (@ 2 hours) x 40 kg = 120 kg milkfish. So the ratio of fuel consumption of old equipment with new equipment for the same production capacity (120 kg) is 6: 1. In terms of capacity production, the new equipment can reach 8 times more in capacity.

Against presto milkfish cooking equipment LTHPC, Arista (2010) has conducted research on the effect of pressure and cooking time on the quality of presto milkfish. The results concluded that the optimum pressure and time in the pressure cooker were to obtain the expected quality of milkfish at a pressure of 1.5 atm and cooking time of 2 hours. Based on the results of organoleptic tests on variations in pressure of 1.5 atm and time of 2 hours has the highest value, because the variation has good quality which includes better appearance, taste, aroma, texture and color compared to other variations of pressure and time. For the levels of protein, fat and water at a pressure variation of 1.5 atm and a time of 2 hours is about 11.6%, 31.1% and 39%.

Meanwhile other studies show similar results, that the best value for all temperature parameters is by 120 minutes heating (Tapotubun, AM, et al, 2008: 69). Compared to presto milkfish which is produced with other tools, presto milkfish—which is cooked with LTHPC, contains higher protein. It is found that presto milkfish cooked with LTHPC has higher protein of 11.6%, sample X (with other machine) was only 5.19%. Even in sample Y (with other machine) only 1.645%. (Test results at the Chemical Laboratory of FMIPA Unnes, December 16, 2010).

4 CONCLUSIONS

Based on the previous discussion, it can be concluded that.

In this study, a set of soft thorn milkfish (presto) cookers with automatic temperature control has been produced. The technical specifications of the tool are as follows:

Height: 80 cm
Diameter: 55 Cm
Pot Material: Stainless Steel (SS 304)
Pan Thickness: 3 mm
Capacity: 40-50 kg of fresh milkfish
Number of Shelves: 10 Shelves
Fuel: LPG
Cooking time: ± 2 hours
LPG consumption: ± 1 kg / process

Presto milkfish cooking equipment has been proven to be able to increase productivity and product quality. Compared to traditional presto cooking equipment, this tool has several advantages, which gives benefits such as greater production capacity, time saving, fuel saving, cost savings, and better presto milkfish quality.

To produce milkfish with new tools, it is necessary to adjust the cooking temperature of milkfish at about 110º C, a minimum pressure of 1.5 atm, and a cooking time of about 120 minutes. However, the parameter setting is not yet standard parameter, especially the time variable because it is influenced also by the volume of raw material being cooked.

In order to economize the consumption of LPG fuel, the temperature control must be set twice. The second setting is about 10º C below the first temperature setting.

5 SUGGESTIONS

There are several suggestions regarding the results of this study as the following:

It is necessary to follow up further production in terms of pan size variation with a capacity of 20, 30, 40, and 50 kg. This is to support milkfish producers who have minimum production capacity and financial capabilities.

The device user is expected to be able to conduct further tests,in terms of etemperature variation, pressure, and cooking time, in order to obtain the best, effective and efficient results.

To the KSM management of "Soft Thorn Milkfish", it is expected to make the best use of the presto milkfish cooking equipment and be able to disseminate this technology to the members.

The continuity of activities requires the support of relevant parties in disseminating this appropriate technology, including the Marine and Fisheries Service, the Industry Agency, the Cooperative Service and the UMKM, as well as other parties concerned with the development of UMKM.

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