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Effect of Amount and Type of Fuel on The Smoked Fish Quality

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ABSTRACT

Indonesia has a diverse range of fish species in both seawater and freshwater. Lampung is one of the provinces in Indonesia that has a rich diversity of fish species. Lampung has a wide variety of fish species, including tilapia. Tilapia is a food material that decomposes quickly due to bacteria and microorganisms. As a result, one of them is the need for profitable handling by utilizing smoking technology. Smoked fish is popular in Lampung, but the most commonly used fuel is coconut shell, coconut coir, and corn cobs. The use of common fuel in the community still cannot assess the smoking fuel that can produce good quality standards of fish. As a result of the aforementioned issues, the research was to evaluate effect of fuel quantity and type on the quality of smoked fish. The goal of this study is to determine the effect of fuel amount on tilapia smoking, the type of fuel that can produce smoked fish of optimal quality, and the cost of fuel needed for tilapia smoking using coconut shell fuel, coconut coir, and corn cobs. The method used in this study was organoleptic testing on 25 panelists using a smoked fish score sheet determined by SNI smoked fish, and then the panelists' scores were processed using excel. The amount of fuel used and the duration of smoking have no effect on the quality value of smoked fish, and the type of fuel that can produce smoked fish of optimal quality, namely coconut coir, passed the SME (export quality certificate) standard with an organoleptic value of smoked fish of 8.0.

1. Introduction

Indonesia has a diverse range of fish species in both fresh and sea water. Lampung is one of Indonesia's provinces with a diverse range of fish species. Tilapia is one of the many fish species found in Lampung. According to the latest census data from the City of Bandar Lampung's Department of Maritime Affairs and Fisheries, tilapia production in Bandar Lampung reached 22.20 tons in 2019. Tilapia is a food ingredient that decomposes quickly due to bacteria or microorganisms, because 80% of the tilapia composition is water, then if the bad environmental conditions allow to promote for the growth of decomposing microbes. Temperature, pH, oxygen, moisture content, storage time, and the cleanliness of facilities and infrastructure are examples of environmental conditions (Yusra, 2016). As a result, there is a need for profitable treatment, one of which is to use fumigation technology (smoke)

Smoked fish is popular in Lampung, with the most common fuels are coconut shells, coconut coir, and corn cobs. Lampung is a province that produces a large number of coconut in smallholder plantations throughout the province. Lampung province's coconut production in 2017-2021 is 94,560, 86,937, 83,435, 83,387, 81,632 tonnes, according to the Directorate General of Plantations. Coconuts produce shells and coir during the processing process, which are classified as residual waste. We can use the abundance of coconut shell and coconut coir waste as fuel in the smoking process. Lampung Province is Indonesia's third largest corn-producing province. The waste manifests itself in the form of corn cobs, which are left alone during the harvest season and pile up. Because there are so many of them, we can use corn cobs as fuel for smoking fish

In current status the community is still unable to assess smoking fuel, which can produce good fish quality standards, in the use of commonly used fuel. Based on the issues raised above, a study was conducted to determine the effect of fuel quantity and type on the quality of smoked fish.

2. Material and Methods

This research was conducted from February 2022 to March 2022, at the Machine Tool Power Laboratory (LDAMP), Department of Agricultural Engineering, Faculty of Agriculture, University of Lampung

Calculate the amount of fuel used during the process of smoking fish and the amount of heat from each fuel (coconut shell, coconut coir, and corn cob), then record the time during the process of smoking tilapia fish. The amount of heat can be calculated using the formula:

$$Q = m \times L$$

Information :
Q : amount of heat (J),
m : the mass of objects that receive and release heat (kg)
L : heat of melting (J/kg)

Organoleptic testing is a method of evaluating food ingredients based on preferences and willingness to use a product. An organoleptic test, also known as a sensory test or a self-sensory test, is a method of testing that utilizes the human senses as the primary tool for determining the acceptability of a product. Organoleptic testing is critical in the application of quality. Organoleptic testing can detect spoilage, deterioration in quality, and other product damage (Dhingra & Jood. 2007).

3. Results and Discussions

3.1 Smoked Fish Water Content

Water is the largest content in fish and functions as a medium for microorganisms to multiply so that the smoking process is aimed at removing the water content of the fish, and is expected to inhibit the growth of these organisms so as to extend the shelf life of smoked fish (Swastawati et al, 2013). The water content of smoked fish will affect the organoleptic value of smoked fish. Low or high water content of smoked fish will determine the level of consumer preference for smoked fish. In addition, the duration of smoking and the type of fish affect the water content of smoked fish. The standard value for the water content of smoked fish based on the Indonesian National Standard (SNI) is a maximum of 60 - 65%. The results of the analysis of smoked tilapia water content can be seen in the table below.

Table 1. Smoked Fish Water Content

Repetition	Fuel Type	Fuel Amount (kg)	Fresh Fish Water Content (%)	Smoked Fish water Content (%)
1	Coconut shell	3.0	76	54
		3.5	76	54
	Coconut Coir	3.0	76	50
		3.5	76	43
	Corncob	4.0	76	57
		4.5	76	55
2	Coconut shell	3.0	76	52
		3.5	76	61
	Coconut Coir	3.0	76	54
		3.5	76	33

According to Mardiana et al (2014) the water content will decrease according to the length of time the smoking is done. The decrease in water content is thought to be caused by the influence of the smoking temperature. The water content contained in smoked fish can affect the shelf life of smoked fish. Because the water content is a medium for microbes to multiply (Agus, et al 2014).

3.2 Fuel Performance Test

3.2.1 Coconut shell

Table 2 shows repetition 1 and 2 smoking fish using coconut shell fuel as much as 3.0 kg takes 3 hours with the amount of heat used (3.0 kg x 30.56 h/kg°C) which is 91.68 h/ kg°C. Using 3.5 kg of coconut shell fuel takes 2 hours with the amount of heat used (3.5 kg x 30.56 h/kg°C) which is 106.96 j/kg°C.

Table 2. Coconut Shell Performance Test

Repetition	Amount of Fuel (kg)	Time (hour)
1	3.0	3
	3.5	2
2	3.0	3
	3.5	2

3.2.2 Coconut coir

Table 3 shows repetitions 1 and 2 of smoking fish using 3.0 kg of coconut coir as fuel and takes 2.5 hours with the amount of heat used (3.0 kg x 16.56 h/kg°C) which is 49.68 j/kg°C. Using 3.5 kg of coconut coir fuel takes 3 hours with the amount of heat used (3.5 kg x 16.56 h/kg°C) which is 57.96 j/kg°C.

Table 3. Coconut Coir Performance Test

Repetition	Amount of Fuel (kg)	Time (hour)
1	3.0	2.5
	3.5	3
2	3.0	2.5
	3.5	3

3.2.3 Corn cob

Table 4 shows that smoking fish using 4.0 kg of corncob fuel takes 3.5 hours with the amount of heat used (4.0 kg x 15.400 h/kg°C) which is 61.6 h/kg°C. Using 4.5 kg of corn cobs takes 4 hours with the amount of heat used (4.5 kg x 15.400 h/kg°C) which is 69.3 j/kg°C.

Table 4. Corn Cob Performance Test

Repetition	Amount of Fuel (kg)	Time (hour)
1	4.0	3.5
	4.5	4

3.3 Organoleptic Testing

Organoleptic testing employs the human senses to evaluate the appearance, aroma, flavor, and consistency of food products. According to (Permadi et al., 2018), panellists are able to recognise sensory characteristics when describing food products. The purpose of organoleptic testing on smoked fish products is to ascertain the panellist's assessment of smoked fish's suitability according to SNI. Sensory testing is closely associated with consumer acceptance of a product because this stage is highly relevant and closely associated with consumer preferences. (Ayustaningwaro, 2014).

This standard employs the Scoring Test, which uses a measure from 9 (nine) for the highest score to 1 (one) for the lowest score. The rejection limit for this product is in 5, which means that if the tested fishery product acquires a value of five or less, it is deemed to not meet the standard and cannot receive a SME. (Export Quality Certificate). The results of organoleptic test can be found at table 5.

Table 5. Organoleptic test score of tilapia smoked fish

Type and amount of fuel	Appearance	Aroma	Taste	Consistency
Coconut shell 3kg	8.2	8.4	8.1	8.0
Coconut shell 3.5kg	8.0	8.4	8.4	8.2
Coconut coir 3kg	8.3	8.7	8.8	8.3
Coconut coir 3.5kg	8.4	8.5	8.9	8.4
Corn cob 4kg	8.	8.3	3.6	7.3
Corn cob 4.5kg	7.4	7.8	3.3	7.4

Appearance

Appearance is the first impression that the panellists evaluate. According to Winarno (1997), the first organoleptic parameter in presentation is colour. Color is the first impression because it stimulates the sense of sight. Colors that are appealing will encourage panellists and consumers to sample the product.

The maximum appearance score is shown in Table 5 for the use of 3.5 kg of coconut coir fuel, with a value of 8.4, indicating that the appearance is attractive, clean, golden brown, and bright according to type. While the use of 4.5 kilograms of corncobs yields the lowest appearance value, 7.4, the appearance is attractive, clean, brown, and rather bland according to type. The duration of smoking and the type of fuel both affect the appearance of smoked salmon. According to Skaljac et al. (2018), smoking can enhance the color, flavor, and aroma of food.

Aroma

Aroma is one of the organoleptic (smell-based) assessment criteria for sensory properties. Aroma is acceptable if the final product has a distinct aroma. (Kusmawati, et al, 2000). Aroma-causing constituents are volatile compounds (which can be isolated from food at concentrations typically below 100 ppm) (Santoso and Murdijati G, 1999).

Table 5 displays the highest aroma score, a value of 8.7 for the use of 3 kg coconut coir fuel, indicating that the smoked fish smells nice, the smoke is sufficient, and there are no additional off-putting odors. In contrast, the use of 4.5 kg of corn cobs as a fuel source yields the lowest aroma value of 7.8, indicating that the smoked fish is less aromatic and that the smoke is sufficient without the addition of offensive odors. The smoke's phenol content is responsible for the aroma and odor of smoked fish (Alcicek et al., 2010). According to Zachara et al. (2017), the components of smoke create a distinct aroma that cannot be replicated in foods with smoked flavors. The chemical components in the smoke will adhere to the fish's skin and penetrate the flesh, altering the characteristic aroma of smoked fish meat (Alcicek et al., 2010; Isamu et al., 2012).

Taste

Taste is something that the tongue perceives. In the human perception of taste, there are four primary tastes: sweet, bitter, sour, and salty, with an additional response to modification (Zuhra, 2006).

The taste parameter is a very important test tool for assessing the quality of smoked fish. Organoleptically, the highest taste score was found in the use of 3.5 kg of coconut coir fuel with a value of 8.9 which means that smoked fish has a good, tasty taste, without any additional disturbing flavors. While the lowest taste organoleptic value is the use of 4.5 kg corn cob fuel with a value of 3.3 which means smoked fish has an unpleasant taste with an additional disturbing taste. The smoking method and the type of wood used will affect the taste of smoked fish (Essumang et al., 2013). According to Alcicek et al. (2010). Smoking gives a specific taste to fish meat.

Consistency

Texture is most important in soft and crunchy foods. The characteristics most often ignored are hardness, cohesiveness, and water content (De Man, 1997).

According to Isamu et al. (2012) and Alçiçek et al. (2010) the difference in texture values in smoked fish is thought to be due to differences in water content and type of fuel. Figure 4 shows the highest value of the panelist's preference level for texture found in the use of 3.5 kg of coconut coir fuel with a value of 8.4 which means that smoked fish has a dense texture, compact, quite dry, tightly interwoven. While the lowest organoleptic texture value was found in the use of 4 kg corn cob fuel with a value of 7.3 which means that smoked fish has a dense, compact, dry texture, tightly interwoven.

After the data from the panelists is obtained, the quality value is determined by finding the average results of each panelist at the 95% level of confidence, meaning that the average value obtained contains

a probability of error of only 5%. In the context of fostering the quality of fishery products, the smallest value is taken in fulfilling the Export Quality Certificate

P($\bar{X}$ - 1,96xs/vnμ < $\bar{X}$ + 1,96xs/mn =95%

$\bar{X} = \frac{i \sum_{=}^{n} 1^{x\, i}}{n}$

$S = \sqrt{\frac{i \sum_{=}^{n} 1\, (xi-x)^2}{n}}$

$S^2 = \frac{i \sum_{=}^{n} 1\, (xi-x)^2}{n}$

Information:
n = number of panelists
X = average quality value
X^i = quality value of the ith panelist, where i = 1 to n
S = standard deviation of quality value
S2 = diversity of quality values
1.96 = standard deviation coefficient at the 95% level

Then the organoleptic value of smoked fish using 3.0 kg coconut shell in repetitions 1 and 2 ranged from 7.68 to 8.67 and 8.00 to 8.39 at the 95% confidence level, so the organoleptic value of smoked fish was 7.68 at repetitions 1 and 8.00 in repetition 2. The organoleptic value of smoked fish using 3.5 kg coconut shells in repetitions 1 and 2 ranged from 7.68 to 8.79 and 7.76 to 8.95 at the 95% confidence level, so the organoleptic values smoked fish was 7.68 in repetition 1 and 7.76 in repetition 2.

The organoleptic value of smoked fish using 3.0 kg coconut fiber in repetitions 1 and 2 ranged from 8.03 – 9.00 and 8.30 – 9.01 at the 95% confidence level, so the organoleptic value of smoked fish was 8.03 in repetition 1 and 8.30 in repetition 2. The organoleptic value of smoked fish using 3.5 kg coconut fiber in repetitions 1 and 2 ranged from 8.05 – 9.06 and 8.02 – 8.93 at the 95% confidence level, so the organoleptic value smoked fish was 8.05 in repetition 1 and 8.02 in repetition 2.

The organoleptic value of smoked fish using 4.0 kg corn cobs ranges from 6.15 to 7.40 at the 95% confidence level, so the organoleptic value of smoked fish is 6.15. The organoleptic value of smoked fish using 4.5 kg corn cobs ranges from 5.90 to 7.05 at the 95% confidence level, so the organoleptic value of smoked fish is 5.90.

Based on the results of the organoleptic values above, it can be seen that for the three types of fuel, coconut coir is the fuel that is most in demand by the panelists for its taste and aroma, because based on the purpose of smoking in preserving fish is to preserve and give a distinctive color, aroma and taste of smoke. on fish. And the use of coconut coir fuel gets the largest organoleptic value of 8 at the 95% confidence level. Meanwhile, the fuel with the smallest organoleptic value was corn cob, which was 6 at the 95% confidence level. In the results of smoked fish using corncob fuel produces a strong sour taste which disturbs the fish so that the panelists are not interested. So that corn cobs are not suitable for use as fuel for smoking tilapia in this drum type smoker.

4. Conclusions

The use of the amount of fuel and the length of time for smoking fish using coconut shell, coconut coir, and corn cob fuel has an effect on the quality value of smoked fish. The type of fuel that can produce smoked fish with optimum quality is coconut coir, with an organoleptic value of 8.0, which means that smoked fish is attractive, clean, golden brown, luminous according to type with a fragrant aroma, sufficient smoke, without any additional disturbing odors. the taste is delicious, savory, without any additional disturbing flavors and the texture is solid, compact, quite dry, tightly intertwined, with a

confidence level of 95%, then it is declared to have passed the SME standard (Export Quality Certificate).

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