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Application of Liquid Smoke on Milkfish (*Chanos chanos*) and Catfish (*Clarias batrachus*) as an Effort to Improve the Smoked Products Quality

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Abstract Fish smoking in Indonesia is still used traditionally, and generally used hot smoking method. The products produced by traditional fish smoking do not meet the quality of products in accordance with Indonesian national standards (SNI). Liquid smoke can be applied to improve the quality of smoked fish products. The aimed of this activity was to the downstream the application of liquid smoke, which was invented through a research, to improve the quality and productivity of milkfish and catfish in UKM Dapoer Sehat dan Dapoer Helena, Semarang. The materials used in this research were milkfish and catfish. Both fish were processed into smoked fish using 5% liquid smoke, and these products were then analysed to discover their water activity, proximate composition, and total bacteria (TPC). The moisture contents of milkfish and catfish were 57.20 % and 59.53% respectively. The total number of bacteria (TPC) in both smoked fish had met the Indonesian smoked fish standard (SNI), which was a maximum 1 x 105 colonies/g. The smoked milkfish and catfish that were processed using liquid smoke with a concentration 5% had met the Indonesian smoked fish standard (SNI 2725:2013). The application of liquid smoke to smoked fish products can improve product quality, and the products are is safe for consumption.

1. INTRODUCTION

Most of fish smoking in Indonesia is still done traditionally using simple equipment and has not considered aspects of health and food safety (Swastawati et al., 2013). The traditional smoking process in Indonesia generally uses hot smoking. The products produced from hot smoking have drawbacks, such: carcinogenic compound benzo[a]pyrene is present; the products are not uniform; the method can cause air pollution, and the products' quality does not meet the (SNI) Indonesian national standards for smoked fish. One of the modern smoking methods that can be used to improve products' quality is using liquid smoke.

Liquid smoke is obtained from the condensation of steam resulted from combustion, and this liquid contains carbon such as organic acids, phenols, and other compounds. Compounds in smoking raw materials such as wood and coconut shell affect the quality of smoked fish such as taste, colour, and anti-microbial (Lingbeck et al. 2014). The use of liquid smoke has several advantages, such as: it is easy to use; its concentrations can be controlled easily; the resulting products are uniform, and it is environmentally friendly. Several regions in Indonesia have several types of smoked fish, namely skipjack fufu, smoked eel, petis lele, and smoked fish (Berhimpon et al. 2018).

This community service activity was carried out at an Usaha Kecil dan Menengah (Small and Medium Enterprise/UKM) in the city of Semarang, Indonesia

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namely the UKM Dapoer Sehat and Dapoer Helena. The reason for choosing this location was because the average monthly production of this UKM reached 10 kg and it still needed to be developed further as the quantity, continuity, and quality of the products produced could not be optimized. This was due to limited equipment, supporting facilities and infrastructure, marketing, and skills processed by workers. This community service program, namely "Penguatan Komoditi Unggulan Masyarakat (PKUM)", was expected to link and match solution among the Academic, Businessman, and Government (ABG). The aimed of this activity was to downstream the application of the findings of a liquid smoke study to improve the quality and productivity of milkfish and catfish in UKM Dapoer Sehat and Dapoer Helena, Semarang, Indonesia.

2. METHOD

2.1 Time and Location

This activity was carried out at an Usaha Kecil dan Menengah (Small and Medium Enterprise/UKM) in the city of Semarang, Indonesia, namely the UKM Dapoer Sehat and Dapoer Helena from August to September 2021.

2.2 Program Dissemination

This activity was aimed to in transfer knowledge about good production methods as well as sanitation and hygiene in the process of making smoked fish products using liquid smoke. Therefore, it was hoped that the UKM could produce quality milkfish processed-products, safe for consumption, nutritious, and have a longer shelf life.

2.3 Improvement of Production Facilities and Assistance for Vacuum Packaging and Labelling Equipment

Vacuum packaging equipment was provided in the context of technology transfer to extend the shelf life of smoked milkfish and smoked catfish in order to improve their marketing.

2.4 The Production of Smoked Milkfish and Smoked Catfish

The milkfish (*Chanos chanos*) and catfish (*Clarias batrachus*) were processed into smoked fish using liquid smoke solution. The fish were eviscerated, cut, and washed thoroughly. Subsequently, the fish were dipped into 7.5% of salt and 5% of liquid smoke solution. The cured fish were placed into an oven and cooked in three stages with different temperatures, 40 – 50ºC for 1 hour, 50 – 60ºC for 1 hour, and 60 – 80ºC for 2 hours. From each smoked fish the steak was removed and put into polypropylene bags, stored at room temperature (Swastawati et al., 2014), and used for laboratory analysis.

2.5 Analysis of Smoked Milkfish and Smoked Catfish

The samples of smoked milkfish and smoked catfish were then analysed to discover their water activity following the method used by Saenab et al (2010); the total plate count was carried out according to the SNI 2332.3:2015 (BSN, 2015), and the proximate composition assessment followed SNI 01-2891-1992 (BSN, 1992). The energy from fat and total energy were also analysed.

3. RESULTS AND DISCUSSION

3.1 Information Session

This session was held at UKM Dapoer Sehat and Dapoer Helena to explain the community service program to be implemented and the regulations that would be applied during the activity. This session was attended by the management of UKM Dapoer Sehat and Dapoer Helena. The management of UKM who attended this information session seemed enthusiastic and active, so that two-way communication occurred. This was seen when the management of UKM responded to the information presented by the community service team and asked various questions. The management who attended hoped that by applying the liquid smoke in the process of smoking their fish, they can improve their products' quality and their income as well.

Figure 1. Program Socialization (PKUM Documentation, 2021)

3.2 Improvement of Production Facilities and Assistance for Vacuum Packaging and Labelling Equipment

The improvement of production facilities was carried out in August 2021. All necessities for facility repairs had been provided and were ready to be used in the repair process according to processing standards. The improvement of facilities was done in the form of repairing smoked fish processing facilities at the UKM. Equipment that supports the production process, such as freezer and ovens, was also provided.

Figure 3. Provision of equipment for production: a) Freezer; b) Oven (PKUM Documentation, 2021)

Figure 2. Improvement the Production Facilities: a) Before the Program; b) After the Program (PKUM documentation, 2021)

3.3 The Production of Smoked Milkfish and Smoked Catfish using Liquid Smoke

Smoked fish products produced using liquid smoke had uniform products in terms of their appearance, distinctive aroma, and taste. The smoked fish products were then analysed to discover their water activity, proximate composition, total bacteria, energy from fat, and total energy.

Figure 4. Smoked Fish Product (PKUM Documentation, 2021)

Water activity (aw) is the amount of free water in food required for microbial growth. The aw value plays an important role in the shelf life of food products (Nanlohy, 2014). The number of microbes in food is determined by the aw value. Foods that have a low aw value will have a longer shelf life. The results of the analysis showed that the average aw value of smoked milkfish and catfish treated with liquid smoke were 0.61 and 0.92 respectively (Table 1). The chemical composition of liquid smoke absorbed by fish meat is influenced by the length of the smoking process. The more the composition of liquid smoke is absorbed, the less the water content in the fish meat is, causing the unavailability of free water needed for the proliferation of microorganisms (Najih et al., 2014). The low aw value still allows bacteria to exist, such as Bacillus cereus as spore-forming bacteria. These bacteria can be osmotic tolerant at low and high temperatures (Ijabadeniyi & Pillay, 2017). The value of water activity is closely related to the presence of water in the material. Water contained in free form can help the process of damage to foodstuffs such as microbiological, chemical, and enzymatic processes (Sudarmadji, 2003).

The proximate composition of smoked milkfish and catfish treated with liquid smoke is presented in Table 2. The moisture content of food is one of the factors that affect enzyme, microbial, and chemical activity, causing changes in organoleptic properties and nutritional value. The milkfish and smoked catfish treated with liquid smoke had a moisture content of 57.20% and 59.53% respectively. The moisture content of the two smoked fishes is within the standard range of Indonesian smoked fish SNI 2725-2013, which is a maximum of 60% (BSN, 2013). Swastawati et al. (2012) reported the application of 5% coconut shell liquid smoke can improve the quality of the water content of stingrays from 73.78% (fresh) to 61.47% (smoked fish).

The average protein content of smoked milkfish and catfish processed with liquid smoke was 34.74% and 28.53% respectively. Khamidah et al. (2019) reported the protein contents of smoked catfish with the different treatment times of soaking durian skin liquid smoke (0 minutes, 30 minutes, 60 minutes, and 90 minutes) are 82.06%, 82.02%, 83.31 %, and 83.68% respectively. The immersion in liquid smoke causes the protein content of the product to increase because the composition of liquid smoke can function as a water binder.

The analysis showed that the average total fat content of smoked milkfish and catfish with liquid smoke amounted to 6.40% and 8.54% respectively. Smoked fish products tend to have low-fat content, and this is because the fish has undergone a processing. The length of smoking time is one of the factors that affect the fat content of the smoked fish products. Longer durations of smoking time can cause damage to fatty acids, so that the fat content will be lower (Swastawati & Sumardianto, 2004).

Table 1. Water activity (aw) and total microbes of smoked fish produced using liquid smoke

Analysis	Smoked fish	
	Milkfish	Catfish
Water activity (aw)	0.61	0.92
Total microbes	1.5 x 103	2.3 x 102
Energy from fat (kcal/100 g)	57.64	1.16
Total energy (kcal/100 g)	198.86	195.64

Table 2. The proximate composition of smoked fish produced using liquid smoke

Analysis	Smoked fish	
	Milkfish	Catfish
Moisture	57.20	59.53
Protein	34.74	28.53
Total fat	6.40	8.54
Ash	2.08	2.23
Carbohydrates	0.56	1.16

The ash contents of smoked milkfish and catfish processed with liquid smoke were 2.08% and 2.23% respectively. The mineral content in the product can affect the ash content of the product. The use of salt in the processing of smoked fish affects the ash content. Khamidah et al. (2019) reported that the lowest average ash content resulted from the treatment of soaking durian skin liquid smoke for 90 minutes at 6.86% and the highest at 30 minutes soaking time at 7.36%.

The decrease and increase in ash content are closely related to the NaCl content in foodstuffs. The addition of NaCl will increase the amount of sodium in food, so that the ash content will increase (Manurung et al., 2017).

Microbiological analysis carried out on milkfish and smoked catfish treated with liquid smoke was the analysis of the total microbes (TPC). The total numbers of bacteria in the milkfish and smoked catfish were 1.5 x 103 colonies/g and 2.3 x 102 colonies/g respectively (Table 1). The total numbers of bacteria in both smoked fish products were below the Indonesian smoked fish standard SNI 2725:2013, which is a maximum of 1 x 105 colonies/g (BSN, 2013). The log of the total plate count. The low total number of microbes caused by smoke containing phenol can be bactericidal and bacteriostatic. Antibacterial phenol compounds can penetrate bacterial cell membranes and destroy bacteria, but this depends on the phenols contained in a bio-preservative. The amount of phenol contained in liquid smoke is higher than the traditional smoked fish (Ariestya et al., 2016; Swastawati et al., 2017).

4. CONCLUSION

The The utilization of liquid smoke at the UKM produced good quality smoked fish products. The smoked fishes (milkfish and catfish) processed using the liquid smoke had met the standards of Indonesian smoked fish (SNI 2725:2013) in terms of proximate composition, water activity, and total bacteria count (TPC). The application of liquid smoke to produce smoked fishes can improve the products' quality, make them safe for consumption, and increase the UKM's productivity that, in turn, can increase its revenue.

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CONFLICT OF INTERESTS

All of the authors of this manuscript entitled "Application of Liquid Smoke on Milkfish (Chanos chanos) and Catfish (Clarias batrachus) as an Effort to Improve the Smoked Products Quality" declared that there is no conflict of interest. This manuscript has been proofread and approved by all authors named. Additionally, the contact person is the corresponding author who will communicate with the representative of JPKM in the editorial process until it is published.

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