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Study of the effect of processing techniques on the quality of galantine made from milkfish (*Chanos chanos*)

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ABSTRACT

Milkfish (*Chanos chanos*) is one of the commonly consumed fishery commodities in Indonesia. However, diversification of processed products from milkfish, such as pindang (fish brine) and soft bone milkfish, is considered too simple. Whereas, milkfish has a high nutritional content. An innovation to attract more people to consume this highly nutritious commodity is to process it into fish galantine. Milkfish galantine is processed with the basic ingredients of milkfish, bread flour, and eggs that are seasoned then molded and processed at high temperatures. The process of making milkfish galantine includes preparing milkfish as raw materials, scaling and gutting the fish, mincing the milkfish meat, mixing it with other ingredients, molding, and processing. Fish galantine is generally made through high-temperature processing, such as roasting and steaming. Different high-temperature processing techniques can affect the quality of fish galantine. Therefore, this research aimed to assess the effect of milkfish composition and different high-temperature processing techniques: roasting and steaming. The different milkfish galantine formulations in this research were made by giving different proportions of minced milkfish meat as treatments: 5%, 10%, and 15%. After that, galantines were processed by steaming. Furthermore, the formulation with the highest hedonic scale score was duplicated by processing using the roasting technique. The results of the four treatments were then tested for proximate composition, vitamins, and minerals. The results of the hedonic evaluation of milkfish galantines processed by steaming showed that milkfish galantine with 15% fish meat proportion had the highest score. The test results showed that the addition of milkfish meat caused significant differences in water, ash, total fat, carbohydrate, protein, and potassium contents. In addition, the processing technique also caused significant differences in all parameters tested.

Introduction

Milkfish is one of the most popular aquaculture commodities in Indonesia. In West Java Province, milkfish farming was able to produce 79,051.67 tons in 2017 and 120,236.53 tons in 2018 (Ministry of Marine Affairs and Fisheries, 2020). Milkfish is a popular food fish in Southeast Asia. In Bugis and Makasar languages, it is known as ikan bolu, and in Indonesian, it is called bandeng. Milkfish farming in Indonesia is quite intensive. It makes milkfish has great potential as raw material for processed fish products. Diversification of processed fishery products provides many choices for people in consuming fish and at the same time, supports the promotion of fish consumption by the government of Indonesia.

One of the diversified milkfish products that can attract consumers is fish galantine. Galantine is a ready-to-eat food that is a modification of ground chicken, beef, or fish products and has a savory taste (Saptariana, 2012). The galantine referred to here is actually a culinary product rooted in the Dutch colonial era in Indonesia, but has become increasingly popular over time with various modifications (Febriane, 2012). The price of chicken galantine and milkfish galantine ranges from IDR 60,000/kg to IDR 100,000/kg (Fania, 2016). As additional information, galantine has a protein

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content ranging from 14.56% to 16.73% (Swastawati dkk., 2018).

One of the commonly used techniques to produce processed galantine is high-temperature processing technique. Some examples of high-temperature processing technique include boiling and steaming (at 100°C), roasting, and frying (at 150°C-300°C). According to Swastawati (2018), processing with high temperatures can alter protein levels in galantine. The high or low decrease in the nutritional content of a food ingredient due to cooking depends on the type of ingredients used and the temperature applied (Sundari, 2015). Based on this elaboration, this research examined the effect of processing techniques on the quality of galantine made from milkfish. The study of processing techniques used four formulations of ingredients to be tested. This product development is expected to produce processed milkfish products that are highly attractive to consumers while maintaining nutritional value.

Milkfish is usually processed as boneless milkfish, soft-bone milkfish, milkfish cake, smoked milkfish, and milkfish galantine (Rahmawati *et al.*, 2014). Galantine is a ready-to-eat food that is a modification of ground chicken, beef, or fish products (Saptariana, 2012). The shape of the galantine is usually tubular like a sausage but with a larger size. Sausage uses tapioca flour as an additional ingredient while galantine uses bread flour and eggs as batter ingredients. Processing milkfish into galantine can also increase the variety of processed milkfish for consumption. Milkfish galantine is made with raw materials from milkfish fillets or surimi or paste. This product has a high protein content but has a relatively short shelf life (Darmawan *et al.*, 2019). Other previous study was by Fadhlullah *et al.* (2021) about eel galantine.

Fish can be processed and preserved with high-temperature processing techniques. According to Sitoresmi (2012), food processing using high temperatures has the effect of increasing the digestibility of food, but high heat can degrade nutrients. The following are examples of high-temperature processing techniques: roasting and steaming. i)Roasting, The purpose of roasting is to increase sensory properties and improve the flavor of food product. Prolonged roasting can cause the texture of the food product to harden. In addition, roasting can also destroy microorganisms and reduce water activity (aw) so as to preserve food product (Sitoresmi, 2012). The effect of roasting is generally related to hydrolysis. In the extreme roasting process, linoleic acid and other fatty acids will be converted to unstable hydroperoxides by the activity of the enzyme lipoxygenase. These changes will affect the nutritional value of fat and vitamins of the product (Palupi, 2007). ii) Steaming, steaming can increase the durability of food by reducing or even killing microorganisms during processing and can improve flavor. Steaming time must be considered because vitamin content can be reduced or even lost in the steaming process (Putri, 2016).

Materials and Methods

Location and time of research

This research was conducted at the Food Processing Teaching Factory of the Karawang Marine and Fisheries Polytechnic from November to December 2021.

Equipment and Materials.

The equipment used in the galantine processing were, among others, food processor (Philips), filler, fume hood, and boiling pot, while the chemical analysis equipment consisted of Kjeldahl apparatus, Soxhlet extractor, oven (Memmert), muffle furnace, analytical balance, evaporating dish, and crucible. The materials used in this research were milkfish (Chanos chanos) from Tirtajaya District, Karawang Regency, herbs and spices, and materials for chemical analysis, which included selenium catalyst (Sigma-Aldrich), sodium hydroxide (Merck), sulfuric acid (Merck), boric acid (Merck), hydrochloric acid (Merck), sodium tetraborate (Merck), hexane (Merck), and pH indicator (Merck).In addition, other ingredients used in the formulation such as Bread Flour, Egg, Red Onion, White Onion, Hazelnut, Sugar, Brown Sugar, Pepper, Nutmeg, Milk Powder, Salt, water with food grade quality and obtained from the food market in Karawang Regency.

The stages of this research comprised preliminary research and main research. The preliminary research included orientation and optimization of galantine making method so that the galantine processing in the main research could be performed effectively. The main research was conducted by making galantine with reference to the experimental group and tests of the nutritional content, sensory quality, and microbiological quality of galantine.

The variables in this research were processing techniques, which were steaming and roasting, and the percentage of minced fich meat based on previous research of eel galantine by Fadhlullah *et al.*, (2021). The research object was divided into four experimental groups:

-K5 : Steaming group with 5% minced fish meat
-K10: Steaming group with 10% minced fish meat
-K15: Steaming group with 15% minced fish meat

-P15 : Roasting group with 15% minced fish meat.

Procedure of the Research on Milkfish Galantine.

i) Preparation of minced milkfish meat, Fresh milkfish were stored in a cooler box at chilling temperature. The milkfish was weighed and gutted to remove the head, scales, and viscera. The fish were split and washed with ice water to remove dirt and blood. Next, the bones were removed from the meat. The meat was then separated from the skin and minced with a food processor. ii) Making galantine with steaming and roasting techniques, All the spices in the formulation were ground and mixed together with the minced milkfish meat, after which the additional ingredients of bread flour, eggs, brown sugar, salt and milk powder were added (Table 1). The batter was molded using a baking pan. The batter was cooked using roasting and steaming techniques based on trials in the preliminary research. The steaming technique referred to Darmawan *et al.* (2019) and the roasting technique referred to Hidayah (2012) with a roasting temperature of 120-160˚C for 30 minutes. Galantines were rested for one hour until the temperature of the galantines stabilized. Galantines were vacuum packed in nylon plastic bag. Then, the packages were labeled with nutritional information and product definition. The final products were stored in the freezer.

Table 1. Milkfish Steak Formulation

No	Ingridients	Formulation			Unit
		K5 (5%)	K10 (10%)	K15 (15%)	
1	Chanos Fish Meat	50	100	150	gram
2	Bread Flour	200	150	100	gram
3	Egg	500	500	500	gram
4	Red Onion	50	50	50	gram
5	White Onion	50	50	50	gram
6	Hazelnut	20	20	20	gram
7	Sugar	40	40	40	gram
8	Brown Sugar	40	40	40	gram
9	Pepper	4	4	4	gram
10	Nutmeg	1	1	1	gram
11	Milk Powder	20	20	20	gram
12	Salt	15	15	15	gram
13	Water	10	10	10	gram
	Total	**1000**	**1000**	**1000**	**gram**

Protein Determination.

Protein levels were analyzed using the Kjeldahl method. Samples that had been dried were carefully weighed as much as 500 mg and then put into the Kjehdahl flask. The samples were then deconstructed with a mixture of catalyst and concentrated sulfuric acid for 2 hours. The ammonia formed was distilled into a mixture of boric acid and orange methyl and red methyl indicators until it turned green. Nitrogen in the form of ammonium borate was then titrated with 0.1 N HCl until the color returned purple. The volume of HCl obtained was calculated to obtain protein content. The protein content determined by the Kjeldahl method is crude protein content because the method can only determine based on its nitrogen content, while other compounds containing nitrogen are not necessarily proteins (AOAC, 1990).

Fat Content Determination.

Fat content was determined by the Soxhlet method. The dried sample was weighed carefully as much as 1 gram, then wrapped in fat-free filter paper. The filter paper was put into a siphon. Soxhlation was done by direct electric heating. Heating was done for up to three hours. The hexane in the round-bottom flask was poured into a dry evaporating dish that had been stabilized, then evaporated until the fat fraction was free of hexane. The dish containing the fat was then carefully weighed and the fat content was determined (AOAC, 1990).

$$Fat\ Content\ (\%) = \frac{Weight\ of\ dish\ with\ fat - Weight\ of\ empty\ dish}{Weight\ of\ sample} \times 100\%$$

Ash Content Determination.

It was done by weighing the crucible that had been dried first in the oven, then the sample was pulverized and weighed together with the crucible. The crucible was ignited in a muffle furnace to a temperature of 600°C for 3 hours. The results of the ashing were put in a desiccator and the weight of the ashes was weighed after cooling (AOAC, 1990).

Water Content Determination.

A total of 100 grams of sample was weighed in a constant crucible. The sample was heated in an oven at 110°C for 30 minutes. Sample that had been dried, weighed again until it reached constant weight (AOAC, 1990).

Sensory Evaluation.

Sensory evaluation was conducted by untrained panelists using hedonic scale test. The parameters used include the levels of acceptance of color, flavor, and aroma and overall acceptance. Panelists were asked to rank the products according to a certain scale (Koswara, 2006).

Data Analysis.

The data obtained from this research were processed statistically using SPSS software version 23.0. The methods used were ANOVA and t-test. Further test was done with the Friedman test.

Results

Sensory evaluation

The percentage of fish meat added into galantine formula was significant (P≤0.05) on level of sensory acceptance of panelists. Mean of its shown in Table 2.

Table 2. Results of Sensory Evaluation of Milkfish Galantines

Formulation	Value of Hedonic test				average
	Appearance	Texture	Odor	Flavor	
K5	3,13	3,07	2,80	3,20	3,0500
K10	3,60	3,33	3,27	3,27	3,3675
K15	3,33	3,67	3,33	3,93	3,5650
P15	3,89	3,88	3,74	3,98	3,8725

Note: K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat

Proximate Composition of Milkfish Galantine

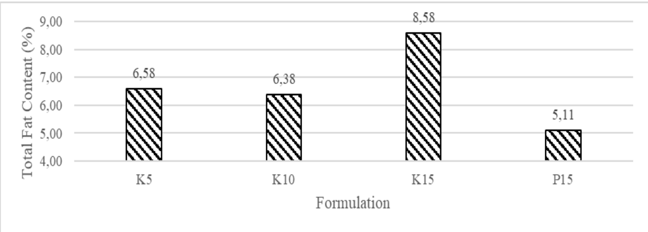

Figure 1. Diagram of total fat content in milkfish steak (K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat)

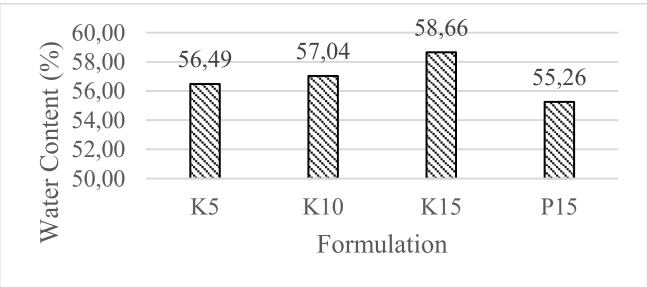

Figure 2. Diagram of moisture content in milkfish steak. (K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat)

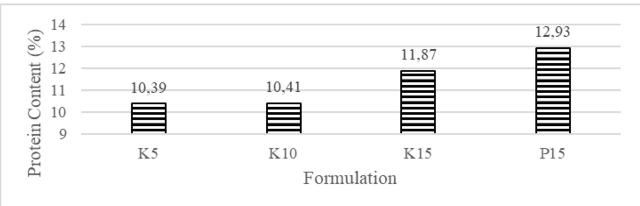

Figure 3. Protein content in milkfish steak. (K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat)

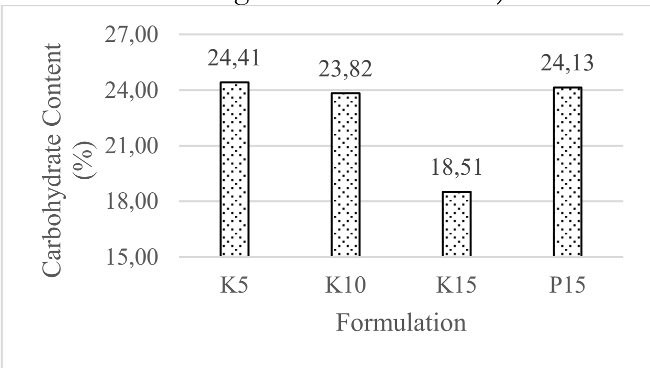

Figure 4. Diagram of carbohydrate content in milkfish steak (K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat)

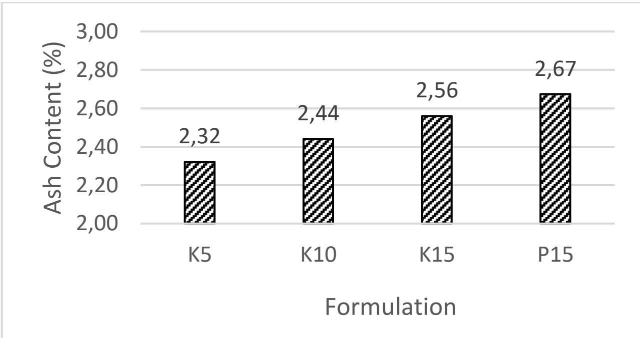

Figure 5. Diagram of ash content in milkfish steak. (K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat)

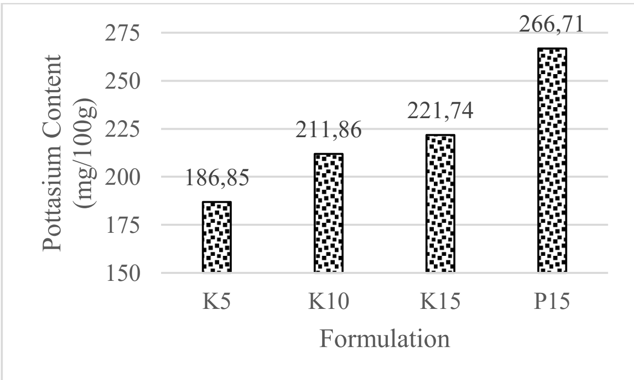

Figure 6. Diagram of potassium mineral content in milkfish steak. (K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat)

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Discussion

Hedonic and sensory evaluation

A total of 25 untrained panelists gave a hedonic assessment of galantine varied with the addition of minced milkfish. The average level of sensory acceptance of panelists can be seen from Table 2. From the results presented in Table 2, it can be seen that based on the appearance parameter, formulation K10, which was galantine with the addition of 10% minced milkfish meat, was preferred by panelists over sample K5 (5% minced milkfish meat addition) and sample K15 (15% minced milkfish meat addition).

Table 3. Proximate Composition of Milkfish Steak

No	Parameter	Unit	Formulation			
			K5	K10	K15	P15
1	Ash Content	%	2,322 ± 0,026	2,442±0,013	2,560±0,010	2,674±0,028
2	Total Fat	%	6,578 ± 0,029	6,376±0,051	8,580±0,028	5,110±0,047
3	Water Content	%	56,486±0,186	57,036±0,527	58,662±0,036	55,258±0,051
4	Carbohydrate	%	24,408±0,022	23,820±0,273	18,514±0,136	24,130±0,177
5	Protein	%	10,214±0,134	10,316±0,079	11,670±0,156	12,784±0,119
6	Potassium	mg/100 g	186,214±0,528	209,128±2,114	223,732±1,637	267,196±0,405

Note: K5 : Steaming with 5% fish meat, K10: Steaming with 10% fish meat, K15: Steaming with 15% fish meat, P15 : Roasting with 15% fish meat

The results of hedonic evaluation of galantines cooked by steaming showed that based on texture, aroma, and flavor parameters, panelists chose sample K15 as the product with the highest acceptance value. The texture parameter was thought to be influenced by the amount of fish meat and bread flour added to the batter because fish meat and flour can bind water more strongly and thus reduce the hardness of the texture (Suryo, 2019).

Meanwhile, the aroma and flavor parameters were thought to be influenced by the addition of fish meat because K15 was the formulation with the most fish meat added. Base on the data in Table 2 shows that if the concentration of ground milkfish meat addition is higher, then it is likely that the panelists will still like the galantine product. This is due to the tendency of the panelists acceptance level to continue to increase from sample K5 to K15 and has not shown any decrease in value.

Differences in organoleptic properties of galantines with different cooking techniques may be influenced by changes in chemical and physical components in the mixture of fish meat and other ingredients in the galantine batter. Differences in texture can be influenced by the level of dryness of the galantine. The same results were also shown by the research of Brainy et al (2014) on tilapia burgers cooked with different cooking techniques, where differences in cooking methods will result in differences in the results of water retention in the product which causes differences in texture.

Proximate Composition of Milkfish Galantine. The results of the proximate composition test on milkfish galantine are presented in Table 3 as follows. The parameters tested were ash, total fat, moisture, carbohydrate, protein, and potassium contents. High-temperature cooking techniques can affect the nutritional composition of fish species, depending on the temperature reached, the length of time the food is exposed to heat, and the method used for cooking (Ansorena 2012). Differences in fat content (Figure 1) can be influenced by the decrease in water content after cooking. During the cooking process, fatty acids undergo hydrolysis and oxidation reactions, which affect not only the fatty acid concentration but also the flavor, aroma, color, and texture of the fish meat (Gonzalez et.al, 2017).

Total fat value is the value of the amount of fat contained in galantine, including saturated fat and trans-unsaturated fat. Based on Table 3 and Figure 1, the mean value of total fat content of galantine in all experimental groups met the quality standards of sausage products, which is a maximum of 20% (Indonesian National Standard (SNI) 3820: 2015). Galantine K15 contained the highest total fat at 8.58% and galantine P15 contained the lowest total fat at 5.11%. The total fat contained in galantine was influenced by several ingredients, which were milkfish meat, eggs, milk powder, and bread flour.

The results of ANOVA of experimental groups with steaming cooking technique showed that the difference in the proportion of milkfish meat addition caused significant differences in total fat content. In addition, the t-test of galantine K15 and galantine P15 also showed significant differences. It indicates that different processing techniques cause significant differences in total fat content in milkfish galantines. These result are in according to research resalt from Swastati *et al.* 2012 stated that changes in fat content in fish during processing can be caused by several factors such as processing technique, temperature, and reactions with chemical compounds in the galantine product.

The moisture content of milkfish galantine are presented in Table 3 and Figure 2. The moisture content of milkfish galantine cooked by steaming increased along with the amount of fish meat added to the batter, but still met the Indonesian National Standard (SNI), which is a maximum of 67%. The increased moisture content could be caused by the interaction between the components in the batter with fish meat that has good gelling properties to trap moisture (Brainy *et. al*, 2014). The lowest moisture content was detected in galantine cooked by roasting, which amounted to 55.26%. Roasting is a dry heat method of cooking so that the process of evaporation of water from the batter with this method is faster than it is with the steaming method.

Heating has been proven to induce protein oxidation, leading to various changes at the molecular level. These changes involve the formation of carbonyl derivatives, reduction of thiol groups, loss of tryptophan fluorescence, accumulation of Schiff base (SB) structures, and formation of intra- and intermolecular cross-links. It can further affect the physicochemical and organoleptic characteristics of fish meat by inducing textural deterioration caused by loss of water-holding capacity and inducing flavor changes due to interactions between secondary lipid oxidation products and proteins (Hu, *et al.* 2017).

The test results (Table 3 and Figure 3) revealed that the protein contents in experimental groups K5, K10, K15, and P15 were 10.39%, 10.41%, 11.87%, and 12.98%, respectively. The percentages showed that the protein contents of the products have met the requirement of the Indonesian National Standard (SNI 3820: 2015), which is at least 8%. The percentages also indicate that the more milkfish meat added (as in experimental groups K5, K10, K15) will increase the protein content in galantine. Galantines cooked with different cooking techniques (K15 and P15) had significantly different protein levels. The highest protein content was found in galantine cooked by roasting, which amounted to 12.93%. This high protein content can be influenced by the loss of water molecules in galantine due to the roasting process. High temperature processing techniques are known to be the most effective in reducing water content in processed products.

The carbohydrate content (Table 3 and Figure 4) in galantine cooked by steaming decreased as the proportion of milkfish meat added increased. It was because in the galantine formulations made, milkfish and bread flour were substitutive. It is known that bread flour has a higher carbohydrate content than fish meat and therefore, the more milkfish meat was added, the less the proportion of bread flour became, causing a decrease in carbohydrate content. The carbohydrate content of the roasted galantine was higher than that of the steamed galantine because of the lower moisture content of the roasted galantine.

One of the proximate components is ash content (Table 3 and Figure 5). Ash content is a value that shows the amount of minerals or inorganic components contained in food ingredients. Hafiludin (2019) reported that ash content in milkfish is influenced by their habitat. Freshwater milkfish has a higher ash content (2.812%) than brackish water milkfish (1.405%). However, the types of minerals contained in the fish are relatively the same. The minerals are macrominerals, comprising Ca, Mg, Na and K, and microminerals, which are Fe, Zn, Cu and Mn.

Potassium is an electrolyte element that has an important function in intracellular fluid. Potassium deficiency can cause metabolic disorders, gastrointestinal disorders, and cardiovascular system disorders (Ibrahim, 2020). Compared to other macrominerals and microminerals, potassium levels in freshwater milkfish and brackish water milkfish are quite high. The potassium level in freshwater milkfish is 311.505 mg/100 grams and that in brackish water milkfish is 318.725 mg/100 grams (Hafiludin, 2019).

In this research, the potassium levels obtained from the experimental groups K5, K10, K15, and P15 were 186.85 mg/100 grams, 211.86 mg/100 grams, 221.74 mg/100 grams, and 266.71 mg/100 grams, respectively (Table 3 and Figure 6). It can be seen that the addition of more milkfish can increase the potassium content in galantine, as in experimental groups K5, K10, and K15. An overview of the increase in potassium levels in galantine products is displayed in Figure 6.

The highest potassium level was discovered in experimental group P15, which was a galantine product processed by roasting. Processing techniques that caused differences in potassium levels were detected in experimental groups K15 and P15. Roasted galantine had higher potassium level than steamed galantine because the roasting process removes more water content than the steaming process does. Roasting is a dry heat method, while steaming is a moist heat method. The heating process that involves water can dissolve nutritional components that are easily dissolved in water, one of which is potassium, which is very soluble in the form of salt. This is in line with research conducted by Sumiati (2008) which revealed that steaming and boiling processes can reduce the ash content of processed tilapia.

Conclusion

The treatment in the form of formulations and processing techniques of milkfish galantine resulted in different hedonic ratings or preference levels. The most preferred milkfish galantine by the panelists was the galantine with P15 group which was 15% milkfish meat proportion and processed by roasting. This formulation contained ash content 2.674%, water content 55.258%, protein 12.784%, total fat 5.11%, carbohydrate 24.13%, and potassium 267.196 mg/100 g.

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