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The effect of different drying times on physicochemical characteristics of surimi powder from kurisi (*Nemipterus japonicus*)

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KEYWORDS

Nemipterus japonicus
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ABSTRACT

Surimi powder is a modification product of frozen surimi blocks produced through drying at a specific temperature and time. Surimi powder has many uses in the diversification of processed fishery products, namely to increase the nutritional and functional value of a product, especially cereal products. This research aims to determine the effect of different drying times on the physicochemical characteristics of the surimi powder of kurisi fish (*Nemipterus japonicus*). The drying times were 9, 12, and 15 hours at 60°C. The resulting kurisi fish surimi powder was observed for its characteristics, including proximate values, color, and product acceptance and then analyzed using Minitab software version 19. The results analysis of variance showed that the drying time had a significant effect ($p < 0.05$) on the value of water content, protein content and ash content, brightness (L*), and yellowish color (b*) but had no significant effect ($p > 0.05$) on the values of a* and ΔE*ab.

Introduction

Surimi industry began to develop in Indonesia in 1995. Until now, there are still ten surimi companies operating in Indonesia, one of which is PT. Kelola Mina Laut (KML Group). The surimi industry is one of the fisheries product processing industries in the form of semi-products (frozen mashed fish meat) which has an excellent opportunity to develop in Indonesia (Sihono et al., 2021). In 2017, the world's total surimi production reached 820,000 MT. Fish dominates surimi production in tropical areas such as in Asian countries. As much as 58.5% of surimi production is produced from Thailand, Vietnam, India, China, Indonesia, Malaysia, Pakistan, and Myanmar (Wasik, 2020).

The genus Nemipterus is commonly found in the tropical and subtropical Indo-West Pacific. Many species of this genus are used as raw materials for producing processed fishery products commercialized in several Asian countries such as India, Japan, Iran, China, Thailand, Indonesia, and Vietnam (Froese and Pauly, 2019). Kurisi fish (*Nemipterus japonicus*) harvested from tropical waters has been widely used for commercial surimi production (Jaziri et al., 2021). Kurisi fish is considered a trash fish, but with the existence of surimi technology, Kurisi fish has become one of the most important fish species in the industrialization and commercialization of surimi because of its abundance, low cost, and white flesh (Wijayanti et al., 2021).

Drying is a method of preservation carried out by evaporating a certain amount of water from food with the help of heat. Reduced water content can cause a decrease in the value of water activity (A_w). A_w value lowed can inhibit the growth potential of microorganisms, inactivate enzymes and prevent various potential chemical and biochemical reactions that cause food quality degradation. Dried food will be more stable and have a longer shelf life. The drying method can also be chosen as an appropriate preservation method, especially if there is no cold storage space available or limited storage space. The drying process will reduce the mass and volume of the material. Thus, the dried product does not require a lot of storage space (Asiah and Djaeni, 2019). The drying method can be used as

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an alternative for frozen products, such as the surimi industry, to reduce storage and shipping costs.

Surimi is a semi-finished product from mashed meat consisting of fish myofibril protein concentrate. Surimi production can be produced through several stages: separating meat from fish skin and bones, chopping meat, washing using cold water, adding salt, adding cryoprotectants, and freezing. Surimi has various benefits, including being used directly to make various processed fishery products such as sausages (Piotrowics and Mellado, 2015), otak-otak (Tawali et al., 2018), nuggets (Moosavi-Nasab et al., 2019), meatballs (Salihah et al., 2016) and kamaboko (Seighalani et al., 2017). In addition, surimi can be used as a fortification ingredient in various processed products such as donuts (Widjaya et al., 2015; Asyari et al., 2016), brownies (Machmud et al., 2012) and wet noodles (Leha and Moiharapon, 2013).

Surimi is stored in frozen form. This method is claimed to be an excellent method for maintaining protein's functional properties and ensuring the quality of frozen surimi is well preserved (Santana et al., 2012). However, along with advances in storage technology in frozen form, it is deemed too expensive to cost, so the drying method becomes a solution in manufacturing powdered surimi to reduce storage and shipping costs. Powdered surimi can be stored at room temperature, significantly reducing freezing and storage costs (Santana et al., 2012).

Surimi powder provides many advantages in the food industry, such as ease of handling, lower distribution costs, more convenient storage, and usability in applications (Majumdar et al., 2017). In addition, surimi powder is also easy to apply to dry products such as snacks and cereals. The powder form of surimi will significantly assist the industry in developing and modifying various formulations of surimi derivative products. The use of surimi powder in food products can provide functional value because it contributes to protein requirements, especially amino acid requirements (Afrianto and Liviawati, 1991). Park and Lin (2005) showed that surimi powder's nutritional value and physicochemical properties make processed fish and other food products ideal. Until now, some studies have been carried out with a focus on the application of surimi flour to food products, one of which is corn-fish snacks (Shaviklo et al., 2011). In addition, the demand for surimi powder for the development of functional food or ready-to-eat products in the world is also gradually increasing (Kolanus, 2020).

The functional properties of surimi powder can be affected by the type of fish and the drying method used. Several investigations of drying surimi using fish and different temperatures have been found such as drying surimi from threadfin (Huda et al., 2000), drying surimi from tilapia (*Oreochromis mossambicus*) (Majumder et al., 2017), drying surimi from baronang (*Siganus* sp.) (Wawasto et al., 2018), and drying surimi from mackerel (*Scomberomorus commersoni*) (Rombe et al., 2020; Kolanus, 2020). Sarkar et al. (2020) revealed that 60^{o}C is the optimal temperature for the drying process to produce surimi powder with good characteristics. Until now, there has been limited research on using different drying times to get good characteristics of surimi powder. Therefore, this study aims to determine the effect of drying time on the physicochemical characteristics of kurisi fish surimi powder (*Nemipterus japonicus*).

Research Methods

Materials

Surimi used in this study was obtained from a local fish processing plant (PT Kelola Mina Laut, Tuban, Indonesia). The chemicals, including aquadest, Kjeldahl tablet (Merck, Germany), H_2SO_4 (Sigma, U.S.A.), phenolphthalein, methyl red, 0.1 N HCl, 45% NaOH, petroleum ether (Merck, Germany). Equipment used in this study was a cabinet dryer automatic, oven (W.T.C. Binder), soxhlet (Gerhardt), destructor, distillation (Velp Scientifica), furnace (Thermolyne), digital scale (Scout pro), and analytical balance (Mettler toledo).

Sample preparation

Sample preparation as described by Majumder et al. (2017) with modifications. Surimi blocks were thawed at room temperature for 4 hours before cutting into small pieces ranging from 1 x 1 cm and a thickness of 0.5 cm. The surimi pieces were placed in an aluminium tray measuring 50x30 cm with a weight of approximately 200 grams of surimi sample. Next, surimi is put into the drying machine (cabinet dryer automatic).

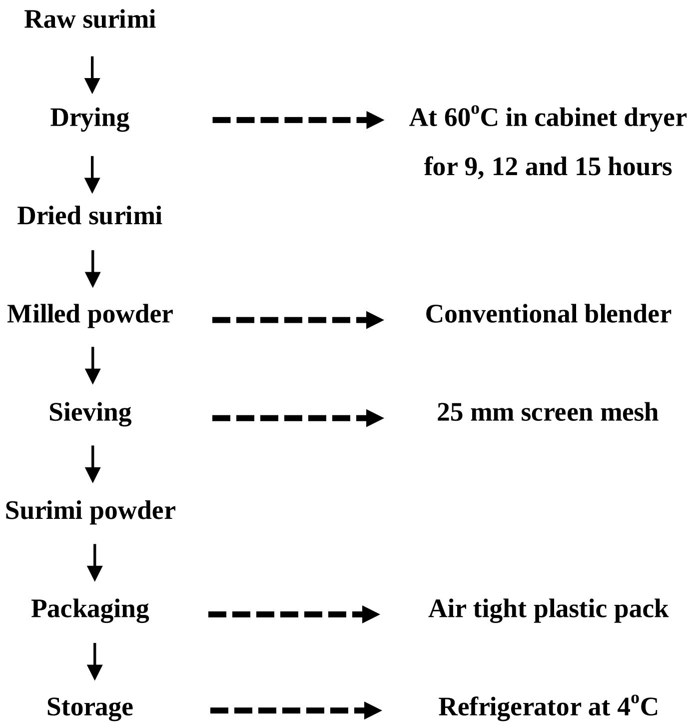

Figure 1. Flow chart of surimi powder preparation

Production of surimi powder

Surimi powder samples can be prepared by following the drying method of Sarkar et al. (2020) with modifications. First, surimi is arranged on a baking sheet and then put into a cabinet dryer at a temperature of 60°C. The drying times used were 9, 12, and 15 hours. The dried surimi was then floured manually using a blender and sieved through a 25-mesh sieve. Finally, the surimi powder was stored in airtight plastic packaging at 4°C for further analysis. The preparation of surimi powder can be seen in Figure 1.

Proximate composition analysis

Proximate analysis was determined using the AOAC (2005) method. Determination of the moisture content of surimi powder can be done using the air oven method. In contrast, the determination of the value of crude protein content can be done using the Kjeldahl method. The fat content value can be determined using the Soxhlet method, while the ash content value can be determined using the dry ashing method.

Color analysis

Color analysis of surimi powder samples using a CS-10 automatic colorimeter (CHNSpec, Hangzhou, China). This tool can be used to analyze the color intensity of surimi powder, which is expressed by the parameters L* (brightness), a* (redness/greenness), b* (yellowish/bluish) , ΔE*ab (total color difference) (total chroma difference) (Prihanto et al., 2021).

Acceptance test

The panellists used in this study were untrained panelists consisting of 20 students from Brawijaya University. The sensory properties (color and aroma) of surimi powder were evaluated. Surimi powder samples were randomly selected to be assessed at room temperature. The hedonic scale consists of nine points, namely (9) like significantly (8) like very much, (7) like moderately, (6) like slightly, (5) neither like nor dislike, (4) dislike slightly, (3) dislike moderately, (2) dislike very much and (1) dislike extremely (Lawless, 2013).

Statistical analysis

The collected data were analyzed using One-Way Analysis of Variance (ANOVA) on Minitab software version 19. Data showing significant differences ($p<0.05$) were subjected to further tests using the Tukey test.

Table 1. Proximate composition of surimi powder at different drying times

Parameter (%)	Treatment (hour)		
	9	12	15
Water content	10.14±0.02[b]	9.67 ±0.08[c]	9.14 ±0.50[d]
Protein content	70.04±0.63[b]	73.16±0.79[a]	74.24±0.61[a]
Fat content	12.23±1.04[a]	13.35±1.78[a]	15.51±1.43[a]
Ash content	2.17 ±0.19[b]	2.93 ±0.45[ab]	2.34 ±0.14[a]

Remarks: *Mean values within a rows followed by the same letters are not significantly different at $p < 0.05$ according to 'Tukey's Multiple Range Test.

Table 2. Color analysis at different drying times

Parameter	Treatment (hour)		
	9	12	15
L*	79.69 ± 0.97[a]	78.36 ± 0.80[a]	74.08 ± 0.98[b]
a*	2.62 ± 0.61[a]	2.01 ± 0.28[a]	1.94 ± 0.17[a]
b*	22.03 ± 0.77[a]	20.78 ± 0.64[ab]	23.00 ± 0.26[b]
ΔE*ab	0.21 ± 0.11[a]	0.81 ± 0.64[a]	0.72 ± 0.26[a]

Remarks: *Mean values within a rows followed by the same letters are not significantly different at $p < 0.05$ according to 'Tukey's Multiple Range Test.

Results and Discussion

Proximate composition

The proximate composition of each surimi powder with different drying time treatments is shown in Table 1. There was a significant difference ($p < 0.05$) in the water, protein, fat, and ash content of kurisi fish surimi powder. Protein is the main component in surimi powder, where the highest protein content of the treatment sample is 74.24±0.61%.

The Food and Agriculture Organization (F.A.O.) classifies the content of fish protein concentrate as 65% (Barzana & Garibay, 1994). The results showed that the protein content of all treatment samples could be categorized into Fish Protein Concentrate (F.P.C.). The increase in protein, fat, and ash content is inversely proportional to the decrease in water content. The long drying time used can cause a decrease in the measured water content in the surimi, so other fractions, such as protein and ash content, increase (Wawasto et al., 2018). Based on research by Majumder et al. (2017), a decrease in water content of 63.79% can increase protein content by 48.83%, fat content by 0.62%, and ash content by 1.50%. In another study, the water content value of 9.05% had a protein content of 60.86%, a fat content of 10.53%, and an ash content of 1.83% (Sarkar et al., 2020).

Color Analysis

The color parameter shows that there is a significant difference ($p < 0.05$) in the characteristics of brightness (L*) and yellowish color (b*). While the value of redness (a*) and E*ab showed nonsignificant values ($p > 0.05$). Color analysis at different drying times can be seen in Table 2.

Surimi powder showed the highest L* in the treatment with a drying time of 9 hours, which was 79.69 ± 0.97, while the lowest value was 74.08 ± 0.98 in the treatment with a drying time of 15 hours, followed by a* value. The highest b* value was obtained at 15 hours of drying treatment (23.00 ± 0.26), followed by the E*ab value. The brightness level of surimi powder shows a slightly lower value than previous studies in Lizardfish, Threadfin bream and Purple-spotted bigeye fish surimi powder at 85.59, 89.57 and 88.33, respectively. Still, the values of a* and b* were higher than those found for surimi powder of the three types of fish from Malaysia (Huda et al., 2001). Factors such as fish species, drying method and the amount of cryoprotectant added can affect the color characteristics of surimi powder (Huda et at., 2001).

The drying time affects the brightness level of surimi powder, where the longer the time used will decrease the brightness of the surimi powder. Therefore, the long drying time causes the surimi powder to have a yellowish to light brown color. Color is essential to the quality of fish protein meals (Shaviklo, 2020). Kurisi fish surimi powder with different drying time treatments can be seen in Figure 2.

(a) **(b)** **(c)**

Figure 2. Surimi powder from fish kurisi with different drying times. (a) 9 hours; (b) 12 hours; (c) 15 hours

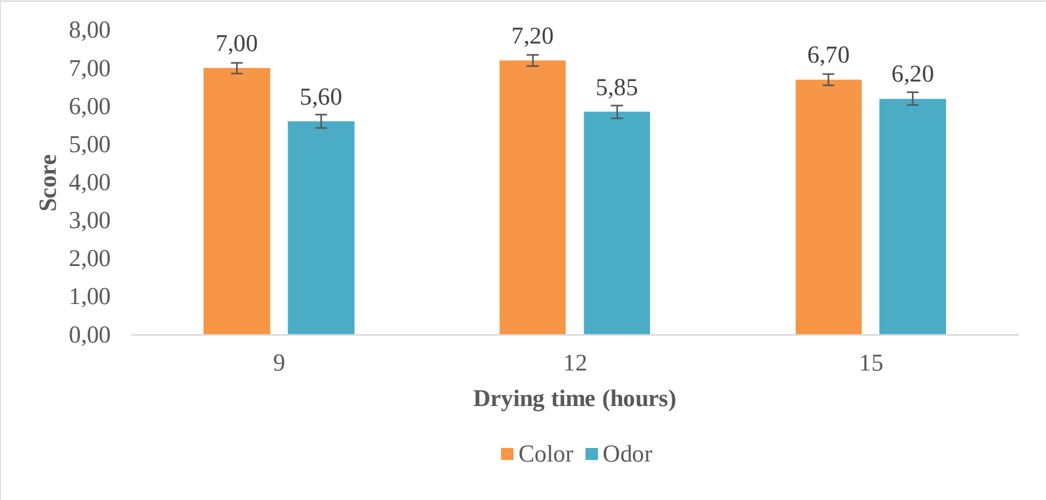

Figure 3. Acceptance test of surimi powder products with different drying time treatments

Acceptance test

The results of the acceptance analysis of surimi powder are presented in Figure 3. The assessment of the color and aroma attributes showed nonsignificant values ($p > 0.05$). The average results of the organoleptic values of surimi powder with different drying time treatments ranged from 6.70 -7.20 for color and 5.85 - 6.20 for odor, respectively.

Panels tend to like the odor of surimi powder which is dried for 15 hours. The fishy of fishery products which is mainly related to lipid oxidation has a negative effect on its application and acceptance for consumers (Yarnpakdee et al., 2012). Appropriate pretreatment with fat removal and drying under suitable conditions has been shown to reduce the fishy odor of gelatin powder products (Hamzeh et al., 2018). The odorous volatiles efficiently removed when the temperature enters during drying, resulting in a product that is not fishy. Thus, long drying time can effectively remove unpleasant odors, especially fishy odors from fish-derived products.

In addition, the panelists also assessed the color parameters. The results showed that the panelists tended to like the color of surimi which was dried for 12 hours. The suitable drying method for raw materials derived from fish protein can increase its nutritional value. On the other hand, the drying method can cause color changes and changes in other physical properties. Color is important in determining the quality of raw materials sourced from fish protein (Shaviklo, 2013). Therefore, surimi powder is also susceptible to drying processes. Drying studies on saithe (Shaviklo et al. 2012) and Cape hake (Pires et al. 2012) revealed that the drying method affect the product's physical characteristics such as the product's color yellowish or dark gray.

Conclusion

The results showed that the quality of surimi powder could be affected by the drying time. The different drying times of surimi fish (*Nemipterus japonicus*) significantly affected surimi powder's physical and chemical properties. All parameters were significantly affected by drying time, except for color parameters, namely a* and ΔE*ab and acceptance test parameters.

Declarations

Conflict of interests The authors declare no competing interests.

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