Proceeding 2nd International Conference Khairun University (IConKU) 2024 *ISBN. 978-602-74809-2-6*
Postgraduate, Khairun University *Vol 1, No 1 (2024)*
Publish Online, 10 Juny 2024

Sensory Characteristics of Salted Skipjack Tuna (*Katsuwonus pelamis*) with Different Salt Concentrations

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Received: May 28, 2024
Accepted: June 2, 2024
Available online: June 10, 2024

Abstract. *Salted fish is a food product made from fish meat preserved by adding a significant amount of salt. One processed product from skipjack tuna is salted fish. This study aims to determine the sensory characteristics of salted skipjack tuna with the addition of different salt concentrations. This research method involved adding salt at concentrations of 10%, 20%, 30%, and 40% by weight/weight using the dry salting method. The fish were cleaned, gutted, butterflied, and sprinkled with coarse salt. The fish were then stored in a container for 24 hours and sun-dried, and 30 untrained panellists will conduct the sensory evaluation. The analysis method used was descriptive. The sensory analysis results with salt additions of 10%, 20%, 30%, and 40% showed appearance scores of 6.16, 6.54, 7.82, and 7.51; aroma scores of 5.84, 6.72, 7.77, and 7.34; taste scores of 5.84, 6.72, 8.09, and 7.21; and texture scores of 5.84, 7.18, 8.15, and 7.51, respectively. The salted skipjack tuna with the highest scores was achieved with 30% salt addition, with appearance, aroma, taste, and texture scores of 7.82, 8.15, 8.09, and 8.15, respectively. The results indicate that increasing salt concentration can enhance the sensory values of salted fish.*
Keywords: *salted skipjack tuna, salt addition, sensory characteristics.*

1. INTRODUCTION

One of the significant fishery resources is skipjack tuna *(Katsuwonus pelamis)*, which has high economic value. Given its substantial potential in Indonesian waters, the prospect of skipjack tuna fisheries in Indonesia is quite promising. Skipjack tuna belongs to the small tuna group, often referred to as white tuna. It measures around 60 cm in length with a slightly larger and plumper body, and its back is dark blue with a purplish hue. The commonly found skipjack tuna in Indonesia is Katsuwonus pelamis.

Salted fish is one of the most straightforward traditional fish processing products. This product is made through a salting process with drying. During the drying process, the fish's moisture content is reduced to 20-35%, preventing the growth of spoilage microorganisms and thus preserving the fish for a certain period. Salted fish processing develops around fish production centres such as fish landing places, fish auctions, and fishery ports (Sipahutar et al., 2020). The quality of raw fish influences the quality of salted fish, the amount and purity of the salt used, and the drying process (Sipahutar & Siahaan, 2020).

Salting is an ancient preservation method still widely used today. Generally, two methods are used: dry salting and wet salting. Dry salting can be applied to both large and small fish. The dry salting method involves using salt crystals mixed with the fish to be preserved. Salt draws out water as it penetrates, causing protein denaturation. The meat becomes opaque and non-sticky and crumbles easily. During the salting process, salt penetrates the fish's body, and liquid is drawn out due to the

concentration difference. This liquid quickly dissolves the salt crystals or dilutes the salt solution. As the fluid exits the fish's body, salt particles enter the fish. Fish that undergo proper salting will have a high shelf life because salt inhibits or completely stops autolysis and kills bacteria within the fish.

Generally, large fish are gutted first and, if necessary, split to thin the meat, making it easier for salt to penetrate. In the salting process, the fish are placed in waterproof containers such as wooden or cemented brick vats. The fish are layered with salt in between. The amount of salt used typically ranges from 10-35% of the fish's weight. The amount of salt used affects consumer preference for appearance, taste, texture, and aroma.

According to Sipahutar et al. (2020), many Indonesians, especially those living along the coast, like salted fish because it is simple to process, passed down through generations, can be applied to all fish types, big or small, and can be stored for a long time. The downside of salted fish products is that they often look unattractive and taste too salty due to the uncertain amount of salt used. Salted fish processors still cannot determine the exact amount of salt to add during the salting process. Moreover, processing is individual, so the amount of added salt is based on personal preference. According to Purna et al. (2021), salted fish available in the market often taste too salty, have a white and rugged texture, and the skin surface usually has white spots. Mandeno & Palawe (2017) suggest that the varying taste and appearance of salted fish are due to the inconsistent amount of salt used.

This study aims to determine the sensory characteristics of skipjack tuna with different salt concentrations using the dry salting method, and increase the knowledge of people working in the field of fishery processing.

2. RESEARCH METHODS

This research was conducted from March to April 2022 at the Politeknik Ahli Usaha Perikanan in Jakarta, Pasar Minggu District, South Jakarta City. Sensory and chemical testing were performed in the Politeknik Ahli Usaha Perikanan Laboratory.

Materials

The raw material used was frozen skipjack tuna *(Katsuwonus pelamis*) with a weight of approximately 2-3 kg and a length of about 30-40 cm, stored in cold storage at the Teaching Factory of Politeknik AUP. The equipment used included knives, basins, cutting boards, buckets (soaking containers), drying trays, drying racks, assessment score sheets for frozen fish (National Standardization Agency 2014), and sensory assessment score sheets for dry salted fish SNI 8273:2016 (National Standardization Agency 2016).

Experimental Design

The study was conducted using an experimental method with a Randomized Block Design (RBD). The treatment involved different salt concentrations: 10%, 20%, 30%, and 40%, with three replications. Sensory evaluation of dry salted fish used the *Kruskal-Wallis* ranking test, followed by a comparative test to see if differences were found (Sugiyono, 2018).

Fish Salting Method

The fish salting method used was dry salting with added salt concentrations of 10%, 20%, 30%, and 40%. The skipjack tuna were gutted, washed, and then coated entirely with salt. The fish and salt were stored at room temperature (28°C) for 48 hours. The fish were then drained, placed on drying trays, and sun-dried for two to three days, depending on sunlight intensity.

Data Collection Method

Data collection was carried out through surveys using questionnaires. The assessment was conducted using a Likert scale with values ranging from 1 to 9. Six semi-trained panellists performed organoleptic testing, and sensory testing was conducted by 30 randomly selected semi-trained and untrained panellists (National Standardization Agency 2006). The obtained data were presented descriptively.

Organoleptic Testing of Raw Frozen Fish

Organoleptic testing of raw frozen fish was performed according to SNI 2696:2013. Observations in the frozen state included ice layer drying and discolouration, while observations during thawing included appearance, aroma, and texture (National Standardization Agency 2013).

Sensory Testing of Dry Salted Fish

Sensory testing of dry salted fish was conducted according to SNI 8273:2016, using parameters such as appearance, aroma, taste, texture, and fungi (National Standardization Agency 2016).

3. RESULTS AND DISCUSSION

Organoleptic Testing of Frozen Skipjack Tuna *(Katsuwonus pelamis)*

Organoleptic testing is a method based on the sensory process, which is a physio-psychological process or the recognition of human senses as the primary tool for measuring the acceptability of a product (Winiati et al., 2019). Organoleptic testing plays an essential role in determining the quality of

a product (National Standardization Agency, 2015). The organoleptic testing of frozen skipjack tuna follows the parameters of frozen fish and organoleptic testing results according to SNI 4110:2014, conducted on fish in a frozen and thawed state, as follows:

Table 1. Organoleptic Test Results of Frozen Skipjack Tuna

	Parameter	Score
Frozen	Ice Layered	7,67±0,52
	Drying	7,83±0,98
	Discoloration	7,67±0,52
Thawed	Appearance	7,67±0,52
	Odour	7,83±0,75
	Meat	7,67±0,52
	Texture	7,68±0,52

The organoleptic scores with overall parameters can be seen in Table 1. for the assessment of whole fish in a frozen state and after thawing. The frozen state assessment shows an appearance score of 7.67, with the specification of an uneven ice layer covering less than 30% of the surface. The drying score is 7.83, with the specification of surface drying covering less than 30% of the product. The discolouration score is 7.67, with the specification of colour changes covering less than 50% of the surface. This data showed that frozen skipjack tuna has not undergoing significant colour changing, which can be inferred from how the ice layer still clear, and the fish skin is not shrivelled. For standard sensory evaluation of fresh fish, attributes such as eye appearance, gill condition, body surface mucus, flesh colour and appearance, odour, and texture are scored on a scale ranging from 7 to 9.

The thawed state assessment shows an appearance score of 7.67 with the specification of a less bright surface. The odour score is 7.83, with the specification of a fresh odour leaning towards neutral. The meat score is 7.67, with the specification of slightly dull meat cuts. The texture score is 7.68, with the specification of slightly less compact and less elastic texture. The overall organoleptic testing result of the frozen raw fish material shows an average score of 7.68. This thawed state data indicates that the quality of this raw material still meets the requirements of SNI 4110:2014, which is an organoleptic score of 7 (National Standardization Agency, 2014).

The specifications for frozen fish are

- a somewhat bright appearance,
- a fresh odour that leans towards neutral, slightly bright meat cuts, and
- a somewhat compact and elastic texture.

Based on these results, the quality of whole frozen skipjack tuna is still suitable for further processing

According to Naiu et al. (2018), fish that are well-frozen and perfectly thawed can also be categorized as fresh fish because they have the same quality as freshly caught fish. In a previous study, Ma'roef et al. (2021) reported that the sensory score of frozen raw fish material used for canned fish was 8. According to Amru and Sipahutar (2022), the sensory score was 7.9 for frozen raw fish material used for frozen tuna loin. The conclusions from previous studies and the results obtained all meet the requirements set by SNI 4110:2014, which is a minimum score of 7, and can proceed with the production process.

Sensory Testing of Final Product of Salted Skipjack Tuna *(Katsuwonus pelamis)*

Sensory quality is a method of testing to assess the quality of products that have undergone processing, specifically for salted skipjack tuna. In using the sensory testing system, we use all five senses, starting with the sense of smell, sight, and touch (Tarwendah, 2017). Sensory evaluation is used as a tool to check the quality of food products related to process control on how the product is produced (Rahayu & Nurosiyah, 2019).

Table 2. Sensory Test Results of Salted Skipjack Tuna

Salt Concentration	Appearance	Odour	Taste	Texture	Fungi
10%	6.16 ± 0.74	5.84 ± 0.67	5.84 ±0.82	5.84 ± 1.34	9 ± 0
20%	6.54 ± 1.28	6.72 ± 0.81	6.72 ±0.74	7.18 ± 0.67	9 ± 0
30%	7.82 ± 0.56	7.77 ± 1.28	8.09 ±1.16	8.15 ±0.56	9 ± 0
40%	7.51 ± 0.83	7.34 ± 0.73	7.21 ±1.32	7.51 ±0.95	9 ± 0

Based on Table 2, the highest scores for salted skipjack tuna are at 30% salt concentration. The sensory scores show that appearance is 7.71, odour 7.77, taste 8.07, texture 8.15, and fungi 9. The discussion of the above parameters is as follows:

Appearance

The sensory score for appearance is a significant parameter in sensory testing because most consumers will choose a product based on its shape and appearance, which can be observed directly with the visual sense (Setyaningsih et al., 2010). Consumer acceptance of a product is not solely determined by appearance, but appearance will influence the consumer's decision to accept it. A product that is whole and appears good will be more attractive than a product that is not whole and appears less good (Winiati et al., 2019). Based on Table 2, the average sensory score for appearance ranges from 6.16 to 7.82. The highest appearance score is 7.82, with the addition of 30% salt, indicating bright, clean, and species-specific fish. The lowest appearance score is 6.16 with the addition of 10% salt, indicating dull salted fish with species-specific brightness. The above results show that the higher the salt concentration, the better the appearance of salted skipjack tuna. As the salt concentration increases, the water content in the fish decreases, making the fish meat more fragile.

According to Akbardianysyah et al. (2018), the appearance parameter of salted fish shows panellist acceptance scores ranging from 6.4 to 7.5, with a specification of 7.5 (clean, bright, species-specific). Sensory evaluation decreases as more salt is added to the soaking process. Similarly, Sipahutar et al. (2021) stated that the more salt added, the lower the appearance score. According to Kapoh et al. (2022), the longer the salting process and the higher the salt concentration, the lower the panellists' preference for salted fish. The higher the salt concentration, the more it affects the hedonic value of salted skipjack tuna (Sipahutar et al., 2022).

These sensory results are similar to a study conducted by Tuyu et al. (2014) on salted selar fish, with sensory scores ranging from 5.83 to 8.27. The results were also influenced by the water content, where the lower the water content in the salted fish product, the better the consumer acceptance of appearance. Tumbelaka et al. (2013) reported that salt concentrations (more than 20%) and longer salting times (more than three days) could make salted fish appear whiter due to excess salt crystals on the fish surface, reducing panellists' preference. According to Sirait et al. (2022), fish with a high salt concentration (up to 25%) use salt as a preservative, leading to appearance changes on the fish surface with fish meat shrinkage.

Odour

According to DeMan (2010), the odour of a product can be perceived by the nose and can be used to determine the delicacy and pleasantness of a food product. Food aroma is one of the crucial factors in determining acceptance of food products by forming volatile compound molecules inhaled by the sense of smell. Odour is determined mainly by the olfactory senses that ascertain the delicacy of food (Winarno, 2014).

Based on Table 2, it can be seen that the odour value of salted skipjack tuna ranges from 5.84 to 7.77. The highest odour value of 7.77 was obtained with the addition of 30% salt, with the specification of being clean, bright, and species-specific. The lowest odour value was obtained at a 10% concentration with a value of 5.84 and a dull specification. These results are due to the addition of salt, which reduces the water content in the salted fish product. As the water content in the fish meat decreases, the original fish odour (fishy smell) diminishes, and the odour resulting from the salt becomes apparent.

This study has similar results to another study done by Tuyu et al. (2014), where the sensory values ranged from 5.37 to 8.23. It was explained that the higher the concentration added, the higher the sensory value for odour. According to Ariyadhi et al. (2021), with the addition of salt, panellist acceptance of the odour of salted "sardinella" fish with values ranging from 7.8 to 8.3 will increase. Sipahutar et al. (2019) added that consumers tend to prefer freshly processed salted fish because the fish still has a specific type of odour, and there has been no physical deviation. According to Reo (2013), the concentration of the salt solution and the drying time can affect the odour value of salted "flying fish (*Decapterus spp.*)". The higher the salt concentration and the longer the drying process, the higher the odour value.

Taste

In general, taste consists of sweet, bitter, sour, and salty. Taste is a determining factor for consumer acceptance of food products. Taste is mainly assessed using the sense of taste or the tongue. Flavour is one of the determining factors for the level of preference for food products.

Based on Table 2, it can be seen that the taste value of salted skipjack tuna ranges from 5.84 to 8.09. The highest taste value of 8.09 was obtained with the addition of 30% salt, with the specification that the salted skipjack tuna tastes salty. The lowest taste value of 5.84 was obtained with the addition of 10% salt, with the specification of a salty taste and an additional taste. It can be concluded that the more salt is added, the saltier the resulting taste, which decreases consumer preference.

According to Riansyah et al. (2013), the addition of salt in the processing process will give a taste to the product. The process of protein hydrolysis into amino acids occurs during the

processing process, where amino acids will decompose into components that play a role in flavour formation. According to Thariq et al. (2014), the more salt added during the processing, the saltier the taste and the lower the taste value for consumer acceptance. This experiment's results are in line with Sirait Ariyadi et al. (2022), where the more salt added, the saltier the taste, resulting in a decrease in consumer preference.

Texture

Texture is a factor that affects consumer preference for food products. Texture can be assessed by feeling the food with the mouth or hands. A good texture will be soft, tender, and easily chewed, while a bad texture will be hard, tough, and difficult to chew.

Based on Table 2, it can be seen that the texture value of salted skipjack tuna ranges from 6.16 to 8.27. The highest texture value of 8.27 was obtained with the addition of 30% salt, with the specification of compact, solid, and flexible fish meat. The lowest texture value of 6.16 was obtained with the addition of 10% salt, with the specification of hard, tough, and less flexible fish meat. These results indicate that the higher the salt concentration given, the harder the texture of the fish meat. This outcome is due to the addition of salt, which can affect the panellist's assessment of the texture of salted skipjack tuna.

According to Agus & Malik (2018), the texture assessment of salted fish by consumers can be judged by the clean and bright colour, hardness, fragility, and compactness of the meat. The decrease in organoleptic value can be caused by bacterial activity due to tissue decomposition by enzymes, causing the texture to become damaged. Winarno (2014) sipahutar. This study is in line with Rahmani et al. (2007), where panellists' preference for the texture of salted snakehead fish tends to increase with increasing salt concentration. The best texture for salted fish is compact, flexible, and dry enough (Yuarni et al., 2018). According to Fahmi et al. (2015), the use of hygroscopic salt in salted fish causes the texture of the fish to become compact and solid because the salt content absorbs the water content in the fish's meat.

Fungi

Based on Table 2, it was found that the sensory result for fungi in salted skipjack tuna is 9. The addition of 10%, 20%, 30%, and 40% salt showed no fungi on the surface of salted skipjack tuna. In freshly sun-dried salted fish, there are no fungi on the surface of the fish meat. The presence of fungi on the surface of salted fish indicates that the salted fish has a high moisture content caused by reactions to the surrounding environment. The presence of fungi is due to humid air temperatures and less intense sunlight, which does not maximize the rate of water content, making the fish meat moist. Therefore, the abundance of water content in salted fish have a linear correlation to fungi growth.

4. CONCLUSION

The sensory quality characteristics of salted fish show that the addition of salt concentration used in the processing of salted fish will affect the improvement of sensory quality. Increasing the salt concentration can increase the sensory value up to 30%, and then, with the addition of 40% salt, the sensory value decreases, reducing consumer preference.

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