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Chemical and Microbiological Characteristics of Sei-Pindang Tuna Fish

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A B S T R A C T

Pindang is a fishery processing product that plays an important role in post-harvest activities. Pindang products have a relatively short shelf life, namely less than 2 days at room temperature. Smoking is a drying technique used to maintain the shelf life of fish by using wood fuel as a smoke producer. Pindang tuna that has undergone the smoking process is given the name Sei-Pindang Ikan Tongkol. The aim of this research is to determine the chemical and microbiological characteristics of Sei-Pindang Tuna Fish. The results showed that sei-pindang tuna had a water content of 44.69 ± 0.66%, histamine content of 11.88 ± 1.12 mg N/100 g, total volatile bases content of 43.23 ± 0.22 mg N/100 g and the total number of bacteria was 2.1 $x10^4$ ± 1.2 $x10^3$ cfu/g.

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INTRODUCTION

Apart from being the main source of food (nutrition), fish is a commodity that provides a livelihood for fishermen and fishery product processing businesses (Masrifah et al., 2015). Processing of fishery products is an important factor in post-harvest activities because fish is a perishable commodity. Fast and precise handling is very necessary to maintain the quality of fishery products that reach consumers in good quality. Fish processing processes and techniques that are well known to the public, both traditional and modern, are drying and smoking. In principle, screening is done to inhibit the growth of microorganisms or enzyme activity in the fish's body which can cause damage (Pandit, 2016).

Kusamba Village, Klungkung, Bali is the largest conservation center in Bali Province. This pindang center is capable of producing up to 20 tons of pindang every day. TPI Kusamba is a fish farming place that still uses simple equipment, pindang production is solely aimed at meeting the needs of the local market. Based on production data from the Kusamba Fish Farm (TPI), it was found that the total production of pindang in June 2018 reached 522,200 kg including tuna, tuna, lemuru, barramundi, and so on, with tuna occupying the highest position, namely 468,200 kg (Pandit and Permatananda, 2019). The finished pindang is only packaged using bamboo baskets, which is very lacking in terms of aesthetics and safety because it is unable to maintain the good quality of the pindang, especially at room temperature (Pandit,2018).

Fish pindang products have a relatively short shelf life, according to research results (Pandit, 2016). tuna fish pindang can only last less than 1 day if stored at room temperature. Therefore, there is a need for other techniques to extend the shelf life of Tongol fish pindang. This research is applied research that will be carried out by buyers to extend the shelf life and add added value and a distinctive smoke flavor that is different from the original pindang product. Tongkol fish pindang that is given the smoking treatment is given the name sei-pindang tuna. It is hoped that sei-pindang tuna can become a quality product and be able to compete in the global market.

THEORETICAL REVIEW

Smoking and Quality of Smoked Fish

The smoke process carried out by most Indonesian people still uses simple tools. Basically, the marinating process consists of a combination of boiling and salting processes to preserve fish, which is a food that rots easily. The boiling and salting process aims to stop or inhibit the growth of bacteria that play a role in the threatening process. The most commonly produced pindang product at the Fish Farm in Kusamba is Tongkol (Pandit & Permatananda, 2019). The panning process in Kusamba Village using bamboo baskets is identical to the saltwater panning process where the fish are arranged in a basket sprinkled with salt, then put into a boiling vessel made from a drum filled with water so that it is submerged, then weighted and boiled. The pindang is then removed and the boiling liquid is used again to boil the fish

with additional water so that the boiled fish remains submerged. This liquid is used for more than twice the boiling process (Pandit, 2016).

Fish that have been processed into pindang fish usually have a long shelf life. If stored properly. The main cause of the decline in the quality of pindang fish is storage techniques which are generally caused by fungi and bacteria due to oxidation. Another cause of the decline in the quality of pindang fish is if it is stored in a place or room with damp air. Pindang fish stored in such places will generally quickly become damaged due to mold, even though the pindang fish has been packed in wooden boxes, baskets or baskets. Therefore, the temperature of the room where pindang fish is stored needs to be monitored before storing it. The most ideal space for storing the preferred pindang fish is to store it in a room with a temperature of 5°C - 15°C and the shelf life of the pindang fish will last a long time (Pandit, 2016). The decrease in the quality of pindang fish can also be caused by poor packaging methods. Packaging that does not meet the Pemandangan Technology standards will greatly affect the quality of the pindang fish that is stored, even though the storage room meets the requirements because if this is not paid attention to, what will arise during the storage process are bacteria and fungi because the room is humid. Good packaging will also reduce damage due to handling that is too rough during the processing process and can also prevent dirt from causing the emergence of harmful substances. The use of 0.07 mm PE plastic packaging for 6 days of storage at room temperature can maintain the stability of the quality of pindang tuna (Pandit, 1997).

Fish Smoking

The results showed that differences in smoking methods and types of fish gave very significant differences ($P<0.01$) to the proximate values (protein, fat, water, ash content). The higher content of phenol, formal aldehyde and organic acids is when using a furnace. So it can be concluded that these two smoking methods and types of fish can be applied for fish smoking processing even though there are tendencies towards specific characteristics of the products produced in terms of appearance, smell, texture and taste (Swastawati et al., 2013). The results showed that there was a change in the organoleptic characteristics of fresh fish with a value of 6.93 ± 0.4 (characteristics: flat eyeballs, pink gill color, clear mucus, less bright flesh cuts, less type-specific odor, slightly soft texture). After traditional processing it became 6.98 ± 0.77 and with liquid smoke it became 7.77 ± 0.61 ($p<0.05$) with the characteristics of a shiny color, the specific smell of smoked fish was less strong, the specific taste of smoked fish was less strong, compact texture and no mold (Dan & Asap, 2018).

The process of smoking fish using smoking technology, produces smoked fish that is more hygienic from dust and flies flying around the fish smoker and the quality of the smoked fish is in accordance with the New Smoked Fish SNI SNI 2725: 2013 with the parameters of water content, fat content, ash content, pH, protein and for organoleptic tests the results of smoked fish regarding aroma, texture and taste were still liked by the panelists (Jantri Sirait & Balai, 2020). The results of the research show that the smoked fish processing process carried out by the community in Singa Village uses a hot smoking method which is carried out openly and has a short smoking time. The organoleptic quality of the raw material for skipjack tuna and yellowfin tuna after being purchased from the catcher/auctioneer and before processing has a value of 8.18, meaning the quality (very fresh) is in accordance with SNI 2729:2006, while the organoleptic quality of the raw material for skipjack tuna and yellowfin tuna after smoking has a value of 7.2, meaning quality (fresh) in accordance with SNI 2725:2013. Smoked skipjack and yellowfin tuna can only last 18 - 20 hours stored at room temperature, after that the product is no longer suitable for consumption (Utami et al., 2019).

The results achieved were as follows: there was an increase in the quality of smoked skipjack tuna through processing technology that met sanitation standards in a closed smoking room, as well as the product being vacuum packed in plastic and efficient use of smoking materials which also increased processor income through higher selling prices (Husen , 2018). The level of safety and quality of smoked fish can be seen from the results of organoleptic tests, phenol levels and Polycyclic Aromatic Hydrocarbon (PAH) levels. The water content of smoked catfish using the liquid smoke method meets SNI standards (60%), but for the smoking cabinet method it still exceeds 60%. Liquid smoke as a smoking method is considered safer than the smoking cabinet method because the benzo(a)pyrene content in the smoking cabinet method still exceeds the limit set by SNI (0.005 ppm). The results of testing smoked skipjack tuna using mangrove wood, coconut shell, and coconut fiber obtained significantly different scores on the variables of appearance, taste, color, texture and aroma (Ghazali et al., 2014).

The best treatment was with a concentration of 10% (v/v) redistilled rubber wood liquid smoke (K1) and a fish soaking time of 15 minutes (L2) with a total plate number value of 4.4×10^3 CFU/g on days 0 and 4.7×10^4 CFU/g on day 6, water content below 60% during storage and organoleptic properties in the form of an aroma score of 4.48 (neutral) and an overall acceptability score of 4.51 (neutral). The research results showed that the water content of smoked mackerel met SNI requirements for a 6 day storage period, namely below 60%. The ALT value of smoked mackerel meets SNI requirements on days 0 and 3 of

observation but no longer meets SNI requirements on day 6 of observation (Suroso et al., 2018).

METHODOLOGY

Research Location and Time

The research location will be carried out at the location of the tuna fish pindang entrepreneur in Kusamba Village, Klungkung Regency, Bali. The research period was carried out for 6 months from the time this proposal was approved for implementation. The location of this research was carried out at the Laboratory of the Faculty of Agriculture, Warmadewa University and the Fisheries Product Analysis Laboratory of the Bali Province Fisheries and Maritime Service.

Research Materials and Tools

The material used for this research was pindang cob produced by TPI Kusamba, with an average length of 26 cm and an average weight of 200 grams. The pindang product is guaranteed to be a new product produced that day, intact without defects, using fresh tuna. The tools used are styrofoam boxes for storing cob pindang products, organoleptic score sheets, electric scales, and polyethylene plastic. The number of repetitions for each treatment was 3 times. The parameters evaluated include chemical parameters such as histamine content, water content, total volatile bases content; microbiological parameters such as the number of bacteria.

Research Procedure

A total of 100 pindang products produced by TPI Kusamba will be sorted first. Pindang with an average length of 26 cm and weight of 200 grams, intact, without defects will be selected as research material, then the smoking process will be carried out using a smoke source from coffee wood. Each group contained 10 pindang tuna fish that had been weeded, cut open and smoked for 1 hour. The parameters evaluated include chemical parameters such as histamine content, water content, and total volatile bases content; microbiological parameters such as the number of bacteria.

RESEARCH RESULT

In this study, mackerel fish were given smoking treatment for 1 hour and then their chemical and microbiological characteristics were observed. The results of smoking pindang tuna or what is called sei-pindang tuna can be seen in Figure 1. The chemical and microbiological characteristics of sei-pindang tuna can be seen in Table 1.

Figure 1. Sei-Pindang Tuna Fish

Table 1. Water content (%), Total Microbes (cfu/gram), TVB Level and Histamine Level of Sei- Pindang Tuna Fish

Observation Parameters	**Sei-Pindang Tuna Fish**
Water content (%)	44.69±0.66
TVB levels (mg N/100g)	43.23±0.22
Histamine Levels (mg N/100g)	11.88±1.12
Total Microbe / Total Plate Count (cfu/g)	$2.1 \times 10^4 \pm 1.2 \times 10^3$

DISCUSSION

Water is an important component in food, all food ingredients contain water in varying amounts, both animal and vegetable foods. The water content in tuna fish meat is 69.40% (Sanger, 2010) while the water content in pindang fish is 67.8% (Hidayat et al.,2020).In this study, the sei-pindang water content of tuna was 44.69 ± 0.66%. Smoking is an effective method for drying fish, and it requires sufficient time for the heat to penetrate the fish muscles, resulting in the release of bound water and replacement of moisture with simultaneous absorption of salt. The level of dehydration resulting from prolonged processing of smoke also contributes to low water content (Kitts et al., 2022). During the drying process, the water content of the fish is lowered, resulting in

a product with reduced volume and higher solute concentration (Jayas, 2016). As the water content of the fish slowly decreases, the water in the flesh moves to the surface, causing the fish to lose its water content (Dewi & Widiyanto, 2021).

TVB (Total Volatile Base) is one of the parameters used to measure the freshness level of smoked fish (Bahrndorff et al., 2022)(Daeng et al, 2016)(Rahmi et al.,2021) The higher the TVB level in smoked fish, the lower the quality and freshness (Wally et al, 2015). The TVB-N value of smoked fish products should be less than 100 mgN/100 g (Palawe et al., 2020). TVB-N value in sei-pindang tunaamounting to 43.23 ± 0.22 mg N/100 g, which means that sei-pindang is still categorized as having good quality. The TVB content of pindang tuna fish was 52.13 mg N/100 g (Ariyani et al., 2004). El-Lahamy et al (2019) also stated that there was a decrease in the TVB-N value during the fumigation process. Decrease in Value of TVB-N due toThe fumigation process is because fumigation is a preservation technique that can reduce water activity (aw) so that it can inhibit microbial growth. If microbial growth is inhibited, there will be a decrease in protein degradation by microbes into more volatile products such as TVB-N (Ayeloja et al., 2020)(Bienkiewicz et al, 2022).

Histamine is a biologically active primary heterocyclic amine compound that is formed in the post mortem phase of Scombroid and non-Scombroid fish meat which contains a lot of free histidine (Korashy, & Farag, 2005). Histamine is formed through decarboxylation of the amino acid histidine by an exogenous decarboxylase enzyme produced by microbes in fish (Ndaw et al., 2007). Histamine is stable against heating and resistant to processing processes including canning processes (Mc Lauchin. Et al., 2005). Fish can contain toxic amounts of histamine without showing spoilage characteristics when observed using commonly used sensory parameters (Codex Alimentarius Commission. 2001). Lower histamine levels in fish are generally considered to be of better quality. According to a study, the quality standard for good fish is histamine levels lower than 10 mg/kg, while levels higher than 30 mg/kg indicate a decrease in quality (Satyadharma et al., 2022). Consumption of fish containing more than 100 mg/100 g of histamine can cause illness with cardiovascular symptoms (body spinning, urticaria, hypotension, and dizziness), gantroenteritis (stomach spasms, diarrhea, and vomiting), and neurological (pain and paraesthesiae) (Mc Lauchin. Et al., 2005). The histamine level of sei-pindang tuna fish was 11.88 ± 1.12 mg N/100g. This shows that tuna sei-pindang is safe for consumption. Tuna fish histamine levels are 21.1 mg N/100 g (Ariyani et al., 2004). Madejska et al., (2022) reported that smoked fish has lower histamine levels than fresh fish. Smoking fish can delay the formation of

histamine in fish products (Madejska et al.,2022). Consumption of fish containing more than 100 mg/100 g of histamine can cause illness with cardiovascular symptoms (body spinning, urticaria, hypotension, and dizziness), gantroenteritis (stomach spasms, diarrhea, and vomiting), and neurological (pain and paraesthesiae) (Mc Lauchin. Et al., 2005). The histamine level of sei-pindang tuna fish was 11.88 ± 1.12 mg N/100g. This shows that tuna sei-pindang is safe for consumption. Tuna fish histamine levels are 21.1 mg N/100 g (Ariyani et al., 2004).

The smoking process is a fish preservation technique by reducing water activity (aw) so that microbial growth can be inhibited (Bahrndorff. Et al., 2022) The higher the water content in fish products, the higher the number of microorganisms that can grow (Daeng et al., 2016)(Rahmi et al., 2021). Based on SNI 7388:2009, the maximum limit for microbial contamination in smoked fish is $5.0x10^5$ colonies/gram. Therefore, sei-pindang tuna meets SNI.

CONCLUSIONS AND RECOMMENDATIONS

Based on the research results, it can be concluded that the chemical and microbiological characteristics of sei-pindang tuna fish are as follows: water content is 44.69 ± 0.66%, histamine content is 11.88 ± 1.12 mg N/100 g, total volatile bases content is 43.23 ± 0, 22 mg N/100 g and the total number of bacteria was 2.1 x104 ± 1.2 x103 cfu/g.

ADVANCED RESEARCH

The author suggests using smoking techniques to preserve pindang fish. Smoked fish has a lower water content so it has a longer shelf life without reducing its nutritional content.

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