Effect of cooking process on the characteristics of *pindang* loin produced from mackerel tuna fish (*Euthynnus affinis*)

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**Abstract.** This research aims to determine the chemical and physical characteristics of *pindang* loin from mackerel tuna fish (*Euthynnus affinis*) produced from the different cooking processes. The cooking process of *pindang* loin was by boiling and steaming respectively at 100 °C for 15 and 30 minutes. As much as 10, 20, and 30% of salt were added during the boiling water. In the steaming process, mackerel tuna loin was immersed in salt solution of 10, 20, and 30% for 30 minutes at the ratio of 1:4 (w/v) then drained at room temperature for ±15 minutes. Observation parameters are proximate composition, salinity, hardness texture, and sensory analysis with descriptive tests. Boiling and steaming process for 15 minutes and 30 minutes, respectively, affected water content, salt content, sensory characteristics, and hardness texture. Properties of *Pindang* loin cooking process with the larger salt concentration in the longer time (30 minutes) tend to produce harder texture than 15 minutes. *Pindang* loin produced from boiling 15 minutes with a salt concentration of 10% produces a protein content of 28.89% with a moisture content of 69.24% can produce a hardness texture of 5532.27 g. Also, it can produce sensory characteristics with an intact appearance, some parts are slightly cracked, the texture is dense and not sticky, light brown colour, the specific aroma of *pindang* and savoury taste.

**1. Introduction**

Mackerel tuna fish (*Euthynnus affinis*) is one type of pelagic fish obtained from catching fisheries in almost all water areas in Indonesia. The volume of production for Indonesia fisheries tends to increases every year, from 2014 to 2017 with a range from 6,037,654 to 6,424,114 tons. Most of the catching fisheries production is obtained by types of pelagic fish, one of which is mackerel tuna fish [6]. Most of the pelagic fish produced in Indonesian waters are tuna, mackerel tuna, and skipjack which are almost obtained in large sizes (> 1 - 2 kg/fish), and small pelagic fish such as baby tuna and *layang* fish. Tuna and skipjack are export commodities in the fisheries sector, while mackerel tuna and small pelagic fish are generally marketed fresh and some are marketed in Java in form of traditional products like as *pindang*. *Pindang* is one of the traditional processed fish products that has long developed. The largest producers of *pindang* fish are in Java (68.43%), other areas in Sumatra (15.34%), Bali and Nusa...
Tenggara (12.25%), Sulawesi Island (3.39%), and Kalimantan Island (0.04%). It shows that pindang fish are a very favorite fish product in almost all regions of Indonesia.

The processing of traditional pindang fish products aims to minimize of fish preservation process by cold chain by using ice or use of cold storage. This is due to limited ice supplies or ice block factories in fish landing bases in several areas in Indonesia. Pindang process is one of the traditional fish preservation techniques that have long been known to the public, which generally uses salt treatment and high temperatures cooking [7]. Salt treatment with high salt concentration functions as a fish preservative but can provide a strong salty taste and is not good for health. Pindang loin from mackerel tuna fish processing innovation by using low salt content in the form of loin can be an alternative to market pindang fish in the modern market. This can also increase the variety of local fish products to further increase the selling value of pindang fish in the domestic market.

In this study, the process of pindang loin from mackerel tuna fish is carried out by treatment in different salt concentrations and cooking processes (boiling and steaming). The purpose of this study is to determine the characteristics of pindang loin from mackerel tuna fish obtained from different salt concentrations and cooking processes.

2. Materials and Methods

2.1. Preparation of pindang loin from mackerel tuna fish.
The freshly frozen Mackerel tuna fish was obtained from the fish landing bases in Muara Baru Jakarta. The mackerel tuna fish was thawed at room temperature, followed by the washing process (include in removing the stomach and head contents) and the filleting process until the loin fillet from mackerel tuna fish was obtained. The washing process was conducted by using ice water and draining at room temperature. Fillet loins were processed into pindang through the salting and cooking processes in different concentrations and times treatments as follows [7].

During the boiling process, the Mackerel tuna loin was placed in a bamboo basket (Naya) in a boiling pan containing salt solution (10, 20, and 30%). The boiling process was carried out at 100 °C for 15 and 30 minutes, then drained at room temperature. Then, in the steaming process, mackerel tuna loin was immersed in a salt solution of 10, 20, and 30% for 30 minutes with a ratio of 1: 4 (w / v), then drained at room temperature for ± 15 minutes. Mackerel tuna loin steaming was carried out at 100 °C for 15 and 30 minutes and drained at room temperature.

These treatments result in pindang loin from mackerel tuna fish with sample code are R10a (boiling with a salt concentration of 10% for 15 minutes), R20a (boiling with a salt concentration of 20% for 15 minutes), R30a (boiling with a salt concentration of 30% for 15 minutes), R10b (boiling with a salt concentration of 10% for 30 minutes), R20b (boiling with a salt concentration of 20% for 30 minutes), R30b (boiling with a salt concentration of 30% for 30 minutes), K10a (steaming with a salt concentration of 10% for 15 minutes), K20a (steaming with a salt concentration of 20% for 15 minutes) and K30a (steaming with a salt concentration of 30% for 15 minutes), K10b (steaming with a salt concentration of 10% for 30 minutes), K20b (steaming with salt concentration of 20% for 3- minutes) and K30b (steaming with a salt concentration of 30% for 30 minutes).

2.2. Observation of parameters
The observation of parameters is proximate, salt content, hardness texture, and sensory testing by using descriptive tests.

2.2.1. Proximate analysis
The proximate analysis includes moisture, ash, protein, and fat contents based on Chemical analysis of fisheries products were published by BSN [1].
2.2.2. **Salt content analysis**

From the ash content, the sample was diluted into 50 ml flask with distilled water and a 10 ml solution is put into a 100 ml Erlenmeyer flask. Then, added 12.5 ml of 0.1 N AgNO\(_3\) and 3 drops of the NH\(_4\)FeSC\(_4\) indicator then titration with KCNS 0.1 N obtained a brick-red precipitate. Salt content is calculated by equation [2].

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NaCl = \frac{58.45 \times (A - B) \times C}{1000 \times D} \times 100\% 
\]

Note: 
- \(A\) = volume of blank titration (ml)
- \(B\) = volume of sample titration (ml)
- \(C\) = normality of KCNS
- \(D\) = sample weight (gr)

2.2.3. **Hardness texture analysis**

Measurement of hardness texture uses the TATX Texture Analyzer with A/TG probe and a test speed of 3 mm/sec, the distance of 30 mm with a load cell of 5 kg.

2.2.4. **Descriptive sensory test analysis**

The sensory description test uses 6 trained panelists by observing the *pindang* loin sample from mackerel tuna fish including its stability for texture, aroma and taste. The test results are presented in the form of a narrative description.

2.2.5. **Data analysis**

The results of measurement for proximate composition, salt content, hardness texture from three replicates treatment were statistically analysed using ANOVA (One-way Analysis of Variance) at a 5% level of significance.

3. **Results and Discussion**

Proximate compositions of *pindang* loin obtained from boiling and steaming treatment at salt concentrations of 10, 20, and 30% are presented in Table 1 and Table 2. The proximate composition indicates nutrition contents like protein, fat, and mineral in ash content. The highest moisture content is 69.19% in the boiling treatment method for 15 minutes with a salt concentration of 10%, while the lowest moisture 64.38% of the steaming treatment for 30 minutes with a salt concentration of 10%. Ash content of *pindang* loin tends to increase with the higher salt concentration used in the boiling process within 15 minutes and 30 minutes. The highest protein content in the sample from the steaming process for 30 minutes at 10% salt concentration was 30.74%. Table 1 shows the protein content of *pindang* loin from the boiling and steaming cooking process for 15 minutes with range 28.01 - 28.89%, which in protein content of the steaming process is lower than in boiling process. However, in 30 minutes of boiling and steaming cooking process, the protein content is not significantly different within a range between 28.81 - 30.74%. The boiling process could increase the interaction between protein molecules and water in which the hydrophilic amino acids bind with water molecules directly to form a strong molecular connective network. It causes some minerals and fat trapped in it. There is still the content of ash and fat in the *pindang* loin.

Table 2 shows salt content produced from *pindang* loin by boiling for 15 minutes and 30 minutes at a salt concentration of 10%, 20%, and 30% are significantly different (\(p<0.05\)), while by steaming process are not significantly different. The use of higher salt concentration can reduce moisture content and increase the salt content of *pindang* loin. The highest salt content is 4.04% in the boiling process for 15 minutes with a salt concentration of 30%, while the lowest salt content is 0.89% at the steaming process for 30 minutes with a salt concentration of 10%.
Salt is one of the food ingredients which has multi-functional widely used in meat processing because of its low cost and diverse technological properties. Salt plays a key role in processing meat products to prevent spoilage, to confer characteristic flavor and create the desired texture, to solubilize myofibrillar proteins, and to enhance adhesion and cohesiveness. Due to these essential functions of NaCl in processed meats, the reformulation of these products to reduce the content of salt must be carefully considered to avoid a negative impact on their shelf life and their sensory quality [8].

**Table 1.** Proximate composition of *pindang* loin produced from mackerel tuna fish for 15 minutes and 30 minutes cooking process.

| Times   | Sample | Moisture (%) | Ash (%)       | Protein (%)  | Fat (%)   |
|---------|--------|--------------|---------------|--------------|-----------|
| 15 minutes | R10a  | 69.24±0.51b  | 2.81±0.09ab   | 28.89±0.46b  | 0.83±0.26a |
|         | R20a  | 66.20±2.14a  | 4.46±0.51bc   | 29.73±0.89b  | 0.77±0.27a |
|         | R30a  | 65.93±2.55a  | 5.09±2.09c    | 29.50±0.71b  | 0.80±0.15a |
|         | K10a  | 68.89±0.45b  | 2.15±0.31a    | 28.20±0.33a  | 0.92±0.36a |
|         | K20a  | 68.84±0.25b  | 2.67±0.33ab   | 28.01±0.31a  | 0.98±0.28a |
|         | K30a  | 69.07±0.68b  | 2.09±0.44a    | 28.17±0.45a  | 0.95±0.24a |
| 30 minutes | R10b  | 67.33±1.36b  | 3.42±0.57a    | 29.51±0.72ab | 0.88±0.13a |
|         | R20b  | 67.82±1.23b  | 5.41±0.27b    | 29.35±0.31ab | 0.88±0.43a |
|         | R30b  | 67.68±2.08a  | 7.33±2.00c    | 29.73±0.17b  | 1.40±0.12a |
|         | K10b  | 64.38±0.60a  | 1.66±0.65a    | 30.74±0.53c  | 0.79±0.18a |
|         | K20b  | 67.49±1.16b  | 3.09±0.52a    | 29.15±0.47a  | 0.81±0.06a |
|         | K30b  | 68.62±0.35b  | 2.37±0.33a    | 28.81±0.30a  | 0.75±0.24a |

**Table 2.** Salt content and hardness texture of *pindang* loin from mackerel tuna fish.

| Times   | Sample | Salt content (%) | Hardness (g)   |
|---------|--------|-----------------|---------------|
| 15 minutes | R10a  | 1.72 ± 0.29a   | 5532.27±69.38a|
|         | R20a  | 2.84± 1.14b    | 7039.61±69.55b|
|         | R30a  | 4.04± 2.75c    | 7365.35±55.17c|
|         | K10a  | 0.89± 0.26a    | 8029.30±61.21d|
|         | K20a  | 1.27± 0.36a    | 8191.26±45.66e|
|         | K30a  | 1.51± 0.43a    | 9669.76±56.96f|
| 30 minutes | R10b  | 1.71± 0.29a    | 9200.33±39.92c|
|         | R20b  | 1.68± 0.57a    | 9417.47±28.87d|
|         | R30b  | 2.68± 1.73b    | 10139.55±50.63e|
|         | K10b  | 0.92± 0.28a    | 8126.27±57.73a|
|         | K20b  | 1.60± 0.56a    | 9009.79±90.48b|
|         | K30b  | 1.99± 0.64a    | 10073.43±65.35c|

Texture characteristics of *pindang* loin produced by boiling and steaming process with concentrations of 10%, 20%, and 30% can be seen from hardness by using the TA-XT Texture Analyzer which is presented in Table 3. The highest hardness texture value is 10073.43 g produced from *pindang* loin at the steaming process for 30 minutes and salt concentration of 30%, while the lowest hardness *pindang* loin is 5532.27 g produced from boiling process for 15 minutes with a salt concentration of 10%. 

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1. **Table**: Proximate composition of *pindang* loin produced from mackerel tuna fish for 15 minutes and 30 minutes cooking process.
2. **Table**: Salt content and hardness texture of *pindang* loin from mackerel tuna fish.
3. **Table**: Texture characteristics of *pindang* loin produced by boiling and steaming process with concentrations of 10%, 20%, and 30%.
The cooking process of *pindang* loin with a high salt concentration in a longer time (30 minutes) tends to produce a harder texture than in shorter times (15 minutes). The salt treatment in the cooking process of *pindang* loin can break the bonds in folding protein molecules into form unfolding molecule structure and bind water molecules during the cooking process. Protein in fish meat also can break caused in water distribution during the cooking process and form a compact microstructure of meat. The salt molecule distribution in form of Na and Cl in the matrix molecule of meat further demonstrated sensory analysis result is saltier. This research provided a new approach to reduce salt consumption in fish cooking for home cooking or the food industry [10]. Furthermore, that salt reduction unfavorably affected the texture of meat products like hams [5] and frankfurters [4], or resulted in a reduced salty taste and less intense colour in salami [3].

Based on the results of the sensory descriptive test (Table 3), the greater salt concentration and the longer time it takes to process the *pindang* loin, results in the denser texture tends to hardness in each cooking process (boiling and steaming). Many nutrients are involved compound of the aromatic that are volatile and give a flavour in meat which contribute to the development of taste and aroma during cooking [9].

| Sample | Descriptive sensory |
|--------|---------------------|
| R10A   | Appearance is intact, some parts are slightly cracked, **texture is dense and not sticky**, light brown colour, specific aroma of *pindang*, savoury taste |
| R20A   | Appearance is intact, some parts are slightly cracked, **texture is dense and not sticky**, light brown colour, specific aroma of *pindang*, salty taste |
| R30A   | Appearance is intact, some parts are slightly cracked, **texture is dense tends to hard and not sticky**, light brown colour, specific aroma of *pindang*, very salty taste |
| R10B   | Appearance is intact, some parts are slightly cracked, **texture is dense and not sticky**, the colour is slightly pale brown, has a specific aroma, savoury taste |
| R20B   | Appearance is intact, some parts are slightly cracked, **texture is dense tends to hard and not sticky**, the colour is slightly pale brown, has a specific aroma, salty taste |
| R30B   | Appearance is intact, some parts are slightly cracked, **texture is dense tends to hard and not sticky**, the colour is slightly pale brown, has a specific aroma, salty taste |
| K10A   | Appearance is intact, some parts are slightly cracked, **texture is rather dense** and not sticky, light brown colour, specific aroma of *pindang*, savoury taste |
| K20A   | Appearance is intact, some parts are slightly cracked, **texture is rather dense** and not sticky, light brown colour, specific aroma of *pindang*, salty taste |
| K30A   | Appearance is intact, some parts are slightly cracked, **texture is dense tends to hard and not sticky**, light brown colour, specific aroma of *pindang*, very salty taste |
| K10B   | Appearance is intact, some parts are slightly cracked, **texture is dense and not sticky**, the colour is slightly pale brown, has a specific aroma, savoury taste |
| K20B   | Appearance is intact, some parts are slightly cracked, **texture is dense tends to hard and not sticky**, the colour is slightly pale brown, has a specific aroma, salty taste |
| K30B   | Appearance is intact, some parts are slightly cracked, **texture is dense tends to hard and not sticky**, the colour is slightly pale brown, has a specific aroma, very salty taste |

4. Conclusions

The cooking process from boiling and steaming with different salt concentrations can produce different characteristics of *pindang* loin in terms of nutrient and salt content, different sensory characteristics, and hardness textures. The cooking process from boiling for 15 minutes at a salt concentration of 10% is the best treatment that can produce a texture of hardness that is not large as 5532.27 g. Also, it can produce sensory characteristics with an intact appearance. Some parts are slightly cracked, the texture is dense
and not sticky, light brown colour, the specific aroma of *pindang*, savoury taste. The protein nutritional content of *pindang* loin is 28.89% with a 69.24% moisture content which is not different from other treatments.

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