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Chemical characteristics of tuna fish bakasang

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Abstract. Fish viscera are wastes produced by fish processing that have high potential as sources of biomolecules such as proteins and lipids. One of the fermented products in Indonesia that uses fish viscera as its raw material is bakasang. This study aims to determine the content the chemical characteristics of bakasang made from Tuna fish viscera under various fermentation condition. The chemical characteristics assessed included free fatty acid (FFA), peroxide value (PV), and thiobarbituric acid (TBA, which is expressed in malondialdehyde/MDA) of the bakasang product. Tuna (*Thunnus* sp.) fish viscera were fermented under the following conditions: temperature 50 and 70°C, for 10 and 15 days with the addition of 20 and 30%. The results showed that tuna fish bakasang processed at a temperature of 50-70°C with salt content of 20-30%, had the following chemical characteristics: FFA = 3.8-4.4%, PV = 2.8-10.5%, MDA = 0.35-1.15 g / 100g sample. These results indicated that bakasang tuna fish processed under the above conditions have good chemical characteristics.

Keywords: bakasang, fermented fish sauce, malondialdehyde, thiobarbituric acid, salt concentration, tuna

1. Introduction

Tuna has high protein (22.6 - 26.2 g/100 g) and low fat content (0.2 - 2.7 g / 100 g) . Furthermore, tuna is rich in calcium, phosphorus, iron, sodium, vitamin A (retinol), and vitamin B (thiamin, riboflavin thiamin, riboflavin and niacin)[1].

Bakasang, a fermented fish viscera sauce, is classified as a spontaneous fermentation, because in its production, it does not require microbial or carbohydrate starters [2] Fermented products made by adding high levels of salt cannot be used as a source of protein because. Therefore, the amount that can be consumed is limited due to its high of saltiness. Such products are usually used only as food stimulants, flavoring food or seasonings [3]. The fishes that can be used for fermentation are cakalang (*Katsuwonus pelamis*) (Fatimah et al., 2017), anchovies (*Stolephorus* sp.), sardines (*Sardinella* sp.), mackerel (*Rastrellinger* sp.), gambusia (*Affinis affinis*), Pacific whiting (*Merluccius* sp.) and other low value fish species [4].



Bakasang is made with different formulations and processing techniques, for example in the ratio of fish-water, salt content, the use of yeast / enzymes, addition of seasonings, storage time, and temperature. Fish sauce fermentation process in Japan uses ratio fish : water = 3 : 1, with 15% salt, room temperature storage and 16% *Aspergillus oryza* [5]. The results of Bahlawan's [2] study (2011) showed that there was a significant influence of salt concentration and storage time on the quality of bakasang. Sabour and Moini [6] (2009) use 20% of *Caspian kilka* in their fermentation. Desniar et al. [7] (2009) reported the increase in salt content from 30 to 50% that in fermented peda fish produced different flavor. Fermented product with a salt concentration of 30% was preferred over 50%.

One of the chemical parameters to understand the quality of bakasang is rancidity. Rancidity can be caused by the results of hydrolysis reactions and oxidation of fish oil in bakasang. Hasan et al. [8] (2014), stated that damage to fish with salting treatment was mostly caused by fat oxidation which resulted in rancid fish, especially in high-fat fish. Oxidation reactions also run faster if the storage temperature is high enough. The purpose of this study was to determine the chemical characteristics of bakasang made from tuna viscera under several processing conditions.

2. Materials and Methods

The fermentation procedure follows the method carried out by Fatimah et al.[9] (2017). The viscera of fresh tuna (*Thunnus* sp.) were bought from a smoked tuna processing house at North Minahasa Regency. The viscera consisted of liver, intestines, heart and eggs. The viscera were washed with running tap water, dried, and cut into smaller parts (± 1 cm). Approximately 250 g of the materials were put in the fermentor, covered with various concentration of salt (20% [s1] and 30% [s2]). The fermentor lids were closed tightly and the fermentation process was carried out at various temperature (50oC [T1] and 70oC [T2] and various fermentation time (10 days [D1] and 15 days [D2]). The fermentors were shaken once a day during the experiment. The samples were taken on the first, tenth, and fifteenth days for analysis. All samples were analyzed three times. Only two closest values of the replications which were used for statistical analysis.

The chemical parameters analyzed were free fatty acid (FFA), peroxide value (PV), and thiobarbituric acid (MDA). Peroxide value and free fatty acid were determined base on AOCS[10] (1989). The FFA content was calculated as percentage of Eicosa-5,8,11,14,17-pentaenoic acid (EPA). Thiobarbituric acid (TBA) value was determined in accordance with the TBA distillation method described by Lynch and Frei (1993).The TBA or TBARS values were expressed in mg of malondialdehyde (MDA)/kg bakasang. Absorbance was measured using spectrophotometer (Shimadzu UV-1800 Serial No. A116351).

One-way Anova was used to analyse the results. The least significant difference (LSD) test was conducted if there were significant differences among the groups. All statistical analyses were carried out using the statistical software SAS (University Edition). The level of significance was set at α level of 0.05, $p < 0.05$. All values were presented as mean+standard deviation (SD) and statistical significance is indicated with appropriate letters on the data tables.

3. Results and Discussion

3.1. Free Fatty Acid content

Figure 1 shows that the FFA content of tuna bakasang increases along with the increasing fermentation time and temperature, but decreases at higher salt concentrations. This is in line with research conducted by Fatimah et al. [9] (2017), who stated that the FFA content decreased along with the increasing salt content.

According to Sutiah et al.[11] (2008), the storage in a certain period of time can cause the rupture of triglyceride bonds in oil and form glycerol and free fatty acids. Khoddami et al.[12] (2009) reported that the higher the temperature, the faster the formation of free radicals and free fatty acids. Free fatty acids can stimulate lipid oxidation and this condition can induce an increase in off-flavor content in the

final product. Based on the standards set in IFOMA[13] (1998), the good free fatty acid content in coarse fish oil is 1-7%, but in certain industries the standard of free fatty acid content is 2-5%.

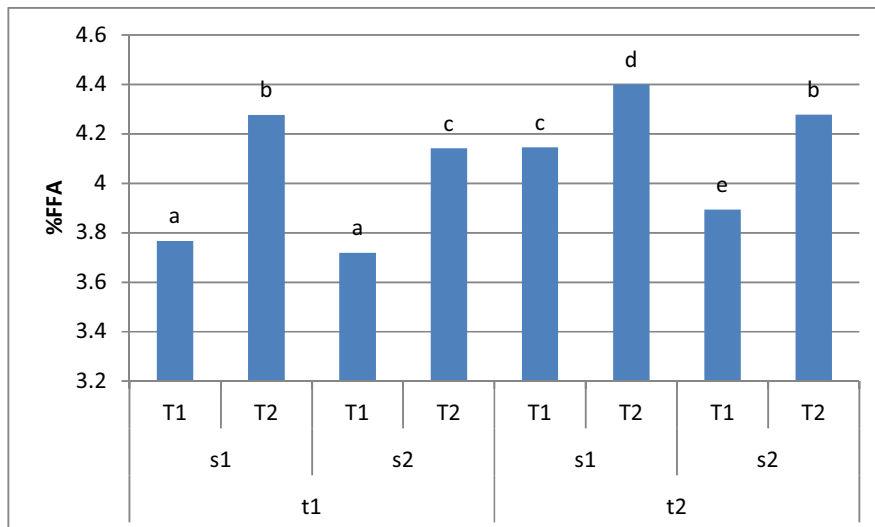


Figure 1. The free fatty acid (FFA) content of tuna bakasang fermented for 10 days (t1) and 15 days (t2), at 50°C (T1) and 70°C (T2), with 20% (s1) and 30% (s2) salts concentration Results with same superscript are not significantly different (P <0.05).

3.2. Peroxide Value

Peroxide value is a number that determines the degree of damage of oil. Oils that contain unsaturated fatty acids can bind oxygen to form peroxides. The peroxide number of tuna bakasang tuna is shown in Fig. 2.

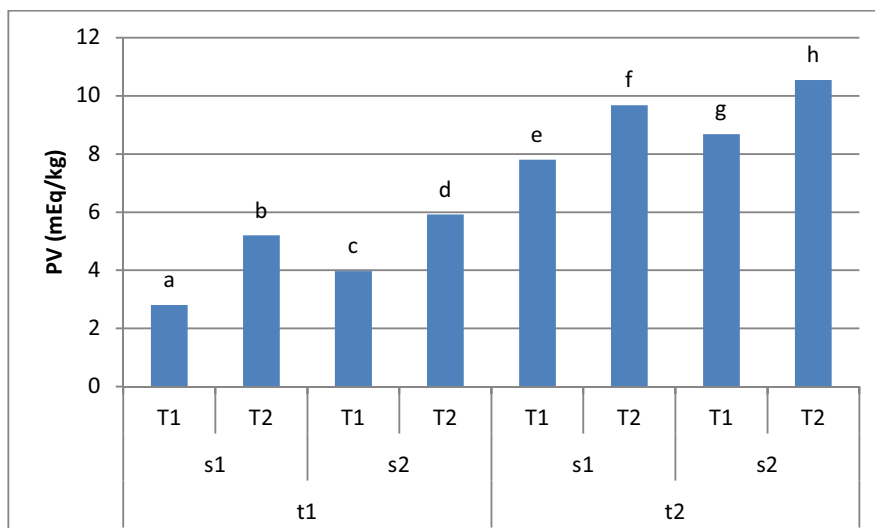


Figure 2. The peroxide value (PV) of tuna bakasang fermented for 10 days (t1) and 15 days (t2), at 50°C (T1) and 70°C (T2), with 20% (s1) and 30% (s2) salts concentration. Results with same superscript are not significantly different (P <0.05).

Peroxide value (PV) was used as measurement of oxidation. In this study, the higher the temperature and the longer duration of fermentation, the greater the peroxide value. This is in line with Husain et al.[14], (2016) that tuna fish oil peroxide (*Thunnus* sp.) increased with the increase of the storage temperature. According to Pak[15] (2005), the peroxide number is an indicator of the stability of oil against oxidation.. Lipid oxidation in tuna is easy to occur, because tuna fish oil is rich in polyunsaturated fatty acids (PUFAs). The increase of salt content can increase peroxide number. According to Raharjo[16] (2004) salt is thought to play a role in catalyzing oxidation through lipoxidase activity. According to the International Fishmeal and Oil Manufacturers Association (IFOMA), the standard peroxide number is 3-25 meq / kg sample. Based on the research data above, the peroxide value of the tuna bakasang passed the predetermined standard.

3.3. Thiobarbituric Acid value

As shown in Fig. 3, the increase in fermentation time, temperature and salting caused the TBA value to increase, where the highest TBA value was in 15 days fermentation time, 70°C temperature, 30% salt content with a value of 1.1528 mg malondialdehyde/kg sample. Conversely, the lowest TBA value is 10 days fermentation time, 50°C temperature, 20% salt content with a value of 0.3261 mg malondialdehyde kg sample. Components of poly unsaturated fatty acids (PUFAs) which are high enough in fish fat are very sensitive to damage caused by the oxidation process. Based on the results of the study, the greater the salt content, the greater the value of TBA. The rancidity induced by salt can also be related to salt impurity because it is mixed with a small amount of metal. According to Boran et al[17] (2006), the good number of TBA for fish oil is 7-8 mg of malondialdehyde/kg sample. Based on this statement, it can be concluded that tuna bakasang with 10 and 15 days fermentation time, 50°C and 70°C temperature, 20% and 30% salt content are still safe because it did not exceed the established standards.

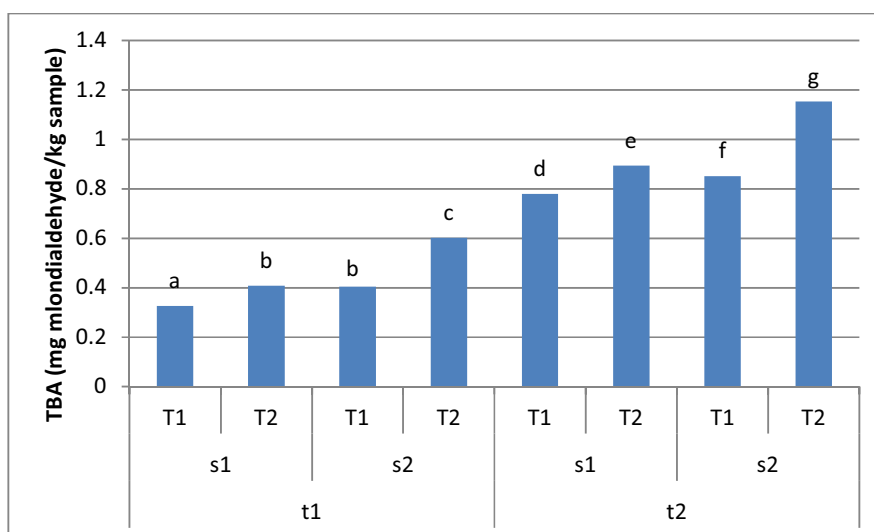


Figure 3. Thiobarbituric Acid value (TBA) value of of tuna bakasang fermented for 10 days (t1) and 15 days (t2), at 50°C (T1) and 70°C (T2), with 20% (s1) and 30% (s2) salts concentration .Results with same superscript are not significantly different ($P < 0.05$).

4. Conclusion

The results of this study showed that the chemical characteristics of bakasang processed under various condition of fermentation time, temperature, and salt content still within the range of values allowed in accordance with existing standards for FFA, MDA, and PV values. Based of these results,

the above processing conditions can be used as a reference for the fermentation process to obtain quality tuna bakasang that can be used as an additive for cooking and food.

Acknowledgement

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