



The Effect of Pineapple Extract (*Ananas comosus* L) on the Quality of Anchovy Fish Sauce

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This research aims to determine the appropriate concentration of pineapple extract to produce anchovy fish sauce with quality that is by the Indonesian National Standard (SNI). The research was conducted from June to September 2021. This research used an experimental method with 4 additional treatments of pineapple extract concentrate, that is 0%, 10%, 15%, 20%. Each treatment used three replications. Observations were made by chemical tests for protein, fat, ash, water and pH levels. The results showed that each treatment had a significantly different effect on the levels of protein, fat, water, ash and the pH value of fish sauce. The treatment according to the Indonesian National Standard (SNI) was the addition of 10% pineapple extract with an average protein value of 15.88%.

Keywords: Anchovy; pineapple extract; fish sauce quality; chemical quality.

1. INTRODUCTION

Anchovy (*Stolephorus* sp.) is a type of small pelagic fish. Anchovy production in Indonesia in

2020 is obtained from the Riau Islands with a production volume of 54,875.85 tons [1]. Anchovy is one of the high-quality foods because all parts of its body can be consumed.

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Anchovy is good for health because it contains calcium and phosphorus for bone and tooth tissue [2]. Anchovy can be processed into various foods such as peyek, pepes and chili sauce.

One processed anchovy products that can be stored for a long time is fish sauce. Fish sauce is a food product that is processed through fermentation made from fish as well as fish waste and salt [3]. Fish sauce is generally made with a high salt content of more than 30%. The use of high salt content in fish sauce causes it to taste very salty and has a distinctive odor and long shelf life [4]. In Indonesia, fish sauce is used as a spice in cooking. There is no statistical data regarding the demand or need for fish sauce products, but what is certain is that there is always a demand or need for this product. Judging from the use of fish sauce in various food menus, the level and development of demand for fish sauce is comparable to the development of the catering industry, restaurant/hotel and household consumption [5]. Making fish sauce traditionally requires a fermentation time of 4 to 12 months [6]. The long process of making fish sauce is a weakness, so it is necessary to have an alternative to speed up the process. The fermentation process in making fish sauce can be accelerated by using enzymes [7].

The enzyme that can accelerate the manufacture of fish sauce is the bromelain enzyme. Bromelain enzyme is one of the proteolytic enzymes that play a role in protein breakdown, producing peptides or amino acids that can increase soluble protein levels [8]. Efforts to accelerate the process of protein hydrolysis in fish meat are mostly done by adding proteolytic enzymes from pineapple extract [9]. The extracts obtained in this study came from ripe pineapples, ripe pineapples besides having the enzyme bromelain also contain sugar, vitamin A, vitamin B, citric acid and malic acid [10]. The action of bromelain enzymes is influenced by pH and temperature [11]. The bromelain enzyme activity in pineapple is in the pH range of 7-8 and a temperature of 50-60°C and is inactive at 80°C [12]. The use of enzymes in fish sauce must pay attention to the quality it produces so that the nutrition of fish sauce can be measured

Measurement of the quality of fish sauce in the Indonesian National Standard (SNI 01-4271-1996) includes pH level and amount of amino

nitrogen according to Indonesian standards a good fish sauce that has a pH of 5-6 and an amino nitrogen content of at least 5% [13]. The quality test of fish sauce in this research included measurements of fat content, water and ash as a development step from previous research. Based on the description above, it is necessary to research the addition of appropriate levels of pineapple extract with different percentages on the quality of anchovy fish sauce as seen from the parameters of protein, fat, water, ash and pH levels.

2. RESEARCH AND METHODS

2.1 Time and Place of Research

This research was carried out from June to September 2021. The main research was carried out at the Laboratory of Fishery Products Processing, Faculty of Fisheries and Marine Sciences, Padjadjaran University, while chemical tests were carried out at the Laboratory of Ruminant Animal Nutrition and Animal Food Chemistry, Faculty of Animal Husbandry, Padjadjaran University.

2.2 Materials and Methods

The tools and materials used in this research are cool bag, refrigerator, analytical scale, knife, plate, cutting board, beaker glass, measuring cup, strainer, stove, blender, pan, jar, mortar and pestle, ice gel, incubator, pH meter, anchovy, pineapple smooth cayenne, aquades, pH buffer solution 4, pH buffer solution 7, salt.

2.3 Research Procedure

2.3.1 Pineapple extract manufacture

The pineapple fruit was peeled from the skin with a knife then the pineapple was cut into small pieces to put in a blender (brand Miyako BL-101GS), after the pineapple was crushed then filtered and separated between the pulp and pineapple extract with a strainer [14].

2.3.2 Fish sauce manufacture

The anchovies were first cleaned with running water and then put into a pan to be steamed for 10 minutes on the stove, then the anchovies were mashed using a mortar and pestle. The finely ground anchovies were put into jars. Each jar was filled with 100 grams per unit and

observed as many as 12 units. Pineapple extract was added with a volume of 0%, 10%, 15% and 20% per three units. The same volume of pineapple extract was added, then added salt with a concentration of 7% (from the amount of meat) for each treatment, after that all the ingredients were mixed in a jar and then closed and allowed to incubate for 3 days in an incubator with a temperature of 55°C after which the fish sauce was ready to be analyzed [15].

2.4 Research Methods

The research method used is an experimental method using a Completely Randomized Design (CRD) consisting of 4 treatments and 3 replications with a fermentation time of 3 days.

The treatment of adding pineapple extract to anchovy fish sauce is:

- A = Without the addition of pineapple extract (0%)
- B = Addition of 10% pineapple extract
- C = Addition of 15% pineapple extract
- D = Addition of 20% pineapple extract

The analysis used is the method of multiple comparisons in the form of the Duncan test method (DMRT) to find that treatment had an effect on anchovy fish sauce. Data from chemical test results in the form of protein, fat, water, ash and pH were analyzed descriptively. Protein was tested using the kjeldahl method [16], determination of fat content using the Soxhlet method [17], moisture content using the oven method [18], determination of ash content [17] and pH [19].

3. RESULTS AND DISCUSSIONS

3.1 Protein Content

Proteins are macromolecules composed of amino acids that function to regulate metabolism

and form tissues in the body. Based on Table 1. the protein content of fish sauce that was given pineapple extract was smaller than the protein content of fish sauce that was not given pineapple extract. This is presumably due to the effect of bromelain enzyme activity on pineapple extract as a proteolytic enzyme or protease that breaks down complex protein compounds into simpler compounds such as amino acids and peptides [20]. The results showed that pineapple extract had no significant effect but decreased. The decrease in protein content indicates a decrease in the total amount of nitrogen because the analytical method used is the Kjeldahl method, which uses the amount of nitrogen as a conversion in the calculation of protein content. This shows that the more volume of pineapple added, the greater concentration of enzymes contained in it, while the speed of hydrolysis will increase along with the increase in enzyme concentration [8], but enzyme work depends on the substrate, so it works within certain limits. The addition of a certain amount of substrate with a fixed amount of enzyme will accelerate the enzymatic reaction to a maximum, then the addition of substrate will not increase the reaction speed. So that the excessive use of enzymes does not affect the value of the dissolved protein because during the process there is no addition of substrate and the available substrate has been used up during the hydrolysis process [21]. The decrease in protein content was also caused by inhibition of hydrolysis by hydrolysis products or by chain severance of all peptide bonds hydrolyzed by enzymes. The greater soluble protein interaction, the dissolving activity will decrease so that the solubility of protein in solvent will decrease and in the end protein will precipitate directly [8]. In addition, the decrease in protein content of anchovy fish sauce is also thought to be due to the addition of acidic pineapple extract. Ripe pineapple fruit has a pH content of 3.0-3.5 [22]. The administration of acidic pineapple extract is suspected of protein denaturation in fish meat.

Table 1. Protein content of fish sauce with the addition of pineapple extract

Addition Concentration Pineapple Extract (%)	Average Protein Content (%)
A	17,19 ± 0,81 ^b
B	15,88 ± 0,65 ^{ab}
C	15,13 ± 0,98 ^a
D	13,62 ± 0,72 ^a

Note: The average value followed by the same letter shows a non-significant difference based on Duncan's further test, at the 5% test level ($p > 0.05$). A = Without the addition of pineapple extract (0%), B = Addition of 10% pineapple extract, C = Addition of 15% pineapple extract, D = Addition of 20% pineapple extract.

3.2 Fat Content

Fat content in foodstuffs influences the form of a specific aroma in food [23]. Based on Table 2. The results of the analysis show that the addition of pineapple extract up to 20% produces fish sauce which has relatively the same fat content, which is 1.21%-1.54%. The fat content produced in fish sauce that was given pineapple extract was smaller than the protein content of fish sauce that was not given pineapple extract. This is presumably due to the hydrolysis of fat which breaks down into fatty acids and glycerol, the hydrolysis process is carried out due to the presence of certain acids, bases and enzymes [24]. The decrease in fat content is due to the bond of fat with protein being broken and divided into simpler components (amino acids and peptides) [25]. The decrease in fat during fermentation occurs due to the decomposition of fat by the enzymatic activity of the fish itself, namely by the lipase enzyme [26]. The production of fish sauce is assisted by the activity of protease and lipase enzymes, namely enzymes that break down fish protein and fat into simple components, namely amino acids and fatty acids [27]. The decrease in fat content occurs because when fermented pineapple extract produces organic acids so that these acids can coagulate proteins. When proteins are coagulated, the bonds that make up the molecular configuration are broken, so that the bonds between fats and proteins or called lipoproteins become detached and come out and clump [28]. Protein functions actively at a certain pH, the protein will coagulate at an acidic pH [29].

3.3 Water Content

Water in foodstuffs can affect the taste, texture and appearance of foodstuffs [30]. Based on Table 3. The results of the analysis showed that the more pineapple extract was added, the higher the water content. The factor of increasing the water content of fish sauce in this

study was influenced by the addition of a pineapple extract solution which has a high water content, smooth cayenne pineapple has a water content of 86.7% [31]. The increase in water percentage during fermentation can also be caused by changes in the type of water, namely from bound water to free water, because fermentation has a low pH. Low acidity (pH) has the ability to liberate water bound to complex compounds and has a hydrophilic group to become free water, for example binding to proteins [32].

3.4 Ash Content

The ash content in food shows the mineral content and determines whether a process is good or not [31]. Based on Table 4. the results of this study on anchovy sauce showed that the addition of 10% to 20% pineapple extract resulted in fish sauce which had relatively the same ash content, which was 34%-35%. The decrease in ash content added with pineapple extract can be caused by the presence of acid from pineapple extract. Mineral components can be dissolved in an acid solution which makes the ash content of a product decrease [33]. The decreased of ash content is caused by an acidic pH, because acid has the ability to dissolve natural minerals and dissolved minerals will settle [34] and mineral solubility is affected by pH and also states that minerals in food can change its chemical form during or after food processing, or interactions with other compounds, thus its solubility may increase or decrease depending on the type of processing method [35].

3.5 pH Value

The pH value is related to the product's shelf life because it is related to the condition of the product against microbial attack [36]. Based on Table 5. the pH measurement results in the sample decreased and increased again at 20% treatment, the pH of fish sauce hydrolyzed using the bromelain enzyme will be more acidic due to

Table 2. Fat content value of fish sauce with the addition of pineapple extract

Addition Concentration Pineapple Extract (%)	Average Fat Content (%)
A	2,86 ± 0,44 ^b
B	1,54 ± 0,19 ^a
C	1,23 ± 0,16 ^a
D	1,21 ± 0,17 ^a

Note: The average value followed by the same letter shows a non-significant difference based on Duncan's further test, at the 5% test level ($p > 0.05$). A = Without the addition of pineapple extract (0%), B = Addition of 10% pineapple extract, C = Addition of 15% pineapple extract, D = Addition of 20% pineapple extract

Tabel 3. Water content of fish sauce with the addition of pineapple extract

Addition Concentration Pineapple Extract (%)	Average Water Content (%)
A	70,90 ± 0,11 ^a
B	72,06 ± 0,21 ^b
C	72,96 ± 0,64 ^c
D	73,85 ± 0,33 ^d

Note: The average value followed by the same letter shows a non-significant difference based on Duncan's further test, at the 5% test level ($p > 0.05$). A = Without the addition of pineapple extract (0%), B = Addition of 10% pineapple extract, C = Addition of 15% pineapple extract, D = Addition of 20% pineapple extract.

Table 4. Ash content of fish sauce with the addition of pineapple extract

Addition Concentration Pineapple Extract (%)	Average Ash Content (%)
A	37,67 ± 0,94 ^c
B	35,92 ± 0,40 ^{ab}
C	35,34 ± 0,77 ^a
D	34,65 ± 0,08 ^a

Note: The average value followed by the same letter shows a non-significant difference based on Duncan's further test, at the 5% test level ($p > 0.05$). A = Without the addition of pineapple extract (0%), B = Addition of 10% pineapple extract, C = Addition of 15% pineapple extract, D = Addition of 20% pineapple extract

Table 5. pH value of fish sauce with the addition of pineapple extract

Addition Concentration Pineapple Extract (%)	Average pH Value
A	6,90 ± 0 ^d
B	6,67 ± 0 ^c
C	6,17 ± 0 ^a
D	6,37 ± 0 ^b

Note: The average value followed by the same letter shows a non-significant difference based on Duncan's further test, at the 5% test level ($p > 0.05$). A = Without the addition of pineapple extract (0%), B = Addition of 10% pineapple extract, C = Addition of 15% pineapple extract, D = Addition of 20% pineapple extract.

the extraction of pineapple which contains natural organic acids from the fruit [9]. In the addition of 20% pineapple extract treatment, the pH value increased. The increase in pH value is due to the reshuffling of proteins into amino acids during autolysis to produce basic ammonia compounds [37]. Ammonia compounds (NH_3) are produced due to protein catabolism [38]. This is the cause of anchovy sauce has a pH difference.

4. CONCLUSION

The results of the study concluded that the addition of 10% pineapple extract with a protein value of 15.88% gave the best results and was in accordance with the Indonesian National Standard (SNI). the highest fat content was 2.86% and the highest ash was 37.67% were found in fish sauce without the addition of pineapple extract (0%) and the highest water content in the 20% treatment was 73.85%. The lowest pH value is 6.17 with a concentration of 15% pineapple extract.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Center for Statistics and Information of the Ministry of Maritime Affairs and Fisheries (KKP) of the Republic of Indonesia. Fishery Production; 2022. Accessed 17 April 2022. Available: https://statistik.kkp.go.id/home/hp?m=prod_lkan_prov&i=2.
- Astawan, M. Healthy with Animal Dishes. Penebar Swadaya, Jakarta; 2008
- Kristianawati F, Ibrahim, Rianingsih L. Addition of Different Enzymes in Processing Fish Soy Sauce from Stomach Contents of Manyung Fish (*Arius thalassinus*) on Product Quality. Fisheries Science Journal. 2014;9(2):24-32.
- Purwaningsih S, Nurhayati. Making Fish Sauce by Combination of Enzymatic and

- Fermentation from Tuna Fish Offal (*Thunnus* sp.). THP Bulletin Journal. 1995;1(1):14-18.
5. Directorate of Credit BPR and MSMEs. Small Business Financing Pattern (PPUK) for Fish Sauce Industry. Bank Indonesia, Jakarta; 2010.
 6. Nurfadilah. Effect of Addition of Pineapple Fruit and Salt with Different Concentrations in Making Fish Sauce of Layang Fish (*Decapterus* sp.) on Total Bacterial Colonies. Journal of Food Processing. 2018;3(2):38-42.
 7. Widawati L. Protein Analysis of Eel (*Monopterus albus*) Fish Sauce with Variation in Volume of Pineapple Extract (*Ananas comosus*). Jurnal Agritepa. 2018;5(1):49-59.
 8. Prasetyo M N, Sari N, Budiyati S. Making Fish Sauce from Snakehead Fish by Enzymatic Hydrolysis using Pineapple Juice. Journal of Chemical and Industrial Technology. 2012;1(1):329-337.
 9. Iskandar T, Widyasrini D A. Effect of Bromelain Enzyme and Incubation Time on the Hydrolysis Process of Lemuru Fish into Soy Sauce. Buana Sains. 2009;9(2): 183-189.
 10. Hossain F, Akhtar S and Anwar M. Nutritional Value and Medicinal Benefits of Pineapple. International Journal of Nutrition and Food Sciences. 2015;4(1): 84-88.
 11. Wiyati PI, Tjitraresmi A. Review: Characterization, Activity and Isolation of Bromelain Enzyme from Pineapple Plants (*Ananas* sp.). Journal of Supplement Pharmacy. 2018;16(2): 179-185.
 12. Suh HJ, Lee H, Cho HY, Yang HC. Purification and Characterization of Bromelain Isolated from Pineapple. Journal Korean Agricultural Chemical Society. 1992;35(4): 300-307.
 13. National Standardization Agency of Indonesia. Fish Sauce. National Standardization Agency of Indonesia; 1996.
 14. Yuanisa N. Effect of Concentration of Pineapple Juice (*Ananas comosus*) and Duration of Fermentation on the Quality of Lemuru Fish Sauce (*Sardinella longiceps*). Thesis. Faculty of Science and Technology Maulana Malik Ibrahim State Islamic University, Malang; 2017.
 15. Widawati L. Protein Analysis of Eel Fish (*Monopterus albus*) Soy Sauce with Variation in Volume of Pineapple Extract (*Ananas comosus*). Journal of Agritepa. 2018;5(1):49-59.
 16. Yenrina R. Methods of Analysis of Food Ingredients and Bioactive Components. Andalas University Press, Padang; 2015.
 17. Andarwulan N, Kusnandar F and Herawati. Food Analysis. Dian Rakyat, Jakarta; 2011.
 18. Sudarmadji S, Haryono B, Suhardi. Analytical Procedures for Foodstuffs and Agriculture Third Edition. Liberty, Yogyakarta; 1984.
 19. National Standardization Agency of Indonesia. Water and Wastewater – Part 11: How to Test the Degree of Acidity (pH) Using a pH Meter. National Standardization Agency of Indonesia, Jakarta; 2019.
 20. Soeka S dan Sulistiani. Characterization of Protease Enzymes from *Stenotrophomonas* sp. Origin of Mount Bromo, East Java. Biology News, 2017;16(2):203-211.
 21. Koesoemawardani D, Nurainy F, Hidayati S. The Process of Making Shredded Fish Protein Hydrosylate. Indonesian Journal of Nature, 2011;13(3): 256-261.
 22. Setyawati I, Yulihastuti DA. Reproductive Appearance and Skeleton Development of Mice Fetus After Administration of Young Pineapple Extract. Veterinary Journal, 2011;12(3): 192-199.
 23. Badriah EL, Suranto, Purwoko T. Making Keong Mas (*Pomacea canaliculata*) Soy Sauce by Fermenting Koji and Adding Pineapple Extract (*Ananas comosus*). Biopharmaceutical. 2008;6(1):1-7.
 24. Poedjiadi A, Supriyanti T. Basics of Biochemistry. Publisher University of Indonesia, Jakarta. 2009;472.
 25. Milla MR, Maiyasa F. Chemical Characteristics of Seaweed Sauce (*Diadema setosum*) with Different Fermentation Time. Marinade. 2022; 5(2):10-18.
 26. Yuliana N. Fermentation Profile “Rusip” made from Anchovy (*Stolephorus* sp.). AGRITECH. 2007;27(1):12-17.
 27. Astawan M. Healthy with Animal Dishes. Self-help spreader, Jakarta;2008; 204 pp
 28. Nurjanah I. The Effect of Addition of Pineapple (*Ananas comosus*) and Fermentation Time to the Making of Tamban Fish Sauce (*Sardinella albella*). Thesis. Faculty of Mathematics and Natural Sciences, University of North Sumatra, Medan. 2017;71.

29. Naga W S, Adiguna B, Retnoningtyas E and Ayucitra A. Coagulation of Protein from Winged Bean Extract by Heating Method. *Widya Teknik*. 2010;9(1):1-11.
30. Novita R, Sadjadi, Karyono T, Mulyono. Pineapple Extract Level (*Ananas comosus* L Merr) and Soaking Time on the Quality of Duck Meat Rejection. *Indonesian Animal Husbandry Journal*. 2019;21(2): 143-153.
31. Sohir and Duri T. Characterization of Physical and Chemical Properties and Their Changes during Storage of Four Pineapple Cultivars. *Enviagro. Journal of Agriculture and the Environment*. 2008; 2(1):15-18.
32. Simanjongrang E, Kurniawati N, Hasan Z. The Effect of Using Papain Enzymes with Different Concentrations on Chemical Characteristics of Tutut Sauce. *Journal of Fisheries and Marine Affairs*. 2012;3(4):209-220.
33. Desmawarni D, Hamzah FH. Variation of Extraction Temperature and Time on Pectin Quality from Banana Peel. *Online Journal of Students of the Faculty of Agriculture, University of Riau*. 2017; 4(1):1-15.
34. Yusuf AN, Putra NK, Suter IK. Effect of Extraction Solution pH on Yield and Pectin Albedo Characteristics of Durian Fruit Peel. *Journal of Food Science and Technology*. 2020;9(1):65-70.
35. Santoso J, Gunji S, Stark and Suzuki. Mineral Contents of Indonesian Seaweeds and Mineral Solubility Affected by Basic Cooking. *Food Sci. Technol. Res*. 2006;12(1):59-66.
36. Makanoneng GA, Mentang F, Dien, Onibala, Panelewen, Makapedua D. Chemical Characteristics and Total Lactic Acid Bacteria (LAB) Tandipang Fish Sauce (*Dussumieria* sp.) with the Addition of Pineapple Fruit Extract. *Fishery Products Technology Media*. 2022;10(1): 7-10.
37. Suparno. Making Fish Filets in a Collection of Papers for a Day Seminar on the Development of Red Tilapia Agribusiness in West Java. Cooperation between the Indonesian Society for Scientific Fisheries and the Fisheries Research and Development Center BBAT, Sukabumi; 1993.
38. Nelson DL, Cox MM. *Lehninger Principles of Biochemistry* Fourth Edition. W.H. Freeman and Company, New York. 2005;1119.

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