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Effect of Adding Liquid Smoke with Various Concentrations on the Characteristics of Chili Anchovy Sauce (Stolephorussp.)

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A B S T R A C T

Anchovy is a fish that widely used to be processed into many products, one of them is chili anchovy sauce, but it has a relatively fast in terms of quality degradation. Using liquid smoke is a way to prevent high salt levels due to preservative function. Liquid smoke is a condensation of steam from burning biomass products contains antioxidants, carbonyls, and phenolics. The study aimed to analyze the effects of liquid smoke addition on the characteristics of chili anchovy sauce. The experimental design used a completely randomized design (CRD) with variation concentrations of liquid smoke (0%, 0.3%, 0.6%, 0.9%). Characteristics analyses consist of water and salt content analysis, total plate count (TPC), phenol levels, fatty acid profile, color, and hedonic testing, with statistical analysis conducted using SPSS 16, including normality and homogeneity tests alongside ANOVA. The results indicated a decrease in salt content to 2.72% and increase in phenol levels to 0.82 mg GAE/g, while TPC decreased to 1.79 log CFU/gr. Notably, water content of the control increased from 23.67% to 29.12% - 38.35% in treated samples, and color values increased, reaching L* 34.46 and b* 18.84 and reduced a* to 20.66. The optimal concentration for liquid smoke addition identified as 0.3%, with a hedonic acceptance range of $8.02 < \mu < 8.11$. Additionally, the fatty acid reduced in saturated, monounsaturated, and polyunsaturated fatty acids in treated samples (7.264%, 7.523%, and 2.234%, respectively) compared to controls (7.530%, 7.914%, and 2.330%). Overall, the addition of liquid smoke significantly improved the quality of chili anchovy sauce by lowering the TPC content and hedonic acceptance.

Keywords:*Liquid smoke, chili sauce, anchovy, characteristics*

1. Introduction

Rice anchovies have a distinctive taste that tends to be salty and are rich in various ingredients such as minerals and protein. One of the processed products from this fish is anchovy rice sauce, which uses chilies and anchovies as the main ingredients. According to Mansyur (2021), anchovies are an important source of nutrition for Indonesian people, with a fresh protein content of 10.3 g per 100 g, and are a significant source of calcium with a content reaching 972 mg per 100 g, exceeding the calcium in milk.

Liquid smoke is a liquid from the condensation of steam resulting from direct or indirect combustion of products containing biomass such as coconut shells, wood, and bark. Liquid smoke has several ingredients that can extend the shelf life of a product. Liquid smoke has the main components, namely acids, phenol derivatives, and carbonyls that act as flavoring, color forming, antibacterial, and antioxidant (Ayudiarti and Sari, 2010).

Anchovy rice sauce is a preparation made from anchovy as the basic ingredient and is known as a food that has high nutritional content and is beneficial for the health of the human body's organs. Anchovy rice sauce is prepared using the raw material, namely anchovy rice, and added with chilies, shallots, and other additional ingredients. There is a problem with anchovy chili products, namely their relatively short shelf life. This is caused by the presence of microbial activity in the chili product when left at room temperature.

This research aimed to determine the quality characteristics of anchovy anchovy sauce with the addition of liquid smoke through testing water content, TPC content, phenol content, salt content, color test, fatty acid profile testing and the level of consumer acceptance of anchovy anchovy sauce through hedonic testing.

2. Material and methods

2.1 Procedure

This research was carried out experimentally in a laboratory. A simple Completely Randomized Design (CRD) with 4 treatments, namely the addition of liquid smoke concentrations of 0%, 0.3%, 0.6%, and 0.9%, with 3 repetitions. Data analysis was carried out using SPSS software with analysis of variance (ANOVA) testing and continued with the Honest Significant Difference (BNJ) test with a level of 5% for the salt content test, water content

test, phenol content test, total plate count (TPC) test, color, fatty acid profile test, and hedonic test. Sensory data testing was carried out using the nonparametric Kruskall-Wallis test and continued with the Mann-Whitney test.

2.2 Water Content Test (SNI 01-2359-1991)

The water content test begins with drying the cup at a temperature of 98 – 100°C (W1), followed by weighing. Then, 2 gram sample was placed in a cup and placed in an oven at a temperature of 95 – 100°C for 5 hours with a partial vacuum. After that, the cup was closed tightly and transferred to a desiccator. The weight of the cup and contents (W3) was weighed after room temperature was reached, and the drying process was continued until the weight was constant.

Water content can be weighed using the formula:

$$\text{Water content (\%)} = \frac{B-C}{B-A} X\ 100\%$$

Information:

A : Empty Cup Weight (g)

B : Weight of cup and sample before drying (g)

C : Weight of cup and sample after drying (g).

2.3 Salt Content Test (SNI 01-2359-1991)

The procedure for testing salt content in fishery products begins by weighing a sample weighing 1-3 grams and placing it in a 250 ml Erlenmeyer flask. Next, 25-50 ml of 0.1N $AgNO_3$ and 20 ml of concentrated HNO_3 were added. The mixture was heated slowly until it boiled, then 50 ml of halogen-free water was added and left to stand at room temperature. After that, 3 ml of Ferric indicator was added and a titration was carried out with 0.1N NH_4CNS until the solution had a permanent light brown color, noting the volume of NH_4CNS used. The final step taken is to calculate the percentage of salt content by calculating the difference between $AgNo_3$ and NH_4CNS multiplied by moles of NaCl (58.44gr/mol) using the formula:

$$\%\ NaCl = [(Vol\ AgNO_3 \times N\ AgNO_3) - (Vol\ NH_4CNS \times N\ NH_4CNS)] \times \frac{58{,}44 \times 100}{berat\ sampel} \times 1000$$

2.4 Phenol Content Test (Rahmadani, 2018)

The phenol content testing procedure begins by weighing a sample weighing 1 gram, then extracted using 10 ml of methanol in an ultrasonic bath for 30 minutes at a temperature of 25°C. Total phenols were measured using the Follin method. Next, 1 ml of extract was mixed with 2 ml of distilled water and 1 ml of FollinCiocalteu reagent, then left for 5 minutes before adding 1 ml of 10% Na2CO3. The mixture was then left in a dark room for 1 hour. The absorbance of the solution was calculated using spectrophotometry at a wavelength of 725 nm, and the phenol content was calculated in mg GAE/gr.

2.5 TPC Test (SNI 2332.3-2015)

Testing TPC levels begins with weighing 25 g of sample or 25 mL of liquid sample, then placing it in a sterile container. Then, 225 mL of Butterfield's Phosphate Buffered Solution was added. The sample was homogenized for 2 minutes and diluted to dilution 101. From this dilution, 10 mL was taken and mixed with 90 mL of Butterfield's Phosphate Buffered Solution for dilution 102. This dilution process was repeated to obtain the next dilution. A sample of 1 mL from each dilution was taken and placed in a sterile petri dish. Each cup was added with 12 mL - 15 mL of PCA, then incubated in an incubator for 48 hours at a certain temperature depending on the type of bacteria being tested.

2.6 Color Test (Markovic et al., 2013)

Testing the color of the anchovy chili sauce begins with placing a sample of the anchovy chili sauce in a container on a base under good light and taking a picture with a high-quality camera so that the image can be seen clearly and in detail. The sample image that has been taken is then carried out in the pre-processing stage first, such as minimizing shadows so that the colors can be seen clearly. Images that have undergone the pre-processing stage will then have their color measured using L* a* b* units, where L* is lightness or brightness, a* is redness or redness, and b* is yellowness or yellowness. The color measurements are carried out with the application, namely MATLAB. The results obtained from color analysis will be positive or negative L* a* b* values.

2.7 Fatty Acid Profile Test (AOAC, 2005)

The fatty acid profile test process begins with the preparation of a working standard solution of Fatty Acid Methyl Esters (FAMEs) in hexane solvent. Samples were extracted in a 50 mL Falcon tube, and then 0.5 M KOH was added to samples with an oil matrix. The mixture of isopropanol and hexane is mixed, stirred, then separated. The hexane phase is evaporated using N_2 gas. Saponification was carried out with KOH in methanol, followed by heating in a water bath. Esterification is carried out by adding BF_3 solution. Next, saturated NaCl and hexane solutions were added and stirred. The extraction process produces two layers, with the hexane phase being separated and transferred into a 2 mL tube containing anhydrous Na_2SO_4. The final sample was analyzed using a Gas Chromatography-Flame Ionization Detector (GC-FID) to obtain a fatty acid profile.

2.8 Hedonic Test (SNI 2346:2015)

The hedonic test is a test that focuses on finding out the magnitude of the difference in quality between more than 1 similar product by providing an assessment regarding certain aspects of a product and knowing the level of liking of a product as well. Based on SNI 2346:2015, testing is carried out by giving scores to aspects of the fish such as taste, appearance, aroma, and texture with a score breakdown of 9, namely very like to 1, namely very, very dislike.

3. Results and Discussion

Table 1. Results of chemical analysis of anchovy rice sauce with the addition of liquid smoke

Parameter	Treatment			
	0% liquid smoke	Liquid smoke 0.3%	Liquid smoke 0.6%	Liquid smoke 0.9%
Salt content (%)	3.09 ± 0.21^{b}	2.72 ± 0.07^{a}	2.74 ± 0.18^{a}	2.77 ± 0.07^{a}
Water content (%)	23.67 ± 0.46^{a}	29.12 ± 0.91^{b}	35.16 ± 0.57^{c}	38.35 ± 0.44^{d}
Phenol content (mg GAE/g)	0.55 ± 0.06^{a}	0.66 ± 0.07^{ab}	0.71 ± 0.05^{ab}	$0.82 \quad 0.09^{b}$

3.1 Salinity Test

Testing the salt content in the anchovy sauce resulted in a different percentage of salt content in each sample at a range of 3.09% in the control sample to 2.77% in the sample with the addition of 0.9% liquid smoke concentration. This indicates that there is a real difference in the salt content of each sample. The anchovy chili sauce sample with the addition of 0.3% liquid smoke had the lowest salt content, namely 2.72%, while the anchovy chili sauce sample without the addition of liquid smoke had the highest salt content, namely 3.09%. The addition of liquid smoke to the anchovy rice chili sauce sample resulted in a reduction in salt content. This is in line with research by Nursiwi*et al.* (2013), where there is a decrease in salt content because the use of liquid smoke can increase the water content in the sample so that the sample salt content can decrease. According to Swastawati*et al*. (2016), a decrease in salt content also occurred in this study, where in samples of smoked catfish that were added with liquid smoke, the salt content of the samples experienced a significant decrease of up to 2.64% - 3.43% compared to catfish without the addition of liquid smoke. The decrease in salt content in products with the addition of liquid smoke is also confirmed by research by Amin and Ali (2021), where samples of tilapia fish smoked using traditional methods and liquid smoke experienced a decrease when smoked with liquid smoke. Tilapia fish with traditional smoking has a salt content in the range of 1.81% - 3.22%, while tilapia fish smoked using liquid smoke has a lower salt content, namely 1.58% - 1.73%.

3.2 Water Content Test

Water content is an important parameter to determine the possibility of damage that occurs in food products. According to Daud et al. (2019), the higher the water content of food, the greater the possibility of damage either as a result of internal biological activity (metabolism) or the entry of destructive microbes. Testing the water content of the anchovy sauce resulted in varying percentages of water content in the samples at a range of 23.67% to 38.35%. Based on these results, samples of anchovy chili sauce without the addition of liquid smoke had the lowest water content results, while anchovy chili sauce with the addition of 0.9% liquid smoke had the highest water content results and the water content increased along with increasing concentration of liquid smoke on the sample. This happened because liquid smoke has a phenol base that can form hydrogen bonds with water, increasing the water-binding capacity of the material and thereby raising the water content in a sample to which liquid smoke is added. According to Alinti*et al.* (2018), water content is an important parameter in determining the quality of smoked fish. The water content contained in a smoked fish product can affect the shelf life of smoked fish because water content can determine the presence of microbial activity in the product. According to Asmawati*et al*. (2020), research on sambal masin (rebon shrimp) without the addition of liquid smoke had a water content value of 73.52% to 66.50%. The water content value can be categorized as quite high compared to anchovy rice sauce with the addition of liquid smoke. As confirmed by the research from Mansyur and Hajriani (2020), anchovy fish sauce without the addition of liquid smoke has a relatively higher water content value. The anchovy sauce tested produced water content values in the range of 33.82 – 46.43%.

3.3 Phenol Content Test

The phenol content in the anchovy sauce with the addition of liquid smoke increased along with the addition of liquid smoke to the anchovy sauce. Anchovy sauce with the addition of 0% liquid smoke has the lowest phenol content value, namely 0.55 mg GAE/g, while anchovy sauce with the addition of 0.9% liquid smoke has the highest phenol content value, namely 0. 82 mg GAE/g. This is due to the addition of liquid smoke elements to the anchovy rice sauce. This increase in phenol levels also occurred in research conducted by Fauziah*et al*. (2014), the results obtained in research on adding a liquid smoke concentration to pindanglayang products experienced an increase in phenol content along with the addition of liquid smoke concentration. Pindanglayang without the addition of liquid smoke had a phenol content of 39.8 mg GAE/g on the second day of storage, but pindanglayang with the addition of 3% liquid smoke had a phenol content of 48 mg GAE/g. This increase in phenol levels also occurred in research by Hutomo et al. (2015), where there was an increase in the concentration of liquid smoke in smoked eel samples from eel samples with an increased concentration of liquid smoke. The eel sample with the addition of 0% liquid smoke had a value of 14.8 mg GAE/g and the eel sample with the addition of 15% liquid smoke had the highest phenol content, namely 16.2 mg GAE/g. According to Handayani*et al*. (2019), who said that liquid smoke has the main components, namely acids, phenol, and carbonyl derivatives which act as flavoring, color forming, antibacterial, and antioxidant.

3.4 TPC Content Test

Table 2. Results of TPC levels of anchovy chili sauce with the addition of various concentrations of liquid smoke

Treatment	TPC levels (log CFU/gr)
Liquid smoke0%	2.17 ± 0.35^{a}
Liquid smoke 0.3%	2.05 ± 0.44^{a}
Liquid smoke 0.6%	1.92 ± 0.18^{a}
Liquid smoke 0.9%	1.79 ± 0.52^{a}

The results of the TPC levels in the anchovy sauce with the addition of liquid smoke in different concentrations did not have a significant difference, even though the TPC levels in the anchovy sauce with the addition of liquid smoke concentrations decreased. TPC levels are a determinant of the presence of bacteria in a sample. The higher the TPC level of a food product, the higher the presence of bacteria in the sample. These results are also in line with research conducted by This is directly proportional to research conducted by Nurjaya (2022), where the fish meatball sample with the addition of 0% liquid smoke had the highest TPC content value, namely 6.348 log CFU/g and the fish meatball sample The one with the lowest TPC levels was the fish ball sample with the addition of a liquid smoke concentration of 3.33%, namely 4.464 log CFU/g. Liquid smoke is a substance that, when added to food products, can reduce and inhibit bacterial activity through the compounds contained in it. According to Handayani*et al*. (2020), liquid smoke contains acid, carbonyl, and phenol compounds that provide antibacterial and antioxidant properties so that liquid smoke can be used as a food preservative as confirmed by Ramadayanti*et al*. (2019), where the phenol and organic acid content in liquid smoke influences the amino acid content of smoked fish. This happened because the combination of the functional component phenol and the high organic acid content synergistically prevents and controls microbial growth.

3.5. Color Test

Table 3. Color test results of anchovy sauce with the addition of various concentrations of liquid smoke

Parameter	Sample			
	K	P1	P2	P3
*L**	29.50 0.49[a]	30.40 0.89[a]	30.91 0.74[a]	34.46 ± 0.87^{b}
*a**	20.61 0.98[a]	23.38 0.98[b]	19.53 0.63[a]	20.66 ± 0.35^{a}
*b**	14.91 ± 0.59^{a}	18.73 ± 0.32^{bc}	17.80 ± 0.22^{b}	18.84 ± 0.27^{c}

Information:

- Data are the average of three replications with different liquid smoke concentrations ± SD
- The data shows that there is a significant difference (P<0.05)

Brightness or lightness (L*) is a unit in color testing that indicates the brightness level of a product. The highest brightness value (L*) was found in anchovy chili sauce with the addition of 0.9% liquid smoke, at 34.46, while the lowest brightness value was in anchovy chili sauce without liquid

smoke, at 29.50. According to Telfer *et al*. (2019), the sensory quality of smoked products, including color, can be influenced by various factors. The use of liquid smoke in a product can generally increase the lightness and redness compared to products without liquid smoke. The increase in the lightness value of anchovy rice sauce is also due to the content of formaldehyde in liquid smoke, which can make the product appear brighter and shinier. According to Fahrul*et al*. (2023), the shiny color is caused by a chemical reaction from compounds in smoked fish, specifically formaldehyde and phenol, which produce an artificial resin layer on the surface of the fish's skin, making it shiny.

Redness (a*) is a value related to the level of redness a product has. This value shows negative (-) for green values and positive (+) values for red. Anchovy chili sauce has a redness value that fluctuates along with the increase in concentration of liquid smoke. The highest redness value was found in anchovy sauce with the addition of 0.3% liquid smoke, at 23.38, while the lowest redness value was in anchovy sauce with the addition of 0.6% liquid smoke, at 19.53. The same thing happened in research conducted by Shiroodi*et al*. (2016), where the smoked salmon sample experienced an increase in redness from a value of 8 in the control sample and increased to a value of 8.5 in the redness of the salmon. The high redness value of the anchovy sauce with the addition of liquid smoke indicates that the sample has a fairly red color. The red color appears from the use of chilies in the raw material. According to Parfianti*et al*. (2016), the red color of chilies comes from the carotenoid pigments. Carotenoids are orange, red, or yellow pigments depending on the type and concentration. This compound is sensitive to alkalis, air, and temperature, especially at high temperatures.

Yellowness (b*) is a value that indicates whether a sample has a color that tends towards yellow or blue. This value shows negative (-) for blue values and positive (+) values for yellow. Anchovy fish sauce has a value that tends to increase, where the lowest b* value was in anchovy rice sauce without the addition of liquid smoke, namely 14.91, while the highest b* value was in anchovy rice sauce with the addition of liquid smoke of 0.9. %. This indicates that the anchovy sauce has a color that tends to be yellowish. Liquid smoke has a color that tends to be yellow, thereby increasing the yellowness value of the chili sauce. An increase in the b* value also occurred in research conducted by Santos *et al*. (2017), where smoked tilapia with the addition of liquid smoke had a higher b* value than without the addition of liquid smoke with a value of 3.19 for tilapia with the addition of liquid smoke while for tilapia without the addition of liquid smoke, it is 0.62. The increase in the b* value in the anchovy sauce was caused by the addition of liquid smoke. Ratnani*et al*. (2021) say that liquid smoke is a liquid produced from the condensation of wood smoke through the pyrolysis process. Liquid smoke components containing acids can affect the taste, pH, color, and shelf life of smoked products. Liquid smoke is golden yellow to dark brown. A brownish-yellow or clear color is preferred for food preservatives.

3.6. Fatty Acid Profile Test

Table 4. Results of fatty acid content in anchovy sauce with the addition of liquid smoke

Types of Fatty Acids	Fatty Acid Content (%)	
	0%	0.3%
SFA (Saturated Fatty Acid)	7.530 0.004	7.264 ± 0.018
MUFA (Mono Unsaturated Fatty Acid)	7.914 0.015	7.523 ± 0.012
PUFA (Poly Unsaturated Fatty Acid)	2.330 ± 0.008	2.234 ± 0.007

Based on the results obtained from testing the fatty acid profile of anchovy sauce with various additional concentrations of liquid smoke, the amino acid content in anchovy sauce was prominent by unsaturated fatty acids. The dominant type of unsaturated fatty acid in anchovy rice sauce with various added concentrations of liquid smoke is oleate (7.42 – 7.8%), the prominent type of saturated fatty acid is stearate (0.75 – 0.78%). The high content of unsaturated fatty acids in anchovy sauce is affected by the raw material used in the sauce, namely anchovies. Anchovies contain various fatty acids, specifically unsaturated fatty acids.

The results in the table above show that anchovy sauce with various added concentrations of smoke dominated by unsaturated fatty acid, can affect the omega content of the sauce. The high level of unsaturated fatty acids in anchovy sauce shows that anchovy sauce contains omega-3, omega-6, and omega-9 play a good role in the body. Omega-3, 6, and 9 fatty acids are some of the types of unsaturated fats that have many benefits for the body.

Table 5. Test results for the fatty acid profile of anchovy rice sauce with the addition of liquid smoke.

Types of Fatty Acids	Fatty Acid Content (%)	
	0%	0.3%
SFA		
C 8:0 (Caprylic Acid)		0.00255 ± 0.000
C 12:0 (Lauric Acid)	0.12 0.000	0.023 ± 0.000
C 14:0 (Myristic Acid)	0.1617 ± 0.001	0.1614 ± 0.001
C 15:0 (Pentadecanoic Acid)	0.885 000	0.00885 ± 0.000

C 17:0 (Heptadecanoic Acid)	0.1655 000	0.01595 ± 0.000
C 18:0 (Stearic Acid)	0.7874 .002	0.7516 ± 0.002
C 20:0 (Arachidic Acid)	0.6765 000	0.0621 ± 0.001
C 22:0 (Behenic Acid)	0.01815 ± 0.000	0.0164 ± 0.000
C 24:0 (Lignoceric Acid)	0.02 0.001	0.0147 ± 0.000
MUFA		
C 16:1 (Palmitoleic Acid)	0.4005 001	0.0382 ± 0.001
C 18:1 W9C (C-Oleic Acid)	7.8057 .015	7.42445 ± 0.003
C 20:1 (Eicosenoic Acid)	0.261 .000	0.0251 ± 0.001
C 24:1 W9 (Nervonic Acid)	0.4235 000	0.0349 ± 0.001
PUFA		
C 18:2 W6C (C-Linoleic Acid)	2.24665 ± 0.010	2.1446 ± 0.010
C 18:3 W3 (Linolenic Acid / W3)	0.0699 ± 0.002	0.0782 ± 0.002
C 20:5 W3 (Eicosapentaenoic Acid)	0.0138 ± 0.000	0.0109 ± 0.000
C 18:2 W6 (Linoleic Acid / W6)	2.24665 ± 0.010	2.1446 ± 0.010

The results of testing the fatty acid profile of anchovy rice sauce with various added smoke concentrations dominated by unsaturated fatty acids can influence the omega content of the sauce. The high level of unsaturated fatty acids in anchovy sauce shows that anchovy sauce contains omega-3, omega-6, and omega-9, which play a good role in the body. Omega-3, 6, and 9 fatty acids are unsaturated fats that have many benefits for the body. Unsaturated fats may help lower the risk of cardiovascular disease and overall death. According to Kusuma and Putri (2020), there are types of fatty acids that are needed by the body, namely essential fatty acids (Essential Fatty Acid), this type of fatty acid is important and essential because the body cannot produce these fatty acids on its own and only comes from the food consumed by the individual. The most important types of essential fatty acids for the body are linoleic acid or linoleic acid (omega-6) and alpha-linoleic acid or alpha-linolenic acid (omega-3).

The test results for anchovy rice chili sauce without the addition of liquid smoke and with the addition of 0.3% liquid smoke showed slight differences. Both versions of the sauce generally contain similar types of saturated and unsaturated fatty acids, but the percentages of these fatty acids differ. The anchovy sauce without liquid smoke contains a higher percentage of both saturated and unsaturated fatty acids compared to the sauce with 0.3% liquid smoke. This difference is due to cooking factors, as the sauce with liquid smoke undergoes a slightly longer cooking process, which can affect the fatty acid content. Fatty acids can be damaged when heated, and the processing process is closely related to heating. According to Nguju*et al*. (2018), the processing and cooking process can damage the fat in food. The level of damage varies depending on the temperature used and the length of processing time; higher temperatures lead to more intense fat damage.

3.7. Hedonic Test

Table 6. Hedonic Test Results for Anchovy Rice Sambal with the Addition of Different Liquid Smoke Concentrations

Parameter	Treatment			
	K	P1	P2	P3
Appearance	7.87 ± 1.00^{a}	7.93 ± 1.2^{a}	7.87 1.00^{a}	7.87 0.98^{a}
Smell	8.17 ± 0.91^{c}	8.00 ± 1.01^{bc}	7.60 ± 0.49^{b}	7.27 0.45^{a}
Flavor	8.13 ± 1.00^{bc}	8.27 ± 0.98^{b}	7.73 ± 0.98^{a}	7.40 1.10^{a}
Texture	7.87 ± 1.00^{a}	8.07 ± 1.01^{a}	7.80 ± 0.99^{a}	7.47 ± 0.86^{a}
Confidence Hose	7.97< μ < 8.02	8.02< μ < 8.11	7.71<μ <7.78	7.34< μ <7.66

Hedonic testing on anchovy chili sauce was carried out by assessing samples including the parameters of appearance, smell, taste, and texture of anchovy chili sauce with various additional concentrations of liquid smoke.

Hedonic testing on the appearance aspect of anchovy chili sauce with the addition of liquid smoke did not show significant differences in all samples of anchovy chili sauce. The highest appearance value was owned by the sample of anchovy chili sauce with the addition of 0.3% liquid smoke, namely

7.93, whereas the anchovy chili sauce with the addition of 0%, 0.6%, and 0.9% liquid smoke had the same appearance value the same, namely 7.87. This proves that liquid smoke does not have a real effect on changing the appearance of the anchovy rice sauce. The same thing also happened in the research of Asnani*et al*. (2022), where the appearance of the bete-bete fish sauce studied also had a color that tended to be bright red and not dull red.

The results of hedonic testing on the odor aspect have significant differences on the odor aspect. Based on the results obtained, the anchovy fish sauce has the highest odor value in the anchovy sauce without the addition of liquid smoke, namely 8.17, followed by the anchovy sauce with the addition of 0.3% liquid smoke at 8.00, the anchovy sauce with the addition of 0.3% liquid smoke. The addition of 0.6% liquid smoke was 7.60 and the lowest odor value was owned by anchovy fish sauce with the addition of 0.9% liquid smoke, namely 7.27. The smell of anchovy fish sauce without the addition of liquid smoke is a specific smell of chili sauce, but the smell of chili sauce with the addition of 0.3%, 0.6%, and 0.9% liquid smoke tends to have a distinctive aroma of liquid smoke which is less favourable panelist. According to Fahrul*et al*. (2023), phenol is a compound produced from the smoking process that forms a distinctive smoke aroma. The aromatic compounds contained in smoke greatly influence the smell of smoked fish samples.

The results of the hedonic test on the taste aspect of the anchovy sauce with various additions of liquid smoke showed significant differences in the results. The taste value of the anchovy fish chili sauce in this sensory test had the highest results for the anchovy fish chili sauce with the addition of liquid smoke with a concentration of 0.3% at 8.27, followed by the anchovy fish chili sauce without the addition of liquid smoke, namely 8.13, and the fish chili sauce. Anchovies with the addition of 0.6% and 0.9% liquid smoke, namely 7.73 and 7.40. Anchovy rice sauce with various concentrations of liquid smoke added generally has a specific chili taste, namely spicy and savory. According to Indrajaya (2016), chili sauce is a sauce whose main ingredient is crushed chilies so that chili juice comes out and has a spicy taste. The addition of liquid smoke to the anchovy rice sauce provides a smoky flavor without having to go through various smoking processes. This is confirmed by Manurung*et al*. (2017), namely that liquid smoke has a real influence on panelists preferences. This is because liquid smoke contains carbonyl compounds which give smoked fish a specific taste.

Hedonic testing on the texture aspect of anchovy chili sauce with various additional concentrations of liquid smoke showed significant differences in the results. Based on the results obtained, anchovy fish chili sauce with the addition of 0.3% liquid smoke concentration had the highest texture value, namely 8.07, followed by liquid smoked anchovy fish chili sauce without the addition of liquid smoke, namely 7.87, followed by anchovy chili sauce. Anchovy with the addition of 0.6% liquid smoke, namely 7.80 and the lowest texture value was owned by anchovy rice sauce with the addition of 0.9% liquid smoke, namely 7.47. According to Anggraini and Widawati (2015), texture is the touch value on a surface such as rough, smooth, hard or soft, rough or slippery, and tactile stimuli can be hot, cold, wet, dry, runny, and thick. The texture of anchovy chili sauce with the addition of liquid smoke is also influenced by the water content of the chili sauce. This is confirmed by Azizah*et al*. (2018), where water content is one of the components that make up food cells which is related to texture, if the water content of the material is lower the texture of the material becomes harder, and vice versa.

4. Conclusions

The conclusions that can be given to the research on the Effect of Adding Liquid Smoke with Various Concentrations on the Characteristics of Chili Anchovy Sauce (*Stolephorus*sp.) is as follows. The characteristic of anchovy (*Stolephorus* sp.) chili sauce with the addition of different concentrations of liquid smoke is that the research results show that the salt content value of the treatment is lower than the control. A decrease in values also occurred in the TPC test results where there was a decrease in the treatment compared to the control. The results of the water content test increased in the treatment compared to the control. An increase also occurred in the results of testing phenol levels, where the treatment experienced an increase in phenol levels compared to the control. The color test increased for L*, a*, and b* values in the treatment compared to the control.

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