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Utilization of Barracuda Fish Skin Gelatin (*Sphyraena*) in Making Body Lotion with the Addition of Liquid Smoke as an Antioxidant and Antibacterial

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ABSTRACT Gelatin can be used as an emulsifier, thickener, and humectant in body lotions. Body lotion must contain natural ingredients that can prevent skin damage such as liquid smoke, which is a natural ingredient that can be used as an antioxidant and antibacterial. The purpose of this study was to determine the potential of gelatin on the features of body lotion and the effect of adding liquid immediately as an antioxidant and antibacterial. The treatments used were gelatin with different concentrations (0%, 1%, 3%, and 5%) in the opening study and liquid smoke concentrations of 0%, 0.3%, 0.5%, and 0.7% in the main study with three repetition times. Parameters observed were viscosity, hedonic, pH, antioxidant activity, and TPC. The analysis revealed that all test parameters had a significant effect ($P<0.05$). The addition of gelatin with a concentration of 3% was the best treatment, with a viscosity value of 2847± 89.37 cP (according to SNI 16-4399-1996) and a hedonic value of $5.73<\mu<5.91$ (preferred by the panelists). While the best treatment for adding liquid smoke as an antioxidant and antibacterial was 0.7% liquid smoke with an antioxidant activity value of 34.87±0.325%, a TPC value of 2.46±0.071 log colonies/g, a pH value of 7.12± 0.025 and did not cause skin irritation.

Keywords: Antibacterial; antioxidant; barracuda fish gelatin; body lotion; liquid smoke

INTRODUCTION

Barracuda fish (*Sphyraena*) or Alu-Alu fish is a marine predatory fish that is also a high-value export commodity. According to fisheries statistical data, the production of alu-alu fish from marine capture fisheries production in 2020 amounted to 37.632,46 tons and increased to 37.794,63 tons in 2021. The increasing amount of barracuda fish production will also increase the amount of waste produced, which, if not handled properly, can have a negative impact on the environment, so it is important to process and utilize waste into more useful products, such as processing fish skin into gelatin.

Gelatin is a polypeptide bond derived from the hydrolysis of fish collagen, also known as the result of denaturation of collagen. The raw material for making gelatin can come from fishery waste such as offal, skin, scales, and bones. There are many uses for gelatin in both the food and non-food industries. Jaya *et al*. previous research (2022), showed that gelatin with a concentration of 2% and 7.5% corn starch was effectively applied to peel-off masks. Gelatin comes from many sources and is experiencing an increase in demand due to its many applications. Fish gelatin can be derived from a variety of marine species (fish, sponges, jellyfish, squid, and snails), with fish accounting for only 1.5% of the total. Gelatin is widely applied to cosmetic products such as lotion and shampoos (Al-Nimry *et al*., 2021).

Body lotion are a type of cosmetic that consists of two phases, namely the oil phase and the water pha, seso an emulsifier is needed to unite the two phases. Gelatin can be used as an emulsifier in making lotions because it can make the oil and water phases homogeneous. Gelatin has amphiphilic properties in the presence of hydrophilic and lipophilic amino acids, which can cause activity on the surface of the molecule. Besides that, gelatin can also function as a thickener and humectant agent. According to Wulanawati *et al*. (2019), lotion is an emulsion with or without medication for topical use in which the liquid phase can be evenly distributed over a large surface area of the skin so that it dries quickly after use and leaves a thin layer of drug components on the skin surface.

Development or innovation in cosmetic products is currently needed to improve the quality of these products. Body lotion is a type of cosmetic that functions to maintain moisture and prevent skin damage. Currently, there are still many cosmetic products that contain chemicals that can have adverse effects on human health. One way that can be done is to use natural ingredients such as liquid smoke in the manufacture of body lotion so that they enrich the content of the product.

Liquid smoke is a natural substance that comes from steam resulting from combustion, directly or indirectly, and that comes from materials that contain such things as lignin, cellulose, hemicellulose, and other carbon compounds. Liquid smoke has been widely used in industry as a disinfectant, fertilizer, pest repellent, and food preservative. Liquid smoke can act as an antioxidant and antibacterial. The presence of antioxidants in body lotions aims to protect the skin from skin damage due to oxidation and prevent premature aging, while the addition of antibacterial agents to body lotions can be used to prevent the growth of bacteria in cosmetics. The component components contained in liquid smoke consist of several groups, namely phenols and their derivatives, carbonyls (ketones and aldehydes), acids, and organic acid derivatives (Agustina *et al*., 2017).

This study aims to discuss the effect of using fish gelatin with different concentrations on the characteristics of

body lotion and the effect of adding liquid smoke as an antioxidant and antibacterial agent with different concentrations in body lotion.

MATERIALS AND METHODS

Materials

Gelatin is made from barracuda fish skin from Pasar Gang Baru Semarang and acetic acid from the Indrasari Chemical Store in Semarang. The ingredients for making body lotion are liquid smoke from PT Asap Cair Multiguna, liquid paraffin, stearic acid, TEA, glycerin, fragrance, and distilled water from the Indrasari Chemical Store, Semarang.

The tools used are a water bath (Memmert brand), glass stirrer, baking sheet, blanch cloth, measuring cup, beaker glass, oven, digital scales, thermometer, dropper pipette, gas stove, pan, lotion bottle, viscometer, pH meter, spectrophotometer, stomacher, vortex, incubator, autoclave, Bunsen, laminar air flow, micropipette, and scorecheet.

Methods

The research method used was the experimental laboratory method, which consisted of two stages: preliminary research, which was carried out to determine the best gelatin concentration (0%, 1%, 3%, and 5%) in making body lotion, and main research, which was carried out by adding liquid smoke. with different concentrations (0%, 0.3%, 0.5%, 0.7%) in body lotion.

According to the journal Rahmawati & Pranoto (2012), the method of making gelatin used in this study involves cutting barracuda fish skin into small pieces, cleaning and washing it, and then soaking it in acetic acid (3%) at a 1:4 ratio for 12 hours. washed and extracted using distilled water with a ratio of 1:3 at 60-70°C for 2 hours, then filtered. The filtrate was refined after being dried in an oven for 48 hours at 65°C.

The method of making body lotion refers to Hardjata *et al*. (2020), which was modified, namely: preparation one in the form of an oil phase consisting of stearic acid and liquid paraffin; preparation two in the form of an aqueous phase consisting of gelatin, glycerin, TEA, and distilled water. Gelatin is first dissolved in water. The two preparations were heated at 70–75°C and stirred separately until thoroughly mixed or homogeneous, then the two phases (oil phase and water phase) were mixed at 70°C and stirred until the two phases were homogeneous and reached a temperature of 40°C to become a triple preparation. The next process is adding liquid smoke in different concentrations (0%, 0.3%, 0.5%, and 0.7%) as well as fragrance and stirring until it is homogeneous and forms a body lotion.

Test methods

Viscosity test (Saptarini & Hadisoebroto, 2020)

A viscosity test on body lotion was carried out using a Brookfield viscometer. Viscosity testing is done by inserting the lotion into the container. Viscosity measurements were carried out using spindle number 64 with a speed set at 20 rpm. The results of the viscosity measurement are recorded after the viscometer shows a stable number or does not change. The viscosity value obtained can be expressed in a unit called a centipoise (cP).

Hedonic test (SNI 2346-2015)

The preference or hedonic test is carried out by means of one or several samples presented simultaneously to panelists who usually consume or use the product being tested, and scores are based on the level of preference using a score of 1-9 for each sensory attribute.

pH test (AOAC, 2005)

Test the level of acidity, or pH, by using a pH meter that has been calibrated using distilled water. Measurements are made directly by dipping the pH eye into the sample until the pH value shown on *the pH meter screen is stable or does not change*.

Antioxidant activity test (Mulyani et al., 2018)

The prepared sample was taken in 3 ml increments and placed in a 10 mL volumetric flask. Next, add 2 mL of DPPH solution to the volumetric flask and 10 mL of ethanol p.a. Leave it in a dark place for 30 minutes; after the operating time, the absorbance of the sample is read using a UV-Vis spectrophotometer at the optimum wavelength. Antioxidant activity is measured by calculating the % inhibition (% inhibition activity), which is determined using the following formula:

$$\% \text{ inhibisi} = \frac{\text{control absorbance-sample absorbance}}{\text{control absorbance}} \times 100\%$$

TPC test (Paramitha et al., 2017)

The sample solution was prepared with a dilution factor of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}. 1 gram of sample was added to 10 mL of sterile 0.85% NaCl solution and stirred until homogeneous, yielding a sample with a dilution factor of 10^{-1}. A 10^{-2} dilution was created by dissolving 1 mL of a 10^{-1} dilution sample in 0.85% sterile NaCl solution until the volume reached 10 mL. In the same way, a serial dilution of 10^{-3} and 10^{-4} was made, inoculating the sample on the media. As much as 1 mL of the diluted sample solution is put into a petri dish, and then 12-15 mL of sterile nutritional agar is poured into the cup. The petri dish is rotated in a figure-eight so that the suspension is mixed homogeneously. Allow it to solidify and incubate overnight at 37°C. The media that had been incubated overnight was removed.

Irritation test (Slamet & Waznah, 2019)

The irritation test was carried out by applying the body lotion that had been made to the backs of the hands of several different respondents for at least 15 minutes, then seeing what reaction was caused after using the body lotion.

Data analysis

The experimental design used in this study was a completely randomized design (CRD). Data from pH, viscosity, antioxidant activity, and TPC tests were tested by normality and homogeneity tests, then analyzed by analysis of variance (ANOVA), and then further tests were carried out in the form of the honest significant difference test (BNJ) if the data were significantly different. The hedonic test data was analyzed with Kruskall-Wallis and continued with the Mann-Whitney test if the results were significantly different.

RESULTS AND DISCUSSION

Viscosity test

Viscosity measurement is carried out to determine the thickness and flow of a material, which is measured using a viscometer. Viscosity is one of the important parameters in a semisolid liquid preparation because it will affect the stability of the emulsion. Based on the test results, it showed that the highest viscosity value in the body lotion sample was the lotion with 5% gelatin concentration and the lowest viscosity value was 0% gelatin concentration. Of the four body lotion samples tested, only two samples complied with SNI requirements, namely those with gelatin concentrations of 3% and 5%. The viscosity requirement according to SNI 16-4399-1996 is 2000-50000 cP. The results of the research that has been done show that the higher the concentration of gelatin used, the higher the viscosity value of the body lotion obtained. These results are in line with research conducted by Rahmandari *et al*. (2021), who applied gelatin to skin cream products, in which the product experienced an increase in viscosity value along with an increase in gelatin concentration. The results of the viscosity test on lotions with control treatment (0%) and gelatin concentrations of 1%, 3%, and 5% are presented in Figure 1.

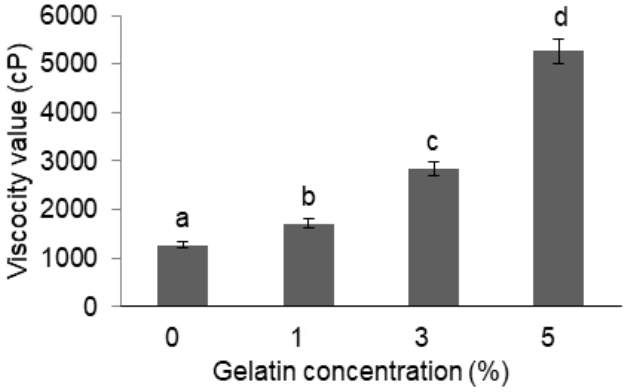

Figure 1. Viscosity measurement result.

High viscosity can affect the viscosity or flowability of a product. The amount of dissolved ingredients in both water and oil influences the thickness of body lotion. A good lotion must also have good viscosity, namely, a level that is neither too low nor too high. Too high a viscosity will make it more difficult for the product to be removed from the lotion preparation, whereas if the viscosity is too low, it will reduce the length of time the lotion sticks to the skin when used (Sutaryono *et al*., 2020). If the viscosity is high, the stability of a product is good, but it will be difficult to apply; if the viscosity is low, the flow rate of the product is large, but the adhesive power is low.

Apparition

The appariton of body lotion as a whole has a range of values from 3.87 to 6.23. Body lotion with the addition of different concentrations of gelatin has a different apparition, the results of the hedonic test show that body lotion with a concentration of 1% is most preferred by panelists which has a clean white and bright apparition. The addition of gelatin has an effect on the apparition of the body lotion, namely the higher the concentration of gelatin, the apparition of the lotion becomes yellowish cream. This could be because the barracuda fish skin gelatin obtained has a yellow-brown color, so that when applied it produces a yellowish cream color in the body lotion. According to Naiu & Yusuf (2018), the addition of gelatin to a product can produce a darker color.

Aroma

Aroma on body lotion has an average of 6.07, which is included in the like criteria. The scent of body lotion comes from the fragrance added to the formula. The results of the assessment through the hedonic test showed that the panelists tended to give almost the same value at each gelatin concentration and liked the aroma added to the formula. This is thought to be due to the aroma added to the four formulations having the same type and amount, namely vanilla aroma. According to Primary *et al*. (2020), aroma is an important parameter for determining consumer acceptance and preference for a product because it can describe the characteristics of the product.

Viscosity

Based on Table 1, body lotion with a gelatin concentration of 3% was most preferred by panelists, which had characteristics like body lotion in general, namely not too runny and not too thick, while body lotion with a concentration of 5% was the least preferred by panelists. The thickness of body lotion increases with increasing concentrations of gelatin. This is because gelatin is a hydrocolloid, which can absorb large amounts of water because it is hydrophilic. Gelatin is a material whose use is increasingly widespread for both food and non- food products; besides functioning as an emulsifier, gelatin can also be used as a thickener, gelling agent, binder, stabilizer, and adhesive (Wijaya *et al*., 2015).

Homogeneity

The results of the hedonic homogeneity test on the body lotion as a whole have a value range of 5,80-6,10. The homogeneity of the resulting body lotion shows good homogeneity; it is evenly mixed and has a uniform and smooth texture. This is because when mixing all the components of the material is done well. Pujiastuti & Kristiani (2019), homogeneity testing was carried out to find out whether the ingredients used in lotion preparations were mixed properly. The homogeneity of a preparation can be affected by the mixing process during preparation.

Moist impression

The results of the hedonic test showed that panelists liked the moist feeling the most in body lotion with a 3% gelatin concentration. The moisturizing effect of body lotion can come from the ingredients used. The ingredients in body lotion that can give a moist feeling to the skin are gelatin and glycerin. Both of these ingredient function as humectant agents that can give the skin a moist impression because gelatin and glycerin are hygroscopic components that can bind water and reduce the amount of water leaving the skin. A humectant is a material that can retain water in a preparation and can function to improve the stability of a material for a long time and protect components that are tightly bound in the material, including water, fat, and other components (Sukmawati *et al*., 2017).

Sticky feeling

Based on Table 1, the results of the hedonic test showed

that the body lotion product with a 3% gelatin concentration was most preferred by the panelists because it had the characteristics of a body lotion that was not too sticky, while the body lotion with a 5% gelatin concentration was the least preferred by the panelists because of its characteristics of being too sticky when applied to the skin. The sticky feeling of body lotion increases with increasing concentrations of gelatin. This is presumably due to the addition of gelatin to the formulation, followed by a reduced water concentration, which causes the body lotion product to become more sticky when applied to the skin. The sticky feeling is one of the parameters that is highly considered when selecting a lotion because the sticky feeling has a relationship with comfort after use (Purwaningsih *et al*., 2014).

Hedonic test

Table 1. Hedonic value of body lotion with different gelatin concentrations.

Characteristics	Gelatin concentration			
	0%	1%	3%	5%
Apparition	5.97±1.16[a]	6.3±0.57[a]	5.03±1.23[b]	3.87±1.55[c]
Aroma	6.07±0.58[a]	6.07±0.58[a]	6.07±0.58[a]	6.07±0.58[a]
Viscosity	4.17±0.75[a]	5.10±0.76[b]	6.17±0.67[c]	3.50±0.51[d]
Homogeneity	5.80±0.67[a]	6.03±0.62[a]	6.10±0.61[a]	5.93±0.45[a]
Moist impression	3.77±0.43[a]	4.80±0.67[b]	5.87±0.57[c]	3.33±0.48[d]
Sticky feeling	4.07±0.69[a]	4.73±0.79[b]	5.67±0.55[c]	2.47±0.51[d]

Main Research

pH test

pH measurement is carried out to determine the value of the degree of acidity of a product, which is measured using a pH meter. The pH value of body lotion with different concentrations of liquid smoke can be seen in Figure 2.

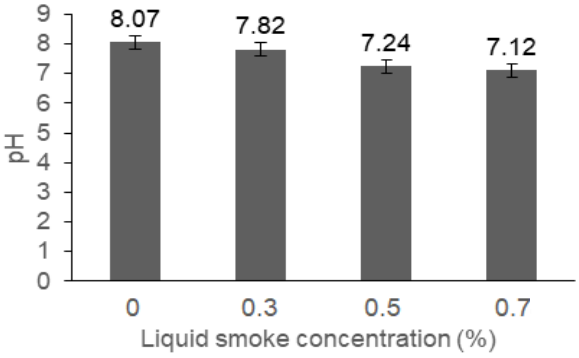

Figure 2. Body lotion pH value.

Based on Figure 2, the sample with the highest pH value is the body lotion sample with 0% liquid smoke concentration, which is 8.07, while the sample with the lowest pH value has a 0.7% liquid smoke concentration, which is 7.12, making it the sample that complies with SNI requirements, namely the sample with a liquid smoke concentration of 0.3%, 0.5%, and 0.7%. The pH value requirements according to SNI 16-4399-1996 are 4.5-8.0. The higher the concentration of liquid smoke, the lower the pH value of body lotion. These results are in line with the research of Hambali & Nurfadhila (2022), who applied liquid smoke to liquid soap products and found that the pH decreased when liquid smoke was added. The addition of liquid smoke causes the pH of liquid soap to decrease as the concentration of liquid smoke increases. Phenolic compounds are a component of liquid smoke. According to Frida *et al*. (2018), the higher the total phenol content in the liquid smoke, the lower the pH value (the more acidic the liquid smoke). The degree of acidity of a product is indicated by its pH value. Cosmetic preparations must have a pH that corresponds to the pH of skin acceptance; if the pH of cosmetic preparations is much different from the skin's or too acidic, then the product tends to cause irritation to the skin; likewise, if cosmetic preparations have alkaline properties, it will cause the skin to dry (Kurnianto *et al*., 2017).

Irritation test

The results of the irritation test on body lotion with the addition of different concentrations of liquid smoke showed negative results on all three assessment parameters. Some of the conditions for lotion products include not causing skin irritation, having a non-stinging odor, not being difficult to use, not sticking to the skin, not causing poisoning, and not leaving stains on clothes (Werdiningsih & Amalia, 2018). Skin irritation is closely related to the pH level of the body lotion sample, so if the pH of the body lotion is still within the appropriate range and no irritation such as itching, redness, or swelling of the skin occurs, the body lotion sample can be declared to meet the test requirements.

Table 2. Body lotion irritation test results with different liquid smoke concentrations.

Concentration	Results		
	Redness	Edema (swelling)	Itching
0%	(-) negative	(-) negative	(-) negative
0.3%	(-) negative	(-) negative	(-) negative
0.5%	(-) negative	(-) negative	(-) negative
0.7%	(-) negative	(-) negative	(-) negative

Antioxidant activity test

Based on the test results, the highest antioxidant activity was in the body lotion sample with a concentration of 0.7% liquid smoke with % inhibition, namely 34.87± 0.325, while the lowest antioxidant activity was in the body lotion sample with a concentration of 0% liquid

smoke with % inhibition of 27.19±0.065. The antioxidant activity of body lotion increases with increasing concentrations of liquid smoke. According to Hutomo et al. (2015), the phenol content will increase along with the increasing concentration of the liquid smoke used. This compound can act as a natural antioxidant because it has the ability to act as a hydrogen donor against free radicals. Phenol contained in liquid smoke has antioxidant properties, so it can inhibit free radical formation in the early stages of oxidation (Fauziah *et al*., 2014). Based on the % inhibition obtained by adding liquid smoke, body lotion has moderate antioxidant activity. Even so, body lotion without the addition of liquid smoke also has an antioxidant activity of 27.19%. This can be caused because the manufacture of body lotion also uses fish skin gelatin, which contains the amino acids glycine and proline. The higher the content of glycine and proline, the higher the antioxidant activity of fish gelatin (Nurilmala *et al*., 2020). The results of testing the antioxidant activity of body lotion are presented in Figure 3.

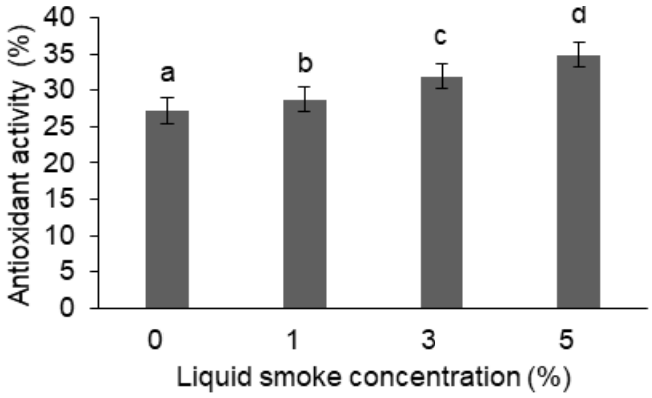

Figure 3. Antioxidant activity of body lotion.

Total Plate Count Test

Table 3. TPC body lotion test results with different concentrations of liquid smoke.

No	Treatment	Total Plate Count (Log colony/g)
1.	0%	4.34±0.072^{c}
2.	0.3%	3.56±0.057^{b}
3.	0.5%	3.33±0.132^{b}
4.	0.7%	2.46±0.071^{a}

Based on the results of the research that has been done, it shows a decrease in the Total Plate Count value along with an increase in liquid smoke concentration. Of the four body lotion samples, three samples did not meet the requirements, namely the body lotion with a 0% liquid smoke concentration of 4.34±0.072 log colonies/g, the body lotion with a concentration of 0.3% liquid smoke with a log TPC value of 3.56±0,057 colonies/g, and the body lotion with a concentration of 0.5% liquid smoke with a log of 3.33±0.132 log colonies/g. whereas in body lotion with the addition of 0,7% liquid smoke, the TPC log value was 2.46 colonies/g, so that it met BPOM requirements. According to Food and Drug Supervisory Agency of the Republic of Indonesia No. 12 (2014), the requirement for total plate number microbial contamination in cosmetic products is 10^3 colonies/g, or 3 log colonies/g. Bacterial activity in body lotion can be inhibited because there are compounds in liquid smoke that act as antibacterials, such as phenol, formaldehyde, and carboxylic acids. Liquid smoke can inhibit bacterial growth due to the presence of phenolic compounds, which can bind to bacterial proteins through hydrogen bonds, causing the protein structure to be damaged. Phenol can also disrupt the integrity of the cytoplasm, which causes the escape of macromolecules and ions from the bacterial cell so that the bacterial cell loses its shape and lysis occurs. The presence of acidic compounds also serves to lower the pH inside the bacterial cells so that the bacteria will release H+ (Erlytasari *et al*., 2019).

CONCLUSIONS AND RECOMMENDATION

Counclusions

The use of barracuda fish skin gelatin with a concentration of 3% showed good parameter characteristics in the viscosity test and hedonic test, with a viscosity value of 2847±89.37 cP and a hedonic value with a confidence interval of 5.73 <μ< 5.91 (preferred by the panelists). In addition, the addition of liquid smoke with a concentration of 0.7% showed the best results as an antioxidant and antibacterial. The antioxidant activity value of body lotion with a 0.7% liquid smoke concentration was 34.87± 0.325% while the total plate count value was 2.46± 0.071 log colonies/g.

Recommendation

Recommendations that can be given from research on the use of barracuda skin gelatin (*Sphyraena*) in making body lotion with the addition of liquid smoke as an antioxidant and antibacterial are that it is necessary to conduct research related to the maximum use time of body lotion products with the addition of liquid smoke.

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