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Effect of the Addition Tilapia Skin Collagen Concentration to Lotion Characteristics

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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

The purpose of this research was to determine the best concentration of the tilapia skin collagen addition to obtain the characteristics of the lotion in accordance with the established standards. The research was carried out at the Fishery Product Processing Technology Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University, Central Laboratory of Padjadjaran University and Faculty of Mathematics and Natural Sciences Laboratory of Padjadjaran University between March 2021 - June 2021. The method used in this research was experimental with a completely randomized design consisted of 5 treatments with 4 replications added the concentration of the tilapia skin collagen (0%, 4%, 5%, 6% and 7%) based on lotion formulations. Parameters observed included pH, viscosity, spreadability, weight loss, homogeneity and the organoleptic (appearance, color, scent, texture). The conclusion from this research was that the addition of 7% the tilapia skin collagen concentration was the best treatment with a homogeneous appearance, a slightly yellowish white color, a slightly lavender scent and a slightly thick texture. The lotion had pH value of 6.35, viscosity of 7,197 cP, 5.74 cm spreadability and a weight loss of 2.8%.

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1. INTRODUCTION

Processed fishery products are the main source of the animal protein in the world apart from processed land livestock meat, eggs and milk [1]. The volume of processed fishery products in 2019 reached 6,850,000 tons with the number of the micro and small-scale fish processing units were amounting to 62,389 units and 670 units of the medium and the large scale [2]. Processed products that are very popular both domestically and abroad tilapia products. The development of the tilapia processed the industry will have an impact on the increase in the waste produced, that is the waste in the form of fish heads, bones, scales, entrails and the fish skin [3].

Fish waste can be a potential alternative to be used as raw material for collagen, one of which is fish skin [4]. The results of the proximate test of dried the tilapia skin contained protein content of 47.43%; water 23.74%; fat 1.68%; and 3.01% ash. The high protein content of the tilapia skin indicates that the tilapia skin had a good quality to be used as a raw material for collagen [5].

Collagen is a main structural component of white connective tissue which covers almost 30% of the total protein in the vertebrate and invertebrate organ tissues [6]. Collagen can be used as a raw material in the cosmetic and pharmaceutical industries. One of the cosmetic products that use collagen as a raw material is lotion. Collagen acts as an active substance in lotions that can provide many benefits for the skin, such as preventing wrinkles, increasing skin moisture, protecting the skin from free radicals, and maintaining the skin elasticity [7].

Lotion is a preparation in the form of a suspension,a solution, or an emulsion for use on the skin, the lotion can also be defined as a runny cream. Lotions are emulsions but have a lower wax and oil content than creams [8].The use of fish skin collagen in the lotion is an alternative to replace the use of commercial collagen, because collagen is usually obtained from the cow skin, the pig skin, or the chicken skin so that its use is not appropriate due to religious considerations and biological contamination [9]. Therefore, it was necessary to do research on increased the concentration of skin collagen in the lotion to get the best lotion characteristics.

2. MATERIALS AND METHODS

The research was conducted from March 2021 – June 2021. The research consisted of collagen isolation, lotion making, lotion pH tested, lotion homogeneity, lotion dispersion and lotion organoleptic was carried out at the Fishery Product Processing Technology Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. Collagen dried used a freeze dryer was carried out at the Central Laboratory of Padjadjaran University. Viscosity tested was carried out at the Faculty of Mathematics and Natural Sciences Laboratory, Padjadjaran University.

2.1 Tools and Materials

The tools used in this research were knife, cutting board, beaker glass (Pyrex), analytical balance (Sonic), measuring cup (Pyrex), measuring flask (Pyrex), filter, refrigator (Sanden intercool), pH meter (Hanna), universal test paper (Mcolorphast), alumunium foil (Klinpak), funnel, filter paper, freeze dryer (Labconco),spatula, hot plate stirrer (Nouva), plastic container, questionnaire sheet, petri dish (Pyrex), 100 gram weight, ruler, Poly propylene plasticand, viscometer (Brookfield). The material used in the research were tilapia skin (*Oreochromis niloticus*) obtained from the market around the city of Bandung, NaOH (Merck) 0.05 M, CH_3COOH (Merck) 0.15 M, Aquades, NaCl (Merck) 0.9 M, stearic acid (Pudak), cetyl alcohol (Croda), liquid paraffin, glycerin (Brataco), triethanolamine (Loba chemie), lavender fragrance (Bronners).

2.2 Research Methods

The method used in this research was experimental. The experimental design used was a completely randomized design (CRD) consisted of 5 treatments and 4 replications. The treatments used in this research consist of:

- Treatment A (control) = Lotion with the addition of 0% concentration of tilapia skin collagen.
- Treatment B = Lotion with the addition of 4% concentration of tilapia skin collagen.
- Treatment C = Lotion with the addition of 5% concentration of tilapia skin collagen.

- Treatment D = Lotion with the addition of 6% concentration of tilapia skin collagen.
- Treatment E = Lotion with the addition of 7% concentration of tilapia skin collagen.

Determination of the treatment of addition of the lowest concentration of collagen based on previous research on the formulation of lotion preparations used fish bone collagen with the addition of 0%, 1.5%, 2.5% and 3.5% treatment [10]. The results showed that the addition of 3.5% fishbone collagen to the lotion was the best treatment, therefore this research used concentration treatment higher than 3.5%.

Determination of the treatment of added the highest concentration of collagen based on previous research on the addition of the fish concentrate in a serum [11]. The results of the research showed that the addition of 7.5%, 10% and 12.5% fish concentrate resulted in a yellower product. The yellow color in cosmetic products is less favored by users of beauty products, one of which is the lotion [12], therefore this research used a treatment concentration lower than 7.5%.

2.3 Research Stages

This research consists of three stages, the first stage was the collagen isolation [13].The second stage was made the lotion [14]. The last stage was the observation with the parameters of lotion pH, lotion viscosity, lotion spreadability, lotion weight loss, lotion homogeneity and lotion organoleptic.

2.3.1 Collagen isolation

Fish skin was cleaned with clean water and cut to a size of 0.5 x 0.5 cm. Then 50 g of fish skin was soaked with a solution of NaOH 0,05 M in a glass beaker with a ratio of 1:10 (w/v) for 4 h.Then the fish skin was separated from the NaOH solution and cleaned used running water until the pH was close to neutral. Then the fish skin was soaked in 0.15 M acetic acid in a ratio of 1:10 (w/v) for 1 h at a temperature of ± 4° C.The extract solution was separated from the raffinate (extraction residue) then added 0.9 M NaCl, stirred until homogeneous and white lumps would form in the solution. The white globules were filtered used filter paper to obtain wet collagen. Collagen was washed used 100 ml of distilled water three times until the pH was close to neutral.The collagen was then dried used a freeze dryer [13].

2.3.2 Lotion making

The formulation for made 50 g lotion preparations with the addition of tilapia skin collagen (Table 1). The principle of made lotion was mixed accompanied by heated and stirred. The material was separated into two parts, namely the preparation of the oil phase (stearic acid, cetyl alcohol, liquid paraffin) and aqueous phase (glycerin, triethanolamine, aquades). The oil phase material was put into a 250 ml glass beaker heated used a hot plate stirrer for 10 min to a temperature of 70-75^{o}C then stirred until homogeneous. The aqueous phase material was mixed into a 250 ml glass beaker heated used a hot plate stirrer for 25 min to a temperature of 70-75^{o}C then stirred until homogeneous. The oil and water phase ingredients were mixed at a temperature of ± 70^{o}C and then stirred. Then the fragrance was added at a temperature of 35^{o}C and then stirred until homogeneous for 1 min. Collagen was added slowly accorded to the concentration of the treatment then homogenized.Then the lotion was left on for 30 min and then put into a container [14].

2.4 Parameter Observe

The parameters observed in this research were pH of the lotion [15], viscosity of the lotion [15], spreadability of the lotion [16], weight loss of the lotion [17], homogeneity of the lotion [18] and the organoleptic of the lotion included appearance, color, scent and texture [15].

2.5 Data Analysis

The data from the lotion homogeneity test was analyzed descriptively. The data from the lotion pH test, lotion spreadability, lotion weight and lotion viscosity were analyzed by parametric statistics used Analysis of Variance (ANOVA) at a 95% confidence level, if there is a significant difference (P<0,05), then processing with Duncan's test at a 95% confidence level.

The data obtained from the lotion organoleptic test were analyzed by non-parametric statistics Friedman test, multiple comparison test performed if $H \leq \chi^2_{\alpha(k-1)}$ which means there is a significant difference (P<0,05) (H_0 is rejected).

Determination of the best treatment used the Bayes method. Bayes method was one of the techniques that can be used for made the best decisions from a number of alternatives with the aim of produced results that consider various

criteria. The results of the Bayes calculation will show the highest priority value which will be determined as the best treatment [19].

3. RESULTS AND DISCUSSION

3.1 Lotion pH

Based on the test results (Fig 1), the pH value of the lotion ranged from 6.35 - 7.35, with the lowest pH value in the treatment with the addition of 7% collagen concentration of 6.35 and the highest pH value in the treatment with the addition of 0% collagen concentration of 7.35. The results of the pH test showed that the lotion complied with the SNI 16-4399-1996 standard as a lotion quality requirement, which ranged between 4.5-8 [15]. The recommended a lotion pH range is between 4.5 - 6.5 accorded to the skin's natural pH [20], so the lotion with the addition of collagen concentrations of 6% and 7% was a treatment with a pH that was suitable for the skin's natural pH.

The results of the Duncan test (Fig 1) showed that the treatment with different concentrations of the addition of tilapia skin collagen gave a significantly different effect (P<0,05) on the pH of the lotion. The decrease in pH value was caused by the addition of collagen which can lower the pH of the lotion. The higher the addition of the collagen concentration, the lower the pH level of the lotion.The addition of a tilapia skin collagen had a neutral pH value which tends to be acidic [21].

3.2 Lotion Viscosity

Based on the test results (Fig 2), the lotion viscosity value ranged from 6,245 - 7,197 cP, with the lowest viscosity value in the treatment of added 0% collagen concentration of 6245 and the highest viscosity value in the treatment of added 7% collagen concentration with a value of 7,197 cP. The results of the viscosity test show that the lotion complies with the standard of SNI 16-4399-1996 as the lotion quality requirement, which is in the range of 2,000-50,000 [15]. The viscosity of a good lotion had a high value, because the higher the viscosity, the more difficult the movement of particles so that the lotion will become stable or no emulsion separation occurs [22]. Based on this statement, the addition of a collagen concentration of 7% was a treatment with a viscosity that was the most suitable for the standard.

The results of the Duncan test (Fig 2) showed that the different treatment of addition of the collagen concentration in tilapia skin gave a significantly different effect (P<0,05) on the viscosity of the lotion. The increase in viscosity value was influenced by the addition of collagen concentration in the lotion. The higher the addition of the collagen concentration, the higher the lotion viscosity value. The increase in the viscosity value occurs because the water content in the lotion tends to decrease and decrease due to the nature of collagen which can bind water, so the lotion will become thicker and the viscosity value will increase [21].

3.3 Lotion Spreadability

Based on the test results (Fig 3), the spreadability value of the lotion ranged from 5.74 - 6.54 cm, with the lowest dispersion value at the addition of 7% collagen concentration of 5.74 cm and the highest dispersion value in the treatment of added 0% collagen concentration with a value of 6.54 cm. The results of the spreadability test showed that the lotion was in accordance with the standard, which was 5-7 cm and was very easy to spread [16].

Table 1. Lotion making formulation

Ingredients	Treatment				
	A (%)	B (%)	C (%)	D (%)	E (%)
Stearic acid	3.5	3.5	3.5	3.5	3.5
Cetyl alcohol	1.5	1.5	1.5	1.5	1.5
Liquid paraffin	3	3	3	3	3
Glycerin	3	3	3	3	3
Triethanolamine	1	1	1	1	1
Lavender fragrance	0.5	0.5	0.5	0.5	0.5
Aquades	87.5	87.5	87.5	87.5	87.5
Tilapia fish skin collagen	0	4	5	6	7

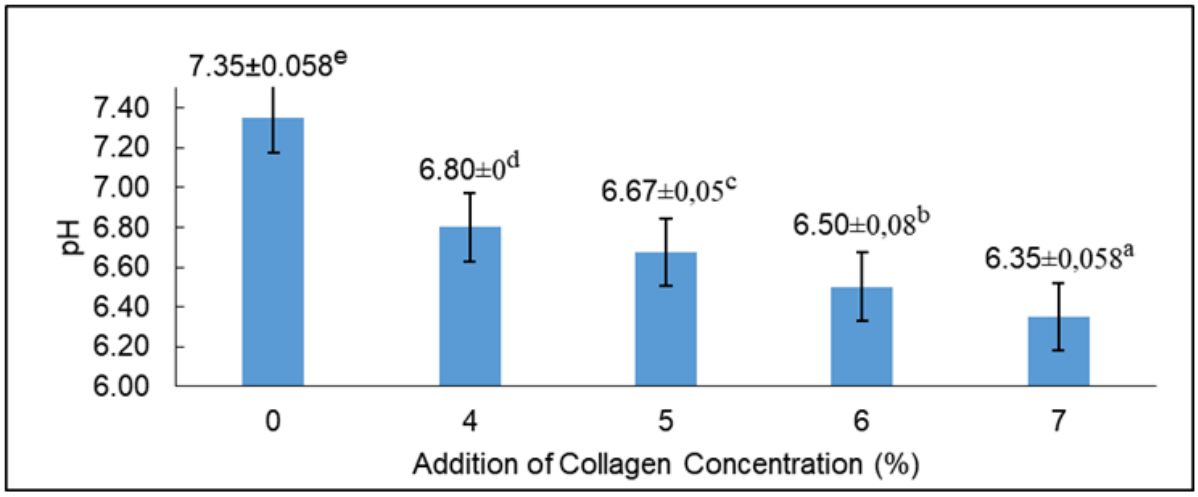

Fig. 1. Lotion pH test results

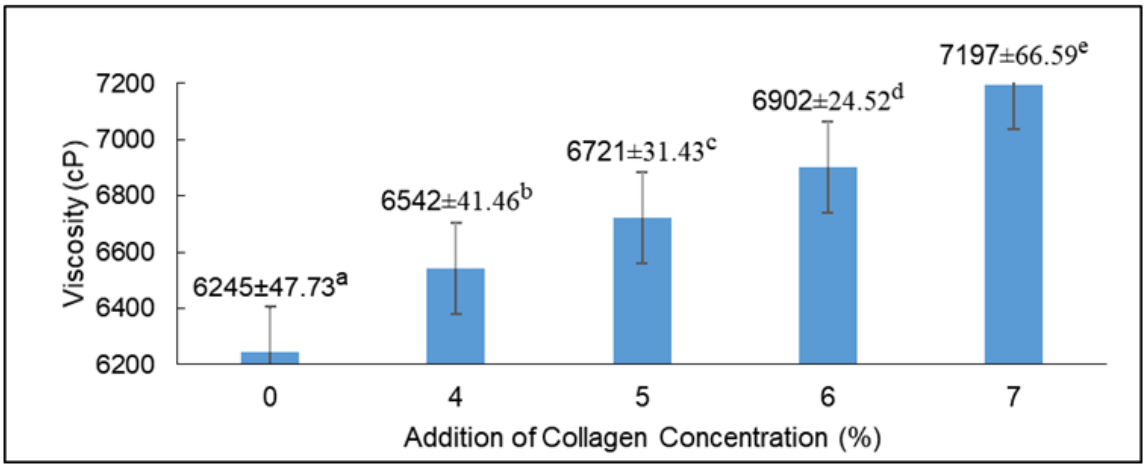

Fig. 2. Lotion viscosity test results

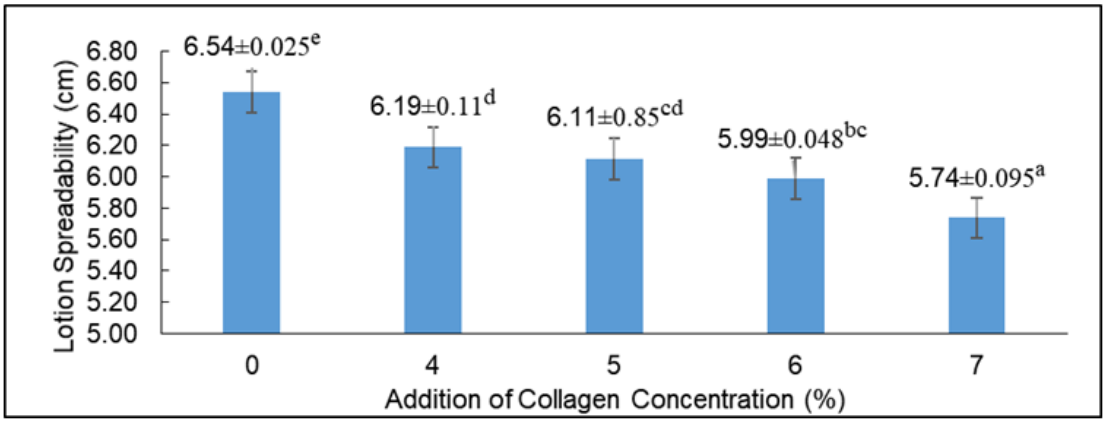

Fig. 3. Lotion spreadability test results

The results of the Duncan test (Fig 3) showed that the treatment with the addition of 0% and 7% collagen concentrations were significantly different (P<0,05) from the other treatments. The addition of 4% concentration of collagen was not significantly different (P<0,05) from the addition

of 5% concentration. The addition of 5% collagen concentration was not significantly different (P<0,05) from the addition of 6% concentration. The decrease in the spreadability due to the addition of collagen is thought to be due to one of the physicochemical properties of collagen, namely increased viscosity. The decrease in the spreadability can be caused by an increase in lotion viscosity [23]. The spreadability is inversely proportional to the viscosity of the lotion, the higher the viscosity the lower the spreadability [24].

3.4 Weight Loss Lotion

Based on the test results (Fig 4), the lotion weight shrinkage value ranges from 2.8 to 6.4%, with the lowest weight loss value in the addition of 7% collagen concentration treatment of 2.8% and the highest weight loss value in the 0% collagen concentration addition treatment with a value of 6.4%. The results of the weight loss test showed that the lotion with the addition of a concentration of 7% collagen was a better treatment than other treatments accorded to the statement of [17], a good lotion had a small percentage of the weight loss or no weight loss.

The results of the Duncan test (Fig 4) showed that the treatment with the addition of 0% collagen concentration was significantly different (P<0,05) from the other treatments. The addition of 4% concentration of collagen was not significantly different (P<0,05) from the addition of 5% concentration. The addition of 5% collagen concentration was not significantly different from the addition of 6% concentration. The addition of 6% collagen concentration was not significantly different (P<0,05) from the addition of 7% concentration.

The decrease in the value of the lotion weight loss was influenced by the addition of the collagen concentration in the lotion. The higher the addition of the collagen concentration, the lower the lotion weight loss value. This was because collagen had a function as a binder of one compound with another compound. Due to the function of the collagen, the addition of collagen can bind water to the lotion [25].

3.5 Lotion Homogeneity

Based on the results of the lotion homogeneity test (Table 2), it shows that all treatments have homogeneous characteristics, because at the time of tested there were no coarse particles or lumps in each lotion treatment.This shows that the ingredients that made the lotion and collagen was dissolved and mixed well. Based on these results, the lotion was in accordance with the standard, a lotion that had good homogeneity if there were no fine grains or clumped particles [18].

The addition of collagen to the lotion does not affect the homogeneity of the lotion, this was because the addition of collagen was carried out slowly and the stirred was carried out until evenly distributed. The homogeneity of the lotion was influenced by the technique or the method of mixed carried out and the tools used in the lotion made the process [26].

3.6 Description and Hedonic Organoleptic Lotion

3.6.1 Appearance

Based on the results of the description test of the appearance of the lotion (Table 3), all treatments had the homogeneous appearance. The lotion was said to had a homogeneous appearance because at the time of tested there was no coarse particles or lumps of the uniform color and there were no phase separation. The homogeneous lotion was caused by the stirred a rate during the manufacture of the lotion was stable so that the ingredients were evenly mixed. Besides the stirred rate, the most important factor in stabilized an emulsion is the physical properties of the emulsified a layer produced by the lotion agent [27].

Table 2. Lotion homogeneity test results

Addition of Collagen Concentration	Replications			
	1	2	3	4
0%	H	H	H	H
4%	H	H	H	H
5%	H	H	H	H
6%	H	H	H	H
7%	H	H	H	H

Description: H = Homogeneous

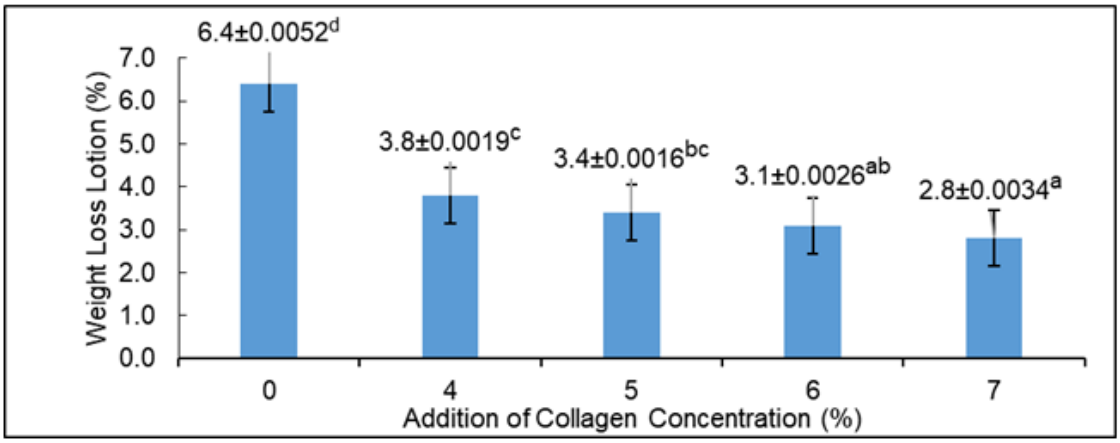

Fig. 4. Lotion weight loss test results

Table 3. Test results description organoleptic lotion

Addition of Collagen Concentration	Appearance	Color	Scent	Texture
0%	Homogeneous	White	Scent of lavender	Diluted
4%	Homogeneous	Slightly yellowish white	Scent of lavender	Slightly diluted
5%	Homogeneous	Slightly yellowish white	Slightly lavender scent	Slightly diluted
6%	Homogeneous	Slightly yellowish white	Slightly lavender scent	Slightly thick
7%	Homogeneous	Slightly yellowish white	Slightly lavender scent	Slightly thick

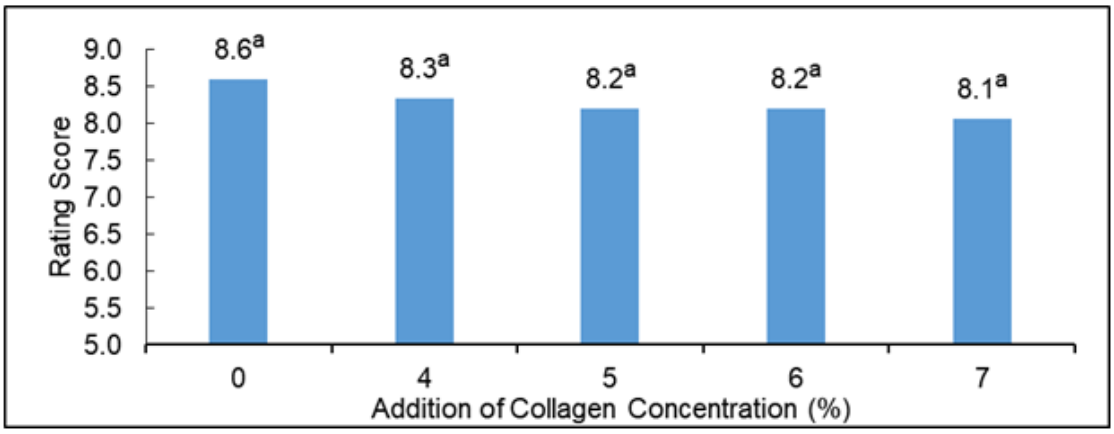

Fig. 5. Lotion appearance hedonic test results

Based on the results of the hedonic test, the appearance of the lotion (Fig 5) shows preference value ranging from 8.1 to 8.4 which means it had liked value. The lowest value was in the addition of 7% concentration treatment and the highest value was in the 0% concentration addition treatment. The results of the multiple comparison test (Fig 5) showed that the treatment with different concentrations of collagen had no significant effect (P<0,05) on the appearance of the lotion. The level of the preference for the appearance received by the panelists was a homogeneous lotion.

3.6.2 Color

Based on the results of the description test of the color of the lotion (Table 3), the addition of 0% concentration treatment had a white color, while the 4%, 5%, 6% and 7% treatments had a slightly yellowish white color. The difference in the color between 0% treatment and other treatments were due to the addition of collagen affected the color of the lotion. The collagen can affect the color of a final product that was added with collagen. Tilapia skin collagen had less brightness and was yellowish white [13].

Based on the results of the hedonic test for the color (Fig 6), the preference value ranges from 6.7 to 8.2, which means it had neutral-like value. The lowest value was in the addition of 7% concentration treatment and the highest value was in the 0% concentration addition treatment. The results of the multiple comparison test (Fig 6) show that the treatment with the addition of 0% concentration was not significantly different (P<0,05) from the treatment with the addition of 4%, 5% and 6% concentrations. The treatment with the addition of 0% concentration was significantly different (P<0,05) from the treatment with the addition of 7% concentration.The treatment with the addition of 4% concentration was not significantly different (P<0,05) from the addition of 5%, 6% and 7% concentrations. The level of the color preference received by the panelists was a white lotion and slightly yellowish white.

3.6.3 Scent

Based on the test results of the description of the lotion scent (Table 3), the addition of 0% and 4% concentration treatments had a lavender scent, 5% and 6% 7% had a slightly lavender scent. The scent of lavender in the lotion was caused by the fragrance added to the lotion. The decrease in the lavender scent in the lotion was caused by the addition of collagen in the lotion. The collagen tends to have a less pleasant scent so that it can reduce the scent produced in cosmetic products [21].

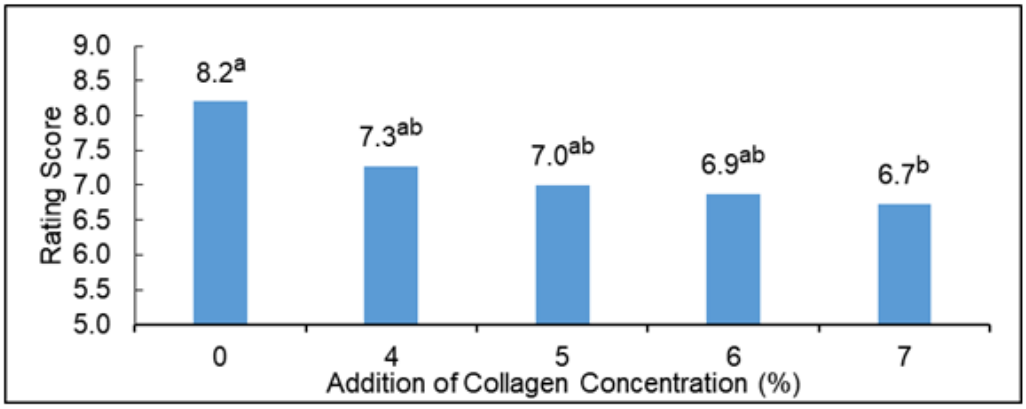

Fig. 6. Lotion color hedonic test results

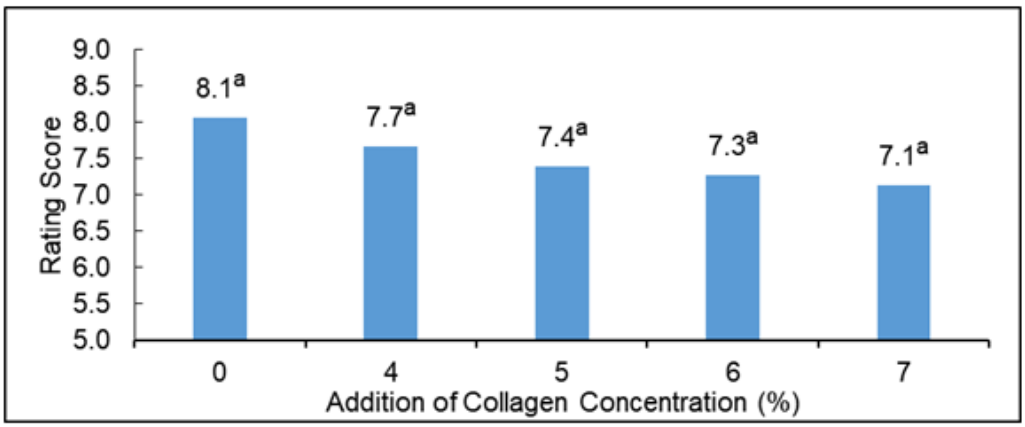

Fig. 7. Hedonic scent lotion test results

Based on the results of the hedonic test on the scent (Fig 7), the preference value ranges from 7.1 to 8.1, which means it had a rather like - like value. The lowest value was in the addition of 7% concentration treatment and the highest value was in the 0% concentration addition treatment. The results of the multiple comparison test (Fig 7) showed that the addition of collagen concentration was not significantly different (P<0,05) from the scent lotion. The level of preference for the scent received by the panelists was a slightly lavender-scented lotion and a lavender scent.

3.6.4 Texture

Based on the results of the lotion texture description test (Table 3), the addition of 0% concentration treatment had a runny texture, 4% and 5% treatments had a slightly runny texture, while 6% and 7% had a slightly thick texture. Determinants of the lotion texture were influenced by constituent ingredients classified in the oil phase such as stearic acid, cetyl alcohol and additives [28].

Based on the results of the hedonic test on texture (Fig 8) shows the preference value ranges from 5.7 to 7.9 which means it had neutral-like value. he lowest value in the addition of 0% concentration treatment and the highest value on the addition of 7% concentration treatment. The results of the multiple comparison test (Fig 8) showed that the 0% treatment was significantly different (P<0,05) from the collagen addition treatment, while the difference in the addition of collagen concentration had no significant effect (P<0,05) on the lotion texture preference value.The level of texture preference accepted by the panelists was that the lotion was slightly runny and slightly thick.

3.7 Decision Making with Bayes Method

Bayes method was one of the techniques used to perform an analysis in made the best decisions from alternatives or treatments by considering the criteria.Parameters weighted in this method include objective parameters (pH, viscosity, spreadability, weight loss and homogeneity) and subjective parameters (appearance, color, scent and texture) [19].

The ranking value used ranges from 1 to 5 according to the treatment of adding the concentration of tilapia skin collagen. The ranking value was obtained based on the results of the best treatment for each parameter. The value of criteria was multiplied by the ranked value to obtained an alternative value. The highest alternative value indicates the best lotion [19].

Based on the results of calculations used the Bayes method (Table 4), the results of the lotion treatment with the addition of a collagen concentration of 7% have alternative values and the highest priority of 3.41 and 0.209.Lotion with a concentration of 0% collagen addition had the lowest alternative and priority values of 3.13 and 0.191.

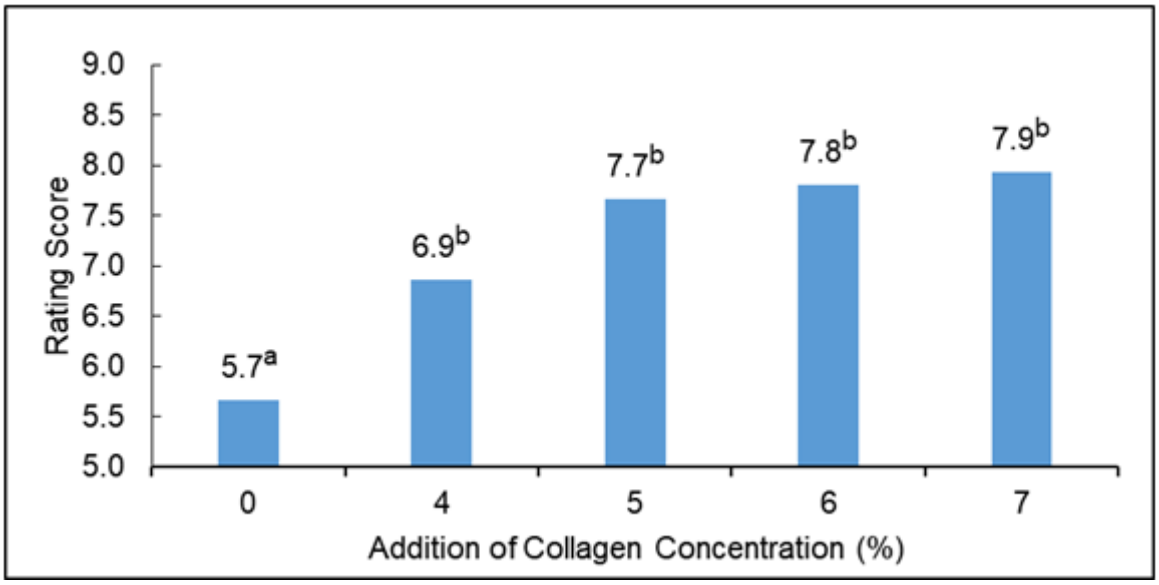

Fig. 8. Lotion texture hedonic test results

Table 4. Bayes method calculation results

Parameter	Rank Value					Value of Criteria
	0%	4%	5%	6%	7%	
pH	1	2	3	4	5	0.136
Viscosity	1	2	3	4	5	0.136
Spreadability	5	4	3	2	1	0.136
Weight Loss	1	2	3	4	5	0.136
Homogeneity	5	5	5	5	5	0.136
Appearance	5	4	3	2	1	0.116
Color	5	4	3	2	1	0.060
Scent	5	4	3	2	1	0.086
Texture	1	2	3	4	5	0.060
Alternative Value	3.13	3.20	3.27	3.34	**3.41**	
Priority Value	0.191	0.196	0.200	0.204	**0.209**	
Rank Treatment	5	4	3	2	**1**	

4. CONCLUSION

Based on the results of the research, it can be concluded that the addition of the best concentration of the tilapia skin collagen to produce a lotion that meets the standards and was preferred by the panelists was 7%. The lotion had a homogeneous appearance, a slightly yellowish white color, a slightly fragrant scent and a slightly thick texture with a pH value of 6.35, a viscosity of 7,197 cP, a spreadability of 5.74 cm and a weight loss of 2.8%.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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