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The effect of *Osteochilus hasselti* (Valenciennes, 1842) bone gelatin addition toward jelly candy's preferences level

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ABSTRACT

The purpose of this research is to determine the concentration of gelatin of nilem fish bone from the panelists. The method used in the research was an experimental method with four treatments of gelatin addition, which are 9%, 10%, and 11% gelatin of nilem fish bone, and addition of 10% of commercial gelatin from the total weight of the material (sucrose, glucose syrup, flavor, citric acid and water). The parameters observed as panelists' preferences are the appearance, flavor, taste and texture which were performed by semi-trained panelists. The data obtained were analyzed using Friedman Test, Multiple Comparison and Bayes Method. The most preferred jelly candy by the panelists is the treatment of adding 10% gelatin of nilem fish bone with a median value of apperance was 7, flavor was 7, taste and texture was 9.

***Keywords*:** gelatin, bone, nilem fish, jelly candy, preference level, *Osteochilus hasselti*

1. INTRODUCTION

Nilem fish *(Osteochilus hasselti)* is one type of native fish in Indonesian waters that lives in calm currents and shallow places such as lakes, rivers and swamps. Nilem fish are easily

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cultived. but production tends to decrease compared to other fish because the utilization of nilem fish is still not maximal [11].

Nilem fish are sold in traditional markets in a fresh state but are less attractive to consumers for consumption because of the huge bones. Community consumption for fishery products is very limited to fresh fish products and processed products. The amount of bones found in nilem fish is one of the shortcomings of nilem fish [5].

In addition to having deficiencies, nilem fish has the advantage of high fecundity which can result in large numbers of eggs [12]. The egg is one of the potential in the field of fisheries processing. Nilem fish eggs can be used as a substitute for caviar.

The use of nilem fish eggs produces waste. The waste which are produced includes bones, skin, fins, scales, head and innards [12]. These wastes are the biggest problem in the fisheries processing industry. So far the waste has not been utilized optimally, the waste is only used for feed ingredients so that the economical value is very small.

Waste can be used to increase added value, one of which is bone. Fish bones contain collagen. Collagen is the main structural protein kind the animal kingdom [1]. Collagen is the main raw material for making gelatin, therefore fish bones have a high enough potential to be used as gelatin [5].

Gelatin consists of 50.5% carbon, 6.8% hydrogen, 17% nitrogen and 25.2% oxygen is an insoluble protein resulting from collagen hydrolysis from various animal sources such as bones and skin which are widely used for industrial use [14]. Gelatin has many application in food, pharmaceutical, photographic and other product [2]. Gelatin in the food industry is used for stabilizers, thickeners, emulsifiers, adhesives, edible food wrappers, increasing water binding capacity, and as a gelling agent for candy products [18]. The properties of gelatin include tasteless, odorless, colorless [2]. The properties of gelatin cause gelatin to be preferred in making *jelly* candy. Gelatin functions as a gel for making jelly candy.

Gelatin used in making *jelly* candy comes from cows or pigs. The use of raw material for skin or pork bones is very inappropriate in Indonesia, where the majority of the population is Muslim because it violates Islamic law [3]. The use of bone or cow skin raw material is also very vulnerable because it is feared that the cow will get anthrax and mad cow disease [11].

Photo 1. Nilem fish - *Osteochilus hasselti* (Valenciennes, 1842)

One of the ingredients that can be used for making gelatin which is clearly halal is the by-product of fish processing, namely from the bones of nilem fish [16-47].

Producing *jelly* using gelatin can inhibit crystallization of the sugar, turning the liquid into a solid, elastic, improve the shape and texture of the *jelly* resulted [6]. The most important actor in making *jelly* candy is the concentration of gelatin in the mixture, because the gel only forms within certain limits. If the given concentration is too low it will be a soft gel or no gel will form, but if the concentration is too high then the gel that is formed will be rigid [13]. This has an effect on the level of people's preference for *jelly* candy, research on the concentration of gelatin from fish bones to *jelly* candy has been widely used, but each fish bone that is used as a raw material for gelatin produces a different quality, therefore it is important to do it research on the effect of the concentration of gelatin from nilem fish bone on *jelly* candy making.

This research aims to determine the concentration of gelatin in the nilem fish bone that is right so that the *jelly* candy can be obtained by the panelists.

2. MATERIALS AND METHODS

2. 1. Materials and Tools

Tools used: Plastic containers, thermometer, stirrer, scales with a precision of 1 g, jelly printer 30× the size of 0×2 cm 3, and pot. Materials used: Nilem fish gelatin, sucrose, glucose syrup, cornstarch, water, sugar flour, citric acid, and flavor.

2. 2. Research Methods

The method used is the experimental method with four treatments.

Treatment A : Adding gelatin as much as 9% of the total weight of the *jelly* candy making material

Treatment B : adding gelatin as much as 10% of the total weight of the *jelly* candy ingredients

Treatment C : adding gelatin as much as 11% of the total weight of the *jelly* candy making material

D (Control) Treatment: addition of commercial gelatin as much as 10% of the total weight of the *jelly* candy making material.

The following is presented in Table 1, which is the composition of the jelly candy with various treatments.

Table 1. Composition Of The Jelly Candy

Materials	Gelatine Addition Treatment (%)		
	9%	10%	11%
Gelatin	**9**	**10**	**11**
Sucrose	45	45	45

Glucose Syrup	20	20	20
Flavor	1	1	1
Citric Acid	0,3	0,3	0,3
Water	23,7	23,7	23,7

Source : [13] with modification

The process of making *jelly* candy [13] was modified: Gelatin of nilem fish bone (according to treatment) was dissolved in water with temperature of 60 ^{o}-70 ^{o} C for 1 minute. After the gelatin was dissolved in water, then 45 grams of sucrose were added, 20 grams of glucose syrup, 3 grams of citric acid, 1 ml of flavor and 23.7 ml of water. The mixture of ingredients was cooked at 70 ^{o}- 80 ^{o} C for 5 minutes until the mixture thickens. The solution formed was then poured into the mold and then left at room temperature for 1 hour. Then cooled in the refrigerator for 12 hours. *Jelly* candies were formed and then left at room temperature for 1 hour, then *jelly* candies were coated with cornstarch and flour sugar in a ratio of 1: 1.

2. 3. Observe Parameters

The parameters observed in this research were jelly candy organoleptic which is the level of preferences for color, flavor, taste and elasticity. Testing the level of preferences using the hedonic test. The panelists used were 20 semi-trained panelists.

2. 4. Data Analysis

Data analysis using non-parametric statistical tests in the form of *Friedman* Test and followed by multiple comparison tests, if there were significant differences in each treatment the best treatment decision-making was analyzed using the *Bayes* method.

The statistical formula that used in the Friedman test as follows:

$$x^2 = \frac{12}{bk\ (k+1)} \sum_{t=1}^{t} (Rj)^2 - 3b(k+1)$$

Description:

Xr2 = Friedman test statistics
n = Repetitions
k = Treatments
Rj2 = Total rank of each treatments

If there is the same number, correction factor (FC) was calculated using the following formula:

$$FC = 1 - \frac{\sum T}{bk\ (k^2 - 1)}$$

Decription:

FC = Correction factors
T = n(t3-t)
t = Number of same numbers

Decision rules for testing hypothesis are:

H0 : The addition of red tilapia bone gelatin powder doesn't give a real effect on panna cotta on α level = 0,05

H1 : The addition of red tilapia bone gelatin powder gives a real effect on panna cotta on α level = 0,05

H0 is accepted and H1 is rejected if Xr2 < Xr2(k-1), while if Xr2 > Xr2(k-1), H0 is rejected and H1 is accepted. If H1 is accepted, the treatments gives a real effect. If there are significant differences inter-treatments, then continues with multiple comparison using the following formula:

$$|Ri - Rj| \geq Z\left\{\frac{\alpha}{k(k-1)}\right\}\sqrt{bk\,(k+1)/6}$$

Description:

| Ri – Rj | = Total rank
Ri = Total rank from sample to-i
Rj = Total rank from sample to-j
α = *Wise error* experiment
b = Number of repetitions
k = Number of treatments

The best treatment decision making taking into account the parameters of appearance, aroma, taste and texture is the Bayes method test. The first step is to determine the comparison matrix of the addition of nilem bone gelatin to jelly candy based on organoleptic test questionnaire data conducted by 20 panelists, then merging data from each criterion using the geometric average formula as follows:

$$X_g = \sqrt[n]{\prod, Xi}$$

Description:

X_G = Geometric average
⊓ = Permutation
n = Number of panelists
Xi = Evaluation by panelists to *i*

Obtained the weight value of criteria data from the results of the average geometry. Then the calculation is done using the Bayes method. The weight value of the criteria obtained is associated with the median value of the organoleptic test results on each treatment criterion and summed so that an alternative value is obtained.

3. RESULT

3. 1. Appearance

The appearance of jelly candy includes the appearance of the surface shape and color. Appearance is the factor that is first seen by consumers visually before finally to other factors. If a product has an unappealing appearance and color, people will hesitate to eat it [15].

Based on the assessment of the color appearance carried out by the panelists, it can be seen that the median values ranging from 5 to 7 indicate that the appearance of jelly candies ranges from normal to preferred by panelists. The results of the level of preference for jelly candy presented in Table 2.

Table 2. Levels of Appearance on the Treatment of Addition of Gelatin from Nilem Fish Bone

Addition of Nilem Fish Bone Gelatin (%)	Median	Average
9	5	4,4a
10	7	7,6b
11	5	5,7a
Control	7	6,9b

Description: Treatment that has letters that show is not significantly different according to multiple comparison test of confidence level 95%

The 10% treatment iscandy *jelly* that is most preferred by panelists because it has a bright, slightly dull color and the shape resembles mold. The 10% treatment using fish gelatin has a slightly dull color compared to the Control Treatment using commercial gelatin because the fish gelatin produced from this research is brownish yellow in color.

The greater the concentration given, the more concentrated the color of jelly candy produced, this statement is supported by [13] which states that the increasing concentration of fish gelatin, causing the appearance of jelly candy is less attractive because the color will become darker.

3. 2. Aroma

One important factor that determines the preference level of a product by panelists is aroma [17]. If a product has an unfavorable aroma, the product is less favored by panelists. Aroma arises because of the combination of the ingredients that make up the product.

Based on the assessment of the aroma done by the panelists, it can be seen that the median values ranging from 5 to 7 indicate that the aroma of jelly candies ranges from normal to favored by panelists. The results of the level of preference for jelly candy presented in Table 3.

Table 3. Levels of Aroma on the Treatment of Addition of Gelatin from Nilem Fish Bone

Addition of Nilem Fish Bone Gelatin (%)	Median	Average
9	5	5,5a
10	7	7,3b
11	5	4,8a
Control	7	6,7b

Description: Treatment that has letters that show is not significantly different according to multiple levels of confidence test 95 %

The observation ofcandy aroma *jelly* with the addition of 10% nilem fish bone gelatin is the most preferred treatment by panelists. Jelly candies are produced slightly flavorful fish. The distinctive aroma is caused by raw fish bones that contain volatile substances such as ammonia [4]. The aroma can be overcome by adding flavor, the flavor added in the same concentration becomes weak due to the reaction with the aroma component of the fish gelatin. The concentration of adding gelatinous bone of nilem fish has an effect on the aroma produced in jelly candy products, the higher the concentration added to the jelly candy formulation will be more flavorful to fish but this does not apply to commercial gelatin, because commercial gelatin sold has met the characteristics of [9] namely the aroma of gelatin is normal (not flavorful).

3. 3. Taste

Taste is a very important factor for determining product acceptance by consumers, although other factors such as appearance, aroma and texture are good, but if the taste is not good, the consumer does not accept the product.

Based on the feeling assessment conducted by the panelists, it can be seen that the median values ranging from 5 to 9 indicate that the taste of jelly candies ranges from normal to highly favored by panelists. The results of the level of preference for jelly candy presented in Table 4.

Table 4. Levels of Taste on the Treatment of Addition of Gelatin from Nilem Fish Bone

Addition of Nilem Fish Bone Gelatin (%)	Median	Average
9	5	4,4a
10	9	8,2b
11	5	4,7a
Control	7	7,5b

Remarks: Treatment that have letters that show not significantly different according to multiple comparison tests of confidence level 95%

The observation ofcandy flavor *jelly* with the addition of 10% nilem fish bone gelatin is the most preferred treatment by panelists. According to [13] jelly candy with the addition of 10% tilapia bone gelatin concentration has a better taste, which is mixing sweet and sour taste that is suitable and supported by better appearance and texture than jelly candy with the addition of other concentrations. This difference was assumed because the concentration of tilapia bone gelatin added was not the same for all treatments, while the sucrose composition, citric acid glucose syrup and flavor were the same for all treatments so that the higher concentration of tilapia bone gelatin was added, the sweetness caused by jelly candy increasingly reduced. This supports the results of research that treatment B is the best treatment and the most preferred by panelists. The flavor produced in jelly candy comes from the composition of gelatin, sucrose, glucose syrup, citric acid, and flavor. The composition given to each treatment is the same, except gelatin. So that the higher the concentration of gelatin in the nilem fish bone added to the jelly candy product, the less sweetness caused while the taste of gelatin and the distinctive taste of the fish are increasingly felt. The lower the concentration of gelatin nilem fish bone added to jelly candy products, the sweetness that is caused is felt while the taste of gelatin and the distinctive taste of fish decreases.

3. 4. Texture

Texture is a very important factor to determine the acceptance of jelly candy products. Because the priority of jelly candy is in its texture. If the texture is not chewy, the candy cannot be called jelly candy. Based on the assessment of the texture carried out by the panelists, it can be seen that the median values ranging from 3 to 9 indicate that the taste of jelly candies ranges rather unpopular until it is highly favored by panelists. The results of the level of preference for jelly candy presented in Table 5.

Table 5. Levels of Texture on the Treatment of Addition of Gelatin from Nilem Fish Bone

Addition of Nilem Fish Bone Gelatin (%)	Median	Average
9	3	3,9a
10	9	8b
11	3	4,1a
Control	7	7,6b

Note: Treatment that has letters that show is not significantly different according to multiple comparison test of confidence level 95%

According to [10] jelly candies must have a rubbery texture, hard-textured jelly candies cannot be classified as jelly candy. The 10% treatment and control treatment showed that the

results obtained could be classified as jelly candy because of the soft texture according to the characteristics found in [10].

The concentration of gelatin addition of nilem fish bone has an effect on the texture produced in jelly candy products, the higher the concentration added to the jelly candy formulation is difficult to print and the harder or stiffer, while the lower the concentration added to jelly candy the texture is very soft and sticky. This statement is also supported by [13] who states that the most important factor in gel formation is the concentration of gelatin in the mixture because the desired gel will be formed only within certain limits. If the gelatin concentration is too high, the gel formed will be stiff, but if the gelatin concentration is too low, the gel will be soft and not even gel will form.

3. 5. Decision Making with Bayes Method

The Bayes method aims to determine the best treatment based on the characteristics of appearance, aroma, taste and texture. This method is one of the best decision-making techniques that aims to produce optimal gains. The best decision oncandy *jelly* is to use the Bayes method. The results of the calculation of the weight value of the jelly candy criteria are presented in Table 6.

Table 6. Weight Value of Jelly Candy

Criteria	Criteria Weight
Appearance	0.11
Aroma	0.10
Flavor	0.44
Texture	0.35

Based on the results of the calculation of the criteria weights show that taste is the criterion with the highest weight between appearance, aroma and texture. Rasa has a criteria weight of 0.44, appearance of 0.11, aroma of 0.10 and texture of 0.35. This shows that the taste of jelly candy is the most important criterion in determining the final decision of the panelist. Data from the calculation of the weighting criteria of appearance, aroma, taste and texture are presented in Table 7.

Based on the results of calculations using the Bayes Method, treatment B with 10% addition of nilem bone gelatin has the highest alternative value of 8.58 followed by treatment D with the addition of commercial gelatin as much as 10% having an alternative value of 7.00 while treatment A and C have the same alternative value which is equal to 4.12 although the treatment of adding gelatin to the nilem fish bones is different. A treatment with the addition of nilem fish bone gelatin as much as 9% while the C treatment added nilem fish re-gelatin as much as 11%. The results of the recapitulation of observations on jelly candy are presented in Table 8.

Table 7. Decision Matrix Jelly Candy with Bayes Method

Treatment	Criteria				Alternative Value
	Appearance	Aroma	Taste	Texture	
A	5	5	5	3	4.12
B	7	7	9	9	8.58
C	5	5	5	3	4.12
D	7	7	7	7	7,00
Value Weight	0.11	0.10	0.35	0 , 44	23.82

Table 8. Results of Research Recapitulation

Parameters	Treatment			
	A	B	C	D
Organoleptic				
Appearance	5	7	5	7
Aroma	5	7	5	7
Taste	5	9	5	7
Texture	3	9	3	7
Bayes Method				
Alternative Value	4, 12	8.58	4.12	7.00

Based on the results of the recapitulation of the organoleptic test using the Bayes method, it was shown that treatment B with the addition of nilem bone gelatin as much as 10% had the most preferred organoleptic characteristics by panelists with the highest appearance value, aroma, taste and texture compared to other treatments. These results are in accordance with the hypothesis. The criteria for appearance, aroma, taste and texture play a role in determining the best treatment based on the Bayes method.

4. CONCLUSION

The most preferred jelly candy by panelists was the addition of 10% nilem bone gelatin.

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