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The Effect of Red Tilapia Bone Gelatin Powder Addition On Preference Level of Panna Cotta

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ABSTRACT

The purpose of this research was to determine the addition of red tilapia bone gelatin powder to produce the most preferred panna cotta. The method of the research was experimental method with four treatments of 2%, 4%, 6% and 8% of red tilapia bone gelatin powder addition level from total weight of the main raw materials (full cream milk and heavy cream). The parameters that observed i.e. appearance, aroma, texture and taste's preference level of panna cotta. Observation result data was analyzed with Friedman test, multiple comparison and Bayes method. Based on research result showed that the most preferred panna cotta was obtained from gelatin powder addition as much as 4%.

Keywords: bone, gelatin, panna cotta, preference level, red tilapia

1. INTRODUCTION

Gelatin is a protein produced by hydrolysis of bone and skin collagen which is widely used for industrial purposes, both the food industry and non food industry [1]. The source of the main raw material for gelatin which is often used by the food and non food industries is the

skin and bones of cattles or pigs. The application of pig skins and bones as raw material for gelatin isn't appropriate to be applied in Indonesia where the majority of the population is muslim. The raw material for making gelatin isn't limited to the skins and bones of cattles or pigs, but fishery products can be used as a source of gelatin. One type of fish that has the potential as a source of gelatin is tilapia.

According to [2] tilapia production from 2010 to 2013 experienced a significant increase with an average increase of 34.85%. This is in line with the high demand for tilapia filet meat in the international market. Tilapia filet meat industries produce a lot of bones waste that hasn't been utilized properly. The availability of bone waste can be used as an alternative raw material for gelatin. Making gelatin from red tilapia bone as an alternative source of raw material is an effort to utilize fish processing waste. Red tilapia bone waste contains protein that contains collagen which is high enough to have the potential to be used as gelatin [1]. Waste from fish bones, especially tilapia bone hasn't been used optimally, which is only used for the manufacture of feed or fertilizer so that the economic value is very small [3]. The people's consumption of fishery products isn't limited to fresh fishery products, but also in the form of processed products [4]. One type of processed product is panna cotta. Panna cotta is an Italian dessert that uses gelatin powder as raw material that cooked with other ingredients such as cream, milk and sugar that served in cold conditions. The softness of panna cotta makes this dessert quite unique compared to other types of dessert. Panna cotta has a soft and semi-solid texture [5]. Gelatin powder in panna cotta has a role as a gelling agent which is influenced by concentration [6].

The application of gelatin powder concentrations below 1% produces panna cotta with a texture that is too soft and doesn't form a perfect gel, while the concentrations above 1,5% produces panna cotta with a stiff texture so that it doesn't match for panna cotta's character [7]. Therefore, it's necessary to study the red tilapia bone gelatin application on panna cotta preference level. The purpose of this research was to determine the addition of red tilapia bone gelatin powder to produce the most preferred panna cotta.

2. MATERIALS AND METHODS

2. 1. Tools and Materials

The tools that used in making panna cotta are stainless pan, wooden spatula, plastic measuring cup, pudding cup and refrigerator. The raw material that used in making panna cotta are heavy cream, full cream milk, sugar and vanilla extract which obtained from local grocery stores and gelatin powder which obtained from extraction process of red tilapia bones.

2. 2. Research Methods

The methods of the research is an experimental method with four treatments. The four treatments that given i.e.:

A = 2% of gelatin powder addition from total weight of the main raw materials (full cream milk and heavy cream)

B = 4% of gelatin powder addition from total weight of the main raw materials (full cream milk and heavy cream)

C = 6% of gelatin powder addition from total weight of the main raw materials (full cream milk and heavy cream)

D = 8% of gelatin powder addition from total weight of the main raw materials (full cream milk and heavy cream)

2. 3. Observe Parameters

The parameters that observed are appearance, aroma, texture and taste's preference level of panna cotta. Scales of preference level is as follows: (1) very dislike; (3) dislike; (5) neutral; (7) like and (9) very like. Panelists that used are 20 people of semi trained panelists. The rejection limit for the hedonic test is 3, meaning that if the product being tested gets the same or smaller value [8].

2. 4. Data Analysis

Observation result data was analyzed with Friedman test, multiple comparison and Bayes method. The statistical formula that used in the Friedman test [9] as follows:

$$\chi_r^2 = \left[\frac{12}{(n \cdot x \cdot k) (k + 1)} x \sum_{j=1}^k (R_j)^2 \right] - [(3n) (k + 1)]$$

Description:

X_r^2 = Friedman test statistics

n = Repetitions

k = Treatments

R_j^2 = Total rank of each treatments

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

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

$$\chi^2_c = \frac{\chi^2}{FC}$$

Decription:

FC = Correction factors

T = $n(t^3 - t)$

t = Number of same numbers

Decision rules for testing hypothesis are:

H_0 : 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 $X_r^2 < X_{r(k-1)}^2$, while if $X_r^2 > X_{r(k-1)}^2$, 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:

$$|\overline{R_i} - \overline{R_j}| \leq Z_{\left\{ \frac{\alpha}{k(k-1)} \right\}} \sqrt{bk(k+1)/6}$$

Description:

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

3. RESULTS AND DISCUSSION

3. 1. Preference Level On Appearance of Panna Cotta

According to [10] appearance is an important organoleptic parameter because it's the first factor that seen by consumers when looking at the food and generally consumers tend to choose foods that have attractive appearance. Median and average value of panna cotta's appearance preference level are presented in Table 1.

Table 1. Median and Average Value of Panna Cotta's Appearance Preference Level Various Treatment of Red Tilapia Bone Gelatin Powder Addition

Addition of Red Tilapia Bone Gelatin Powder (%)	Median	Average
2	3	3,8 a
4	7	7,3 b
6	7	7,0 b
8	6	5,9 b

Based on the results of the Friedman test analysis showed that red tilapia bone gelatin powder addition treatment affected panna cotta's appearance preference level. The 4% treatment has the highest average value compared to other treatments because it has semi solid characteristic and in accordance with the characteristic of jelly products according to [11].

According to [7] that the application of gelatin powder concentrations below 1% produces panna cotta with a texture that is too soft and doesn't form a perfect gel, while the concentrations above 1,5% produces panna cotta with a stiff texture so that it doesn't match for panna cotta character. In fact, 4% treatment doesn't produce a gel that is stiff but semi solid and in accordance with the panna cotta character.

3. 2. Preference Level On Aroma of Panna Cotta

Aroma is one of the important factors that must be considered in the use of red tilapia bone gelatin because it's feared that it will affect the panelists' acceptance of the panna cotta aroma. Median and average value of panna cotta's aroma preference level are presented in Table 2.

Table 2. Median and Average Value of Panna Cotta's Aroma Preference Level Various Treatment of Red Tilapia Bone Gelatin Powder Addition

Addition of Red Tilapia Bone Gelatin Powder (%)	Median	Average
2	5	5,3 a
4	7	6,2 ab
6	5	5,5 ab
8	5	5,8 ab

Based on the results of the Friedman test analysis showed that red tilapia bone gelatin powder addition treatment affected panna cotta's aroma preference level. The 4% treatment had the highest average value compared to 6% and 8% treatment because panna cotta has less smell of gelatin. According to [12] the fish's aroma in fish bone gelatin is suspect to be caused by the fish's aroma in bone materials that are still carried away during the process of making gelatin. This is also suspect to be caused by the presence of volatile substances, such as ammonia in gelatin which causes the fish's aroma.

According to [13] the typical fish's aroma is caused by ammonia and amino acid glutamate that contained in foodstuffs. The greater addition of gelatin powder, panna cotta is increasingly dislike by panelists. This is because the aroma of gelatin will be smelled more. According to [12] that the aroma of gelatin in food products can be covered using flavor. According to [14] the flavors which are often used in the making of panna cotta are varied, example for chocolate panna cotta which uses chocolate powder.

3. 3. Preference Level On Texture of Panna Cotta

According to [15] texture assessment aims to determine the panelists' acceptance level to the elasticity or hardness of a food product by using the sense of touch. Median and average value of panna cotta's texture preference level are presented in Table 3.

Table 3. Median and Average Value of Panna Cotta’s Texture Preference Level Various Treatment of Red Tilapia Bone Gelatin Powder Addition

Addition of Red Tilapia Bone Gelatin Powder (%)	Median	Average
2	4	4,4 a
4	9	8,3 c
6	6	5,8 ab
8	5	4,6 ab

Based on the results of the Friedman test analysis showed that red tilapia bone gelatin powder addition treatment affected panna cotta’s texture preference level. The 4% treatment produces the highest average value because it produces a chewy texture compared to other treatments and in accordance with the characteristics of jelly products according to [11]. [16] explained that giving the right amount of gelatin powder would produce a soft texture on panna cotta. According to [6] gelatin powder in panna cotta has a role as a gelling agent which is influenced by concentration.

The greater addition of gelatin powder, panna cotta is increasingly dislike by panelists. This is because the texture will become more dense. [17] explained that 1% of gelatin powder concentration produced a chewy texture compared to 1,25% and 1,50%. The texture will be more stiff along with increasing of gelatin concentration.

3. 4. Preference Level On Taste of Panna Cotta

According to [18] taste is one of the factors that influence consumers’ acceptance of a food. Median and average value of panna cotta’s taste preference level are presented in Table 4.

Table 4. Median and Average Value of Panna Cotta’s Taste Preference Level Various Treatment of Red Tilapia Bone Gelatin Powder Addition

Addition of Red Tilapia Bone Gelatin Powder (%)	Median	Average
2	9	8,2 c
4	7	6,5 c
6	5	4,4 ab
8	3	3,8 a

Based on the results of the Friedman test analysis showed that red tilapia bone gelatin powder addition treatment affected panna cotta’s taste preference level. The 2% treatment

produced the highest average value because panna cotta had a very sweet taste and a slight taste of gelatin compared to other treatments. This is suspect to the influence of the gelatin powder material. The higher addition of gelatin powder, panna cotta is increasingly dislike by panelists. This is because the sweet taste in panna cotta will disappear and the taste of gelatin will be more feel. According to [19] non volatile compounds that contains nitrogen such as free amino acids plays a role in flavoring of fishery products. According to [20] flavor compounds that used in jelly pudding products are usually fruit flavor such as mangoes, strawberries, grapes, apples and melons. The addition of flavor compounds can reduce the taste of gelatin in panna cotta.

3. 5. Decision Making with Bayes Method

Bayes method aims to determine the best treatment based on four product criterias, i.e. appearance, aroma, texture and taste. The results of calculating the criteria weight values for panna cotta are presented in Table 5.

Table 5. Panna Cotta’s Criteria Weight Value

Criteria	Criteria Weight Values
Appearance	0,18
Aroma	0,16
Texture	0,21
Taste	0,45

Based on the results of the analysis of the panna cotta’s criteria weight values shows that the taste has the highest criteria weight value compared to other criterias. Taste criteria weight value is 0,45, texture is 0,21, appearance is 0,18 and aroma is 0,16. This is shows that the taste are the most important criteria in determining panelists' final decisions. Data from the calculation of the weight of the criteria and the determination of the best treatment based on the criteria of appearance, aroma, texture and taste of panna cotta from 20 semi trained panelists on panna cotta’s preference level are presented in Table 6.

Table 6. Panna Cotta’s Assessment Decision Matrix with Bayes Method

Treatment (%)	Criteria				Alternative Value	Priority Value
	Appearance	Aroma	Texture	Taste		
2	3	5	4	9	6,24	0,27
4	7	7	9	7	7,41	0,32
6	7	5	6	5	5,57	0,24

8	6	5	5	3	4,28	0,18
Weight Value	0,18	0,16	0,21	0,45		

Based on calculation results with Bayes method showed that highest alternative value (7,41) obtained from 4% of gelatin powder addition treatment (Treatment B) (Table 6). Therefore, 4% of gelatin powder addition treatment expressed as the best treatment by considering the criteria of appearance, aroma, texture and taste.

3. 6. Mathematical Equations

Table 7. Hedonic Test Results On Appearance, Aroma, Texture and Taste of Panna Cotta

No.	<i>Panna Cotta</i> with Addition of Red Tilapia Bone Gelatin Powder															
	Appearance				Aroma				Texture				Taste			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1	5	7	7	5	3	7	7	5	3	9	5	3	5	5	5	3
2	3	7	9	7	5	7	5	7	5	7	7	5	7	7	5	5
3	3	7	3	3	7	9	5	3	5	9	3	5	9	7	3	5
4	3	7	7	7	3	7	5	5	3	9	7	5	9	9	3	3
5	5	9	7	5	3	3	7	5	3	7	7	5	9	7	3	3
6	3	9	7	5	5	7	7	7	3	9	7	5	9	5	3	3
7	3	7	7	5	5	9	3	5	3	9	7	7	7	7	5	5
8	3	7	9	7	5	7	7	7	3	9	5	5	9	7	5	5
9	3	7	7	5	3	7	3	3	5	7	7	5	9	7	5	3
10	3	9	9	5	7	5	9	7	7	7	5	5	5	7	5	5
11	5	7	7	7	3	3	7	5	3	7	7	5	7	7	5	5
12	3	7	5	5	3	7	9	5	3	7	5	5	9	7	5	3
13	5	7	7	7	9	7	5	5	7	9	5	3	9	5	5	5
14	5	7	5	7	9	7	5	5	7	9	7	5	9	7	3	3
15	5	7	9	7	9	5	5	3	3	9	5	3	9	7	5	3
16	3	7	9	7	5	5	7	9	7	9	5	5	9	7	5	5

17	5	7	7	7	7	5	3	7	5	9	5	5	7	5	5	3
18	3	7	7	7	3	3	5	9	5	9	7	5	9	7	3	3
19	3	7	7	5	7	5	3	7	3	7	3	3	9	5	5	3
20	5	7	5	5	5	9	3	7	5	9	7	3	9	5	5	3
Total	76	146	140	118	106	124	110	116	88	166	116	92	164	130	88	76
Mean	3,8	7,3	7,0	5,9	5,3	6,2	5,5	5,8	4,4	8,3	5,8	4,6	8,2	6,5	4,4	3,8
Median	3	7	7	6	5	7	5	5	4	9	6	5	9	7	5	3
Mode	3	7	7	7	3	7	5	5	3	9	7	5	9	7	5	3

Table 8. Calculation Results of Panna Cotta Rank Appearance with Addition of Red Tilapia Bone Gelatin Powder

Repeat	Treatment							
	A		B		C		D	
	Real	Rank	Real	Rank	Real	Rank	Real	Rank
1	5	1,5	7	3,5	7	3,5	5	1,5
2	3	1	7	2,5	9	4	7	2,5
3	3	2	7	4	3	2	3	2
4	3	1	7	3	7	3	7	3
5	5	1,5	9	4	7	3	5	1,5
6	3	1	9	4	7	3	5	2
7	3	1	7	3,5	7	3,5	5	2
8	3	1	7	2,5	9	4	7	2,5
9	3	1	7	3,5	7	3,5	5	2
10	3	1	9	3,5	9	3,5	5	2
11	5	1	7	3	7	3	7	3
12	3	1	7	4	5	2,5	5	2,5
13	5	1	7	3	7	3	7	3

14	5	1,5	7	3,5	5	1,5	7	3,5
15	5	1	7	2,5	9	4	7	2,5
16	3	1	7	2,5	9	4	7	2,5
17	5	1	7	3	7	3	7	3
18	3	1	7	3	7	3	7	3
19	3	1	7	3,5	7	3,5	5	2
20	5	2	7	4	5	2	5	2
R _j	23,5		66		62,5		48	
R _j ²	552,25		4356		3906,25		2304	

Friedman Test Statistics Calculation

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

$$x^2 = \frac{12}{20.4(4+1)} \sum_{t=1}^t (552.25 + \dots + 2304) - 3.20(4+1)$$

$$x^2 = 33,56$$

Observation data has the same number, so the calculation of correction factors is as follows:

Table 9. Calculation of Panna Cotta Appearance Correction Factors

Score	Rank	T	N	T ³	T ³ -T	N(T ³ -T)
3	2	3	1	27	24	24
5	1,5	2	3	8	6	18
5	2	3	1	27	24	24
5	2,5	2	1	8	6	6
7	2,5	2	4	8	6	24
7	3	3	5	27	24	120
7	3,5	2	5	8	6	30
9	3,5	2	1	8	6	6
Amount						252

Calculation of Correction Factor:

Test statistics that have been corrected:

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

$$H_c^2 = \frac{x^2}{FK}$$

$$FC = 1 - \frac{252}{20.4(4^2-1)}$$

$$H_c^2 = \frac{33.56}{0.79}$$

$$FC = 1 - \frac{252}{1200}$$

$$H_c^2 = 42,47$$

$$FC = 0,79$$

x^2	33,56
H_c^2	42,47
$x^2_{0.05}$	9,49

Value of x^2 dan $H_c^2 > x^2$ table of credibility level 95%, meaning testing is significantly different (H_0 rejected and H_1 accepted). There are differences among treatment, so need to do multiple comparison test as follows:

$$\begin{aligned} |R_i - R_j| &\geq Z\sqrt{bk(k+1)/6} \\ &\geq (2.64)\sqrt{(20)(4)(4+1)/6} \\ &\geq (2.64)\sqrt{66.67} \\ &\geq (2.64)(8.16) \\ &\geq 21,54 \end{aligned}$$

Table 10. Determination of Panna Cotta Appearance.

Treatment	Total	A	B	C	D	Credibility Level 95%	Real Level
A	23,5					21,54	a
D	48	24,5					b
C	62,5	39	14,5				b
B	66	42,5	18	3,5			B

Treatment that has a real level with the same alphabet shows that it is not significantly different according to multiple comparison test at credibility level 95%

Table 11. Calculation Results of Panna Cotta Rank Aroma with Addition of Red Tilapia Bone Gelatin Powder

Repeat	Treatment							
	A		B		C		D	
	Real	Rank	Real	Rank	Real	Rank	Real	Rank
1	3	1	7	3,5	7	3,5	5	2
2	5	1,5	7	3,5	5	1,5	7	3,5
3	7	3	9	4	5	2	3	1
4	3	1	7	4	5	2,5	5	2,5
5	3	1,5	3	1,5	7	4	5	3
6	5	1	7	3	7	3	7	3
7	5	2,5	9	4	3	1	5	2,5
8	5	1	7	3	7	3	7	3
9	3	2	7	4	3	2	3	2
10	7	2,5	5	1	9	4	7	2,5
11	3	1,5	3	1,5	7	4	5	3
12	3	1	7	3	9	4	5	2
13	9	4	7	3	5	1,5	5	1,5
14	9	4	7	3	5	1,5	5	1,5
15	9	4	5	2,5	5	2,5	3	1
16	5	1,5	5	1,5	7	3	9	4
17	7	3,5	5	2	3	1	7	3,5
18	3	1,5	3	1,5	5	3	9	4
19	7	3,5	5	2	3	1	7	3,5
20	5	2	9	4	3	1	7	3
Rj	43,5		55,5		49		52	
Rj ²	1892,3		3080,3		2401		2704	

Friedman Test Statistics Calculation:

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

$$x^2 = \frac{12}{20.4(4+1)} \sum_{t=1}^t (1892.3 + \dots + 2704) - 3.20(4+1)$$

$$x^2 = 2,32$$

Observation data has the same number, so the calculation of correction factors is as follows:

Table 12. Calculation of Panna Cotta Aroma Correction Factors

Score	Rank	T	N	T ³	T ³ -T	N(T ³ -T)
3	1,5	2	3	8	6	18
3	2	3	1	27	24	24
5	1,5	2	4	8	6	24
5	2,5	2	3	8	6	18
7	2,5	2	1	8	6	6
7	3	3	2	27	24	48
7	3,5	2	4	8	6	24
Amount						162

Correction Factor Calculation:

Test statistics that have been corrected:

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

$$H_c^2 = \frac{x^2}{FK}$$

$$FC = 1 - \frac{162}{20.4(4^2-1)}$$

$$H_c^2 = \frac{2.32}{0.87}$$

$$FC = 1 - \frac{162}{1200}$$

$$H_c^2 = 2,69$$

$$FC = 0,87$$

x^2	2,32
H_c^2	2,69
$x^2_{0.05}$	9,49

Value of x^2 and $H_c^2 < x^2$ table of credibility level 95%, meaning testing is not significantly different (H_0 accepted dan H_1 rejected).

Table 13. Determination of Panna Cotta Aroma

Treatment	Total	A	B	C	D	Credibility Level 95%	Real Level
A	43,5					21,54	a
C	49	5,5					ab
D	52	8,5	3				ab
B	55,5	12	6,5	3,5			ab

Treatment that has a real level with the same alphabet shows that it is not significantly different according to multiple comparison test at credibility level 95%

Table 14. Calculation Results of Panna Cotta Rank Texture with Addition of Red Tilapia Bone Gelatin Powder

Repeat	Treatment							
	A		B		C		D	
	Real	Rank	Real	Rank	Real	Rank	Real	Rank
1	3	1,5	9	4	5	3	3	1,5
2	5	1,5	7	3,5	7	3,5	5	1,5
3	5	2,5	9	4	3	1	5	2,5
4	3	1	9	4	7	3	5	2
5	3	1	7	3,5	7	3,5	5	2
6	3	1	9	4	7	3	5	2
7	3	1	9	4	7	2,5	7	2,5
8	3	1	9	4	5	2,5	5	2,5
9	5	1,5	7	3,5	7	3,5	5	1,5
10	7	3,5	7	3,5	5	1,5	5	1,5
11	3	1	7	3,5	7	3,5	5	2

12	3	1	7	4	5	2,5	5	2,5
13	7	3	9	4	5	2	3	1
14	7	2,5	9	4	7	2,5	5	1
15	3	1,5	9	4	5	3	3	1,5
16	7	3	9	4	5	1,5	5	1,5
17	5	2	9	4	5	2	5	2
18	5	1,5	9	4	7	3	5	1,5
19	3	2	7	4	3	2	3	2
20	5	2	9	4	7	3	3	1
Rj	35		77,5		52		35,5	
Rj ²	1225		6006,3		2704		1260,3	

Friedman Test Statistics Calculation:

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

$$x^2 = \frac{12}{20.4(4+1)} \sum_{t=1}^t (1225 + \dots + 1260.3) - 3.20(4+1)$$

$$x^2 = 35,87$$

Observation data has the same number, so the calculation of correction factors is as follows:

Table 15. Calculation of Panna Cotta Texture Correction Factors

Score	Rank	T	N	T ³	T ³ -T	N(T ³ -T)
3	1,5	2	2	8	6	12
3	2	3	1	27	24	24
5	1,5	2	5	8	6	30
5	2	3	1	27	24	24
5	2,5	2	3	8	6	18

7	2,5	2	2	8	6	12
7	3,5	2	5	8	6	30
Amount						150

Correction Factor Calculation:

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

$$FC = 1 - \frac{150}{20.4(4^2-1)}$$

$$FC = 1 - \frac{150}{1200}$$

$$FC = 0,88$$

Test statistics that have been corrected:

$$H_c^2 = \frac{x^2}{FK}$$

$$H_c^2 = \frac{35,87}{0,88}$$

$$H_c^2 = 40,99$$

x^2	35,87
H_c^2	40,99
$x^2_{0.05}$	9,49

Value of x^2 dan $H_c^2 > x^2$ table of credibility level 95%, meaning testing is significantly different (H_0 rejected and H_1 accepted). There are differences among treatment, so need to do multiple comparison test as follows:

$$\begin{aligned}
 |R_i - R_j| &\geq Z\sqrt{bk(k+1)/6} \\
 &\geq (2.64)\sqrt{(20)(4)(4+1)/6} \\
 &\geq (2.64)\sqrt{66.67} \\
 &\geq (2.64)(8.16) \\
 &\geq 21,54
 \end{aligned}$$

Table 16. Determination of Panna Cotta Texture

Treatment	Total	A	B	C	D	Credibility Level 95%	Real Level
A	35					21,54	a
D	35,5	0,5					ab
C	52	17	16,5				ab
B	77,5	42,5	42	25,5			c

Treatment that has a real level with the same alphabet shows that it is not significantly different according to multiple comparison test at credibility level 95%

Table 17. Calculation Results of Panna Cotta Rank Taste with Addition of Red Tilapia Bone Gelatin Powder

Repeat	Treatment							
	A		B		C		D	
	Real	Rank	Real	Rank	Real	Rank	Real	Rank
1	5	3	5	3	5	3	3	1
2	7	3,5	7	3,5	5	1,5	5	1,5
3	9	4	7	3	3	1	5	2
4	9	3,5	9	3,5	3	1,5	3	1,5
5	9	4	7	3	3	1,5	3	1,5
6	9	4	5	3	3	1,5	3	1,5
7	7	3,5	7	3,5	5	1,5	5	1,5
8	9	4	7	3	5	1,5	5	1,5
9	9	4	7	3	5	2	3	1
10	5	2	7	4	5	2	5	2
11	7	3,5	7	3,5	5	1,5	5	1,5
12	9	4	7	3	5	2	3	1
13	9	4	5	2	5	2	5	2
14	9	4	7	3	3	1,5	3	1,5
15	9	4	7	3	5	2	3	1
16	9	4	7	3	5	1,5	5	1,5
17	7	4	5	2,5	5	2,5	3	1
18	9	4	7	3	3	1,5	3	1,5
19	9	4	5	2,5	5	2,5	3	1
20	9	4	5	2,5	5	2,5	3	1
Rj	75		60,5		36,5		28	
Rj ²	5625		3660,3		1332,3		784	

Friedman Test Statistics Calculation:

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

$$x^2 = \frac{12}{20.4(4+1)} \sum_{t=1}^t (5625 + \dots + 784) - 3.20(4+1)$$

$$x^2 = 42,05$$

Observation data has the same number, so the calculation of correction factors is as follows:

Table 18. Calculation of Panna Cotta Taste Correction Factors

Score	Rank	T	N	T ³	T ³ -T	N(T ³ -T)
3	1,5	2	5	8	6	30
5	1,5	2	5	8	6	30
5	2	3	2	27	24	48
5	2,5	2	3	8	6	18
5	3	3	1	27	24	24
7	3,5	2	3	8	6	18
9	3,5	2	1	8	6	6
Amount						174

Correction Factor Calculation

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

$$FC = 1 - \frac{174}{20.4(4^2-1)}$$

$$FC = 1 - \frac{174}{1200}$$

$$FC = 0,86$$

Test statistics that have been corrected

$$H_c^2 = \frac{x^2}{FK}$$

$$H_c^2 = \frac{42.05}{0.86}$$

$$H_c^2 = 49,18$$

x^2	42,05
H_c^2	49,18
$x^2_{0.05}$	9,49

Value of χ^2 dan $H_c^2 > \chi^2$ table of credibility level 95%, meaning testing is significantly different (H_0 rejected and H_1 accepted). There are differences among treatment, so need to do multiple comparison test as follows:

$$\begin{aligned}
 |R_i - R_j| &\geq Z\sqrt{bk(k+1)/6} \\
 &\geq (2.64)\sqrt{(20)(4)(4+1)/6} \\
 &\geq (2.64)\sqrt{66.67} \\
 &\geq (2.64)(8.16) \\
 &\geq 21,54
 \end{aligned}$$

Table 19. Determination of Panna Cotta Taste

Treatment	Total	A	B	C	D	Credibility Level 95%	Real Level
D	28					21,54	a
C	36,5	8,5					ab
B	60,5	32,5	24				c
A	75	47	38,5	14,5			c

Treatment that has a real level with the same alphabet shows that it is not significantly different according to multiple comparison test at credibility level 95%

Table 20. Multiple Comparison Test Results On Appearance, Aroma, Texture and Taste of Panna Cotta

No.	A-Ar	Ar-A	A-T	T-A	A-Tx	Tx-A	Ar-T	T-Ar	Ar-Tx	Tx-Ar	T-Tx	Tx-T
1	7,00	0,14	0,33	3,00	0,14	7,00	0,33	3,00	0,20	5,00	0,20	5,00
2	0,14	7,00	0,14	7,00	9,00	0,11	0,20	5,00	9,00	0,11	7,00	0,14
3	7,00	0,14	0,20	5,00	0,14	7,00	0,20	5,00	0,20	5,00	1,00	1,00
4	9,00	0,11	0,14	7,00	0,11	9,00	1,00	1,00	0,20	5,00	3,00	0,33
5	0,14	7,00	7,00	0,14	0,11	9,00	0,11	9,00	0,14	7,00	1,00	1,00
6	1,00	1,00	0,11	9,00	0,33	3,00	1,00	1,00	1,00	1,00	1,00	1,00
7	7,00	0,14	0,14	7,00	0,14	7,00	0,11	9,00	7,00	0,14	5,00	0,20
8	9,00	0,11	0,14	7,00	9,00	0,11	0,14	7,00	1,00	1,00	1,00	1,00

9	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	5,00	0,20	5,00	0,20
10	7,00	0,14	0,20	5,00	3,00	0,33	0,20	5,00	0,33	3,00	5,00	0,20
11	5,00	0,20	0,20	5,00	5,00	0,20	0,33	3,00	0,20	5,00	3,00	0,33
12	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	5,00	0,20	1,00	1,00
13	0,14	7,00	9,00	0,11	0,14	7,00	0,20	5,00	0,14	7,00	0,11	9,00
14	0,14	7,00	0,20	5,00	7,00	0,14	7,00	0,14	9,00	0,11	7,00	0,14
15	0,20	5,00	0,20	5,00	0,33	3,00	0,14	7,00	0,14	7,00	9,00	0,11
16	0,20	5,00	0,14	7,00	7,00	0,14	0,20	5,00	0,33	3,00	0,14	7,00
17	1,00	1,00	0,33	3,00	1,00	1,00	0,33	3,00	1,00	1,00	3,00	0,33
18	5,00	0,20	0,33	3,00	5,00	0,20	0,20	5,00	3,00	0,33	3,00	0,33
19	3,00	0,33	0,11	9,00	0,20	5,00	0,14	7,00	3,00	0,33	7,00	0,14
20	5,00	0,20	0,14	7,00	0,33	3,00	1,00	1,00	5,00	0,20	0,11	9,00
Total	68,96	43,71	21,05	96,25	49,97	64,23	14,83	83,14	50,88	51,62	62,56	37,45
Mean	3,45	2,19	1,05	4,81	2,50	3,21	0,74	4,16	2,54	2,58	3,13	1,87
X _G	1,42	0,70	0,31	3,20	0,79	1,25	0,34	2,89	0,94	1,05	1,59	0,62

Determine the comparison matrix of panna cotta with addition of red tilapia bone gelatin powder based on characteristics from the questionnaire data on appearance, aroma, taste and texture for the most preferred panna cotta by the panelists. In this data can be seen in the range of values 1, 3, 5, 7 and 9, the data of the partner produces a value of 1,00; 0,33; 0,20; 0,14 and 0,11. Multiple comparison are carried out by 20 semi trained panelists, so it is necessary to combine data for each criterias using the following geometric average formula.

$$X_G = \sqrt[n]{\prod_i X_i}$$

Description: X_G = Average geometric

∏ = Permutation

n = Total panelist

X_i = Value of panelist to-i

So that the priority values of each criterias are obtained from the results of the average geometry data as follows.

Table 21. Criteria Weight Values of Panna Cotta

Criteria	Appearance	Aroma	Texture	Taste	Amount	Criteria Weight
Appearance	1,00	1,42	0,79	0,31	3,52	0,18
Aroma	0,70	1,00	0,94	0,34	2,98	0,16
Texture	1,25	1,05	1,00	0,62	3,92	0,21
Taste	3,20	2,89	1,59	1,00	8,67	0,45
Total					19,11	1,00

Do the calculations using Bayes method. The normalization value or weight of the criteria obtained multiplied by the median value of the results of the organoleptic test on each treatment criterias then added up, so that the alternative values are as follows.

Table 22. Determination of Panna Cotta Products with The Bayes Method Using Median Values

Treatment	Criteria				Alternative Value	Priority Value
	Appearance	Aroma	Texture	Taste		
A	3	5	4	9	6,24	0,27
B	7	7	9	7	7,41	0,32
C	7	5	6	5	5,57	0,24
D	6	5	5	3	4,28	0,18
Weight Value	0,18	0,16	0,21	0,45	23,50	1,00

Alternative Value

Treatment A : $(3 \times 0,18) + (5 \times 0,16) + (4 \times 0,21) + (9 \times 0,45) = 6,24$

Treatment B : $(7 \times 0,18) + (7 \times 0,16) + (9 \times 0,21) + (7 \times 0,45) = 7,41$

Treatment C : $(7 \times 0,18) + (5 \times 0,16) + (6 \times 0,21) + (5 \times 0,45) = 5,57$

Treatment D : $(6 \times 0,18) + (5 \times 0,16) + (5 \times 0,21) + (3 \times 0,45) = 4,28$

Priority Value

Treatment A : $6,24/23,50 = 0,27$

Treatment B : $7,41/23,50 = 0,32$

Treatment C : $5,57/23,50 = 0,24$

Treatment D : $4,28/23,50 = 0,18$

4. CONCLUSIONS

- 1) The most preferred panna cotta was obtained from 4% of red tilapia gelatin powder addition.
- 2) Further research is needed regarding the shelf life of panna cotta until the expiration date of panna cotta is found.

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