

UTILIZATION OF CAESALPINIA SAPPAN L. EXTRACTION AS A NATURAL COLORANT IN SHRIMPPASTE

By Mardiah

UTILIZATION OF CAESALPINIA SAPPAN L. EXTRACTION AS A NATURAL COLORANT IN SHRIMP PASTE

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Abstract : Red shrimp paste is one of the consumers' attractions. Usually, shrimp paste uses textile dyes. The purpose of this study is to obtain a natural red pigment that is safe when applied to food products. The method used is the addition of *Caesalpinia sappan* extract 0.01% (w/w) and 0.02% (w/w) when compared with the control. Test parameters include water content, salt content, protein content, acid insoluble ash content, pH, hedonic organoleptic test. The results showed that the addition of *Caesalpinia sappan* extracts significantly affected water content (21.94% -28.06%), salinity (7.05% -6.55%), ash content (0.45% -0.48 %) and pH (6.99-6.40). The hedonic test results obtained that the preferred shrimp paste is by adding 0.02% (w/w) of *Caesalpinia sappan* extract with °hue 50.11 (shrimp paste has red colour).

Keywords: Shrimp paste, colour, *Caesalpinia sappan* extract

1. INTRODUCTION

1.1. Background

Terasi or shrimp paste is an essential ingredient of Indonesian food that is much in demand by the public. Terasi or shrimp paste is a preserved product for small fish or small shrimp that has been processed through curing or fermentation, grinding and drying. Many people like shrimp paste because of its distinctive taste and aroma, significantly to increase appetite. However, shrimp paste that is favoured by consumers is coloured shrimp paste that looks attractive. This condition encourages producers to use synthetic colouring in the manufacturing process. Most of the producer use of artificial colouring is Rhodamin B.

Rhodamin B is a dye for paper, and textile so that this dye is dangerous to health (Salam, 2008). Rhodamin B is most hazardous if consumed, it can cause interference with liver function, even liver cancer. Hence in the Regulation of the Minister of Health of the Republic of Indonesia No.722 / MenKes / Per / IX / 88. Rhodamin B is one of the prohibited ingredients as food additives. Several regions such as in Central Java (Siswantari, 2006), East Kalimantan (Arjuan, 2008), Bangka-Belitung (Anon., 2011b) and West Java precisely in Bogor City (Barokah, 2016) have Shrimp paste that uses textile as colouring agents. This problem encourages the use of natural dyes that are red in making shrimp paste. Plants that have the potential to be used as natural red dyes are *Caesalpinia sappan* L. The isolation process carried out on *Caesalpinia sappan* L. pigment extract showed that the main component contained there was brazilin (Sanusi, 1989; Kim 1997). Brazilin is a yellow crystal, but if oxidized and exposed to sunlight will quickly form a red colour (Felter and Loyd, 2005). At low pH (pH 2-5) brazilin has a yellow

colour, neutral pH (pH 6-7) brazilin has a sharp red colour and moves towards purple is red with increasing pH (Adawiyah and Indriati, 2003).

Caesalpinia sappan wood contains antibacterial compounds and has anticoagulant (anti-clotting) properties. In terms of safety, acute toxicity tests (LD 50), lymphocyte cell proliferation and K-562 mouse cancer cells in vitro show that brazilin pigment is safe for health (Sundari et al. 1998; Puspaningrum, 2003 ; Ye et al. 2006). Based on the above, *Caesalpinia sappan* wood has the potential to be applied to foods that are red like shrimp paste. The results of several studies indicate that the *Caesalpinia sappan* wood extract can function as a natural colouring agent and preservative in food products. Therefore it necessary to test the effectiveness of the use of *Caesalpinia sappan* wood extract as a natural colouring agent in shrimp paste production.

1.2 Research purposes

The benefit of this research is to get a natural red dye that is relatively safe when compared with synthetic dyes and get the best addition of *Caesalpinia sappan* dye in shrimp paste making.

2. METHODS

2.1 Time and Location

The research place at the Laboratory of Food and Microbiology-Polytechnic AKA Bogor and IKM Terasi JUJUN Kampung Panyairan, Patugaran Palabuan Ratu, West Java. Conducted from July to October 2018.

2.2 Tools and Materials

The tools used were pH meter, analytical balance, tools glass for analyses, centrifuge, thermometer and spectrophotometer SHIMADZU brand type 1700. Materials needed *Caesalpinia sappan* wood, ethanol, gallic acid, folin ciocalteau, Na₂CO₃ 5%, AgNO₃ 0.1 N, HNO₃ (p), NH₄CNS 0.1 N, H₂SO₄ (p), NaOH 30%, H₃BO₄ , HCl 0.2 N, PCA media, sterile aquabidest, small shrimp (rebon), and salt.

Materials needed, namely Secang (*Caesalpinia sappan*) wood, ethanol, gallic acid, folin ciocalteau, Na₂CO₃ 5%, AgNO₃ 0.1 N, HNO₃ (p), NH₄CNS 0.1 N, H₂SO₄ (p), NaOH 30%, H₃BO₄ , HCl 0.2 N, PCA media, steril aquabidest, rebon shrimp, and salt.

2.3 Methodology

There are two stages of research namely, the first stage is the extraction of *Caesalpinia sappan* wood and shrimp preparation, the second stage is the manufacture of shrimp paste with the treatment to fading natural colouring from *Caesalpinia sappan* wood extract.

2.3.1. *Caesalpinia sappan* Wood Extraction

Caesalpinia sappan wood shavings obtained from farmers are already in the form of dry wood shavings. These wood shavings will be crushed into more delicate

powder using a Hammermill with a 40 mesh sieve size. Then this powder will be used in the next stage, namely the extraction stage.

Caesalpinia sappan wood extraction using water and boiling at 70°C for 20 minutes. It was then filtered and obtained *Caesalpinia sappan* wood extract filtrate. Furthermore, the colour variation contained in the *Caesalpinia sappan* wood extract using a chromameter, analysis of total tannins, and total phenols. The flow chart of the *Caesalpinia sappan* wood extraction process can be seen in Figure 1.

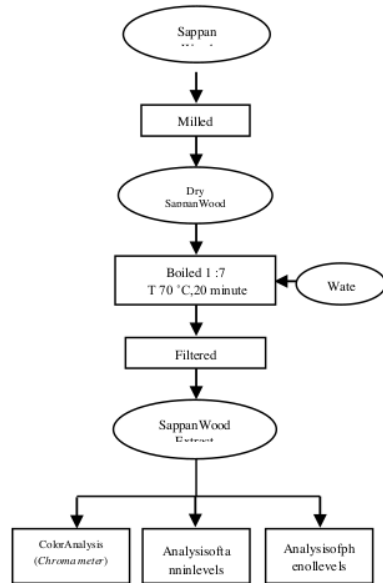


Figure 1 *Caesalpinia sappan* Wood Extraction Flow Chart

2.3.2. Shrimp Preparation

The preparation stage of small shrimp (rebon) is drying the rebon shrimp, then measuring the water content and water activity (Aw)

2.3.3. Shrimp Paste Making with Addition of Natural Dyes *Caesalpinia sappan* Wood Extract

The process of making shrimp paste was washing small fresh shrimp (rebon) using water then drying(I) until the shrimps are half-dry, then the milling (I) process is carried out with the addition of 15% salt and then fermented for 24 hours. Then drying (II) is done for 8 hours and fermented again for 24 hours. On milling (II) is done by adding *Caesalpinia sappan* wood extract according to the treatment of 0% (A0), 0.01% (A1) and 0.02% (A2). Then the printing process is carried out, then do drying (III). The process flow diagram for making shrimp paste in this study is presented in Figure 2.

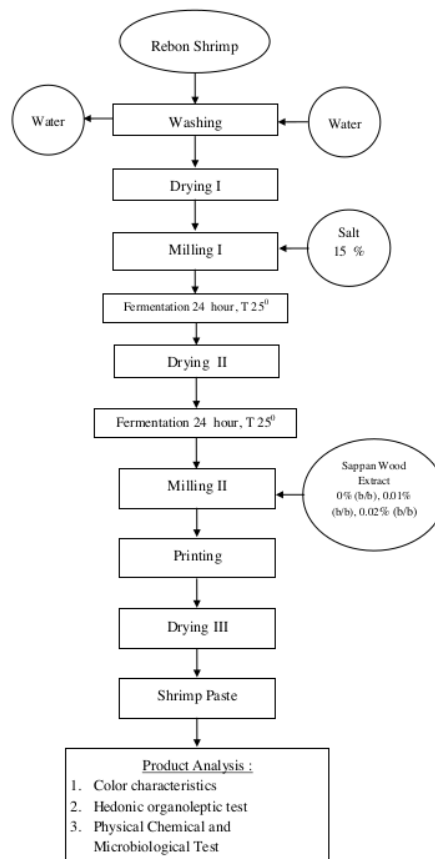


Figure 2 Processing of Shrimp Paste

⁵**2.4 Experimental design**

The experimental design used was a Completely Randomized Design (CRD) one factor with three levels of treatment, namely without the addition of *Caesalpinia sappan* wood extract 0% (A0), the addition of *Caesalpinia sappan* wood extract 0.01% (A1) and the addition of *Caesalpinia sappan* wood extract 0.02% (A2) to shrimp paste weight with 2 (two) replications.

2.5 Analysis Method

The analysis carried out includes:

1. Colour characteristic using the Chromameter tool. The treatment with the addition of *Caesalpinia sappan* wood extract and without addition (control) and market shrimp paste received a colour intensity measurement.
2. The products get the hedonic organoleptic test with parameters (aroma, taste, colour, appearance and texture) which aims to determine the level of preference of panellists with 1-7 scale preferences.
3. Physicochemical & Microbiological Risk Test
4. Water content analysis (SNI No.235-11-2015)
5. Analysis of protein content (SNI No.01-2354-4-2006)

6. Ash content analysis (SNI 01-2354-1-2011)
7. pH test (AOAC, 2005)

2.6 Data analysis

Analysis of the data used in the study used ¹²analysis of variance (ANOVA) if $p < 0.05$ (significant effect) to compare the data obtained. Further tests namely the honestly substantial difference Test (HSD) and use Microsoft Excel 2010 to present additional analysis data.

3. RESULTS AND DISCUSSION

3.1 Secang Wood Color Extraction (*Caesalpinia sappan* Linn.)

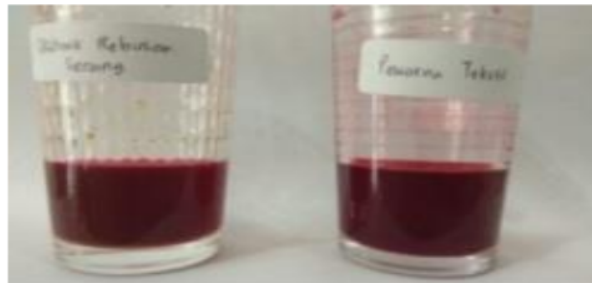


Figure 3. *Caesalpinia sappan* Wood Color Extract and Textile Dyes

The extraction of *Caesalpinia sappan* L. wood using water as a solvent, by boiling at 70°C for 20 minutes. Farhana et al. (2015) suggested that the best brazilein content of the *Caesalpinia sappan* L extract is when boiled at 70°C for 20 minutes. *Caesalpinia sappan* L wood extract has a purplish red colour with a yield of 31.42%.

Caesalpinia sappan L wood extract is also anti-bacterial, which can inhibit bacterial activity in the digestive tract, because it contains gallic acid in *Caesalpinia sappan* L. wood extract (Fazri, 2009). So that the *Caesalpinia sappan* L. wood extract was analyzed by tannin content and total phenol to determine the content contained in the section produced.

Table 1 Results of measurements of water content and ¹⁹ a_w in the process of making shrimp paste

Process	Water Content (% wb)				a_w	
	⁷ Shrimp Paste 0% (b/b)	Shrimp Paste 0.01% (b/b)	Shrimp Paste 0.02% (b/b)	Shrimp Paste 0% (b/b)	Shrimp Paste 0.01% (b/b)	Shrimp Paste 0.02% (b/b)
Fresh Shrimp Paste	80,92% ± 0,27%	80,92% ± 0,27%	80,92% ± 0,27%	0,98±0,01	0,98±0,01	0,98±0,01
Drying I	57,48% ± 0,71%	57,48% ± 0,71%	57,48% ± 0,71%	0,70±0,01	0,70±0,01	0,70±0,01
Drying II + Salt	49,37% ± 0,86%	49,37% ± 0,86%	49,37% ± 0,86%	0,76±0,01	0,76±0,01	0,77±0,01
Drying III + Secang wood extract	21,94% ± 0,06%	26,13% ± 0,50%	28,06% ± 0,30%	0,48±0,01	0,55±0,03	0,59±0,01

The level of tannic extract in this study was obtained by 0.103% with a total phenol of 245.46 mg / g. These are consistent with the results of the extraction carried out by Winarti & Sembiring (1998) resulting in a tannin content of 0.137% respectively.

3.2 Shrimp Preparation

The initial stage of making shrimp paste is by drying the small shrimp (rebon) repeatedly. At each stage of drying shrimp, there are measurements of water content and water activity (a_w). Microorganisms have minimum a_w so that it can ¹³ grow well, like bacteria with 0.90 a_w ; yeast 0.8 - 0.9 a_w ; mould 0.6 - 0.7 a_w . The results of measurements of water content and a_w available in Table 1.

Table 2 ¹⁸Results of measurements of water content and a_w in the process of making shrimp terasi

Process	Water Content (% wb)				a_w	
	Shrimp Paste 0% (b/b)	Shrimp Paste 0.01% (b/b)	Shrimp Paste 0.02% (b/b)	Shrimp Paste 0% (b/b)	Shrimp Paste 0.01% (b/b)	Shrimp Paste 0.02% (b/b)
Fresh Shrimp Paste	80,92% ± 0,27%	80,92% ± 0,27%	80,92% ± 0,27%	0,98±0,01	0,98±0,01	0,98±0,01
Drying I	57,48% ± 0,71%	57,48% ± 0,71%	57,48% ± 0,71%	0,70±0,01	0,70±0,01	0,70±0,01
Drying II + Salt	49,37% ± 0,86%	49,37% ± 0,86%	49,37% ± 0,86%	0,76±0,01	0,76±0,01	0,77±0,01
Drying III + Secang wood extract	21,94% ± 0,06%	26,13% ± 0,50%	28,06% ± 0,30%	0,48±0,01	0,55±0,03	0,59±0,01

Fresh shrimp has a water content of 80.92% with A_w levels at 0.98. The A_w results are susceptible to microbial attack, so the washing process of fresh shrimp must be done quickly, carefully and sanitary. Drying (I) obtained a water content of 57, 48% with A_w content 0.70. Data above shows that the drying process can reduce water content and a_w content from shrimp samples. In the second drying, the water content was 49.37% with the A_w content amounted to 0.77. A_w results on drying (I) and drying (II) are A_w levels that are prone to mould growth so that the storage process must maintain moisture. In the third drying for shrimp paste A0,

the water content was 21.94% and Aw of 0.48, shrimp paste A1 obtained a moisture content of 26.13% with Aw range of 0.55, and for A2 shrimp paste, it contains a moisture content of 28.06% with Aw content of 0.59. The Aw content of shrimp paste in the third drying can be declared a from microbial growth, both from the growth of bacteria, yeast and mould.

3.3 Color Characteristics of Secang Wood Extract, Rhodamin B Color and Shrimp Terasi.

Colour characteristics of *Caesalpinia sappan* L. wood extract, Rhodamin B and Shrimp paste are available in Table 2.

3.3.1. L Value (Brightness)

Table 3 Color Characteristics of *Caesalpinia sappan* Wood Extract, Rhodamin B and Shrimp terasi

Treatment	Color			°Hue
	L	a	b	
Color of secang wood extract	30,41±0.03	1,30±0,01	0,96±0,01	36,38±0.14
Color of rhodamin B	30,68±0,02	6,70±0,02	1,70±0,06	15,78±0,23
Shrimp Paste on the market	32,23±0.56	8,79±0.40	2,91±0.24	18,29±0.62
A ₀ (0 %)	32,35±0.01	1,02±0.02	1,51±0.02	57,65±0.20
A ₁ (0.01%)	34,10±0.43	1,60±0.23	1,68±0.21	48,51±0.43
A ₂ (0.02%)	36,66±0.07	2,46±0.03	2,70±0.04	50,11±0.18

Based on Table 3,the colour test of L value of *Caesalpinia sappan* wood extract was at 30.41. Based on the L value that the *Caesalpinia sappan* wood extract has a low brightness (dark). This value is included in the indication of dark colour because it is below number 50. L value of rhodamin b extract to obtained by 30.68, which also indicates dark colour, the L value in shrimp paste that has on the market got an L value of 32.23. For shrimp paste A0 (without the addition of dyes) the L value was 32, 35, the shrimp paste with the addition of 0.01% A1 *Caesalpinia sappan* wood extract was 34.10, and the L value for the shrimp paste with the addition of 0.02% A2 *Caesalpinia sappan* extract was 36, 66. The brightness value (L) indicates that the addition of *Caesalpinia sappan* wood extract gives a difference in brightness. Shrimp paste with the addition of the *Caesalpinia sappan* wood extract has a high brightness value compared to the shrimp paste without the addition of the *Caesalpinia sappan* wood extract. Hunter Lab (2012) states that the L (brightness) value with a low number (0-50) indicates the darkness of the colour, while the L value with a high number (51-100) determines the colour brightness.

Table 4 Colour Characteristics of *Caesalpinia sappan* Wood Extract, Rhodamin B and Shrimp Terasi

Treatment	Color			°Hue
	L	a	b	
Colorof secang woodextract	30,41±0.03	1,30±0.01	0,96±0.01	36,38±0.14
Colorofrhodamin B	30,68±0.02	6,70±0.02	1,70±0.06	15,78±0.23
ShrimpPasteonthemarket	32,23±0.56	8,79±0.40	2,91±0.24	18,29±0.62
A ₀ (0 %)	32,35±0.01	1,02±0.02	1,51±0.02	57,65±0.20
A ₁ (0.01 %)	34,10±0.43	1,60±0.23	1,68±0.21	48,51±0.43
A ₂ (0.02 %)	36,66±0.07	2,46±0.03	2,70±0.04	50,11±0.18

3.3.2. Rating a (Red / Green)

The value is a chromatic coordinate that represents a red or green value on a scale of -80 to 100. A positive value indicates the degree of redness of the sample, while a negative value represents the degree of the greenness of the example. Values of all treatments get a positive value which shows all treatments have a red degree. Amount of *Caesalpinia sappan* wood extract at 1.30, indicating that *Caesalpinia sappan* wood extract had a red degree. Value of Rhodamine b is 6,70 also has a red colour but redder when compared with the *Caesalpinia sappan* wood extract. Shrimp paste samples values that have been old in the market are 8.79. For the shrimp paste values A₀ (control) and A₁ (the addition of 0.01%) were 1.02, and 1.60, respectively. the value for A₂ shrimp paste (addition of 0.02%) was 2.46. The increase in the value of a in shrimp paste was caused by staining made of *Caesalpinia sappan* wood which contains red brazilin pigment.

3.3.3. Value b (Yellow / Blue)

The value of b represents the chromatic colours in blue and yellow. The b value is on a scale of -70 to 70. The positive b value indicates the degree of yellow of the sample, while the negative b value represents the blue degree of the model. Based on the test value of *Caesalpinia sappan* wood extract b of 0.96, which shows that *Caesalpinia sappan* wood extract has a degree of yellow. To test the value of b on rhodamin b obtained by 1.70, which hill us rates that rhodamin b also has a degree of yellow.

In shrimp paste that has-beens old in the market, a b value of 2.91 is obtained. While for shrimp paste with various treatments, the amount of b ranged from 1.51 to 2.70. The highest value obtained is 2.70 in shrimp paste with the addition of 0.02% *Caesalpiniasappan* wood extract. The addition of 0.01% *Caesalpinia sappan* wood extract gives a value of b of 1.60, then for shrimp paste without the addition of dyes obtained a value of b of 1.51. The results of the importance of b on shrimp paste show that shrimp paste has a colour that tens to be yellowish. If the value of b is more optimistic, the colour that will be producing increase singly yellow. According to Safitri (2009), the amount of b indicates the yellow and blue degrees

of the sample. The more positive (growth) a value of b, the more yellow the sample and vice versa, the more negative (decrease), the more blue the sample.

3.3.4. °Hue value

L, a *, b * values indicate coordinates in three-dimensional space related to brightness (L) and degree of hue (°Hue). Hue is a part of the visual sensation that refers to the reception of red, yellow, green, or blue (Arjuan, 2008). The °hue value of *Caesalpinia sappan* wood extract is 36.38 with a red colour range. The pH value of *Caesalpinia sappan* wood extract was 6.82. Neutral pH (pH 6-7) brazilein has a sharp red colour and move toward purplish red with increasing pH. (Adawiyah and Indriati, 2003). °hue value on rhodamin b obtained was 18.29 with a red colour range.

According to Arjuan (2008), shrimp paste generally has a colour that leads stored (red) or reddish yellow (yellow-red). Terasi (shrimp paste) has a red stain if °hue 18°-54° and yellow-red if °hue 54°-90°. Based on the test hue values of shrimp paste ranged from 48.51 to 57.65. The highest amount obtained is 57.65 in the A0 shrimp paste which moves towards reddish yellow, in the A1 shrimp paste obtained °hue of 48.51 with a red colour range, and in the A2 shrimp paste 50.11 the red colour range. The results indicate that the addition of *Caesalpinia sappan* wood extract can increase the red colour in shrimp paste.

3.4 Organoleptic Test

The panellists used were 30 people who as semi-trained panellists. The data processed with the help of SPSS using analysis of variance (ANOVA) with a level of 5%, if p < 0.05 (significantly different) to compare the data obtained, then further tests, namely Hone ¹⁰ Significant Difference Test (HSD). Shrimp paste organoleptic test data can be seen in Table 3.

Table 5 Shrimp Organoleptic Test Results

Treatment Sample	Aroma	Color	Taste	Sightings	Texture
A ₀ (0 %)	5,0 ^a ⁸	5,0 ^a	4,4 ^a	5,0 ^a	5,2 ^a
A ₁ (0.01%)	5,1 ^a	5,3 ^a	4,5 ^a	5,2 ^a	5,0 ^a
A ₂ (0.02%) ⁶	5,7 ^b	6,3 ^b	4,7 ^a	5,5 ^b	5,5 ^a

Information : 1 = Strongly dislike, 2 = Dislike, 3 = Quite dislike, 4 = Neutral, 5 = Quitelike, 6 = Like, 7 = Strongly like, different notations show significant differences at a significant level p < 0,05.

3.4.1. Aroma Hedonic Test

Based on the hedonic aroma test results, panellists gave a value of 4.95 to 5.65, which is "neutral to quite like". The ¹⁵ highest organoleptic test value in A2 treatment with a score of 5.65 (quite like). The results of the analysis of variance (ANOVA) showed that the treatment factor A had a significant effect (p < 0.05) on the taste preference of shrimp paste samples. The administration of *Caesalpinia*

sappan wood extract did not show a significant interaction on the level of flavour preference of the samples. These are due to the aroma produced by shrimp paste with a high addition resulting in a sharper aroma (not fishy). The formation of this scientist thought to have tannin contained in the *Caesalpinia sappan* wood extract. According to Ismarani (2012), tannin shaves a distinctive odour.

3.4.2. Colour Hedonic Test

Based on the results of an analysis of variance (ANOVA) showed that the treatment factor A significantly affected ($p < 0.05$) on the colour preference of shrimp paste samples. Based on the colour hedonic test results, panellists gave a value of 4.95 to 6.25, which is "neutral - like". The highest organoleptic test results in A2 treatment with a score of 6.25 (likes-strongly likes) and the lowest in the A0 treatment with a score of 4.95 (neutral-quite likes).

The colour of the shrimp paste produced in A0 treatment visually appears dark to the colour of the soil, thereby reducing the panellists' level of preference for the colour of the shrimp paste. The colour of shrimp paste with the addition of *Caesalpinia sappan* wood extract 0.02% (A2) gives a red colour to the shrimp paste because of *Caesalpinia sappan* wood contained in the section.

3.4.3. Taste Hedonic Test

Based on the hedonic test results, panellists gave a value of 4.35 to 4.65, which is "neutral - quite like". The highest organoleptic test value is in A2 treatment with a score of 4.65 (neutral – rather like). Results of analysis of variance (ANOVA) showed that the treatment factor A had no significant effect ($p < 0.05$) on the taste preference of shrimp paste. The administration of *Caesalpinia sappan* wood extraction did not show a significant interaction on the level of taste preference of the sample shrimp paste.

The unique taste of shrimp paste comes from protein that turns into amino acids that can cause a good taste (Sari *et al.*, 2009). Another statement by Karim (2014), during the fermentation process the process of breaking down proteins into amino acids, one of which is glutamic acid which is a source of umami flavour from shrimp paste.

3.4.4. Appearance Hedonic Test

Based on the hedonic appearance test results, panellists gave a value of 5.03 - 5.53 is "quite like - like". The highest organoleptic test value in A2 treatment with a score of 5.53 (quite like-like). The results of the analysis of variance (ANOVA) showed that the treatment factor A had a significant effect ($p < 0.05$) on the preference for shrimp paste sample appearance. The administration of *Caesalpinia sappan* wood extract did not show a significant interaction on the level of taste of sample appearance. The first impression that is felt by consumers when they see a product is usually through the formation of the product and in general consumers prefer an attractive appearance. The Appearance of shrimp paste with the addition of *Caesalpinia sappan* wood extract 0.02% is more appealing.

3.4.5. Texture Hedonic Test

Based on the hedonic texture test results, panellists gave a value of 5.03 - 5.50, which is "quite like - like". The highest organoleptic test value is in A2 treatment, with a score of 5.50 (quite like-like). Results of analysis of variance (ANOVA) showed that the treatment factor A had no significant effect ($p < 0.05$) on the texture preference of shrimp paste. The administration of *Caesalpinia sappan* wood extract did not show a significant interaction on the level of sample appearance. Many things distinguish the texture of food ingredients, including the ratio of protein content, fat, processing temperature, water content and water activity.

3.5. Organoleptic Test

The panelists used were 30 people who were classified as semi-trained panelists. The data that has been obtained is then processed with the help of SPSS using analysis of variance (ANOVA) with a level of 5%. If $p < 0.05$ (significantly different) to compare the data obtained, then further tests are carried out, namely Honestly Significant Difference Test (HSD). Shrimp paste organoleptic test data can be seen in Table 3

3.6. Shrimp Terasi Physicochemical and Microbiological Test

Table 6 Shrimp Terasi Physico Chemical and Microbiological Test

Treatment	Test Parameters							
	Water content	Salinity	Protein content	Ash content	pH	ALT (koloni /gram)	Coliform (Apm/g)	E- Coli
A ₀ (0%)	21,94% ± 0,06% ^a	7,05% ± 0,02 ^a	45,29% ± 0,75% ^a	0,45% ± 0,05% ^a	6,9 ± 0,1 ^a	1,7 x 10 ³	3,6	(-)
A ₁ (0,01%)	26,13% ± 0,50% ^b	6,63% ± 0,01 ^b	45,98% ± 1,19% ^a	0,60% ± 0,02% ^b	6,6 ± 0,1 ^a	8,5 x 10 ²	3,6	(-)
A ₂ (0,02%)	28,06% ± 0,30% ^c	6,55% ± 0,01 ^c	47,95% ± 0,77% ^a	0,85% ± 0,03% ^c	6,4 ± 0,1 ^b	2,6 x 10 ²	<3	(-)
SNI 2716:2016	Maks 35%	Maks 20%	Min. 15%	Maks. 1,5%	-	-	3,6	(-)

Information : different notations show significant differences at a significant level $p < 0,05$.

3.6.1. Shrimp Terasi Water Content

Based on the test of water content in shrimp paste, the values range between 21.9-28.1%. The highest value was 28.1% and 26.1% in A2 and A1 respectively, and the lowest was 21.9% in A0 shrimp paste. The results show that the shrimp paste water content is by SNI 2716: 2016 (2016) that the maximum water content of shrimp paste is 35%. From Table 4 above the moisture content in shrimp paste has increased by 4-6%.

Results of analysis of variance (ANOVA) showed that the treatment factor A had a significant effect ($p < 0.05$) on the water content of shrimp paste samples. These results indicate that the higher the addition of natural dyes of *Caesalpinia sappan* wood extract added, the water content of the shrimp paste will increase.

Increasing of water content in shrimp paste is caused by the *Caesalpinia sappan* wood extract in the form of liquid. The section contains water so that it increases the water content in shrimp paste products.

3.6.2. Protein levels

The purpose of a total protein test is to know the protein content of each shrimp paste sample and compare with SNI 2716: 2016 (2016). Based on the results of the analysis of variance (ANOVA) showed that the treatment factor A had no significant effect ($p < 0.05$) on the protein content of shrimp paste samples. The results obtained in this study are following SNI 2716: 2016 (2016), which states that the minimum protein content of shrimp paste is 15%. As well as based on research conducted by Adawyah (2007), the protein content of shrimp paste is around 20-45%, the product of shrimp paste with the addition of *Caesalpinia sappan* wood extract can be accepted.

The highest protein content in shrimp paste treatment with the addition of 0.02% *Caesalpinia sappan* wood extract (A2) is 47, 9% and the lowest protein content in shrimp paste without adding the *Caesalpinia sappan* wood extract (A0), which is 45.3%. The difference in protein content to be due to the difference in the addition of *Caesalpinia sappan* wood extract added to shrimp paste. The presence of protein in *Caesalpiniasappan* wood is 2.2 g per 100 g of dried *Caesalpinia sappan* wood, increasing the amount of protein added to shrimp paste by treating A1 and A2. The results obtained indicate that the greater the addition of *Caesalpinia sappan* wood extract, the higher the protein content in shrimp paste.

3.6.3. Ash Content

In this research, the insoluble ash content in each treatment (A0, A1 and A2) ranged from 0.4 to 0.8%. Shrimp paste ash content according to SNI 01.2716.2016 (2016) shrimp paste product is 1.5%. Results of analysis of variance (ANOVA) showed that the treatment factor A significantly affected ($p < 0.05$) on the ash content of shrimp paste samples.

These results indicate that the higher the addition of natural dyes extracts of *Caesalpinia sappan* wood added, the ash content in shrimp paste increase. The difference in ash content to be due to the difference in the addition of *Caesalpinia sappan* wood extract added to shrimp paste. Ash content in *Caesalpinia sappan* wood that is 1.4% in 100 g of dried *Caesalpinia sappan* wood increases the accumulation of ash content in shrimp paste by adding *Caesalpinia sappan* wood extract 0.01% (A1) and *Caesalpinia sappan* wood extract 0.02% (A2). The higher the addition of section, the higher the ash content produced.

3.6.4. pH test

Analysis of pH as one of the factors that influence and determine the type of organism that is dominant in fermentation. The pH analysis on shrimp paste by adding extracts of 0.01% and 0.02% and control.

Results of analysis of variance (ANOVA) showed that the treatment factor A had a significant effect ($p < 0.05$) on the shrimp paste pH analysis. Based on the

pH test on shrimp paste, the values range from 6.6 to 6.9. The highest value obtained is 6.9 in A0 and 6.7 in A1. The lowest is 6.6 in A2. These results indicate that shrimp paste with different treatments has decreased the pH value. The pH value in shrimp paste decreased by 0.1 - 0.4%. The most likely cause of this case of lightly acidic *Caesalpinia sappan* wood extract is 6.82. So that more *Caesalpinia sappan* wood extract, the pH decrease. The results of the pH value in the study of Sari et al. (2009), each has a pH of 6.8, 5.8 and 5.7. The highest pH value is 6.8, which is in fish paste without the addition of rosella extract (A0) and the lowest pH level is 5.7 in the fish paste treatment with the addition of rosella extract 20% (A2).

The decreased pH to be due to the amount of lactic acid produced by the metabolism of lactic acid bacteria in the fermentation process. According to Ndaw *et al.* (2008) that lactic acid bacteria are the dominant microorganisms in some fermented fish products. According to Adawiyah (2006), making shrimp paste has a pH of around six and during the fermentation process the pH of the shrimp paste for the rise to 6.5, finally after the shrimp paste is formed the pH drops back to 4.5 which causes fermentation microorganisms to decrease. If the fermentation is allowed to continue, there will be an increase in pH and the formation of ammonia.

³ 4. CONCLUSIONS AND SUGGESTION

4.1 Conclusion

Based on the results of this study can be concluded as follows:

1. *Caesalpinia sappan* wood extract can act as a natural red colouring agent in the shrimp paste making process.
2. The addition of *Caesalpinia sappan* wood extract as a natural dye for shrimp paste based on hedonic organoleptic tests is the addition of *Caesalpinia sappan* wood extract 0.02% (w / w).
3. Physicochemical results of shrimp paste with the addition of *Caesalpinia sappan* wood extract 0.02% are 28.0% water content, 47.95% protein content, ash content 0.85% and pH value 6.4.
4. The addition of *Caesalpinia sappan* wood extract in shrimp paste production accordance with SNI Shrimp paste No.2716: 2016.

4.2 Suggestion

1. This research is the first step in the application of the use of natural dyes from *Caesalpinia sappan* wood in the process of making shrimp paste. It needs to be carried out the stability test as the storability of the shrimp paste colour by adding *Caesalpinia sappan* wood extract.
2. It is necessary to test the addition of *Caesalpinia sappan* wood extract with a higher range so that the optimization of *Caesalpinia sappan* wood extract in shrimp paste manufacturing.

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