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## The Use of Rajungan (*Portunus Pelagicus*) Shells as Flour in Wet Noodles Ingredient

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# The Use of Rajungan (*Portunus Pelagicus*) Shells as Flour in Wet Noodles Ingredient

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**Abstract.** Wet noodles are raw noodles which had first undergone boiling process in boiling water before being marketed. Thus this type of noodle has 52 percent water content. Innovations in food products are not only focused on its form and taste. Now people are beginning to pay attention to the food's nutritional value. One alternative is to use rajungan (*Portunus Pelagicus*) shell waste, therefore increasing its economic value by adding it into noodle products. This study employed an experimental method with a complete random design. Five treatments and four replications was done in this research. The concentration of carrageenan kappa substitute was 10%, 20%, 30%, and 40%. The main parameters in this study were proximate test, hedonic test, and *texture analyzer* test. The proximate test data were analyzed using anava (variance analysis), while the hedonic test and texture analyzer test employed the *kruskal-wallis* test. From the proximate test data results it was revealed that the substitution of flour with rajungan shell significantly affect the increase in protein, fat, ash, and water levels. Protein, water and ash levels with the highest substitution of rajungan shell flour were treated by giving the highest shell flour with a value of 26.381%, 10.730%, and 43.887%, the lowest value of fat content was 0.162%. The addition of shell flour also shows the highest hedonic value.

**Keywords.** wet noodles, rajungan flour, proximate value, hedonic value

## 1. Introduction

Rajungan (*Portunus pelagicus*) is one of the leading export commodities of Indonesian fisheries sold in the form of frozen rajungan or canned rajungan meat. Rajungan production in Indonesia reached 42,411 tons in 2011 (Khasanah et al., 2016). The large market demand for rajungan is therefore directly proportional rajungan processing plant. This is because in one rajungan produces waste which consists of 57% shells, 3% *body reject*, and 20% cooking water (Syahbuddin et al., 2014). Therefore, it is essential to manage waste from the rajungan processing plant.

Rajungan shell waste was found to contain high nutritional value including water (10.16%), ash content (56.10%), fat (2.88%), protein (12.90%), calcium (10, 12 mg /100gr), and phosphorus (2.67 mg/100gr). Seeing the high content of mineral and protein, rajungan shell waste could potentially be produced into economically valuable products. It can be used as human food products in the form of flour as it is rich in minerals and proteins, then applied as additional raw materials in a certain product (Khasanah, et al, 2016).

One of the economically valuable products in which rajungan shell is used in its ingredients is flour subtitle is noodles. The wet noodle products which are circulating in the market have low nutrition



value, especially the protein and minerals content (Fadhli, 2017). The current research on wet noodles production by substituting flour with rajungan shell flour was aimed to determine the effect on the quality of wet noodles.

## 2. Methodology

### 2.1. Research tools

The tools used in the study were analytical balance (Mettler Toledo), *autoclave* manual (925 25 Quart Pressure Cooker Canner), grinder (Geuwa), pasta maker (OX355AT Oxone Noodle Maker).

### 2.2. Research tool and ingredients

The tool used in the research was the mini plant of PT. Phillips Seafood Indonesia in Kenjeran, Surabaya. The main ingredients used were rajungan (*Potunus Pelagicus*) shell flour (100 gram), 100 gram of flour, 2 grams of tapioca flour, 10 ml of water, 2 grams of salt, and 10 ml of eggs.

### 2.3. Research design

This research was an experimental study. An experimental research tests the relationship between cause and result. This study was aimed to determine the possible causal relationship by giving one or more treatments and comparing them non treatment control variable (Silalahi, 2010). This study employed a complete randomized design (CRD) with treatment of 0%, 10%, 20%, 30%, 40% and 4 replications.

### 2.4. Working procedure

#### 2.4.1. Making rajungan (*potunus pelagicus*) shells flour

The first step was to clean the shell from any possible remaining meat attached. After that, it was washed 3 times with running water, after which the size will be reduced. Then, the shell was boiled at 75 °C for 15 minutes. To make the shell softer, a presto process was carried out for 30 minutes.

The soft shell was then re-dried with an oven at 50°C for 1 hour. Dried rajungan shell fragments were grinded with a *grinder* to produce rajungan shell flour (Ferazuma et al., 2011). As soon as the milling process was done, crab shell flour was sifted with size of 100 mesh (Yanuar, 2013).

#### 2.4.2. Making wet noodle rajungan (*portunus pelagicus*) shell flour substitute

The dough was made by mixing 100 grams of flour, 2 grams of tapioca flour, 2 grams of salt, 10 ml of water, and 10 ml of eggs (Lubis, et al, 2013). All ingredients were stirred until it was mixed well. After that, mix the rajungan shell flour into the mixture. The dough was then molded using a *pasta maker*.

#### 2.4.3. Proximate testing

##### a. Protein Levels (AOAC 2007)

In this study, protein levels were tested at the Universitas Airlangga Surabaya's Tropical Disease Diagnostic Center Laboratory. The Protein levels were calculated using the following formula:

$$\% N = (v \text{ HCl} \times N \text{ HCl} \times \text{BMn} \times 14,007 \times \text{fp}) / \text{sample weight} \times 100\% \quad (1)$$

$$\% \text{ protein} = \% N \times \text{conversion factor} \quad (2)$$

##### b. Moisture content (AOAC 2007 )

An empty cup was dried first in 105-110°C for 10 minutes, then cooled in desiccator for 30 minutes and where it was weighed. A sample of 2 grams was weighed and placed in a cup then heated in an oven for 3-4 hours at a temperature of 105-110°C. The cup was then cooled in a desiccator and weighed again afterwards. Water content presentation can be calculated by the following formula:

$$\% \text{ water content} = (\text{weight before drying} - \text{weight after drying}) / \text{sample} \times 100\% \quad (3)$$

## c. Ash content (AOAC 2007)

A wet sample of 4 grams was placed in a porcelain container and then put in the oven with a temperature of 60-105°C for 8 hours. Then the dried sample was burned using *hotplate* for 20 minutes. It was then put in the furnace at 600°C for 3 hours until it turned into ash, then weighed. The ash content was calculated by the following formula:

$$\% \text{ ash content} = \text{ash weight} / \text{sample weight} \times 100\% \quad (4)$$

## d. Fat content (AOAC 2007)

A Fat flask was dried in an oven at 105°C for 30 minutes then cooled (A). The sample was weighed at five grams (S), then wrapped in filter paper. The filter paper was tied with fat-free wool yarn and put into a soxhlet tube, then doused with fat solvent and mounted to a distillation device. The reflux was carried out for five hours until the solvent which descended to the bottom of the fat flask was clear. The distillation results were heated in an oven at 105 °C for 60 minutes. The next step was cooling down the fat flask in the desiccator for 20-30 minutes then weighed (B). The fat content can be calculated using the following formula:

$$(\text{BA}) \text{ Sample weight} \times 100 \quad (5)$$

## e. Carbohydrate levels (AOAC 2007)

Carbohydrate analysis was done *by difference*, which is the result of 100% reduction with water, ash, and protein content, as well as fat level. Carbohydrate analysis was calculated using the formula:

$$100\% - (\text{moisture content} + \text{ash content} + \text{fat content} + \text{protein content}) \quad (6)$$

## 2.4.4. Hedonic

The Hedonic testing was carried out in the Food Laboratory of the Faculty of Fisheries and Marine Sciences in Universitas Airlangga. Hedonic testing was conducted by 30 untrained panelists from the students of Fisheries Technology Program of Universitas Airlangga. Wet noodle products were tested by giving them codes. Then, the panelists were asked to give an assessment that includes color, aroma, taste, and texture (Adawyah, 2011).

2.4.5. Texture profile analysis using the *texture analyzer* TA-XT2i

*Texture Analyzer* was tested in the Food Technology Laboratory, University of Trunojoyo, Madura. The parameters observed included *hardness*, *springiness*, *cohesiveness*, *gumminess*, *chewiness* and *resilience*.

## 2.4.6. Data Analysis

The data obtained from proximate analysis and *texture analyzer* of wet noodle using rajungan shell flour were analyzed by Analysis of Variants and then continued with *Duncan Multiple Range Test*. The hedonic test results were carried out by statistical analysis of the *Kruskal-Wallis test*.

## 3. Results and discussion

## 3.1. Results

## 3.1.1. Proximate Test

The average of proximate test data for wet noodle products can be seen in Table 1.

**Table 1.** Average noodle protein levels wet.

Treatment	Protein	Water	Ash	Fat	Carbohydrate
0%	13,047 <sup>c</sup> ± 0,886	8,675 <sup>c</sup> ± 0,117	39.056 <sup>c</sup> ± 0.202	0.217 <sup>b</sup> ± 0.045	39.004 <sup>c</sup> ± 0.915

10%	15.786 <sup>d</sup> ± 0.994	9.322 <sup>d</sup> ± 0.114	40.316 <sup>bc</sup> ± 0.601	0.185 <sup>ab</sup> ± 0.009	34,389 <sup>d</sup> ± 1.394
20%	21.738 <sup>c</sup> ± 0.550	9.702 <sup>c</sup> ± 0.171	41.192 <sup>b</sup> ± 0.641	0.180 <sup>a</sup> ± 0.017	27.186 <sup>c</sup> ± 1.039
30%	24.119 <sup>b</sup> ± 0.850	10.415 <sup>b</sup> ± 0.212	42.901 <sup>a</sup> ± 1.452	0.176 <sup>a</sup> ± 0.006	22.397 <sup>b</sup> ± 1.039
40%	1.25326.381 <sup>a</sup> ± 0.744	10.730 <sup>a</sup> ± 0.198	43.887 <sup>a</sup> ± 1.481	0.162 <sup>a</sup> ± 0.007	18.8391.511 <sup>a</sup> ± 1.039

Description: SD = Standart deviations Different *superscript* in the same column indicate a significant difference ( $p < 0.05$ ).

The highest average results of wet noodle protein level were at 40% treatment. The 0% treatment as a comparison without the substitution of rajungan shell flour produced the lowest average protein content. This value was significantly different ( $P < 0.05$ ). Zero percent indicated the lowest value of protein content among other treatments. The difference in notation on treatment 40%, treatment 30%, treatment 20%, and treatment 10%, showed that the increase in the concentration of crab shell flour affects the value of protein.

The statistical test of water content shows that 0% is significantly different ( $p > 0.05$ ) with 10%, 20%, 30%, and 40%. Advanced tests with Duncan test (*Duncan Multiple Range Test*). Based on Table 1, it was revealed that the value of water content was different for 40%, treatment of 30%, treatment of 20%, treatment of 10% and treatment of 0%. It showed that the increase in the concentration of rajungan shell flour affects the moisture content.

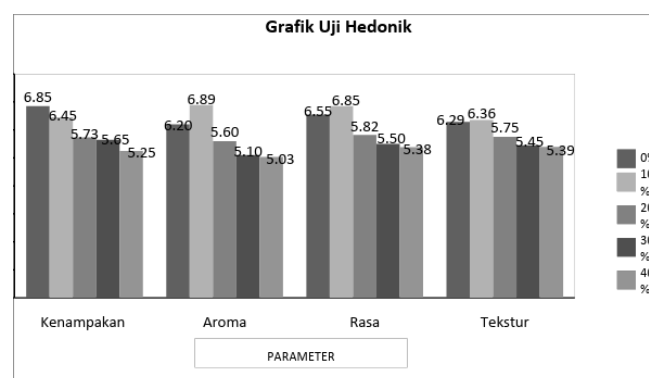
The follow up Duncan Test results (*Duncan Multiple Range Test*) exhibited differences in the treatment of 30% and 40% ash content. Differences were also prevalent in the results of fat content values through statistical tests. There were differences in the treatment of 20%, 30% and 40% which means that substitution of crab shell flour has the same effect on the value of fat content.

Carbohydrate level values showed significantly different results ( $P < 0.05$ ). The 0% treatment showed the lowest carbohydrate level value among other treatments. The difference in 40%, 30%, 20%, and 10%, showed that the increase in the concentration of substitution of crab shell flour affect the carbohydrate value of wet noodles.

### 3.1.2. Hedonic value

Data on average hedonic value of wet noodle products with substitution of rajungan shell flour can be seen in table 2.

**Table 2.** The hedonic value of wet noodle products with substitution of rajungan shell flour.



The highest appearance parameter values were obtained at 0% with an average of 6.85 which means quite enjoyable. The highest average of scent parameter was obtained at 10% treatment with a

value of 6.89, while the lowest average was obtained at 40% with a value of 5.03. The taste preference parameter showed the highest value was obtained at 10% with an average of 6.85 which means quite enjoyable. The results of the statistical analysis showed that the highest taste parameter was obtained at 10% treatment with a value of 6.85, while the lowest average was 40% with a value of 5.38. The results of the statistical analysis revealed a P value of 0.002 or less than 0.05 ( $P > 0.05$ ) which means that the taste parameter has a significantly different result with all treatments.

The average results of most favorite wet noodle texture were 10% with a value of 6.36. Meanwhile, the lowest average was obtained at 40% with a value of 5.39. Statistical analysis showed a P value of 0.001 or less than 0.05 ( $P < 0.05$ ) which means that texture parameters have significantly different results.

### 3.2. Discussion

The results of the protein levels of wet noodle protein with substitution of rajungan shell flour exhibited an increase. This condition was caused by the fact that the protein content of crab shells was higher than the protein content in the ingredients used. Water content is an essential characteristic of food because water content can affect appearance, texture, and taste in food (Lubis, et al, 2013). The water content test results on wet noodles with substitution of rajungan shell flour continue to increase. The increasing water content did not affect the quality of wet noodles. This was because the water content in wet noodles with substitution of crab shell flour still met the wet noodle quality standard SNI 01-2987-2015 with the maximum standard of 35 mass fraction %.

The amount of water content was due to the increase in the percentage of rajungan shell flour used in the production of wet noodles. In addition, the high protein content of crab shell flour can affect the moisture content in wet noodle products. High protein flour has greater water absorption compared to the low protein ones (Billina A, et al, 2015).

The percentage of ash content is the overall mineral content found in food ingredients. Mineral elements in the body function as building and regulating substances. Elements of mineral such as sodium, potassium, calcium, magnesium and phosphorus are present in the body in significant amounts and hence are called macro mineral elements. Other mineral elements such as iron, iodine, copper and zinc are present in the body in only small amounts, thus they are called micro minerals (Yanuar, 2013). The test results for the ash content of wet noodles with substitution of rajungan shell flour exhibited an increase. This was because the crab shell has a fairly high mineral content. According to Yanuar (2013) rajungan shell waste contains ash (56.10%). Subsequently, the mineral content is quite high, namely calcium (10.12 mg/100gr) and phosphorus (2.67 mg/100gr).

The crab shell has a low fat content. It confirmed a previous study by Yanuar (2013) which found that 100gr of crab shell flour only contained 0.19% fat. Low fat content in food is not a problem. On the other hand, high fat levels in food results in unstable and easily damaged or rancid food. One of the causes of rancidity is fat oxidation (Aliya, et al., 2016).

The analysis of carbohydrate content in wet noodles with substitution of rajungan shell flour has showed a decrease. The source of carbohydrates in the production of noodles comes from wheat flour. The decrease in carbohydrate levels due to the increasing concentration of crab shell flour given will also reduce the composition of flour in the production of wet noodles. In addition, according to Nurhijadah and M. Yusuf (2010), there is no carbohydrate content in the proximate analysis of both rajungan shell and meat flour.

The percentage of appearance of wet noodles with substitution of crab shell flour, showed the highest value of panelists' preference at the 10% formulation. Differences in preferences from each treatment are thought to be caused by changes in color, shape or hardness of wet noodles which complies the increase in the amount of substituted rajungan shell flour. Therefore, different results of hedonic tests on the appearance of wet noodles are caused by the small percentage of the substitution of rajungan shell flour. The highest appearance assessment is at 10% substitution formulation. It showed that such concentration was the best formulation in wet noodles production according to the panelist's assessment.

Aroma is one of the key variables. Because in general, consumer's preference towards food products is largely determined by aroma. The highest value of the hedonic test of the aroma of wet noodles with substitution of rajungan shell flour was found in the substitution formulation of 10%. This is allegedly because the aroma of such concentration matches the reception of the sensory smell of the panelist. Wet noodles with substitution of rajungan shell flour have a distinctive aroma. The distinctive aroma of rajungan is caused by volatile components found in rajungan (Ismiwarti, 2005). The importance of the panelists' assessment of food aroma is due to its ability to determine the view of the overall taste of food ingredients. Aroma can provide stimulation to the consumer's sensory acceptance of a product (Lestari et al., 2015).

Sensing is divided into four main flavors, namely sweet, salty, bitter, and sour (Lestari et al., 2015). Taste is an important factor that determines the final decision of consumers to accept or reject a product. The 10% concentration is the highest value favored by panelists, presumably because of the composition of the ingredients of wet noodles matches the tastes of the panelists. At 10% concentration, the protein and fat content is more balanced than other concentrations, boosting the overall preference of the panelists.

The texture value obtained from the hedonic test shows that the 10% composition has a texture favored by panelists. The texture of wet noodles with higher substitution of rajungan shell flour has a low texture value, due to the reduced composition of flour in the dough.

*Texture Analyze* is a tool used to test the texture properties of food ingredients (Indiarto, et al, 2012). *The Texture Analyzer* can be used to view data in graphic format, measure gradients, areas, averages, and simultaneously store the data into other devices. The results parameters measured using *Texture analyze* include *hardness*, *springiness*, *cohesiveness*, *gumminess*, *chewiness* and *resilience*.

*Hardness* is the maximum peak at the first pressure or at the first bite. The units used are kg, g or N (Indiarto, et al, 2012). The best concentration of substitution of crab shell flour is found in the 10% formulation. The difference *hardness* is caused by the different fat content in all treatments.

The level of hardness of a product is influenced by fat content. According to Pratama, et al. (2014) fat can form a complex with amylose which reduces the degree of development, but the higher ratio of fat to amylose causes hardness to decrease because more fat does not form a complex with amylose. Free fat that does not form complexes with amylose causes the product to become softer.

Another factor that affects the *hardness* value is the water content in high crab shell flour. In addition to fat and water content factors, the degree of development of the water solubility index and the water absorption index can affect the value of *hardness* a product between the degree of gelatination (Pratama, et al, 2014).

*Springiness* or elasticity can be interpreted as recovery time between the end of the first bite and the beginning of the second bite (Indiarto, et al, 2012). There are no units of measurement because this parameter calculate time difference area. The test results of the *springiness* showed that the 0% formulation has the highest value. This is because the greater the substitution formulation is, the less amount of flour will be used, resulting in a decrease in elasticity in wet noodle products. Wheat flour contains lots of gluten. Gluten consists of gliadin and glutenin. Gliadin functions as an adhesive and adds elasticity to the dough. Meanwhile, glutenin makes the dough strong and holds CO<sub>2</sub> gas so that the dough can expand and form pores (Rosalina. Et al, 2018).

*Cohesiveness* is defined as the rate at which materials are mechanically destroyed (Indiarto, et al, 2012). The highest value of *cohesiveness* in wet noodle products is obtained at 10% formulation. These results indicate that the 10% formulation is not rapidly destroyed mechanically compared with other formulations. The high value of *cohesiveness* in the 10% formulation is allegedly due to the comparative composition of wheat flour with crab shell flour, so that it can form a good texture of wet noodle dough.

The *Gumminess* on wet noodles with substitution of rajungan shell flour was more stable than the control variable. The value of *gumminess* is stable because the larger the formulation is, the less will the composition of flour be. Carbohydrate molecules in wheat flour has the ability to absorb water six to seven times greater than protein (Mervina et al., 2012). This condition causes the value of

*gumminess* of wet noodles with rajungan shell flour more stable, because it absorbs water which is able to develop the noodle dough.

The value of *chewiness* of the control treatment is higher than the other treatments. The difference in value is due to the higher starch content in wheat flour. The starch content in noodle products results in greater gelatinization. According to Indriyanti, et al. (2013) starch which with high amylose content has stronger hydrogen bond because of the large number of straight chains in the granule. Therefore, it requires greater energy for gelatinization and thus the resulting noodles are more elastic.

The highest value of *resilience* in wet noodle products was obtained in the control treatment. The high value of *resilience* is higher amount of gluten in control treatment compared to the others. Gluten can act as an air trap, resulting with fewer number of cavities in the dough (Prayitno. Et al. 2018). This condition causes the noodle dough in the control formulation to have denser texture.

#### 4. Conclusion

From the research it can be concluded that the substitution of rajungan shell flour (*Portunus pelagicus*) in the production process of wet noodles can improve the quality of wet noodle products.

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