The Use of Seaweed Flour (*Kappaphycus alvarezii*) as an Innovation in the Manufacture of High Fiber *Fettucine* Pasta Products

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Abstract. *Fettucine* is one type of pasta that is generally made from wheat flour with a mixture of eggs and water. Wheat flour is rich in carbohydrates and low in fiber can cause obesity. One of the alternatives to overcome this problem is to increase fiber consumption by utilizing fishery commodities such as seaweed to be the main ingredient in making fettucine, namely *Kappaphycus alvarezii* seaweed flour. This study used experimental laboratory research methods to determine the effect of adding *Kappaphycus alvarezii* seaweed flour as a source of fiber to the nutritional value and organoleptic characteristics of fettucine. The design used was a completely randomized design (CRD) with one factor, consisting of 4 concentration treatments and 3 replications. The results showed that there was a significant difference between treatments (P<0.05). The highest nutritional value is obtained from the addition of 50% containing water (26.18%), ash (3.58%), protein (3.04%), fat (5.83%), fiber (3.29%), and carbohydrate (58.08%). Meanwhile, organoleptic test results with hedonic parameters showed the best treatment at the addition of 20% with an average color value (6.50%), aroma (6.77%), texture (7.17%), and taste (6.87%).

1. Introduction

Globalization has an influence on the behavior of the world community, including in Indonesia. If in the previous period the Indonesian people were more familiar with various types of local food, now people's knowledge of foreign food is increasing. One of them is fettuccine pasta. Pasta products are largely popular worldwide and well accepted because of their sensory attributes [1]. Its convenience and palatability make it a popular dish [2]. Conventional pasta is mainly manufactured using wheat flour as the primary ingredient [3]. Wheat flour are rich in carbohydrates and low in fiber [4]. The high consumption of carbohydrates and low consumption of fiber in the body can cause obesity [5] One of the alternatives to overcome this problem is to increase fiber consumption by utilizing fishery commodities such as seaweed to be the main ingredient in making fettucine, namely *Kappaphycus alvarezii* seaweed flour. The fiber contained in seaweed is an important compound that is useful in preventing obesity because fiber has filling properties so it doesn’t get hungry quickly. High fiber intake will not contribute more calories so that it can help in controlling weight [6]. Therefore, this research was to investigate the effect of adding *Kappaphycus alvarezii* seaweed flour as a source of fiber to the nutritional value and organoleptic characteristics of *fettucine*. 
2. Material and Method

2.1 Materials
The ingredients used are *Kappaphycus alvarezii* seaweed flour was purchased from online, eggs, salt, cooking oil, wheat flour and water. While the chemicals for analysis are kjeldahl table, distilled water, sulfuric acid, methylene red, methylene blue, sodium hydroxide, boric acid, 4 M hydrochloric acid, alcohol, and sodium chloride.

2.2 Research preparation
This study used experimental laboratory research methods to determine the effect of adding *Kappaphycus alvarezii* seaweed flour as a source of fiber to the nutritional value and organoleptic characteristics of fettucine. The design used was a completely randomized design (CRD) with one factor, consisting of 4 concentration treatments and 3 replications.

2.3 Preparation of fettucine
Mix the ingredients using a mixer for 5 minutes or until the dough is smooth. Then, shape the dough into a round and cover with plastic wrap. Then, let stand for 1 hour at room temperature. After that, roll out the dough to the appropriate thickness using a pasta maker. Next, boil the dough that has been milled using boiling water for 5 minutes or marked by the floating of the fettucine paste. The formulation of the fettucine paste used in this study can be seen in Table 1.

2.4 Proximate content analysis
Protein, carbohydrate, fiber, ash, water, and fat contents analysis was carried out at Faculty of Fisheries and Marine Airlangga University Surabaya. The analysis of protein, fat, water, ash, carbohydrate, and fiber contents were carried out by Kjeldahl [7], Soxhlet [8], and carbohydrate by different [9].

2.5 Organoleptic test analysis
Organoleptic and hedonic testing of fettucine pasta which involves the taste, aroma, texture, and color was carried out by semi-trained panelists, consisting of 30 students from Faculty of Fisheries and Marine Airlangga University Surabaya. Sensory assessment of fettucine pasta refers to SNI 2346:2011 and the results from hedonic test are categorized into a scale of 1 to 9.

2.6 Data analysis
Data analysis is carried out using SPSS application. The results from nutrients testing were processed by applying ANOVA test. The calculation can be continued with Duncan's Multiple Distance Test to find out which treatment gives the best test results, treatments that are significantly different, and treatments that are not significantly different [10]. Meanwhile, the data from the organoleptic test were analyzed using the Kruskal-Wallis test.

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**Table 1. Fettucine Pasta Formula**

| Ingredients                  | Weight | M₀  | M₁  | M₂  | M₃  |
|------------------------------|--------|-----|-----|-----|-----|
| Wheat flour (%)              | 100    | 80  | 65  | 50  |
| Seaweed flour (%)            | 0      | 20  | 35  | 50  |
| Egg (g)                      | 25     | 25  | 25  | 25  |
| Salt (g)                     | 1      | 1   | 1   | 1   |
| Water (ml)                   | 20     | 20  | 20  | 20  |
| Vegetable oil (ml)           | 3      | 3   | 3   | 3   |

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3. Results and Discussion

3.1 Water content
The average value of the water content of fettucine paste products has a value between 26.18-34.44%. The M3 treatment was the best result with an average value of 26.18%. The results of the ANOVA test on water content showed a significant difference (P<0.05) in each treatment, so it was continued with Duncan's test. The results of Duncan's test analysis showed that the water content of P0 and P3 was not significantly different. Meanwhile, M1 was significantly different from M0, M2, and M3. The results of the water content test on fettucine paste products with the addition of *Kappaphycus alvarezii* seaweed flour can be seen in Table 2.

| Treatments | Average ± SD | Standard SNI 01-2897-1992 |
|------------|--------------|---------------------------|
| M0         | 26.19±0.156a | Maks. 35%                 |
| M1         | 34.44±0.253c |
| M2         | 29.43±0.251b |
| M3         | 26.18±0.223a |

*Different superscript letter notations in the same column indicate a very significant difference between treatments (p<0.05). M0 (0% seaweed flour), M1 (20% seaweed flour), M2 (35% seaweed flour), M3 (50% seaweed flour).*

3.2 Ash content
The average value of ash content of fettucine pasta products with the addition of *Kappaphycus alvarezii* seaweed flour has a value that ranges from 0.57 to 3.58%. The results of the ANOVA test on the ash content showed a significant difference (P<0.05) in each treatment, so it was continued with Duncan's test. The results of Duncan's test analysis showed that the ash content of M2 and M3 was significantly different from that of M0 and M1 but not significantly different from each other. Meanwhile for M0 it was significantly different from M1, M2, and M3. The results of the ash content test on fettucine paste products with the addition of *Kappaphycus alvarezii* seaweed flour can be seen in Table 3.

| Treatments | Average ± SD | Standard SNI 01-2897-1992 |
|------------|--------------|---------------------------|
| M0         | 0.57±0.144a  |
| M1         | 1.32±0.420b  |
| M2         | 3.21±0.219c  |
| M3         | 3.58±0.596c  |

*Different superscript letter notations in the same column indicate a very significant difference between treatments (p<0.05). M0 (0% seaweed flour), M1 (20% seaweed flour), M2 (35% seaweed flour), M3 (50% seaweed flour).*

3.3 Protein content
The value of protein content in fettucine pasta products with the addition of *Kappaphycus alvarezii* seaweed flour has a value ranging from 1.33-3.04%. The M3 treatment was the best result with an average value of 3.04%. The results of the ANOVA test on protein content showed a significant difference (P<0.05) in each treatment, so it was continued with Duncan's test. The results of Duncan's analysis showed that the protein content of M0 and M3 were not significantly different, while M1 was significantly different from M0, M2, and M3. The results of the protein content test on fettucine paste products with the addition of *Kappaphycus alvarezii* seaweed flour can be seen in Table 4.
### Table 4. Protein Content

| Treatments | Average ± SD | Standard SNI 01-2897-1992 |
|------------|--------------|---------------------------|
| M0         | 2.82±0.075<sup>c</sup> |                           |
| M1         | 1.33±0.185<sup>a</sup>  | Min. 3%                   |
| M2         | 2.32±0.125<sup>b</sup>  |                           |
| M3         | 3.04±0.142<sup>c</sup>  |                           |

<sup>a</sup> Different superscript letter notations in the same column indicate a very significant difference between treatments (p<0.05).

<sup>b</sup> M<sub>0</sub> (0% seaweed flour), M<sub>1</sub> (20% seaweed flour), M<sub>2</sub> (35% seaweed flour), M<sub>3</sub> (50% seaweed flour).

### 3.4 Fat content

The value of fat content in fettucine pasta products with the addition of *Kappaphycus alvarezii* seaweed flour has a value ranging from 5.83 to 6.18%. The results of the ANOVA test on fat content showed a significant difference (P<0.05) in each treatment, so it was continued with Duncan's test. The results of Duncan's test analysis showed a significant effect on the fat content values of M<sub>0</sub> and M<sub>3</sub>. While the M<sub>1</sub> and M<sub>2</sub> treatments showed that were not significantly different from the fat content of M<sub>0</sub> and M<sub>3</sub>. The results of the fat content test on fettucine paste products with the addition of *Kappaphycus alvarezii* seaweed flour can be seen in Table 5.

### Table 5. Fat Content

| Treatments | Average ± SD | Standard SNI 01-2897-1992 |
|------------|--------------|---------------------------|
| M0         | 6.18±0.159<sup>b</sup>  |                           |
| M1         | 6.09±0.190<sup>ab</sup>  |                           |
| M2         | 6.00±0.098<sup>ab</sup>  |                           |
| M3         | 5.83±0.045<sup>a</sup>  |                           |

<sup>a</sup> Different superscript letter notations in the same column indicate a very significant difference between treatments (p<0.05).

<sup>b</sup> M<sub>0</sub> (0% seaweed flour), M<sub>1</sub> (20% seaweed flour), M<sub>2</sub> (35% seaweed flour), M<sub>3</sub> (50% seaweed flour).

### 3.5 Fiber content

The value of crude fiber content in fettucine pasta products with the addition of *Kappaphycus alvarezii* seaweed flour has a value ranging from 2.18-3.29%. The results of the ANOVA test on crude fiber content showed a significant difference (P<0.05) in each treatment (M<sub>0</sub>,M<sub>1</sub>,M<sub>2</sub>,M<sub>3</sub>), so it was continued with Duncan's test. The results of Duncan's test analysis showed that the crude fiber content of P<sub>0</sub> was not significantly different from that of M<sub>1</sub> but significantly different from M<sub>2</sub> and M<sub>3</sub>. While the crude fiber content in M<sub>2</sub> was not significantly different from M<sub>3</sub> but significantly different from M<sub>0</sub>. Meanwhile, the crude fiber content of M<sub>3</sub> was significantly different from that of M<sub>0</sub> and M<sub>1</sub>. The results of the fiber content test on fettucine paste products with the addition of *Kappaphycus alvarezii* seaweed flour can be seen in Table 6.
Table 6. Fiber Content

| Fiber content | Treatments | Average ± SD | Standard SNI 01-2897-1992 |
|---------------|------------|--------------|---------------------------|
|               | M0         | 2.18±0.032^a |                           |
|               | M1         | 2.48±0.047^ab|                           |
|               | M2         | 2.81±0.045^bc|                           |
|               | M3         | 3.29±0.564^c |                           |

^a Different superscript letter notations in the same column indicate a very significant difference between treatments (p<0.05).

^b M0 (0% seaweed flour), M1 (20% seaweed flour), M2 (35% seaweed flour), M3 (50% seaweed flour).

3.6 Carbohydrate content

The value of carbohydrate content in fettucine pasta products with the addition of *Kappaphycus alvarezii* seaweed flour has a value that ranges from 25.52-32.44%. The results of the ANOVA test on carbohydrate levels showed a significant difference (P<0.05) in each treatment, so it was continued with Duncan’s test. The results of Duncan’s test analysis showed that there was a significant difference in each treatment (M1, M2, M3, M4). The results of the carbohydrate content test on fettucine paste products with the addition of *Kappaphycus alvarezii* seaweed flour can be seen in Table 7.

Table 7. Carbohydrate Content

| Carbohydrate content | Treatments | Average ± SD | Standard SNI 01-2897-1992 |
|----------------------|------------|--------------|---------------------------|
|                      | M0         | 62.06±0.200^a|                           |
|                      | M1         | 54.34±0.258^b|                           |
|                      | M2         | 56.23±0.110^d|                           |
|                      | M3         | 58.08±0.920^a|                           |

^a Different superscript letter notations in the same column indicate a very significant difference between treatments (p<0.05).

^b M0 (0% seaweed flour), M1 (20% seaweed flour), M2 (35% seaweed flour), M3 (50% seaweed flour).

3.7 Organoleptic test

The results of the organoleptic test with *Kappaphycus alvarezii* seaweed flour substitution can be seen in Table 8.

Table 8. Organoleptic test

| Parameter | Average value ± SD | M0          | M1          | M2          | M3          |
|-----------|--------------------|-------------|-------------|-------------|-------------|
| **Color** |                    | 6.47 ± 0.507^a| 6.50 ± 0.509^a| 5.97 ± 0.556^b| 5.70±0.466^b|
| **Aroma** |                    | 6.47 ± 0.507^a| 6.77 ± 0.728^a| 6.03 ± 0.615^b| 5.57±0.679^c|
| **Texture** |                  | 6.37 ± 0.490^a| 7.17 ± 0.531^b| 6.17 ± 0.379^a| 5.63±0.556^d|
| **Flavor** |                  | 6.50 ± 0.509^a| 6.87 ± 0.629^b| 5.87 ± 0.346^c| 5.50±0.572^d|

^a Different superscript letter notations in the same column show a very significant comparison between the treatment differences at the Mann-Whitney test level (P<0.05).
The aroma parameter shows the average value between 5.57 to 6.77. The highest average value was obtained by M1 (Kappaphycus alvarezii seaweed flour 20%) with a value of 6.77 and the lowest was found in the M3 treatment (Kappaphycus alvarezii seaweed flour 50%) with a value of 5.57. The more seaweed flour is added, the value of the aroma decreased, because aroma because seaweed has a distinctive (fishy) smell [11].

The texture parameter shows the average value between 5.63 to 7.17. The highest average value was obtained by M1 (Kappaphycus alvarezii seaweed flour 20%) with a value of 7.17 and the lowest was found in the M3 treatment (Kappaphycus alvarezii seaweed flour 50%) with a value of 5.63. The processing process that involves heat causes the protein to denature and makes the product stiff [12]. Moreover, the increase in fiber value can make the texture of product harder [13].

The flavor parameter shows the average value between 5.50 to 6.87. The highest average value was obtained by M1 (Kappaphycus alvarezii seaweed flour 20%) with a value of 6.87 and the lowest was found in the M3 treatment (Kappaphycus alvarezii seaweed flour 50%) with a value of 5.50. The more seaweed flour is added, the value of the flavor decreased, it caused alkaloid compounds from seaweed such as phenols can caused a bitter taste in food product [14].

4. Conclusions
It can be concluded that the M1 treatment (Kappaphycus alvarezii 20% seaweed flour) on the fettucine pasta product is the best treatment which has the highest average preference value which indicates that M1 is the most preferred by the panelists. This study suggested to research can also be carried out on the shelf life of fettucine pasta products added with Kappaphycus alvarezii seaweed flour.

5. References
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