Analysis The Effect of the Use Seaweed (*Eucheuma cottonii*) as The Substitution Material to Tapioca Flour on The Quality of Snakehead Fish (*Channa striata*) Nugget

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Abstract. The study aimed to determine the effect of the use of seaweed (*Eucheuma cottonii*) as a substitution material to tapioca flour on the quality of snakehead fish (*Channa striata*) nugget. The method used was experimental method and composed as non-factorial, Completely Randomized Design (RAL). The factor of the treatment was substitution of tapioca flour with seaweed in the processing of snakehead fish nugget, consisting of 4 treatment levels, namely: 75 ggs tapioca flour and 0g wet seaweed (N0), 0 g tapioca starch and 75 g wet seaweed (N1), 50g tapioca flour and wet seaweed 25 gs (N2), 25gs tapioca starch and 50 gs wet seaweed (N3), in each 500 ggs of snakehead fish formulation. The results indicated that the snakehead fish nugget substituted by tapioca flour and seaweed showing the significat effect on the value of organoleptic (appearance, odor, taste, texture, folding test), and proximate (water, protein, fiber content) . The quality of snakehead fish nugget using the tapioca starch and seaweed (N2) was showing the highest value of appearance 7.92 aroma 7.14, flavor 7.5, and texture 8.29; as well as the highest value of folding test 5.0 (AA). The content of moisture was 36.63%, protein 13.10%, and crude fiber 1.02%. So that, the best product of snakehead fish nugget proximat with substitution of 50g tapioca flour and wet seaweed 25 gs (N2) was appropriate to the Indonesia National Standard (SNI 77758-2013).

Keywords: substitution, snakehead fish seaweed, nugget

1. Introduction

Nugget is a fast food that becomes an alternative to society. The famous nugget in the community is chicken nugget or chicken nuggets because it is the first nugget that emerged and marketed in the community. As time goes by, the nugget continues to grow until the fish nuggets is found, which is a nugget made of fish meat.

Usually the fish that can be used for the nugget is a cork fish (*Channa striata*). The fish are loved by the community because it has a high nutrient content, that is with protein levels reaches 25.2% (BB). In 100 grams of cork contains water 13.61; Abu 5.96; Fat 1.70; Carbohydrate 3.53 (% bk), Zn 3, 09mg; Fe 4, 43mg [1].

In addition to meat as the main ingredient nugget, the type of flour used as a binder in the manufacture of nuggets is also variegated, one of which is tapioca flour. Tapioca starch is used as a binder because it has a high protein content and can increase the emulsification of fats. The binder in the dough can serve as the emulsifier material. Binders also function to reduce depreciation at
processing time and increase water connective power. Proteins in the form of flour are believed to contribute to water-binding properties as well as a deformed, and a gel-forming material [2].

To overcome the dependence on flour and to improve the texture of the existing nugget, it is necessary to look for alternatives by utilizing vegetable sources in the water. Indonesia is a maritime country with a length of coastline approximately 81,000 km, rich in various types of vegetable sources, especially seaweed.

Potential seaweed can be developed and utilized, where seaweed has been used as a food ingredient and medicine. One type of Indonesian seaweed that has an important economical value is Rhodophyceae (red algae). Eucheuma Cottonii Seaweed has fiber content and is a seaweed-producing caragency. The Eucheuma cottonii seaweed is the most commonly found seaweed on the market. The formulation of red seaweed Eucheuma cottonii in chicken nuggets is done by substitutions of flour on the nugget with seaweed. This is because the Caragenan in the red seaweed Eucheuma cottonii has the same properties as tapioca flour, namely as a gel-forming agent, coagulate, and Stabiliser [3].

Because of the efforts to diversify the food fibre that can meet the nutritional needs of people by adding it to food products. Nugget is a food product with a broad consumer segmentation, so it is chosen in this research to add seaweed that serves to improve the sensory characteristics better in terms of texture.

This research aims to know how to analyze the influence of seaweed use as a substitute for tapioca starch to the quality of the cork fish nuggets. Benefits Research is as scientific information about the nutrient content contained in the cork fish nuggets added seaweed.

2. Research methods
The materials used in this research are fresh cork fish, wet seaweed (Eucheuma cottonii), eggs, garlic, salt, sugar, pepper and ice cubes. While the chemicals used are aquades, sulfuric acid, sodium hydroxide, boric acid, chloride acid, Cu complex, pp indicator and mixed indicator (methylene red and blue).

The tools used in making nuggets are knives, cutting boards, blenders, basins, trays, spoons, baking pans, stoves, pans, spatulas, pans, and refrigerators. The tools used for proximate analysis are the analytical scales of Beaker glas, drip dropper, Kjeldahl flask, Erlenmeyer, desicator, porcelain cup, measuring cup, oven, and digital camera for documentation during the study.

The experimental method, which is substituted tapioca starch and seaweed in the processing of cork fish nuggets. The experimental design used is complete random design (RAL), non factorial with 4 levels of treatment, N0 treatment without seaweed (tapioca flour 75g and wet seaweed 0g), N1 (flour 0g tapioca powder and wet seaweed 75g), N2 (50g tapioca flour and 25g wet seaweed), N3 (25g tapioca flour and 50g wet seaweed), with a cork meat formulation of 500 grams on each treatment. The experiment was made 3 times a replay resulting in 12 units of trial.

Procedure of making seaweed slurry [4]
1) Wet seaweed is washed with flowing water
2) Then cut into pieces resulting in a smaller size
3) Seaweed that has been cut into a blender next for 3 minutes

Process of making nuggets with seaweed substitutions (modified [5])
1) The cork fish in the fillet is taken from the flesh, then washed
2) Once in the fillet then milled
3) Then add the garlic, salt, sugar, pepper, egg yolks, stir well then add the tapioca flour and seaweed according to each treatment, stirring again
4) Once the ingredients are completely homogeneous then put in a baking sheet that has been given a mantega, then steamed for 30 minutes at a temperature of 100° C
5) The steamed dough is cooled then cut and then inserted in cornstarch and rolling on the Panir flour
6) Nugget is then kept in freezer for 24 hours
7) Subsequent nuggets stored in the freezer is fried and carried out organoleptic test and proximate test
3. Results and discussions

Analysis of the chemical content of fresh cork fish and wet seaweed can be seen in table 2 and 3.

**Table 2. Chemical content of fresh cork fish.**

| Chemical components | Fresh cork fish (%) |
|---------------------|---------------------|
| Air                 | 69.93               |
| Protein             | 16.26               |

Based on table 2, indicates that the value of fresh fish water content as much as 69.93%, protein 16.26% and fiber content 1.68%. Result of Directorate General of Fisheries (1996), fresh Cork contains water as much as 77.40%, 19.30% protein.

**Table 3. Chemical content of seaweed wet.**

| The chemical components | Seaweed wet (%) |
|-------------------------|-----------------|
| Water                   | 84.55           |
| Protein                 | 1.53            |
| Crude fiber             | 0.82            |

According to table 3, shows that the value of seaweed’s water content is 84.55%, protein 1.53% and fiber content is 0.82%. The results of Yani Research (2006), wet seaweed contains as much water as 60.90%, 2.96% protein, crude fiber 0.96%.

3.1 Visual value

The panelist's response to the nuggets of cork fish with the addition of seaweed can be seen in table 4.

**Table 4. The average value of the cork fish nuggets substitutions of tapioca starch and seaweed.**

| Repetition of treatment | N0  | N1  | N2  | N3  |
|-------------------------|-----|-----|-----|-----|
| I                       | 7.72| 7.48| 7.72| 7.64|
| II                      | 7.80| 7.56| 7.96| 7.72|
| III                     | 7.96| 7.56| 8.04| 7.80|
| Average                 | 7.83| 7.53a| 7.91d| 7.72b|

Description: The numbers followed by the notation of different letters in the same column mean different treatments are real.
According to table 4, it can be seen that the average value of tapioca starch and seaweed in the treatment of N2 with an average value of 7.91 while the average value of the lowest is in the N1 treatment is 7.53.

Results analysis of variances showed that the use of seaweed as a material substitutions of tapioca flour on cork fish nuggets a real influence on the fine value of the cork fish, where Fcalculate (6.11) > FTable (4.07). To know the difference between treatment then proceed with real difference test honestly (BNJ). Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.

This is due to the addition of seaweed as substitution. Seaweed has a milky white color although the higher the concentration of the addition of seaweed then the resulting color is not too different, the resulting appearance of the curator is white to the gray and the appearance of the nugget that has been glued with flour after fried is yellowish. In the treatment of No (tapioca flour 75g and wet seaweed 0g) The cork fish nuggets is thick yellow, intact and neat.

The N1 treatment (tapioca flour 0g and wet seaweed 75g) has a pale yellow appearance, somewhat intact and less neat. The treatment of N2 (50g tapioca flour and wet seaweed 25g) has a bright yellow appearance, intact and neat. The N3 treatment (25g tapioca flour and 50g wet seaweed) has a pale yellow appearance, intact and somewhat neat.

### 3.2 Aroma value

The average value of organoleptic test of the aroma nuggets of cork fish with the addition of seaweed can be seen in table 5.

| Table 5. The average value of the aroma nugget cork fish Substitutions tapioca starch and seaweed. |
| Repetition of treatment | N0 | N1 | N2 | N3 |
| I | 6.92 | 6.84 | 7.16 | 6.92 |
| II | 7.08 | 6.92 | 7.08 | 6.84 |
| III | 7.00 | 6.84 | 7.16 | 7.00 |
| Average | 7.00c | 6.87a | 7.13d | 6.92b |

According to table 5, it can be seen that the average value of the highest aroma is the fish nuggets of tapioca starch and seaweed in the treatment of N2, which is 7.13 and the lowest average aroma value in N1 treatment is 6.87.

Results of analysis of variances of seaweed use as a material substitution of tapioca flour on cork fish nuggets of cork fish give a real influence on the value of the aroma value of the cork fish Nugget where Fcalculate (9.46) > FTable (4.07). To know the difference between treatment then proceed with real difference test honestly (BNJ). Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.

This is because seaweed has no aroma, the more additional use of seaweed as a substitute then the aroma of fish meat in the fish nuggets not kiss so the panelist less like it. At the N0 treatment (tapioca starch 75g and wet seaweed 0g) has a strong fish meat aroma.

The N1 treatment (tapioca flour 0g and wet seaweed 75g) is somewhat smelled by the aroma of fish. The treatment of N2 (50g tapioca flour and wet seaweed 25g) aroma of fish and additives balanced. The N3 treatment (25g tapioca flour and 50g wet seaweed) is somewhat smelled by the aroma of fish.

### 3.3 Taste value

The average value of organoleptic test of the flavor of the cork fish with the addition of seaweed can be seen in table 6. According to table 6, it can be seen that the average taste of the highest flavor is the fish nuggets of tapioca flour substitutions and seaweed on the treatment of N2 is 7.51 and the lowest average aroma value in N1 treatment is 6.89.
Table 6. The average value of taste of the fish nugget of tapioca starch substitutions and seaweed.

| Repetition of treatment | N0   | N1   | N2   | N3   |
|-------------------------|------|------|------|------|
| I                       | 7.40 | 6.85 | 7.41 | 7.00 |
| II                      | 7.57 | 6.93 | 7.64 | 7.00 |
| III                     | 7.84 | 6.93 | 7.49 | 7.09 |
| Average                 | 7.84c| 6.89a| 7.51d| 7.03b|

Results analysis of variances showed that the use of seaweed as the ingredient substitutions of tapioca starch on the cork fish nuggets a real influence on the value of flavor value of the cork fishes where \( F_{\text{calculate}} (45.89) > F_{\text{table}} (4.07) \). To know the difference between treatment then proceed with real difference test honestly (BNJ). Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.

At the N0 treatment (tapioca starch 75g and wet seaweed 0g) has a taste of fish tasted and savory. The N1 treatment (tapioca flour 0g and wet seaweed 75g) The flavor of the fish is reduced and not savory. The treatment of N2 (50g tapioca flour and wet seaweed is 25g) the flavor of the fish is still tasted and savory. The implementation of the N3 (25g tapioca flour and wet seaweed 50g) The flavor of fish starts to decrease and is not savory.

This is due to the use of different seaweed in each treatment, the more seaweed used as a substitute material will cover the flavor of the fish in the nugget so that the product is less likely to be liked.

Organoleptic test of flavor tends to decline with more and more use of seaweed because the use of more seaweed will reduce the flavor of the product [6].

3.4 Texture value

The average value of organoleptic test on the texture of the cork fish nuggets with the addition of seaweed can be seen in table 7.

Table 7. The average value of the texture of a cork fish nuggets substitutions of tapioca flour and seaweed.

| Repetition of treatment | N0   | N1   | N2   | N3   |
|-------------------------|------|------|------|------|
| I                       | 7.49 | 6.13 | 8.21 |      |
| II                      | 7.26 | 6.46 | 8.29 | 6.86 |
| III                     | 7.27 | 6.54 | 8.37 | 7.26 |
| Average                 | 6.73c| 6.38a| 8.39d| 6.73b|

Based on table 7, it can be seen that the average value of the highest texture is the fish nugget tapioca starch substitutions and seaweed in the treatment N2 is 8.28 and the lowest average texture value at N1 treatment is 6.36.

Results analysis of variances showed that the use of seaweed as the ingredient substitutions of tapioca flour on cork fish nuggets a real influence on the value of the texture value of the cork fish Nugget where \( F_{\text{calculate}} (32.81) > F_{\text{table}} (4.07) \). To know the difference between treatment then proceed with real difference test honestly (BNJ). Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.

At the N0 treatment (tapioca flour 75g and wet seaweed 75g) The texture nugget of cork fish produced very dense, compact and chewy. The N1 treatment (tapioca flour 0g and wet seaweed 75g) has a compact texture, not solid and not chewy. The treatment of N2 (50g tapioca flour and 25g of wet seaweed) has a solid, compact and chewy texture. The N3 treatment (25g tapioca flour and 50g wet seaweed) has a compact and less chewy solid texture.
This is because more and more use of seaweed as a substitute material then the resulting texture is increasingly soft. The changes in the texture may be because seaweed contains caragenan that has high water absorption capability resulting in lower texture value.

The texture of a product is influenced by water binding power, if a product has a larger water tie then there will be less water lost during the cooking process, so that the texture will decrease [7].

3.5 Folding test
The results of the average folding test of the cork fish nuggets with the addition of seaweed can be seen in table 8.

Table 8. Average value of folding test, cork, tapioca starch and seaweed substitutions.

| Repetition of treatment | N0  | N1  | N2  | N3  |
|-------------------------|-----|-----|-----|-----|
| I                       | 5.00| 3.00| 5.00| 4.00|
| II                      | 5.00| 3.00| 5.00| 4.00|
| III                     | 4.00| 3.00| 5.00| 5.00|
| Average                 | 4.68c| 3.00a| 5.00d| 4.34b|

Based on table 8, it can be seen that the average score of the highest folding test is the fish nuggets of tapioca starch and seaweed in the treatment of N2, which is 5.00 and the lowest aroma average value in N1 treatment is 3.00.

Results analysis of variances showed that the use of seaweed as the ingredient substitutions of tapioca flour on cork fish nuggets a real influence on the value of folding tests of cork fish nuggets where Fcalculate (13.83) > FTabel (4.07). To know the difference between treatment then proceed with real difference test honestly (BNJ).

Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.

In the treatment of N0 (tapioca flour 75g and wet seaweed 0g) folding test results There is a slight fraction during the process of folding test. The N1 (0g tapioca flour and wet seaweed 75g) contained a fraction of the folding test process. The treatment of N2 (50g tapioca flour and wet seaweed 25g) there is no fraction in the process of folding tes.

3.6 Moisture content
The value of water content of cork nuggets with the addition of seaweed can be seen in table 9.

Table 9. Average value of water content (%) Nugget of fish cork substitutions tapioca starch and seaweed.

| Repetition of treatment | N0    | N1    | N2    | N3    |
|-------------------------|-------|-------|-------|-------|
| I                       | 34.77 | 43.71 | 36.21 | 34.41 |
| II                      | 31.79 | 40.53 | 37.09 | 38.74 |
| III                     | 34.42 | 40.13 | 36.62 | 38.47 |
| Average                 | 33.81a| 41.46d| 36.64b| 38.55c|

In table 9, it can be seen that the average water content of the fish nuggets substitutions of tapioca flour and seaweed ranges between 41.46% up to 33.81%. The highest water content average is owned by N1 treatment, which is 41.46%, while the lowest water rate is the N0 treatment of 33.81%.

Results of variance analysis showed that the nugget of cork fish with the use of seaweed as a material of substitutions of tapioca flour is very noticeable to the moisture content, where Fcalculate (17.45) > FTabel (4.07). Then the test is carried out real difference of honest (BNJ). Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.
Increased moisture content in Cork fish nuggets is due to the use of seaweed as a substitute material, because the wet seaweed contains high water 84.55%. Moreover, seaweed also has good water binding capability, so that at the time of cooking moisture content can be maintained.

3.7 Protein levels
The value of protein levels of the cork fish nuggets with the addition of seaweed can be seen in table 10. In table 10, it can be seen that the average protein level of the fish nugget tapioca starch and seaweed ranges between 15.08% up to 10.93%. The highest protein level is owned by the N1 treatment, which is 15.08%, while the lowest water rate is the N0 treatment of 10.93%.

Results analysis of variances showed that the cork fish nuggets of the use of seaweed as the ingredient of tapioca starch substitutions gave very real influence to the protein levels, wherein Fcalculate (290.19) > FTabel (4.07).

Then the test is carried out real difference of honest (BNJ). Based on the results of a real difference between honest (BNJ) test shows that each treatment differs from the level of 95% confidence.

3.8 Crude fiber content
Average crude fiber content of nugget cork fish tepung tapioca and seaweed ranges between 1.34% up to 0.92%. The highest gross fibre rate is owned by the N1 treatment, which amounted to 1.34%, while the lowest water rate is the N0 treatment of 0.92%.

4. Conclusions and suggestions

4.1 Conclusions
Based on the results of research and analysis that has been done can be concluded that the fish nuggets of tepug tapioca substitutions and seaweed has a noticeable effect on organoleptic value (appearance, aroma, flavor, texture, folding test) and proximate value (moisture content, protein, fiber content).

The quality of cork fish Nugget tepug Tapioca and the best seaweed is the treatment of 50g tapioca flour and wet seaweed 25g (N2), with a fine value of 7.92; Aroma 7.14; Flavor 7.53; Texture 8.29; Supported with a folding test result with a value of 5.00 (AA). The water content value is 36.63%, the rate of the proximate of the cork fish nuggets at the treatment (N2) corresponds to the standard (SNI).

4.2 Suggestions
The author also advises to conduct research on the period of saving the Cork's fish nuggets and identify the type of bacteria found in the product.

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