

# Study of Proses Innovation on African Catfish (*Clarias Gariepinus*) Gluten-Free Product

*by Wisnu Cahyadi -*

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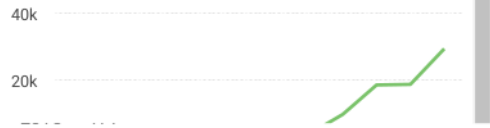


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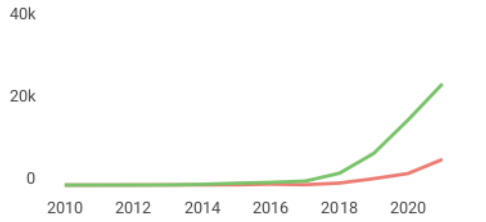




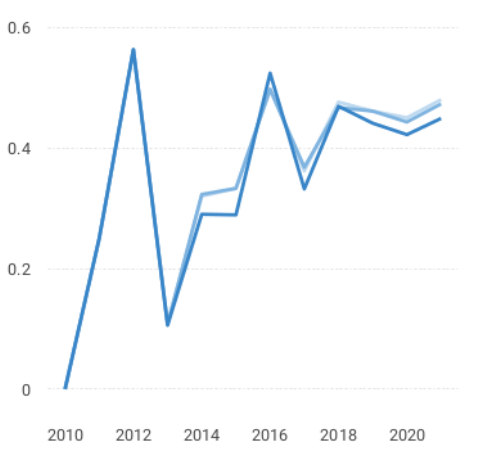
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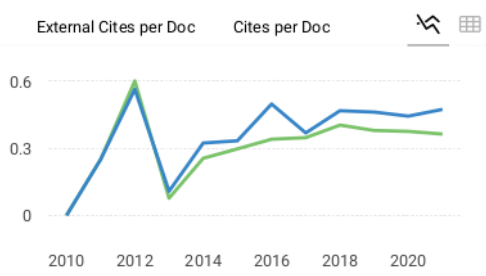
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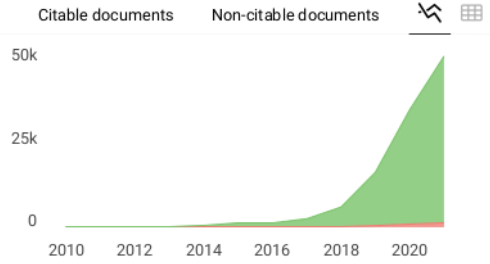
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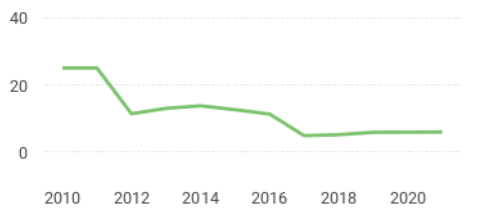
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## Study of process innovation on African catfish (*Clarias gariepinus*) gluten-free product

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## Study of process innovation on African catfish (*Clarias gariepinus*) gluten-free product

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**Abstract.** Ground dendeng was used as one of the innovations of African catfish gluten-free products in this research. The research aims of the study were to determine the effect of drying temperature and the addition of seaweed on characteristics of African catfish ground dendeng. Randomized block design (RBD) was carried out. The first stage of this research was aimed to determine the best formula for the product and analyzing protein, water, and fat content of African catfish meat. This research consisted of 2 factors (drying temperature and amount of seaweed). Characteristics of chemical, physical, organoleptical, and microbiological responses were analyzed. Results of this research showed that water content and taste attribute of African catfish ground dendeng was not affected by the temperature of drying and additional of seaweed. Meanwhile, the aroma, color, and texture attribute, also carbohydrate, protein, and fat content of African catfish ground dendeng were affected.

**Keywords:** African catfish, seaweed, ground dendeng

### 1. Introduction

Catfish are much liked by the community because it contains many benefits for the human body and health. Catfish originated from Africa and it was first imported to Indonesia in 1984. Catfish are easily accepted by Indonesian people because contains high nutrition value, rapid growth, high adaptability to the environment, good taste, and low price. Nutritional composition of catfish includes protein content (17.7%), fat (4.8%), minerals (1.2%), and water (76%) [1].

The advantages of catfish compared with other animal products are its leucine and lysine containing. Catfish processed into many varieties of menus. Starting from the "pece!" menu that is often wanted by the customer. Innovations in catfish-based food products become shredded catfish products, catfish bone chips, catfish crackers, catfish ice cream, catfish nuggets, and catfish "dendeng" [2].

Dendeng is one of the traditional preserved meat product that is very popular in Indonesia [1]. In general, the usual "dendeng" that sold in the market are made from meat such as cows, chicken or ducks meat. "Dendeng" can not only be made from animal meat but also with the addition of plant foods such as seaweed. One example way to use seaweed is used as an additive in making "dendeng". Making beef "dendeng" with the addition of seaweed can increase the value of consumption of



seaweed products, increase the economic value of seaweed, and add nutritional value to beef "dendeng" products.

Seaweed contains hydrocolloid and pharmaceutical compounds, so seaweed has been used by fishermen and the community as daily food. Several studies have shown that seaweed contains gelatine, carrageenan and alginate components that have the potential to reduce plasma cholesterol. Gelatine components are known to reduce blood cholesterol by up to 39% [3], while alginate has the potential to reduce blood cholesterol through inhibition of cholesterol absorption in the intestine [4].

Seaweed has been utilized as food, food supplements, pharmaceuticals, cosmetics, textiles, and alternative energy materials which have been widely researched and developed. Each seaweed contains a large nutritional value, such as a source of protein, fat, and carbohydrate [5].

Compared to that food from land plants (tubers, fruit, cereals, and beans), the total fiber content of seaweed is relatively higher than them. On the other hand, a fiber that contains in the land food is usually contained more insoluble fiber, whereas some seaweed has higher soluble fiber than the insoluble fiber, such as *E. cottonii* and *S. polycystum*. Several studies showed that dietary fiber has important health values, especially in reducing the accumulation of cholesterol in the blood [6]. "Dendeng" is one of the foods categorized as "Intermediate Moisture Food" which has water activity at 0.6-0.7 as its characteristic which only a small percentage of microbes can grow on the product, so the product has a higher level of durability than other food products in general. One of the most important things in making "dendeng" is drying. Drying aims some water content from material so that the activity of microorganisms decreases [7]. According to Gaman and Sherington (1992), the problem that arises in the drying process is the occurrence of case hardening, which is a condition where the surface of the food becomes wrinkled and hard, and in meanwhile the water is trapped inside [8].

## 2. Research methods

The main ingredients that used in this research are African catfish meat (*Clarias gariepinus*) obtained from the Gumilang Farm in Sukabumi and seaweed obtained from its cultivation in the Pontang area of Serang Regency in Banten Province. The ingredients used for chemical analysis are alcohol, toluene, aquadest, kjedahl salt, selenium, concentrated H<sub>2</sub>SO<sub>4</sub>, KI, HCl, NaOH, N-hexane, luff school solution, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>, 2 granules of Zink, and indicator phenolphthalein.

The tools that used in African catfish ground dendeng making are cabinet dryer, digital scale, food processor brand Phillips, rubber, knives, cutting board, trays, oven, desiccator, volumetric flask, drop pipette, bunsen, burette, Erlenmeyer 250 ml brand Pyrex, condensor, boiling stones, a set of distillation device, and a texture analyzer

The preliminary research was carried out by analyzing protein content with kjedahl method, fat content with sohxlet method, and water content with gravimetric method on raw materials, and determine the formulation of the good African catfish ground dendeng by using the organoleptic test with hedonic method for 30 panelists.

The main research is a further study from preliminary research, which determinates the best drying temperature among 55°C, 60°C, and 65°C and the substitution of seaweed among 15%, 20%, and 25%. The experimental design used in this study was a randomized block design (RBD) with 3 replications.

The design of the responses carried out in the main study of African catfish ground dendeng making is chemical, microbiological, organoleptical, and physical tests that were conducted for selected samples. Chemical analysis is the determination of carbohydrate levels with the Luff-School method [9], protein content with the Kjeldahl method [9], fat content with the Soxhlet method [9], water content with the gravimetric method [9], and calculation of RDA (Nutrition Adequacy Rate). The microbiological response is the determination of the number of microbes with a total plate count (TPC) method (Fardiaz, 1992). Organoleptic responses carried out with hedonic methods based on the level of preference of panelists, which tested included the color, scent, texture, and flavor responses of African catfish ground dendeng mixed with seaweed. The panelists that have to test the milled "dendeng" of African catfish are 30 panelists on a numerical scale as follows: (1) very dislike, (2)



dislike, (3) somewhat dislike, (4) rather like, (5) like, (6) really like. Physical responses are hardness and elasticity tests with a texture analyzer method on selected samples.

### 3. Results and discussion

#### 3.1. Proximate result

Preliminary research results aim to determine the composition (protein, fat, and water) of the raw material where the results can be seen in table 1, and to determine the selected formulation where the results can be seen in table 2.

**Table 1.** Results of raw material analysis.

Raw Material	Analysis result (%)		
	Protein	Fat	Water
African Catfish meat	16.63	4.70	78.03

The preliminary study with 3 (three) different formulations, by performing an organoleptic response with the hedonic method, the treatment formulation number 1 (one) was selected.

The organoleptic results value (table 2) showed that the taste attribute in each formula was significantly different. These different formulations produced significant differences product, caused by the difference in the amount of palm sugar added to the different formulations.

The more palm sugar added, the more the African catfish ground dendeng browned. The less palm sugar added the color of the African catfish ground dendeng was rather brown. The organoleptic results show that the variation of the formula is significantly different from the scent of African catfish ground dendeng. The scent of dendeng generally smelled of strong spices. According to Fitriyanti (2010), the formation of scents in the end product was determined by one of the raw materials [10].

The gas molecules that stimulated aroma were contained in a small number. The organoleptic results showed that the taste attribute in each formula was not significantly different. It was because African catfish ground dendeng was using the same type of material so that the flavor of dendeng did not specifically affect the response of the panelists.

The organoleptic results showed that the texture attribute in each formula was not significantly different, because African catfish ground dendeng was using the same type of material and the addition of seaweed was the same, so the texture of the dendeng did not specifically affect the response of the panelists.

**Table 2.** Organoleptic result of hedonic method.

Sample	Test responses				Total
	Color	Aroma	Texture	Flavor	
1	4.50	4.50	4.70	4.10	17.80
	A	C	a	a	
2	3.90	3.70	4.33	4.33	16.26
	B	A	a	a	
3	3.93	4.30	4.57	4.33	17.13
	C	B	a	a	

Note: The average value followed by different letters, was significantly different according to Duncan's advanced test at the 5% level.

#### 3.2. Main research results

The main research was a continuation of the preliminary research which aimed to determine the drying temperature among 55 °C for 8 hours, 60 °C for 7 hours, and 65 °C for 6 hours and substitution of seaweed additions: 15%, 20%, and 25% the right to the characteristics of African catfish ground dendeng. The main research organoleptic test was carried out by using hedonic test on the value of the

color, aroma, texture of dendeng before fried, and the taste of dendeng after it was frying. In addition, in the main research chemical analysis was carried out, protein, water, fat, carbohydrate content, and microbiological analysis using the total plate count (TPC) method.

*Organoleptic response*

*1. Color*

The results were showed that the drying temperature and seaweed substitution and its interaction had a significant effect on the color of African catfish dendeng (table 3).

**Table 3.** Effect of interaction between drying temperature and seaweed substitution on the color attribute.

Drying temperature	Seaweed substitution		
	15%	20%	25%
55 °C, 8 hours	4.26 A c	3.89 A b	3.74 B a
60 °C, 7 hours	4.15 A b	4.19 A c	3.91 B a
65 °C, 6 hours	4.11 A b	3.99 B b	3.22 A a

Note: Lowercase letters were read horizontally and uppercase letters were read vertically. Different letters stated significant differences in the 5% level of Duncan test.

The results of color attribute testing showed that the higher the drying temperature, the brown color that was formed was thicker and stronger because it was due to the Maillard reaction when it was drying at high temperatures on the African catfish ground dendeng (figure 1).



**Figure 1.** African catfish ground dendeng.

*2. Aroma*

The results of variation analysis were showed (table 4) that the drying temperature and seaweed substitution and its interaction significantly influenced the aroma of African catfish ground dendeng.

**Table 4.** Effect of Interaction between drying temperature and seaweed substitution on aroma attributes.

Drying Temperature	Seaweed substitution		
	15%	20%	25%
55 °C, 8 hours	4.13 C a	4.10 B a	4.05 B a
65 °C, 7 hours	4.52 B b	3.89 A a	4.07 B a
65 °C, 6 hours	3.86 A b	3.89 A b	3.19 A A

Note: Lowercase letters were read horizontally and uppercase letters were read vertically. Different letters stated significant differences in the 5% level of Duncan test.

The results of the aroma attribute test showed that the higher the level of addition of seaweed, the more aroma will be produced on the meat.

### 3. Texture

The results of the variance analysis were showed that the substitution of seaweed had a significant effect on the characteristics of the jerky texture of dumbo catfish, so it continued Duncan's further test for concentration of seaweed (table 5).

**Table 5.** Effect of seaweed substitution on the texture attributes of African catfish dendeng.

Treatment	Average result (%)
15%	6.15 a
25%	6.28 b
20%	6.42 c

Note: The average value marked with the same letter showed no significant difference at the 5% level of Duncan test.

The results of the texture attributes test showed dendeng texture on seaweed substitution had a significant effect on each treatment. It can be seen that the more the concentration of seaweed, the lower reception of panelists because the texture of the catfish grind will be getting stronger and harder.

### 4. Taste

The result of variance analysis calculation was showed that the drying temperature and the substitution of seaweed and the interaction of both did not significantly affect the taste of African catfish ground dendeng. The results of the taste attribute test showed that the most preferred treatment by panelists for the taste of African catfish ground dendeng was the combination of drying temperature 60 °C for 7 hours and 15% substitution of seaweed. It was because the treatment has a savory, tasty, and balanced flavor so that the distinctive taste of beef dendeng mixed with African catfish was more taste. Because the addition of spices and seaweed in African catfish ground dendeng making process was dried which effected a Maillard reaction and flavor, providing various components of the flavor of African catfish ground dendeng.

### Chemical responses

#### 1. Protein content

The result of variance analysis was showed that the substitution of seaweed had a significant effect on the protein content of African catfish ground dendeng, so it continued Duncan's further test for concentration of seaweed (table 6).

**Table 6.** Effect of seaweed substitution on the protein attributes of African catfish dendeng.

Treatment	Average result (%)
25%	35.35 a
20%	36.58 b
15%	38.50 c

Note: The average value marked with the same letter showed no significant difference at the 5% level of Duncan test.

The results of the protein content test showed that the substitution of seaweed into the ingredients had an effect on the protein content of African catfish ground dendeng. It can be seen that the more the addition of seaweed, the lower the protein content of African catfish ground dendeng. It was because more addition of seaweed reduced the addition of African catfish meat to the production of beef dendeng catfish to adjust the percentage in the formulation.

#### 2. Water content

The results of variance analysis showed that the drying temperature and the substitution of seaweed and its interaction did not significantly affect the moisture content of African catfish dendeng. Selected treatment for African catfish dendeng was the combination of drying temperature 65 °C for 6 hours with 20% substitution seaweed. The treatment chosen had the lowest water content of 9.76%.

#### 3. Fat content

The results of the analysis of variance found that the concentration of seaweed had a significant effect on the fat content of African catfish ground dendeng, so it continued Duncan's further test for concentration of seaweed (table 7).

**Table 7.** Effect of seaweed substitution on levels of African catfish dendeng.

Treatment	Average result (%)
25%	2.15 a
20%	2.41 b
15%	2.69 c

Note: The average value marked with the same letter showed no significant difference at the 5% level of Duncan test.

It was known that the average value of seaweed substitution treatment showed significantly different at the level of 5%. It was explained that the substitution of seaweed into the ingredients had an effect on the level of the fat content of African catfish ground dendeng. The more the addition of seaweed, the lower the level of fat in dendeng. It was because the more addition of seaweed will reduce the addition of African catfish meat to the production of dendeng to adjust the percentage, in the formulation of African catfish dendeng.

#### 4. Carbohydrate content

The results of variance analysis told that the substitution of seaweed had a significant effect on the carbohydrate content of African catfish ground dendeng, so it continued Duncan's further test for concentration of seaweed (table 8).

**Table 8.** Effect of seaweed substitution on the carbohydrate content of African catfish dendeng.

Treatment	Average result (%)
15%	37.48 a
20%	39.32 b
25%	40.28 c

Note: The average value marked with the same letter showed no significant difference at the 5% level of Duncan test.

The results of the carbohydrate content test showed that the higher the concentration of seaweed added, the higher the carbohydrate content. This was consistent with the statement of Astawan (2008) that the more vegetable ingredients added to processed animal products, the higher the carbohydrate content contained in it.

#### *Microbiological response*

Microbiological response of African catfish ground dendeng was analyzed by the total number of microbes of representative samples. It was aimed to determine how the drying temperature and seaweed concentration can be influenced by microbial growth. The results of microbiological test analysis revealed that the lowest number of microbes was found in the treatment of drying at 65 °C for 6 hours with 15% substitutional seaweed. Bacterial growth, in general, will be influenced by environmental factors. The influence of these factors will give an illustration that showed an increase in the number of different cells.

#### *Physical response*

The results of variance analysis showed that the drying temperature (60 °C, 7 hours) with the substitution of seaweed (15%) was selected by analyzing the physical response of texture analyzer test because the treatment was preferred by panelists in terms of color, aroma, taste, and texture and has a 38.24% of protein, and 2.69% of fat.

Results of the texture analyzer test with the attributes of hardness and suppleness of selected African catfish ground dendeng products were 3888,0 g force and 2.29%. it was known that the ground dendeng had a high level of hardness and elasticity. The addition of seaweed concentration and drying temperature caused an increase in hardness and suppleness in African catfish ground dendeng.

#### **4. Conclusion**

The drying temperature had an effect on the color and scent of dendeng catfish but did not affect the texture, taste, protein, fat, water, and carbohydrate content of African catfish dendeng. Seaweed substitution influenced the color, scent, texture, protein, fat, and carbohydrate content of African catfish dendeng, but did not affect the taste and moisture content of African catfish dendeng. The interaction between drying temperature and seaweed substitution influenced the scent and color but did not affect the texture, taste, protein, water, fat, and carbohydrate content of African catfish dendeng. Based on the calculation of% AKG according to energy requirements dendeng catfish products were 2000 kcal/day obtained in 100 grams of serving which contained total calories of 326 kcal, where there was 24 kcal fat, 152 kcal protein, 150 kcal carbohydrate.

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