**Additon Effect of Mocaf Flour in Organoleptic and Physicochemical Characteristic Catfish (*Clarisa sp.*) Crakers Production**

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**Abstract.** Crackers are a type of snack which popular and has low nutritional value. One of the raw materials used to make crackers is tapioca flour. An alternative that can be used to reduce needed for tapioca flour is to replace tapioca flour with mocaf flour and add catfish to the crackers nutritional value. The purpose of this study was to determine the effect of the addition of mocaf flour and catfish on physicochemical characteristics of crackers. This study uses several proportions of mocaf flour and tapioca flour. There are five formulas: F1 (50:50) F2 (60:40) F3 (40:60) F4 (0:100) F5(100:0). Each formula organoleptically analyzed to determine the best treatment. The method used in this study used a completely randomized design (CRD) with three repetitions. The data obtained were analyzed using One way ANOVA (Analysis of variance) and followed by the DMRT test. The results obtained showed that the selected formulation (de Garmo) was found in formulation of mocaf flour (60g): (40g) tapioca flour : (100g) catfish meat. The results of physicochemical tests included 53.11% swelling power, 2.41% moisture content, 23.30% fat content, and 16.92% protein content.

**Keywords**: Catfish crakers, Mocaf, Physicochemical,

# INTRODUCTION

Food diversification plays a significant role in food production and reduces dependence on local food [1]. Cassava is a food component that is used as an alternative to reduce dependence on local food. Food that is often consumed and the second largest food product after rice is cassava. The plant known as cassava (*Manihot ultilissima*) has enormous potential to be used as a staple food. The composition of cassava consists of 60% moisture content, 35% starch, 2.5% crude fiber, 1% protein, 0.5% fat, and 1% ash content. Cassava can be modified to flour with measured fermentation process, and the result is mocaf. Mocaf can be utilized in several processed food products to reduce wheat flour usage. One of the food products that are in great demand by the public is flour-based crackers.

Crackers are a food that is quite popular with the public and can be consumed every day [2]. Cracker products have their own value in the form of shape, taste and have varying nutritional values depending on the elements in the mixture. The most important characteristics of crackers are light, savory, dry, thin and crunchy texture. According to the Indonesian National Standard (SNI 2009), the chemical composition of raw crackers per 100 grams is moisture content with a maximum of 12%, maximum ash content is 0.2% and minimum protein is 5% [3]. Protein is the main chemical composition in processed crackers [4]. According to Kusumaningrum and Sikin (2016), the most common ingredient in cracker production is tapioca flour which can make crackers crispy and has a low chemical content. While mocaf flour has characteristics that can absorb protein, it further reduces the waste of crackers so that crispness decreases. Protein also needs to be added to cracker products to enhance their taste and nutritional content [5]. One type of protein that can be added is fish products. Catfish is a fish that is easy to obtain and inexpensive [6].

The nutritional content of catfish consists of 17.09% protein, 2.27% fat, 78.05% water, 1.25% ash, and 0.86% carbohydrates. [7]. The protein content in catfish is almost equivalent to freshwater and marine fish. Another advantage of using catfish is that it is cheap and easy to obtain. The addition of catfish in making crackers is expected to increase the nutritional value and quality of catfish crackers. According to Fauzi *et al*., (2022) adding animal protein from cork and tengiri fish with a formula 300 g snakehead fish + 200 g mackerel with adding 40 g tapioca flour + 60 g mocaf can produce a product that is highly preferred and the best [8]. Therefore, it is necessary to conduct research on the effect of the addition of mocaf flour in the manufacture of catfish crackers (*Clarisa sp.*) to determine customer preference and physicochemical properties.

**METHOD**

**Materials**

Materials used in this study were 500 g catfish, 200 g mocaf, 10 g salt, 400 ml water, 10 g coriander, 15 g baking soda, and 15 g garlic. The equipment used in this study included digital scales, plastic basins, gloves, pans, gas stoves, stirrers, choppers, knives, cutting boards, spoons, tray, measuring cup (1000 mL), measuring spoon. Chemical analysis tools and material for catfish crakers included analytical scales, desiccators, drying ovens, porcelain cups, clamps, electric stoves, mortars, pestles, thermometer, hoses, soxhlet flasks, water pumps, beakers, measuring cups, filter paper, pipettes, kjeldahl flasks, petroeleum ether, distilled water, H2SO4, HCl, NaOH.

**Formulation of Catfish (Clarisa sp.) Crakers**

This catfish cracker is processed from mocaf and tapioca flour. There are 5 catfish cracker formulas. Group 1 - 5 used 100 g of catfish. Group 1 - 3 used a combination of mocaf and tapioca flour with a concentration of 50 g, 60 g, and 40 g mocaf with the remaining percentage of tapioca flour. Group 4 was 100 g tapioca flour. Group 5 was 100 g of mocaf. The study used a completely randomized design (CRD) with 5 treatments and 3 replications. Comparison of mocaf and tapioca flour treatments that will be used in this study can be seen in Table 1.

**Table 1.** Formulas of crakers

|  |  |  |  |
| --- | --- | --- | --- |
| Formulas | Catfish (g) | Mocaf Flour (g) | Tapioca Flour (g) |
| Group 1 | 100 | 50 | 50 |
| Group 2 | 100 | 60 | 40 |
| Group 3 | 100 | 40 | 60 |
| Group 4 | 100 | - | 100 |
| Group 5 | 100 | 100 | - |

All products were prepared in the Rekayasa Pangan laboratory of Sebelas Maret University PSDKU-Madiun. The recipes are given in Table 2.

**Table 2.** Recipe for Each Catfish Crackers Formulation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Material (g) | Formulas | | | | |
| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 |
| Mocaf | 60 | 40 | 100 | 0 | 50 |
| Tapioca flour | 40 | 60 | 0 | 100 | 50 |
| Catfish | 100 | 100 | 100 | 100 | 100 |
| Onion | 3 | 3 | 3 | 3 | 3 |
| Salt | 2 | 2 | 2 | 2 | 2 |
| Enhanche flavour | 1 | 1 | 1 | 1 | 1 |
| Sugar | 1 | 1 | 1 | 1 | 1 |
| Coriander | 2 | 2 | 2 | 2 | 2 |
| Baking soda | 3 | 3 | 3 | 3 | 3 |
| Water (ml) | 80 | 80 | 80 | 80 | 80 |

**Organoleptic Analysis of Catfish (Clarisa sp.) Crakers**

Organoleptic testing was conducted based on a modified study [9]. Taste, aroma, color, and crispness of catfish crackers were evaluated as part of the organoleptic evaluation process with 37 untrained panelists. The range was highly favorable to highly unfavorable, or 5-4-3-2-1. By offering conventional scores that are always accessible. Score 5 for strongly like, score 4 for like, score 3 for netral, score2 for dislike and score 1 for strongly dislike. Data analysis was carried out using the One-Way Anova method using IBM SPSS 26 software. If there is a significant difference, it is followed by Duncan's Multiple Range Test (DMRT) at a significance level of α = 0.05. The average value of the relationship between the weight value and the largest treatment value, namely the optimal treatment, was determined by calculating using the de Garmo method. When analyzing the de Garmo method, the best treatment was chosen based on the highest NP value.

**Physicochemical Analysis of Catfish (Clarisa sp.) Crakers**

Physical analysis was carried out through the testing of expandability and crispiness. Chemical analysis performed on crakers is moisture content by thermogravimetric method, fat content by Soxhlet method, and protein content by kjeldahl method.

**RESULT AND DISCUSSION**

**Organoleptic Analysis of Catfish (Clarisa sp.) Crakers**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Formulation** | **Color** | **Flavor** | **Aroma** | **Texture** |
| F1 (60 : 40) | 3.84b ± 0,64 | 3.62a ± 0,75 | 4.32b ± 0,62 | 4.19a ± 0,73 |
| F2 (40 : 60) | 3.41a ± 0,98 | 3.54a ± 0,80 | 3.92a ± 0,89 | 3.84a ± 1,14 |
| F3 (Mocaf flour) | 3.43ab ± 0,95 | 3.57a ± 0,76 | 3.70a ± 0,87 | 3.97a ± 0,79 |
| F4 (Tapioca flour) | 3.19a ± 0,87 | 3.86a ± 0,82 | 3.51a ± 0,90 | 4.19a ± 0,77 |
| F5 (50 : 50) | 3.49ab ± 0,76 | 3.68a ± 0,78 | 3.76a ± 0,95 | 4.11a ± 0,84 |

**Table 3.** Sensory Test Results of Catfish Crackers

Different letters in the same column indicate significant differences (p<0.05)

1 = really dislike, 2= dislike, 3= neutral, 4= like, 5= really like.

The color of food ingredients is usually used to determine their quality and provide a separate assessment by panelists. In general, color has several functions in food products, one of which is in the frying process. The appearance of brown color is often used as a sign of the final maturity of frying products. Based on Table 3, there is a noticeable difference in color parameters between F1 and F2, F4. This difference is due to the amount of mocaf and tapioca used. In the 60 g mocaf formulation, the color of the product tends to increase compared to formulation 2 and formulation F4, which uses full of tapioca. Crackers made from tapioca have a brighter color, namely yellowish white, while crackers made from a mixture of tapioca and mocaf have a slightly darker and brownish color. This is supported by research by Despita et al. (2015) on improving color quality obtained from treating soy milk crackers with tapioca flour, where the color of the crackers became whiter and brighter in the processed crackers.

Taste is one aspect that can influence whether people will accept a food product. Taste is something that is perceived by the sense of taste or the tongue [10]. Based on Table 3, the sensory test of catfish chips, the taste parameter shows that all of formulation has no difference and tends to increase. The increase in the taste parameter is due to the use of mocaf flour, which tends to increase, which can affect the taste of catfish chips so that they are preferred by panelists. Mocaf flour affects the taste of chips because its manufacturing process is modified through fermentation, causing changes in characteristics in the form of increased viscosity (binding) that can absorb protein well. According to Badrian (2020), the ability of mocaf flour to absorb high-quality protein allows for an increase in fish flavor and enhances the enjoyment of panelists when consuming it.

Aroma is one of the criteria used in sensory evaluation (organoleptic) which involves the sense of smell. Based on Table 3, the results of the sensory test of catfish crackers on the aroma parameter there are five formulations with different results. In formula 1 (60 g mocaf : 40 g tapioca flour) shows significant difference with formula 2, 3, 4 and 5. Mocaf has a more distinctive aroma because mocaf flour is produced through a modification process during cassava fermentation. Formula 1 has increased compared to other formulations on the aroma parameter. This is because mocaf flour formulations tend to enhance and provide a distinctive aroma compared to other formulations. Mocaf flour has a sufficient amount of amylose to bind complexly with fatty acids and other organic components to create a distinctive cracker aroma (Diniyah et al., 2018). According to Darmawan (2012), although mocaf flour has better aroma quality than tapioca flour, its aroma quality is still inferior to wheat flour [11].

The crispiness of food products is an important attribute in foods such as chips or crakers. Based on Table 3, the sensory test of catfish crakers shows that all formula are not significantly different among all treatment samples. This was due to the increase in tapioca flour concentration, which can affect the crispiness of catfish chips. According to Kusumaningrum (2009), the factor that affects the crispiness of chips is the composite flour ingredient, indicating that the expansion volume of fish chips increases with the amylopectin content. Meanwhile, the amylose content in tapioca flour ranges from 20 to 27%, and the amylopectin content is 83% [12]. The range of amylose and amylopectin content in mocaf flour is 21.81% to 26.39% for amylose and 54.25% to 59.61% for amylopectin. Therefore, the ability of fish chips to expand increases with the amount of tapioca flour used in the formulation, resulting in crispy fish chips with open pores.

Determination of the best treatment for catfish crackers in this study was carried out using the de garmo method which can be seen in Table 4.

**Table 4.** Analysis results *de garmo* test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Mocaf : Tapioca Flour** | **Parameter** | | | | |
| **Color** | **Flavor** | **Aroma** | **Texture** | **Total** |
| 60 : 40 | 0.0096 | 0.04586 | 0.0407 | 0.04443 | 0.14058 |
| 40 : 60 | 0 | 0.02078 | 0.01202 | 0 | 0.0328 |
| Mocaf | 0.00315 | 0 | 0.01363 | 0.01709 | 0.03387 |
| Tapioca Flour | 0.04099 | 0 | 0 | 0.04443 | 0.08541 |
| 50 : 50 | 0.01624 | 0.01195 | 0.01692 | 0.01867 | 0.06378 |

The best treatment was determined by comparing the product values for each treatment as determined by the panelists. The treatment with the highest product value (NP) was considered the best treatment because this value was obtained by considering all variables that play a role in determining product quality. Based on Table 4, the results of the best treatment analysis (*de Garmo* method) in this method were carried out on organoleptic parameters including color, flavor, aroma and texture. This was supported by the panelists' fairly good acceptance, with the highest parameter weight of several parameters being in the sample (60 mocaf flour: 40 tapioca flour). The highest value was obtained from the largest total, which was 0.14058 and provides a sufficient indication that, in general, this product will be accepted by consumers.*Physical Analysis of the flowering power of catfish (Clarisa sp.) crackers.* The best treatment obtained will be tested for its physicochemical properties.

**Physicochemical Analysis of Catfish (Clarisa sp.) Crakers**

The expansion testing used in this study employed a caliper with an accuracy of 0.05 mm. The parameters observed in determining the expansion of the crackers were measured before and after frying. In this study, the expansion was calculated for the best sample with three repetitions. The expansion power of crackers in the study of adding mocaf flour (Modified Cassava Flour) in the manufacture of catfish crackers (Clarisa sp.) with the formulation (100g catfish meat + 60g mocaf flour + 40g tapioca flour) was 53.11%. This is in line with the research by Huda et al. (2013), which states that the expansion rate of commercial crackers ranges from 38-145%, and the research by Zulfahmi et al. (2014), which states that the expansion rate of crackers is greater in the range of 28.58-121.14% [13, 6].

**Table 5.** Physical test results of flowering power catfish crackers

|  |  |  |
| --- | --- | --- |
| Catfish Formulation | Mocaf-Tapioca flour Formula | Physical Analysis of Expansion test |
| Average |
| 100g | 60g + 40g | 53,11 % |

One way to determine the effectiveness of the ingredients used to make crackers, so that the cracker processing can be considered successful, is through expansion. If the crackers have a dense texture and the greatest expansion, they are considered good. The expansion of crackers affects how crispy they are; the crispier the crackers, the higher their expansion. The gelatinization process during cooking affects the expansion of crackers. According to Huda (2009), the more starch is added, the greater the expansion of crackers during frying. When fried, starch granules with incomplete gelatinization will produce low expansion, while starch granules with complete gelatinization will produce maximum expansion [13].

According to Kusumaningrum (2009), crackers made with tapioca flour have the highest expansion rate because the higher the amylopectin content in fish crackers, the greater the expansion rate [12]. Basically, starch gelatinization occurs in the dough during the steaming stage, before the dough is shaped and dried. As the temperature increases during the frying process, the water bound to the starch gel evaporates. The resulting vapor pressure will exert pressure on the starch gel, affecting the expansion and simultaneously creating air pockets inside the fried crackers [14]. Another factor that affects the expansion of catfish crackers is that the high protein content of the crackers tends to prevent amylopectin from binding water in the gel, preventing steam formation and reducing the air space in the fried crackers [15].

**Chemical Analysis of Catfish (Clarisa sp.) Crakers**

The results of chemical analysis of catfish cracker products added with mocaf flour can be seen in Table 6.

**Table 6.** Chemical test results of catfish crackers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Catfish Formulation | Mocaf-Tapioca flour Formulation | Chemical Analysis | | |
| Water Content % | Fat Content % | Protein Content % |
| 100g | 60g + 40g | 2,41 % | 23,30% | 16,92% |

Based on Table 6, it can be seen that the results of moisture content testing on the addition of mocaf flour (Modified Cassava Flour) in the production of catfish crackers (Clarisa sp.) with the formulation (100g catfish meat + 60g mocaf flour + 40g tapioca flour), the resulting moisture content is 2.41%, which is in accordance with the SNI 012713-1999 guideline, which is a maximum of 11%. The quality of raw or cooked crackers can be determined by their moisture content. During the drying process, the moisture content of ingredients that do not evaporate will affect the quality of the crackers. The quality of crackers is also influenced by water concentration; if the water content is high, it will inhibit the cracker development process, resulting in crackers that are harder, drier, and crispier [16].

According to Fitrawati et al., (2018) stated that the increase in water content was due to the increase in the amount of protein added. The water content of the catfish crackers produced was low because of the frying process, during which water evaporated from the dough, causing the water content to decrease [17]. Another factor that affected the water content was the content of the raw materials used. In the study by Pratama et al. (2020), the production of microwareable shrimp crackers with the addition of mocaf flour significantly increased the water content. During the gelatinization process, the amylose contained in mocaf has the ability to bind water molecules to the substance [18]. Steaming can also affect the water content of catfish crackers. Steaming can also affect the water content of catfish crackers.

The fat content produced in the study of adding mocaf flour (Modified Cassava Flour) in the production of catfish crackers (Clarisa sp.) with the formulation (100g catfish meat + 60g mocaf flour + 40g tapioca flour) was 23.30%, as shown in Table 6. The results show that this does not comply with the SNI 012713-1999 guideline, which stipulates a maximum of 0.5%. This is because the process of frying crackers using oil can affect the fat content in fish crackers. This is in line with the research by Neiva et al. (2011), which found that the fat content of fried catfish crackers is quite high (26.11%) [19]. The development of crackers is also related to fat content. This is because during the frying process, the water bound to the starch granules is pushed out of the crackers and replaced by cooking oil. Based on Ginting's (2013) research, the higher the protein content in crackers, the more oil the crackers absorb.

Based on Table 6, it can be seen that the results of protein content testing using the micro-Kjeldahl method on fish crackers with the formulation (100g catfish meat + 60g mocaf flour + 40g tapioca flour) show an average value of 16.2%. Based on SNI 012713-1999, which stipulates a minimum protein content of 6%, this study meets the SNI standard for fish crackers. In fish crackers, the main source of protein is fish, so the more fish meat used, the higher the protein content [20]. Catfish has a nutritional content of protein (17.7%), fat (4.8%), minerals (1.2%), and water (76%) [21]. The protein content in crackers is very important because, in addition to being a source of nutrition, protein can also affect the expansion of crackers. This is because protein can bind starch granules in the matrix, which will change the gelatinization of starch [22]. According to Zulfahmi et al. (2014), amylopectin granules are thickened by protein, therefore the more protein added, the more visible the texture of the crackers will be.

**CONCLUSION**

The preferred catfish cracker formulation based on organoleptic testing is the formulation using 60g mocaf flour + 40g tapioca flour + 100g catfish meat. This can be seen from the highest NP value of 0.18472 compared to other NP values. Research on the effect of the addition of mocaf flour (Modified Cassava Flour) in the manufacture of catfish crackers (*Clarisa sp.*) has a physical characteristic value of the parameter of fish cracker expansion power of 53.11%. While the value of chemical characteristics includes water content is 2.41%, fat content is 23.30% and protein content is 16.92%.

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