PHYSICAL AND CHEMICAL CHARACTERISTICS OF CATFISH FLOUR BY FREEZE-DRYING METHOD

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Abstract

Introduction: Catfish is a fish that contains high protein and has bioactive fatty acid components that can increase immunity. Catfish is widely available in Indonesia, so it is necessary to make flour to be used in a variety of processed products. Making flour using freeze-drying has the advantage of maintaining various original physical and chemical characteristics.
Objectives: The study aimed to determine catfish flour's physical and chemical characteristics by the freeze-drying method
Method: This research was conducted in January-October 2022 at the Food Technology Laboratory, Department of Nutrition, Health Polytechnic of the Ministry of Health Bandung and a chemical analysis on catfish flour at Saraswanti Laboratory, Bogor. Catfish flour is made using the freezedrying method with a freeze-dryer. The Saraswanti Laboratory conducts the chemical analysis of moisture, ash, energy, protein, fat, carbohydrates, iron, dietary fiber content, and shelf life **Result:** 100 g of catfish flour contains a moisture content of 3,90%, ash content of 3.21%, 396.71 Kcal of energy, 69.95% protein, 10.19% fat, 6.30% carbohydrates, 5.62% dietary fiber, and 1.87 mg of iron with a shelf life of 312 days. The yield of catfish flour is 25.5%.
Conclusion: Catfish flour made using the freeze-drying method already meets the requirements of SNI fish flour. Catfish flour can affect the product's physical and chemical characteristics. Catfish flour can increase the product's nutritional value for the better because it contains high protein and is a source of fiber.

Keywords: Catfish Flour, Freeze Drying, Local Food Production

INTRODUCTION

Catfish is one of the native Indonesian waters that has succeeded in cultivation. There are two types of catfish known in Indonesia. First, the local catfish (Pangasius pangasius) often called jambal (Pangasius jambal), and second, the Bangkok catfish or Siam catfish *(Pangasius hypophtalamus synonym P. sutchi).*[1]

Catfish is a source of animal protein that has bioactive components of unsaturated fatty acids that can improve immune function. [2] Catfish is one type of fish that contains high protein.[3] Nutrients contained in 100 grams of energy catfish 135 kcal, protein 17 grams, fat 6.6 grams, carbohydrates 1.1 grams and Fe 1.6 mg.[4]

Catfish is a local food in West Java whose utilization has not been maximized.[2] Catfish production in Indonesia is quite abundant namely in 2022 it is 161.114 tons.[5] Besides being abundant, catfish is also one type of fish that tends to be cheap in the market.[6] For catfish

to be used in various processed products, it must first be processed into catfish flour.[3] Many studies have used catfish flour as an ingredient in making processed products such as instant baby porridge in the research of Noer et al., 2014, crakers of Siamese catfish flour in the research of Ernisti et al., 2018, and mocaf patin cookies in the research of Fajrina and Hastuti, 2022. The use of catfish flour aims to increase the protein content in these products.[7,6,3,8]

Catfish can be made into flour by *freeze-drying* method. *Freeze-drying* is a drying method that is carried out using low temperatures. The water content contained in the product in the form of phase water will be converted into a solid phase (ice). Then is converted into the vapor phase by the principle of sublimation by controlling its temperature and pressure.[9] Products produced by *the freeze-drying* method have advantages from various characteristics, namely, physical, chemical, and microbiological. Unlike other methods, Freeze-drying can maintain the product's physical characteristics such as aroma, taste, color, and texture.[10] Judging from chemical characteristics, the *freeze-drying* method is also better at maintaining the nutritional content of products such as vitamins, minerals, and other active ingredients. In addition, this method can inhibit the growth of bacteria.[9]

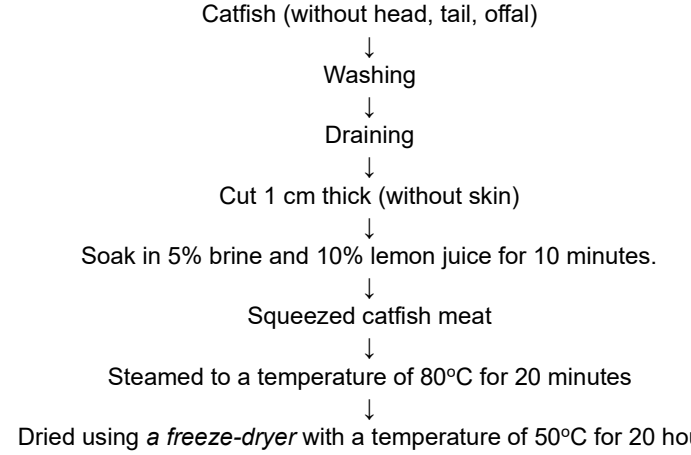
Based on the above background, researchers are interested in conducting research to determine the physical and chemical characteristics of catfish flour with the freeze-drying method.

METHODS

This research was conducted in January-October 2022 at the Food Technology Laboratory, Department of Nutrition, Politeknik Kesehatan Kemenkes Bandung and a chemical analysis on catfish flour in the form of water content, ash content, energy, protein, fat, carbohydrates, iron, food fiber content, and shelf life at the Saraswanti Laboratory, Bogor.

Tools used in making catfish flour are basins, filters, knives, cutting boards, *freeze dryer*, grinder. The ingredients needed in making catfish flour are catfish, 5% salt water, and 10% lemon water.

Making catfish flour first separates catfish from the head, tail, and offal. Then the fish is washed and drained. Ikan patin (without skin) cut 1 cm thick, then soaked with 5% salt water and 10% lemon juice for 10 minutes. After that the fish meat is squeezed and steamed at 80^{o}C for 20 minutes. Steamed catfish meat is dried using a *freeze dryer* with a gradual temperature of -18^{o}C to 50^{o}C for 20 hours. Dried fish meat is ground using a grinder to produce catfish flour. The flow diagram of making catfish flour can be seen in Figure 1.



↓
Milled using a grinder
↓
Catfish flour

Figure 1. Flow diagram of making catfish flour

Chemical Analysis

The chemical analysis includes water content, ash content, energy, protein, fat, carbohydrates, iron, dietary fiber, and shelf life. The chemical analysis was conducted at Saraswanti Lab in 2022.

Catfish Flour Yield Calculation

The yield measurement of catfish flour is calculated based on the ratio of the weight obtained to the weight of the starting material expressed in percent (%).[11] The calculation is carried out using the formula: Yield (%) =

$$\frac{flour\ \ weight}{initial\ \ weight\ \ of\ \ material} x \quad 100\%$$

RESULTS AND DISCUSSION

Physical characteristics of catfish flour

Figure 1 shows the results of the siege process with *the freeze-drying* method.

Figure 1. Dried Catfish and Catfish Flour

Figure 1 shows that the resulting catfish flour is brownish-yellow and has a fine texture.

The physical characteristics of catfish flour are color, aroma, and texture. The physical characteristics of catfish flour are not much different from the physical characteristics of the original material, catfish. Making catfish flour by *freeze-drying* method can maintain the physical characteristics of flour, such as aroma, taste, color, and texture.[10] The color of the resulting catfish meal is brownish-yellow. The color of catfish meal can affect the color of the product. In Arza and Tirtavani's research (2017), adding catfish flour and carrots of as much as 25 g each can produce an attractive color, namely yellow-orange.[3] Catfish flour produced by freeze-drying method has a strong fish aroma.It is can affect the aroma of products made from catfish flour. The higher the concentration of adding catfish flour, the stronger the aroma produced.[12] Freeze-drying method also produces smooth catfish flour, like flour in general, although the flour is not sifted using a sieve. Catfis flour also has a fish flavor in general.

Chemical Characteristics

In this study, chemical analysis was carried out on catfish meal in the form of water content, ash content, energy, protein, fat, carbohydrates, iron, dietary fiber, and shelf life. Chemical analysis as an assessment of the quality of foodstuffs, especially on the standards of food substances that should be contained in these foodstuffs. [13]

The following are the results of laboratory analysis of catfish flour in 100 grams.

Table 1. Test Results of Catfish Flour Laboratory Analysis in 100 grams

No	Types of Analysis	Result
1	Energy (kcal)	396,71
2	Protein (g)	69,95
3	Fat (g)	10,19
4	Carbohydrates (g)	6,30
5	Moisture (%)	3,90
6	Ash (%)	3,21
7	Dietary fiber (g)	5,62
8	Iron (mg)	1,87
9	Shelf life (day)	312

Source: Primary data Lab. Saraswanti, 2022

Table 1 shows that in 100 g of catfish flour contains high protein (69.95%). Comparison of the quality of catfish flour with the Indonesian National Standard fish flour is presented in Table 2 below.

Table 2. Quality Comparison of Catfish Flour and SNI Fish Flour

Composition (%)	Fish Flour	SNI 01-2715-1996/Rev.92		
		Quality I	Quality II	Quality III
Moisture	10,35	10*	12*	12*
Ash	3,21	20*	25*	30*
Protein	69,95	65**	55**	45**
Fat	10,19	8*	10*	12*
Carbohydrate	6,3	-	-	-
Diatery fiber	5,62	-	-	-
Iron	1,87	-	-	-

*Max value
**Minimum value

Table 2 shows that catfish flour meets the quality requirements of fish flour standards SNI 01-2715-1996/Rev.92.

Moisture

Moisture content is one of the important parameters to determine the quality of these food ingredients because moisture content is related to the durability of food ingredients and food safety.[14] All kinds of foodstuffs have different amounts of Moisture content.[15] Moisture content of catfish flour produced meets the standard quality requirements of fish flour according to SNI 01-2715-1996/Rev.92, which contains a maximum water content of 10% (quality 1) and 12% (quality 2 and 3).[16] Compared with the SNI quality requirements, the catfish flour is of good quality when viewed from the moisture content.

Heating treatment can remove water content in foodstuffs.[14] This study chose a lowtemperature drying method known as freeze-drying. Freeze drying can remove moisture content until the content is only 1%. The longer the drying time, the lower the moisture content contained in a material. It happens because the material's water is sublimated over a long drying time.[10]

Ash

The ash content of a product indicates the mineral content contained in the ingredients, purity, and cleanliness of a product produced.[17] The ash content of catfish flour produced in this study was higher than that of fish flour in other studies, which was 3.21%. In the research of Tampubolon et al., 2018 the ash content of sembilang dingin fish flour was 2.1% and in the research of Wirawan et al., 2018 there was 2.94% cork fish meal ash.[18,13] This happens because if the minerals contained in food are high, the ash content produced will also be high. [19] The ash content requirement in fish meal, according to SNI 1996 is a maximum of 30%, so it can be said that the ash content of catfish flour meets these requirements.[16]

Energy

Based on the results of research that has been done, it can be seen that the energy content of catfish flour per 100 g is higher than the energy content of wheat flour.[4] Catfish flour can increase the nutritional content of a food product, one of which is energy if used as a substitute material in manufacturing products.[6]

Protein

Based on the results of studies that have been carried out, the protein content of catfish flour is high. When viewed based on the SNI fishmeal quality standard (1996) the protein content of quality I fish flour is at least 65%, so it can be said that catfish meal has met SNI requirements.[16] Compared with the protein content of snakehead fish meal in the research of Wirawan et al, 2018 of 65.3%, the protein content of catfish flour is higher.[13] This difference occurs because when viewed from the nutritional content of catfish and fresh snakehead fish, catfish has a higher protein content than snakehead fish.[4] The method of making flour also affects the protein content of flour.

According to BPOM regulation No. 1 of 20 22, a product can be claimed as a highprotein product if 100 grams the product contains 21% protein. So it can be said that catfish flour is one of the food ingredients that meet the requirements if it is claimed to be a highprotein product.[20]

Fat

Based on the results of research that has been done, it can be known that the fat content of catfish flour is 10.9%. When viewed based on the SNI fishmeal quality standard

(1996) the fat content of quality III fish meal is a maximum of 12%, so it can be said that catfish meal has met SNI requirements.[16]

Carbohydrate

Based on the results of research that has been done, it can be seen that the carbohydrate content of catfish meal is 6.3%. The carbohydrate content of catfish flour is higher than that of penja fish meal in Fajriana's study, 2019, which is only 0.64%.[21]

Iron

Based on the results of research that has been done, it can be seen that the iron content of catfish flour is higher than snakehead fish flour, which is 1.87%, while the iron content of snakehead fish meal is 0.9%. It happens because of differences in raw materials and the fish drying method. In 2019 Nadimin and Lestari, making cork flour, used an oven for drying, while this study used a freeze dryer.

Dietary Fiber

Based on the research results, it can be seen that the dietary fiber content of catfish flour is 5.62%. According to BPOM regulation No. 1 of 2022, a product can be claimed as a source product of dietary fiber if the product has a fiber content of 3 g per 100 g or 3%, so it can be said that catfish flour is one of the food ingredients that meet the requirements if it is claimed to be a source of fiber product.[20] Dietary fiber is good for health. Dietary fiber can help in weight control, overcome diabetes, prevent gastrointestinal disorders, colon cancer, and cardiovascular disease and can reduce blood cholesterol.[22]

Catfish Flour Yield

The yield of catfish flour is 25.5%. Yield compares the flour's dry weight with fresh catfish's weight without head, tail, skin and offal. The yield of catfish flour is lower than that of catfish bone flour in the study of Pangestika et al., 2021 with a yield of 38.6%. Catfish flour is higher than sembilang dingin fish flour yield in the study of Tampubolon et al., 2018.[18] The greater the percentage of yield flour, the higher the flour's economic and effectiveness value.[15] The yield of flour is affected by the boiling method used. It happens because of the dissolution of non-mineral components (water, protein, and fat) in the ingredients due to the duration of boiling so as to reduce the yield of flour.[23] Boiling temperature affects the yield of fish flour. The higher the boiling temperature, the lower the yield of fish flour.[15] Heruwati (2002) in Tampubolon et al., 2018 stated that the yield value of fish flour was inconsistent. It was caused by the type of species and type of food that fish consumed and how to fillet fish. The better the fillet method in fish, the greater the yield produced.[18]

CONCLUSION

Catfish flour made using the freeze-drying method already meets the requirements of SNI fish flour. Catfish flour can affect the product's physical and chemical characteristics. Catfish flour can increase the product's nutritional value for the better because it contains high protein and is a source of fiber.

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