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Article

The Proximate Analysis and Nutrition Assessment of Catfish Flour Produced by Different Drying Time and Temperature

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Abstract: Catfish (Clarias sp.) is a type of freshwater fish that people often consume because of its high nutritional value, deliciousness, and affordability. However, catfish products are often damaged due to high water content. Production of catfish flour is an alternative to make catfish products more durable and easier to diversify. The objective of this study is to determine the proximate and nutritional content of catfish flour produced using different drying times (duration) and temperatures. This study used an experimental laboratory method with two treatment factors, namely drying temperature consisting of 2 levels (60°C and 150°C) and drying time (duration) consisting of 2 levels (36 hours and 3 hours). The result showed the proximate and nutrition content of catfish flour with a drying temperature of 60°C and duration of 36 hours was fat 17.3402%, protein 83.9166%, water 9.8682%, ash 4.7125%, Fe 0.0157%, Ca 0.0602%, Zn 0.0029%. While the proximate and nutrition content of catfish flour with a drying temperature of 150°C and duration of 3 hours was fat 22.0204%, protein 85.9741%, water 6.1044%, ash 4.2682%, Fe 0.0022%, Ca 0.1073%, Zn 0.0032%. This finding reveals that drying temperature and time affected catfish flour's proximate and nutrition content.

Keywords: catfish flour, proximate, nutrition content, drying time, drying temperature

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1. Introduction

Catfish (Clarias sp.) are much sought after and consumed by the people. The cheap price means that catfish are widely cultivated and distributed in society [1,2]. Catfish have quite bright prospects and have great potential to be developed in Indonesia [2]. Catfish's advantages include fast growth, high adaptability, delicious taste, and high nutritional content [1]. The energy and nutritional composition of catfish includes energy 92 kcal, fat 2.82 grams, protein 16.2 grams, vitamin A 70 mcg, calcium 14 mg, iron 0.25 mg, and sodium 42 mg [3].

Most people consume catfish in the form of fried, grilled, and cooked in coconut milk. Innovations on catfish are still rare. Therefore, a strategy is needed in processing catfish-based products, such as processing catfish into flour. Processing catfish into flour will improve its functional value due to becoming intermediate raw materials in ready-to-eat products so that it is easier to process into a variety of food products [4]. In addition, catfish has a high water content of 80% so catfish meat is easily damaged

which hinders its use as a food ingredient [5]. Processing catfish into flour will give it a longer shelf life [6].

The method used in making flour is drying method. The most important step in the manufacture of catfish flour is to determine the quality of the flour during the drying process. Preserving perishable agricultural yields has been a longstanding practice, with drying emerging as one of the most effective methods [7,8]. This technique is a reliable strategy to prevent spoilage and extend the shelf life of agricultural products [7,9,10].

The primary objective of the drying process is to diminish the water content to a specific level, thereby inhibiting enzyme activity and microbial growth, which can lead to the deterioration of food ingredients. The principle of the drying process is the process of heat transfer and water diffusion from the material being dried. This procedure induces alterations in various aspects, including physical properties like shape and color, chemical properties, and nutritional content, such as carbohydrates, fats, and proteins. The reduction in the number of components, particularly protein, fat, certain vitamins and minerals vulnerable to leaching during washing and heat sensitivity, becomes evident during the drying process [7,8,10]. This shows that the duration of drying process and the elevated drying temperature correlate with the quality of catfish flour [7].

Based on several previous studies, this research focuses on the proximate analysis and nutrition assessment of Catfish flour produced by different drying time and temperature. Drying temperature and drying time (duration) in this study are two factors that affect the quality of catfish flour [8,10]. This study aims to describe proximate and nutrition content of catfish flour produced by different drying time (drying duration) and temperature.

2. Materials and Methods

The main materials used in this study were catfish obtained from the traditional market in Jember, East Java, Indonesia. The equipment used in this research includes an oven, stainless pan, gloves, 80 mesh sieve, and blender. This study used an experimental laboratory method with two treatment factors. The treatment factors were drying temperature consisting of 2 levels namely 60°C and 150°C; and drying time (duration) consisting of 2 levels namely 36 hours and 3 hours. The Number of replications per treatment is twice.

The procedure included sorting catfish flour was adopted from previous research in making catfish bones flour [11]. The procedure of making catfish flour that was sorting the catfish in order to obtain good quality catfish, separating the catfish meat from other parts of the fish, washing the catfish meat, steaming the catfish meat at 90 °C for 5 minutes, and drying the catfish meat in the oven. Drying temperature consists of 2 levels that are 60°C and 150°C, and drying time (duration) consists of 2 levels that are 36 hours and 3 hours. After that, dry catfish meat was mashed using a blender and sifted using a 60 – 80 mesh sieve until it became a smooth and homogeneous flour. For the last step, the catfish flour was analyzed for its nutritional content in the CDAST Laboratory of Universitas Jember.

Figure 1. Process of making catfish flour

The energy and nutritional content of catfish flour was analyzed in the laboratory. The analyses carried out include:

Table 1. Laboratory analysis method

Parameter	**Method**
Ash	Gravimetric
Water	Gravimetric
Protein	Kjeldahl
Fat	Soxhlet
Iron	Flame Photometry
Zinc	Flame Photometry
Calcium	Flame Photometry

The ash content was analyzed by the gravimetric method; water content was analyzed by the gravimetric method; protein content was analyzed by the Kjeldahl method; fat content was analyzed by the Soxhlet method; iron content was analyzed by flame photometry method, zinc content was analyzed by flame photometry method, and calcium content were analyzed by flame photometry method. The statistical analisis method use descriptive analysis use excel.

3. Results and Discussion

Catfish (Clarias sp.) are have high nutritional value [1]. On 100 grams of catfish contains energy 92 kcal, fat 2.82 grams, protein 16.2 grams, vitamin A 70 mcg, calcium 14 mg, iron 0.25 mg, and sodium 42 mg [3]. Processing catfish into flour will gives it a longer shelf life [6]. The method used in making flour is drying method [9].

Figure 2. Catfish flour

According to Figure 2, the difference in drying times and temperatures in processing catfish into flour affects the colour and taste of catfish flour. Based on the observation, catfish flour dried using 60°C for 36 hours has a browner color and a saltier taste. Whereas catfish flour dried using 150°C for 36 hours has a grayish color and a savory taste. The difference in drying times and temperatures in processing catfish into flour also affects the proximate characteristic of catfish flour, as presented in Table 2.

Tabel 2. Results of proximate and nutritional content analysis of catfish flour

Drying time (hours)	Drying temperature (°C)	Proximate and Nutrition Composition (%)						
		Water	Ash	Fat	Protein	Fe	Zn	Ca
36	60	9.8682	4.7125	17.3402	83.9166	0.0157	0.0029	0.0602
3	150	6.1044	4.2682	22.0204	85.9741	0.0022	0.0032	0.1073

3.1 Water

The shorter drying time with the higher drying temperature, the lower water and ash content, and the higher fat and protein content of catfish flour. Table 2 presents the shorter drying time with the higher drying temperature, the lower water content of catfish flour. When a material is subjected to higher drying temperatures for an extended period, the moisture content within the material tends to evaporate more rapidly. This results in lower water content or moisture content in the material [12,13]. This is in line with the results of previous research, which stated that drying time affects water content. This is because prolonged drying causes a greater amount of water to evaporate, resulting in a decrease in the water content of the flour [14]. Other previous research shows water content is influenced by the duration of the drying process; this is due to extended drying leading to increased water evaporation, resulting in a reduction of water content in the flour [15].

Based on Table 2, the water content in both types of catfish flour is quite low, namely 9.8682% and 6.1044%, which contributes to a longer shelf life. As a result, catfish flour becomes less susceptible to microbial growth and enzymatic activity that can lead to spoilage. Food products with the water content below 14% are sufficiently secure against mold growth. Meanwhile, for dehydrated products like flour and starch, the recommended maximum water content is 10% [7]. This shows that the water content in both catfish flour is in accordance with the recommendations. The drying process is a method used to remove moisture from a substance, such as food or other materials, in order to preserve it and inhibit the growth of microorganisms and enzymes. By reducing the water content to a certain level, the drying process creates an environment that is unfavorable for the proliferation of bacteria, molds, and other microorganism [7,9,10]. Additionally, enzymes, which are biological catalysts that can cause undesirable changes in the quality of the material, are also less active in a dry environment. The reduction of water content through drying helps to extend the shelf life of food products and prevent spoilage [10,16].

3.2 Ash

Ash content indicates the total mineral content of a food material [17]. Increased temperature and prolonged drying time result in higher ash content in the flour [16]. Raising the drying temperature is believed to lead to an elevation in the ash content of catfish flour. This is attributed to the reduction in water content in catfish pieces, causing an increase in the concentration of remaining ingredients, notably minerals. Meanwhile,

the duration of drying process (drying time) has no effect on the ash content of the flour [16]. This aligns with the findings of the study, indicating that catfish flour dried at high temperatures have higher ash content than catfish flour dried at low temperatures (4.2682% vs 4.7125%), as presented in Table 2. The ash content is contingent on factors such as the material type, ashing technique, and the duration and temperature applied during the drying process [8].

3.3 Fat

The fat content resulting from variations in drying time ranged between 17% and 22%. Elevated temperatures and extended drying durations were found to correlate with an augmentation in fat content, inversely proportional to declining water content. This trend aligns with the previous finding, which asserted that heightened temperatures and prolonged drying periods contribute to an escalation in material fat content. The rise in fat content under conditions of elevated drying temperatures and durations is attributed to a reduction in water content, leading to an increase in the percentage of fat content [7,10,18].

3.4 Protein

The protein content in food can determine the quality of the food, where the higher the protein content, the better the quality of the food [7]. According to Table 2, it is known that the protein content of both Catfish flour is 83.9166% and 85.9741%. By reducing the water content, food ingredients will contain compounds such as protein, fats and minerals in higher concentrations, however generally the vitamin content of these ingredients will decrease. Protein content which begins to denature due to increasing temperature and drying time. Prolonged exposure to high temperatures during heating and drying can lead to the denaturation of proteins. The denaturation process is critical, as it can damage amino acids, and the resistance of proteins to heat is closely linked to the specific amino acids constituting the protein structure flour [7,10,18]. Consequently, the protein levels decline with an increase in heating temperature. This underscores the importance of achieving the right combination of temperature and drying time in the production process to ensure optimal protein levels in the resulting catfish flour [19].

3.5. Minerals

Mineral content tends to decrease during the production process (Table 2), along with decreasing water content. Prolonged exposure to high temperatures during heating and drying can lead to the decreasing mineral content. It is due to during the cooking process, the fish's body releases a certain amount of water which allows other nutrients to be released, including minerals, namely calcium, iron, and zinc. In addition, each mineral has a different solubility in water, the cooking process using water can result in loss of some minerals in catfish flour [6,7]. Other previous studies show that minerals are generally not sensitive to heat, however, are very susceptible to washing or processing involving water such as boiling and steaming. Most of the mineral's dissolve in water during cooking which causes the loss of vitamins and some important minerals. The decrease in mineral (calcium, iron, and zinc) content in catfish flour can be caused by the washing and steaming process during flour production [20]

4. Conclusions

The proximate and nutrition content of catfish flour with a drying temperature of 60°C and drying time of 36 hours was lower level of fat, protein, Ca, Zinc and higher level of water, ash, Fe catfish flour with a drying temperature of 150°C and drying time

of 3 hours. This finding reveals that drying temperature and time affected catfish flour's proximate and nutrition content.

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