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Quality assessment of high calcium Catfish (*Clarias* sp.) bone flour made by boiling and drying methods

Quality assessment of high calcium Catfish (*Clarias* sp.) bone flour made by boiling and drying methods

P R Ratri[1*], M Jannah[1] and Sabran[1]

[1] Health Department, State Polytechnic of Jember, Jalan Mastrip PO BOX 164, Jember 68121, Indonesia.

[*]email: putri_ratri@polije.ac.id

Abstract. Catfish (*Clarias* sp.) is a type of fish that is widely cultivated and consumed by community, especially in Indonesia. However, catfish bone has not been used optimally even though its nutritional content is quite high. The production of catfish bone flour can be an alternative source of functional food. This study aims to utilize catfish bone waste as high calcium flour and analyze its nutritional contents. This study consists of two steps, namely flour production and nutritional analysis. Catfish were prepared by eviscerating the internal organ and washing until clean. Then it were dipped into boiling water for 30 minutes at 100°C and separated bone from other parts. The boiled catfish bones were dried at 150°C for 1 hour using oven and ground into flour using blender. The raw flour was then sifted by sieve 60-80 mesh. Proximate analysis results showed that catfish bone flour contained 8.2985% fat, 2.1883% protein, 0.0096% zinc, 0.0028% iron, 10.73% water, 49.9346% ash, and 8.4059% calcium. Calcium content in catfish flour is 8405,9 mg/100g (>380 mg/100 g), therefore it is permitted to "high calcium" claim. Due to its nutritional content, catfish bone flour can be used as a raw material of functional food.

1. Introduction

Catfish (*Clarias* sp.) is a type of fish that is widely cultivated and consumed by a wide community, especially in Indonesia. Catfish meat is a nutritious food that is easy to serve as a side dish. At the size of consumption, catfish meat is highly nutritious, savoury in taste, white-colored with an 17% protein content whose function is almost the same as beef, which is 19%. Protein of catfish contains essential amino acids such as isoleucine, leucine, lysine, and phenylalanine in sufficient quantities, even higher in content compared to the standard essential amino acids released by FAO for body needs [1]. In addition, catfish are also known to contain omega-3 fatty acids 13.6 g / 100 gr, omega-6 fatty acids 22.2 gr / 100gr and omega-9 fatty acids 19.5 gr / 100gr [2].

The use of catfish is only consumed by the meat part while the bone part is discarded and tends to become food waste. Fishbone waste from year to year continues to increase so it will have an unfavourable impact, both from the amount to the stench caused by the presence of the waste. The waste of fish bone has potential to be developed into functional food because it contains various important nutrients, such as calcium. Fishbone has a very high calcium content and also contains living cells and intracellular matrix in the form of mineral salts, including calcium phosphate, calcium carbonate, and magnesium phosphate. The utilization of fish bones can be done through the process of processing fish bones into flour [3][4].

Fish bone flour is one of the preservation products derived from fish body parts that are rarely used, namely dry bones which are ground into flour. Fish bone flour has high nutritional value, especially the content of calcium and phosphorus. Fish bone flour contains nano calcium and calcium-phosphorus which are the highest available among other calcium [5]. Fish bones that are processed into flour aim to make it easy to consume and can increase the absorption of nutrient intake. The raw material for making a fish bone flour for human consumption is in the form of fish bones that are still fresh and have not decayed [6].

In recent years, the use of fish bones in food diversification has been growing. Nutrition and food academics have begun to use fish bone waste in their research. Bone flour must have standardized quality requirements so that it can be used further. The following qualification requirements must be possessed by fish bone flour according to the National Standardization Agency in 1992: the maximum water content is 8%, the fat content is 3% (for grade I) and 6% (for grade II), phosphate content as P_2O_5 20%, the minimum phosphorus content of 8%, and silica content of 1% [7]. In this study, the production of catfish bone flour was carried out, with the aim of optimizing the utilization of animal food resources rich in protein and calcium. The resulting catfish bone flour is expected to be used and processed into other processed food ingredients such as cakes, bread, noodles, and so on so as to increase the diversification of food rich in health benefits.

2. Material and method

2.1. Materials

The material used in this study was 25 kg of fresh catfish bone (*Clarias* sp.). The tools used in this research are plastic basins, gloves, stainless pan, gas stove, chopper, analytical scale, oven, 60-80 mesh sieve, and blender.

2.2. Methods

This research was conducted in two stages, the first stage is flour production, and the second stage is nutrient analysis. The productions of the fish bone flour are using boiling and drying methods. The first step of the flour production is sorting the fish, then separating the bones and fish meat, washing, boiling the fish bones, cleaning the fish bones from the meat that is still attached, and then drying the bone in the oven (temperature 150^{o}C) for 1 hour. The dry bone then mashed with a chopper and blender. Coarse fishbone flour that has been formed is then sieved through a 60-80 mesh sieve 3 times to obtain a fine flour texture.

After obtaining a fine flour texture, the next step is analyzing the nutritional content. Nutrient analysis was carried out at the CDAST Laboratory of the State University of Jember. The analyzes carried out include: 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 [8].

2.3. Data analysis

The data generated through laboratory tests were then analyzed descriptively by comparing the existing data according to the reference value of good fish bone flour criteria.

3. Results and Discussion

The part of fish body should be source of animal food. The of fishery industry waste so far is generally only buried and processed into animal feed. Fish bones are one of the waste products of the fishing industry that have not been used properly. One of the water products rich in calcium is fish, especially the bones. The catfish bone is easy to obtain and has a good quality of nutrients. This source could be processing into another food source such as bone flour. The bone flour can be used as a food supplement and drug to prevent osteoporosis [9].

In this study, fish bone flour was made using catfish. Catfish is one of the protein-source food that is widely consumed in the Indonesian community. The nutritional composition of catfish includes protein (17.7%), fat (4.8%), minerals (1.2%), and water (76%). %) [10]. Catfish are known to have essential amino acids such as leucine and lysine. Leucine (C6H13NO2) is useful for children's growth and maintain nitrogen balance in the human body. Leucine is also useful for the reshuffling and formation of muscle protein. While is beneficial to help a child grow, replace muscle tissue, increase calcium absorption, and form carnitine. Lysine is also important for the growth and development of body [10]

Catfish bone flour was made by boiling and oven methods. This method was chosen because this method is quite effective and efficient for producing flour with simple tools and a relatively easy way. A total of 25 kg of catfish was cleaned and separated between the bones and meat. After that, the process of boiling and drying the bones is carried out. The next step after boiling and drying is refining the catfish bone material to form flour with the desired texture (Figure 1). The 25 kg of fresh catfish obtained as much as 410 g of fish bone flour. The resulting catfish bone flour has a color that tends to be darker and a fishy smell that is quite obvious. The resulting fish bone flour was then tested for its nutritional content which included: water content, ash content, fat, protein, calcium, Zn, and Fe minerals. The laboratory analysis results are described in table 1 below.

Source: Research documentation

Figure 1. The catfish bone flour

Tabel 1. The nutrition contents analysis results of catfish bone flour

No.	Parameter	Value (%)	Test Method
1	Water content	10,7300	Gravimetri
2	Ashes content	49,9346	Gravimetri
3	Fat	8,2985	Soxhlet
4	Protein	2,1883	Kjeldahl
5	Calsium (Ca)	8,4059	Flame Photometry
6	Zinc (Zn)	0,0096	Flame Photometry
7	Iron (Fe)	0,0028	Flame Photometry

Source: Primary data

In this study, the results were obtained from a fish bone flour with a water content of 10.7300%. This value exceeds the maximum standard of good-quality bone flour [7]. The water content is still quite high due to the less than optimum drying process. In this study, the drying method was carried out using a temperature of 150°C for 1 hour. The addition of temperature or drying time can be done to reduce the high-water content. Low water content can increase the shelf life of flour so that it is more durable for storage.

The fat content in the fish bone flour produced is 8.2985%. This value indicates that catfish bone flour is included in grade II bone flour [7]. Fat fills the bones, which contain many joints. It has a complex bond and is difficult to remove the fat even by soaking it in an alkaline solution [11]. The fat content in the bone of mature fish is a larger amount [12]. Fish fatty acids are unsaturated fatty acids. The number of fatty acids in fish bone flour in some species was found to contain nearly 80% unsaturated fatty acids [13].

In addition, based on table 1, it can be seen that the ash content of fish bone flour shows a very high number, namely 49,9346%. The ash content of bone flour describes the total mineral content that does not burn in the ashing process. This is directly proportional to the calcium content of catfish bone flour which is quite high, namely 8,4059%. Calcium content in catfish flour is 8405,9 mg/100g (>380 mg/100 g), therefore it is permitted to "high calcium" claim.

4. Conclusion

Catfish bone flour which was successfully produced by boiling and drying method had a fat nutrient content is 8.2985%, protein content is 2.1883%, zinc content is 0.0096%, iron content is 0.0028, water content is 10, 7300%, ash content is 49.9346%, and calcium content is 8.4059. Calcium content in catfish flour is 8405,9 mg/100g (>380 mg/100 g), therefore it is permitted to "high calcium" claim. All of these contents illustrate that catfish bone flour has the potential as a functional food and can be used as raw material for making other foods.

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