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TECHNOLOGY FOR UTILIZING BY-PRODUCTS OF PROCESSED STRIPED CATFISH (*Pangasianodon hypophthalmus*) AS FOOD RAW MATERIALS

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ABSTRACT

Striped catfish (*Pangasianodon hypopthalmus*) is well known in Asia, specifically in Southeast Asia, such as Vietnam, Thailand, Indonesia, Malaysia, Cambodia, Burma, and Brunei Darussalam. Currently, catfish have been exported to almost all countries in the world. This study aims to analyze the chemical composition of processed catfish by-products and find alternatives for their economic utilization. The research method used is the experimental method, namely conducting experiments on using processed by-products of catfish as food raw materials. Furthermore, quality analysis was performed on processed by-products and raw food materials, namely proximate analysis and amino acid profile. Proximate analysis of processed catfish by-products (meat attached to bones, belly fat, fish bones, and offal) includes protein, fat, water content, carbohydrates, and amino acids. These by-products are still classified as functional. Therefore, this research utilizes these by-products in food raw materials. The chemical analysis (proximate) results of the products produced showed numbers that meet SNI quality standards as food products. By-products of catfish processing (fillets and smoked catfish) can be utilized as food raw materials in the form of fish concentrate flour, fish bone meal, and fish oil.

Keywords: Technology Utilization, By-Products, Food Raw Materials

1. INTRODUCTION

Striped catfish (*Pangasianodon hypopthalmus*) is popular because it has a relatively short maintenance time, affordable capital, and a reasonably broad market[1-2]. In Indonesia, patin fish cultivation centers are spread in several regions, such as Jambi, South Sumatra, Riau, Lampung, South Kalimantan, and Central Kalimantan. Export opportunities for catfish are still very wide open to all corners of the world. In addition, domestic market needs are also increasing[3-4].

Catfish-producing countries generally process all parts of catfish, such as the skin by-products utilized as collagen material widely used in cosmetics. The remaining meat is used for fish oil or protein concentrate. In addition, the head and bones of catfish are also used to make fishmeal. Catfish by-products can be processed into various economically valuable food raw material products, namely protein concentrate, fish bones, and fish oil. Several researchers have conducted extraction, refinement, and characterization to produce fatty acid profiles from catfish processing by-products. On average, the fatty acid profile of processed catfish oil presents fractions of 32%, 34%, and 28% of total saturated, monounsaturated, and poly-unsaturated fatty acids[5-7].

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Collagen is generally derived from pigs or cows. It is used for various biomedical and pharmaceutical purposes, such as pain management associated with osteoarthritis, hypertension, tissue engineering, and human implants. Collagen from these animals has limitations due to the risk of disease transmission and religious constraints. Collagen from catfish by-products was analyzed. Based on the characteristics of catfish skin collagen, this by-product material has the potential to be utilized in the pharmaceutical and food industries[8-9].

The processing of catfish by-products on an industrial scale causes many problems related to environmental pollution. The by-products include (meat attached to bones, belly fat, fish bones, and offal) and are generally discarded. Catfish have a high nutritional content, especially the well-known fish oil, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA)[10-11].

The amount of by-products produced from catfish processing, such as meat attached to bones, belly fat, fish bones, and offal, is about 20-67% of the total processed catfish. Most of the by-products are disposed to the environment around the business location without prior processing, causing negative impacts[12].

Cleaner production is a preventive and integrated environmental management strategy that needs to be applied continuously in the production process and product life cycle to reduce risks to humans and the environment. Applying the concept of cleaner production is expected to reduce the cost of handling by-products, reduce environmental damage, and bring benefits to the patin fish processing business and the surrounding community[13-14].

This study aims to assess the technology of utilization of processed catfish by-products produced, analyze the chemical composition of by-products, and find alternatives for the economic utilization of by-products produced in the Postharvest Processing Center unit of Koto Mesjid village, Kampar Regency, Riau.

2. RESEARCH METHOD

Time and Place

This research was conducted in 2022 at the Postharvest Processing Center Unit of Koto Mesjid village, Kampar Regency, Riau, Indonesia.

Method

The research method used is the experimental method, which applies the processing technology of by-product utilization in several laboratories at Riau University. In this study, by-products include meat attached to bones, belly fat, fish bones, and patin offal.

Procedures

Leftover Meat Attached to the Bone

Tetelan meat is converted into fish protein concentrate Buchari[15], as follows: Fish Protein Concentrate is processed from tetelan beef, meat flakes tethered from the bones from the fish filet process. The procedure for processing fish protein concentrate is as follows: Fresh catfish measuring 0.7-1.0 kg/fish are filed, skin removed, and then cut into small pieces. After that, it is finely ground with a meat grinder (food processor) with the addition of 0.5% salt. Next, the pulverized meat is steamed for 30 minutes and then pressed to remove some water.

Then, a 0.5 N $NaHCO_3$ solution was added until the pH was isoelectric, and a paste was formed. Extraction was performed using isopropyl alcohol solvent (1:3) for 10 hours to form a precipitate or residue. Then, it dried at 40^0-50^0C for 15 hours in a cabinet dyer, and after drying, it was blended and then ground with a 60-mesh sieve to obtain fish protein concentrate. Fish protein concentrate is used as a raw food material for derivative products.

Belly Fat Side Results

By-products of belly fat come from processing fish filets and smoking, then

converted into fish oil. Processing belly fat into fish oil Ayu & Pi[16] starts with cooking it in a large cauldron until it becomes liquid. The resulting oil is still crude (crude oil), so it still needs to be refined or purified again. The stages of fish oil refining Nazir et al.[17] are as follows:

Degumming

The oil is shaken or stirred first, weighed, and heated to 70ºC. After that, it is put into a separating flask, hot water is added to as much as 10-20% of the oil volume, and then it is allowed to stand for 10 minutes. After that, three layers will be formed: oil, gum, and water. Water and gum are removed from the separator flask. Checking the pH is done by measuring the pH of the separated water. The gum and water are separated until the pH reaches a neutral pH.

Neutralization

The degummed oil was weighed, heated to a temperature of 80ºC, added a certain amount of caustic soda according to the calculation, and stirred with a stirrer for 2 minutes. After that, the oil is put into a separating flask and then washed with washing water (hot distilled water) as much as 5 percent of the weight of the oil. After forming three layers in the oil, namely oil, soap stock, and water, the soap and water are separated from the oil. The separation is stopped until the pH of the separation water becomes neutral. After the pH becomes neutral, 1 percent anhydrous salt is added to the oil to reduce the water content in the oil.

Bleaching

The neutralized oil was weighed and heated to a temperature of 80-100ºC. Then, activated charcoal is added to as much as 1 percent of the weight of the oil and stirred for 10 minutes. After stirring well, the oil is filtered with filter paper, and pure oil is obtained.

Fishbone By-Product

Fishbone by-products are obtained from processing fish filets and scraped off the meat still attached to the bones. Furthermore, it is converted into fish bone meal with the following procedure: Fish bones are washed thoroughly with running water and cut into small pieces, then boiled for 30 - 60 minutes at 80^0 C. After that, soak in 1.5 N NaOH solution for 2-3 hours so that the bones become a paste, then dry in a dryer at 80-100^0C for 4-6 hours or until the moisture content is less than 10%. After that, it was crushed with a blender until smooth, then sieved with an 80 mesh sieve to produce a catfish bone meal.

3. RESULT AND DISCUSSION

By-products of catfish processing

In the process of processing catfish into consumer products, there are parts of the fish that are not utilized directly. These parts are referred to as by-products. Although often considered waste, catfish by-products have great potential to be processed into value-added products. By-products are obtained from processing catfish fillets (Figure 1) and smoked fish (Figure 2).

Figure 1. Striped catfish filet

Figure 2. Salai (smoked) striped catfish

The number of by-products produced from fish fillets in the form of tail and head bones amounted to 194.60 g (35.0%), teeth meat (the remaining meat attached to the bones) 33.36 g (6.0%), and belly fat. 38.90 g (7.0%), and 61.16 g (11.0%) offal. While in

smoked catfish processing activities, the by-products produced consisted of belly fat as much as 24.5 g (7.0%) and offal as much as 38.5 g (11.0%). Thus, by-products produced from filet processing amounted to 59%, and smoking amounted to 18%.

Based on field observations, the by-products produced at the Postharvest Processing Center in Koto Mesjid village do not yet have a standard operating procedure (SOP). This can be seen in the process of processing salai (smoked) fish, where by-products are collected in a plastic basket with holes so that the contents spill onto the floor, and when cleaning the floor, the washing water flows into the gutter (Figure 3).

Figure 3. Collection of by-products from smoked fish processing.

Catfish Protein Concentrate

The results showed that the protein content of KPI flour raw materials was 75.31%, the water content was (8.86%), and the fat content was low at around 6.34% (Table 1)

Table 1. Proximate composition of catfish protein concentrate

No.	Proximate content	Number (%)
1	Protein	75.31
2	Fat	6.34
3	Ash	5.66
4	Crude fiber	3.83
5	Water	8.86

Thus, the resulting catfish protein concentrate can be used as raw food. Furthermore, the analysis of amino acid composition contained in catfish protein concentrate contains all types of essential amino acids (9 types) needed by the human body, such as leucine, isoleucine, lysine, valine, threonine, phenylalanine, tryptophan, methionine and threonine (Table 2).

Table 2. Amino acid profile of catfish protein concentrate

No.	Types of amino acids	Number(%)
1	Leucine	6.35
2	Valine	4.18
3	Lysine	7.13
4	Threonine	3.59
5	Methionine+ Cystine	2.75
6	Tyrosine+ Phenylalanine	3.19
7	Tryptophan	0.09
8	Aspartic acid	8.09
9	Glutamic acid	12.34
10	Serine	3.06
11	Histidine	1.93
12	Glycine	2.89
13	Arginine	5.17
14	Alanine	4.62
15	Phenylalanine	3.20
16	Isoleucine	4.46

The results of the analysis of the amino acid composition contained in catfish protein concentrate contain all types of essential amino acids (9 types) needed by the human body, such as leucine, isoleucine, lysine, valine, threonine, phenylalanine, tryptophan, methionine, and threonine with Thus, fish protein concentrate produced from tetelan meat can be utilized as food raw material, especially snacks[18-19]. Furthermore, according to Yaqin et al.[20], the type of amino acids that make up the protein determines the protein quality of a food ingredient. The human body needs amino acids, primarily essential amino acids. The human body cannot produce these essential amino acids, so they must be obtained from food.

Fish Oil

Belly fat by-products amount to about 8 - 10%, depending on the size of the fish. Large fish weighing over 1 kg tend to have a

relatively low belly fat percentage. By-product Belly fat is further processed into fish oil and analyzed[21-22]. The peroxide number and free fatty acids (FFA) (Table 3) of catfish oil produced are still low, meaning they meet the quality standards permitted by the International Fish Oil Standard[23].

Table 3. Quality analysis results of catfish oil from belly fat by-products

No.	Chemical index	Unit	Result
1.	Acid index	mgKOH/g fat	0.47
2.	Peroxide index	meq/kg	7.35
3.	Iodine index	g/100g	4.86
4.	FFA	% w/w	0.85
5.	Saponification index	mgKOH/g fat	180.4

In Table 3, the peroxide and free fatty acid (FFA) numbers of catfish oil produced are still low, so they meet the permitted quality standards. International Fish Oil Standards Indah et al.[23] state that the value of oxidation parameters that meet the standards include peroxide number (PV) ≤ 10.00 meq/kg and free fatty acid number ≤ 1.50%. In this way, the fish oil produced is still good and meets the quality standards of good quality fish oil[24-25].

Catfish bone meal

Fishbone by-products are obtained from processing catfish fillets in the form of head, tail bones, and fins. This by-product is utilized to obtain raw materials for bone meal. This by-product is not recommended to be used as a raw food material, so it needs to be processed further so that it can be used as a source of raw food materials such as gelatin2626. The parameters analyzed in this study were moisture content (6.43%), ash (66.80%), fat (2.16%), protein (12.08%), and calcium (2.53%) (Table 4).

Table 4. Proximate composition of catfish bone meal

No.	Proximate Composition	Number (%)
1.	Water	6.43
2.	Ash	66.80
3.	Fat	2.16
4.	Proteins	12.08
5.	Calcium	12.53

The relatively low water content of about 6.43% indicates that the flour has good storability, as low water content reduces the risk of microbial growth. The high ash content of about 66.80% means the flour is mineral-rich. This is an important characteristic of bone meal, which is used as a source of minerals, especially calcium and phosphorus. The low-fat content of 2.16% indicates that most of the fat has been removed during the flour-making process, which can reduce the risk of fat oxidation and extend the shelf life. The significant protein content of 12.08% indicates that this flour can also serve as a protein source, although not the main one. The high calcium content of 12.53% is one of the main reasons for using fish bone meal in animal feed or dietary supplements, as calcium is essential for bone and tooth formation.

4. CONCLUSION

Based on the results of the research that has been carried out, it can be concluded as follows: This research aims to process by-products (tetelan meat, belly fat, fish bones, and offal) into food raw materials, such as fish protein concentrate, bone meal, and fish oil with quality that meets standards. So far, these by-products have not been optimally utilized because they are only used as ingredients for making feed and plant fertilizers, so the economic value is very small. Therefore, processing technology can increase the added value of processed catfish by-products.

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