Al-Jahiz: Journal of Biology Education Research
ISSN 2722-5070 (Print) ISSN 2722-5275 (Online)
Vol. 7 No. 1 January-June 2026
Available online at:
http://e-journal.metrouniv.ac.id/index.php/Al-Jahiz

Seafood Innovation Processing Octopus into Flour and Proximate Composition Analysis as Highly Nutritious Food

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Article Information

Article History:
Received: July 08, 2025
Revised: February 02, 2025
Published: February 23, 2025

Keywords:
Octopus vulgaris, Proximate composition, Local food

ABSTRACT

In Kaur Regency, Bengkulu Province, the potential for *Octopus vulgaris* is very abundant. Based on data from the Kaur Regency Fisheries Service, the octopus catch in 2023 was 349,310 kg of octopus. However, the Kaur regency only processes octopus by drying it. In fact, there is another innovation, namely by processing octopus into flour that has nutritional content that is beneficial for health and is durable and can be used as a basic ingredient for various types of food products. This study aims to process octopus into flour and analyze the proximate content of octopus flour. The work procedure is to select the type of *Octopus vulgaris* that is still fresh, then clean it, then boil it, then slice it, then dry it in the sun until dry, grind it into powder, then store it in a tightly closed container. Furthermore, the flour was analyzed at the Biology Laboratory of the University of Bengkulu. The proximate content was analyzed based on SNI 01-2715-1996. The results of the macronutrient content are fat content meets SNI Class II standards of 8.19% (SNI Class II fat content < 10%), protein content meets 32.41% and carbohydrate content is 7.08%. The results of micronutrient content are level calcium meets SNI Class I standards of 0.15 % (SNI Class 1 > 0.1 %), magnesium content of 0.87 % and iron content of 5,412 ppm. While other nutritional content analyzed is water content meets SNI Class I standards of 1.96% (SNI Class 2 > 0.1%). Class I <10%), fiber content meets SNI Class I standards of 0.73% (SNI Class I <1.5%) and ash content meets SNI Class I standards of 4.2% (SNI Class I <20%). Conclusion Flour octopus content *macronutrients, micronutrients* and other nutritional content has met SNI Class I and II standards.

How to Cite: Sari, A. S. P., Karyadi, B., Nursa'adah, E., Nurhamidah, Wardana, R. W., & Pursitasari, I. D. (2026). Seafood Innovation Processing Octopus into Flour and Proximate Composition Analysis as Highly Nutritious Food. *Al Jahiz: Journal of Biology Education Research*. 7(1), 89–106. DOI: https://doi.org/10.32332/al-jahiz.v7i1.11202.

Published by: Al-Jahiz: Journal of Biology Education Research
Website: https://e-journal.metrouniv.ac.id/index.php/Al-Jahiz/index
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INTRODUCTION

Animal protein sources are often the main choice in people's daily consumption menus because they have high nutritional content. One potential source of animal protein that is still underutilized is octopus (*Octopus vulgaris)* . Octopus is a marine animal that can be used as a nutritious food ingredient because it contains high levels of protein. Specifically, octopus has the potential as a source of marine energy that is suitable for human consumption. Food products derived from octopus have high protein content (70%–85% based on dry matter), significant levels of major and trace minerals (calcium, magnesium, phosphorus, potassium, sodium, copper, iron, zinc, and zinc), significant levels of essential vitamins (A, C, E, thiamine, riboflavin, niacin, and pyridoxine), β-carotene, elastin, and collagen (Cerezo Valverde et al., 2015). Long-chain omega-3 fatty acids have a long market share (high nutrition, food products derived from octopus offer a number of advantages compared to other aquatic foods. For example, food products derived from octopus itself can achieve higher edible results (80%–85%) compared to crustaceans (40%–45%), and fish (40%–75%) and consistently present the desired white meat, mild flavor profile, and meat texture (Manimaran et al., 2016).

Apart from that, octopus meat also contains protein, fat, carbohydrates, vitamins and iron. Octopus has good benefits for children's growth and development, repairs body tissue and is good for metabolism (Takwin et al., 2021). According to Riyanto et al. (2017), every 100 g of octopus meat contains 15-16 g of protein, 1 g of fat, 73-91 calories, and also contains vitamins B3, B12, Potassium, Phosphorus, Selenium, Iodine. Blood octopus contains hemocyanin protein which is rich in copper for oxygen transport (Takwin et al., 2021).

In various coastal areas of Indonesia, especially in Kaur Regency, Bengkulu Province, octopus is widely caught as a fishery by-product, but its utilization and processing are still limited, often only consumed directly in fresh form or simply preserved. Based on the results of interviews with fishermen around the coast in Kaur Regency and also supported by data from the Kaur Regency Fisheries Service, data on octopus catches in Kaur Regency in 2023 was 349,310 kg of octopus. The type of octopus caught was *Octopus vulgaris* with different size variations ranging from octopus weighing 500 g to 2000 g. However, the utilization of the abundant octopus in the Regional Head Regency has not been maximized. The Regional Head only processes the octopus into dried octopus which will later become the raw material for making Octopus Gulai. In fact, octopus can be processed into processed products that have high added value. One way to increase

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the added value of food is to process octopus into more innovative food products raw materials such as flour. If this abundant octopus is not processed into flour, it will quickly rot and become organic marine waste. Processing octopus so that it does not rot quickly is only done by freezing it, even though there are other more appropriate ways to process octopus into a more nutritious and attractive seafood source, namely processing it into flour which can later be developed into various types of more attractive and nutritious foods.

Octopus Flour is an innovative product in the form of a fine powder that contains macronutrients. Micronutrients that are beneficial for health, such as high protein content, and low fat and cholesterol, have great potential to be developed as functional food ingredients or alternative protein sources. With simple processing technology, octopus can be processed into flour which can be used as a basic ingredient for various food products. Octopus flour can be processed into various food products**.** Interestingly, for example, it is processed into cilok, bakwan, risoles, meatballs, noodles, crackers or porridge so that it can open up new business opportunities for the coastal communities of Kaur Regency by creating new products based on innovative, attractive and nutritious marine protein. By being processed into octopus flour, it becomes more durable because fresh octopus is very easy to rot and damage because octopus has a high water and protein content. In addition, by being processed into flour, all parts of the octopus can be utilized properly so that it can reduce marine organic waste.

Previous research is research conducted by Valentino & Nur'aini (2018). This study discusses Kaur Regency, Bengkulu Province, which has the potential for typical food to be developed into traditional food, as a source of regional typical food. The development of regional typical food sources needs to be done to support tourism development in Kaur Regency, but identification of regional typical food sources is still very minimal. The results of the study showed that Kaur Regency has 13 (thirteen) types of traditional foods, consisting of 5 types of food or side dishes, namely octopus satay, marunggai and tape fish curry, ipun curry, lempipi and kaur pais fish curry, 6 (six) types of snacks, namely keras juadah, kelicuk, lelampit, serawe, nylon, sagun and 2 (two) types of drinks, namely belang and Kubu root drinks, as well as kengkawang and Batang root drinks. The weakness of this study is the limited types of local foods studied, only focusing on regional specialty foods. Snacks. Further research can be done by expanding the types of foods studied, including staple foods and drinks. Research can explore the potential for developing local food products to increase the nutritional and economic value of the community.

The second study was conducted by Takwin et al. (2021) this study discusses Cilok made from Octopus. Cilok that has been circulating in the community is cilok made from meat, but the price of meat is relatively expensive so that there needs to be a new innovation in the form of cilok made from cheap ingredients but with high nutritional value. Octopus cilok (*Octopus* sp) which is rich in nutrition is a solution that can be developed as a new food innovation today. The purpose of this activity is to create independent business opportunities through the production of healthy and nutritious octopus cilok for all levels of society. The method used is direct practice of making octopus cilok and analyzing business feasibility. The weakness of this study is that an in-depth analysis of the proximate content in octopus cilok has not been carried out. Further research can also be focused on the analysis of the *proximate nutritional content* in processed foods made from octopus.

The third study was conducted by Pattipeilohy et al. (2021) the benefits of this study are to contribute to octopus processors in developing the potential that exists in improving the family economy. In addition, it provides information on octopus sausage processing for other researchers. The results of this study obtained a sensory test value of octopus sausage of 7.0 and a water content of 54% which can be concluded that the octopus sausage produced has met the quality requirements for meat sausage according to SNI 7755: 2013. However, the weakness of this study is that an in-depth analysis of the proximate content in octopus sausage has not been carried out. Further research can also be focused on the analysis of the *proximate nutritional content* found in processed foods made from octopus.

Based on the results of several previous studies, it can be concluded that research is needed on processing local potential food ingredients in the form of processing octopus into flour and analyzing the content of the octopus flour. So far, octopus research has only been processed into sausages and cilok has not been made into flour. Then, previous studies have not discussed the nutritional content of processed octopus foods. Then, in other studies, there has not been an in-depth analysis of the proximate content contained in octopus cilok. Further research can focus on analyzing the proximate nutritional content contained in processed foods made from octopus. Therefore, research is needed that discusses information about the exploration of the existence of octopus in Kaur Regency, octopus and its use as a food ingredient, octopus flour processing techniques, the context of the results of octopus nutritional content. Before this product can be further developed as a functional food ingredient, a scientific and systematic proximate content

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analysis is necessary. This research is important as a scientific basis in the development of octopus-based products, as well as a reference for the food industry in creating high-nutrition product innovations. Information on nutritional content, especially proximate levels in octopus flour, is still limited. Proximate analysis is a chemical analysis method for identifying the nutritional content of a feed or food ingredient. Proximate analysis examines a number of components, such as water content, organic matter, and others (ash), carbohydrates, protein, and fat. Proximate analysis allows for the nutritional value of a food ingredient to be determined and its quality can be compared with other products. Proximate analysis is performed in a laboratory according to the working procedures for each ingredient being analyzed. The results of this nutritional analysis can be used to determine the nutrients in octopus flour that are beneficial to the body's metabolism.

Therefore, this study aims to develop octopus into flour that can be processed into various other interesting foods and continued by analyzing the proximate content of octopus flour to evaluate the potential use of octopus flour as a source of nutrition in the food industry. The results of this study are expected to contribute to the development of nutritious and high economic value seafood products, as well as supporting local seafood-based food diversification.

RESEARCH METHODS

Sample material

The materials used in this activity include fresh *Octopus vulgaris and Octopus joubini ,* which is then processed into octopus flour from fishermen on Linau Beach, Kaur Regency.

Image 1. *Octopus vulgaris*

Image 2. *Octopus joubini*

Meanwhile, the tools used in this activity are adjusted to the proximate parameters used in this activity. This research was conducted in several locations. The sampling stage was carried out at Linau Beach, Kaur Regency, while the proximate content analysis was carried out at the Biology Laboratory of the University of Bengkulu. The research was conducted for 1 month, namely in

April 2025. Primary data was obtained by direct measurement method. Measurements are made through direct observation of the results of proximate content analysis carried out in the laboratory.

Process

The method and process for making octopus flour from *Octopus vulgaris* and *Octopus joubini* is the same, namely starting with selecting ingredients by selecting fresh octopus and then weighing it first heavy 500 grams of lamb. Then cleaned by first separating the octopus body from the outer skin that is still dirty then washed using running water and, after that drained. Then boiled for 30 minutes using a steamer and a regular stove, after that cooled and drained. Then the octopus is thinly sliced with a size of 1-2 cm so that the octopus dries quickly. After that, the octopus is dried and dried under the hot sun for 1-2 days depending on the weather until the octopus is dry and the octopus meat can be destroyed. Then the octopus is ground using a chopper and grinder until the octopus becomes smoother. Then the octopus is sieved using an iron tea strainer and continued with a smaller and finer plastic tea strainer so that octopus flour with a very smooth texture is obtained. Then the final result of the flour is sieved and the weight of the octopus flour is obtained as much as 205 g of wheat flour. After that, the wheat flour is stored using a closed container so that the wheat flour can be preserved and last a long time.

Sample Analysis

The weight of flour used in each calculation depends on the analysis performed. In the calculation of protein content analysis, the weight of flour used is 1 gram of O. vulgaris and O. joubini octopus flour samples. In the calculation of fat content analysis, the weight of flour used is 5 grams of *O. vulgaris* and *O. joubini* octopus flour samples. In the calculation of water content analysis, the weight of flour used is 5 grams of *O. vulgaris* and *O. joubini* octopus flour samples. In the calculation of ash content analysis, the weight of flour used is 5 grams of *O. vulgaris* and *O. joubini* octopus flour samples. In the calculation of crude fiber content analysis, the weight of flour used is 2 grams of *O. vulgaris* and *O. joubini* octopus flour samples.

Water Content Analysis (Gravimetry)

At this stage, the porcelain cup is heated in an oven at 105°C for 30 minutes, then cooled in a desiccator and weighed (W1). A 5-gram sample of ground octopus flour is placed in a previously weighed cup (W2). The cup containing the sample is placed in an oven at 105°C for 3-4 hours or until the weight is constant. The cup is removed, cooled in a desiccator, and weighed again (W3).

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The calculation of water content analysis was carried out using the gravimetric method with the principle of loss of water content weight when heated at a temperature of 105ºC (Fikriyah and Nasution 2021) .

Water content (%DB) = $\frac{W3}{W2} x100$

Water content (% WB) =

$$\mathbf{WB} = \frac{W3}{W1}\ x\ 100\%$$

Water content (% DB) =

$$\mathbf{DB} = \frac{W2}{W1}\ x\ 100\%$$

Total Solid Material (%) =$\frac{W2}{W1} x100$

Information:

W1 = initial sample weight

W2 = dry sample weight

W3 = weight loss/weight difference

Ash content analysis (Gravimetry)

At this stage, a clean and dry porcelain cup (W1) is weighed. Put 5 grams of octopus flour sample into the weighed porcelain cup (W2). Then the cup containing the sample is put into a furnace at a temperature of 500-600°C for 4-6 hours until all organic materials are burned and only ash remains. Cool the cup in a desiccator, then weigh it again (W3). The calculation of ash content is done using the gravimetric method. The testing process The ash content used is the gravimetric method with the principle that ash content oxidizes all organic substances at high temperatures, namely around 500-600 º C (Fikriyah & Nasution, 2022).

Ash content (%) =$\frac{W2-w1}{Ws} x100$

W1 = Weight of empty glass

W2 = Weight of cup + ash after burning

Ws = Initial weight of the weighed sample

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Fat Content Analysis (Soxhlet Extraction)

Weigh 5 grams of dry octopus flour sample of known weight (W1). The sample is placed on filter paper or thimble in a Soxhlet apparatus. Install the Soxhlet with an extraction flask containing a solvent (ether or n-hexane). Extraction is carried out for 6-8 hours until the solvent that rises to the condenser carries all the fat from the sample. Then the flask is extracted, remove the solvent, and dry the fat in an oven. Weigh the fat residue in a porcelain cup (W2). Fat analysis was carried out using the soxhletation method. Soxhletation was chosen because this method can be used for heat-resistant inorganic compounds such as fatty acids. Extraction with a tool and moistened with lipid solvent, the residue is dried in an oven until its weight is constant. Determination of fat content is done by weighing the difference in sample weight before and after the residue is extracted.

$$\text{Fat Content (\%)} = \frac{\mathbf{W2-W1}}{\mathbf{W1}} \boldsymbol{x100}$$

Information

W1 = dry octopus flour sample with known weight

W2 = fat residue

Carbohydrate Content Analysis (Based on Differences)

Carbohydrate content is calculated from the total difference of 100% with the total amount of other components that have been analyzed (water content, ash content, fat content, and protein). The carbohydrate content of food ingredients is determined by calculating the difference of 100% with the total amount of other ingredients (water content, protein content, fat content, and ash content).

This method of determining carbohydrate levels is called the "carbohydrate based on difference" method (Lubis et al., 2004).

$$\text{Reduce content} = \frac{\mathrm{C\,(b-a)p}}{\mathrm{G}} \mathrm{x100\%}$$

Information

C = Concentration of standard solution

b = Volume of empty solution

a = Volume of sample solution

p = Dilution factor

G = Sample weight

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Protein Content Analysis (Kjeldahl Method)

A 1 gram sample of octopus flour was put into a Kjeldahl flask. Then 20 mL of concentrated sulfuric acid and 0.5 grams of Kjeldahl catalyst were added. It was heated until the solution became clear (all nitrogen was converted to ammonium sulfate). After cooling, add NaOH solution and distill to convert ammonium to ammonia. The resulting ammonia was captured in boric acid solution and titrated with standard HCl.

Protein content = % N x Conversion factor N

Information:

% N : Kjeldhal method results

Crude Fiber Analysis

Weigh about 2 grams of dried octopus flour sample into an Erlenmeyer flask. Add 1.25% sulfuric acid solution, then heat for 30 minutes while stirring. Filter the mixture and rinse with hot water. Add 1.25% NaOH solution to the remaining residue and heat again for 30 minutes. Filter again, wash with hot water, and dry the residue in an oven until it reaches constant weight.

Calcium, Magnesium, and Iron

Calcium and magnesium analysis is performed using titrimetric methods. Iron content analysis is performed using spectrophotometric methods. Titrimetry is a quantitative analysis method that involves measuring the volume of a standard solution required to react with the analyte. For calcium and magnesium analysis, complexometric titration with EDTA as the titrant is often used (Bisergaeva & Sirieva, 2020). Spectrophotometry is used for iron content analysis due to its sensitivity and specificity in detecting low concentrations using a specific color reaction.

$$\text{Ca, Mg, Fe (\%)} = \frac{titration\ result\ x\ 0{,}2\ x\ ash\ solution}{ash\ solution\ x\ sample\ weight} \text{X } 100$$

RESEARCH RESULT

Octopus Description

The general morphology of octopuses found on the coast is characterized by a soft body without a shell. *Octopus vulgaris* does not have an outer shell, only a hard beak as the strongest part of its body. It has 8 arms equipped with a concave circular suction cup that functions to move on the seabed and catch prey. It has a main body part called a mantle, shaped like a pouch and made of muscle. *Octopus vulgaris* has good eyesight, with slit-shaped pupils. The body length (including

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arms) can reach 30–91 cm, the weight varies from 300-2500 g. It has smooth, non-scaly skin and the color of the mantle is blackish brown.

In terms of physiology, *Octopus vulgaris* has three hearts consisting of two branchial hearts pumping blood to the gills, one systemic heart pumping blood throughout the body. *Octopus vulgaris* has blue blood containing hemocyanin as an oxygen binder, so the blood is blue. *Octopus vulgaris* breathes with gills, water enters the mantle cavity and exits through the siphon. *Octopus vulgaris* has a complex nervous system, has a large brain and a highly developed nervous system, making octopus the most intelligent invertebrate animal.

The habitat of *Octopus vulgaris* is wide, can be found in tropical, subtropical waters, and is widely found in Indonesian waters, especially in Kaur Regency, then also widely found in the Mediterranean Sea, the eastern Atlantic Ocean, Japanese waters. Lives in shallow coastal waters to a depth of 100-200 meters, especially on coral reefs, sandy or rocky bottoms

DISCUSSION

Nutritional Content Analysis

The results of the laboratory analysis obtained the composition of macronutrient levels consisting of protein levels, fat levels, and carbohydrates which can be seen in table 1.

Table 1. Results of the analysis of macronutrient levels of octopus flour

Types of Octopus	Macronutrient Levels		
	Protein (%)	Fat (%)	Carbohydrates (%)
Octopus vulgaris	32.41	8.19	7.08
Octopus joubini	33.25	26.0	22.59

Based on table 1, Protein content of *Octopus vulgaris* samples was 32.41% lower when compared to *Octopus joubini* which was 33.25 % and also lower when compared with *O. hubbsorum* which has a protein content of 69.38%, dry weight from the Pacific Ocean waters, Acapulco, Guerrero, Mexico (Palacios-Abrantes et al., 2017). However, the protein content of *Octopus vulgaris* is higher than the protein content of *O. cyanea* at 18.61% (Soewarlan et al., 2023)

Octopus flour is a source of protein. Protein is one of the important macronutrients in our diet (Girdhar et al., 2026). Proteins are polymers of amino acids linked together with establish closeness peptide. Molecule protein contains element metal like iron copper (Villa Gomez et al., 2025)

The next macronutrient content is fat. Cephalopod bodies generally consist of high total protein with low fat (Schmidt & Mouritsen, 2022). The fat content in octopus flour in table 1 reaches 8.19 %, lower when compared to *Octopus joubini* 26% but higher than *O. cyanea* 2.83%

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(Soewarlan et al., 2023) and also higher than *O. hubbsorum* 2.77% (Palacios-Abrantes et al. 2017). The plankton contains fatty acids consumed by planktivorous fish which are then consumed by octopus Lourenço et al. (2017), conducted research in Antarctic sea waters and found that consumption of zooplankton by octopus resulted in increased fat content. The range of fat content in this study is likely determined by the presence of several foods involved in the octopus food chain, especially those that contain a lot of fat.

Low fat content in octopus flour can be a good choice for those on a low-fat diet or maintaining heart health. Octopus is naturally low in fat but high in protein, so it can provide a feeling of fullness for longer and help control weight. Low fat also means fewer calories from fat, which can help prevent obesity and metabolic diseases when consumed in proportion. Processed octopus products with low fat content tend to have lower cholesterol levels, so they are good for maintaining normal blood cholesterol levels. The high protein and low fat content makes octopus flour a good source of animal protein, without the risk of excess saturated fat (Venn, 2020). Lipids play a role in providing good and bad aromas to food and providing lubrication to food in the mouth. Three groups play from lipid in the food are triacylglycerols, phospholipids and sterols (Samaranayake et al., 2026).

Other macronutrient content is carbohydrates. Information on carbohydrate content in octopus is the least found, however, different types provide varying amounts. The carbohydrate content in *Octopus vulgaris* flour is 7.08 % higher than *O. cyanea* at 6.37% but lower than *Octopus joubini* at 22.59 % and also lower than *O. Hubbsorum* amounting to 20.53% (Palacios-Abrantes et al., 2017; Soewarlan et al., 2023). This difference is caused by differences in species, habitat at the sampling location and possibly differences in the life cycle of the samples. According to Soewarlan et al (2023), carbohydrate data for the nutritional composition of cephalopods (including octopus) vary across different databases because they come from different species, different locations and in different life cycle states .

Carbohydrates are the most important source of food energy in the world. The function of carbohydrates in the body is as a glycogen reserve, protein reserve work, antiketogenic effects, other functions are liver work greatly affects muscle activity, fat tissue is a very preferred or very specific fuel for the liver, glycogen stored in the heart muscle is very important when energy is not enough to carry out body activities (Mæhre et al. 2018) .

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Next, the results of the micronutrient content of *Octopus vulgaris* and *Octopus joubini* octopus flour were analyzed. The results of laboratory analysis of the composition of micronutrient levels were obtained, consisting of calcium levels, magnesium levels and iron levels. Can be seen in the table below.

Table 2. results of the analysis of micronutrient levels of octopus flour

Types of Octopus	Macronutrient Levels		
	Calcium (%)	Magnesium (%)	Iron (ppm)
Octopus vulgaris	0.15	5.87	5.41
Octopus joubini	0.19	1.24	4.00

Based on table 2, it can be seen that octopus flour also contains important minerals such as calcium, magnesium, and iron which are beneficial for the body. The calcium content of *Octopus vulgaris* flour is 0.15 % lower than the calcium content of *Octopus joubini flour* of 0.19% . Calcium is needed for the formation and maintenance of strong bones and teeth, and plays a role in muscle contraction, blood pressure regulation, and nervous system function (Shlisky et al., 2022). Like octopus, squid also has low calcium levels. The low calcium content in squid is because squid does not have an outer skin as a source of calcium (Zeng et al., 2025).

Another mineral content is magnesium. The magnesium content in *Octopus vulgaris* octopus flour is 0.87 % lower than the calcium content in *Octopus joubini flour* of 1.24% . Magnesium is useful for balancing the nervous system and body metabolism, helping to regulate blood pressure, protein and DNA synthesis. Other functions are to maintain neuromuscular and cardiovascular function. Magnesium is an essential mineral that plays a role in more than 300 biochemical reactions in the body, including energy metabolism, protein synthesis, and muscle and nerve function (Bisergaeva & Sirieva, 2020).

Another micronutrient found in octopus is iron. The iron content in *Octopus vulgaris* octopus flour is 5,412 ppm, which is higher than the calcium content in *Octopus joubini flour* of 4.0 ppm. Iron is essential for forming hemoglobin and myoglobin, as well as transporting proteins in the blood and muscles. Although the iron content in octopus flour is relatively low, its contribution is still significant as an additional source of iron in the daily diet.

Furthermore, in addition to analyzing the macronutrient and micronutrient content, other contents in *Octopus vulgaris* and *Octopus joubini oflour were also analyzed,* namely water content, ash content and fibe . The results of laboratory analysis of the composition of water content, ash content and fiber are obtained, which can be seen in the table below.

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Table 3 results of analysis of other levels of octopus flour

Types of Octopus	Other levels		
	Water (%)	Ash (%)	Fiber (%)
Octopus vulgaris	1.96	4.20	0.732
Octopus joubini	3.39	5.45	1.20

Based on table 3, it can be seen that octopus flour also contains several other components such as water, ash and fiber. Water is an important component, they occupy the intercellular space and play a role in dissolving various vitamins, mineral salts and certain nitrogen compounds (Soewarlan et al., 2023). Water content is the amount of water contained in the ingredients mentioned in the percent. Level water Also one of the very important characteristics of food ingredients, because water can affect the appearance, texture, and taste of food ingredients (Palacios-Abrantes et al., 2017). The water content in food ingredients also determines the freshness and durability of the food ingredients, high water content will make it easier for bacteria, fungi, and yeast to grow, so that changes will occur in the food ingredients (Fikriyah & Nasution, 2022).

Level octopus flour water *Octopus vulgaris* considered very low, only 1.96 % when compared to *Octopus joubini* at 3.39%. This result is also lower than the research conducted by Soewarlan et al. (2023), on *O. cyanea* 70.79 %, and research conducted by Palacios-Abrantes et al. (2017) on *O. hubbsorum 64.15* % . The difference in water content is due to the drying process first in *Octopus vulgaris* and *Octopus joubini.* Water activity is a term that is related to the ability of microbes to grow in a particular environment. This low water content is due to the drying process in making flour.

In addition to water, another parameter that is also measured in octopus flour is the ash content. The ash content obtained in *Octopus vulgaris* is 4.20% lower when compared to the ash content in *Octopus joubini* which is 5.45%. However, it is higher when compared to the ash content in *O. cyanea* which is 3.50%. This difference indicates that there is a variation in the composition of mineral nutrients in different species (Soewarlan et al., 2023). The purpose of measuring ash content is to determine the amount of mineral content. contained in octopus flour. Analysis of ash content in a food ingredient is carried out to determine the mineral content in the food ingredient (Rodríguez-González et al. 2015) . Analysis of ash content is carried out by heating the material at a high temperature (110 ^{0}C), the remaining material after heating is minerals or metals because of the organic elements contained in octopus flour containing carbon, hydrogen,

and oxygen have evaporated into water vapor and carbon dioxide gas. In addition, ash content is also used to determine whether a processing process is good or not and also to prove the existence of food adulteration (Vera et al., 2025).

The next mineral content analyzed is fiber. The fiber content of octopus flour *Octopus vulgaris* as big as 0.732 % lower compared to the octopus *Octopus joubini* at 1.20% and also lower than *O. cyanea* by 2.84% (Palacios-Abrantes et al., 2017). While *O. hubbsorum* does not contain fiber content. Ash and fiber content in Cephalopods are not the main focus, so there is very little information about these two compounds. Variations in nutrient composition in this study were more due to intrinsic factors of age, type, and size of octopus, extrinsic factors of habitat, type of food (feed intake), and post-capture handling at the fisherman level (time, temperature, and cooling). Different sizes or weights determine the age of the octopus caught, this difference affects the chemical composition of the octopus (wet weight). The same thing was found in previous studies by Palacios-Abrantes (2017) and Oliveira et al. (2019)

Dietary fiber is included in the group of carbohydrates whose chemical structure is very complex and is the edible part of plants, which cannot be digested by digestive enzymes, acids, or microorganisms. microorganisms in the intestines, but can be fermented partially or completely in the large intestine. Lack of fiber can disrupt the process of removing food waste from the intestines. Fiber is a non-nutritional component whose adequacy is always considered in the daily menu. Consumption fiber Can reduce absorption fat, but consumption fiber which is excessive and can reduce the absorption of vitamins and minerals.

Overall, the nutritional content consisting of macronutrients, micronutrients in other contents such as water, ash and fiber in octopus flour shows that this product has the potential to provide benefits in meeting daily nutritional needs. Octopus flour is considered healthy and nutritious and suitable for food diversification. However, its use must be adjusted to individual nutritional needs and the type of product produced. Octopus flour offers a more protein-rich alternative. This makes octopus flour a good choice to diversify animal protein sources in the daily diet, especially for individuals who require higher protein intake or are looking for alternative protein from non-conventional sources.

Furthermore, the nutrient content contained in octopus flour is compared with the SNI 01-2715-1996 standard. The results of the comparative test of the composition of macronutrient

Al-Jahiz: Journal of Biology Education Research
ISSN 2722-5070 (Print) ISSN 2722-5275 (Online)
Vol. 7 No. 1 January-June 2026
Available online at:
http://e-journal.metrouniv.ac.id/index.php/Al-Jahiz

levels consisting of protein content, fat content, carbohydrates with SNI standards are obtained, which can be seen in the table below.

Table 4.4 Results of Proximate Content Analysis of Octopus Flour according to SNI

Composition	Condition			Flour Octopus (*Octopus vulgaris)* %	Compliance	Flour Octopus (*O.joubini)* %	Compliance
	SNI (Grade I) %	SNI (Grade II) %	SNI (Grade III) %				
Level water (max)	10	12	12	1.96	SNI Quality I	3.39	SNI Quality I
Fat content (max)	8	10	12	8, 19	SNI Quality II	26	
Level of ash (max)	20	25	30	4.20	SNI Quality I	5.45	SNI Quality I
Crude fiber (max)	1.5	2.5	3	0.732	SNI Quality I	1.20	SNI Quality I
Protein content (min)	65	55	45	32.41		33.25	
Calcium (max)	2.5-5.0	2.5-6.0	2.5-7.0	0.15		0.19	

Based on table 1, the results of the laboratory analysis of the composition, obtained levels of protein, fat content, carbohydrates, water content, ash content, fiber, calcium, magnesium and iron. The results of this proximate analysis were compared with the SNI quality requirements and have been in accordance with the standards set by SNI for octopus flour. For the cells highlighted in gray it means does not meet SNI standards. For water content of *Octopus vulgaris* octopus flour was obtained 1.96% and has met SNI quality one and the water content of *Octopus joubini octopus flour* was obtained 3.39% and met SNI quality one. For the fat content of *Octopus vulgaris* octopus flour, it was obtained 8.19% meets SNI quality II. For the fat content of *Octopus joubini octopus flour* is obtained 26% and does not meet SNI standards (highlighted in gray). For ash content of *Octopus vulgaris* octopus flour was obtained 4.20% and has met SNI quality one while the ash content of *Octopus joubini octopus flour* was obtained 5.45% and met SNI quality one. The crude fiber content of *Octopus vulgaris* octopus flour was obtained at 0.73% and has met SNI quality I. While the fiber content of *Octopus joubini octopus flour was obtained 1.20* % and met SNI quality I. %. For the protein content of *Octopus vulgaris octopus flour* , it was obtained 32,41% and does not meet SNI standards (highlighted in gray). while the protein content of *Octopus joubini* octopus flour was obtained 33,25% and does not meet SNI standards (highlighted in gray). For the calcium content of *Octopus vulgaris octopus flour* , it was obtained 0.15% and does not meet SNI standards (highlighted in gray). while

the calcium content of *Octopus joubini* octopus flour was obtained 0.15% and does not meet SNI standards (highlighted in gray).

CONCLUSION

Octopus vulgaris can be processed into octopus flour which has good nutritional content for body metabolism. Analysis was conducted in the laboratory and produced the nutritional content of Octopus vulgaris octopus flour, namely protein (32.41%), fat (8.19%), carbohydrates (7.08%), calcium (0.15%), magnesium (0.87%), iron (5.412 ppm), water content (1.96%), ash content (4.20%) and fiber content (0.73%). While the nutritional content of Octopus joubini octopus flour is protein (33.25%), fat (26.0%), carbohydrates (22.59%), calcium (0.19%), magnesium (1.24%), iron (4.0 ppm), water content (3.39%), ash content (5.45%) and fiber content (1.20%).

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