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Characterization of the proximate content and fatty acid profile of squid (*Loligo* sp). from Maluku waters

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ABSTRACT

Cephalopod production from year to year has also increased. The purpose of this study was to compare the results of the proximate composition analysis and the characterization of the fatty acid content of squid (*Loligo* sp.) Obtained from Maluku waters. The analysis results showed that the proximate content in the form of the highest protein was in the waters of the Aru archipelago, followed by the regencies of West Southeast Maluku and West Seram (19.85%, 16.78%, 14.66%). The highest carbohydrates were in the samples from the waters of West Seram Regency then West Southeast Maluku and Aru Islands (7.3%, 3.3%, 2.09%). The highest fat content was dominated by samples from the waters of West Seram Regency, followed by West Southeast Maluku and Aru Islands (1.23%, 0.94%, 0.91%). The samples' moisture collected was almost the same at the three locations, namely 76.58% in the waters of West Southeast Maluku Regency, 75.25% in West Seram, and 74.66% in the waters of Kepualauan Aru. The composition of ash and fiber was dominated by samples collected from the Aru Islands and Western Seram District (249% and 2.46%). The Fatty Acid test found that the results varied between locations, namely non-essential fatty acids, namely Palmitic Acid, which was dominated by location, and essential fatty acids, namely DHA, EPA, and ARA.

Key words : *Loligo sp, Maluku waters, Squid*

Introduction

The squid group contributed the most significant contribution with an average of 70.42%, followed by the squid 23.17% and the octopus group 6.41% (Syarifuddin, 2011). Cephalopods, including cuttlefish, squid, and octopus, are among an important marine resource since they are rich in taste and have few inedible parts. The connective tissue of cephalopods is highly developedcompared to fish in general. Its body contains a low level of lipid. However, omega-3 polyunsaturated fatty acids presented the majority of the total lipid (Ozyurt *et al.*, 2006; Thanonkaew *et al.*, 2006; Phillips *et al.*, 2002). In the culinary industry, squid is usually served as seafood in large places such as restaurants and hotels because when compared to other seafoods, the price of squid is still affordable. Squid has potential as a source of nutrition because it contains unsaturated fatty acids such as omega-3, which prevents hardening of the arteries and reduces blood viscosity that causes platelet clumping in the blood (Moneysmith, 2003). In general, all Indonesian people consume all parts of the squid's body, starting from the meat (body), head, and all of the innards. Squid also has a high enough cholesterol content that some people sometimes hesitate to consume.

The nutritional composition of cuttlefish hasbeen reported by some researchers (Thanonkaew *et al.*, 2006; Villanueva *et al.*, 2004; Ozyurt *et al.*, 2006;

Phillips *et al*., 2002). Fatty acids are one of the main components of fat composition that can be sourced from animals and plants that play an important role in the body. Its chemical content is unsaturated fatty acids, especially from the PUFA (polyunsaturated fatty acid) group (Kordi and Ghufran, 2010). Other important components are DHA and EPA. These two fatty acids are obtained from phytoplankton which is the main food for marine animals (Rosli *et al.*, 2012). DHA itself plays a role in the development of brain cells (Birch *et al.*, 2007). This study aimed to determine the proximate composition and characterize the content of beneficial fatty acids in squid caught in different waters in Maluku waters.

Material and Methods

Sample preparation

The sample used was squid (*Sephia* sp) obtained from the Aru Islands, West Seram District, and West Southeast Maluku District. The samples obtained are fishermen's catches, which are directly obtained from traditional markets in each location. For further analysis, the sample was prepared by freezing it for further delivery to the Integrated Chemistry Laboratory, Bogor Agricultural University. Several analyses were carried out, including proximate analysis (protein, carbohydrates, fat, water) and fatty acid profile analysis.

Proximate analysis

Proximate analysis, i.e., Protein content, ash, moisture, and fat, is determined using the published method (Patricia *et al*., 2014; Pratama *et al.*, 2019).

Fatty Acid Characterization using GC-MS

Fatty acid characterization using a published method (Chiu and Kuo, 2020). The analytical method used has the principle of converting fatty acids into their derivatives, namely methyl esters, to be detected by chromatography. The fat or oil sample is hydrolyzed into fatty acids, then transformed into its more volatile ester form. The transformation was carried out by methylation to obtain fatty acid methyl esters (FAME). Furthermore, FAME was analyzed by gas chromatography.

Identification of fatty acids

The identification of fatty acids was carried out using the published method (Shen *et al*., 2016) by injecting methyl esters into the Shimadzu GC 2010 gas chromatograph. The gas used as the mobile phase was nitrogen gas with a pressure flow of 30 ml/minute and oxygen with a 200-250 ml/minute flow. The column used is a capillary column with a length of 60 m and an inner diameter of 0.25 mm with a film thickness of 0.25 m. The programmed temperature used was 190 °C which was maintained for 15 minutes. Then the temperature was increased to a final temperature of 230 °C, which was held for 20

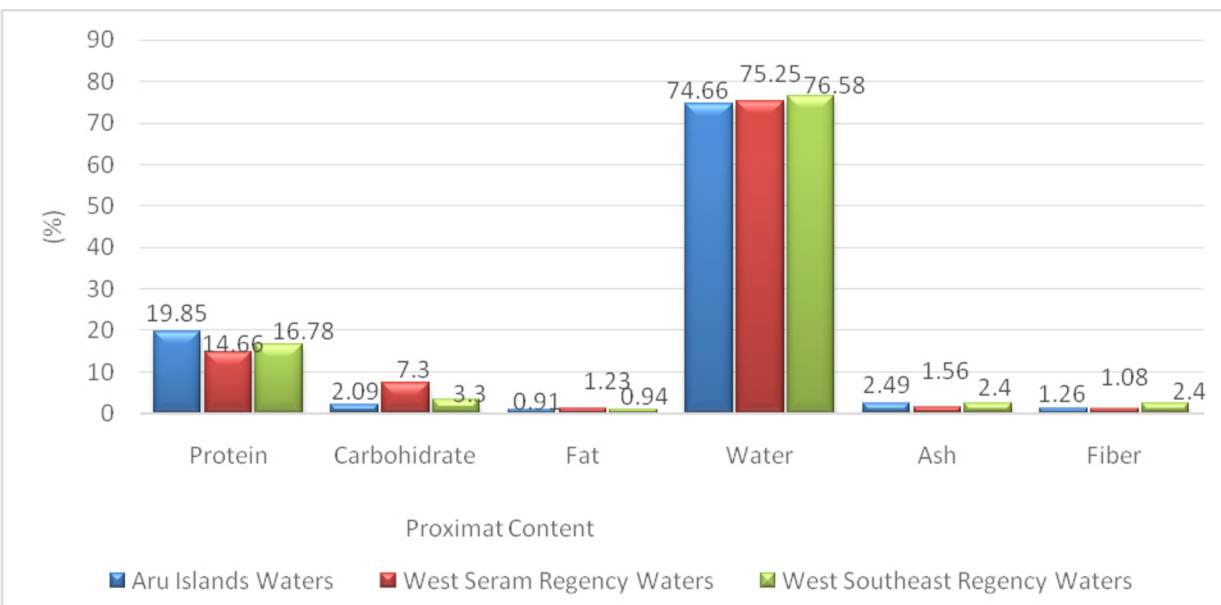

Fig. 1. Composition of proximate squid (*Loligo* sp.) from different water locations

minutes, the injector temperature was 220 °C, and the detector temperature was 240 °C.

Results and Discussion

The nutritional content of squid was obtained through proximate analysis, including water, protein, fat, and ash content. Carbohydrate content is obtained through calculations by difference. Proximate analysis was carried out on all parts of the body of the squid sample.

The measure of water content showed almost the same values, namely 76.68%, 75.25%, 74.66% at the locations of Aru Islands Waters, West Seram Regency Waters, West Southeast Regency Waters. The water content measured in this study is evaporated water and is not strongly bound in the material network with the help of heat. Papan *et al.* (2011) conducted previous research, the squid (*Sepia arabica*) showed a lower water content, which was 73.02%. High water content in squid can cause a faster deterioration in quality, especially if not handled properly because free water can be a medium for microbial growth and also chemical reactions in the tissue.

Ash content is a mixture of inorganic or mineral components contained in a food ingredient. Foodstuffs consist of 96% organic matter and water, while the rest are mineral elements (inorganic). Organic materials will burn during the combustion process, but the inorganic components will not because that is called the ash content (Winarno, 2008). The ash content of squid showed different values, namely 1.56%, 2.4%, 2.49%. Differences in habitat and environment can cause high and low ash content. The balance of mineral ions in body fluids requires regulation of enzyme work, acid-base balance, membrane transfer of important bonds through cell membranes, and maintenance of muscle and nerve sensitivity to stimuli (Almatsier, 2006).

Protein is needed because it contains amino acids, which plays a role in its composition, which is the precursor for many coenzymes, hormones, nucleic acids, and molecules essential for life. Protein in the human body has a unique function and cannot be replaced by other nutrients, namely building and maintaining cells and body tissues (Almatsier, 2006). Sugiyama () quantified the total protein content of 20% in the squid (*T. pacificus*) viscera.

The analysis of the protein content of squid (*Loligo* sp.) ranks second after water. The results obtained showed variations in the three locations, namely 14.66%, 16.78%, and 19.85%. Research conducted by Papan *et al*. (2011) showed a higher value of 17.00%. Differences in protein levels can be caused by several factors: habitat, age, digested food, the rate of metabolism, the rate of movement, and the level of maturity of the gonads. Ecological conditions in which the squid, due to different waters, will provide different food sources (Papan *et al.*, 2011).

Fat is a component that is soluble in organic solvents such as hexane, ester, and chloroform. Animal fat is generally solid at room temperature, while plant fat is a liquid. The analysis results showed that the fat content was lower than the water content, namely 0.91%, 0.94%, and 1.23%. The low-fat content is due to the high water content. Fat generally has several functions, including producing energy, building and forming body structures, carrying fat-soluble vitamins (Suhardjo and Kusharto, 1988).

The calculation of carbohydrates using the by difference method is a method of determining carbohydrate levels in foodstuffs roughly, where crude fiber is also counted as carbohydrates (Winarno, 2008). Carbohydrates found in animals are stored in glycogen, abundant in muscles and the liver (Almatsier, 2006). This calculated carbohydrate content is thought to be in the form of glycogen and crude fiber. If the amount of carbohydrates available in the body is not sufficient, there will be an increase in fat breakdown. If the carbohydrate and fat levels are also insufficient, the protein will be overhauled to produce energy.

Characterization of fatty acid composition of squid (*Loligo* sp.)

Fatty acids are long-chain organic acids that makeup lipids, consisting of straight hydrocarbon chains having a carboxyl group (COOH) at one end and a methyl group (CH3) at the other. The results of the analysis of squid fatty acids consist of 6 types of saturated fatty acids (SAFA), namely lauric acid (C12:0), myristic (C14:0), pentadecanoic (C15:0), palmitic (C16:0), heptadecanoate (C17:0), and stearate (C18:0). Three types of monounsaturated fatty acids (Monounsaturated Fatty Acid / MUFA), namely palmitoleic acid (C16:1), oleic acid (C18:1), and eicosanoid acid (C20:1), as well as five types of polyunsaturated fatty acids (Polyunsaturated Fatty). Acid/PUFA), namely linoleic acid (C18:2n6c), linolenic acid (C18:3n6), arachidonic (C20:4n6), eicosapentaenoic/EPA (C20:5n3), and docosahexaenoate/DHA (C22:6n3). Three of the eight unsaturated fatty acids are omega-3 groups (linolenic acid, EPA, and DHA), two omega-6 groups (linoleic and arachidonic acids), and one omega-9 group (oleic acid). This value is obtained through the results of the chromatogram on the analysis using gas chromatography. GCMS test results show certain types of fatty acids, as shown in Table 1.

Table 1. shows the results of the characterization of squid fatty acids obtained from different water locations in Maluku waters. The composition of these fatty acids consists of saturated fatty acids and unsaturated fatty acids. Nagarajan *et al.* (2012) reported better alanine content, glutamic acid and aspartic acid in the gelatin of splendid squid (L. formosana), whereas tyrosine phenylalanine, histidine, and lysine noticed at the lower level. In the present study, leucine and tryptophan were the highest essential amino acid (EAA) content in the sample. These results show that the content of unsaturated fatty acids with multiple double bonds or (PUFA) consisting of DHA, EPA, and ARA has the highest value and varies at each location, as shown in Figure 2.

According to some experts, DHA (Docosahexaenoic Acid) and EPA (Eicosapentaenoic Acid) are included in essential fatty acids. However, although the body can synthesize both, the process runs very slowly so that additional intake or addition is needed from outside the body, which comes from food. DHA is one of the essential nutrients that can also be obtained from fish oil which contains 5-20%. The role of DHA is critical because it helps brain development (Birch *et al.,* 2000).

This research needs to be developed further. The test materials can be varied using various consumptive organisms such as the Tilapia fish group (Insani *et al*., 2020; Hasan and Tamam, 2019), which have been widely cultivated as animal protein. In addition, we recommend using native Indonesian fish as test animals, such as Lobocheilos fish (Hasan *et al.*, 2019) and Beardless barb (Hasan *et al*., 2021). Other fish can be used as test animals if they have high economic potential for consumption, such as snakehead fish (Pratama *et al*., 2019), and alligator gar (Hasan *et al.,* 2020), and even mangrove gastro-

Table 1. Characterization of Fatty Acid Composition in Squid (*Loligo* sp)

No	Composition of fatty acid compounds (%) Fatty Acid	Location A	Location B	Location C
	Lauric Acid, C12:0	0.05	0.03	0.02
	Myristic Acid, C14:0	1.13	0.94	0.81
	Myristoleic Acid, C14:1	0.09	0.13	0.11
	Pentadecanoic Acid, C15:0	0.26	0.25	0.24
	Palmitic Acid, C16:0	10.25	11.30	10.51
	Palmitoleic Acid, C16:1	0.37	0.34	0.29
	Heptadecanoic Acid, C17:0	0.51	0.52	0.61
	Cis-10-Heptadecanoic Acid, C17:1	0.04	0.04	0.08
	Stearic Acid, C18:0	3.79	3.89	4.72
	Oleic Acid, C18:1n9c	1.10	1.38	1.28
	Linoleic Acid, C18:2n6c	0.13	0.19	0.11
	Arachidic Acid, C20:0	0.07	0.07	0.09
	Cis-11-Eicosenoic Acid, C20:1	0.66	0.62	0.79
	Cis-11,14-Eicosedienoic Acid, C20:2	0.13	0.14	0.14
	Behenic Acid, C22:0	0.07	0.08	0.07
	Cis-8,11,14-Eicosetrienoic Acid, C20:3n6	0.04	0.06	0.03
	Arachidonic Acid, C20:4n6	4.54	5.23	5.13
	Tricosanoic Acid, C23:0	0.02	0.02	0.02
	Cis-13,16-Docosadienoic Acid, C22:2	0.05	0.04	0.04
	Lignoceric Acid, C24:0	0.09	0.12	0.10
	Cis-5,8,11,14,17-Eicosapentaenoic Acid, C20:5n3	8.14	5.67	6.02
	Nervonic Acid, C24:1	0.06	0.06	0.10
	Cis-4,7,10,13,16,19-Docosahexaenoic Acid, C22:6n3	22.37	19.47	22.14
	Fatty Acid Total	53.95	50.59	53.43

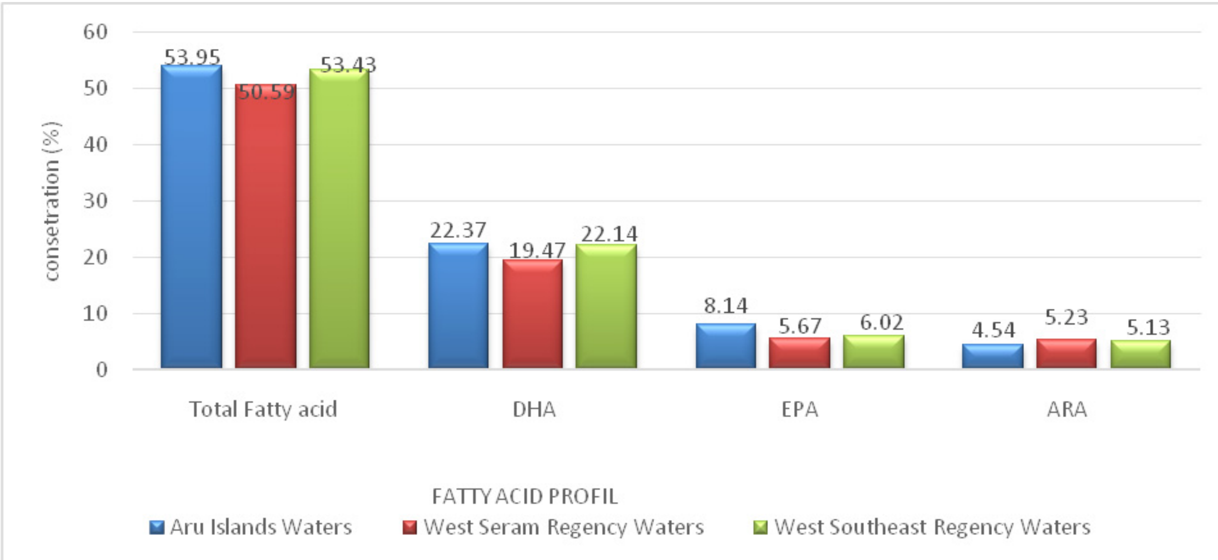

Fig. 2. Composition of unsaturated fatty acids (DHA, EPA, ARA) squid (*Loligo* sp.)

pods (Islami and Hasan 2020). In addition, the fish must meet the criteria for a good test animal (Islamy and Hasan, 2021).

Conclusion

From the results of this study, it can be concluded that the proximate composition and fatty acid profile of squid (*Loligo* sp) collected from Maluku waters have varying values. The highest proximate composition was found in squid obtained from the western Seram waters, followed by samples collected from the waters of Aru and West Southeast Maluku. Meanwhile, the fatty acid profile was dominated by squid samples obtained from the waters of the Aru Islands, followed by samples from the waters of southeastern-west Maluku and western Seram.

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