

BIOCHEMICALS COMPOSITION OF SEA CUCUMBER *STICHOPUS OCELLATUS* FROM BELITUNG WATERS, INDONESIA

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Abstract

Sea cucumbers have been known to have a high nutritional value for healthy foods. However, it typically depends on the species and their living habitat. In this study, the biochemicals composition of sea cucumber *Stichopus ocellatus* collected from Belitung waters, Indonesia was analysed in order to find out its potential used as a source of healthy foods for human in the future. The proximate analysis showed that the content of moisture, ash, protein, fat, and carbohydrate of *S. ocellatus* were found in the range of 70.06%, 21.04%, 6.64%, 0.84%, and 1.42% wet weight, respectively. The body wall of *S. ocellatus* was found to be rich of minerals content; i.e. sodium, calcium, potassium, iron, phosphor, and magnesium were about (in mg/100g) 7622.61, 2105.73, 134.97, 5.65, 1537.10, and 560.63, respectively. Vitamin B2 (0.02 mg/100g) and vitamin E (0.32 mg/100g) were also detected in the body wall of *S. ocellatus*. The major component of saturated fatty acid, monounsaturated fatty acid and polyunsaturated fatty acid were found to be palmitic (0.17%), oleic (0.07%) and arachidonic acid (0.14%). About 16 amino acids were observed, in which, threonine (3679.77 mg/kg) and glycine (10356.84 mg/kg) are the major component of essential amino acid and non-essential amino acid, respectively. The results show that *S. ocellatus* collected from Belitung waters have potential biochemical composition to be used as a healthy food for human in the future.

Key words: sea cucumber, *Stichopus ocellatus*, body wall, nutritional value, healthy foods

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INTRODUCTION

Sea cucumber is an invertebrate animal living in sea water belonging to the phylum of Echinodermata. Sea cucumbers are widely consumed extensively in China and Japan (Duan *et al.*, 2010). Many reports have mentioned that sea cucumbers contain multiple valuable active compound such as saponin, triterpene glycosides, fucosylated chondroitin sulphate, phospholipids, polysaccharides, cerebroside, acid mucopolysaccharide, and other extracts and hydrolysates (Shi *et al.*, 2016).

Over the past few decades, sea cucumbers have been commercially exploited in worldwide. Mainly, the class of Holothuroidea is one of valuable sea cucumbers in market. In this context, there are more than 50 species of Holothuroidea with high economic value in Asia seafood markets. In South-East Asia, the important sources of sea cucumber are Indonesia, Vietnam, Philippines, Malaysia and Thailand, while Singapore and Hong Kong are

being the major export countries (Rahman and Yusoft, 2017).

Generally, the determination of biochemicals content is focused on the nutritional value of the sea cucumbers since they are regarded as a potential functional food resources (Al Azad *et al.*, 2017). As the commercial product, the grade of sea cucumbers is related to some parameters such as the species, tastes, the abundances, the colours, the thickness of the body wall, the appearances, textures, constituency, dryness and market demand (Drazen *et al.*, 2008).

Stichopus ocellatus is a species of sea cucumber in the genus of *Stichopus*. It is the dominant species found by fishermen in the Belitung waters. *S. ocellatus* has been reported to contain potential biochemical components, however, there is no report about the biochemical content of this species collected from the Belitung waters. In this study, we evaluated the biochemical content of sea cucumber *S. ocellatus* collected from Belitung

waters, Indonesia in order to see its nutritional potency as a commercial functional food products in the future.

MATERIALS AND METHODS

Sample collection and preparation

The fresh sea cucumber *Stichopus ocellatus* was purchased from the fisherman in Belitung Island, Indonesia. This is one of sea cucumbers that are abundant in Belitung Island. The sample sea cucumber was collected during low tide season from the shallow up deeper parts of the sea. The sample was washed with sea water to remove sand as well as solid particles, and then dissected to remove its internal organs. Thereafter, the sample was inserted in the plastic bag and kept in the icebox to be brought into Marine Natural Product Laboratory, Research Center for Oceanography – LIPI in Jakarta. Afterward, the sample was stored at -20°C prior analysis.

Proximate analysis

The proximate analysis was conducted according to the AOAC standard method (AOAC, 1990). About 2 g of *S. Ocellatus* was oven dried at 105°C for 4 hours. Afterward, the sample was cooled in a desiccator and reweighted until the mass constant to measure the moisture content (AOAC, 1990). Ash content (%) was determined by heating 2 g of *S. ocellatus* for 4 hours in a muffle furnace at 550°C. After cooled in a desiccator, the sample was reweighted (AOAC, 1990).

The fat content (%) was determined by Soxhlet apparatus (AOAC, 1990). Briefly, about 2 g of *S. ocellatus* sample was wrapped with a filter paper and then put it into the thimble. Afterward, the reflux was conducted for 5 hours with 120 ml of petroleum ether as the organic extracting solvent. The spent samples with the thimble were reweighted. Protein content (%) was determined by calculating the elemental N determination using the nitrogen-protein conversion factor of 6.25 (AOAC, 2000). While the carbohydrate content (%) was determined by difference.

Mineral analysis

Minerals (phosphorus, iron, calcium, potassium, magnesium and sodium) content

were determined by using the Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) method.

Vitamin analysis

Vitamin A and vitamin E were determined by using High Performance Liquid Chromatography (HPLC) Alliance waters, Photo Diode Array (PDA) with LiChrosper 100 RP-18 (5 µm) 4 mm x 250 mm column. Vitamin B1 and Vitamin B2 were determined by using Ultra Performance Liquid Chromatography (UPLC) H Class Waters, Photo Diode Array (PDA) with ACQUITY UPLC BEH Amide 1.7 µm 2.1 x 100 mm column, while vitamin B12 was determined by using Ultra Performance Liquid Chromatography (UPLC) Nexera X2 and Mass Spectrometry (MS/MS) Shimadzu 8060.

Amino acid analysis

Sample and standard solution preparation was carried out according to literature methods (Waters, 2012). Amino acid content was determined by using Ultra Performance Liquid Chromatography condition as follow: Flow rate (0.5 ml per minute); column (AccQ Taq Ultra C18 1.7 µm (2.1 x 100 mm); temperature (49°C); mobile phase (mobile phase A = Eluent A Concentrate AccQ Taq Ultra from Waters (Part No. 186003838), mobile phase B = 10% mobile phase D; mobile phase C = Aquabidest and mobile phase D = Eluent B AccQ Taq Ultra from Waters (Part No. 186005859); detector (FDA, wavelength 260 nm) and injection volume (1 µl).

Sample preparation: A total of 0.1 g sample was added 5 ml HCl 6N and then hydrolysed for 22 hours at temperature 110°C. The hydrolysed mixture was cooled and transferred into volumetric flask 50 ml and then diluted to volume with aquadest. The solution was filtered with a 0.45 µm filter. A 500 µl filtrate was added 40 µl AABA and 460 µl aquabidest. 10 µl of the solution was added 70 µl AccQ Fluor Borate and 20 µl reagent fluor A and then vortexed for 1 minute. The solution was incubated for 10 minutes at 55°C and then injected into UPLC system.

Preparation for a standard solution: A 40 µl standard solution was mixed with an amino

acid. 40 µl internal standard AABA and 920 µl aquabidest were added and then homogenized. 10 µl of standard solution and 70 µl AccQ Fluor Borate were added and then vortexed. The 20 µl reagent fluor A was added and then vortexed. The solution was incubated for 10 minutes at 55°C and injected into UPLC system.

Fatty acid analysis

Fatty acid analysis was carried out by using gas chromatography (Perkin Elmer Clarus 580 GC). The apparatus condition was used as follow: Flow rate (18.0 cm/sec with column length 100 m); column (Superco SPTM 2560 100 m 0.25 mm 0.2 µm); carrier gas (N₂); detector FID (240°C); injector temperature (220°C) and split (1:100).

Sample preparation for fat extraction was carried out according to AOAC standard method (AOAC, 2000). A total of 5 g sea cucumber *S. ocellatus* was added with 4 ml isopropanol and 6 ml n-hexane and then the solution was shaken for 1 minute. The solution was subsequently centrifuged for 3 minutes at 9000 RPM. The supernatant was moved into a Hach tube and dried in a water bath. Approximately, 0.03 – 0.04 g of the fat extract was added 1.5 ml KOH methanol 0.5 M. The solution was heated in a water bath at 100°C for 20 minutes and then cooled. Subsequently, 1.5 ml of BF₃ 20% in methanol was added and then heated in a water bath at 100°C for 20 minutes. The solution was cooled down to 30°C while shaken and then was added with 3 ml of saturated NaCl and 0.2 ml of n-hexane was added. The n-hexane methyl ester layer was transferred into 10 ml volumetric flask, diluted with n-hexane and the injected to gas chromatography system.

RESULTS AND DISCUSSION

Proximate composition

The proximate analysis results, including moisture, ash, protein fat and carbohydrate content of the sea cucumber *Stichopus ocellatus* collected from Belitung waters are shown in table 1. It is found that the moisture content of the sample was about 70.06% based

on the wet weight. Chang-Lee *et al.* (1989) reported that the moisture content of organisms can be influenced by several factors, such as geographical variations, feeding, behaviour, the collection time of the year and environmental factors. In general, if compare to other fishes and shellfishes, the fresh body wall of sea cucumbers contain higher moisture (Lee *et al.*, 2012). On the other hand, the high moisture content of sea cucumber was deemed as a tonic by fisherman (Wen *et al.*, 2010).

Apparently, most of the fresh sea cucumber have the high moisture content in high value. Previous study showed that the moisture content of several fresh sea cucumbers is also in the high value, such as *Holothuria tubulosa* (84.3%), *H. mammata* (85.24%) and *H. polii* (81.24%) (Aydin *et al.*, 2011). *Apostichopus japonicus* were in the range of 84% to 91% (Lee *et al.*, 2012; Gao *et al.*, 2016), *Parastichopus* sp. (89% to 90%) (Chang-Lee *et al.*, 1989), *Acaudina molpadioides* (76.97%) and *Thelenota ananas* (87.83%) (Chen, 2003), *Cucumaria frondosa* (87% to 90%) (Zhong *et al.*, 2003), *Isostichopus* sp. (83% to 86%) (Drazen *et al.*, 2008; Vargara and Rodriguez, 2016), *Actinopyga mauritiana* (76.54% to 84.71%) (Omran, 2013; Haider *et al.*, 2015), *H. arenicola* (72.12%) (Haider *et al.*, 2015), *H. scabra* (84.49% to 87.21%) (Ozer *et al.*, 2014; Omran, 2013 and Al Azad *et al.*, 2017), *H. edulis* (85.56%) (Al Azad *et al.*, 2017), *Bohadschia marmorata* (83.17%) (Omran, 2013), *H. arenicola* (68.49%) and *H. parva* (67.92%) (Salarzadeh *et al.*, 2012), *H. leucospilota* (81.41% to 88.4%) (Svelashev, 1991; Omran, 2013), *B. argus* (91.4%), *H. impatiens* (83.1%), *H. pardalis* (85.5%), *H. atra* (85.8%), *H. moebii* (86.8%), *S. chloronotus* (94.3%), *Euapta godeffroyi* (84.2%) and *Pearsonothuria graeffei* (89.3%) (Svelashev *et al.*, 1991), *H. nobilis* (76.05%) (Oedjoe, 2017).

The ash content may due to the mineral deposit and other organic matter in sea cucumbers (Al Azad *et al.*, 2017). The ash content of our sample was found in the range value of 21.04% based on wet weight.

TABLE 1. Proximate composition of sea cucumber *Stichopus ocellatus*

No	Parameter	Result (%)
1	Moisture content	70.06
2	Ash content	21.04
3	Protein content	6.64
4	Fat content	0.84
5	Carbohydrate content	1.42

This result is higher than the reported values in some other species, such as *H. polii* (7.85%), *H. mammata* (5.13%) and *H. tubulosa* (5.13%) (Aydin *et al.*, 2011), *Isostichopus* sp. (3.16% to 3.81%) (Vergara and Rodriguez, 2016), *A. japonicas* (2.99% to 3.30%) (Gao *et al.*, 2016). Apparently, the differences in the levels of ash in sea cucumbers are also influenced by the species and the living environments of sea cucumbers.

The protein content of the sea cucumber of *S. ocellatus* was observed to be ~6.64% wet weight. The result was higher than other species reported in the previous study namely *H. scabra* (5.45% to 5.78%) (Ozer *et al.*, 2004); Al Azad *et al.*, 2017), *Isostichopus* sp. (2.74% to 6.63%) (Vergara and Rodriguez, 2016), *Parastichopus* sp. (2.5%) (Chang-Lee *et al.*, 1989) and *Apostichopus japonicas* (1.13% to 5.40%) (Lee *et al.*, 2012; Gao *et al.*, 2016), but lower than *H. edulis* (7.48%) (Al Azad *et al.*, 2017), *H. tubulosa* (8.82%), *H. polii* (8.66%), *m* and *H. mammata* (7.88%) (Aydin *et al.*, 2011), *H. arenicola* (24.37%) and *H. parva* (17.61%) (Salarzadeh *et al.*, 2012), *A. molpadioides* (12.94%) and *T. pineapple* (16.64%) (Chen, 2003).

The fluctuation of the protein content in sea cucumbers may be influenced of the seasonal variation, the life cycle of the species, the geographical aspects and the physiological characteristics (Ozer *et al.*, 2004). Aydin *et al.* (2011) also reported that the seasonal variation could have influenced of the chemical composition of sea cucumbers.

The fats content of sea cucumbers is influenced by the temperature of their living habitat, in which, the constant temperature gives more higher fat content than those under corresponding fluctuation temperature (Dong *et*

al., 2006). Other factors that might influence the variation of the fat content in sea cucumbers are the type of species, reproductive, feed and feeding pattern as well as on environmental conditions (Lee *et al.*, 2012).

It is found that the sample of *S. ocellatus* contained 0.84% wet weight of fat. The previous studies also reported that sea cucumbers have a very low in fat content, such as *H. arenicola* (2.88%) and *H. parva* (2.43%) (Salarzadeh *et al.*, 2012), *A. japonicas* (0.28% to 0.33%) and *S. japonicas* (0.56% to 2.3%) (Lee *et al.*, 2012), *H. scabra* (0.17% to 0.37%) (Ozer *et al.*, 2004), *H. polii*, *H. mammata* and *H. tubulos* was 0.15%, 0.18% and 0.09 respectively (Aydin *et al.*, 2011), *Isostichopus* sp. (0.07% to 2.4%) (Vergara and Rodriguez, 2016), *T. ananas* (0.27%) and *A. molpadioides* (0.03%) (Chen, 2003).

The carbohydrate content examined in this study was about 1.42%. The results of the previous studies reported that the fresh sea cucumbers have very low carbohydrate contents, such as *H. nobilis*, *H. scabra*, *H. atra*, *H. edulis*, *H. impatiens*, *H. leucospilota*, *A. lecanora* dan *Bohadschia argus* were 0.56%, 0.45%, 0.87%, 1.14%, 1.37%, 2.12%, 2.31% and 1.89% respectively (Oedjoe, 2017) and *A. japonicus* was 0.2% to 0.6% (Gao *et al.*, 2011; Jiang *et al.*, 2013).

Mineral composition

TABLE 2. Mineral composition of sea cucumber *Stichopus ocellatus*

No	Parameter	Result (mg/100 g)
1	Sodium	7622.61
2	Calcium	2105.73
3	Potassium	134.97
4	Iron	5.65
5	Phosphor	1537.10
6	Magnesium	560.63

The information about the mineral content in sea cucumbers is still very limited. Minerals are important components of enzymes, hormones and enzyme activators. Some minerals are essential for people such as magnesium, sodium, phosphor and calcium, in

which, they are important in terms of the nutritional point of view (Gocer *et al.*, 2018).

Sodium (7622.61 mg/100 g) was found as the major component evaluated in this study, followed by calcium, phosphor, magnesium, potassium, and iron was 2105.73 mg/100 g, 1537.10 mg/100 g, 560.63 mg/100 g, 134.97 mg/100 g and 5.65 mg/100 g respectively. Haider *et al.* (2015) also reported out that sodium has been reported in the major quantities in sea cucumber *A. mauritiana*.

Barzkar *et al.* (2017) reported that magnesium is the major component in the sea cucumber *H. arenicola*, while iron is the major component in the sea cucumber *S. horrens*. Calcium is reported as the major component evaluated in the sea cucumber *H. sanctori* (Gocer *et al.*, 2018), *H. arenicola* (Haider *et al.*, 2015), *Parastichopus californicus* (Bechtel *et al.*, 2012),

Based on those results and the results of previous studies indicated that the difference in the dominant mineral content in sea cucumbers is influenced by the different types of sea cucumbers. In general, the macro minerals levels of seafood may be expected to be influenced by age, maturity, season, spawning cycle, water temperature and availability of food, feeding system of organism and types of diet (Olgunoglu and Olgunoglu, 2017).

Vitamin content

TABEL 3. Vitamin content of sea cucumber *Stichopus ocellatus*

No	Parameter	Result (mg/100 g)
1	Vitamin A	nd
2	Vitamin B1	nd
3	Vitamin B2	0.02
4	Vitamin E	0.32
5	Vitamin B12	nd

Note ; nd = not detected

Vitamin A, B1, B2, E and B12 were examined in this study. The results showed that sea cucumber of *S. ocellatus* contained vitamin B2 and E, while vitamin A, B1 and B12 were not detected. Vitamin B2 was also reported in the *Acaudina molpadioides* and *Thelenota ananas* (Chen, 2003) and *S. vastus* (Ardiansyah and Rasyid, 2016), while vitamin E was detected in

the *A. japonicas* (Weng *et al.*, 2013), *A. molpadioides* and *T. ananas* (Chen, 2003) and *H. scabra* (Sroyraya *et al.*, 2017). Vitamin A and B1 was reported in the sea cucumber *S. vastus* (Ardiansyah and Rasyid, 2016) and *A. molpadioides* and *T. ananas* (Chen, 2003), Vitamin C was reported in the sea cucumber *H. scabra* (Sroyraya *et al.*, 2017), while vitamin B3 was detected in the sea cucumber *A. molpadioides* and *T. ananas* (Chen, 2003).

Fatty acid profile

The majority of fatty acid obtained in *Stichopus ocellatus* is found to be SFA (Saturated Fatty Acid) followed by MUFA (Monounsaturated Fatty Acid) and PUFA (Polyunsaturated Fatty Acid). The fatty acids profile of sea cucumber *Stichopus ocellatus* is shown in table 4

Saturated fatty acid

Palmitic acid is observed to be the major SFA followed by lauric acid, myristic acid, stearic acid, capric acid, caprylic acid, heptadecanoic acid, arachidic acid, heneicosanoic acid, behenic acid and lignoseric acid respectively. Similar to the previous study, palmitic acid is the major SFA in *S. hermanni*, *Thelenota anax*, *T. ananas*, *Bohadschia argus*, *Holothuria fuscunctata*, *H. fuscogilva* and *Actinophyga caerutes* (Wen *et al.*, 2010), *H. polii* (Sicuro *et al.*, 2012), *H. atra*, *H. leucospilota*, *H. impatiens*, *H. moebii*, *H. pardalis*, *A. lecanora*, *Pearsonothuria graeffei*, *S. chloronotus* and *Euapta godeffroyi* (Svelashev *et al.*, 1991), *A. mauritiana* (Omran, 2013), *H. scabra* and *H. edulis* (Al Azad *et al.*, 2017), *Parastichopus californicus* (Bechtel *et al.*, 2013), *H. scabra*, *H. leucospilota* and *H. atra* (Ridzwan *et al.*, 2014).

In the other species, myristic acid was reported to be the major SFA *H. leucospilota*, *H. scabra* and *B. marmorata* (Omran, 2013). Stearic acid was the major SFA in *A. mauritiana* (Wen *et al.*, 2010), *Athyonidium chilensis* (Careaga *et al.*, 2012), *H. tibulosa* (Sicuro *et al.*, 2012), *H. arenicola* (Haider *et al.*, 2015) and *S. horrens* (Fradelina *et al.*, 1999). Capric acid was the major SFA in *A. mauritiana* (Haider *et al.*, 2015), whereas behenic acid was the major

SFA in *H. leucospilota* and *H. scabra* (Yahyavi *et al.*, 2012).

TABLE 4. Fatty acid composition of sea cucumber *Stichopus ocellatus*

No	Parameter	Result (%)
1	C8:0 (caprylic acid)	0.01
2	C10:0 (capric acid)	0.02
3	C12:0 (lauric acid)	0.11
4	C14:0 (meristic acid)	0.07
5	C16:0 (palmitic acid)	0.17
6	C16:1 (palmitoleic acid)	0.05
7	C17:0 (heptadecanoic acid)	0.01
8	C18:0 (stearic acid)	0.09
9	C18:1 (oleic acid)	0.07
10	C18:2 (linoleic acid)	0.02
11	C20:0 (arachidic acid)	0.01
12	C20:1 (eicosenoic acid)	0.05
13	C20:2 (eicosenoic acid)	0.01
14	C20:4 ω 6 (arachidonic acid)	0.14
15	C20:5 ω 3 (eicosapentaenoic acid)	0.01
16	C21:0 (heneicosanoic acid)	0.01
17	C22:0 (behenic acid)	0.01
18	C22:2 (docosadienoic acid)	0.01
19	C22:6 ω 3 (docosahexaenoic acid)	0.01
20	C24:0 (lignoseric acid)	0.01
21	C24:1 ω 9 (nervonic acid)	0.02
22	SFA (Saturated Fatty Acid)	0.52
23	MUFA (Monounsaturated Fatty Acid)	0.19
24	PUFA (Polyunsaturated Fatty Acid)	0.22

Monounsaturated fatty acid

Oleic acid is observed the major MUFA followed by palmitoleic acid, eicosenoic acid and nervonic acid respectively. Similar to the previous study reported by Ozer *et al.* (2004), oleic acid was the major MUFA obtained in *Bohadschia marmorata*, *Holothuria leucospilota*, *H. scabra* and *Actinopyga mauritiana*. In the other species, eicosenoic acid was the major MUFA in *B. argus*, *Stichopus hermanni*, *A. mauritiana*, *H. impatiens*, *H. pardalis*, *H. atra*, *H. leucospilota*, *A. lecanora*, *H. moebii*, *Euapta godeffroy* and *S. chloronotus* (Svelashev *et al.*,

1991). Nervonic acid was the major MUFA obtained in *Athyonidium chliensis* (Careaga *et al.*, 2012).

Palmitoleic acid was the major MUFA in the sea cucumber *H. tubulosa* and *H. polii* (Sicuro *et al.*, 2014), *Parastichopus californicus* (Bechtel *et al.*, 2013), *Pearsonothuria graeffei* and *S. japonicas* (Svelashev *et al.*, 1991), *H. fuscunctata*, *Thelenota anax*, *T. ananas*, *Actinopyga caerulea* and *H. fuscogilva* (Wen *et al.*, 2010), *H. leucospilota*, *H. atra* and *S. horrens* (Ridzwan *et al.*, 2014) and *H. scabra* (Ridzwan *et al.*, 2014; Al Azad *et al.*, 2017). Frigon *et al.*, (2014) stated that the present of palmitoleic acid in the fatty acid composition of marine organisms may be influenced by marine microalgae such as *Phaeoactylum tricorutum* which contain high value of palmitoleic acid. Pentadecenoic acid was the major MUFA obtained in *H. arenicola* and *A. mauritiana* (Haider *et al.*, 2015) and erucid acid was the major MUFA obtained in *H. leucospilota* and *H. scabra* (Yahyavi *et al.*, 2012).

Polyunsaturated fatty acid

Arachidonic acid was the major PUFA examined in this study followed by linoleic acid, eicosadienoic acid, eicosapentaenoic acid, docosadienoic acid, docosahexaenoic acid and lignoseric acid respectively. Similar to the previous study reported that arachidonic acid was the major PUFA obtained in *Bohadschia argus* (Svelashev *et al.*, 1991); Wen *et al.*, 2010), *Holothuria edulis* (Al Azad *et al.*, 2017), *H. atra*, *H. impatiens* and *H. leucospilota*, *H. moebii*, *A. lecanora*, *Pearsonothuria graeffei* and *Stichopus chloronotus* (Svelashev *et al.*, 1991), *A. caerulea*, *S. herrmanni*, *H. fuscogilva*, *Thelenota anax*, *T. anax*, *A. mauritiana* and *H. fuscunctata* (Wen *et al.*, 2010), *H. scabra*, *H. leucospilota*, *S. horrens* and *H. atra* (Ridzwan *et al.*, 2014).

The other PUFA, such as eicosapentaenoic acid was the major PUFA in *S. japonicas* and *Euapta godeffroyi* (Svelashev *et al.*, 1991) and *Parastichopus californicus* (Bechtel *et al.*, 2013). Docosahexaenoic acid was the major PUFA in *H. leucospilota* and *H. scabra*

(Yahyavi *et al.*, 2012). Eicosadienoic acid was the major PUFA obtained in *Athyonidium chilensis* (Careaga *et al.*, 2012). Eicosatrienoic acid was the major PUFA in *H. polii* and *H. tubulosa* (Sicuro *et al.*, 2012). Linoleic acid was the major PUFA in *A. mauritiana* and Cis-5,8,11,14,17-eicosapentanoic in *H. arenicola* (Haider *et al.*, 2015). Linoelaidic acid was the major PUFA in *A. mauritiana*, *H. scabra*, *H. leucospilota* and *Bohadschia marmorata* (Omran, 2013).

Based on the above results, the fatty acid composition is varied due to the variation of the species and the habitat of sea cucumbers (Al Azad *et al.*, 2017). According to Taboada *et al.* (2003), food sources and ambient temperature of different regions could affect the fatty acids composition in the sea cucumbers.

Amino acid profile

It is found that about 16 amino acids were detected in fresh sea cucumber *S. ocellatus*, in which, threonine (3679.77 mg/kg) was found to be the major essential amino acid, followed by leucine (2852.53 mg/kg), valine (2680.13 mg/kg), phenylalanine (2082.56 mg/kg), isoleucine (1824.06 mg/kg), lysine (1632.56 mg/kg), histidine (972.62 mg/kg) and tryptophan (446.49 mg/kg) respectively. It is similar to the previous study which reported that threonine is the major essential amino acid in *Bohadschia argus*, *Thelenota anax*, *T. ananas*, *Stichopus herrmanni*, *Holothuria fuscogilva*, *Actinopyga caerulea* and *H. fuscounctata* (Wen *et al.*, 2010).

In the other species, valine was reported to be the major essential amino acid in *B. marmorata* (Omran, 2013), arginine in *H. tubulosa* and *H. polii* (Sicuro *et al.*, 2012), *H. arenicola* (Haider *et al.*, 2015), *Apostichopus japonicas* (Lee *et al.*, 2012) and *Parastichopus californicus* (Bechtel *et al.*, 2013). Histidine was the major essential amino acid obtained in *H. scabra* and *H. leucospilota* (Omran, 2013). Lysine was the major essential amino acid in *A. mauritiana* (Omran, 2013), whereas leucine in *A. mauritiana* (Haider *et al.*, 2015) and *B. argus* (Wen *et al.*, 2010).

TABLE 5. Amino acid composition of sea cucumber *Stichopus ocellatus*

No	Parameter	Result(mg/kg)
Essential amino acids		
1	Histidine	972.62
2	Isoleucine	1824.06
3	Leucine	2852.53
4	Lysine	1632.56
5	Methionine	nd
6	Phenylalanine	2082.56
7	Threonine	3679.77
8	Tryptophan	446.49
9	Valine	2680.13
Non-essential amino acids		
10	Alanine	4729.41
11	Arginine	4929.05
12	Aspartic acid	6377.70
13	Glutamic acid	9858.82
14	Serine	3238.31
15	Prolife	5449.42
16	Tyrosine	1709.18
17	Glycine	10356.84
18	Cysteine	nd

Note : nd = not detected

The major non-essential amino acid examined in this study was found as glycine (10356.84 mg/kg). It is similar to the previous study which showed glycine as the major non-essential amino acid obtained in *T. ananas*, *S. herrmanni*, *T. anx*, *H. fuscogilva*, *B. argus*, *H. fuscounctata* and *A. caerulea* (Wen *et al.*, 2010), *A. mauritiana*, *H. scabra*, *B. marmorata* and *H. leucospilota* (Omran, 2013), *H. arenicola* and *A. mauritiana* (Haider *et al.*, 2015), *H. polii* and *H. tubulosa* (Sicuro *et al.*, 2012). In the other species, glutamic acid was the major non-essential amino acid obtained in *A. japonicas* (Lee *et al.*, 2012) and *P. californicus* (Bechtel *et al.*, 2013).

CONCLUSION

Sea cucumber of *S. ocellatus* has significant protein content and low-fat content. The sample contains sodium as the major mineral component. Vitamin B2 and vitamin E are also identified in the *S. ocellatus*. The analysis of fatty acids observe that the body wall of *S. ocellatus* contains palmitic acid, oleic acid and arachidonic acid as the major component of

SFA, MUFA and PUFA, respectively. There are 16 amino acids identified in *S. ocellatus*, in which, threonine is found to be the major component of essential amino acid, while glycine is detected as the major component of non-essential amino acid. Therefore, *S. ocellatus* could have potential nutritional value to be used as a healthy food for human in the future.

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