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NUTRITIONAL VALUE AND HEAVY METAL CONTENT OF CRAB MEAT AND ITS BYPRODUCT WHITE MUD CRAB *Scylla paramamosain*

KANDUNGAN NUTRISI DAN LOGAM BERAT DAGING DAN BYPRODUCT KEPITING BAKAU PUTIH Scylla paramamosain

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ABSTRACT

Mud crab is fishery commodity that has high economic value and rich of nutritional aspect such as essential amino acids, vitamins, minerals, and fatty acids. In addition, high concentrations of heavy metals in the natural habitat of crabs can accumulate in these organisms which can endanger health if consumed. However, there is little information regarding the nutritional and heavy metal content of meat and byproducts in mud crab. The objective of the study are to compare the beneficial component of the meat and byproduct of *Scylla paramamosain* and to investigate food safety from heavy metal contamination. Proximate, vitamin A, D, and E content were analyzed using HPLC, vitamin B1, B2, C, and amino acid profile was determined by using UPLC, vitamin B12 was determined by LC-MS, mineral and heavy metal were determined by standard method of AOAC. In addition, the determination of fatty acid was analyzed by gas chromatography. Result showed that protein per gram as the majority content of each form (10.24% in crab meat and 12.47% in byproduct). Vitamin B2, B12, and E were detected in sample. On contrary, heavy metals examined in this study were not detected. L-Glutamic acid was the most abundant of amino acids composition (11037.79 mg/kg of crab meat and 15993.22 mg/kg of byproduct), while omega-3 fatty acids, omega-6 fatty acids, and omega-9 fatty acids are also contained in this species. The result showed *Scylla paramamosain* as source of beneficial food and safe to consume.

Keywords: heavy metal, nutritional, proximate, *Scylla paramamosain*

ABSTRAK

Kepiting bakau merupakan komoditas perikanan yang memiliki nilai ekonomi tinggi dan kaya akan aspek gizi seperti asam amino esensial, vitamin, mineral, dan asam lemak. Tingginya konsentrasi logam berat di habitat alami kepiting bakau dapat terakumulasi dan membahayakan kesehatan apabila dikonsumsi. Namun demikian, informasi mengenai kandungan nutrisi dan logam berat dari daging dan produk sampingan pada kepiting bakau masih terbatas. Tujuan dari penelitian ini adalah untuk membandingkan komponen bermanfaat dari daging dan produk sampingan Scylla paramamosain serta untuk menyelidiki keamanan pangan dari kontaminasi logam berat. Analisis kadar proksimat, Vitamin A, D, dan E menggunakan HPLC, kadar vitamin B1, B2, C, dan profil asam amino ditentukan dengan menggunakan UPLC, vitamin B12 ditentukan dengan menggunakan LC-MS, mineral dan logam berat ditentukan dengan metode standar AOAC. Selain itu, asam lemak dianalisis dengan kromatografi gas. Hasil penelitian menunjukkan bahwa protein per gram sebagai mayoritas kandungan masing-masing bentuk (10,24% dalam daging kepiting dan 12,47% dalam produk sampingan). Vitamin yang terdeteksi dari sampel adalah vitamin B2, B12, E. Sebaliknya, logam berat yang di analisis dalam penelitian ini tidak terdeteksi. Asam L-Glutamat adalah komposisi asam amino yang paling melimpah (11037,79 mg/kg daging kepiting dan 15993,22 mg/kg produk sampingan). Selain itu, asam lemak omega-3, asam lemak omega-6, dan omega- 9 asam lemak juga terkandung dalam spesies ini. Hal ini menunjukkan bahwa Scylla paramamosain merupakan sumber pangan yang bermanfaat dan aman untuk dikonsumsi.

Kata kunci: *logam berat, nutrisi, proksimat, Scylla paramamosain*

I. INTRODUCTION

Mud crab is a commodity that has high economic value and potential for cultivation. The number of local and international market demands for mud crabs is increasing from year to year (Harisud *et al*., 2019). Included in Indonesia, Mud crab (*Scylla* spp.) is also one of the high economic fishery commodities. The extent of marketing and the high selling value of mangrove crabs make the business grow (Sunarto *et al*., 2015). Mud crabs are much in demand due to their highly delicate flavor and meat content, thus supporting the economy of the fresh water-fishery industry around the world (Yusof *et al*., 2020). Proven by the export value of fishery products report in 2020, it illustrates that there is an increase in the export value of crab commodities, in 2016 USD 321,846,423 and in 2020 USD 367,519,713 (KKP, 2020).

Mud crab is known have nutrition that beneficial for human health. It contained high protein, low fat, and high polyunsaturated fatty acids (Wu *et al*., 2019; Nanda *et al*., 2021). Many studies have been reported about nutritional value in mud crab. For instance, the effect of salinity and rearing period in different gender on nutritional value (Wu *et al*. 2019) and effect of light on biochemical compositions (Farhadi *et al*. 2021). In addition, a lot of studies of proximate analysis from various crab species (Yusof *et al*., 2019). Crabs from the genus *Scylla* are reported have microbial and antioxidant activities whose applications can be utilized in the pharmaceutical, cosmetic, and other biomedical fields (Yusof *et al*., 2017; 2019).

The beneficial components investigation of food is very important such as the proximate analysis. This method is used for determining nutrient and it can be implemented in the aquaculture products (Yusof *et al*., 2019). Likewise, other important values such as fatty acid and amino acid compositions should be analyzed. Jiang *et al*. (2014) have been developed method for evaluating protein content. The fatty acids are classified into three categories, including saturated fatty acids, monounsaturated fatty acids, and polyunsaturated fatty acids (Wang *et al.*, 2021a). Some of fatty acid such as linoleic acid and linolenic cannot be synthesized by human body and must be provided from the diet (Jiang *et al*., 2014).

Mud crabs are living (spawning, nursery, and feeding ground) in the mangrove ecosystems (Sunarto *et al.*, 2015). That ecosystem is influenced by anthropogenic activities, urban sewage, industrial effluents, agricultural run-off, port activities, mining, etc (Dudani *et al*., 2017). Many kinds of pollutants released from these activities for instance heavy metals can contaminated sediments and they will accumulate in organisms and enter the human body through food chain (Shakeri & Moore, 2010; Doğanlar & Atmaca, 2011).

Therefore, high attention is needed to this study because there is an accumulation of heavy metals in the mangrove ecosystems reported in numerous countries including Indonesia (Hamzah & Setiawan, 2010) and there is less information about bioaccumulation levels of the harmful heavy metals in mud crabs (Ateshan *et al*., 2018).

These information correlations not only make the nutritional investigation as only one important review in this study but also heavy metals issue that may contain in the crab's body that would cause endanger human health. The aim of this study are to compare the beneficial component of the meat and byproduct of *Scylla paramamosain* and to investigate food safety from heavy metal contamination.

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II. RESEARCH METHODS

2.1. Sample Collection and Preparation

The materials used in this study consisted of crabs, *Scylla paramamosain* as the main ingredients with local name kepiting bakau putih, purchased from the

Pademangan fish market, North Jakarta in December 2018. The sample then separated into the meat and byproduct then weighed 500 grams each and stored in the freezer before testing.

2.2. Proximate Analysis

Proximate compositions of meat crab and byproduct was analyzed as follows. The percentage moisture content was analyzed by drying 2 g mud crab *S. paramamosain*. Then it was heated for 8 hours and put into an oven at 100°C. After that, reweighed the dried sample by putting it into a desiccator after allowing it to cool (AOAC, 1980). Percentage ash content was analyzed by heating mud crab *S. paramamosain* in a muffle furnace at 550°C for 24 hours until it turned white, freely of carbon. Reweighed immediately after the sample was removed from the furnace and after cooled in a desiccator to room temperature (AOAC, 1980). The percentage of fat content was analyzed by loosely wrapping 2 g mud crab *S. paramamisain* with a filter paper. After that, put into the thimble which was fitted to a clean round bottom flask. Soxhlet extraction process was carried out with hexane solvent for 24 hours. After that spent samples were kept and weighed (AOAC, 1980). The percentage of protein was determined by calculating the elemental N determination using the nitrogen-protein conversion factor of 6.25 (AOAC, 1980). The differences of all weight results would be an estimation of carbohydrate composition: 100 % – (moisture + ash + protein + fat) %. The samples are measured in triplicate at each analysis.

2.3. Vitamins, Minerals, and Heavy Metal Analysis

Vitamin A, D, and E content was analyzed by High-Performance Liquid Chromatography (HPLC) Alliance Waters, using PDA detector with Li Chrospher column (100 RP-18 (5um) 4 mm x 250 mm) using total 10 g sample for each analysis. On the other hand, Vitamin B1, B2 content (total 3 g sample used) and Vitamin C content (total 1 g sample used) were analyzed by Ultra Performance Liquid Chromatography (UPLC) H Class Waters, using PDA detector with ACQUITY UPLC BEH Amide 1.7 um 2.1 x 100 mm column. Vitamin B12 (total 3 g sample used) was analyzed using LC-MS. Minerals content including magnesium (Mg), iron (Fe), calcium (Ca), potassium (K) was analyzed by the standard AOAC method by ICP-OES using total 10 g sample for each analysis. Iodine was analyzed based on AOAC Official Method 992.22 and Waters Ion Analysis Method by HPLC using 5 g sample. Taurine was analyzed based on AOAC 997.05.2001 method by HPLC using 1 g sample. The heavy metals content (Hg and Pb) was analyzed by the standard AOAC method (1990) by ICP-OES using 2 g sample for each analysis. The samples are measured in triplicate at each analysis.

2.4. Amino Acid Composition

The Amino acid composition with total 0.1 g sample used was analyzed using Ultra Performance Liquid Chromatography (UPLC) The apparatus condition was as follow: Detector (PDA, wavelength 260 nm); Temperature (49 ºC); Column (AccQ Tag Ultra C18 1.7 µm (2.1 x 100 mm), Waters); Mobile phase (Gradient composition system); Flow rate (0.5 ml/minute); Injection volume (1 µL). The samples are measured in triplicate at each analysis (Waters, 2012).

2.5. Fatty Acid Composition

Fatty acid composition with total 5 g sample used was determined by gas chromatography (GC) with the following conditions. Flow rate was setting into 18.0 cm/second using column (Supelco SPTM 2560 0.25 mm 0.2 µm, length 100 m). Nitrogen (N_2) was used as carrier gas, injector temperature was set 225 °C, using detector FID 240 °C and split condition (1:100). The samples are measured in triplicate at each analysis (AOAC, 2000).

2.6. Data Analysis

All data were processed using Microsoft Excel and analyzed using descriptive analysis.

III. RESULTS AND DISCUSSION

3.1. Proximate Composition

Mud crab is a good source of protein for marine life as well as human diet. It is important to have the information of mud crabs' nutritional components since the demand is increasing as one of the featured fisheries products. Respectively, the percentages of moisture, ash, protein, carbohydrates, and fat of *S. paramamosain* according to their source are presented in Table 1.

As shown in Table 1, the moisture content in the crab byproduct is higher than in crab meat. In comparing to other studies, the moisture content in crab meat is lower than *S. paramamosain* that has been found in China. They have been reported that moisture in *S. paramamosain's* muscle were 79.7% in Bohai Sea, 77.1% in East China Sea, and 77.7 in South China Sea (Wang *et al*., 2021a). Another study showed that the moisture content in the muscle female mud crab was 76% (Wang *et al*., 2021b).

The ash content in crab meat fourteen times higher than in crab byproduct. The ash content in crab byproduct almost similar with the ash content in Bohai Sea and East China Sea (1.63%) (Wang *et al*., 2021a) and 1.78% ash content was reported in the muscle female mud crab (Wang *et al.*, 2021b).

The percentage of protein content per gram of each form (10.24% in crab meat and 12.47% in byproduct) are lower than protein content in the muscle's *S. paramamosain* in Bohai Sea (15.1%), East China Sea (17.9%), and South China Sea (16.8%) (Wang *et al*., 2021a). Another study by Wang *et al*. (2021) showed that 19.91% protein content in muscle female *S. paramamosain*. Beside that. the lipid content in China's crab were higher (0.665%-0.85%) than our study (Wang *et al*., 2021b). Meanwhile, the protein content is relatively higher than two other component aspects (carbohydrate and fat). In other words, dominating protein content in the result was proving the reason why protein content is the primary value in this species. However, the research by Yusof (2020), the nutritional component content of *S. paramamosain* are 2.32% carbohydrate, 12.53% protein, and 0.23% fat. These results explained that protein is the main composition of the three macromolecules in muscle tissues of *S. paramamosain*. It has been assumed that the amount of protein content detected is indeed in the range of these values. This is supported by Sreelakshmi *et al*. (2016) research on other two mud crab species (*S. serrata* and *S. tranquebarica*) shows that the lowest protein content is 10.27% of male *S. serrata*'s claw and 17.63% of female *S. tranquebarica*'s body.

Reviewing the low-fat content of each result shows that mud crab acts as an excellent diet due to its balance nutrient content and delicious seafood. Nevertheless, storage condition and its preparation process like extraction on mud crabs could affect nutritional value (Ninlanona & Tangkrock-Olan, 2008). In addition, ovarian maturation

Table 1. Proximate composition of *Scylla paramamosain*.

No.	Nutrient Component	Crab Meat (%)	Crab Byproduct (%)
1	Moisture	56.15	84.20
2	Ash	25.88	1.82
3	Protein	10.24	12.47
4	Carbohydrate	7.35	0.37
5	Fat	0.38	1.14

process of the female crabs is influenced by fat. It plays role as a source of energy, supply essential fatty acids and fat-soluble vitamins (Azra & Ikhwanuddin, 2015).

3.2. Vitamins and Minerals Content

It has been reported that mud crab are also a source of vitamins and minerals. In this study, we evaluated the content of vitamins A, B1, B2, B12, C, D, and E in each sample in form of meat and byproduct as shown in Table 2. There are vitamins contained of the tested sample such as vitamin B2, vitamin B12 and vitamin E that found on crab meat while only vitamin B12 and vitamin E found in crab byproduct. Similar to previous research on another mangrove crab species, vitamin A, C, D, E, K, B6 and B12 were detected in the *Sesarma breckii* yet vitamin B1 and B2 were not detected (Sakthivel *et al*., 2014).

Meanwhile, the mineral content as shown in Table 3, Calcium (Ca) is the highest mineral content and Iron is the lowest mineral content on crab meat sample. This result is different with *Scylla paramamosain* from China Sea that shown that Potassium was the highest content in the muscle crab (Wang *et al*. 2021a; 2021b). Calcium and Magnesium are significantly higher than *Scylla paramamosain* in China Sea. Calcium and Magnesium contents were 59.9 and 35.5mg/100g in Bohai Sea, 54.99 and 36.5 mg/100g in East China Sea, and 47.8 and 25.29 mg/100 g in South China Sea. However, Potassium content in our study is lower than in China Sea (342, 358, and 277 mg/100 g). The Iron content in China sea (3.04, 2.98, and 1.6 mg/100 g) were lower than our study (Wang *et al*., 2021a).

On byproduct sample, Taurine was the highest mineral content followed by Calsium, Potassium, Magnesium, Iodin, and Iron. In general review, the mineral content on crab meat has relative higher than byproduct sample.

In another mangrove crab's tissue (*Sesarma breckii*), there are seven mineral content were detected. Totally, Calcium (209.3 mg/100 g) was the highest mineral content followed by Potassium (115.3 mg/100 g), Sodium (36.4 mg/100 g),

Table 2. Vitamin content of *Scylla paramamosain*.

No.	Nutrient Component	Crab Meat	Crab Byproduct
1	Vitamin A (mcg/100 g)	nd	nd
2	Vitamin B1 (mg/100 g)	nd	nd
3	Vitamin B2 (mg/100 g)	0.24	nd
4	Vitamin B12 (mcg/100 g)	1.80	11.20
5	Vitamin C (mg/100 g)	nd	nd
6	Vitamin D (mcg/100 g)	nd	nd
7	Vitamin E (mg/100 g)	1.60	3.71

*nd: not detected

Table 3. Mineral content of *Scylla paramamosain*.

No.	Nutrient Component	Crab Meat	Crab Byproduct
1	Magnesium (mg/100 g)	1192.24	48.32
2	Iron (mg/100 g)	9.12	7.18
3	Potassium (mg/100 g)	142.34	202.98
4	Calsium (mg/100 g)	12811.96	261.59
5	Iodine (mcg/100 g)	21.28	8.37
6	Taurine (mg/kg)	570.15	3481.11

Magnesium (21.8 mg/100 g), Iron (3.2 mg/100 g), Zinc 1.67 (mg/100 g) and the lowest mineral content was Copper (1.4 mg/100g) (Sakthivel *et al*., 2014). The differences in vitamin or mineral content in each species may be affected by various factors. Generally, the chemical composition of marine organisms could be triggered by several factors such as environmental conditions, physiological characteristics, life cycle, and habitat (Diniz *et al*., 2012).

3.3. Heavy Metal Content

The investigation of heavy metals content in this species according to their product form is presented in Table 4. Referring to BSN (The National Standardization Agency of Indonesia) for the allowable maximum contamination of heavy metals in food, and the Department of Health and Human Services, Public Health Service, FDA (Food and Drug Administration of United State), all the non-essential metals (Hg and Pb) in the crab meat and byproduct form were below the allowed limits for human consumption (NSAI, 2009; US, 2019). Therefore, it can be concluded that *S. Paramamosain* in each form product in this study was safely consumed.

Compared to previous study in *Scylla paramamosain* muscle male, it contained non-essential metals but still under the safety requirements; Lead (Pb) 0.089 (mg/kg dry weight) and Mercury (Hg) 0.135 (mg/kg dry weight) (Jiang *et al*., 2014). In addition, compared to other crab species (*Eriocheir sinensis)* in China, the mercury and lead content were ranged 0.018-0.061 mg/kg and 0.046-0.42 mg/kg, respectively (Wang *et al*., 2021c). Mercury and lead are non-essential metals that are potentially harmful to organisms if their concentrations exceed the threshold. This metal has no role and function in crustacean metabolism (Ateshan *et al*., 2018).

3.4. Amino Acid Composition

The result of amino acids investigation in this species according to their product form is presented in Table 5. It reveals ten essential and eight non-essential amino acid as the review-targeted aspects. Referred to the table, the most abundant of essential amino acids is L-Lysine in each form product, 5299.34 mg/kg of crab meat and 9177.98 mg/kg byproduct. In comparison to study by Wang *et al*. (2021a), it was found that Arginine was the most abundant. The Arginine in the muscle of Bohai Sea, East China Sea, and South China Sea were 12700, 13800 and 15100 mg/kg, respectively. In our study, the highest amino acid is L-Glutamic acid from the non-essential amino with 11037.79 mg/kg of crab meat and 15993.22 mg/kg of byproduct. The result is similar with previous studied that glutamic acid was the most abundant in *Scylla paramamosain* muscle (25700 mg/kg in East China Sea) (Wang *et al*., 2021a) and 26100 mg/kg in Guangdong beach (Wang *et al*., 2021b).

Another study reported that glutamic acid is also the most abundant of non-essential content in every form of sample (male muscle, female muscle, female hepato-pancreas, male hepato-pancreas, and ovary) in *Scylla paramamosain* (Jiang *et al*., 2014). In the function of many organ systems, numerous pieces of evidence show the importance of glutamine. Glutamic acid is an amino acid functionally used on forming proteins and it turns into glutamate in the body system, a chemical that can help nerve

Table 4. Heavy metal content of *Scylla paramamosain.*

No.	Nutrient Component	Crab Meat	Crab Byproduct
1	Mercury (Hg)	nd	nd
2	Lead (Pb)	nd	nd

*nd: not detected

Table 5. Amino acid composition of *Scylla paramamosain*.

No.	Amino acid	Crab Meat (mg/kg)	Crab Byproduct (mg/kg)
	Essential		
1	L-Threonine	3328.76	5623.13
2	L-Leucine	4340.08	7226.74
3	L-Lysine	5299.34	9177.98
4	L-Arginine	3660.57	8240.31
5	L-Valine	3705.86	4692.47
6	L-Isoleucine	2648.59	4497.14
7	L-Phenilalanine	2683.45	3904.27
8	L-Methionine	nd	1462.74
9	L-Histhiodine	1560.32	2549.36
10	L-Tryptophan	330.28	956.76
	Non Essential		
1	L-Proline	3093.67	3906.06
2	L-Tyrosine	1649.31	3250.93
3	L-Aspartic acid	7428.58	9012.57
4	Glysine	5271.42	8065.12
5	L-Alanine	5233.58	6630.36
6	L-Glutamic acid	11037.79	15993.22
7	L-Serine	3030.53	4106.61
8	L-Sistine	nd	nd

*nd: not detected

cells in the brain send and receive information from other cells that may be involved in learning such as memorizing. Previous researched has reported that glutamic acid plays a role in lowering blood pressure. This is proven by people who consume more glutamic acid have lower blood pressure compared to others (Dutta *et al.*, 2013).

3.5. Fatty Acid Composition

The contained fatty acid compositions in each form sample of *Scylla paramamosain* are shown in Table 6. Based on the table, the most various fatty acid was shown in the crab meat sample. As precursors and critical elements within metabolic pathways, fatty acids may work additively, individually, or synergistically which actively influences and/or alters the systematic of membrane fluidity, cell structure, and disease pathogenesis (Johnson & Bradford, 2014). Among all of fatty acids, the most dominant fatty acids were unsaturated fats in crab meat with 0.7508%. Some fatty acids were not detected in each tested sample, such as Caproic acid, Capric acid, Undecanoic acid, Lauric acid, Heneicosanoic acid, Lignoceric acid, Erucic acid, T-Linoleic acid, Linolenic acid, and Eicosatrienoic acid. Overall, the fatty acids contents in crab meat was higher than in crab byproduct.

In this study, omega-6 fatty acid was found by 0.3530 % in crab meat 0.0947 % in byproduct. The omega-6 fatty acid has the potential to influence some chronic diseases, atherosclerosis and cardiovascular disease (Mori & Hodgson, 2013). Another family of unsaturated fatty acids like omega-3 found in this result was 0.1890% in crab meat and 0.0768% in byproduct. Included docosahexaenoic acid (DHA, 0.0682% in crab meat) and eicosapentaenoic acid (EPA, 0.1054% in crab meat), omega-3 fatty acids are naturally revealed in fish oil and have a function to be anti-inflammatory nutrients

Table 6. The fatty acid composition of *Scylla paramamosain*.

No	Fatty acid Composition	Crab Meat (%)	Crab Byproduct (%)
1	Saturated Fatty acid	0.3897	0.1322
2	C 4:0 (Butyric acid)	nd	0.002
3	C 6:0 (Caproic acid)	nd	nd
4	C 8:0 (Caprylic acid)	nd	0.00144
5	C 10:0 (Capric acid)	nd	nd
6	C 11:0 (Undecanoic acid)	nd	nd
7	C 12:0 (Lauric acid)	nd	nd
8	C 13:0 (Tridecanoic acid)	nd	0.0017
9	C 14:0 (Myristic acid)	0.0146	0.0078
10	C 15:0 (Pentadecanoic acid)	0.0082	nd
11	C 16:0 (Palmitic acid)	0.1826	0.0725
12	C 17:0 (Heptadecanoic acid)	0.0263	0.0061
13	C 18:0 (Stearic acid)	0.1447	0.0403
14	C 20:0 (Arachidic acid)	0.0042	nd
15	C 21:0 (Heneicosanoic acid)	nd	nd
16	C 22:0 (Behenic acid)	0.0055	nd
17	C 23:0 (Tricosanoic acid)	nd	0.00143
18	C 24:0 (Lignoceric acid)	nd	nd
19	Unsaturated fatty acid	0.7508	0.2488
20	Monounsaturated fatty acid	0.193	0.0733
21	C 14:1 (Myristolic acid)	nd	0.00167
22	C 15:1 (Pentadecenoic acid)	nd	0.00164
23	C 16:1 (Palmitoleic acid)	0.0282	nd
24	C 17:1 (Heptadekenoic acid)	0.0104	nd
25	C 22:1 (Erucic acid)	nd	nd
26	C 18:1 w9C (C-oleic acid)	0.1314	nd
27	C 18:1 w9C (T-Oleic acid)	nd	0.00151
28	C 20:1 (Eicocenoic acid)	0.005	nd
29	C 24:1 w9 (Nervonic acid)	0.0165	0.00164
30	Polyunsaturated fatty acid	0.5578	0.1755
31	C 18:2 w6C (C-Linoleic acid)	0.0816	0.03
32	C 18:2 w6T (T-Linoleic acid)	nd	nd
33	C 20:2 (Eicosadienoic acid)	0.0131	nd
34	C 22:2 (Docosadienoic acid)	0.0026	nd
35	C 18:3 w3 (Linolenic acid / w3)	0.0137	0.0041
36	C 18:3 w6 (Linolenic acid / w6)	nd	nd
37	C 18:3 w6C (C-Linolenic acid)	0.0146	nd
38	C 20:3 w3 (Eicosatrienoic acid / w3)	nd	nd
39	C 20:3 w6 (Eicosatrienoic acid / w6)	0.0052	nd
40	C 20:4 w6 (Arachidonic acid) AA	0.2653	0.0647
41	C 20:5 w3 (Eicosapentaenoic acid) EPA	0.1054	0.041
42	C 22:6 w3 (Docosahexaenoic acid) DHA	0.0682	0.0317
43	Omega-3 Fatty acids	0.189	0.0768
44	Omega-6 Fatty acids	0.353	0.0947
45	Omega-9 fatty acids	0.1314	0.0616

*nd: not detected

and took a role in the treatment of allergic diseases, neuropathic pain, arthritic pain, cardiovascular prevention, and hypertriglyceridemia (Miyata & Arita, 2015). DHA or EPA is produced by marine plants, phytoplankton and algae that transferred through the food web which integrated into the lipids of aquatic organisms (Shahidi & Ambigaipalan, 2015). Our result found that EPA and DHA were detected in both sample. In this study, omega-9 fatty acid was found by 0.1314% in crab meat and 0.0616% in byproduct. Considered as potential disease mediators, omega-9 fatty acids have usually been known contained in olive oil and macadamia oil that generally have a role in hypolipidemic, hypotensive, and reduce atherogenicity (Johnson & Bradford, 2014).

In other study, there are also many kinds of fatty acids contained in the edible part body of *Scylla paramamosain*; Caprylic acid, Lauric acid, Tridecanoic acid, Myristic acid, Pentadecanoic acid, Palmitic acid, Palmitoleic acid, Heptadecanoic acid, Heptadekenoic acid, Stearic acid, Heneicosanoic acid, Eicosadienoic acid, Arachidic acid, and Tricosanoic acid. As overall aspect review of fatty acid based on that study showed that total of Saturated fatty acid is 41.56% in hepato-pancreas male, total unsaturated fatty acid is 69.44% in muscle female, total monounsaturated fatty acid is 32.97% in hepato-pancreas female, and total polyunsaturated fatty acid is 52.99% in muscle female (Jiang *et al*., 2014). In addition, the study by Wang *et al*. (2021a) reported that in muscle, saturated fatty acids content was ranged 28.1-41.8%, monounsaturated acids content was ranged 27.1-34.4%, and polyunsaturated acids content was 31.2-44.8%.

From the results, there are generally differences in the composition of meat and byproduct. The difference is probably due to the degradation process that occurs. Unused parts from byproduct such as intestines have a tendency to decompose more quickly which will make a difference in the types of amino acids and fatty acids that are formed. That is why people prefer meat than byproduct. On the other hand, some elements have a tendency to accumulate in certain parts but this was not conducted in this study. The differences in general can also be influenced by the type and species of crabs. Moreover, it also affected by external factors such as environmental, habitat, and food sources (Jiang *et al*., 2014).

IV. CONCLUSION

In this study, the differences nutritional value and heavy metal content between crab meat and crab byproduct were observed. The moisture, protein, fat, amino acids in crab byproduct were higher, whereas mineral contents (except Potassium and Taurine) and fatty acids in crab meat were higher than crab byproduct. The high protein value and low fat were proven in each tested sample of *Scylla paramamosain*. The main mineral content was Calcium, Magnesium and Taurine. L-Glutamic acid is the main component of amino acids. Unsaturated fatty acid was found dominant in both meat and byproduct that contain omega-3, omega-6, and omega-9. In this study heavy metals were not detected in all sample. Therefore, the results showed that Scylla paramamosain can be used as a beneficial food in the future and safe to consume. Further studies are required to separate its analysis by gender, muscle, hepatopancreas, and gonad.

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