NUTRITIONAL CHARACTERISTICS OF SEA CUCUMBER (*Stichopus vastus*) USING CHEMICALS AND PHYSICAL TREATMENT

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Abstrak

Indonesia is one of the main sources of sea cucumber in the world with high total production for domestic consumption and export market. Sea cucumber has potential as a source of traditional foods, medicine, and functional food due to the high nutritional component in sea cucumbers. The purpose of this research was to determine the different nutritional characteristics of sea cucumber obtained by chemical (ethanol extractions of 20%, 25%, and 30%) and physical treatment (boiling and steaming). The results showed that chemical treatment (30% ethanol) had the best nutritional components being composed of protein 77.35%; moisture 9.14%; ash 6.67%; fat 0.10%; and carbohydrate 6.18%, while in physical treatment, steaming had the best nutritional components in composed of 61.49% protein content, 11.53% moisture, 10.76% ash, 2.22% fat, and 14.00% carbohydrate. Amino acid profiles in chemical treatments (ethanol 20%, 25%, and 30%) were 53.60%, 56.74%, and 61.65% respectively, while the amino acid profiles in physical treatments (boiling and steaming) were 50.31% and 52.96%, respectively. Glycine and glutamate acid, non-essential amino acid, were dominated by both chemical and physical treatments.

Keywords: amino acid, boiling, ethanol, proximate, steaming

Karakteristik Gizi Teripang (*Stichopus vastus*) yang Diberi Perlakuan Kimia dan Fisik

Abstract

Indonesia merupakan salah satu sumber utama teripang di dunia dengan total produksi yang tinggi untuk konsumsi domestik dan pasar ekspor. Teripang memiliki potensi sebagai sumber makanan tradisional, obat-obatan, dan pangan fungsional karena komponen gizi yang tinggi pada teripang. Tujuan penelitian ini adalah untuk mengetahui perbedaan karakteristik gizi teripang yang diperoleh secara kimiawi (ekstraksi etanol 20%, 25%, dan 30%) dan perlakuan fisik (perebusan dan pengukusan). Hasil penelitian menunjukkan bahwa perlakuan kimia (etanol 30%) memiliki komponen nutrisi terbaik yang terdiri dari protein 77,35%; kelembapan 9,14%; abu 6,67%; lemak 0,10%; dan karbohidrat 6,18%, sedangkan dalam perlakuan fisik, pengukusan memiliki komponen nutrisi terbaik yang terdiri dari kandungan protein 61,49%, kelembaban 11,53%, abu 10,76%, lemak 2,22%, dan karbohidrat 14,00%. Profil asam amino dalam perlakuan kimia (etanol 20%, 25%, dan 30%) masing-masing adalah 53,60%, 56,74%, dan 61,65%, sedangkan profil asam amino dalam perlakuan fisik (perebusan dan pengukusan) masing-masing adalah 50,31% dan 52,96%. Glisina dan asam glutamat, yang merupakan asam amino non-esensial, merupakan profil asam amino yang dominan

Kata kunci: asam amino, etanol, perebusan, pengukusan, proksimat

INTRODUCTION

Sea cucumber, marine biota of the phylum Echinodermata, has around 2,000 species in the world with high widely distribution area. From 37 countries of sea cucumber producers, Indonesia has high exported sea cucumbers (12.76%) followed by Malaysia 9.61%, United States 8.66%, Philippines 7.87%, China 6.61%, Hong Kong 2.05%, Japan 3.94%, Australia 1.10%, and Britain 0.16%. Thus, Indonesia is one of the main sources of sea cucumbers in the world with high total production for domestic consumption and export market (Brown *et al.*, 2010).

There are some genera from sea cucumbers found in Indonesia such as *Holothuria*, *Muelleria*, and *Stichopus*. From 23 species of sea cucumbers found in Indonesia many have been exploited due to high economic value. These species consisted of pink sea cucumber (*Holothuria edulis*), black sea cucumber (*H. vacabunda*), red sea cucumber (*H. vatiensis*), brown sea cucumber (*H. marmorata*), and sand sea cucumber (*H. scabra*). Hence, all of them are widely cultivated and traded in Indonesia (Martoyo *et al.*, 2007). Currently, sea cucumber from *Stichopus* genus is continued to explore as important commodities. Sulardiono (2012) reported that sea cucumber has a spawning with no season patterns and always occurs throughout the year. Thus, sea cucumber (*S. vastus*) is very potential to be utilized.

Sea cucumber has metabolic secondary either polar compound or nonpolar compound which of potential used as medicine (Dobretsov *et al.*, 2009). Hence, sea cucumber has pharmacological functions such as anti-cancer, anti-inflammatory, anti-coagulant, and anti-hypertension (Bordbar *et al*., 2011). Furthermore, sea cucumber has potential as a source of traditional foods, medicines, and functional food due to the high nutritional component in sea cucumbers.

Generally, dried sea cucumber is well processed to market as to prolong its shelf life (Chong *et al.*, 2015). The dried sea cucumber was obtained by processing either by boiling or steaming. Thus, the processing of sea cucumber will affect nutritional content. However, there is little published nutritional composition of dried sea cucumber especially sea cucumber obtained by chemical processing. The purpose of this research was to determine the different nutritional characteristics of sea cucumber obtained by chemical and physical treatment.

MATERIAL AND METHODS

Materials

The main material used in this research was sea cucumber (*S. vastus*) from Natuna Waters, Kepulauan Riau Province, Indonesia. The weight of sea cucumber was around 200 to 500 g/each sea cucumber. The main chemical material used in this research was ethanol (Merck, Germany).

Methods

This research was conducted by prepare the fresh sea cucumber and making of sea cucumber powder. The sea cucumber powder was obtained by milled and dried processing with chemical treatment (ethanol extractions of 20%, 25%, and 30%) and physical treatment (boiling and steaming). All products were analyzed for proximate content and amino acid profiles.

Preparation of fresh sea cucumber

Fresh sea cucumbers were first processed by removing their internal organs/viscera. The different body parts were collected and were analyzed by yield for each part of sea cucumber. The body flesh of sea cucumber was used in this research and sliced into small pieces, then refrigerated before further processing.

Chemical treatment (ethanol extraction)

The body flesh of sea cucumber was milled with a size of 60 mesh. A 100 g of powdered sea cucumber was extracted using ethanol solvent at an appropriate treatment of 20%, 25%, and 30%, then was refrigerated for 24 hours. Furthermore, the sample was centrifugated at 10,000 rpm for 15 minutes with a temperature of 4 ^{o}C to separate supernatant and precipitate. Finally, the precipitate was dried using freeze drying (Nurjanah, 2008; Karnila, 2012). The powder of sea cucumber was analyzed for proximate and amino acid profiles.

Physical treatment (boiling and steaming)

The sliced body flesh of sea cucumber was boiled for 15 minutes whereas the other sample was steamed for 15 minutes, then each sample was soaked using 15% salt liquid for 15 minutes and dried to remove the moisture in the sea cucumber. Furthermore, dried sea cucumber was milled to obtain the sea cucumber powder. The powder of sea cucumber was analyzed by proximate and amino acid profiles.

Nutritional characteristics

The nutritional characteristic of the sea cucumber powder were measured by proximate composition and amino acid profiles according to AOAC (2005). The proximate compositions were analyzed for moisture content by oven-drying, crude protein by the Kjeldhal method, lipid by acid hydrolysis, ash content by mineralization of samples, and carbohydrate by different. Then, amino acid profiles of the powder sea cucumber were analyzed by reversed-phase HPLC.

RESULT AND DISCUSSION

Proportion of Sea Cucumber

The average body length of sea cucumber was 200.11±42.88 mm and an average weight of 301.11±82.40 g. The body parts of sea cucumbers consist of body flesh and stomach content (viscera, gonad, and impurities). The proportions of sea cucumber are shown in Table 1.

Table 1 Proportion of sea cucumber *S. vastus* and *H. edulis*

Body parts	Proportion (%)	
	S. vastus	*H. edulis**
Body flesh	78.58±0.01	39.30
Stomach (viscera, gonad, and impurities	21.42±0.10	60.67

Note: * (Susanto *et al.*, 2014)

Table 1 show that the body flesh of *S. vastus* has a higher proportion (78.58%) than the body flesh of *H. edulis* (39.30%). Therefore, the body flesh of *S. vastus* has thicker skin than the other species. Hartati *et al.* (2016) reported that the body part of phylum Stichopodidae has thick and slippery integuments (skins) on dorsal body flesh since there is papillous spread throughout the dorsal body flesh of Stichopodidae. Moreover, *H. edulis* has thin skin and difficult to separate between body mass and skin in this species (Susanto *et al.*, 2014).

Proximate Composition

The proximate compositions of sea cucumber powder using chemical and physical treatments were presented in Table 2. The chemical and physical treatments before powder processing in sea cucumber decreased and increased nutritional components.

The table 2 shows that the protein content in the fresh body wall of sea cucumber (66.55%) increased in sea cucumber powder using chemical treatment (ranged from 74.25 to 77.35%). Moreover, the protein content in the sea cucumber powder decreased using physical treatment (ranged from 57.86 to 61.49%). The highest decrease of protein content was found in boiling treatment (57.86%). Purwaningsih *et al.* (2015) reported that protein was unstable and could be denatured by the increasing of temperature. Boiling dissolves water-soluble proteins such as sarcoplasmic resulting in lower protein content (Suryaningrum & Syamdidi, 2013). The nutritional composition can be affected by heat and method used to cook (Isabel *et al.*, 2015).

The protein content in the sea cucumber powder increased using chemical treatment (ranged from 74.25 to 77.35%). Solvent extraction is the method of choice for the several species of marine biota especially the abundant fatty species because the protein is effectively separated from lipids, thereby reducing stability problems normally associated with residual oxidation lipid. protein with ethanol extraction had better protein functionality that overall properties (water binding and cooking yield) (Kristinson & Rasco, 2000). Protein as antibodies can be seen in the active compound content as an antibacterial (Haugh *et al.*, 2002), antifungal

Table 2 proximate compositions of powder sea cucumber using chemical and physical treatments

Component	Sea cucumber powder	Powder (%)				
		Chemical (ethanol extraction %)			Physical	
		20	25	30	Boiled	Steamed
Moisture	11.60±0.01	10.58±0.04[a]	10.35±0.01[a]	10.35±0.01[a]	11.69±0.01	11.53±0.01
Ash	9.31±0.01	7.25±0.01[a]	7.17±0.01[b]	7.17±0.01[b]	10.76±0.01	13.79±0.05
Protein	66.55±0.02	74.25±0.01[a]	76.13±0.03[a]	76.13±0.03[a]	57.86±0.06	61.49±0.04
Lipid	0.52±0.02	0.16±0.06[a]	0.13±0.01[a]	0.13±0.01[a]	2.17±0.08	2.22±0.02
Carbohydrate	13.00±0.00	6.47±0.04[a]	6.03±0.02[a]	6.03±0.02[a]	14.49±0.05	14.00±0.02
Crude fiber	2.66±0.01	2.66±0.04[a]	2.11±0.05[a]	2.11±0.05[a]	2.40±0.01	2.54±0.01

(Murray *et al*., 2000 and Aryantina 2002), and anticoagulants (Mulloy *et al*., 2000).

Hutomo *et al*., (2015) stated that the water contained in the material will determine the quality of the material because it relates to durability and food safety. All types of foodstuffs contain water in different amounts. The difference in water content obtained is strongly influenced by the method and species of fish used. The decrease in water content is influenced by cooking factors which cause the liquid from inside the crab meat to seep out (drip occurs) (Tapotubun *et al*. 2008). The water that comes out of the product also carries other nutritional components dissolved in the water during boiling, such as protein, lipid and crude fiber.

Boiled sea cucumber meat has a smaller ash content than steamed sea cucumber, which is 10.76% (wd) and 13.79% (wd), respectively. The decrease in ash content in boiled sea cucumber meat is thought to be caused by the mineral content in sea cucumber meat dissolved in water during boiling. Tamrin & Prayitno (2008) stated that steaming will cause a decrease in nutrients in food but the decrease is not as much as boiling. Sea cucumber skin is the body wall consisting of the cuticle which is the layer lime-covered shield and there are thorns that are microscopic chalk grains spread over the epidermis (Fetcher, 1969).

Amino Acid Profiles

The amino acid profiles of sea cucumber powder using chemical and physical treatments are shown in Table 3. Fifteen amino acids were detected, including nine essential amino acids and 6six non-essential amino acids.

Table 3 showed that the total amount of amino acids in fresh sea cucumber meat is higher than chemical and physical treatment. The highest types of amino acids essential were found in fresh sea cucumber meat, namely arginine (6.17%) and leucine (2.87%), while in the chemical treatment 30% the highest amino acid was arginine (6.06%). In the physical treatment, the highest amino acid in steaming is arginine (5.76%)

The highest types of amino acids non essential were found in fresh sea cucumber meat, namely glycine (11.90%) and glutamate (10.87%), while in the chemical treatment 30% the highest amino acid was glysine (12.32%). and in the physical treatment, the highest amino acid in steaming is glycine (10.6%).

Glutamate and glycine were dominant amino acids in other sea cucumbers, including *Actinopyga mauritiana*, *A. japanicus*, *Bohadschia argus*, *Cucumaria frondosa*, *H. fuscogilva*, *H. fuscopunctata*, *S. hermanni*, and *Thelenota ananas* (Wen *et al*., 2010; Yang *et al*., 2015; Zhong *et al*., 2007). The higher glycine can reduce levels of total cholesterol in serum. Thus, sea cucumber was utilized as a traditional remedy for hypertension and an ideal food for people with hyperlipidemia (Wen *et al*., 2010).

Tabel 3 Amino acid profiles of sea cucumber powder using chemical and physical treatments

Component	Sea cucumber powder	Powder (%)				
		Chemical (ethanol extraction %)			Physical	
		20	25	30	Boiled	Steamed
Essential Amino Acid						
Leucine	2.87	2.30	2.57	2.76	2.37	2.53
Histidine	0.41	0.25	0.31	0.32	0.40	0.41
Lysine	1.03	0.38	0.84	0.93	1.03	1.18
Arginine	6.17	5.67	5.99	6.06	5.54	5.76
Valine	2.37	1.90	2.07	1.90	2.01	2.12
Isoleucine	1.98	1.60	1.71	1.60	1.63	1.73
Threonine	2.43	3.20	3.30	3.35	2.88	3.10
Phenylalanie	1.35	1.17	1.21	1.61	1.17	1.25
Methionine	0.79	0.61	0.62	1.09	0.61	0.68
Total	19.40	17.08	18.62	19.62	17.64	18.76
Non-Essential Amino Acid						
Tyrosine	1.30	1.12	1.16	1.39	1.03	1.03
Aspartic	0.41	5.93	5.99	6.84	5.70	5.97
Alanine	1.03	6.12	6.33	6.63	5.22	5.41
Glycine	6.17	10.40	11.70	12.32	10.04	10.66
Glutamate	2.37	10.53	10.51	12.04	9.00	9.26
Serine	1.98	2.42	2.43	2.81	1.68	1.87
Total	19.40	36.52	38.12	42.03	32.67	34.20
Grand Total	58.68	53.60	56.74	61.65	50.31	52.96

CONCLUSION

The treatment using chemical treatment (30% ethanol extraction) has higher protein and amino acids than physical treatment for both boiling and steaming. Glycine and glutamic acid, non-essential amino acid, were dominated by both chemical and physical treatments.

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