

Proximate composition and amino acid profiles of sea cucumbers collected at Nam Du Island, Kien Giang province, Vietnam

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Abstract. Within the framework of the project to investigate the current status of artisanal sea cucumber fishing and the composition of species in Nam Du Island, Kien Giang Province, the nutritional values of seven common species of sea cucumbers (*Holothuria atra*, *H. leucospilota*, *H. scabra*, *Stichopus hermanni*, *S. horren*, *S. monotuberculatus* and *S. variegatus*) were assessed in this study. The results showed that the proximate composition and amino acid profiles of these sea cucumbers studied greatly varied among species. Average contents fluctuated as follows: moisture from 87.5 to 92.3%, crude protein from 41.3 to 55.3%, crude lipid from 0.93 to 3.01%, ash from 18.9 to 37.1%, fiber from 0.32 to 0.48%, carbohydrates from 4.79 to 31.3%, calcium from 0.92 to 4.58% and phosphorus from 0.35 to 1.06% of dry weight. Overall, all species of sea cucumbers analyzed have high protein contents and low lipid levels. Moreover, total essential amino acid (AA), non-essential AA and total AA were in the ranges of 6.91-8.94%, 15.65-19.86%, and 23.11-28.80% of dry weight, respectively, of which *H. scabra* and *H. leucospilota* contained significantly higher levels of essential AA than other species. These two species are recommended as the healthiest food for human consumption.

Key Words: sea cucumber, proximate composition, amino acid, Nam Du Island.

Introduction. Sea cucumbers are marine invertebrate of the phylum Echinodermata, which are commonly found throughout the oceans of the world (Purcell et al 2012). They are important groups in the marine ecosystem since they excrete inorganic nitrogen and phosphorus compounds by their dietary nature, increasing the production of benthonic organisms that are crucial for oligotrophic oceans (Kitano et al 2003; Purcell et al 2016). Moreover, sea cucumbers have high nutritional values as they contain large amounts of essential amino acids, fatty acid, minerals, and bioactive compounds that act as a healthy food for humans (Azad et al 2017). Therefore, they are considered as tonic food and utilized as medication in Asian countries for a long time (Choo 2008; Bordbar et al 2011; Omran 2013, Devanadera et al 2015). According to Otero-Villanueva & Ut (2007), sea cucumbers have been heavily captured and processed as bêche-de-mer or trepang since the 1990s, and these products are mostly traded on the Asian markets (Purcell et al 2013; Rahman & Yusoff 2017).

Sea cucumbers were intensively caught in Vietnam for foodstuffs as well as aquarium uses, which caused a marked depletion of their population in nature (Otero-Villanueva & Ut 2007; Choo 2008; Tuan 2013). Kien Giang province is situated in southwest Vietnam, belongs to the Mekong Delta, and shares borders with Cambodia and the Gulf of Thailand. It has 200 km of shoreline and 63,290 km² of fishery area and is one of Vietnam's top fishing provinces, which provides almost 40% of the Delta's total seafood fishing (Viettrade 2012; Hai 2013). The Kien Giang Sea contains 143 islands, with 43 of them being inhabited. Nam Du Island, comprised of 21 small islands and rocky ridges, is part of Kien Giang's shoreline and a biodiversity hotspot, supporting a diverse range of key fishing areas as well as an abundant sea cucumber resource. However, several species of sea cucumber in Nam Du water have been continuously exploited,

resulting in overfishing and a decrease in their natural population, especially high-value commercial species (Hai 2013; Khanh et al 2020). The nutritional values of sea cucumbers were investigated in terms of proximate composition and amino acid profiles of seven species commonly found on Nam Du Island as part of a research project to identify new sea cucumber species in the study area.

Material and Method

Description of the study sites. This study was conducted in Nam Du Island, Kien Giang province, Vietnam. Nam Du Island is located in the Gulf of Thailand ($9^{\circ}41'N$ $104^{\circ}20'E$), with 21 small islands and rocky projections (Figure 1).

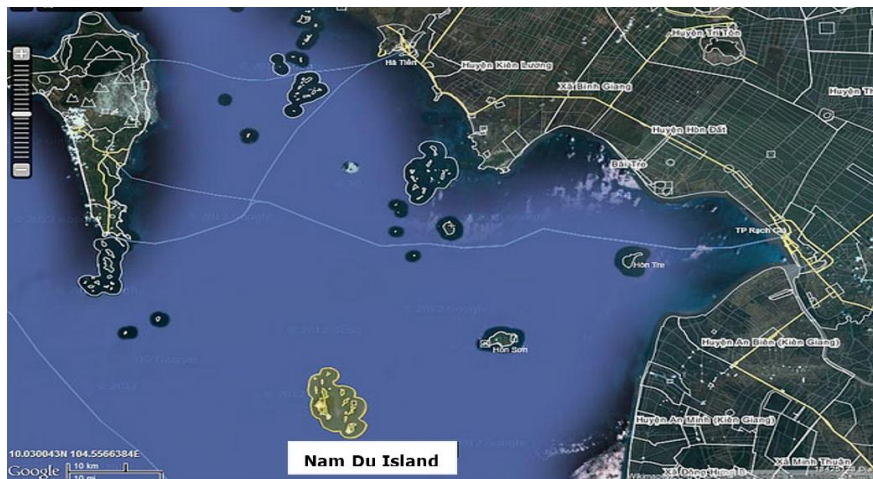


Figure 1. Google map showing the sampling site for sea cucumbers in Nam Du Island of Kien Giang province, Vietnam.

Sampling time. Collecting sea cucumber species in Nam Du Island was conducted during 2018 with a total of six sampling trips (March, April, May, October, November, and December) covering intertidal zones, coral flats, sea grass beds, and rocky ridges in this island. At other times of the year, the sea becomes unsuitable for catching sea cucumbers due to heavy winds, storms, or rainfall, resulting in huge waves and very turbid water. As a result, catching activities in bad weather was impossible. At each sampling time, we randomly collected 50 individuals or more, and fishing sea cucumbers was only done at night, from 19:00 h to 23:00 h. To collect sea cucumbers in shallow areas (intertidal zones or at low tide at a depth of 3 m), free diving was applied with catching either by hand or with a dip net. At depths ranging from more than 3 m to 30 m, a snorkeling device connected to an air compressor on a vessel to supply oxygen through a tube was maintained during diving to collect sea cucumbers.

Environmental parameters. The key environmental factors (water salinity, temperature, pH, alkalinity, dissolved oxygen, and transparency) at Nam Du Island in 2018 were provided by the environmental monitoring project conducted by the Department of Agriculture and Rural Development of Kien Giang province.

Identification of sea cucumber species. All collected sea cucumbers were determined at species level at the sampling station following the systematic documents of Ho (1991) and Purcell et al (2012). Identification of species was performed by checking their morphological features and ossicles.

Preparation and analysis of samples. Seven common species of sea cucumbers were identified during the sampling period and selected for biochemical analysis. The sea cucumber specimens were eviscerated after collection, in order to eliminate inner organs and immediately stored on ice prior to being sent to the laboratory, where they were kept at $-20^{\circ}C$ until analyzed. The frozen sea cucumber samples were analyzed for the

proximate composition (moisture, crude protein, crude lipid, ash, fiber, calcium, and phosphorus) using the AOAC 950.46 method, and the amino acid profiles were determined on the basis of Ref. TCVN 8764:2012.

Statistical analysis. All percentage values were transformed to arcsine and the data was tested for variance homogeneity using the Levene test prior to statistical analysis. Variations in the nutrient content of different species of sea cucumbers were assessed using one-way ANOVA and the Post-hoc Tukey HSD test (SPSS 16.0) was used to detect significant differences at $p < 0.05$.

Results and Discussion

Environmental parameters and natural conditions in Nam Du Island. Table 1 shows the basic environmental characteristics of water at Nam Du Island, that were recorded in 2018 by the Department of Agriculture and Rural Development in Kien Giang province.

Table 1

The key environmental parameters of the water at Nam Du Island in 2018

<i>Parameters</i>	<i>Data range</i>
Salinity	28-35 g L ⁻¹
Surface water temperature	26-30°C
pH	8.0-8.6
Transparency	60-250 cm
Alkalinity	80-120 mg CaCO ₃ L ⁻¹
Dissolved oxygen	5.8-7.4 mg L ⁻¹

Additionally, the natural environment of Nam Du Island is distinguished by the presence of coral reefs (including patch and bordering reefs), seagrass, seaweed beds, and stony ridges that create a unique configuration. These components produce a wide taxonomic range of flora and fauna of economic importance (https://vi.wikipedia.org/wiki/Quang_dao_Nam_Du). Natural constituents and environmental factors reveal that this island is an ideal place for sea cucumbers and other marine life (Dissanayake et al 2010).

Sea cucumber species. In this investigation, seven common species of sea cucumbers from Nam Du Island were identified, three of which belong to the Holothuriidae family (*Holothuria atra*, *H. leucospilota* and *H. scabra*) and four of which belong to the Stichopodidae family (*Stichopus hermanni*, *S. horren*, *S. monotuberculatus* and *S. variegatus*) (Khanh et al 2020). The nutritional compositions of these species were evaluated.

Proximate composition of sea cucumbers. The biochemical composition of seven sea cucumber species harvested in the Nam Du Island is presented in Table 2. The results showed that the average moisture level of fresh sea cucumbers varied from 87.5 to 92.3%, with the highest value in *H. leucospilota*, which significantly differed from *H. atra*, *H. scabra* and *S. monotuberculatus* ($p < 0.05$) but had not statistical differences compared to the remaining species ($p > 0.05$). The crude protein contents varied in the range of 41.3-55.3% where the values of *H. atra*, *H. scabra* and *S. hermanni* and *S. variegatus* were similar ($p > 0.05$), and significantly higher than other species. The *S. monotuberculatus* contained the lowest protein level, and showed a significant difference with most of the studied species, except for *S. horren*. The crude lipid content of sea cucumbers was categorized in two groups, the high lipid group (2.53-3.01%) consisted of *H. leucospilota*, *H. scabra* and *S. hermanni* and the low lipid group, comprising *H. atra*, *S. horren*, *S. monotuberculatus* and *S. variegatus* (0.93-1.39%), with significant differences between the two groups ($p < 0.05$). The average ash contents showed a high variation among the sea cucumber species (18.9-37.1%), where *H. scabra* had the highest ash

level, while *H. leucospilota* and *S. hermanni* had the lowest ash values, and these species were significantly different from the remaining species. In particular, the fiber contents of the seven species studied was very low (0.32-0.48%) and quite similar among the species ($p>0.05$).

Table 2
Proximate composition (% dry weight) of seven sea cucumber species collected in Nam Du Island, Kien Giang province

Composition	<i>Holothuria atra</i>	<i>Holothuria leucospilota</i>	<i>Holothuria scabra</i>	<i>Stichopus hermanni</i>	<i>Stichopus horren</i>	<i>Stichopus monotuberculatus</i>	<i>Stichopus variegatus</i>
Moisture	88.2±0.8 ^a	92.3±0.6 ^b	87.5±0.7 ^a	88.9±0.8 ^{ab}	89.4±1.2 ^{ab}	87.6±0.5 ^a	89.1±1.4 ^{ab}
Protein	51.2±1.7 ^c	46.2±1.9 ^b	55.3±0.9 ^c	52.1±0.7 ^c	44.0±0.7 ^{ab}	41.3±0.7 ^a	53.3±0.3 ^c
Lipid	1.20±0.22 ^a	3.01±0.18 ^b	2.53±0.22 ^b	2.57±0.12 ^b	1.39±0.49 ^a	0.93±0.21 ^a	1.24±0.04 ^a
Ash	28.1±1.2 ^b	19.2±0.8 ^a	37.1±0.2 ^d	18.9±0.7 ^a	25.3±1.3 ^b	27.0±0.8 ^b	31.8±0.5 ^c
Fiber	0.35±0.04 ^a	0.37±0.06 ^a	0.34±0.08 ^a	0.40±0.04 ^a	0.35±0.04 ^a	0.32±0.06 ^a	0.48±0.05 ^a
CHO	19.1±2.7 ^{bc}	31.3±2.7 ^d	4.79±0.85 ^a	26.0±1.2 ^{cd}	28.9±2.5 ^d	30.5±0.4 ^d	13.3±0.3 ^b
Ca	3.00±0.25 ^b	1.03±0.06 ^a	4.58±0.40 ^c	0.92±0.13 ^a	1.57±0.28 ^a	1.69±0.03 ^a	0.98±0.09 ^a
P	0.68±0.05 ^b	0.37±0.06 ^a	1.06±0.13 ^c	0.35±0.08 ^a	0.64±0.06 ^{ab}	0.67±0.06 ^b	0.49±0.04 ^{ab}

CHO-Carbohydrate; Ca-Calcium; P-Phosphorus. Values are means ±SD, (n=3) and means with different superscripts in the same row are significantly different ($p<0.05$).

Carbohydrate levels (CHO) showed a wide range (4.79-31.3%), where *H. leucospilota*, *S. horren*, *S. monotuberculatus* had significantly higher values compared to other species, except *S. hermanni*. Especially, *H. scabra* had an extremely low CHO level. The highest calcium (Ca) content was observed in *H. scabra* (4.58%), followed by *H. atra* (3.00%), and the remaining species had the lowest values (0.92-1.69%). There was a significant difference between the three groups. Phosphorus levels showed similar patterns to those observed for Ca, ranging from 0.35 to 1.06%, where *H. scabra* had the highest value and showed a significant difference from other species. Moreover, *H. leucospilota* and *S. hermanni* were found to have the lowest phosphorus contents.

According to the previous investigation, the nutritional value of sea cucumbers varied depending on the species, due to seasonal changes and feeding habits (Wen et al 2010; Bordbar et al 2011; Ketharani & Sivashanthini 2016; Thu & Thuy 2019; Medina-Lambraño et al 2021). In addition, fresh sea cucumber has a high moisture content, differing among the studies, according to the collection season, environmental conditions, geographic variances, and developmental stage (Wen et al 2010; Bordbar et al 2011; Haider et al 2015; Ardiansyah et al 2020). For example, Wen et al (2010) identified the biochemical components of eight commonly processed industrial sea cucumber species, i.e. *Actinopyga caerulea*, *A. mauritiana*, *Bohadschia argus*, *Holothuria fuscogilva*, *H. fuscopunctata*, *Stichopus hermanni*, *Thelenota ananas* and *T. anax*. The protein content was found to be between 40.7 and 63.3% and the lipid content was very low (0.3–1.9%), except for *T. anax* and *A. caerulea*, while their ash contents were very high (15.4–39.6%). Proximate composition of *Actinopyga mauritiana*, *H. scabra*, *Bohadschia marmorata* and *H. leucospilota* were examined by Omran (2013). The author found high protein contents (43.23 to 48.27%), carbohydrates (44.62 to 48.56%) and low lipid levels (4.60 to 5.66%). Among the test samples, *A. mauritiana* had the greatest level of protein (48.27%), *H. leucospilota* had the lowest content of total lipids (4.6%), and *H. scabra* had the largest proportion of carbohydrates (48.65%). According to Ketharani & Sivashanthini (2016), the proximate composition among five species of sea cucumber (*Holothuria leucospilota*, *H. scabra*, *H. spinifera*, *Stichopus naso*, *Thelenota anax*) caught in the Jaffna Peninsula, Sri Lanka, varied significantly. All the studied species had high moisture contents (84.52-92.55%) and low levels of lipid (0.25-0.40%), protein (3.00-10.06%) and ash: 1.90-9.22%, on a fresh weight basis. *H. leucospilota* and *H. spinifera* showed higher protein contents, *T. anax* had higher lipid levels, and *H. spinifera* had a higher content of ash than any other sea cucumber species studied. Similarly, proximate compositions (dry weight) varied considerably between the two sea cucumber species (*H. edulis* and *H. scabra*). Moisture, crude protein, crude lipids and ash of 85.5, 70.5, 1.37 and 1.27%, respectively, were observed in *H. edulis*. *H. scabra* contained 84.5% of

moisture, 51.2% of crude protein, 0.27% of crude lipids and 4.44% of ash (Azad et al 2017). Furthermore, Sroyraya et al (2017) revealed that *H. scabra* had a high protein content (22.50% in the whole body and 55.18% in the body wall) and low lipids (1.55% in whole body and 1.02% in body wall). The current study is consistent with the previous studies: the proximate composition of sea cucumbers collected at Nam Du Island, Kien Giang province, varied greatly among species and was characterized by high protein and low lipid levels (Ridzwan et al 2014; Haider et al 2015; Sroyraya et al 2017).

Amino acid profiles of sea cucumbers. Amino acid profiles of seven sea cucumber species collected in Nam Du Island, Kien Giang province is summarized in Table 3. Seventeen amino acids of sea cucumbers, including nine essential amino acids and eight non-essential amino acids, were detected.

Essential amino acid (EAA). Total EAA ranged from 6.91 to 8.94%, where *S. hermanni* and *S. monotuberculatus* had the lowest contents, and the highest values were observed for *H. scabra* and *H. leucospilota*, while other species (*H. atra*, *S. horren* and *S. variegatus*) had intermediate values. Statistical results indicated that total EAA in *H. scabra* significantly differed ($p < 0.05$) from other species, except *H. leucospilota* ($p > 0.05$). Considering the individual amino acid, arginine, leucine and valine were found in higher proportions, compared to other individual amino acids. Arginine levels ranged from 1.34 to 2.37%, where the *Holothuria* genus had significantly higher values than the *Stichopus* genus ($p > 0.05$). Histidine content was similar ($p > 0.05$) among species, ranging from 0.27 to 0.38%. The lowest and highest concentrations of isoleucine were observed in *H. leucospilota* (0.43%) and *H. scabra* (0.81%), respectively, that significantly differed from other species. The contents of leucine and lysine varied in the ranges of 1.09-1.44% and 0.72-1.07%, respectively, where the highest values were detected in *H. leucospilota* and were significantly different ($p < 0.05$) from most of the species. Notably, the levels of methionine and threonine were much lower compared to other amino acids (0.37-0.51% and 0.44-0.72%, respectively); this indicated that methionine and threonine are the limiting essential amino acids in the sea cucumber species studied. The highest level of phenylalanine was found in *H. scabra* (1.05%) and significantly different from other species, while the lowest level was in *H. atra* and *S. variegatus* (0.65-0.66%). Valine concentrations fluctuated from 0.89 to 1.12%, being significantly lower in *H. leucospilota*, than in *H. atra*, *H. scabra* and *S. horren*.

Non-essential amino acid (NEAA). Total NEAA of sea cucumbers ranged from 15.65 to 19.86%, where the lowest and highest values were found in *S. horren* and in *H. scabra*, which statistically differed from other species ($p < 0.05$). With respect to each amino acid, the levels of alanine fluctuated between 1.92 and 3.24%, of which *H. atra* was the highest, followed by *H. scabra*, and the lowest proportion was *S. horren* while the remaining four species had intermediate levels. Aspartic acid levels were relatively high (2.45-3.10%) in all species with the exception of *H. atra*, which contained the lowest level (0.89%) and differed significantly from other species. Particularly, most of the sea cucumber species had very low levels of cysteine (0.08-0.16%) and relatively low levels of tyrosine (0.65-0.85%) except *H. atra*, which contained considerably higher levels of cysteine (1.11%) and tyrosine (1.59%) compared to other species. The concentrations of glutamic acid and glycine were more dominant than for other amino acids, ranging from 3.09-3.95% and 2.37-5.21%, respectively. For the glutamic acid, *H. atra* and *H. scabra* had significant higher proportions than other sea cucumber species. Concerning glycine, *H. scabra* contained the highest percentage, followed by *S. variegatus* and were statistically different, compared to the remaining groups ($p < 0.05$). The average contents of proline were the lowest in *H. atra* (1.28%) and the highest in *H. scabra* (2.85%). Moreover, the mean concentrations of serine and tyrosine fluctuated between 1.08-2.42% and 0.65-1.59%, correspondingly, where in *H. atra* they were significantly higher than in the other species.

Table 3

Amino acid profiles (% dry weight) of seven sea cucumber species collected in Nam Du Island, Kien Giang province

<i>Species</i>	<i>Holothuria atra</i>	<i>Holothuria leucospilota</i>	<i>Holothuria scabra</i>	<i>Stichopus hermanni</i>	<i>Stichopus horren</i>	<i>Stichopus monotuberculatus</i>	<i>Stichopus variegatus</i>
	EAA						
Agrinine	2.37±0.06 ^d	2.13±0.09 ^{cd}	2.25±0.08 ^d	1.34±0.09 ^a	1.79±0.05 ^b	1.90±0.05 ^{bc}	1.86±0.09 ^{bc}
Histidine	0.34±0.03 ^a	0.38±0.04 ^a	0.32±0.04 ^a	0.29±0.03 ^a	0.31±0.03 ^a	0.27±0.02 ^a	0.34±0.03 ^a
Isoleucine	0.61±0.03 ^{bc}	0.43±0.02 ^a	0.81±0.04 ^d	0.62±0.06 ^{bc}	0.59±0.03 ^{ab}	0.63±0.08 ^{bcd}	0.78±0.0 ^{cd}
Leucine	1.09±0.06 ^a	1.44±0.04 ^c	1.39±0.03 ^{bc}	1.13±0.08 ^a	1.18±0.04 ^a	1.24±0.02 ^{ab}	1.21±0.05 ^{ab}
Lysine	0.72±0.03 ^{ab}	1.07±0.06 ^c	0.84±0.04 ^b	0.76±0.05 ^{ab}	0.70±0.03 ^{ab}	0.63±0.04 ^a	0.71±0.03 ^{ab}
Methionine	0.37±0.03 ^a	0.51±0.02 ^b	0.48±0.02 ^{ab}	0.45±0.05 ^{ab}	0.43±0.03 ^{ab}	0.38±0.04 ^a	0.46±0.02 ^{ab}
Phenylalanine	0.65±0.02 ^a	0.88±0.04 ^c	1.05±0.03 ^d	0.77±0.01 ^{bc}	0.84±0.02 ^c	0.71±0.02 ^{ab}	0.66±0.04 ^a
Threonine	0.44±0.08 ^a	0.72±0.03 ^c	0.64±0.04 ^{bc}	0.50±0.03 ^{ab}	0.57±0.04 ^{abc}	0.55±0.03 ^{abc}	0.48±0.03 ^{ab}
Valine	1.11±0.06 ^b	0.89±0.04 ^a	1.12±0.06 ^b	1.02±0.02 ^{ab}	1.09±0.06 ^b	0.96±0.03 ^{ab}	1.03±0.04 ^{ab}
Total EAA	7.65±0.29 ^{ab}	8.39±0.25 ^{bc}	8.94±0.23 ^c	6.91±0.26 ^a	7.47±0.33 ^{ab}	7.29±0.24 ^a	7.44±0.25 ^{ab}
	Non-EAA						
Alanine	3.24±0.05 ^d	2.19±0.04 ^b	2.50±0.02 ^c	2.14±0.02 ^b	1.92±0.04 ^a	2.15±0.03 ^b	2.11±0.04 ^b
Aspartic acid	0.89±0.04 ^a	2.66±0.05 ^b	3.10±0.06 ^c	2.68±0.06 ^b	2.51±0.08 ^b	2.57±0.11 ^b	2.45±0.09 ^b
Cystine	1.11±0.08 ^b	0.16±0.04 ^a	0.11±0.02 ^a	0.08±0.01 ^a	0.13±0.02 ^a	0.09±0.01 ^a	0.14±0.02 ^a
Glutamic acid	3.91±0.16 ^c	3.30±0.07 ^{ab}	3.95±0.08 ^c	3.37±0.05 ^{ab}	3.09±0.05 ^a	3.13±0.08 ^a	3.52±0.11 ^b
Glycine	2.37±0.08 ^a	3.85±0.06 ^b	5.21±0.05 ^e	4.18±0.06 ^c	4.01±0.04 ^{bc}	4.20±0.05 ^c	4.41±0.04 ^d
Proline	1.28±0.06 ^a	2.44±0.10 ^c	2.85±0.08 ^d	2.21±0.03 ^{bc}	2.18±0.05 ^b	2.33±0.06 ^{bc}	2.19±0.04 ^b
Serine	2.42±0.05 ^c	1.24±0.04 ^{ab}	1.38±0.06 ^b	1.12±0.08 ^a	1.06±0.05 ^a	1.11±0.04 ^a	1.08±0.02 ^a
Tyrosine	1.59±0.06 ^c	0.85±0.03 ^b	0.79±0.04 ^{ab}	0.74±0.02 ^{ab}	0.77±0.03 ^{ab}	0.65±0.02 ^a	0.81±0.05 ^{ab}
Total non-EAA	16.79±0.26 ^b	16.68±0.14 ^b	19.86±0.32 ^c	16.50±0.23 ^{ab}	15.65±0.26 ^a	16.20±0.27 ^{ab}	16.67±0.19 ^b
Total AA	24.43±0.55 ^a	25.07±0.39 ^a	28.80±0.54 ^b	23.40±0.49 ^a	23.11±0.58 ^a	23.49±0.51 ^a	24.11±0.44 ^a

EAA-essential amino acid; Non-EAA-non-essential amino acid. Values are means ± SD, (n = 3) and means with different superscripts in the same row are significantly different (p<0.05).

Total amino acid (TAA). The mean concentrations of total AA in sea cucumbers ranged from 23.11 to 28.80%, with *H. scabra* having a considerably higher value ($p < 0.05$) than the other species. Based on the proximate composition and amino acid parameters in the present study, it was discovered that compared to other sea cucumber species examined, *H. scabra* and *H. leucospilota* had superior nutritional values.

Generally, the proximate composition and amino acid profiles of sea cucumbers collected in Nam Du Island, Kien Giang province vary greatly among species. These results are consistent with the previous studies, confirming that the nutritional composition of sea cucumbers varies due to environmental factors, season, species, climatic conditions, geographical location, behavior and handling procedures (Wen et al 2010; Bordbar et al 2011; Salarzadeh et al 2012; Ibrahim et al 2015; Thu & Thuy 2019). The findings of Wen et al (2010) revealed that three limiting essential amino acids (histidine, lysine and methionine) were detected in eight dried sea cucumber products (*Stichopus hermanni*, *Thelenota ananas*, *Thelenota anax*, *Holothuria fuscogilva*, *Holothuria fuscopunctata*, *Actinopyga mauritiana*, *Actinopyga caerulea* and *Bohadschia argus*), while the glycine was dominant among the amino acids found in all species. Analogous results were found in the current study: the contents of histidine and methionine in sea cucumber were much lower compared to other essential amino acids, whereas glycine was more dominant than other non-essential amino acids. According to Omran (2013), sea cucumbers have a high protein content, with essential and non-essential amino acids including glycine, lysine, threonine, and valine, which are employed for therapeutic reasons. Sea cucumber can be considered a healthy food and is frequently consumed due to its high protein and low fat concentrations, as evidenced by the numerous documents that mention it (Wen et al 2010; Haider et al 2015; Thu & Thuy 2019). According to Sroyraya et al (2017), the three dominant amino acids (in dry weight) detected in both the whole body and body wall of *H. scabra*, which included glycine (34.11 and 79.65 mg g⁻¹), glutamic acid (31.91 and 67.64 mg g⁻¹) and proline (22.34 and 44.52 mg g⁻¹), respectively. Moreover, the sea cucumber (*Stichopus variegatus*) collected in Indonesia contained essential nutrients for human health, with a high protein (34.33%) and a low lipid content (1.08%), which also had the highest levels of essential amino acid (5.79% of lysine) and non-essential amino acid (4.99% of glycine), compared to other amino acids (Ridhowati et al 2018). Another study (Moradi et al 2019) found that two sea cucumber species (*Holothuria leucospilota* and *Stichopus hermanni*) collected at Qusem Inland had high contents of aspartic acid and low contents of lysine and arginine. In the present investigation, the proximate composition and amino acid profile of sea cucumbers collected on Nam Du Island in Kien Giang province, Vietnam considerably varied among species, which is consistent with the studies described above.

Conclusions. The seven species of sea cucumber analyzed in this study were classified as a healthy food for human consumption, with a high protein content and a low lipid level. In particular, *H. scabra* and *H. leucospilota* contained higher levels of essential amino acids than other species, which have the potential to be a functional food for humans. This finding provides valuable information on the nutritional quality of the sea cucumbers inhabiting in Nam Du Island, Kien Giang Province, Vietnam.

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