The Proximate Composition and the Nutritional Value of Some Sea Cucumber Species Inhabiting the Sudanese Red Sea

Mona Y. Ibrahim [1*]; Sheikheldin M. Elamin [1]; Yousif B. Abu Gideiri [2] Sayed M. Ali [3]
1, Department of Fisheries, Faculty of Marine Sciences and Fisheries, Red Sea University, Port Sudan, Sudan. P.O. Box 24
2, Department of Zoology, Faculty of Science, University of Khartoum
3, Department of Fish Science, Faculty of Agricultural Technology and Fish Science, Al-Neelain University

Abstract
Some biochemical studies (protein, fat, moisture and ash) were done on three species of holothurians namely *Holothuria scabra*, *Actinopyga echinites* and *Holothuria atra*, which were collected from Abu Hashish and Kilo Tammania areas in Sudanese Red Sea. Statistical analysis showed that there was a significant difference ($P<0.05$) in moisture, ash and protein content of the air-dried and processed animals. However, a non-significant difference ($p>0.05$) in fat content is encountered. Differences in moisture and fat content of *H. atra* collected from the two sites are insignificant while the difference in protein and ash contents are significant. All the measured contents in *A. echinites* are assumed not to differ significantly between the two areas except in their fat content.
Keywords: holothurians, sea cucumber**,** biochemical, Red Sea, Sudan

1. Introduction
The holothurians, are soft bodied echinoderms comprising a diverse group of flexible, elongated, worm like organisms, with a rubbery like skin and gelatinous body looking like cucumber ,hence the name " sea cucumbers" (Conand,1990). There are about 80 species of sea cucumber belonging to 22 genera in the Red Sea (vine, 1986). Many authors have studied the chemical composition of the Mediterranean and the Indo-pacific species (Hyman, 1955). Svetashev *et al.* (1991) had studied the lipid and fatty acid contents of some species from temperate and tropical regions. Furthermore, Maven *et al.* (1995) analyzed the fatty acid and mineral composition of Papau New Guinea species.

From the Egyptian Red sea coast Abdel-Razek *et al*. (2005) studied the reproductive biology, while Omran (2013) studied the morphometric parameters and the proximate chemical composition of *Actinopyga mauritiana*, *Holothuria scarba*, *Bohadschia marmorata* and *Holothuria leucospilota***.** Sea cucumber fishery started in Sudan in a small scale since 1980s. During the last 2 decades species which harvested in Sudanese Red Sea regions have been exported as dry product. Fishers collected and processed sea cucumber and the products were sold to exporters for markets in Hong Kong and Singapore (Lawrence *et al.*, 2004). *H. scabra*, *A. echinites* and *H. atra* are among the major commercially exported species according to Marine Fisheries Administration (personal communication). Consumption of raw sea cucumber or with minimal preparation is common in Japan and Korea (Infofish, 1992). In spite of the uncountable benefits of the sea cucumbers, no local consumption has been practiced in Sudan. There is no information exists related to sea cucumber species of Sudan in terms of their proximate composition. For this, the present work aims to highlight the nutritional value of some local Sudanese sea cucumber inhabiting the Red Sea coast namely (*H. scabra*, *A. echinites* and *H. atra*) in order to evaluate their quality and their economic importance.

2. Material and Methods
A total of 20 animals of different lengths and weights for *H. scabra*, *A. echinites* and *H. atra* were taken randomly during year 2000. Ten of these were tagged and then subjected to the processing regime followed Conand and byrne (1993). The other 10 were gutted, tagged and allowed to dry by air for several days without processing till they attained a constant weight. Their mean length and weight were estimated. Analysis for moisture, fat, protein and ash contents were done according to Shakweer *et al.* (1998) for the powdered mixture of the first 10 animals and separately for the second ones. The analyses were repeated three times.

Determination of moisture content:

Moisture was determined as the difference, in weight of the specimen sample before and after dehydration (to constant weight in an electric oven at (90°c) for about 6-8 hours then cooled to room temperature in a dissector and weighed. The moisture content was calculated according to the formula:

$$\% = \text{moisture content} = \frac{\text{Difference in weight}}{\text{weight of sample}} \times 100$$

The amount of each biochemical component is expressed as percentage of the dry weight basis. This is to avoid any error caused by variation in water content.

Determination of ash content:

The ash was determined by heating-sample (5g) in a Muffle furnace in a crucible at 200°C for two hours, then the temperature was raised gradually every two hours to reach 550-600°C. The samples were left in the furnace at this temperature for 6 hours. The weight of the residue represents the ash content.

The ash percentage was determined using the formula:

$$Ash\% = \frac{\text{weight of ash}}{\text{weight of initial sample}} \times 100$$

Determination of crude fat:

The crude fat was determined by Soxhiet method using hexane at 140°C for 3 hours in a Soxtec system HT. sample residue was dried at 85°C till a constant weight was maintained . The difference in the weight of sample due to fat extraction was determined according to Bilgh and Dyer (1959) and Smith *et al.* (l964) as

$$\frac{W_1 - W_2}{W_2} \times 100$$

Where W_1, the initial weight and W_2, the weight after extraction.

Determination of protein content:

The protein content of the dry sample was determined according to the method adopted by Wrong (1923); Alexander (1956); and Abu Elwafa *et al.* (1994). The estimation of protein is based on determining the total Nitrogen by the use of Kjeltic Auto Distillation .Total crude protein can be calculated according to the formula

$$\% \text{ Crude protein content} = \% \text{ of Nitrogen} \times 6.25$$

It is important to point out that all the subsequent results shown in the present investigation are the mean of at least three determinations. To indicate the degree of significance of the biochemical differences between the processed and non- processed holothurians collected from the two study sites, student t-test was applied

3. Results

Figures 1 and 2 presented the biochemical contents of air-dried and processed for *H. atra* and *A. echinites* at the two sites of the study, while figure 3 showed the biochemical contents for air-dried and processed of the three species from Kilo Tammania area. From these figures mentioned below we can summarize the following:

1. *A. echinites* has slightly higher protein content than *H. atra* in both localities.
2. Fat contents in the three species are generally low and are comparable.
3. Ash contents of *H. atra* and *A. echinites* ranged between 28.07% and 33.68%; 37.85 and 41.39 for air-dried and processed specimens respectively.
4. Among the three species studied, *H. scabra* has the highest protein content.
5. There is an appreciable loss of protein during processing.

Tables 1 showed the mean, standard deviation and p- values of the biochemical content for air-dried and processed sea cucumbers from Kilo Tammania area. Where a highly significant difference ($p<0.01$) between air-dried and processed specimens for (moisture, ash and protein), while no significant difference was encountered for the fat content. Table 2 showed the p- values and significant difference of biochemical content of air-dried and processed for *H. atra* and *A. echinites* between Kilo Tammania and Abu hashish areas.

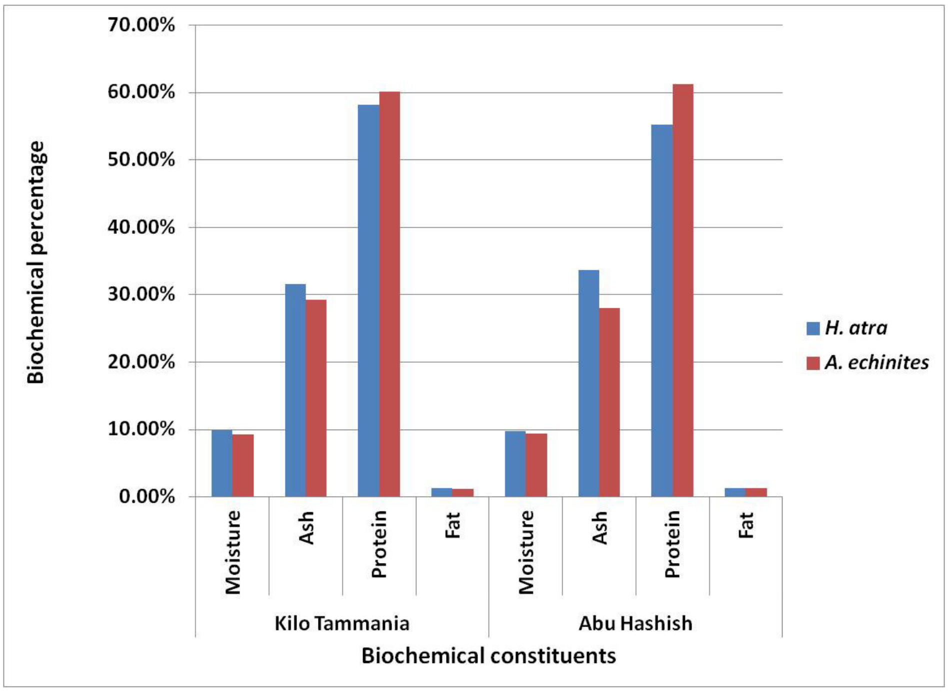

Figure 1: Biochemical constituents of air-dried sea cucumbers collected from Kilo Tammania and Abu Hashish

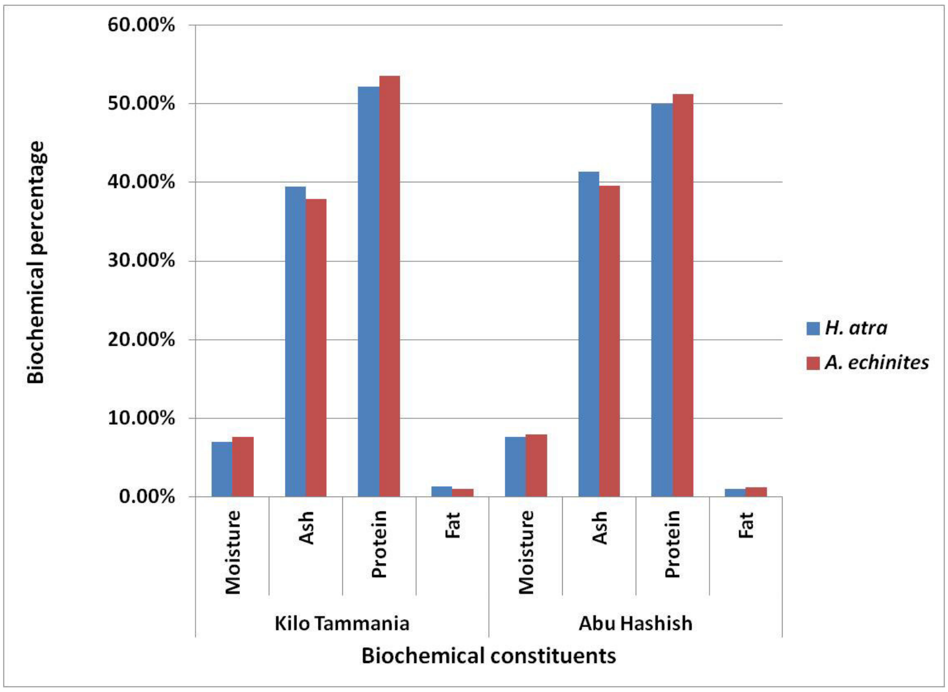

Figure 2: Biochemical constituents of processed sea cucumbers collected from Kilo Tammania and Abu Hashish.

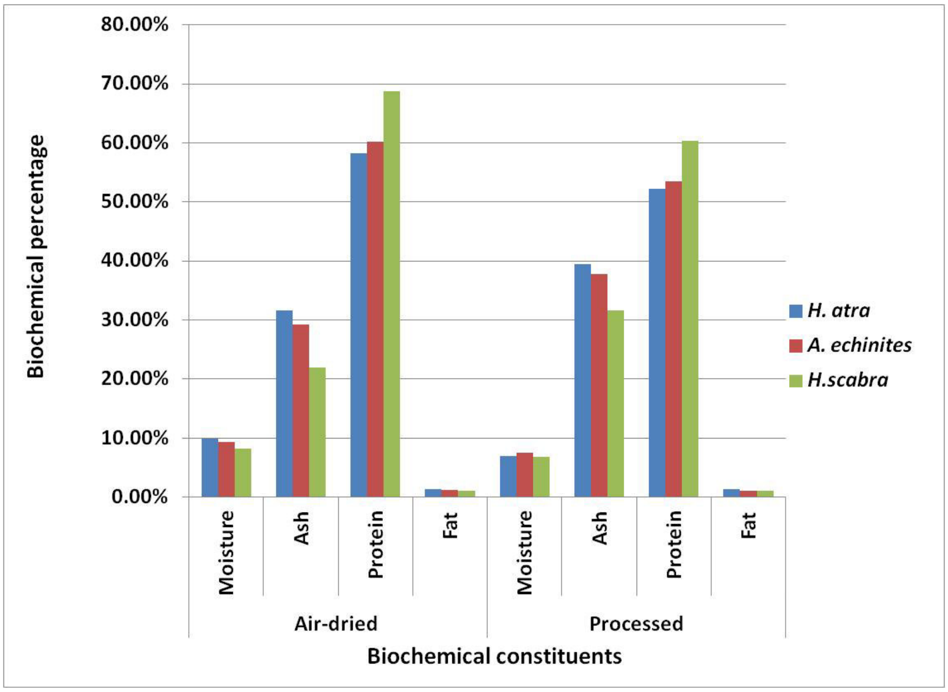

Figure 3: The percentage of biochemical constituents for air-dried and processed sea cucumbers from Kilo-Tammania area.

Table 1. Mean, Standard deviation (SD) and p-value for biochemical constituents of sea cucumbers *H. atra*, *A. echinites* and *H. scabra* (air-dried and processed) from Kilo Tammania area.

Species	Parameter(%)	Air-dried	Processed	p- value
		Mean ± SD	Mean ± SD	
H. atra	Moisture	9.90 ± 0.01	7.00 ± 1.00	<.0.01
	Ash	31.58 ± 0.42	39.50 ± 0.50	<.0.01
	Protein	58.20 ± 0.72	52.20 ± 0.80	<.0.01
	Fat	1.32 ± 0.00	1.30 ± 0.00	>0.05
A. echinites	Moisture	9.30 ± 0.10	7.60 ± 0.92	<.0.01
	Ash	29.25 ± 0.25	37.85 ± 0.65	<.0.01
	Protein	60.20 ± 0.20	53.50 ± 0.50	<.0.01
	Fat	1.25 ± 0.01	1.05 ± 0.00	>0.05
H. scabra	Moisture	8.20 ± 0.15	6.90 ± 0.25	<.0.01
	Ash	22.02 ± 0.27	31.67 ± 0.30	< 0.01
	Protein	68.67 ± 0.37	60.40 ± 1.11	< 0.01
	Fat	1.11 ± 0.01	1.03 ± 0.00	> 0.05

p>0.05=insignificant, p<0.05=significant and p<0.01= highly significant.

Table 2. The p- value of biochemical content of sea cucumbers *H. atra* and *A.echinites* (air-dried and processed) between Kilo Tammania and Abu hashish areas.

Parameter	p- value		p- value	
	Processed *H. atra*	Air- dried *H. atra*	Processed *A. echinites*	Air- dried *A. echinites*
Moisture	0.288	0.211	0.288	0.222
Ash	0.002	0.020	0.093	0.062
Protein	0.021	0.120	0.053	0.051
Fat	1.000	0.303	0.013	0.010

p>0.05=insignificant, p<0.05=significant and p<0.01= highly significant.

4. Discussion

In some parts of the world sea cucumber is known to be used as food for centuries (Fabinyi, 2012 and Jenkins and Mulliken, 1999).

The significant difference between biochemical composition, of processed and air dried sea cucumbers showed in Table 1 might be attributable to the processing procedure, which was carried out in five steps that may considerably change the nutritive value. According to Ghang-Lee *et al.* (1989) there was no significant difference in the chemical analysis of canned sea cucumber made from fresh-cooked, salted –cooked and cooked & dried materials.

It is worth mentioning that the nutritive values refer to biochemical contents that include proteins and fats of processed sea cucumber, are still high and the relative proportion of the nutritive values will be maintained even after the processing is completed, and the values obtained were very close to those reported by Özer *et al.* (2004) who determined the proximate chemical composition using two methods of processing at Marmara, and within the range mentioned by Chen *et al.* (2011) who determined the main nutrient profiles in various species of sea cucumber. To this attribute Bordbar *et al.* (2011) stated that the commercially processed sea cucumbers are rich source of crude protein in comparison to most of the sea foods so far in use. Wen *et al.* (2010) investigated the chemical and nutritional composition of eight common commercially processed sea cucumber species and found the protein contents to be within the range of 40.7 to 63.3%, and a relatively very low level of fat (0.3–1.9%), except for *Thelenota anax* and *Actinopyga caerulea*, while the ash content is markedly high (15.4–39.6%). According to Chen *et al.* (2011), the fully dried sea cucumber material may contain protein content as high as 83% and is sold in tabulated or capsulated forms as nutritive complement.

The contents of moisture, protein, fat, ash, and carbohydrates for fresh sea cucumbers to vary from 82.0 to 92.6, 2.5 to 13.8, 0.1 to 0.9, 1.5 to 4.3 and 0.2 to 2.0%, respectively (Mehmet *et al.*, 2011). The processed sea cucumber (trepang), being rich in protein, vitamin A and C, calcium, iron, magnesium, zinc, sodium, fat and carbohydrate, is regarded by Chinese medicals as general health tonic (Navarro *et al.,* 2012; Bordbar *et al.*, 2011; Omran, 2013 and Conand, 1990). It must be an intention and prime objective to adopt a processing method that results in minimal loss of the nutritive value and yet renders a competitive marketing with similar product from elsewhere; this opinion is also in accordance with Jenkins and Mulliken (1999). As for the three species handled in this work, it is appropriate to state that while *H. atra* and *A. echinites* require same steps of processing, yet *H.scabra* alone requires a special treatment to acquire the same quality.

The significant difference in protein and ash contents between the two study areas (Table 2) may be due to the differences in environmental factors in the two areas as the proximate composition of sea cucumbers may differ to a wider extent depending upon the species, seasonal variations and feeding regimes (Bordbar *et al.*, 2011). However, there were only a few reports about chemical composition being used in the geographical classification of aquatic food materials. Furthermore, the chemical composition of sea cucumbers are influenced by the local environmental factors especially the water environment (Salarzadeh *et al.*, 2012).

Sudanese people consider sea cucumber non-edible organism. The reason behind may be that the product appears to be unappetizing. This is in consistent with the Egyptian (Omran, 2013) and Iranian (Salarzadeh, 2012) people.

5. Conclusion

The investigated sea cucumbers from the Sudanese coast have a high protein content, and very low content of fats whether air dried or processed. So there is a great potential to encourage utilization of sea cucumbers as a food commodity and to develop valuable functional foods with physiological benefits for human beings .

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