Nutritional value of the sea cucumber *Holothuria scabra* from Fiji Islands

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Introduction

At least 58 species of sea cucumbers are harvested commercially from the world's oceans, and this practice has existed for over 1,000 years. Sea cucumbers are consumed raw, dried or boiled in many tropical and subtropical countries. Dried sea cucumber is known as beche-de-mer (BDM) and is particularly popular in the over 40-year age group where it is consumed primarily for its perceived medicinal properties. There is high demand for BDM and other sea cucumber products in Southeast Asian countries with China, Hong Kong, South Korea, Singapore and Japan being among the major markets.

BDM processing involves an uncomplicated sequence of actions resulting in a product that is non–perishable if stored in dry, dark conditions. Briefly, post-harvest steps include first boiling, slitting and gutting, second boiling, smoking and finally sun-drying. Current processing techniques (cooking and drying) used in the Pacific Islands have been used since the 1800s and are well documented. However, poor processing techniques often result in poor quality products and loss of revenue; regional extension programmes have been established to address this issue.

There is an increasing global awareness of the human health benefits of seafood relating to their relatively high levels of essential nutrients such as omega-3 fatty acids. Traditional BDM processing involves multiple boiling, salting and drying, which is likely to result in significant loss of important nutrients. Yet, this aspect of BDM processing is poorly documented. This section provides a brief overview of the nutritional profile of sea cucumbers traded in Southeast Asian countries.

Material and methods

Sandfish (*Holothuria scabra*) (Fig. 1) were harvested from Tavua Bay (17°26'29.4"S 177°51'44.4"E) in northern Viti Levu, Fiji Islands, at low tide. They were left on a flat surface for five minutes, and then their lengths and wet weights were recorded. The samples were then gutted and held in an esky (portable cooler) with ice for immediate transportation to the University of the South Pacific (USP) Laboratory in Suva.

Figure 1. Sandfish (*Holothuria scabra*) harvested from Tavua Bay, Fiji (image: Ravinesh Ram, 2015).

The sandfish were cooked in 45°C water and the temperature was slowly increased to 80°C. They were cooked for around 20 minutes or until they became cylindrical in shape, hard and bouncy. Samples were then sun dried for one to two weeks, then cooked for a second time and fi-

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nally dried. Samples of the dried sandfish were then pulverised and assayed for their nutrient composition. Nutrient analysis (proximate composition – protein, ash, lipid and carbohydrates – and fatty acid profile) was performed at Deakin University in Australia, while moisture content measures – assessed gravimetrically after heating at 105°C for 24 hours until a constant mass was obtained – were done at the University of the South Pacific in Fiji.

Results and discussion

The sandfish specimens used in this study had a mean length of 19.63 ± 1.23 cm and a mean weight of 104.87 ± 9.87 g. Sea cucumbers are regarded as a high-quality seafood with medicinal value and are generally consumed raw, dried or boiled to optimise their medicinal properties. They are rich in protein, which makes up around 50% of the dried product (Table 1), but this richness varies between species. Data for sandfish in the present study showed elevated levels of protein (76.57%) compared with other sea cucumber species exported from Fiji. Because of their high protein content, sea cucumbers are also crushed into tablets as human diet supplements. The moisture content of dried sandfish was found to be 9.48%, which was within the range of other sea cucumber species, which ranged from as low as 1.2% to 15.1% (Table 1). This could be due to the water holding capacity of tissue, which varies among sea cucumber species. The moisture content is obviously much higher in fresh sea cucumbers and generally ranges from 76% to 85% (Omran 2013; Haider et al. 2015). Fresh sea cucumbers, including *H. scabra*, also have high protein and low fat contents, and carbohydrate levels similar to those of protein (Table 1). The carbohydrate level of processed *H. scabra* was 2.63% in this study (Table 1).

The total fat in processed dried sandfish was found to be 1.26% compared with a range of 0.3–9.9% in other sea cucumber species (Table 1). The lipids of processed sandfish contain essential fatty acids, including the polyunsaturated fatty acids (PUFA), which are considered vital for human well-being such as eicosapentaenoic acid (20:5(n-3), EPA), docosahexaenoic acid (C22:6(n-3), DHA) and arachidonic acid (20:4(n-6), AA) (Table 2). These PUFA are associated with reduced risk of coronary heart disease and cancer. The ash content of processed sandfish is 10.06% and within the range of values reported for other sea cucumber species (2.12–39.6%; Table 2). The relatively high values for ash are due to the presence of spicules or ossicles (calcium carbonate) in the epidermis.

Table 1. Proximate composition of processed dried sea cucumbers.

Species	Moisture (%)	Ash (%)	Total protein (%)	Total fat (%)	Carbohydrates (%)	References
Holothuria scabra	9.48	10.06	76.57	1.26	2.63	(Present study)
Holothuria scabra	N/A	2.26	43.43	5.66	48.65	(Omran 2013)
Holothuria fuscogilva	11.6	26.4	57.8	0.3	N/A	(Wen et al. 2010)
Thelenota ananas	15.1	25.1	55.2	1.9	N/A	(Wen et al. 2010)
Stichopus hermanni	10.2	37.9	47.0	0.8	N/A	(Wen et al. 2010)
Thelenota anax	1.2	39.2	40.7	9.9	N/A	(Wen et al. 2010)
Holothurian fuscopunctata	7.0	39.6	50.1	0.3	N/A	(Wen et al. 2010)
Bohadschia argus	13.0	17.7	62.1	1.1	N/A	(Wen et al. 2010)
Bohadschia marmorata	N/A	6.03	43.23	4.83	45.91	(Omran 2013)
Holothuria leucospilota	N/A	4.3	45.71	4.60	44.96	(Omran 2013)
Actinopyga mauritiana	N/A	2.12	48.27	4.99	44.62	(Omran 2013)
Actinopyga mauritiana	N/A	31.81	66.86	0.76	N/A	(Haider et al. 2015)

Table 2: The major fatty acids in processed (dried) *Holothuria scabra*.

Fatty acid	Common name	Content (mg g^{-1} dry)
16:0	palmitic acid	24.66 ± 11.75
18:0	stearic acid	27.78 ± 6.01
16:1(n-7)	palmitoleic acid	11.00 ± 6.51
18:3(n-3)	linolenic acid	Not detected
20:4(n-6)	arachidonic acid (ARA)	19.22 ± 0.97
20:5(n-3)	eicosapentaenoic acid (EPA)	14.45 ± 1.21
22:6(n-3)	docosohexaenoic acid (DHA)	0.49 ± 0.27*

Sea cucumbers also contain essential minerals, including copper, magnesium and potassium, which assist human metabolic processes such as gastrointestinal functioning and nervous and immune functions. Sea cucumber tissues also contain high levels of amino acids and collagen. The most abundant amino acids in sea cucumbers were glycine, glutamic acid, aspartic acid, alanine and arginine that together constituted between 58% and 65% of the total amino acids. Glycine has been reported to help in reducing serum cholesterol levels.

Sea cucumbers serve as a tonic and traditional remedy for many ailments, and are considered to have unique biological and pharmacological properties, including antiangiogenic, anticancer, anticoagulant, antihypertension, anti-inflammatory, antimicrobial, antioxidant, antithrombotic, antitumor and wound healing activities. Such medicinal properties are related to the presence of bioactive compounds such as triterpene glycosides (saponins), chondroitin sulfates, glycosaminoglycan, sulfated polysaccharides, sterols (glycosides and sulfates), phenolics, specific peptides, cerebrosides and lectins. Consumption of sea cucumbers is thought to aid growth, blood clotting and wound healing thereby supporting their use as a traditional remedy for burns and cuts.

Consumption of sea cucumbers is associated with a number of health benefits; however, incorrect processing techniques used in the Pacific Islands are potentially destructive to the nutrient composition of resulting BDM. Repeated boiling and drying reduces levels of proteins, fatty acids, amino acids and minerals during the processing of sea cucumbers. Less destructive processing techniques need to be established that help retain key nutrients, resulting in more nutritious and beneficial products. Further studies are needed in this field, including a study of seasonal changes in nutrient compositions of sea cucumbers that would help define optimal harvesting times.

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