Life Sciences, Medicine and Biomedicine LSMB

Review Article

Profiles and Biological Values of Sea Cucumbers: A Mini Review

Siti Fathiah Masre

Biomedical Science Programme, Faculty of Health Sciences, Universiti Kebangsaan Malaysia (UKM), 50300 Kuala Lumpur, Malaysia.

https://doi.org/10.28916/lsmb.2.4.2018.25
Received 8 October 2018, Revisions received 19 November 2018, Accepted 23 November 2018, Available online 31 December 2018

Abstract

Sea cucumbers, blind cylindrical marine invertebrates that live in the ocean intertidal beds have more than thousand species available of varying morphology and colours throughout the world. Sea cucumbers have long been exploited in traditional treatment as a source of natural medicinal compounds. Various nutritional and therapeutic values have been linked to this invertebrate. These creatures have been eaten since ancient times and purported as the most commonly consumed echinoderms. Some important biological activities of sea cucumbers including anti-hypertension, anti-inflammatory, anti-cancer, anti-asthmatic, anti-bacterial and wound healing. Thus, this short review comes with the principal aim to cover the profile, taxonomy, together with nutritional and medicinal properties of sea cucumbers.

Keywords: sea cucumber; invertebrate; echinoderm; therapeutic; taxonomy.

1.0 Introduction

Sea cucumbers are marine invertebrate under phylum Echinodermata (Kamarudin *et al.,* 2017). This cylindrical invertebrate that lives throughout the worlds' oceans bed is known as sea cucumber or 'gamat' in Malaysia (Kamarudin *et al.,* 2017). There are more than 1200 sea cucumber species available of varying morphology and colours throughout the world (Oh *et al.,* 2017). Within the coastal areas of Malaysia, sea cucumbers can be located in Semporna Island, Pangkor Island, Tioman Island, Langkawi Island and coastal areas within Terengganu. Among the most popular species are *Stichopus hermanni*, *Stichopus horrens*, *Holothuria atra*, *Holothuria fuscogilva* and *Holothuria scabra* (Zulfaqar *et al.,* 2016). Among the 80 species of sea cucumbers found in coastal areas of Malaysia (Kamarudin *et al.,* 2010), a few of them are toxic, but most are seafood delicacies. Sea cucumbers have been eaten since ancient times and are among the most commonly consumed echinoderms (Hirimuthugoda *et al.,* 2006). Even in South-East Asia, sea cucumbers can be found taken as an essential food supplement as they contain high nutritional values (Manan *et al.,* 2016).

Sea cucumbers and their products have long been purported as a source of traditional medicines due to their various important nutritional and medicinal values (Pangestuti and Arifin, 2018; Oh *et al.,* 2017). Furthermore, these invertebrates have been reported to cure several ailments and diseases (Pangestuti and Arifin, 2018; Masre *et al.,* 2015). Traditional believers often consume the fluid portion of sea cucumbers to remain fits and healthy, and fishermen have practised this action while out of the sea for an extended period. Sea cucumbers are also reputed to reduce hypertension, useful in asthma, healing of internal wounds and may act as an anticancer (Pangestuti and Arifin, 2018). Furthermore, the coelomic fluid of sea cucumbers has been reported to contain high bioactive substances that are suggestive to orchestrate an essential role in wound healing (Masre *et al.,* 2015). Therefore, the objectives of this review article are to present in details the profile of sea cucumbers, the taxonomy of sea cucumbers, and to discuss various nutritional and medicinal values of sea cucumbers.

***** Correspondence: *Biomedical Science Programme, Faculty of Health Sciences, Universiti Kebangsaan Malaysia (UKM), 50300 Kuala Lumpur, Malaysia.*
e-Mail: sitifathiah@ukm.edu.my

2.0 Profile of sea cucumbers

The sea cucumber is better known as *Gamat* by the Malays and *Hoisam* by the Chinese (Kamarudin *et al.,* 2015). They are also called *trepang* or *bêche-de-Mer* (Purcell *et al.,* 2018), while it is called *bat* or *balat* and *brunok* in the East Malaysia (Kamarudin *et al.,* 2015). Sea cucumber is an extended class of echinoderms, Holothuroidea. Animals in the Holothuroidea class are characterised by their soft body tissue, bilaterally symmetrical, and lie on one side with an elongated body axis between the mouth and the anus (Sim, 2005; Moore, 2006). They also have three tissue layers and a coelom (Moore, 2006).

Sea cucumbers are a soft-bodied, invertebrate relative of the starfish and sea urchin (Charles Darwin, 2006). They are tube-shaped animals somewhat like worms and come in a variety of colours (Conand, 2006) and sizes reaching up to a meter in length and over 5kg of weight (Mondol *et al.,* 2017; Kerr and Kim, 2001). Sea cucumbers have a mouth at one end, and an anus at the other end and these creatures do not have a real head (LeBlanc, 2005). The integument body wall of sea cucumbers is muscular and has embedded spicules, but these invertebrates are unique by having no bones. The spicules are in many different shapes that correspond to each sea cucumber species (Salarzadeh *et al.,* 2013). The integument body wall of sea cucumber consists of a thick dermal region including loose and dense connective tissues, circular and longitudinal muscles and coelomic epithelium (Miguel-Ruiz and García-Arrarás, 2007).

Meanwhile, the visceral internal parts of sea cucumber consist of many subdivisions of the sea cucumber coelom, which are the water vascular system and the body coelom. The body coelom of sea cucumber contains the internal visceral organs, and it is the central body cavity in the inner parts of the sea cucumber. For the coelomic fluid of sea cucumber, it is produced by the water vascular system and filled up the coelom space (Jiang *et al.,* 2016; Mokhlesi *et al.,* 2012). Sea cucumbers have a single, branched gonad. Respiratory trees that are also a characteristic of sea cucumbers have highly branched tubes attached to the intestine, and this structure facilitates sea cucumbers in taking the oxygenated sea water (Zhao *et al.,* 2014; Moore, 2006).

Most sea cucumbers are deposit-feeders that ingest sediment with organic matter (MacTavish *et al.,* 2012; Michio *et al.,* 2003). They belong to the family Aspidochirotida, which includes the Holothuriidae and Stichopodidae. Other sea cucumbers are suspension feeders, and these belong to the family Dendrochirotida, which includes the genus *Cucumaria* (Kelly, 2005). Their anterior tube feet will form long buccal tentacles that are held out to the mouth like a net or gather food from the sand (Moore, 2006). Sea cucumbers have slow locomotion either by worm-like wriggling of the muscular body wall or by tube feet in ambulacral grooves on the underside of its body (Moore, 2006).

These invertebrates have a lifespan of five to ten years and most of the time they reproduce within two to six years' period (Kelly, 2005). Sea cucumbers can reproduce through sexual reproduction as well as asexual reproduction. Commonly, they reproduce sexually, but the process is not too intimate, where the eggs and sperm are ejected in the water and fertilised. The event followed by the formation of larvae which float in the ocean until they settle in an appropriate place. Then, juvenile sea cucumbers are formed from the larvae and will develop into adult sea cucumbers (SPC, 2010; Charles Darwin, 2006). In asexual reproduction, sea cucumbers propagate through the process of transverse fission that occur under natural conditions and then regenerate either the anterior or posterior end (Mackey and Hentschel, 2002). These invertebrates can be found at all depth of the sea from the intertidal zone to the deepest oceanic trenches, and are distributed over all latitudes from the poles to the tropics (Mondol *et al.,* 2017; Hawa *et al.,* 2004).

3.0 Taxonomy of sea cucumbers

Inevitably, the taxonomy for several groups of sea cucumber remains unclear, and even certain species have been redefined in the past decade (Toral-Granda *et al.,* 2008). Holothuroidea, sea cucumbers are one of the five defined classes under the phylum of Echinodermata, the most acquainted marine invertebrates (Mondol *et al.,* 2017; Zito *et al.,* 2005). There are three subclasses under Holothuroidea; Apodacea, Aspidochirotacea and Dendrochirotacea (Mondol *et al.,* 2017) and six orders under the Holothuroidea class; i) Aspidochirotida, ii) Apodida, iii) Dactylochirotida, iv) Dendrochirotida, v) Elasipodida and vi) Molpadiida (Mondol *et al.,* 2017). Furthermore, Holothuriidae and Stichopodidae are the two well-known families of sea cucumber especially in Malaysia from the Aspidochirotida order that are commonly well explored (Choo, 2008). Then, under the Stichopodidae family in Malaysia, there are two genera which are *Stichopus* and *Thelenota* (Kamarudin *et al.,* 2015). While under the Holothuriidae family, the genera are *Holothuria, Actinopyga, Pearsonothuria,* and *Bohadschia* (Bordbar *et al.,* 2011).

The essential keys for identification of sea cucumber until species phase could be determined by the spicules and ossicles shape found in the dermis layer around the sea cucumber's integument body wall (Kamarudin *et al.,* 2017; Salarzadeh *et al.,* 2013) and also are influenced by the internal organs like gonad system and respiratory tree (Pratas *et al.,* 2017; Kamarudin *et al.,* 2010). In Malaysia, the total of sea cucumber species from the genus *Holothuria* and genus *Stichopus* is comprised of 16 and 8 species respectively that was found to date (Kamarudin *et al.,* 2015) and this amount included only a small portion of a total of approximately 1250 identified sea cucumber species in the world (Oh *et al.,* 2017). The *Stichopus spp.* from the family Stichopodidae has been taxonomically described as *gamat* among locals, and this includes *Stichopus horrens* and *Thelenota anax* (Kamarudin *et al.,* 2015).

However, identification of taxonomy for the species in a universally way is a scientific discipline that is still controversial and often seen as a burden rather than a facility by a large number of biologists. For example, *S. variegatus* which holds its name from 1868 until 1995 when researchers changed its name to *S. horrens* in 1995 when they found that it is synonym to *S. variegatus* (Samyn, 2000). Furthermore, *S. variegatus* also frequently mistaken to be similar to *S. hermanni*. However, with detail observations, the behavioural differences have been detected where it is proved that sea cucumber *S. hermanni* is a diurnal species while the other species is a nocturnal type (Zulfigar *et al.,* 2000). Therefore, the erroneous in identifying the taxonomy of sea cucumber should be avoided as it could bring incorrect conclusions in fundamental and practical levels in the future (Samyn, 2000).

4.0 Nutritional and medicinal values of sea cucumber

Historically for over many centuries, sea cucumbers have been an exotic food delicacy and utilised in folk medicines for the Asians. Sea cucumbers circuitously create a potential contribution to economies and livelihoods of coastal communities, being the most economically important fishery and non-finfish export in many countries (Purcell *et al.,* 2018). Sea cucumber can be consumed in many ways, and the most favoured product is the dry integument body wall known as *beche-de-mer* that has been considered as a food delicacy and folk medicine for many people particularly in Asia and the Middle East (Oh *et al.,* 2017). It is believed as an ultimate food for people with high blood pressure and muscular disorders due to its minimal fat and high protein contents (Wen *et al.,* 2010).

People in Western Pacific regularly consumed sea cucumbers especially the organ parts as a source of protein for traditional diets (Purcell *et al.,* 2014; Toral-Granda *et al.,* 2008). Moreover, the internal organs of sea cucumbers are believed to be good for pregnant and parturient women (Mao et al., 2015; Lambeth, 2000). Since the sixteenth century, the Chinese had treated sea cucumber as medicinal substances

and it was first written in the Bencao Gangmu which is a highly influential of materia medica (Hoek and Bayoumi, 2017). From local perspectives, the healing properties of sea cucumber came to light when injured fishers applied the coelomic fluid from sea cucumbers to their wounds and learned that the wounded area healed rapidly (Farouk *et al.*, 2007).

Primarily, sea cucumber has been collected for food, but extensive research on sea cucumber has discovered it as a source of medicinal components (Pangestuti and Arifin, 2018). Sea cucumbers have real therapeutic value and potential to be commercialised in the field of modern treatment and cosmetics. These creatures are well known of their high protein contents and a very minimal carbohydrate and fat levels (Zaenuri *et al.*, 2016; Olivera-Castillo *et al.*, 2013). The amino acids profile, especially the essential amino acids and the presence of necessary trace elements makes sea cucumber a healthy food item (Zaenuri et al., 2016). The dominant amino acids found in sea cucumbers are glutamic acid, glycine, and proline (Sroyraya *et al.*, 2017; Wen *et al.*, 2010). Also, sea cucumbers do contain rich nutritional contents comprising arachidonic acids, glycosaminoglycan, collagen, gamma aminobutyric acid (GABA), vitamin C and E, (Sroyraya *et al.*, 2017; Li *et al.*, 2017; Masre *et al.*, 2011). The integument body wall of sea cucumber consists of rich insoluble collagen, which has several pharmacological roles including tissue repair (Park *et al.*, 2012), antioxidant (Abedin *et al.*, 2014) and anticancer (Zhou *et al.*, 2012). Furthermore, the extracts from the digestive tract, gonad, muscles, and respiratory tract of sea cucumber, *Cucumaria frondosa* showed an excellent potency of an antioxidant activity due to its high amounts of phenols and flavonoids compounds (Mamelona *et al.*, 2007).

Sea cucumber has been nominated as poly-anion-rich food due to the presence of glycosaminoglycan (GAG) (Li *et al.*, 2017) that has several physiologically active functions including (a) inhibition of some cancer cells such as colon cancer (Borsig *et al.*, 2007) and melanoma (Zhao *et al.*, 2013); (b) enforcing immune function (Wang *et al.*, 2017); (c) anticoagulant (Wu *et al.*, 2015); and (d) antidyslipidemia (Qi *et al.*, 2017). Another active substance in sea cucumbers, triterpene glycosides also reported having potential in tissue repair and wound healing (Pangestuti and Arifin, 2018), anticancer activity in leukemic cells (Yun *et al.*, 2012), antifungal (Park *et al.*, 2014), and antiobesity effect (Guo *et al.*, 2016).

Additionally, several past studies have indicated that the sea cucumber extracts have the antibacterial activity (Kiani *et al.*, 2014; Farjami *et al.*, 2013). Farouk *et al.*, (2007) showed particular Malaysian sea cucumber species (*Holothuria atra* and *Cucumaria fundosa*) having a moderate antibacterial activity against *Klebsiella pneumoniae*, *Serratia marscens*, *Pseudomonas aeruginosa* and *Enterococcus feacalis*. Moreover, sea cucumbers have been recorded to display curative effects on many diseases such as liver and kidney diseases (Dakrory *et al.*, 2015), constipation (Wen *et al.*, 2010), hypertension (Sadegh *et al.*, 2016), asthma (Lee *et al.*, 2016) and rheumatoid arthritis (Oh *et al.*, 2017). Meanwhile, the invertebrate's body wall exhibited a neuroprotective effect after spinal cord injury (Patar *et al.*, 2012) and an inhibitory effect on gastric ulcer (Fahmy *et al.*, 2015).

5.0 Conclusion

Sea cucumbers are highly valuable commodity since the past decades due to their therapeutic and nutritional properties. Overall, there are two main salient features of sea cucumber. First, undoubtedly is their medicinal value. Researchers isolate their active compound to exploit in countless biological activities. Second, sea cucumber could be generated as a multimillion-dollar item as they form a gourmet food and increase the development of the food industry throughout the world.

6.0 Declaration

The author declares no conflicts of interest in this work.

7.0 Acknowledgements

The author is grateful to the Biomedical Science Programme, Faculty of Health Sciences, National University of Malaysia for the facilities.

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