IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 12, Issue 5 Ver. III (Sep. – Oct. 2017), PP 30-36
www.iosrjournals.org

Review, The (medical) benefits and disadvantage of sea cucumber

Leonie Sophia van den Hoek, [1)] Emad K. Bayoumi [2).]
[1] *Department of Marine Biology Science, Liberty International University, Wilmington, USA. Professional Member Marine Biological Association, UK.*
[2] *Department of General Surgery, Medical Academy Named after S. I. Georgiesky of Crimea Federal University, Crimea, Russia*
Corresponding Author: Leonie Sophia van den Hoek

Abstract: *A remarkable feature of Holothurians is the catch collagen that forms their body wall. Catch collagen has two states, soft and stiff, that are under neurological control [1]. A study [3] provides evidence that the process of new organ formation in holothurians can be described as an intermediate process showing characteristics of both epimorphic and morphallactic phenomena. Tropical sea cucumbers, have a previously unappreciated role in the support of ecosystem resilience in the face of global change, it is an important consideration with respect to the bêche-de-mer trade to ensure sea cucumber populations are sustained in a future ocean [9]. Medical benefits of the sea cucumber are; Losing weight [19], decreasing cholesterol [10], improved calcium solubility under simulated gastrointestinal digestion and also promoted calcium absorption in Caco-2 and HT-29 cells [20], reducing arthritis pain [21], HIV therapy [21], treatment osteoarthritis [21], antifungal steroid glycoside [22], collagen protein [14], alternative to mammalian collagen [14], alternative for blood thinners [29], enhancing immunity and disease resistance [30]. However tropical sea cucumbers, have a previously unappreciated role in the support of ecosystem resilience in the face of global change, it is an important consideration with respect to the bêche-de-mer trade to ensure sea cucumber populations are sustained in a future ocean. [9] Thus, if we like to use the sea cucumber for our benefit in the medical healthcare, we must take care of the disadvantage, the effect on the environment related to overfishing. The suggestion from this point of view is to use sea cucumber in the health care, but only use sea cucumbers from mariculture/farming.*

Keywords*: Holothuroidea, collagen, ecosystem resilience, medical benefits, mariculture, farming.*

Date of Submission: 08-09-2017 Date of acceptance: 20-09-2017

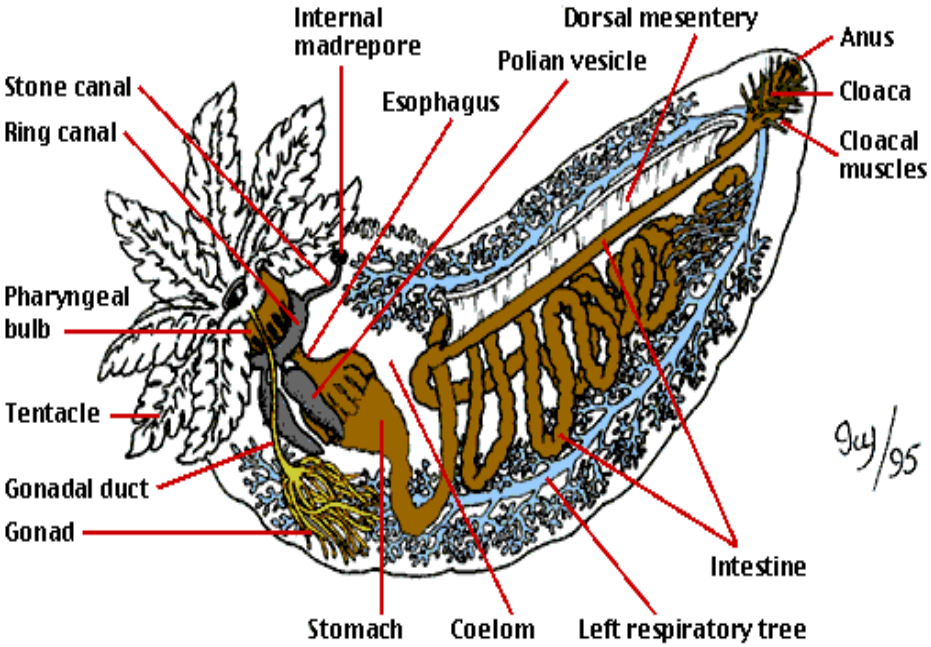
I. Introduction

Sea cucumber is a marine mammal, which can be recognized by their thick leathery skin and body-shape comparable with the fruit cucumber. The classification name of sea cucumber is Holothurian. For this review, we found sea cucumbers in the red sea shallows, we added pictures of our findings. See picture 1 and 2;

Picture 1; sea cucumber in the red sea 2-3 meter deep.

Picture 2, sea cucumber in the red sea 2-3 meter deep.

A remarkable feature of Holothurians is the catch collagen that forms their body wall. Catch collagen has two states, soft and stiff, that are under neurological control [1].



This can be loosened and tightened at will, and if the animal wants to squeeze through a small gap, it can essentially liquefy its body and pour into the space. To keep itself safe in these crevices and cracks, the sea cucumber will hook up all its collagen fibers to make its body firm again [2]. Sea figure 1 for the anatomy of the sea cucumber;

Figure 1: Main internal anatomical features of a cucumariid sea cucumber (Dendrochirotida). Drawing by Ivy Livingstone. Copyright © 1995 BIODIDAC.

We removed the sea cucumber organs and cut him open, to show the leathery skin of the mammal from the inside and out, see pictures 2 and 3;

Picture 2 and 3, sea cucumbers from the red sea, stripped from organs.

Echinoderms are the deuterostome group with the most striking capacity to regenerate lost body parts. Members of the class Holothuroidea can regenerate most of their internal organs following a typical evisceration process [3]. A study [3] provides evidence that the process of new organ formation in holothurians can be described as an intermediate process showing characteristics of both epimorphic and morphallactic phenomena.

In using sea cucumber for our we benefit we must take care of its defends mechanism, sea cucumbers (Holothuroidea) eject parts of the gut in order to scare and defend against potential predators such as crabs and fish [4], or humans.

When stressed, the sea cucumber faces away from the attacker and contracts its body wall muscles sharply. This causes the wall of the cloaca to tear and the anus to gape. This process can take 20 minutes, with final detachment of the tentacles and introvert sometimes taking as long as 12 hours [5, 6, 7]. See pictures 4 and 5.

Picture 4 and 5; result of rejecting body parts of the sea cucumber.

In contrast, A research, [8] hypothesizes that visceral atrophy in P. californicus is an expression of seasonal diapause induced by reduced food availability. And not as said above, as a defends against other mammals.

Role Sea cucumber in ecosystems

Tropical sea cucumbers, have a previously unappreciated role in the support of ecosystem resilience in the face of global change, it is an important consideration with respect to the bêche-de-mer trade to ensure sea cucumber populations are sustained in a future ocean. Sea cucumbers, some of the largest benthic inhabitants of tropical lagoon systems, can influence diel changes in reef carbonate dynamics. Whether they have the potential to exacerbate or buffer ocean acidification over diel cycles depends on their relative production of total alkalinity (AT) through the dissolution of ingested calcium carbonate (CaCO3) sediments and release of dissolved inorganic carbon (CT) through respiration and trophic interactions [9]. In a recent study [9], the potential for the sea cucumber, Stichopus herrmanni, a bêche-de-mer (fished) species listed as vulnerable to extinction, to buffer the impacts of ocean acidification on reef carbonate chemistry was investigated in lagoon sediment mesocosms across diel cycles. Stichopus herrmanni directly reduced the abundance of meiofauna and benthic primary producers through its deposit-feeding activity under present-day and near-future pCO2. These changes in benthic community structure, as well as AT (sediment dissolution) and CT(respiration) production by S. herrmanni, played a significant role in modifying seawater carbonate dynamics night and day [9].

Furthermore, Sea cucumbers are thought to play an important role in the recycling and remineralization of organic matter in reef sands through feeding and bioturbation [10]. Sediments in tropical coastal habitats can trap a substantial amount of organic matter [11]. Water flows can transport OM into and within the sediment, and small organisms living within sediments are able to efficiently degrade OM [12]. Because the seafloor and the overlying water are closely linked through such transport processes, changing the function of sediments can have direct negative consequences on the quality of the overlying water [11]. Porous sediments are thus considered as a kind of biocatalytical filter system [12]. Thus, the removal of sea cucumbers reduces the

efficiency of reef sediment to function as a filter system to buffer organic matter pulses, and negatively affects the function and productivity of inshore reef ecosystems [10 - 13].

Dietary delicacy and a traditional remedy

Sea Cucumbers are fascinating in their use. For example, eating *trepan*, sea cucumber, is a custom in China, especially in coastal areas. From the nutritional viewpoint, sea cucumber is an ideal tonic food. It is higher in protein and lower in fat than most foods. And in Malaysia, sea cucumber generally known as "Gamat" is a dietary delicacy and a traditional remedy for healing various internal and external wounds [14 - 15].

The history of sea cucumber in China can be traced back to the Ming Dynasty (1368–1644 BC) at least, when sea cucumber was recorded in the Bencao Gangmu, a famous materia medica written by Li Shizhen. Sea cucumber was recorded as a tonic and a traditional medicine in many ancient writings (e.g. Shiwu Bencao, Bencao Gangmu Shiyi, Wuzazu, Bencao Congxin) from the Ming Dynasty to the Qing Dynasty [16 - 17].

In India Larvae and juveniles, were produced for the first time in 1988 at the Research Centre of Central Marine Fisheries Research Institute of Tuticorin on the south-eastern coast of India. The culture of sea cucumbers in prawn farms comes as a bonus for the prawn farmers. However, in recent years the prawn farming industry in India has been rocked by disease and legal problems [18].

Medical benefits sea cucumber

Sea cucumber has several medical benefits, such as a new research [19] has shown us the use of sea cucumber in losing weight and A high fat diet (HFD) supplemented with sea cucumber (SC) prevents obesity and protects against HFD associated metabolic dysfunction, such as an increase in plasma glucose, non-esterified fatty acids (NEFA) and triacylglycerol (TAG), which are the markers for insulin resistance, by targeting adiponectin. Furthermore, SC protects against hypercholesterolemia by increasing the mRNA expression of ATP-binding cassette (ABC) G-5 and -8 in the intestine, thereby increasing cholesterol excretion. X represents inhibition by SC. See Figure 2 [19].

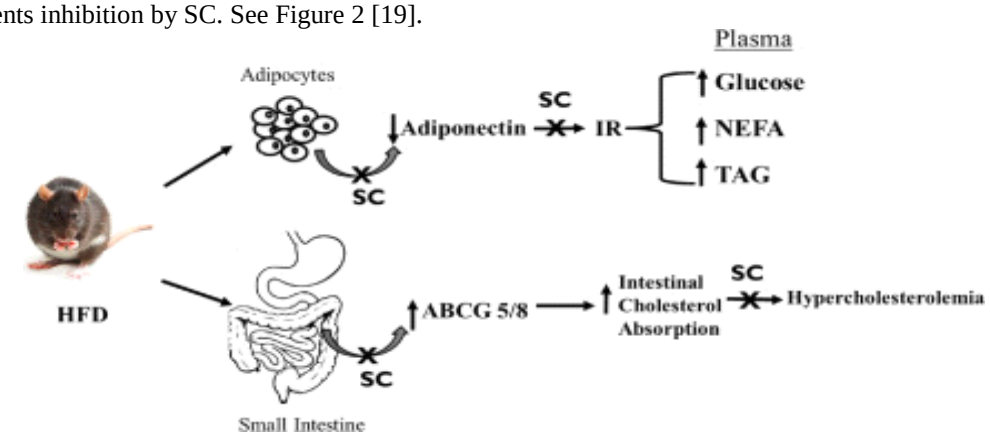


Figure 2, Graphical abstract of a high fat diet (HFD) supplemented with sea cucumber (SC) [19].

And another research shows that Carboxyl oxygen and amino nitrogen atoms in the SCOHs could bind calcium ions, forming SCOH–calcium complexes. These complexes improved calcium solubility under simulated gastrointestinal digestion and promoted calcium absorption in Caco-2 and HT-29 cells [20].

For modern applications, dried sea cucumber used as a nutritional supplement is prepared in capsules or tablets. The fully dried material has a protein concentration as high as 83 per cent. From the Western medical viewpoint, the reason sea cucumber is valuable is it serves as a rich source of the polysaccharide chondroitin sulfate, which is well known for its ability to reduce arthritis pain: as little as 3 g per day of dried sea cucumber has been helpful in significantly reducing arthralgia. Its action is similar to that of glucosamine sulfate, which is useful for treating osteoarthritis. Sulfated polysaccharides also inhibit viruses; there is a Japanese patent for sea cucumber chondroitin sulfate for HIV therapy [21].

An older research has shown that an antifungal steroid glycoside, holotoxin, has been isolated from the sea cucumber Stichopus japonicus (Selenka). In vitro, it exhibits high activity against various fungi, including vegetable pathogens, but has scarcely any activity against Gram-positive and Gram-negative bacteria and mycobacteria in vitro [22].

Sea cucumber (Echinodermata: Holothuroidea), in wet or dried form has high commercial value, with increasing global production and world trade. The body wall of sea cucumber, Bohadschia bivitatta, was studied with respect to its collagen protein. About 70% of the total body wall protein was accounted for by highly insoluble collagen fibers. High yield of Pepsin-solubilized collagen was successfully isolated, and evidence of Diperiodic bands confirms it as fibrillar collagen. This collagen could be useful as an alternative to mammalian

collagen in the nutraceutical and pharmaceutical industries [14]. Collagen is an abundant protein in animal tissues and has a wide range of applications in the biomedical, pharmaceutical, cosmetic, and food industries [23].

Furthermore various bioactive compounds have been identified from sea cucumbers, such as, Frondanol A5 from Cucumaria frondosa for its chemo preventative effects, [24] Mucopolysaccharides from Stichopus japonicus for anticancer effects, [25] Sulphated polysaccharides from S. japonicus for proliferation neural stem/progenitor cells, [26] Saponins from Pentacta quadrangular is for anti-angiogenic effect, [27] and Pepsin-Solubilized Collagen (PSC) from S. japonicas to improve proliferation of human keratinocytes [28].
In a recent study [29], the fucosylated chondroitin sulfate was purified from sea cucumber Holothuria polii. They investigated the physicochemical and structural characteristics of FuCS. FuCS has a high sulfate content and a relatively low average molecular mass. The FuCS exhibited a high anticoagulant effect mediated by both HCII and AT. They found that FuCS represent a naturally alternative for first generation anticoagulants [29]. Thus, sea cucumber can be used as an alternative for blood thinners.

In another study, a feeding experiment was conducted to investigate the interaction of probiotic Bacillus subtilis and prebiotic fructooligosaccharide (FOS) on the growth performance, immunity, intestinal microflora and disease resistance of sea cucumber (Apostichopus japonicus). In the groups with 1.82 × 107 CFU B. subtilis/g diet, FOS supplementation remarkably decreased VBC. And higher level of FOS (0.50%) resulted in significantly higher TCC and PO activity compared with 0.25% FOS ($P < 0.05$). Moreover, the animals fed with diets supplemented with 0.25% and 0.50% FOS at each B. subtilis level had notably lower cumulative mortality after 14 days following V. splendidus exposure ($P < 0.05$). Under the experimental conditions, dietary B. subtilis and FOS had a synergistic effect on enhancing immunity and disease resistance of sea cucumber ($P < 0.05$) [30].

II. Conclusion

Medical benefits of the sea cucumber are; Losing weight [19], decreasing cholesterol [10], improved calcium solubility under simulated gastrointestinal digestion and promoted calcium absorption in Caco-2 and HT-29 cells [20], reducing arthritis pain [21], treatment osteoarthritis [21], HIV therapy [21], antifungal steroid glycoside [22], collagen protein [14], alternative to mammalian collagen [14], alternative for blood thinners [29], enhancing immunity and disease resistance [30]. However tropical sea cucumbers, have a previously unappreciated role in the support of ecosystem resilience in the face of global change, it is an important consideration with respect to the bêche-de-mer trade to ensure sea cucumber populations are sustained in a future ocean. [9] Thus, if we like to use the sea cucumber for our benefit in the medical healthcare, we must take care of the disadvantage, the effect on the environment related to overfishing.

As seen above, sea cucumber has several medical benefits, this review suggest that we use the sea cucumber for medical purposes, which could replace some chemical medicine used in the health care. From the nutritional viewpoint, sea cucumber is an ideal tonic food. It is higher in protein and lower in fat than most foods. Which could also change the future in modern farming. However, the removal of sea cucumbers reduces the efficiency of reef sediment to function as a filter system to buffer organic matter pulses, and negatively affects the function and productivity of inshore reef ecosystems [10 - 13]. The suggestion from this point of view is to use sea cucumber in the health care, but only use sea cucumbers from mariculture/farming. We should only use sea cucumber from farming because we need to conserve the nature, by stopping the overfishing of the sea cucumber, Holothuroidea [13]. With farming we can also adjust to the amount of production sea cucumbers we need.

References

[1] Jose del Castillo and David S. Smith. (1996) "We Still Invoke Friction and Occam's Razor to Explain Catch in the Spines of Eucidaris Tribuloides." Biological Bulletin 190:243-244
[2] Piper, Ross (2007). Extraordinary Animals: An Encyclopedia of Curious and Unusual Animals. Greenwood Press. ISBN 0-313-33922-8.
[3] José E. García-Arrarás, Lourdes Estrada-Rodgers, Roberto Santiago, Irma I. Torres, Lucy Díaz-Miranda, Ilia Torres-Avillán. Cellular mechanisms of intestine regeneration in the sea cucumber, Holothuria glaberrima Selenka (Holothuroidea:Echinodermata). Journal of Experimental Zoology, Volume 281, Issue 4, 1 July 1998, Pages 288–304 1. DOI: 10.1002/(SICI)1097-010X(19980701)281:4<288::AID-JEZ5>3.0.CO;2-K
[4] Flammang, P.; Ribesse, J. & Jangoux, M. (2002). "Biomechanics of adhesion in sea cucumber cuvierian tubules (Echinodermata, Holothuroidea)". Integrative and Comparative Biology. 42 (6): 1107–15. PMID 21680394. doi:10.1093/icb/42.6.1107. Retrieved August 14, 2013.
[5] Anon. "Learn about sea cucumbers; Defences and predators". Retrieved August 14, 2013.
[6] Byrne, M. (1985). "Evisceration behaviour and the seasonal incidence of evisceration in the Holothurian Eupentacta quinquestemita (Selenka)". Ophelia. 24 (2): 75–90. doi:10.1080/00785236.1985.10426621.
[7] Byrne, M. (2001). "The morphology of autotomy structures in the sea cucumber Eupentacta quinquesemita before and during evisceration". Journal of Experimental Biology. 204: 849–863. PMID 11171409.
[8] Peter V. Fankboner and, J. Lane Cameron, Seasonal atrophy of the visceral organs in a sea cucumber. Canadian Journal of Zoology, 1985, 63(12): 2888-2892, https://doi.org/10.1139/z85-432.

[9] Kennedy Wolfe, Francisco Vidal-Ramirez, Sophie Dove, Dione Deaker, Maria Byrne. Altered sediment biota and lagoon habitat carbonate dynamics due to sea cucumber bioturbation in a high-pCO2 environment. Global Change Biology, 20 July 2017, DOI: 10.1111/gcb.13826.

[10] Eriksson, H. and Byrne, M. (2015), The sea cucumber fishery in Australia's Great Barrier Reef Marine Park follows global patterns of serial exploitation. Fish Fish, 16: 329–341. doi:10.1111/faf.12059

[11] Lee S, Ferse S, Ford A, Wild C, Mangubhai S (2017) Effect of sea cucumber density on the health of reef-flat sediments. In S. Mangubhai, W. Lalavanua and S.W. Purcell (eds.). Fiji's Sea Cucumber Fishery: Advances in Science for Improved Management. Wildlife Conservation Society. Report No. 01/17. Suva, Fiji. pp. 54–61.

[12] Wild C, Rasheed M, Werner U, Franke U, Johnstone R, Huettel M (2004) Degradation and mineralization of coral mucus in reef environments. Marine Ecology Progress Series 267:159–171

[13] Leonie Sophia van den Hoek, Emad K. Bayoumi. Management of global sea cucumber utilization, 2017

[14] Siddiqui YDa, Arief EMa*, Yusoff Aa, Hamid SSAb, Norani TYa, Abdullah MYSa, Extraction, Purification and Physical Characterization of Collagen from Body wall of Sea cucumber Bohadschia bivitatta, Siddiqui et al. 2013 Health and the Environment Journal, 2013, Vol 4, No. 2 pp.

[15] Jiaxin Chen, Overview of sea cucumber farming and sea ranching practices in China. SPC Beche-de-mer Information Bulletin #18 – May 2003.

[16] Huizeng, F. 2001. Sea cucumber: Ginseng of sea. Zhongguo Marine Medicine, 82(4):37–44.

[17] Yuhai, J. 1996. Blue Materia Medica, China pharmaceutics of marine, lakes and marshes. Xueyuan Press.156–160

[18] James, D B (2004) Captive breeding of the sea cucumber, Holothuria scabra, from India. FAO Fisheries Technical Paper (463). pp. 385-395.

[19] Surendiran Gangadarana, Sukhinder Kaur Cheemaa. A high fat diet enriched with sea cucumber gut powder provides cardio-protective and anti-obesity effects in C57BL/6 mice. (2017) Elsevier, https://doi.org/10.1016/j.foodres.2017.06.066

[20] Sun, N., Cui, P., Lin, S., Yu, C., Tang, Y., Wei, Y., Xiong, Y. and Wu, H. (2017), Characterization of sea cucumber (*stichopus japonicus*) ovum hydrolysates: calcium chelation, solubility and absorption into intestinal epithelial cells. J. Sci. Food Agric. doi:10.1002/jsfa.8330

[21] Jiaxin Chen, Overview of sea cucumber farming and sea ranching practices in China. SPC Beche-de-mer Information Bulletin #18 – May 2003.

[22] Shigetoshi Shimada, Antifungal Steroid Glycoside from Sea Cucumber, Science 28 Mar 1969: Vol. 163, Issue 3874, pp. 1462 DOI: 10.1126/science.163.3874.1462

[23] Kittiphattanabawon, P., Benjakul, S., Visessanguan, W., Nagai, T. & Tanaka, M. (2005). Characterisation of acid-soluble collagen from skin and bone of bigeye snapper (Priacanthus tayenus). Food Chemistry, 89(3), 363-372.

[24] Janakiram, N. B., Mohammed, A., Zhang, Y., Choi, C. I., Woodward, C., Collin, P., Steele, V. E. & Rao, C. V. (2010). Chemopreventive effects of Frondanol A5, a Cucumaria frondosa extract, against rat colon carcinogenesis and inhibition of human colon cancer cell growth. Cancer Prevention Research, 3(1), 82.

[25] Lu, Y., Zhang, B. Y., Dong, Q., Wang, B. L. & Sun, X. B. (2010). The effects of Stichopus japonicus acid mucopolysaccharide on the apoptosis of the human hepatocellular carcinoma cell line HepG2. The American Journal of the Medical Sciences, 339(2), 141

[26] Zhang, Y., Song, S., Song, D., Liang, H., Wang, W. & Ji, A. (2010). Proliferative effects on neural stem/progenitor cells of a sulfated polysaccharide purified from the sea cucumber Stichopus japonicus. Journal of bioscience and bioengineering, 109(1), 67-72.

[27] Tian, F., Zhang, X., Tong, Y., Yi, Y., Zhang, S., Li, L., Sun, P., Lin, L. & Ding, J. (2005). Research Paper PE, a New Sulfated Saponin from Sea Cucumber, Exhibits Anti-Angiogenic and Anti-Tumor Activities In Vitro and In Vivo. Cancer biology & therapy, 4(8), 874-882.

[28] Park, S. Y., Lim, H. K., Lee, S., Hwang, H. C., Cho, S. K. & Cho, M. (2011). Pepsinsolubilized collagen (PSC) from Red Sea cucumber (Stichopus japonicus) regulates cell cycle and the fibronectin synthesis in HaCat cell migration, doi:10.1016/j.foodchem.2011.11.032.

[29] Mohamed Ben Mansour, Rafik Balti, Véronique Ollivier, Hichem Ben Jannet, Frédéric Chaubet, Raoui Mounir Maaroufi. Characterization and anticoagulant activity of a fucosylated chondroitin sulfate with unusually procoagulant effect from sea cucumber. Carbohydrate Polymers, Volume 174, 15 October 2017, Pages 760-771. https://doi.org/10.1016/j.carbpol.2017.06.128.

[30] Qin Zhang. Hongming Ma, Kangsen Mai, Wenbing Zhang, Zhiguo Liufu, Wei Xu, Interaction of dietary Bacillus subtilis and fructooligosaccharide on the growth performance, non-specific immunity of sea cucumber, Apostichopus japonicus. Fish & Shellfish Immunology, Volume 29, Issue 2, August 2010, Pages 204-211 https://doi.org/10.1016/j.fsi.2010.03.009.

[31] All photos are taken by Emad K. Bayoumi in the red sea nearby Saudi-Arabia, Rabigh. Only use the photos with reference to this article.

Leonie Sophia van den Hoek. "Review, The (Medical) benefits and disadvantage of sea cucumber." IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS) , vol. 12, no. 5, 2017, pp. 30–36.