

SEA CUCUMBER FISHERIES, UTILIZATION AND TRADE IN VIETNAM

By Mr. Nguyen Quang Hung ⁹

1. Introduction

Sea cucumber is a valuable and nutritious food. Sea cucumber meat contains many nutrients in a high percentage such as protein (76%), amino acids (lysine, proline ...) and many trace substances such as P, Cu, Fe..., many vitamins, hormones and active biological substances such as Saponin Rg, Rh. It also contains few lipids and almost no cholesterol so that it is a kind of ideal food that can be used by obese people and people with blood-lipid disorders. Furthermore, it is also a kind of good medical material especially in traditional care and cure methods. It can be used in treatment of gastritis and stomach ulcers, anemia, nervous breakdown, lack of libido in men, and backache, amongst other things.

It has varying commercial values depending on species and product. Price of *Holothuria atra* is about \$10 USD per fresh kg, *H. scabra* is about \$20 USD per fresh kg, *H. echinites* is about \$5 USD per fresh kg, *H. nobilis* is about \$14 USD per fresh kg, and *H. ananas* is about \$10 USD per fresh kg.

In Vietnam, sea cucumbers are plentiful and have high biodiversity, with about 90 known species. The *Holothuria*, *Sticopus*, and *Colochirus* families are the most abundant (Thai Tran Bai, 2004). They are found in a variety of geographical areas, from the littoral zone to deep sea, and coral reefs around islands. However, as they are of high economic as well as medicinal value, many species are being overfished. This situation is aggravated due to the irresponsible management and lack of closed control in coastal local authorities, causing the sea cucumber resources to rapidly decline. Many species now are listed as overfished in the Red Book of Vietnam in various districts. Sea cucumbers live abundantly on bottom substrates or in burrows in sand or mud, making them especially vulnerable to fishing in high volume..Data from the Fisheries Department of Kien Giang showed that after 10 years (from 1993 to 2003), total catch around Phu Quoc Islands had reduced by about 10 times (in

1993 total catch was approximately 3 tons per day, but in 2003 total catch had dropped to nearly 0.3 tons per day). Meanwhile, fishing activities that use destructive techniques such as explosives,, bottom trawl, electrical push, and electrical trawl net all pose great threats for sea cucumbers and their ecosystems.

Hence, an understanding of species composition, distribution, biology, fishing status, commercial culture, processed products and extracts from sea cucumbers, as well as marketing and trade of sea cucumbers are all necessary to find suitable solutions to manage and maintain this resource sustainably in Vietnam.

2. Taxonomic information

2.1. Species composition

Statistics obtained from continuing studies indicate that there are about 90 species of sea cucumber in Vietnamese seawaters (Thai Tran Bai, 2004). Sea cucumbers are especially abundant around Cat Ba Island, Co To Island, Bach Long Vi Island, The Gulf of Tonkin, Ly Son Island, Khanh Hoa, Truong Sa Archipelago, Phu Quoc Island, and Tho Chu Island (Dao Tan Ho, 1996). Of the 90 species identified, 19 species belonging to five families Cucumariidae (3 species), Holothuriidae (10 species), Stichopodidae (1 species), Molpadiidae (1 species), Synaptidae (4 species) have been found in The Tonkin Gulf (annex 1).

Khanh Hoa is another area that has an abundant stock of sea cucumbers, of which many species are of economical value i.e. *Holothuria martensii*, *H. atra*, *H. Scabra*, *H. echinites*, *H. mauritiana*, *H. nobilis*, *H. Ananas*.

Con Dao also has high diversity of species with 16 species belonging to five families Holothuriidae (9 species), Stichopodidae (2 species), Cucumariidae (1 species), Caudinidae (1species), Synaptidae (3 species) (annex 2).

⁹ Member of the Ad hoc Regional Working Group on Sea Cucumber Fisheries and National Focal Point for Vietnam, Research Institute for Marine Fisheries (RIMF)

Table 1. Summary table for sea cucumber species composition in Vietnam

Sea cucumber Species	Family name	Local name	Commercial value (Price/kg) – USD (1), (2), (3)
1. <i>Actinopyga echinites</i>	Holothuriidae	Ốn ốt mít, Hối sầm mít	4,5; 10; 21
2. <i>Actinopyga mauritiana</i>	Holothuriidae	Ốn ốt dốa, Hối sầm mít hoa	5; 8; 15
3. <i>Holothuria nobilis</i>	Holothuriidae	Ốn ốt vú, Ốn ốt dốa, Hối sầm vú.	1,7; 3; 5
4. <i>Holothuria atra</i>	Holothuriidae	Hối sầm ền	17,5; 20; 25
5. <i>Holothuria (Mertensiothuria) leucospilota</i>	Holothuriidae	-	9; 15; 25
6. <i>Holothuria impatiens</i>	Holothuriidae	-	2,0; 4,7; 8
7. <i>Holothuria Scabra</i>	Holothuriidae	Hối sầm cát, Hối sầm trồng	1; 1,7; 5
8. <i>Bohadschia graeffei</i>	Holothuriidae	-	10; 15; 21,3
9. <i>Thelenota ananas</i>	Stichopodidae	Ốn ốt lốu, Hối sầm lốu	5; 8; 12,5
10. <i>Stichopus chloronotus</i>	Stichopodidae	Dốa chuốt biốn	-
11. <i>Synapta maculata</i>	Synaptidae	-	-

Note: (1), (2), (3) mean commercial value (price/kg) gradually increase, most of which the price is double 1 to 2 times approximately for each level.

Results obtained from previous studies have shown that genus *Holothuria* can adapt widely to various ecosystems. For example, it can live from high littoral zones to deep reefs around islands.

The genera and families in Vietnamese seawater with the greatest number of species, are Holothuriidae (*Holothuria*, *Sticopus*), Cucumaridae (*Colochirus*, *Cucumaria*), and Sinaptidae (*Protankyra*).

2.2. Biology characters of some common and commercial sea cucumbers in Vietnam

FAMILY: Holothuriidae	
<p>Scientific name: <i>Actinopyga echinites</i> (Jaeger, 1883)</p> <p>Vietnamese name (local name): Ốn ọt mít, Hời sâm mít</p> <p>English name (common name): Deep – water redfish</p> <p>Description:</p> <ul style="list-style-type: none"> - Size: Length: 20 - 30 cm; Width: 2 - 4 cm; Body wall thickness: 7 mm; Live weight: 0.5 - 1 kg - Shape: Body shape is cylindrical, it is wider in the middle and tapers toward the two ends. It lies on dorsal side. There are many papillae and many podia arranged in line along the mouth on the ventral side and 20 tentacles in a circle. Anus is turned dorsally at the ends of the long axis of the body. anus has five teeth around them . (following the specimens) - Color: Brownish. The ventral color is lighter than dorsal color. <p>Habitat: This species is abundant on reef flats and the upper part of coastal reef slopes, on sandy bottoms, turtle-grass beds and among living corals, under littoral, on dead coral, found in high density in 2-5m of water. Average density is a few hundred animals per hectare.</p> <p>Distribution: Vietnam: Khanh Hoa (Hon Khoi, Hon Doi, Hon Tai, Hon Rua, Hon Tre, Hon Mieu), Truong Sa Archipelago, Con Dao Island, Phu Quoc, Tho Chu); World: East Africa, East India, West and South Pacific Ocean</p>	
<p>Scientific name: <i>Actinopyga mauritiana</i> (Quoy & Gaimard, 1883)</p> <p>Vietnamese name (local name): Ốn ọt dĩa, Hời sâm mít hoa</p> <p>English name (common name): Surf redfish (White spotted sea cucumber)</p> <p>Description:</p> <ul style="list-style-type: none"> - Size: Length: 25 - 30 cm; Width: 3 - 4 cm; Weight: up to 1 kg. - Shape: The body of this species of sea cucumber is arched on the upper side and flat on the lower side. Large brown and white speckled cucumber, body lined with tube feet. There are many podia on the ventral side but not arranged into a line. Anus is turned dorsally at the ends of the long axis of the body; ring of five small teeth and a white ring around anus. Mouth with 25 tentacles (following the specimens) <p>Habitat: It is usually found where the surf breaks on the reefs, firmly attached to coral stones, often at a depth of 4 -7 m water.</p> <p>Distribution: Vietnam: Khanh Hoa (Hon Khoi, Hon Tre, Hon Mieu), Truong Sa Archipelago, Con Dao Island, Phu Quoc, Tho Chu; World: East India, North Sea of Australia, West and South Pacific Ocean and Hawaii.</p>	

Scientific name: *Holothuria nobilis* (Selenka, 1867)
Vietnamese name (local name): ốn ốt vú, ốn ốt dầa, Hối sầm vú.
English name (common name): Black teatfish

Description:

- Size: Length: 30- 40 cm; Width: 4- 6cm; Weight: 2- 3 kg
- Shape: Body is loaf-shaped. Six to eight teats like projections can be seen on each side of the body in live specimens. There are many podia on the ventral side but not arranged into a line. Mouth is directed toward the ventral side. Five small teeth and a bunch of teats around anus. The body is covered with a fine coat of coral sand, and is cream colored with black blotches (following the specimens)

Habitat: This species is found in shallow waters in lagoons. It is more commonly found on shallow reef bottoms that are not subject to terrigenous influence, or sandy bottoms at 4 – 7m of water. Juveniles may be found on turtle-grass beds.

Distribution: Vietnam: Khanh Hoa (Hon Doi, Hon Tre), Truong Sa Archipelago, Con Dao Island; World: East Africa, East India, West and South Pacific Ocean.



Scientific name: *Holothuria atra* (Jaeger, 1833)
Vietnamese name (local name): Hối sầm ốen
English name (common name): Lolly fish

Description:

- Size: Length: 10- 50 cm; Width: 3- 8cm; Weight: 0,2- 1,5kg.
- Shape: Body is uniformly black with fine coating of sand and looks like a sausage.

Habitat: The most common species in the tropical Indo – Pacific Ocean. It may form dense aggregations in shallow water sandy habitats, just below the tidal mark.

Distribution: Vietnam: Con Dao Island, Phu Quoc Island, Nha Trang Bay...; World: East Africa, Red Sea, throughout the western Pacific to the Hawaiian Islands (Lembah Strait, Sulawesi, Indonesia).



Scientific name: *Bohadschia graeffei* (Semper, 1868)
Vietnamese name (local name):
English name (common name):

Description:

- Size: Length: 10- 50 cm; Width: 3- 8cm; Weight: 0,2- 1,5kg.
- Shape: This species radically changes its appearance in its transition from a juvenile to an adult. Adults are beige with black spots and short, white-tipped tubercles.

Distribution: Vietnam: Nha Trang Gulf; World: Red Sea, Maldives to Australia; New Caledonia; New Guinea, Indonesia and Philippines (Batangas, Luzon, Madang), Papua New Guinea



Scientific name: *Holothuria (Mertensiothuria) leucospilota* (Brandt, 1835)

Vietnamese name (local name):

English name (common name):

Description:

- Size: Length: 30- 40 cm (maybe 50cm);
- Shape: This species has a long snake-like body. It has a peculiar habit of sticking its posterior end under a stone. The anterior end projects out from the stone and keeps on moving with the ventrally directed tentacles. On being disturbed the animal throws out white sticky threads. Like *H. atra* it is uniformly black in color.

Habitat: It lives in reef flats and under stone. The anterior end projects out from the stone to the sand, its posterior end under a stone.

Distribution: Vietnam: Nha Trang Gulf, Coto- Thanhlan, Halong Bay (Quang Ninh), Cat Ba Island (Haiphong), and other coastal coral reefs; World: West Indo Ocean, Red Sea, West Pacific Ocean to Hawaii Island (Cock Island).



Scientific name: *Holothuria impatiens* (Forsk., 1775)

Vietnamese name (local name):

English name (common name):

Description: In this species, the body is bottle-shaped with a long neck and rough surface, sandy to touch. It is covered with conical warts from which filamentous appendages emerge. It is a secretive form found under dead coral stones. On disturbing the animal white sticky threads are ejected. It is an active sea cucumber. It is light brown with 4-5 dark brown transverse bands on the upper side near the anterior end.

Habitat: Often two or three specimens are found under the same coral stone. This species is commonly found in shallow water rubble habitats

Distribution: Vietnam: Con Dao, Gulf of Tonkin; World: East Africa; Red Sea to the Hawaiian Islands. This species is also known from tropical Atlantic and the Mediterranean (Batangas, Luzon, Philippines)



Scientific name: *Holothuria Scabra* (Jaeger, 1883)

Vietnamese name (local name): Hôi sâm cát, Ốn cát, Hôi sâm trng.

English name (common name): Sandfish

Description:

- Size: Length: 40 cm; Weight: 400gr.
- Shape: The body is oval and stout with flattened ends; *H. scabra* has prominent wrinkles on its upper surface and is generally smaller and lighter than the versicolor variety. The upper side is grey in color with white or yellow horizontal bands, with 7-8 pleats. The lower side is white in color with fine black dots. Podia is tubular and small, its base is light grey. The ventral surface is white and concave with podia arranged randomly on the lower side. Mouth on the ventral side with 20 yellow-brownish tentacles in radiation. Anus at the end of the body with 5 bunches of papillae, each one has 5-8 pieces in pyramid shape. Gonad gland is small with short tentacles and without cuivier tube. This is the most widely used species after *A. Japonicus* and also the most valuable species for processing. It is gregarious in nature and is therefore easily exploited.

Habitats: It often lives near low saline areas and frequently in muddy-sandy bottoms. It spends part of the day buried in sand. It comes out of sand during feeding time. It can be found in the intertidal region to a depth of 10 m. It is found in sand and younger forms are distributed near the shore, and as they grow they migrate to deeper waters for breeding. It can adapt to conditions of varying temperature and salinity, from 25 – 31°C, 20 – 34,5 ‰.

Distribution: Vietnam: Khanh Hoa (Cam Hai, Cam Thanh, Cam Phuc, Cam Ranh), Nha Trang Bay (Cua Be, Song Lo), Van Phong Bay (Van Gia), Xuan Dai Bay (Vung Trao, Vung Mam, Vung Dong and Cu Mong), Cau River (PhuYen), Phu Quoc Island.



FAMILY: Stichopolidae

Scientific name: *Thelenota ananas* (Jaeger, 1833)

Vietnamese name (local name): Ốn t u, Hôi sâm u

English name (common name): Prickly redfish

Description

- Size: Length: 75cm; Width: 11.5cm; Height: 8.5cm
- Shape: Very distinctive appearance due to numerous large pointed teats in groups of two or three all over the body surface. The body is reddish orange with 'teats' darker than the rest of the body surface. There are numerous large tube feet on the flat underside. The tube feet on the underside are bright orange (following specimens).
- Habitats: Found in 7-10m depth on sandy bottom or dead corals.

Distribution: Vietnam: Khanh Hoa (Hon Tre, Hon Khoi), Truong Sa Archipelago, Tho Chu; World: East India, West and South Pacific Ocean



Scientific name: *Stichopus chloronotus* (Brandt, 1835)

Vietnamese name (local name): Dĩa chuốt biền

English name (common name): Greenfish

Description: Roughly square in cross-section with large prominent papillae at each corner of the square. Body surface otherwise smooth. Many tube feet in three rows on underside. The body is uniformly dark green with numerous elongate papillae, each tipped with orange.

Habitats: Found in shallow water rocky and rubble habitats. Can adapt to a range of salinity above 20‰. Found commonly in coral reefs, rocks or sandy bottoms.

Distribution: Vietnam: Con Dao, Hai Phong, Quang Ninh, Chan May, Cu Lao Cham and Khanh Hoa; World: East Africa, from Madagasca to Western Pacific and Hawaiian Islands (Batangas, Luzon, Philippines).



Scientific name: *Stichopus variegatus* (Semper, 1868)

Vietnamese name (local name):

English name (common name): Curryfish

Description: Unlike other species of *Stichopus*, *S. variegatus* lacks elongate tubercles. The body is burnt orange with darker low tubercles arranged in distinct rows.

Habitats: Found in shallow water rubble and sandy habitats.

Distribution: Vietnam: Tonkin Gulf; World: Western Indian Ocean; Red Sea to Australia, New Caledonia; Indonesia; Philippines; Japan and Belau (Heron Island, Great Barrier Reef, Australia).



FAMILY: Synaptidae

Scientific name: *Synapta maculata* (Chamisso & Eysenhardt, 1821)

Vietnamese name (local name):

English name (common name):

Description: Body is long and snake-like. It can reach more than 2 m in length. It is usually found on the reef flat. It shovels sand into the mouth with its relatively large tentacles. Tentacles are seen to be in active movement during feeding. It crawls along by holding on to solid objects. It is tan to brown in color with black markings. The whole body surface has small white rings that are closely arranged.

Habitats: Found in shallow sandy habitats and grass beds.

Distribution: Vietnam: Tonkin Gulf; World: Southeast Asia, Red Sea, from Western Pacific Ocean to Society Islands (Sulawesi, Indonesia).



3. Products and Utilization

3.1. Sea Cucumber Fisheries

3.1.1. Fishing status of sea cucumber:

Due to their high value in medicine and food, some Holothuroid species are subject to intensive fishing in the Vietnamese sea, such as *Holothuria scabra*, *Actinopyga echinites*, *Thelecanthias ananas*, *Holothuria nobilis*, and *Holothuria nobilis*. These species are over fished mainly in Khanh Hoa, Con Dao, and Truong Sa, and especially in Phu Quoc. This has resulted in the quantity of sea cucumbers in Phu Quoc facing depletion. Ten years ago, about 3 tons of sea cucumber were caught each day around Phu Quoc, however now the catch is only 300 kg per day.

Truong Sa Archipelago also has a high abundance of sea cucumbers and large numbers of fishermen come from Lyson Island (Quang Ngai). According to statistical data obtained by the People's Committee of Lyson District, during 1990 to 1995 one fishing boat could catch about 1,400 kg per voyage (32 days). At the time of writing, the price of 1kg of sea cucumber is 500,000 VND, so that 1,400kg of sea cucumber is worth about 700 million VND. Thus, the average income for a labourer on a boat is about 25 - 40 million VND. It is for this reason that sea cucumbers are being increasingly exploited, as the number of fishermen targeting sea cucumbers continues to rise (about 30% of fishermen in Lyson fish for sea cucumbers)

Bach Long Vi Island is another area suffering from overfishing and lack of responsible planning. In the past, there existed a large population of red and white sea cucumbers, but now they have disappeared.

SCUBA diving is the main method used to catch sea cucumbers. This method places pressure on sea cucumber populations due to the crowded fishermen and high fishing volume, as sea cucumbers normally live in flocks making it easy to catch large quantities. Consequently, sea cucumber resources are in rapid decline. In addition, other fishing methods catch sea cucumbers as bycatch, simultaneously damaging sea cucumber habitat. Examples of such methods include trawl net with undersized mesh, explosives and electrical fishing gear. These fishing methods result in large deaths of sea cucumbers and other living organisms, disrupting the ecosystem balance in that area.

Several attempts to protect sea cucumber species in Vietnam have been made, including designated zones for reproduction areas, and banning trawling and the use of explosives. However, these solutions have not brought back positive results as yet.

3.1.2. Sea cucumber culture status:

From 1991-1995, Research Center III of Aquaculture implemented a national project: 'Research to build up a process to produce artificial seeds and commercial culture of sea cucumbers' (*Holothuria scabra*, *Actinopyga echinites*). The results showed that the average monthly growth rate of sandyfish was 1.2 – 2cm in length and 40 – 60gr in weight (Nguyen Chinh, 1996). When compared with experimental results from cultures grown in a cement tank, an earthen pond and a pond with stone walls, it was found that *H. Scabra* had an optimum growth rate in the earthen pond, and that *Actinopyga echinites* was best grown in the pond with stone walls. Culture care and management for both species was relatively simple, as they could be poly-cultured with other animals, and the sea cucumber's ability to maintain sediment cleanliness played an important role for the ecosystem in the pond. The cement tank could be used for artificial seed production and maintenance, brock stock culture of parent.

From 2000 to 2003, the Project of Sea Cucumber Rearing, which involved cooperation between ICLARM and Research Center III of Aquaculture, produced artificial seeds successfully. They also succeeded in experimentally culturing larvae in the earthen pond, cage and weir. The results revealed that sea cucumber growth rates in the pond varied depending on the size of the seed. Seeds that were initially 1.6gr grew to 60gr/indiv. after being reared for 1.5 – 2 months; seeds that were initially 5.5gr grew to 130gr/ind. after 2.5 months; seeds that were initially 28gr grew to 96gr/ind. after 1.5 months; seeds were 30gr after 3 months; they were 300gr/ind.(R. Pitt & N.D.Q.Duy, 2003). However, the survival rate of sea cucumbers was not stable (0-100%), and was dependent on many factors, especially on sediment and salinity.

From 2001 – 2003, Research Center III of Aquaculture in cooperation with SUMA (FSPS program) implemented the project 'Study on

rearing sea cucumber (*Holothuria scabra*) in shrimp (*Penaeus monodon*) culture pond in order to improve environment'. The results suggested that at least 70% of sea cucumbers could survive in a salinity range from 20 – 400/00. A salinity in the range of 25-35‰ yielded a high survival and growth rate, while the optimal salinity condition was 30‰. (Nguyen Thi Xuan Thu, 2003). Sea cucumbers were cultured in shrimp ponds in an attempt to improve the cleanliness of the environment, however when the sea cucumbers were harvested they were only 100g/individ. (size on market was 500gr/ind.), so it therefore took longer to culture the sea cucumbers to an appropriate size.

Generally, the experimental rearing of sea cucumbers in shrimp ponds is still limited. The majority of the sea cucumbers come from natural fishing. However, there are some commercial culturing techniques that are economically viable, such as the culturing of the sandy sea cucumber (*Holothuria scabra*) in Nha Trang – Khanh Hoa done by the Research Institute III for Aquaculture. Production volume is 2-3 tons per ha and in addition this mode of culturing employs many people in the Van Hung commune – Van Ninh District – Nha Trang City.

3.2. Local usage and processing

3.2.1. Use as a nutritious and functional food:

Experimental results show that sea cucumbers are one of the most nutrient-rich foods. For example, 100g of dry sea cucumber contains about 76gr protein, five times more than lean pork meat and 3.5 times more than beef. Sea cucumber also contains essential amino acids lysine and proline, and trace minerals P, Fe and Cu, as well as Se, which can neutralize heavy metals (Pb, Hg) that enter the body through consumption of food. In addition, it has multi vitamins, hormones, bio- active compounds (two kinds of Saponin as Rg, which can stimulate the nervous system, has anti-fatigue properties, and can strengthen health; Rh can inhibit cancer cells).

Sea cucumber's use as a nutritious food and useful medicine often involves it's being combined with other remedial dishes, as below:

- *Ulcerative colitis and stomach inflammation:* put intestine of sea cucumber on earthen tiles, dry well and then grind into powder. Use by drinking about 0.5 -1 gr. two times per day.

- *Anaemia:* Use sea cucumber and Vietnamese apple (without pip) in equal quantity, dry well, then grind into powder. Drink 9 gr. with warm water 2 times per day. Alternatively, use 1 individual sea cucumber stew with enough quantity of ear-wood and little candy, eat during day.
- *Nerve asthenia:* (Photopsia, backache, tiredness, insomnia, spermatorrhoea, premature ejaculation): 30gr sea cucumber stew with 100 gr of sticky rice and spices into gruel. Eat several times during a day.
- High blood pressure and atherosclerosis: Stew 50g sea cucumber with little candy and eat during a day.
- *Constipation:* 30gr sea cucumber with 120gr clean raw pork large intestine with 15gr black ear-wood, stew together with spices then eat in several days.
- *Backache and amnesia:* 30gr sea cucumber and 60gr pork spine and 15gr nucleus of peach, stew with spices and eat in several days.
- *Anaphrodisia:* 20gr sea cucumber and 100gr goat meat and stew together and eat during a day.
- *Epilepsy:* Dry well the viscera, grind into powder then drink about 12gr of powder with wine in many days.

3.2.2. Extraction of sea cucumber for medicinal materials:

3.2.2.1. Extraction of Holothurin B from black sea cucumber (*Holothuria vagabunda*)

According to Chau Van Minh's study (2005), Holothurin B can be extracted from black sea cucumber (*Holothuria vagabunda*), and used to cure spasm disease caused by parasite, cerebral confusion, stomach inflammation, asthma, backache and high blood pressure. It is not toxic for humans, and can even be used to reduce growth of tumors. In addition, it may also be used to reduce pain, rheumatoid arthritis, osteoarthritis, strengthen flexibility of joints, and as an anti- cancer and anti-fungal agent.

Extraction method for Holothurin B: Process *Holothuria vagabunda* to eliminate inorganic salts, grease, fatty acids and other impurities, to obtain methanol solution. From the methanol solution, it is possible to extract condensed Chlorofoc solution.

After chromatography, Holothurin B compound is obtained in white crystal needle shape (Chau Van Minh, 2005).

3.2.2.2. Extraction of HOLM-1 and HOLM-2 from Blackfish *Holothuria martensii*

Holothuria martensii is a common species in the Vietnamese sea. It is also of medicinal value, being used to cure diseases caused by parasites, and cerebral confusion, amongst other things. In an application of marine biotechnology programme (2002-2005), Chau Van Minh et al (2005) used *H. martensii* as a source of HOLM-1 (one type of Holothurin B) and HOLM-2 (one type of Holothurin A). Holothurin A is used in medicine in a similar way to Holothurin B, and it is especially effective in cancer treatment.

Extraction method for HOLM-1 and HOLM-2: Inorganic salts are first eliminated from *H. martensii*, which is then cut into small pieces, and ultrasound and methanol are used to obtain MeOH solution. Next, Chloroform and water extract MeOH fractionally, to become MeOH condensed solution. After chromatography of MeOH condensed solution the products are HOLM-1 (Holothuria B) and HOLM-2 (Holothurin A) (Chau Van Minh et al, 2005).

3.2.2.3. Extraction of steroid compounds from *Actinopyga mauritiana*

Do Tan Loi (1991) recognized that grease of sea cucumber has an effect on metabolism stimulation, increasing oxidation- deoxidization, and anti-arteriosclerosis. It was discovered that substances of bioactive compounds in sea cucumber were not protein, it could be solved into lipid. Studied team Nguyen Van Cuong, Nguyen Kim Do, Nguyen Thi Dieu Thuy, Do Thi Hong Viet, Nguyen Tai Luong (1998) started to extract bioactive compounds of sea cucumber and showed that it's originated as steroid

Extraction: Extracted sea cucumber *Actinopyga mauritiana* by immersing in 50% alcohol for 2 weeks or quickly extracted by solex. After that, the

mixture was extracted fractionally with benzene and butanol. Steroid compounds were obtained by thin layer chromatography.

3.2.2.4. Extraction of lectin and peptide from Whitefish (*Holothuria scabra*)

Lectin:

Lectin extracted from *Holothuria scabra* can actively agglutinate erythrocyte cells of all human blood groups. It can also be used in the classification of erythrocytes, stimulation of leukocyte cell division, and cell studies in normal and pathology (Nguyen Van Cuong et al , 2000).

Lectin extraction: Dry sea cucumber was ground by homogenizator, then extracted in buffer pBS , then centrifuged 1200 round per min. would get crude solution and residue. Crude solution was extracted by ammonium sulphate precipitation and then, by ion exchange chromatography, to obtain lectin.

Peptides:

Peptide solution can increase an animal's relaxation, therefore helping it to conserve energy. This is important in the accumulation of energy materials such as ATP and glycogen. When the body becomes more active, this source will be mobilized to release energy. Nguyen Van Cuong et al (2000) tested the effects of the peptide fractional solution on white mouse and found that it enhanced relaxation and therefore also saved energy in the white mouse.

Peptide extraction: Peptides were extracted from *Holothuria scabra* by precipitation of acetone and TCA, then gel filter chromatography on Sephadex G15. Result from chromatography – electrophoresis on paper showed nerved peptide bands exist in one of eight segments of gel filter chromatography

3.2.2.5. *Amorvita* Sea cucumber product

One box of *Amorvita* sea cucumber contains two x 10 capsules. The medicine is composed of hydrolysis powder of sea cucumber: 200mg, Vitamin B1: 10mg, Vitamin B6: 10mg, and excipient equivalent 1 capsule.



Figure 1: Amovita sea cucumber on the market in Vietnam.

- Uses: Strengthen health, maintain energy, anti muscle asthenia, anti aging, strengthen immunity, supplement amino acids, mineral traces, blood form factors, increase blood circulation, improve oxygen absorption, anti myocardium illness, catalyze enzyme reactions, enhance metabolism and nutrients absorption, reduce cholesterol in blood, increase synthesis of protein..
 - Indication: to improve health, athletes, hard working people, nervous people or people under pressure, male lack of libido, after surgery, after illness, asthenic person, aged person
 - Dose: Normal: 1 capsule 3times per day.
 - For Libido: beginning dose (1-2 months initially): 2 capsules 2-3 times per day; maintain dose: 1 capsule 2-3times per day or following doctor's instruction.
- Market in Vietnam: Ho Chi Minh City has the largest market for sea cucumbers. Fresh sea cucumber usually have the intestines removed, is chilled and transported to the city. However, the market for seed consumption (produced by Research Institute III for aquaculture – Nha Trang) is concentrated in places such as Quang Ngai, Ninh Thuan, Phu Yen and Khanh Hoa provinces. At the moment seed availability is still limited but may increase in the future.
 - In Asian countries, sea cucumber is viewed as a high-class dish, while in European countries it is also valued and served in luxurious restaurants under the name Cucumis marinus.
 - Cost: Normally, sea cucumbers that weigh from 0.3 – 0.5kg/ind. cost 17-20,000 VND/fresh kg. However, the price is also dependent upon the size, season and species (table 2).
 - Furthermore, extracted products used for medicinal purposes will be more expensive, for example, a box of Amovita sea cucumber above cost 225,000 VND.

Table 2: Cost of some commercial sea cucumber on Vietnamese market.

Scientific name	Local name	Product form	Price / kg (US\$)
1. <i>Actinopyga echinites</i>			4,5-21
2. <i>A. mauritiana</i> c.f.		Steroid	5-15
3. <i>H. (H.) atra</i>			1,75-5
4. <i>H. (M.) nobilis</i> , <i>H. (M.) whitmaei</i>			17,5-25
5. <i>H. (M.) scabra</i>		Lectine, peptide	9-25
6. <i>Holothuria</i> sp., <i>H. (M.) leucospilota</i> c.f.			4,75
7. <i>Pearsonothuria graeffei</i>			1,75
8. <i>Stichopus chloronotus</i>			21,25
9. <i>Thelenota ananas</i>			12,5
10. <i>Holothuria martensii</i>		HOLM-1 and HOLM-2	-
11. <i>Holothuria vagabunda</i>		Holothurin B	

Source: information collected from Departments of Fisheries.

Distributors:

- Holothurin B, HOLM-1 and HOLM-2 products are distributed by chemical Institute of natural compounds (18- Hoang Quoc Viet Str, Ha Noi, Viet Nnam).
- Steroid compounds extracted from sea cucumber distributed by Institute of Biotechnology.
- Lectin and peptide extractions distributed by Institute of Biotechnology.
- 'Amovita sea cucumber' distributed by Traphaco - Joint stock company (75 Yen Ninh, Ba Dinh, Ha Noi, Viet Nam).

4. Trade

Sea cucumbers are an high commercial species group so that they are being caught for sale. Some species are being overfished to satisfy market demands. However, commercial activities of sea cucumbers haven't checked clearly so that import-export statistical data (import-export yield, import-export cost, etc.) of these species is still unconnected and uncomprehensive through many years. Almost, the commercial data of sea cucumbers is selected from import-export companies of sea cucumbers or from fishermen or from traders.

Sea cucumbers are usually caught in the south of VietNam (Phu Quoc, Ly Son, Con Dao, Tho Chu and Truong Sa Archipelago). Sea cucumbers from these areas are gathered, transported to Ho Chi Minh market and exported to some countries in Asia (China, Hong Kong, Japan, Taiwan, Singapore), Canada, America and Australia. The species are usually exploited and transported to Ho Chi Minh

Market including: *Holothuria scabra*, *Thelenota ananas*, *Bohadschia argus*, *Holothuria nobilis* và *Stichopus chloronotus*.

Sea cucumbers market in VietNam includes two kind of products: frozen and dried sea cucumber products. The frozen products are very rare. They are cooked, canned for export market. The dried sea cucumbers are common products in VietNam. They are provided to either domestic or overseas market. If dried products are wetted, they are usually sold at local supermarkets. Some export companies of sea cucumbers in VietNam following:

+ HX export company
Address: 405/2 Xo Viet Nghe Tinh St.,
Binh Thanh Dist., Ho Chi Minh City

They are exporting different kind of dried sea cucumbers such as: White teat fish, Flower teat fish, Green fish, Yellow sand fish, White sand fish, Black sand fish, Lolly fish, Curry fish, Pyhon fish,

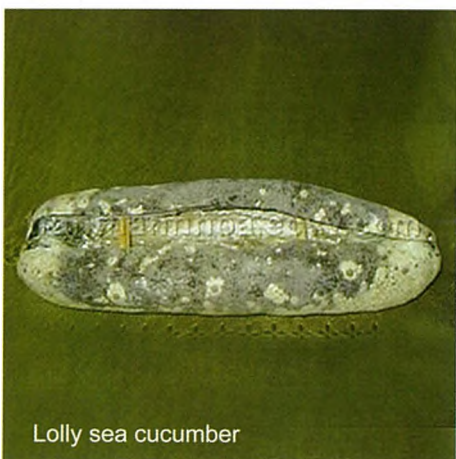


Figure 2: some dried sea cucumber products of HX export company



Figure 3: Dried sea cucumber products of Phu Mai company ltd.

Shark's skin, Shark's fin, Fish maw (Globefish, Pangacious fish maw, Lacfish maw...), Sea horse, etc.

Market: sea cucumber products have been exported to more than 20 countries, such as China, Japan, Korea, Singapore, United States, etc.

Phu Mai company ltd.

Address: 192 Van Kiep St., Ward 3, Binh Thanh Dist., Ho Chi Minh city

Địa chỉ: 192 Đường Văn Kiệp, Khu 3, Quận Bình Thạnh, Thành phố Hồ Chí Minh

Market: Some countries of northern America, Eastern Europe, Southeast Asia, Eastern Asia

In addition, there are some other export companies of sea cucumbers, such as: *Viet Delta industrial Co., Ltd.* (20/5 Dinh Bo Linh St., Ward 24, Binh Thanh Dist., Ho Chi Minh City), *Anbai sea product company ltd.* (1 Bach Ma Street, District 10th HoChiMinh-Viet Nam), etc.

5. Conclusion and recommendation

5.1. Conclusion

- Vietnam is one of countries where has abundant resource of sea cucumber. According to statistical previous studies showed that known about 90 species. Major families and genera of sea cucumber are Family Holothuriidae (genus *Holothuria*, *Sticopus*), family Cucumaridae (genus *Colochirus*, *Cucumaria*), family Sinaptidae (genus *Protankyra*). From that, there

are about 10 species, which have high nutrition and commercial value, for example: *Holothuria martensii*, *H. atra*, *H. scabra*, *H. echinites*, *H. mauritiana*, *H. nobilis*, *H. ananas*... These species have been studied to use as food, medicine and extracted bioactive compounds. However, up to now, there isn't full studied and statistic in stock capacity assessment of sea cucumber in Vietnam.

Though, there were some studies on pilot of artificial seed production and commercial culture scheme and initial satisfactoried results were gotten. However, scale is still small, not stable, and don't satisfy for demand of sea cucumber market.

- Now, most of sea cucumber yield for domestic or overseas trading and consumption is contributed from mainly natural fishing. Thus, the resources now face to declination in everywhere, many commercial species are still overfished and threaten to distinct if do not act in sustainable management and utilization.
 - Use of sea cucumber in functional food and medicine is great potential. Some bioactive compounds such as Holothurin B, HOLM-1, and HOLM-2, lectin, peptide and sea cucumber Amornita are being produced but still need more specific and professional studies about sea cucumber in order to exploit effectively its resource and uses.
- Trade, process and consumption of sea cucumber in Vietnam generally is in small scale, there do not invest and manage in systematic. Sea cucumber products are consumed under raw or crude type.

5.2. Recommendation

- Need to study and statistic fully about species composition and structure, distribution, biology, stock capacity in Vietnamese water in order to be scientific witness for protection and responsible uses.
- Study and apply advanced techniques in seed production and commercial culture of some economic species to serve for trading, consumption and processing as well as material source for extraction bioactive compounds.
- Intensify scientific statistical management, monitoring, protection and reproduction of economic sea cucumber species in scope of area and countries members of CITES, SEAFDEC.
- Intensify international cooperation in protection, development and orientation in sustainable uses of sea cucumber resources among countries in ASEAN.

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