



Abstract

Shrimp is an exceptionally nutritious seafood item. It is a high-protein food, low in fats content, and high demand in international seafood markets because of its authentic test. *The chapter of the book summarized the general discussion about shrimp, its importance, source and location of shrimp around the world, world production statistics, international shrimp business policy, export market of shrimp, factors affecting seafood business in international seafood markets, and morphometric identifications and taxonomic classification of commercially important species.* The content of the chapter also helps to know the difference between the most remarkable exportable shrimp species like *Penaeus monodon* and *Penaeus vannamei*.

Keywords

Penaeus monodon · *Penaeus vannamei* · Seafood · Taxonomy · Morphology

1.1 Introduction

Shrimp is one of the most common and popular types of seafood consumed worldwide. Popularization of shrimp is increasing day by day due to its sweet succulent flavor, delicious test, quality nutrients, low fat content, and a rich source of omega-3 fatty acids. Shrimp lipid contains mostly polyunsaturated fatty acid (PUFA), which includes linoleic acid and alpha-linolenic acid that are parent compounds of omega-6 and omega-3 acid that provides a variety of health benefits like retina and brain development (Oksuz et al. 2009). The omega-3 fatty acids help to reduce cholesterol levels in the blood and are thought to reduce the risks of heart attacks, some cancers, and many other diseases (Dore 2012). Omega-3 fatty acids in shrimp also lead to reduce the risk of cardiovascular diseases, overcome weight loss,

and lower blood pressure. Furthermore, shrimps are a rich source of calcium, iodine, vitamin D, vitamin B₃, zinc, and protein and low in saturated fats.

The shrimp industry was started to develop on a large scale in coastal areas of Southeast Asia in the 1970s. *Penaeus monodon*, *P. vannamei*, *P. orientalis*, *P. merguensis*, *P. semisulcatus*, *P. indicus*, *Macrobrachium rosenbergii*, *M. monoceros*, *M. nipponense*, etc. are the remarkable species exported worldwide. Among these species *P. monodon* and *P. vannamei* have the most remarkable contribution in international seafood market. Seafood refers to any form of sea life regarded as food consumed by humans, including fish and shellfish prominently. Shellfish include various species of mollusks, crustaceans, and echinoderms. Edible sea plants such as seaweed and microalgae are also known as seafood widely eaten as sea vegetables around the world. *P. monodon* known as black tiger (BT) is one of the most remarkable exportable items in frozen seafood. It's a unique product because of its authentic test, nutritional content, and regional and global demand in the seafood market. At the beginning of the 1970s, the species *P. monodon* was the preferred species for many years because of its authentic test, but the species was very sensitive to infectious disease. This susceptibility to disease has led to a preference for the farming of *L. vannamei*, which has constituted the largest shrimp industry growth worldwide (Thornber et al. 2020). Note that *P. vannamei* is the most extensively farmed species at current world. Difference between *Penaeus monodon* and *P. vannamei* is given in the following table (Table 1.1).

Besides consumptions a significant proportion of shrimp is also used as the ingredients of fish feed, fertilizer, medicine, and other purposes. The major shrimp-producing Asian countries are China, India, Bangladesh, Vietnam, Thailand, Indonesia, Malaysia, and the Philippines, whereas majority share comes from China which is around 61% of total Asian shrimp production. Besides China, India contributes 6%, Indonesia contributes 5%, Vietnam contributes 4%, and Bangladesh contributes 3% of total Asian shrimp production. The rest of 21% comes from other Asian countries (Barua and Hossain 2019). The Latin American shrimp-producing countries are Brazil, Ecuador, Mexico, Honduras, Nicaragua, and Peru. The species *P. monodon* is native to Asian countries, but the species *P. vannamei* is native to the Pacific coast of Mexico to Peru. Other vannamei producer countries are China, Thailand, Indonesia, Malaysia, Vietnam, India, the Philippines, Taiwan P.C., Brazil, Ecuador, Mexico, Venezuela, Honduras, Guatemala, Nicaragua, Belize, Pacific Islands, Colombia, Costa Rica, Panama, El Salvador, the United States, Cambodia, Suriname, Saint Kitts, Jamaica, Cuba, Dominican Republic, and Bahamas. Major crustaceans' production in world aquaculture (2010–2018) is given on the following table (Table 1.2; Fig. 1.1).

Millions of million people are engaged in seafood industries as well as the chain of shrimp business and lead their livelihood in different ways like seafood harvesting, transportation, processing, packaging, shipment, restaurants, and retail business.

The existing problems in shrimp business are the scarcity of raw materials, intensification of aquaculture, and uses of heavy antibiotics. Shrimp farmers of third countries are also diverting to other businesses as they didn't get proper

Table 1.1 Difference between *P. monodon* and *P. vannamei* shrimp

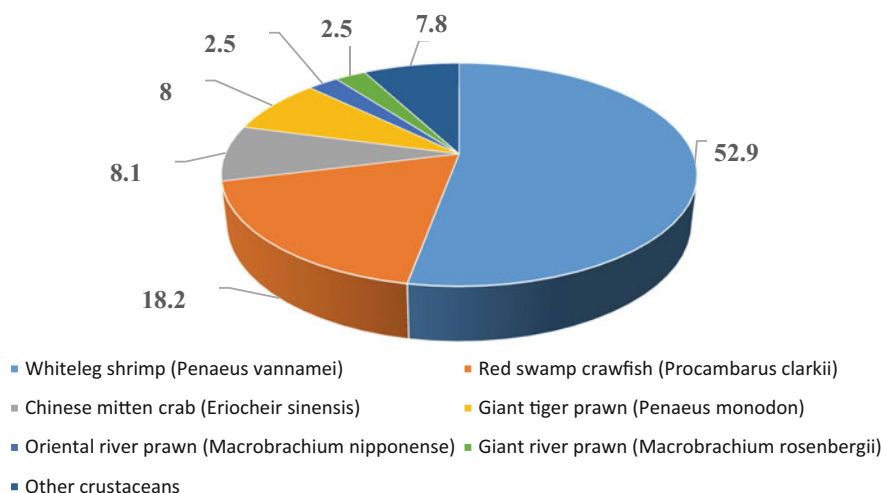
Characteristics	<i>P. monodon</i>	<i>P. vannamei</i>
Common name	Black tiger shrimp or tiger prawn or giant tiger prawn	Whiteleg shrimp or Pacific whiteleg shrimp
Color	Grayish green/dark greenish/reddish brown	Off-white to greenish-white
Stripes	Back with alternating dark and light transverse stripes	Back with alternating dark and light transverse stripes
Stocking density	Lower	Higher
Production	Lower production	Higher production
Production cycle	Production cycle is longer	Production cycle is shorter
Salinity tolerance	Salinity tolerance higher	Salinity tolerance lower
Temperature tolerant	Temperature range 25–30 °C. Can't grow well at lower temperature	Temperature range 15–35 °C. Can grow in lower temperature
Growth performance	Growth performance slower	Growth performance faster
Size	Larger in size	Smaller in size
FCR	FCR higher	FCR lower
Dietary protein requirements	Dietary protein requirements are higher	Dietary protein requirements are lower
Post-harvest handling	Post-harvest handling can be easier. Quality can be degraded if processing time is very long	Post-harvest handling cannot be easier. Quality can be degraded within very short time
Test	Unique test	Testy but not as black tiger
Price	Higher price in international seafood market	Lower price in international seafood market

remuneration in response to their production cost. In addition, processing industries declared themselves bankrupt frequently making the people unemployed. It's threat for the fisheries sector in near future. So, it is high time to be conscious more about this sector. Besides shrimp, emphasis should be given to other exportable items, i.e., white fish, live fish, smoked fish, dry fish, crab, kuchia, value-added/marinated products, byproducts (head, shell, gut content, fish scale, turtle edge, etc.), and marine resources (seaweeds, octopus, lobster, mollusks, loligo, sepia, cuttlefish, etc.) that are the potential resource for the near future. The government should come forward to manage this industry sustainably. Proper planning, necessary initiatives, and immediate response should be taken immediately to improve our culture technology and development of the new technique to process quality products.

Table 1.2 Major crustaceans' production in world aquaculture (2010–2018)

Types of crustaceans	Year (production in 1000 tonnes)				
	2010	2012	2014	2016	2018
Whiteleg shrimp (<i>Penaeus vannamei</i>)	2648.5	3144.9	3595.7	4126	4966.2
Giant tiger prawn (<i>Penaeus monodon</i>)	562.9	669.3	701.8	705.9	750.6
Oriental river prawn (<i>Macrobrachium nipponense</i>)	193.1	200	204.1	245	237.1
Giant river prawn (<i>Macrobrachium rosenbergii</i>)	217.7	216.2	233.7	238.4	234.4
Red swamp crawfish (<i>Procambarus clarkii</i>)	596.3	548.7	659.3	894.7	1711.3
Chinese mitten crab (<i>Eriocheir sinensis</i>)	572.4	650.7	722.7	748.8	757
Other crustaceans	687.9	586.1	631.1	717.3	729.9
Total	5478.8	6015.9	6748.4	7676.1	9386.5

FAO (2020)

Major Crustaceans Production in World Aquaculture in 2018
(Thousand tonnes)**Fig. 1.1** Percentage of major crustaceans' production in world aquaculture (FAO 2020)

1.2 Factors Affecting Seafood Business in International Seafood Market

The shrimp business of the world is affected by a variety of parameters because of global competition. If the respective authorities failed to control these parameters, there is huge chance to collapse the business because the rival countries will take the opportunities. The factors affecting shrimp business in international seafood market are as follows:

- Quality of raw materials (freshness, test, texture, and color).
- Culture technology (either organic or inorganic; either wild catch or cultured, if cultured then it is intensive, semi-intensive, or traditional, etc.).
- Quality of export grade final product (either the country produces top-quality or poor-quality product).
- Competition with other shrimp-producing countries.
- Business policy of different business countries.
- Fluctuation of customer demand in international export market.
- Fluctuation of market price.
- Fluctuation of currency.
- Duration of shipment (either the product is shipped earlier or delay shipment. In the case of delayed shipment and/or non shipment both are dangerous for the international seafood business). Remember that it is very difficult to achieve a quick response from both parties (suppliers and buyers) according to the changing of customer's demand because of long duration of shipment.
- Payment system.
- Marketing chain.
- Generalized System of Preference (GSP) facilities.

Lack of proper knowledge and technology, scarcity of raw materials, lack of well-equipped machineries and laboratories, and lack of well-certified processing industries in third world countries are the common factors that reduce their business day by day. Furthermore, high labor charge and high operational cost are the key factors for developed countries.

1.3 Taxonomic Classification of Shrimp

The term “taxonomy” is derived from Greek words “*taxis*” meaning arrangement and “*nomia*,” meaning distribution or method. So, taxonomy is the study of naming, identifying, describing, and classifying organisms which include animals, plants, and microorganisms. Classification can be done through the analysis of morphological, behavioral, genetic, and biochemical characteristics. The following are the taxonomic classification of some important species of exported shrimp.

1. Black tiger/giant tiger shrimp	2. Whiteleg shrimp/Pacific white shrimp
Kingdom: Animalia	Kingdom: Animalia
Phylum: Arthropoda	Phylum: Arthropoda
Subphylum: Crustacea	Subphylum: Crustacea
Class: Malacostraca	Class: Malacostraca
Order: Decapoda	Order: Decapoda
Family: Penaeidae	Family: Penaeidae
Genus: <i>Penaeus</i>	Genus: <i>Litopenaeus</i>
Species: <i>P. monodon</i>	Species: <i>L. vannamei</i>

3. <i>Chaka</i> /white shrimp	4. Cat tiger/sea cat
Kingdom: Animalia	Kingdom: Animalia
Phylum: Arthropoda	Phylum: Arthropoda
Subphylum: Crustacea	Subphylum: Crustacea
Class: Malacostraca	Class: Malacostraca
Order: Decapoda	Order: Decapoda
Family: Penaeidae	Family: Penaeidae
Genus: <i>Fenneropenaeus</i>	Genus: <i>Penaeus</i>
Species: <i>F. indicus</i>	Species: <i>P. semisulcatus</i>
* <i>Penaeus indicus</i> in previous	

5. Harina/brown harina	6. Fresh water king prawn/scampi
Kingdom: Animalia	Kingdom: Animalia
Phylum: Arthropoda	Phylum: Arthropoda
Subphylum: Crustacea	Subphylum: Crustacea
Class: Malacostraca	Class: Malacostraca
Order: Decapoda	Order: Decapoda
Family: Penaeidae	Family: Palaemonidae
Genus: <i>Metapenaeus</i>	Genus: <i>Macrobrachium</i>
Species: <i>M. monoceros</i>	Species: <i>M. rosenbergii</i>

1.4 Morphometric Identification of Shrimp

Shrimps are laterally compressed crustaceans with a streamlined shape for swimming (Rudloe and Rudloe 2009). It has elongated and slender shaped bodies with long muscular abdomens commonly found in marine, brackish, and freshwater ecosystems both of cold water and warm water regions. The tropical and subtropical regions around the world are most popular for warm water shrimps; however, the

ocean waters of the northwest and northeast regions of the United States and Canada are popular for cold water shrimp. The whole shrimp is divided into two parts:

1. The head
2. The body

The head is fused with a thorax called cephalothorax that is protected by a shell called a carapace. The carapaces of shrimps are more cylindrical, and the shell of carapace is harder and thicker than the shell elsewhere on the shrimp. The gills of the shrimp are located inside the carapace. The front of the carapace which is tapered and curved shape with a serrated edge is called rostrum. The rostrum is a forward extension rigid structure that can be used to attack or as a defense mechanism of shrimp. There are two compound eyes which are attached to the base of the rostrum by movable stalks. These compound eyes are used for detecting movement and vision. The head also consists of two pairs of antennae (one pair is long and another pair is short) and mouth with jaws, mandible and maxilla. The antennae of shrimps are an important organ used as sensors which can help them to feel where they touch and help to assess smell, taste, and suitability of the prey. The antennular appendages are also serving as detectors of chemical, tactile, and vibrational stimuli (Vickery et al. 2012). Again, the body is divided into two parts:

1. Abdomen
2. Tail

The body also consists of six segments. The first five segments each contain a pair of swimming legs, whereas the sixth segment consists of the tail. The tail consists of two pairs of appendages called uropods and the telson. Shrimp can swim forward by paddling their well-developed pleopods (swimmerets) on the underside of their abdomens. They can also move backward very quickly by flipping their tail uropods (Rudloe and Rudloe 2009). The uropods of shrimp function as the steering mechanism during their movement and also take part in raid movement. The female shrimp releases eggs into the water, and the nauplius larvae come up from the eggs and turn into protozoa, zoea, metazoea, mysis, postlarva, and juvenile stages and finally become adult shrimp. The growth of shrimp depends on molting. The growth of shrimp is blocked when the exoskeleton of the shrimp becomes hard and required molting for further growth. Molting is mostly a night event. Molting is essential for faster growth of shrimp but also helps to remove scar, infection, parasites, damaged parts, and limb loss (Panakorn 2018). During the molting process, there is increased respiration and CO₂ production and decreased feeding of shrimp (Corteel and Nauwynck 2010).

See the following morphometric characteristics of shrimp *P. monodon* (Figs. 1.2 and 1.3).

The following are the images of different types of exported shrimp (Figs. 1.4, 1.5, 1.6, 1.7, 1.8, and 1.9).

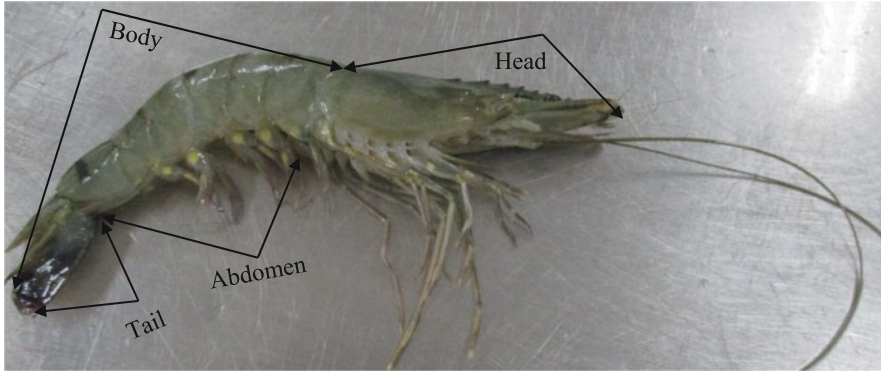


Fig. 1.2 Major divisions of shrimp's body (*P. monodon*)

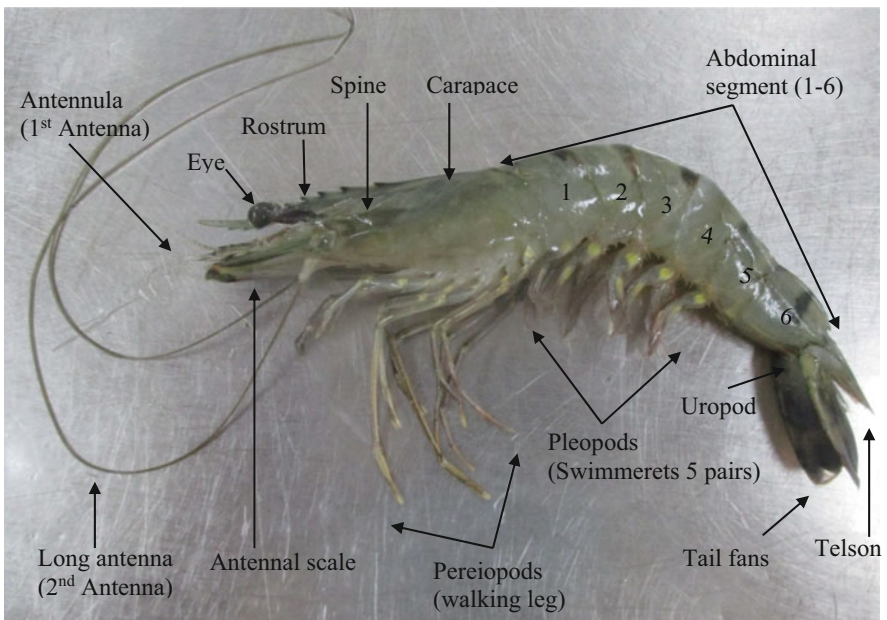


Fig. 1.3 Morphometric characteristics of shrimp *P. monodon*

Fig. 1.4 Black tiger shrimp



Fig. 1.5 Vannamei shrimp



Fig. 1.6 Freshwater shrimp



Fig. 1.7 Harina shrimp



Fig. 1.8 Cat tiger shrimp



Fig. 1.9 Chaka shrimp



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