International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Gross Anatomy and Physiology of an Indian Prawn (*Fenneropenaeus indicus)*

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Abstract: ***Crustacean aquaculture is one of the oldest and economically important aquaculture industries in the world. It involves commercial and experimental culture of several species of oysters, crabs, and freshwater crustaceans (prawns and crawfish), but the culture of prawn dominates the worldwide market in shellfish aquaculture. In this present study, it was aimed to learn about the important external features of a prawn and alsotheir functions related to swimming, digestion, and respiration.***

Keywords: External Anatomy, Physiology and Prawn

1. Introduction

Crustaceans are a group of hard-bodied animals that are members of the phylum Arthropoda that they share with such other organisms as spiders, scorpions, centipedes, millipedes, insects, and horseshoe crabs. Arthropods are characterized by having an exoskeleton (composed of a carbohydrate polymer called chitin, minerals, mostly CaCO3, and proteins) and segmented appendages. Crustaceans are a sub-group of arthropods that are segmented, primarily aquatic, and use gills to breath. There are many types of crustaceans that are surprisingly dissimilar to the eye – brine shrimp, crabs, copepods (zooplankton), lobsters, and barnacles. The species of crustaceans that are important for aquaculture are all in the class Malacostraca. All adult members of the Malacostraca have 19 segments (1-5 are the head, 6-13 are the thorax, and 14-19 are the abdomen), although some of the segments may be partially fused, such as the cephalothorax, or carapace, of lobsters (head and thorax fused).In addition to being malacostracans, the major groups of cultured crustaceans — lobsters, crabs, crawfish, shrimp and prawns — are members of the order Decapoda, having five (5) pairs of walking legs (periopods) on segments 9 –13. In some species (Maine lobster, crabs, and some prawns) the first pair are clawed, or chelate, and may be used for capturing food or defense; penaeid shrimp and the palinurid lobsters (Caribbean spiny lobster) have no chelated appendages. There are also appendages on the abdomen, called pleopods, which may be modified for swimming (swimmerets) and/or hold fertilized eggs (females). Most decapod crustaceans (with the exception of crabs) have a fan-shaped tail (called the telson) comprised of several uropods. The abdomen, equipped with the paddle-like telson serves for locomotion, and it is often used to rapidly escape from potential predators.Decapod crustaceans, and all arthropods for that matter, are housed in a hard exoskeleton, called the carapace, which is comprised of a carbohydrate polymer, called chitin, minerals (mostly CaCO3), and proteins. This structural arrangement poses a unique challenge for growth, similar to a knight who has outgrown his metal armour. In order to grow, the animal must shed the old carapace, secrete a new, larger one that it will eventually fill and shed again (figure). This process of shedding the exoskeleton is called ecdysis or molting. The molt cycle is normally triggered by external stimuli (light and temperature), as well as internal signals, which initiate the secretion of the hormone ecdysone, which facilitates the molting events that follow. It requires a series of physiological steps — breaking down the old shell, storing the CaCO3, regenerating missing limbs, building carbohydrate reserves for chitin production, and finally the physical act of extraction from the old, hard carapace and inflating (with water) the new soft carapace to a larger size. For the next day or so, the shell is soft (hence the term soft-shelled crabs), and the animal is immobile and highly vulnerable to predation. Once the shell has hardened the animal will resume its regular activities. Usually a few days before ecdysis, the crustacean will find a secure hiding place and suspend feeding activities. The prawn is common in rivers, ponds and other fresh-water areas. It is nocturnal, bottom-dweller and lives within underwater crevices and aquatic vegetation's. It takes all kinds of food specially decaying leaves. It is a good swimmer but is also capable of crawling on the surface and at the time of danger can jump backwardly. It may attain a length up to seventy-five centimetres.

2. Materials and Methods

Indian white prawn inhabits the coasts of East Africa, South Africa, Madagascar, the Gulf, Pakistan, the Southwest and East coast of India, Bangladesh, Thailand, Malaysia, Philippines, Indonesia, Southern China and the Northern coast of Australia. *P. indicus* is non-burrowing, active at both day and night, and prefers a sandy mud bottom.It is also the subject of an aquaculture industry, the main countries involved in this being Saudi Arabia, Vietnam, Iran and India. Fresh Prawn samples were collected from the local vendors for its external structural investigation and specimens were photographed in orderto document body colouration and for examination of external structures.All specimens were collected in full observance of local government regulation, and in obedience to appropriate animal care standards.

3. Result and Discussion

The body of Prawn is elongated, hemispherical and slightly tapering at the posterior end (fig 1) as it was reported by (Feny et al., 2008) in prawn.

Figure 1

The fresh specimen is slightly bluish in colour. The entire outer surface of the body is covered by hard exoskeleton (fig 2) as it was mentioned by (Fransen., 2014)

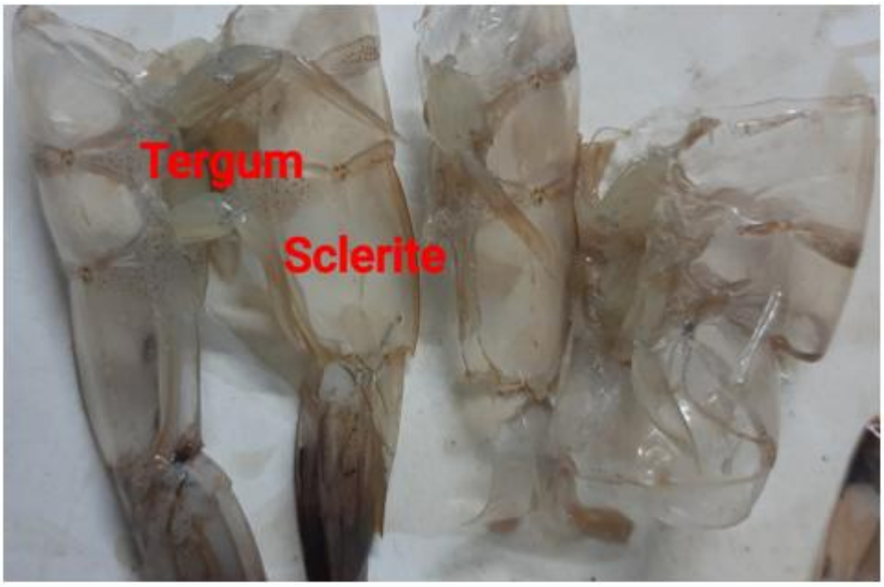

Figure 2

The body is distinctly divided into two parts—cephalothorax and abdomen, the head fused with the chest called the cephalothorax (fig3) as it was observed by (Wang et al., 2000, Lighter., 1996) (Fenny., 2018, Chanratchakaool et al., 1998) in shrimp and prawn.

Figure 3: Cephalothorax

A continuous shield-like exoskeletal covering, called carapace, (fig 4) encloses the cephalothorax.

Figure 4

Ventrally, the carapace is covered by several hard sternal plates.Cephalothorax is the broad, un-segmented and cylindrical anterior part as it was reported by (Fenyet al., 2018) in prawn. Both these parts bear on their ventral surfaces paired appendages. This section consists of 13 sections, 8 segment the chest and 5 segments on the head (fig 10). Body and the abdomen consists of 6 segments, each segment has a pair of swimming feet are also segmented, which are specialised for different functionsas it was observed by Alday and Flegel., 1999) in prawn.

Rostrum

On the dorsal and median surface, the carapace is drawn into a long serrated projection towards the anterior end. This is defensive in function.The head protected by a shell called a carapace, the front of the carapace tapered and curved shape of the letter "S" so-called rostrum (fig 5), at the top of the rostrum there are serrations which totalled 7-9, while the bottom three serrations as it was mentioned by (Fransen., 2014) in shrimp and prawn.

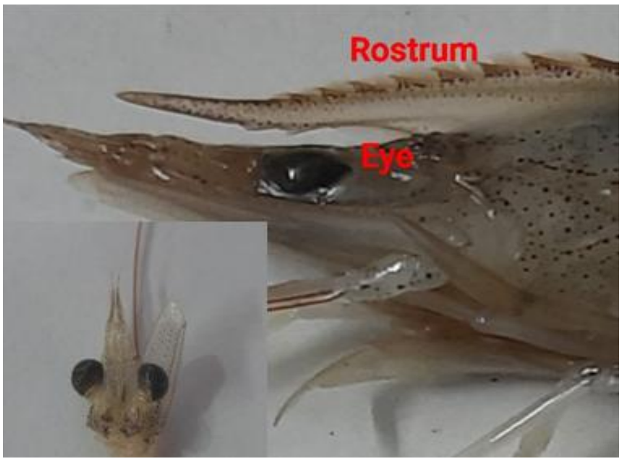

Figure 5

Eye

Another section contained in the head including: a pair of compound eyes. Near the base of the rostrum and on each side of the carapace is placed an eye (fig 5).Each eye is black and hemispherical and made up of several visual elements. It is thus called compound eye and it is mounted on a movable and jointed stalk. It is responsible for detecting light as it was observed by (Feny., 2018 and Fransen., 2014) in prawn.

Spines

These are small pointed structures, present in pairs on each lateral side of the carapace and posterior to each eye. The anterior pair is known as antennal spines and the short posterior pair is the hepatic spines (fig 6) as it was mentioned by (Chanratchakaool et al., 1995) in prawn.

Figure 6

Appendages

Thirteen pairs of appendages are present on the ventral side of prawn. The close apposition of these appendages speaks about the fusion of cephalothoracic segments as it was reported by (Feny et al., 2018) in prawn. The first five pairs, i.e. First antenna or Antennule, Second antenna, Mandible, First maxilla or Maxillula and Second maxilla are known as cephalic appendages. The remaining eight pairs are called thoracic appendages or periopods, which include three pairs of Maxillipeds and five pairs of walking legs (fig 7) as it was observed by (Fransen., 2014) in prawn.

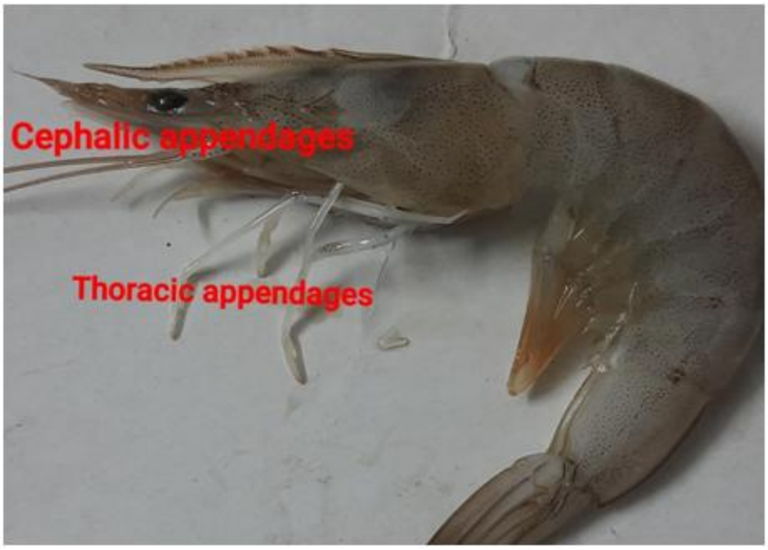

Figure 7

First antenna

First antenna is also known as antennule. It is placed near the base of the eye stalk. Its protopodite carries an additional segment, a spiny precoxa. The basis is longer than coxa and its exo and endopodites are modified as feelers or flagella.The outer feeler has two branches and the smaller branch carries olfactory setae, probably for determining smell (fig 8). The precoxa carries the balancing organ, called statocyst and the coxa is beset with many sensory hairs as it was mentioned by (Feny., 2018 and Alday., 1999) in prawn.

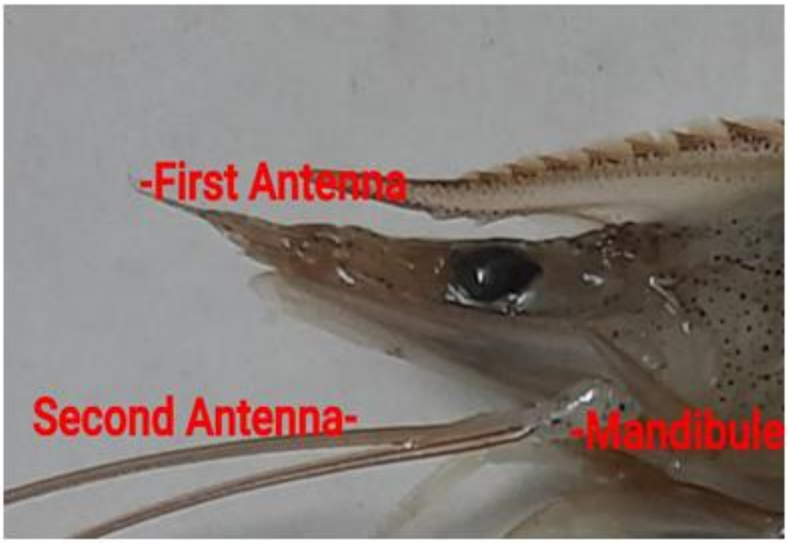

Figure 8

Second antenna

It is situated immediately after the first antenna. The coxa contains a specialised organ, called green gland, or antennal gland (or maxillary gland), which serves as excretory organ as it was observed by (Chanratchakaool et al., 1998) in prawn. The exopodite is modified as a leaf-like squama or scale with setae along its inner margin. The scale serves as a balancer during swimming (fig 8). The endopodite has become a long many-jointed flagellum and carries numerous tactile setae as it was discussed by (Fransen., 2014) in prawn.

Mandible

It is placed on the outer side of the mouth and is responsible for crushing the food. In its protopodite, the coxa is modified to form as spoon-shaped proximal apophysis and solid distal part called head as it was mentioned by (Feny et al., 2018) in prawn (fig 9).

Figure 9: Mandibule and maxilla of a prawn

The head contains stout molar process with five to six yellow teeth and thin incisor process with three closely set white teeth. The basis portion of protopodite and the endopodite form a three- jointed mandibular palp, which remains in front of the head of the mandible and carries sensory setae. The exopodite is absent as it was discussed by (Alday., 1999) in prawn.

First maxilla or Maxillula:

This crown-shaped smallest appendageis placed slightly posterior to the mouth. It consists of three small leaf-like plates carrying sensory setae in their margins.Two to these plates (formed by coxa and basis) are projected inwards and are called jaws or 1 or endites (fig 9). The remaining plate is endopodite and is directed outwards. The exopodite is absent. The first maxilla is responsible for pushing the food inside the mouthas it was reported by (Chanratchakaool et al., 1998) in prawn.

Second maxilla:

It is fan-shapedand placed immediately after the first maxilla. The coxa is much reduced and the basis is bifurcated and directed inwards to form endites or jaws (fig 9). The exopodife is large, fan-shaped and known as scaphognathite or batar. The endopodite is small and placed between the basis and exopodite. The second maxilla serves double functionsjaws are for food-getting and the scaphognathite is for producing constant water current within the gill chambers as it was mentioned by (Fransen., 2014 and Feny et al., 2018) in prawn.

First maxilliped

The coxa and basis of the protopodite are flattened to become jaws and bear stiff setae on their inner margins. In addition to short endopodite and long exopodite, the coxa bears a bilobedepipodite (fig 10).

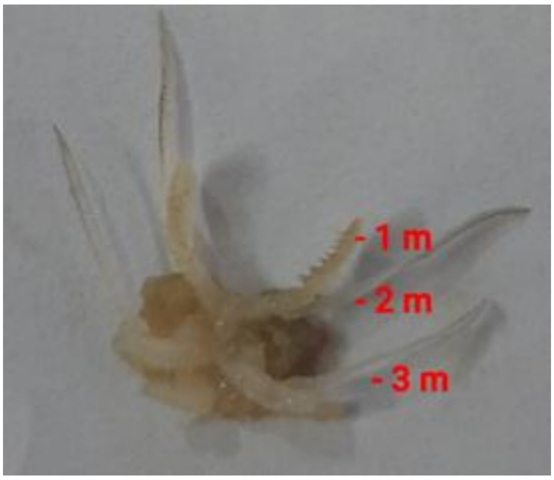

Figure 10: First maxilliped (1-m), Second maxilliped (2-m) and Third maxilliped (3-m)

The exo and endopodite parts of coxa together with basis help in the in-pushing of food. The epipodites help in respiration as it was reported by (Fransen., 2014 and Feny et al., 2018) in prawn.

Second maxilliped

Here the short coxa carries on its outer margin a small epipoditeand a gill. The inner margin is lined with numerous setae. The exopodite is long and un-jointed but the endopodite is made up of five segments ischium, merus, carpus, propodusand dactylus (fig 10). The last two segments are curved back¬wards to form a knife-like structure as it was observed by (Chanratchakaool et al., 1998) in prawn.

Third maxilliped

This appendage is leg-like and its coxa carries a thin epipodite on the outer side. The exopodite is thin and un-jointed but the endopodite has three segments, proximal, middle and distal (fig 10). The proximal segment is formed by the fu¬sion of ischium and merus, middle is carpus and the distal segment is formed by the fusion of propodus with dactylus as it was mentioned by (Alday and Flege., 1999) in prawn.

Walking legs

There are five pairs of walking legs for crawling. Each leg has a short protopodite with distinct coxa and basis and a prominent five segmented endopodite. These endopodite segments are ischium, merus, carpus, propodus, and dactylus (fig 11).

Figure 11

The epi- and exopodites are absent. The first and second legs possess pincers formed by the attachment of dactylus on propodus and are called chelate legs, while the rest are known as non-chelate legs. The second walking leg being the largest is known as large chela and the first walking leg is called small chela as it was reported by (Fransen., 2014) in prawn.

Mouth

The mouth is a slit-like unpaired and median aperture on the ventral side of the cephalothorax and is situated in between third and fourth segments. It is encircled by mandibles, maxillae and first maxillipeds. It is concerned with the ingestion of food (fig 8)Mouth with jaws (mandibles) are strong, a pair of large antennae, a pair of fins head (scophocerit), a pair of jaws auxiliaries (maxilliped), and 5 pairs of feet road (pereopod) as it was recorded by (Alday and Flegel., 1999) in prawn.

Renal apertures

It is present as a minute opening on a raised papilla near the base of each second antenna (fig 12). It serves as an outlet of excretory duct from the excretory organ, green gland as it was observed by (Feny et al., 2018) in prawn.

Figure 12

Gonopores

The position of these paired openings depends upon the sex of the individual. In males, the gonopores are seen on the inner sides of the coxae of fifth walking legs and in females these are in similar positions on the third walking legs (fig 13) as it was differentiated by (Fransen., 2014 and Feny et al., 2018) in prawn.Male prawn is large in size when compared to that of female of same age followed by narrower abdomen in male and the abdomen is wider in female, walking legs are closely set in male and walking legs are set apart in female (fig 13) as it was observed by (Fransen., 2014 and Feny et al., 2018) in prawn.

Figure13: Position of gonophores in male and female prawn

Statocyst openings

Tine statocysts or the balancing organs of prawn communicate with the exterior through minute pores. There are two statocysts situated one on the base of each first antenna (fig 8) as it was observed by (Chanratchakaool et al., 1998) in prawn.

Abdomen

The abdomen is composed of six distinct segments and a posterior-most triangular telson (fig 14).. Each abdominal segment is laterally compressed and is bounded by a ring-like exoskeletal piece, called the sclerite (fig 2). The sclerite of one segment covers the sclerite of the following segment. Such imbricate arranged sclerites are united with each other by thin un-calcified arthroidal membrane. Each sclerite consists of a ventral plate-like sternum and a dorsal arch-shaped tergum (fig 2) as it was mentioned by (Chanratchakaool et al., 1998) in prawn.The tergum suspends freely on the lateral sides as pleuron. The pleuron is connected with the appendage of the corresponding side by a small plate-like epimeron. The imbricate arrangement of the sclerites and its hinge-like joints (marked by orange spots) permit free vertical movements of the abdomen. Each abdominal segment carries a pair of appendages on its ventral sides. These appendages are called pleopods and the last pair is modified and known as uropods (fig 14) as it was reported by (Alday and Flegel, 1999) in prawn.

Figure 14

Pleopods or Swimmerets

One pair of pleopods is present in each of the first five abdominal segments (fig 14). In each pleopod the protopodite has a longer basis than the coxa. The exopodite is longer than the endopodite. Both the exo and endopodites bear tactile setae but the former is larger. An additional hook-like process, appendix interna is present on the inner sides of the endopodites of 2nd, 3rd, 4th and 5th pleopods. These processes of both the sides in females unite to form a basket for carrying eggs. The second pleopods of the male prawn have an additional process which is known as appendix masculina. The pleopods are primarily meant for swimming as it was discussed by (Alday and Flegel., 1999) in prawn.

Uropod

One pair of uropods is present in the last segment, one on each side of the telson. The protopodite is one segmented but the exo- and endopodites are large and fan-shaped (fig 14).. The exopodite is divided by a fine suture but the endopodite is not sutured. The tactile setae are arranged at the margin of both the exo- and endopodites. The uropods are used for changing direction and also for leaping backwards. Only one aperture called anus is present near the base of the telson on its ventral side. This is the opening of alimentary canal for the purpose of egestion as it was reported by (Fransen., 2014 and Feny et al., 2018) in prawn.

4. Conclusion

As aquaculture expands, it is essential that veterinary medicine be cognizant of its new opportunities in aquatic animal medicine. This is a relatively new field, and we are still pioneering, turning to the practice of rearing aquatic animals in controlled settings. The culture of aquatic organisms under controlled conditions is receiving increased attention as a major opportunity in alternative agriculture. There is a need for more research and expertise in aquatic animal medicine. Issues related to the health of aquatic animals represent both an opportunity and challenge for veterinary medicine.

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