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Structural Organization and Operational Importance of Head and Mouth Parts of Machrobrachium Rosenbergii

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Abstract:

Crustacean aquaculture is one of the oldest and economically important industries in the world and prawns contributes a lion's share in it. Machrobrachium rosenbergii inhabits the East cost of India. Prawn sample were collected from the local vendors for its external morphological investigation and specimens snaps were captured for examination of external structures. The mouth is slit- like unpaired and median aperture on the ventral side of the cephalothorax. It is encircled by labrum, labium, mandibles, maxillae and first maxillipeds. The present study aimed to learn about the structure and its important features of different mouth parts and appendages of Machrobrachium rosenbergii. formerly Machrobrachium rosenbergii *(Giant river prawn)* is also popular as Indian Prawn. Due to high nutritious value *M. rosenbergii* have been secured their name in list of world seafood items. *M. rosenbergii* is also considered as an economic coastal food in India. Crustaceans are a group of hard-bodied animals that belonging to the phylum Arthropoda and they shared closed taxonomical relation with organisms as spiders, scorpions, centipedes, millipedes, insects, and horseshoe crabs. Arthropods are characterized by having an exoskeleton which composed of a chitin, $CaCO_3$, and various protein molecules and segmented appendages. Crustaceans are a sub-group of arthropods that are segmented, primarily aquatic, and use gills to breath.

Keywords: Arthropods, Machrobrachium rosenbergii, exoskeleton, Chitin

Introduction:

The phylum Arthropoda, which includes creatures like spiders, scorpions, centipedes, and other hard-bodied animals, includes a group of creatures known as crustaceans insects, horseshoe crabs, and millipedes (Borror et al., 1998). Arthropods are distinguished by possessing segmented appendages and an exoskeleton made of chitin, a carbohydrate polymer, minerals, primarily $CaCO_3$, and proteins (Zhao et al., 2019). A segmented, primarily aquatic group of arthropods known as crustaceans uses gills to breathe (Zhao et al., 2019; Lamsdell et al., 2020). Brine shrimp, crabs, copepods (zooplankton), lobsters, and barnacles are just a few

of the numerous crustacean species that are remarkably different from one another (Webber et al., 2010). The class Malacostraca contains all of the significant species of crustaceans for aquaculture (Toyota et al., 2021).

While some of the segments, like the cephalothorax, or carapace, of lobsters, may be partially united, 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) (head and thorax fused) (Violet Beaulah 2020). The main subgroups of domesticated crustaceans, such as lobsters, crabs, crawfish, shrimp, and prawns, are also malacostracans and belong to the order Decapoda (Ortea et al., 2012). They have five pairs of walking legs (periopods) on segments 9 to 13, among other characteristics (Ortea et al., 2012). Penaeid shrimp and palinurid lobsters (such as the Caribbean spiny lobster) lack chelated appendages, although the first pair of some species (such as Maine lobster, crabs, and some prawns) are clawed and may be employed for grabbing prey or defending oneself (Violet Beaulah 2020).

Moreover, the abdomen has pleopods, which are extensions that can either contain fertilised eggs or have swimming modifications (swimmerets) (females) (New M.B. 2002). With the exception of crabs, most decapod crustaceans have a fan-shaped tail (called the telson) made up of multiple uropods (Violet Beaulah 2020). The telson, which is attached to the abdomen, is used for mobility and is frequently employed to flee from prospective predators (Violet Beaulah 2020). Decapod crustaceans, as well as all other arthropods, live inside of hard exoskeletons called carapaces that are made of proteins, a mineral called $CaCO_3$, a carbohydrate polymer called chitin, and minerals (Grunenfelder et al., 2014). Its structural configuration presents a special challenge for expansion, like a hero who has outgrown his metal armour (Violet Beaulah 2020). The animal must secrete a new, larger carapace, shed its old one, and grow (Violet Beaulah 2020).

In rivers, ponds, and other freshwater habitats, the prawn is widespread (Primavera, J. H. 2006). It lives at night, bottom-dweller that inhabits aquatic plants and underwater crevices (Primavera, J. H. 2006). It consumes all types of food, particularly decomposing leaves (Violet Beaulah 2020). Although it can swim well, it can also crawl on the surface and, in an emergency, jump backwards (Violet Beaulah 2020). It can grow to a maximum length of 75 centimetres (Asaduzzaman et al., 2008). Owing to its excellent nutritional value, *M. rosenbergii* (prawn) has earned a spot on the list of seafood products available worldwide (Visavale et al., 2011). In India, *M. rosenbergii* is regarded as a valuable coastal food (Visavale et al., 2011; Arulkumar et al., 2017). The purpose of the current study was to learn more about

the composition and distinguishing characteristics of the various mouth parts and appendages of Machrobrachium rosenbergii.

- **Materials and methods:**

Prawn sample were collected from the local vendors for its external morphological investigation and specimens snaps were captured for examination of external structures. The mouth is slit- like unpaired and median aperture on the ventral side of the cephalothorax. It is encircled by labrum, labium, mandibles, maxillae and first maxillipeds.

- **Results and discussion:**

Prawns have an elongated, hemispherical body that taper somewhat at the back (Feng et al., 2018). The body is divided into two parts - cephalothorax and abdomen. Every body part of prawn has different functions.

3.1 Mouth:

On the ventral side of the cephalothorax, between the third and fourth segments, is the mouth, an unpaired, midline opening that resembles a slit. Mandibles, maxillae, and initial maxillipeds surround it. It is worried about food consumption. Strong jaws (mandibles), five pairs of road feet, two pairs of big antennae, two pairs of head fins (scophocerit), two pairs of jaws auxiliaries (maxilliped), and a mouth (pereopod) (Alday & Flegel 1999).

3.2 Mandible:

The mandible, which is located on the outside of the mouth, breaks down food. The coxa is altered in its protopodite to take the form of a solid distal head and a spoon-shaped proximal apophysis. The head has a thick incisor process with three closely spaced white teeth and a narrow molar process with five to six yellow teeth. Protopodite's fundamental component and the endopodite produce a three-jointed mandibular palp that carries sensory setae and remains in front of the mandible's head. There is no exopodite (Feng et al., 2018).

3.3 Rostrum:

The carapace is pulled into a protrusion with long serrated edges on the dorsal and median surfaces that points anteriorly. The purpose of this is defensive. The head is shielded by a shell called a carapace, and the front of the shell has a letter "S"-shaped taper and curve called a rostrum. The top of the rostrum has 7-9 serrations, while the bottom three serrations are smaller (Fransen 2014).

3.4 Eye:

A pair of eyes present in head region. Each of the hemispherically shaped, black eyes has several visual components. Hence, it is known as a compound eye, and it is positioned on a

flexible stalk with joints. Its function is to sense light (Fransen 2014).

3.5 Appendages:

On the ventral side of the prawn, thirteen pairs of appendages are visible. The cephalothoracic segments' fusion is shown by the tight apposition of these appendages. Cephalic appendages are the first five pairs, including the First antenna or Antennule, Second antenna, Mandible, First maxilla or Maxillule, and Second maxilla. Three pairs of Maxillipeds and five pairs of walking legs make up the remaining eight pairs, which are referred to as thoracic appendages or periopods (Violet Beaulah 2020).

3.6 Spines:

On each lateral side of the carapace and posterior to each eye, there are two of these tiny pointed features. The short rear pair is referred to as the hepatic spines, and the anterior pair is known as the antennal spines (Chanratchakool et al., 1995).

3.7 Labrum and Labium:

Almost all extant Euarthropoda have a feature called the labrum, which resembles a flap and is located directly in front of the mouth. The Pycnogonida, which are likely related to chelicerates, are the most obvious outliers. The labium serves as the insect's "lower lip," while the labrum serves as its "upper lip" in entomology (Hunt et al., 1992).

3.8 First Antenna:

Antennule is another name for the first antenna. It is positioned close to the eye stalk's base. A spiny precoxa is carried by the protopodite of the organism. The exo and endopodites of the basis are altered to function as feelers or flagella, and it is longer than the coxa. The smaller of the two branches on the outer feeler contains olfactory setae, which are likely used to detect smell. The statocyst, a balancing organ, is carried by the precoxa, and the coxa is covered in numerous sensory hairs (Feng et al., 2018; Violet Beaulah 2020).

3.9 Second antenna:

It is located just following the first antenna. The green gland, also known as the antennal gland or maxillary gland, is an unique organ found in the coxa that performs the function of an excretory organ in prawns. The exopodite has been transformed into a scale-like squama with setae along the inner margin. The scale acts as a stabiliser while swimming. A lengthy, numerous-jointed flagellum with numerous tactile setae, the endopodite has developed (Violet Beaulah 2020).

3.10 First Maxilla:

This smallest appendage, which resembles a crown, is situated just behind the mouth. It is made up of three tiny, leaf-like plates with sensory setae along their edges. These two plates,

which are produced by the coxa and the basis, extend inward and are known as the jaws or the endites. Endopodite makes up the final plate, which faces outward. Exopodite is not present. The first maxilla is in charge of shoving food into the mouth (Chanratchakool et al., 1995).

3.11 Second Maxilla:

It is positioned just after the first maxilla and has a fan-like shape. The coxa is significantly smaller, and the basis is split in half and pointed inward to create endites, or jaws (fig. 9). The huge, fan-shaped exopodife is sometimes referred to as batar or scaphognathite. Small and positioned between the basis and exopodite is the endopodite. The second maxilla has two purposes. The scaphognathite and jaws work together to maintain a steady flow of water within the gill chambers (Fransen 2014).

3.12 First Maxilliped:

The protopodite's coxa and basis have stiff setae along their inner borders and have been flattened to resemble jaws. A bilobed epipodite is found on the coxa in addition to short endopodite and long exopodite. Along with the basis, the exo- and endopodite components of the coxa aid in driving food into the body. The epipodites facilitate breathing (Feng et al., 2018)

3.13 Second Maxilliped:

The short coxa in this instance has a gill and a tiny epipodite on its outer margin. There are several setae lining the inner border. The endopodite is made up of five segments, including the ischium, merus, carpus, propodus, and dactylus, unlike the exopodite, which is lengthy and not joined. To create a structure resembling a knife, the final two segments are curled backward (Chanratchakool et al., 1995; Violet Beaulah 2020).

- **Third Maxilliped:**

Its coxa has a slender epipodite on the outside of the leg-like appendage. Although the endopodite comprises three segments—proximal, middle, and distal—in contrast to the exopodite's thin and unjointed structure. ischium and merus fuse to produce the proximal segment, carpus forms the intermediate segment, and propodus and dactylus combine to make the distal section (Alday & Flegel 1999).

3.15 Walking legs:

Five sets of walking legs are available for crawling. A noticeable five segmented endopodite and a small protopodite with an unique coxa and basis are seen on each leg. Ischium, Merus, Carpus, Propodus, and Dactylus are the endopodite segments in question. Exo- and epipodites are not present. Chelate legs are the first and second legs, which are distinguished from the

others by having pincers generated by the attachment of dactylus to propodus. The first walking leg is referred to as tiny chela, and the second walking leg, which is the largest, is known as large chela (Violet Beaulah 2020).

3.16 Renal apertures:

Each second antenna's base has a tiny aperture on a raised papilla that contains it. It functions as the excretory duct's outflow from the green gland's excretory organ (Feng et al., 2018).

3.17 Gonopores:

The location of these paired apertures is determined by the person's sex. The gonopores are located on the inner edges of the coxae of the fifth walking leg in males, and at a position identical to this on the third walking leg in females. When compared to female prawns of the same age, male prawns are larger in size, followed by an abdomen that is narrower in males and wider in females, as well as walking legs that are more closely spaced in males than they are in females (Fransen 2014; Feng et al., 2018).

3.18 Statocyst openings:

Tiny pores are used by tin statocysts, or the prawn's balancing organs, to connect with the outside world. Each first antenna's base has one statocyst, and there are two total (Chanratchakool et al., 1995).

3.19 Abdomen:

The abdomen is divided into six separate segments, including a triangular telson towards the back. A ring-shaped exoskeletal component known as the sclerite surrounds each abdominal segment, which is laterally compressed. One segment's sclerite is covered by the sclerite of the segment after it. Thin, uncalcified arthroidal membranes connect these imbricately organised sclerites to one another. Each sclerite is made up of a dorsal arch-shaped tergum and a ventral plate-like sternum. On the lateral sides, the tergum hangs freely as a pleuron. An epimeron, which resembles a tiny plate, connects the pleuron to the appendage on the corresponding side. The sclerites' imbricate arrangement and their joints, which resemble hinges, allow the abdomen to move freely in all directions. A pair of appendages are present on the ventral sides of each abdominal segment (Chanratchakool et al., 1995; Alday & Flegel 1999).

- **Conclusion:**

In conclusion, after critical review of the available literature from the different sources, it is realised that there is lack of direct evidences which represent nutritional benefits of prawn species including *M. rosenbergii*. Coastal food have been analysed by various scientific communities. In spite of this, the thorough scientific investigation of prawns remained

unexplored. There are only few studies reported on high-throughput imaging based anatomical explanation of prawns. Present investigation may help to create baseline to generate anatomical signatures of *M. rosenbergii* with special reference to their nutritional potential.

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