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Observations on feeding behaviour of fresh water prawn *Macrobrachium lamarrei* (Crustacea: Decapoda)

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Abstract
Freshwater prawn are promising candidates for aquaculture and knowledge of food and feeding habit is must for successful culture. Present study investigates the feeding mechanism and role of appendages in feeding behaviour of freshwater prawn, *Macrobrachium lamarrei*. Mostly preferred food was dried prawn powder and least preferred was groundnut cake. Prawns showed cannibalistic behaviour frequently in lab. Antenna and antennules were the main sensory appendages which help in locating and orientation while I & II chelate legs were used for detection, catching and transferring of food up to the mouth. Maxillipedes, maxilla and maxillula played the supportive role. Mechanism of feeding and functional role of different appendages in feeding behaviour have been discussed.

Keywords: freshwater prawn, *M. lamarrei*, feeding behaviour, appendages

Introduction
Crustaceans are one of the largest groups of Arthropods which includes many freshwater forms such as crayfish, lobster, shrimps, prawns etc. Crustaceans are very important for the ecosystem as they play a vital role as a food source for animals. Prawns are generally omnivorous in their feeding nature and play a vital role in food chain in tropical water (Carnevali *et al*., 2012) [3]. Prawns are a good source for nutrients such as proteins, free amino acids and vitamins A and D (Proudfit and Robinson.,1955; Singh., 1977) [16, 22]. Therefore, they are high in demand in both the national and international markets (Martin., 1996; Sankar *et al*., 2011) [12, 17]. For better growth and production in freshwater aquaculture, the animal must be fed with a nutritionally balanced feed in order to provide better growth within a stipulated time period (Ahmed, 1998) [1]. Food and feeding habits play a vital role in order to evaluate rate of growth, maturation of gonads, population density and other metabolic activities of aquatic organisms (Nandkumar and Damodar, 1998; Kulkarni *et al*., 1997; Kawamura *et al*., 2018) [13, 11, 9]. Freshwater prawn, *M. lamarrei* is a smaller prawn, readily available in river Gomti in and around Lucknow (U.P.), India, throughout the year. This prawn is translucent, fully adapted to freshwater having abbreviated development, easy in maintenance and a promising candidate for freshwater aquaculture included in list of culturable prawns (Holthuis, 1980) [7]. These prawns may also serve as a better laboratory model for environmental monitoring (Shukla and Sharma, 2010; Kalpana and Meena, 2016) [20, 8]. Very few studies regarding digestive system and feeding of freshwater prawns are there (Patwardhan 1937; Sharma and Shukla 1990; Sharma and Shukla 1992) [15, 18, 19].
Considering the aquaculture potential of *M. lamarrei*, present work has been taken into account to evaluate role of feeding appendages and feeding behaviour in freshwater prawn, *Macrobrachium lamarrei.*

Material and Methods
Freshwater prawns, *Macrobrachium lamarrei* (Crustacea, Decapoda) were collected from the river Gomti in and around Lucknow (U.P.), India with the help of Local fisherman and transferred to laboratory (N- 26^{O} 49'5" E-80^{O} 55' 58") and maintained in glass aquaria (Sharma and Shukla, 1990) [18]. The animals before being used for experimental purposes were subjected to lab acclimation for 5-7 days and kept starved for 48 hrs before experiment. The animals were given different kinds of food i.e., readymade fish food, dry prawn powder,

peanut cake, yeast and parts of dead prawns etc. The feeding nature and role of appendages were observed and recorded with a digital camera (Sony DSC-W810) and video clips were analysed. Various stages of feeding were studied and photographed by stereo binocular microscope.

Results

Freshwater prawn, *Macrobrachium lamarrei* (Plate1, Fig A) is bottom dweller and omnivorous in habit. It is more active in night than day. In laboratory they show cannibalistic behaviour feeding in dead and weak prawns in aquaria (Plate 1, Fig B), (Plate 2, Fig F). Various feeds provided in lab i.e. Readymade fish food, dried prawn powder, yeast and groundnut cake etc. Showed a variety of preferences. The most preferred food was dried prawn powder while least preferred was groundnut cake showing order:

Dried prawn powder > readymade fish food > yeast > Groundnut cake

Prawns showed sensation, orientation, food catching and consummatory behaviour. As food was sprinkled on the surface of water, first it senses food with the help of antenna & antennules (Plate 2 Fig 1&2). Thereafter, it holds food with second chelate legs (pereiopod), transfers to first chelate leg (peeriopod). First chelate leg also searches food in front of the mouth and holds the food. Searching and holding was carried out preferably with second chelate legs in a sideways way. Then food is held in chela (pincers) while first chelate legs showed active searching of food in front of the mouth. Right chelate legs were comparatively more used than left chelate legs. At times, first chelate legs also showed searching and holding of food. In case of larger food pellets like readymade food, I & II chelate legs combinedly holds the food and bring it to the mouth zone. After reaching to the mouth, food is teared and masticated with mandibles. During this process, food is properly supported by I, II, III maxillipeds, maxilla & maxillula (Plate 2; Fig 3,4 & 5). Feeding with dead prawns, it holds pieces of food with the help of I chelate legs, III maxillipeds and feeds at the bottom of aquaria (Plate 2; Fig 6). Sometimes walking legs are also seen to search the food and scrap the surface of food as well as the bottom of aquaria. Due to translucent colour, well fed individuals are marked with food contents in the cardiac stomach (Plate 1; Fig 3). The II and III maxillipeds hold the food particles in a comfortable position and mandibles help in tearing and grinding of food. Chelate legs and III maxillipeds are vital appendages for picking up the food particles and placing them into the mouth. Mandibles are used mainly for cutting and grinding the food.

Discussion

Macrobrachium lamarrei is a freshwater prawn. It is omnivorous and prefers the cannibalistic nature of feeding as it reflects preference to the parts of dead prawns over ready-made fish food. Probably, this preference is shown by the prawn owing to the soft texture of the parts of dead prawns as it is easy in tearing and cutting into fine particles and digestion. Firstly, the prawn senses and searches for the food with the help of olfactory appendages such as antennules and antennae. Similar behaviour has been observed in Palaemon *Macrobrachium rosenbergii* (Patwardhan, 1937; Kuwamara *et al*., 2018). The understanding of sensory mechanism and receptors and how they help in acquiring and consuming food particles is important in the aquaculture of *M. lamarrei* Once the prawn detects the precise location of food, it moves towards it with the help of walking legs and catches the food with the help of II chelate legs and conveys it to the I chelate leg. The first chelate legs also play an important role in searching and holding the food. However, the II chelate legs are major appendages used in searching and holding of food. The chela (pincers) also helps in holding the food. In the present study, it was observed that freshwater prawn *M. lamarei* prefers right chelate leg for holding and searching the food. Mandibles play a vital role in tearing and masticating the food particles. The maxillipedes, maxilla and maxillula also play a supportive role in this whole process. Due to the translucent colour of prawn, the food content present in stomach can be seen without dissecting the animal.

In decapod crustaceans, the chemical stimuli are perceived by chemosensory organs (Derby and Atema, 1982; Nigam, 1976). Eap *et al*., (2020) [4, 14, 5] reported that in *L.vannamei* olfactory chemosensors are distributed on the antennules mediate odor-activated searching for food pellets with the help of lateral and medial antennular flagella. Similar type of sensory and olfactory setae have been on antennules and antennae of *M. lamarrei* (Shukla, 2004). In the present study, it was noticed that antennae and antennules function as olfactory organs and help in sensing and detection of chemical stimuli. This behaviour provides an assumption that antennae and antennules bear chemosensory receptors on them. The olfactory setae & asthetases may help in sensing & orientation towards food.

Macrobrachium rosenbergii and *Litopenaeus vannamei* search for the food particles with the help of chelate walking legs and thereafter pick up the food (Kawamura *et al*., 2018) [9]. Hindley and Alexander (1978) [6] also reported that the banana prawn (*Penaeus merguiensis*) picks up the food with the help of the first three pairs of walking legs. Sharma & Shukla (1990) [18] observed with the help of Scanning Electron Microscopy that the first and second chelate legs of *M. lamarrei* consist of denticulated setae and sensory pads which may help the prawn in collecting, detecting and transferring food to the mouth. In the present study, we observed that *Macrobrachium lamarrei* picks up the food with the help of II chelate legs and preferably the right one. The I chelate legs also help in searching and holding the food. The chelate legs bear setae and seem to be chemo sensitive in nature. When large food pellets are given, the I and II chelate legs combinedly holds the food and bring them to the mouth. Suthers (1984) [23] reported in eastern king prawn (*Penaeus plebejus*) that chelate walking legs are used in cutting large food particles with the help of its pincers. In the present study, it was observed that sometimes, III walking legs are seen to search the food and scrap the surface of food as well as bottom of aquaria.

Freshwater prawn *Macrobrachium kistnensis* picks up the food item with the help of walking chelate legs and third maxillipedes (Kalpana and Meena, 2016) [8]. *L. vannamei* picks up the food pellet with the help of III maxilliped (Kawamura *et al*., 2017) [10]. Kawamura *et al*., (2018) [9] reported that *L.vannamei* and *M. rosenbergii* pick up the food pellet with the help of chelate walking legs and maxillipedes are not involved. In the present study, we observed that feeding process in *M. lamarrei* was supported by I, II, III maxillipedes, maxilla & maxillula. While eating the dead parts of prawn, it holds the food with the help of I chelate legs, III maxillipedes and feed at the bottom of aquaria. The II and III maxillipedes hold the food particle in comfortable position. The chelate legs and III maxillipedes play an important role in picking up the food and conveying it to the

mouth. Above observations are in support of present findings. Kawamura *et al*., (2018) [9] found that L. *vannamei* and *M. vannamei, could* not cut off the food with the help of pincers and process the food exteriorly. All the food particles were masticated with the help of mandibles. The mandible of *L. vannamei* was devoid of the molar process and hence, could not masticate the pellets. In *M. rosenbergii*, the mandible was hard and it was able to masticate several food items with different range of hardness. The present study showed that mandible plays an important role in mastication of food particles. The mandible of *M. lamarrei* consists of both molar process and incisor process. *M. lamarrei* showed preference to the parts of dead prawns and the groundnut cake was least preferred (Author's unpublished data). It suggests that the prawn showed preference to animal origin food items over others. Bauer (2004) [2] stated that the molar process is mainly used in grinding whereas the incisor process is used in cutting and slicing the food into fine particles. The incisor and molar process of *M. lamarrei* appears to have the similar function i.e., cutting and grinding of the food respectively.

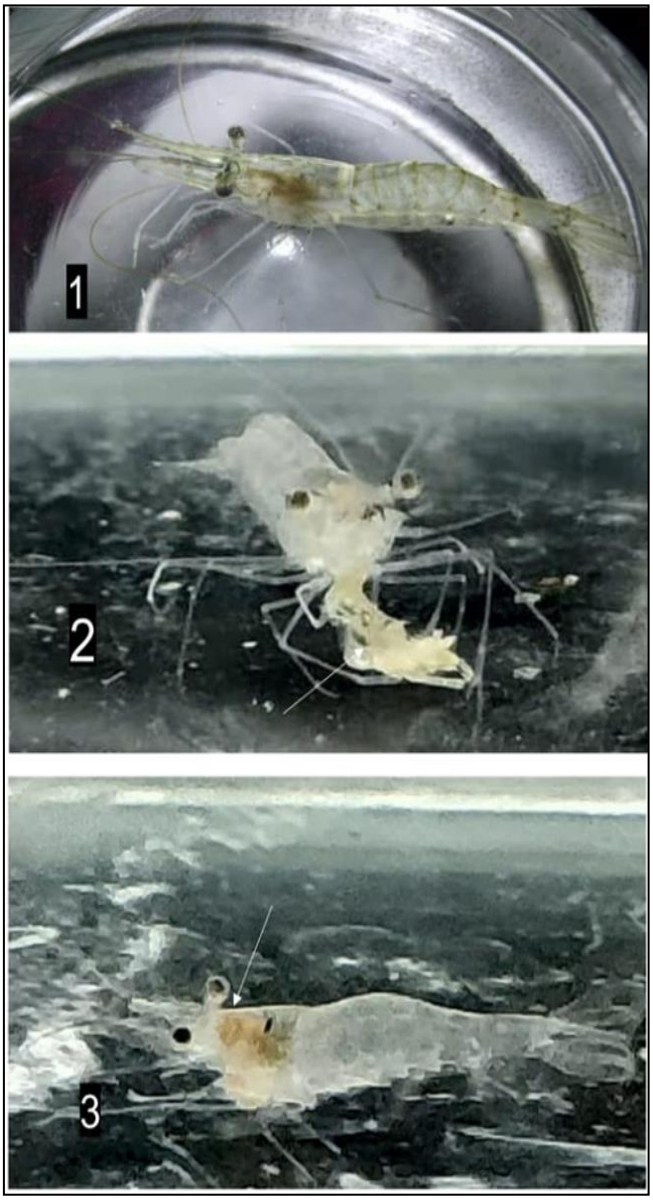

Fig 1: *M. lamarrei*
Fig 2: Feeding of dead prawn powder
Fig 3: Completely

Plate 1: Photographs of feeding behaviour of *M. lamarrei*

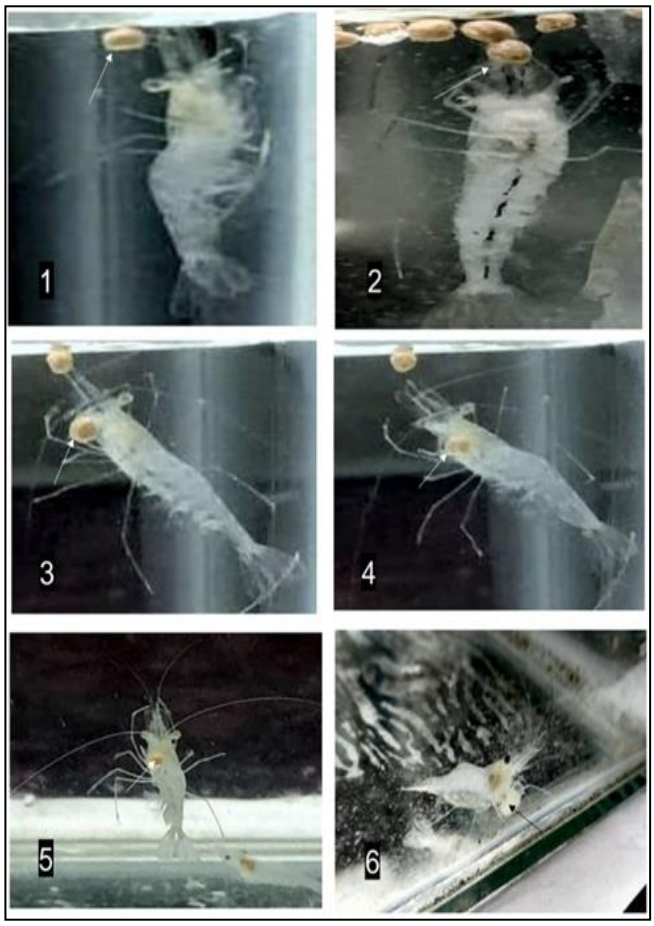

Fig 1: Sensing of food
Fig 2: Orientation towards food
Fig 3: Holding food with Chela
Fig 4: Cosummatory behaviour
Fig 5: Consummatory behaviour
Fig 6: Feeding of dead prawn piece

Plate 2: Photographs showing feeding behaviour of *M. lamarrei*

Conclusion

Present study is indicative of food preference, and role of feeding appendages in smaller freshwater prawn, *Macrobrachium lamarrei*, which is a promising candidate for freshwater aquaculture. The study may also be helpful in designing of proper food for their successful culture.

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