

Chemoreception Studies in Relation to Feeding Responses in the Marine Shrimps H. Milne Edwards (*Penaeus indicus*) and Miers (*Metapenaeus dobsonii*)

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Abstract

A study of chemoreception in relation to feeding and other factors involved showed that feeding behavior in shrimps can be triggered by chemical stimuli. However, *P. indicus* and *M. dobsonii* differ significantly in their chemotactic response to different stimuli.

Introduction

Chemoreception in relation to feeding and the various factors involved were investigated under laboratory and field conditions by behavioral and growth studies in *P. indicus* and *M. dobsonii*. The entire sequence of feeding behavior in shrimps, from appetitive behavioral pattern to the consumatory act of feeding can be triggered by chemical stimuli alone. The chemotactic indices, Db and Rb were used to classify the feeding stimuli as attractant and repellent, based on their chemotactic property.

Analysis

Analysis of extracts of natural food materials of both the species showed that they are attractive to *P. indicus* and *M. dobsonii*, whereas squid ink acted as a feeding repellent for shrimps. The feeding response increased with increase in extract concentration and decreased with squid ink concentration. The major attractant and stimulant substances present in the extracts were free amino acids (with 78.2% of the extract activity

in *P. indicus* and 50.28% in *M. dobsonii*), and nucleotides. Soluble proteins and peptides, lipids and carbohydrates also evoke a feeding response but at a lower level.

The maximum feeding response was produced by neutral followed by basic amino acids and Inosine Mono Phosphate (IMP) among the nucleotides. At the same concentration level, L-amino acids were found more stimulatory than the corresponding DL-amino acid. The threshold concentration of L-amino acids ranged between 4×10^{-2} M and 1×10^{-10} M for *P. indicus* and 1.5 to 1×10^{-10} M for *M. dobsonii*, and in the case of DL-amino acids it was between 1×10^{-2} M and 1×10^{-5} M for both species. Maximum feeding response and feed ingestion was produced by amino acids like lysine, methionine, glycine, alanine and proline in *P. indicus* and lysine, methionine, alanine, phenylalanine and leucine in *M. dobsonii*. Most of the amino acids have an effect on feeding activity, but those like glycine and lysine acted differently as attractants, incitants and stimulants at progressively increasing concentrations.

Environmental parameters like pH and salinity had a pronounced

influence on the chemoreception and feeding response, which was chemotactically more active at pH between 7.0 and 9.0 and salinity between 15 and 25 ppt. The feed intake was reduced by 50% at pH 6.0 and 10.0. The alertness towards feeding stimuli increased with the degree of starvation up to certain levels and thereafter decreased due to the physical weakness of the animal.

The agar matrix bioassay served as a cheap and efficient method to screen a wide variety of attractants and stimulants. Flavoring the diets with potential natural and synthetic chemoattractants and stimulants reduced the time required to attract the shrimps to the feed and initiate ingestion activity. It also improved the palatability and acceptability and subsequently improved food intake, growth, survival, food assimilation efficiency, specific growth rate and food conversion. This marked increase in the food intake and growth could be due to the increased digestive activity of the pancreatic secretion and the resultant increase in appetite.

The attractants and stimulants produced more or less the same pattern for ingestion activity as that

elicited during the behavioral trial. It also indicated that the growth performance of various feeding stimuli could be predicted directly from the behavioral trial.

The chemoreceptors most concerned with feeding are on the antennules, pereopods and on the mouth parts. Antennule chemoreceptors were involved in the distance chemoreception and to mediate arousal and search for potential food. The mouth and leg receptors functioned mainly as contact

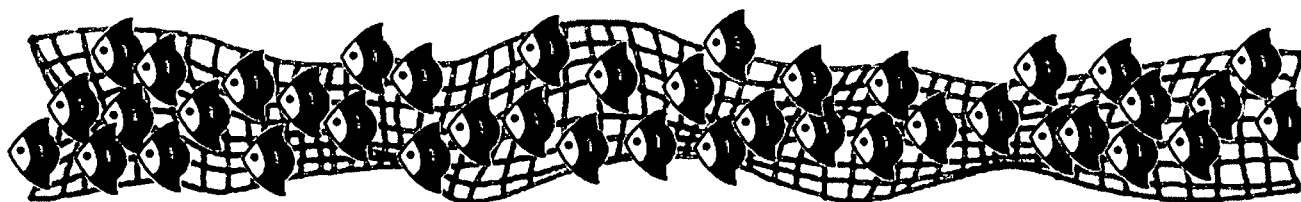
chemoreceptors involved in the seizure and ingestion activity and to some extent they are also involved in distance chemoreception. Morphologically distinct chemosensory sensilla present on these appendages were the primary sites for chemoreception in these species.

Conclusion

Both *P. indicus* and *M. dobsonii* differed significantly in their chemotactic response to different

stimuli. Among the various stages of animals studied, juveniles were chemotactically more active than the postlarvae and sub-adults.

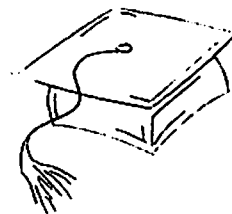
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