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Feeding behavior and ingestion rate of juvenile shrimp of the genus *Penaeus* (Crustacea: Decapoda)

Abstract

The feeding behavior and the factors that influence the ingestion rate of feed in shrimp are described. The main factors that influence the ingestion rate of food in shrimp are mainly: the selection of food, food stability, satiety, feeding frequency, density and dispersion of the food, shrimp size, molting stage, temperature, dissolved oxygen in the water, photoperiod, anti-nutritional factors and toxic substances. These factors can influence the ingestion rate individually or synergistically during shrimp growth. It is necessary to know the oral structures, the feeding process and combine the effect of the biochemical, physiological, nutritional and environmental factors of shrimp to optimize the ingestion rates in native shrimp mainly.

Keywords: Ingestion rate, prawn, shrimp, feeding

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Introduction

The determination of food ingestion rates and the time required to consume a satiation ration is necessary to determine the optimal rate and duration of feeding,[1] in shrimp and prawn farming. Shrimp are organisms that detect food through chemical receptors associated with the sense of smell (distance receptors) and sensitive or contact receptors that function as the sense of taste.[2] The aim is to describe the feeding behavior and the factors that influence the rate of ingestion in shrimps and prawns.

Results and discussion

In general, shrimp spend much of their time on the bottom substrate carrying organic and inorganic particles to its mouth.[3] The search for food takes a long time from shrimp activity and there is a tendency to select large sizes and the search ceases when the food is detected remotely by chemoreceptors.[4] The food particles are manipulated by chelated pereiopods which pass them to the mouthparts.[5]

The food particles are collected by the chelated pereiopods and they are passed to the oral parts, beginning their passage with a pre-oral cavity composed of setae that are found in the first two pairs of maxillipeds and maxillae. These pass them to the mandibles that sheared off and crushed the food particles, the setae of the labrum push them into the esophagus, and the labrum and paragnaths prevent them from coming out of the mouth. Non-food particles are expelled down by the appendages of the cavity worries.[3] The third maxilliped is very important in the shrimp feeding process, because together with the pereiopods they can hold large particles in the mouthparts. It has endopodite which are used in the feeding, cleaning and reception of pheromones. On the inner edges of the ischia have thorns that help hold the food particles so that they are ingested or discarded. All distal segments have long setae that are used to clean chelated pereiopods and antennules.[6] Four phases have been identified in the ingestion of food in shrimp which can be presented separately or together:[7]

i. Introduction into the pre-oral cavity;
ii. Passage of food up the pre-oral cavity;
iii. Insertion of food into the mandibular region and
iv. Trituration and swallowing.

The study of the rate of intake is necessary to design and evaluate practical diets and has been required to perform finest nutritional studies. The ingestion rate in shrimp is influenced by

a. The selection of food;
b. Food stability;
c. Satiety;
d. Feeding frequency;
e. Density and dispersion of the food;
f. Shrimp size;
g. Molting stage;
h. Temperature;
i. Concentration of dissolved oxygen in the water;
j. Photoperiod;
k. Anti-nutritional factors and toxic substances.

The dry matter ingestion rate in grams/hour has been calculated from the following equation:[8]

$$I = (M_i - M_f - M_p) / T \quad (1)$$

Where: I = dry matter ingestion rate in grams per hour, M_i = initial weight of dry matter in grams placed in each experimental unit; M_f = final weight of dry matter in grams; M_p = loss of dry matter and T = residence time of the ration in the experimental unit.

The factors that influence the rate of food intake in shrimp are described.

a. The preference for a food in shrimp is determined in part by the pre-stational stimulus or palatability of the food (taste, shape, size, color and texture).[9] It has been determined that the L-amino acids, the quaternary amino betaine, fatty acids as well as, lipid compounds and extracts of marine by-products including shrimp by-product meal accelerate the food detection and ingestion and indirectly improve feed efficiency in animals aquatic;[10]

b. Artificial diets have limited stability in water, so a decrease in shrimp ingestion rate occurs, which is inversely proportional to the time of immersion of diets in water. So an increase in the frequency of feeding could be a very effective technique to prevent the loss of water soluble nutrients.

c. Satiety in shrimp occurs once the proventriculus is full, feeding continues can only occur after the food ingested is transported to the intestine.[11] Some studies indicate that the species of penetrated shrimp can fill their proventriculus during feeding in 1-10 minutes and empty it in 1-4 hours.[12] In general, the filling and emptying of the proventriculus fully determines the ingestion rate in shrimp;[9]

d. The shrimp ingestion rate is modified with the frequency in which it is fed, being that a frequency of twice per day resulted in the increase of the rate of food consumption of this organism, compared with frequencies of one and three times per day;[13]

e. Ingestion rate decreases with the increase in shrimp density in the ponds, but this effect is modified if the food is dispersed throughout the pond.[14] Nunes and Parsons[15] found that when comparing the method of dispersion of food throughout the area, against a system of concentration of food in trays at two ends of the pond, shrimp had significantly higher levels of ingestion in the ponds where it was dispersed the food and its foraging activity was more efficient;

f. It was observed that the feed ingestion rate progressively increased as shrimp size increased, but decreased progressively when the intake rate was standardized with respect to the individual's body weight. Although pre-adult and adult shrimp ingested greater absolute amounts of food than juvenile shrimp, juveniles had higher ingestion rates per gram of body weight than adults;[15]

g. Shrimp in the stages of pro ecdisis and ecdisis can decrease, or, stop feeding completely.[16] In studies with juveniles (15 to 25 g) of shrimp, it was observed that shrimp decreased their ingestion rate considerably (from 2.7 g/day to 1.2 g/day) in the two days prior to the change and during it.[17] It has also been seen that most shrimp in ecdisis, emerged for less time and did not feed during the night, compared to individuals in intermolt period;[18]

h. In shrimp it was found that as the temperature of the medium increases, not only does the ingestion rate increase, but the forage time also increases, and it does so linearly with respect to temperature;[19]

i. In low concentrations of dissolved oxygen (<2.5 mg/L) growth rates are lower and reduced in food intake;[9]

j. In shrimp there is an increase in food intake associated with light periods. During the day *L. vannamei* consumes at least half of all food offered, tiger shrimp prefers to feed when there is light; and maximum pellet ingestion rates occurred when pink shrimp was under relatively high light intensities;[20]

k. Ingestion rate in shrimp is negatively affected by exposure to toxic substances,[21] such as chromium, copper, zinc, nickel and saponins among others.[18]

Conclusion

Four phases have been identified in the ingestion of food in shrimp. The feeding behavior begins with the manipulation of the particular ones in the sediment with the chelated pereiopods and the detection of the food by means of chemoreceptors. Thus, the particles are transferred to the oral parts, where the particles are rejected or consumed depending on their nature. All this through a rate of ingestion that is determined by the effect of at least eleven factors.

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Conflicts of interests

The authors state that there is no conflict of interests.

References

1. Talbot C. Some aspect on the biology of feeding and growth in fish. *Proceedings of Nutrition Society*. 1993;52(3):403–416.
2. Mendoza R, Montemayor J, Verde J, et al. *Chemoattraction in crustaceans: Role of homologous molecules. Advances in Aquaculture Nutrition III.* Mexico: Memories of the Third International Symposium on Aquaculture Nutrition. Monterrey, Nuevo León. 1999:365–401.
3. Alexande CG, Hindley JPR. The mechanism of food ingestion by the banana prawn, Penaeus Merguiensis. *Marine Behaviour and Physiology*. 1985;12(1):33–46.
4. Hindley JPR. The detection, location and recognition of food by juvenile banana prawns, Penaeus merguiensis de Man. *Journal Marine Behaviour and Physiology*. 1975; 3(3):193–210.
5. Hindley JPR, Alexander CG. Structure and function of the chelate pereiopods of the banana prawn, Penaeus merguiensis. *Marine Biology*. 1978;48(2):153–160.
6. Alexande CG, Hindley JPR, Jones SG. Structure and function of the third maxillipeds of the banana prawn Penaeus merguiensis. *Marine Biology*. 1980;58(4):245–249.
7. Sick LV, White D, Baptist G. The effect of duration of feeding, amount of food, light intensity, and animal size on rate of ingestion of pelleted food by juvenile penaeid shrimp. *The Progressive Fish–Culturist*. 1973;35(1):22–26.
8. Lee PG, Lawrence AL. Digestibility. In: D'Abramo LR, Conklin DE, Akiyama DM, editors. *Crustacean Nutrition*. EUA: World Aquaculture Society. 1977. p. 194–247.
9. Métallier R, Guillaume J. *Feeding of fish: Applications, raw materials and additives used in fish foods*. In: Nutrition and Feeding of Fish and Crustaceans (Guillaume JS, Kaushik P, Métallier R, editors.). UK: Praxis Publishing; 2001. p. 279–295.
10. Condrey RE, Gosselink JG, Bennett HJ. Comparison of the assimilation of different diets by Penaeus setiferus and P. aztecus. *Fishery Bulletin*. 1972; 70(4):1281–1292.

11. Hentshel BT, Feller RJ. Quantitative immunoassay of the proventricular contents of white shrimp Penaeus setiferus Linnaeus: a laboratory study. *Journal of Experimental Marine Biology and Ecology*. 1990;139(1):85–99.

12. Taechanuruk S, Stickney RR. Effects of feeding rate and feeding frequency on protein digestibility in the freshwater shrimp (Macrobrachium rosenbergii). *Journal of the World Mariculture Society*. 1982;13(4):63–72.

13. Raheed MA, Bull CM. Behaviour of the western king prawn, Penaeus latisulcatus Kishinouye: effect of food dispersion and crowding. *Australian Journal of Marine and Freshwater Research*. 1992;43(4):745–752.

14. Nunes AJP, Parsosns GJ. Feeding Levels of the Southern Brown Shrimp Penaeus subtilis in response to food dispersal. *Journal of the World Aquaculture Society*. 1999;30(3):331–348.

15. Drach P, Tchernigovtzeff C. On the method of determining the stages of interme and its general application to crustaceans. *Life Environment*. 1967;18:595–609.

16. Rothlisberg PC. Aspects of penaeid biology and ecology of relevance to aquaculture: a review. *Aquaculture*. 1998;164(1):49–65.

17. Hill BJ, Wassemberg TJ. Preferences and amount of food eaten by the prawn Penaeus esculentus over the moult cycle. *Australian Journal of Marine and Freshwater Research*. 1992;43(4):727–735.

18. Hill BJ. *Effect of temperature in duration of emergence, speed of movement and catchability of the prawn Penaeus esculentus*. In: Rothlisberg PC, Hill BJ, Staples DJ, editors). Australia: Second Australian National Prawn Seminar, NPS2; 1985. p. 77–83.

19. Arias P. *Factors that affect the ingestion rate of penetrated shrimp: comparison of two species (Litopenaeus setiferus Linnaeus, 1767 and L. vannamei Boone, 1931)*. Mexico: Bachelor thesis, Science Faculty, National Autonomous University of Mexico. 2006. p. 105.

20. Chen JC, Lin CH. Toxicity of copper sulfate for survival, growth, molting and feeding of juveniles of the tiger shrimp, Penaeus monodon. *Aquaculture*. 2001;192(1):55–65.

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