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LIVE AND INERT FOODS FOR POSTLARVAE OF THE GIANT FRESHWATER PRAWN *MACROBRACHIUM ROSENBERGII*

S.T. Indulkar* and S.G. Belsare

Marine Biological Research Station, Dr. Balasaheb Sawant Konkan Agricultural University, Peth Killa, Ratnagiri, 415 612, India

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Abstract

Five live or inert food organisms (adult *Artemia*, *Moina*, *Tubifex* worms, clam meat, poultry egg custard) were evaluated as feed for postlarvae of *Macrobrachium rosenbergii*. The postlarvae (avg 5.2±0.22 mg, 7.2±0.38 mm) were reared in plastic pools (0.9 m diameter x 0.6 m) containing 100 l fresh water, stocked at one postlarva per liter for 30 days, with five replicates of each treatment. There were significant differences ($p<0.05$) in final weight gains of the postlarvae (62.94-88.86 mg), final length gains (16.45-20.71 mm) and survival (69.67-92.33%). The live *Moina* were superior to the other foods with a significantly higher weight gain (1708.92±54.03%), length gain (287.70±4.76%) and specific growth rate (9.45±0.1%/d). The higher protein (66.16%) and n-3 HUFA (10.20%) levels in *Moina* may explain these results.

Introduction

Feeding of cultivable decapod crustaceans is often better known for juveniles and adults than for larvae and postlarvae (Moller, 1978). The feeding habits of *Macrobrachium rosenbergii* were studied by Ling (1969) who reported that it is omnivorous.

The size at which *M. rosenbergii* postlarvae are stocked into growout ponds plays an important role in achieving maximum production and profitability. A wide variety of feeds have been tested in postlarval stages: fresh

fish meat, squids, crockers, clams, mussels, shrimps, *Acetes*, chironomid larvae, crab meat, *Tubifex* worms, beans, grains, poultry eggs and high protein compounded diets (Reddy, 1997). Prawn larvae and postlarvae prefer live organisms to formulated feed. Live organisms serve as living capsules of nutritive elements such as essential proteins, lipids, carbohydrates, vitamins, minerals, amino and fatty acids (New, 1998). Under growout conditions, the freshwater prawn feeds on natural

* Corresponding author. E-mail: indulkarst@rediffmail.com

food organisms that are supplemented with combinations of prepared diets (Tidwell et al., 1997). To achieve maximum production and profitability, the nutritional components of natural foods must be identified and quantified. However, there is a dearth of information on the use of live and inert food organisms and their effects on the growth and survival of *M. rosenbergii* postlarvae.

In this study, the relative effects of live and inert foods, i.e., *Moina*, adult *Artemia*, *Tubifex* worms, clam meat and poultry egg custard, on the growth and survival of *M. rosenbergii* postlarvae during their nursery phase were evaluated under laboratory conditions.

Materials and Methods

The freshwater cladoceran *Moina sp.* was cultured in a concrete cistern (3.3 x 0.9 x 0.5 m) using the phased fertilization method (Shirgur and Indulkar, 1987). They were collected with a scoop net and washed thoroughly before feeding them to the postlarvae.

Freshly hatched *Artemia* nauplii were grown in 35 ppt water in a concrete cistern applying organic (oil cake) and inorganic (single super phosphate and urea) fertilizers. When they reached 3-5 mm, the adult *Artemia* were removed and chopped into small pieces (0.2-0.5 mm) before being fed to the postlarvae.

Tubifex worms were cultured in a concrete cistern using a mixture of garden soil and digested sludge as the culture bed and a continuous water flow of 0.25-0.5 l/min. Groundnut oil cake (100 g) and cattle dung (10 kg) were applied weekly as organic fertilizers. The required quantity of worms was hand picked daily, washed thoroughly under tap water and chopped into small pieces before feeding them to the postlarvae.

The live marine clam (*Meritrix meritrix*) was collected from Mirya Creek near Ratnagiri Coast and the meat was separated, chopped and washed prior to serving it to the postlarvae.

Whole hen eggs (albumin and yolk) were stirred and steamed for nearly 10 min, cooled and washed. The custard was passed through a 0.1 mm mesh sieve under pressure and then fed to the postlarvae.

The postlarvae came from a single brood and single batch raised at the pilot hatchery of the Marine Biological Research Station, Peth Killa, Ratnagiri, India. They were acclimatized to fresh water and fed 40% protein flake feed until they reached postlarvae stage 5. They were divided into batches of 100 and randomly stocked into 25 plastic pools (5 replicates of 5 trial feeds) of 0.9 m diameter x 0.6 m, filled with 100 l fresh water. The stocking density was one postlarva per liter of water (Garces and Heinen, 1989). Three pieces of tile were placed in each pool to increase the surface area and provide hiding places for the postlarvae.

The average weight and length of the postlarvae were recorded at the beginning of the experiment by randomly measuring 50 animals from the experimental lot. The plastic pools were maintained at ambient temperature in a shaded place and provided with aeration. The prawns were fed twice a day *ad libitum*, once in the morning and once in the evening. Leftover feed was removed by siphoning, pools were cleaned daily and lost water was made up by adding fresh water. The experiment lasted 30 days. The proximate composition (protein, lipid and ash) and some fatty acids (% of total lipid) of the foods and the proximate composition of the postlarvae before and after the experiment were determined according to standard methods (AOAC, 1984).

Dissolved oxygen, pH and temperature were measured daily by standard methods. The water temperature ranged 26.5-29.0°C, pH 7.8-8.2 and dissolved oxygen 5.6-8.08 ppm, well within the tolerance limits of *M. rosenbergii* postlarvae (New and Singholka, 1985; Ang and Cheah, 1986).

After 30 days, the prawns in each pool were counted, weighed and their length measured. The data for growth and survival were analyzed by one-way analysis of variance (ANOVA) to test significant differences among means. To determine significant differences between the foods, F-values ($p < 0.05$) were determined using Fisher's Protected Least Significant Difference test (Snedecor and Cochran, 1967).

Results

The body weights and lengths, growth and survival are presented in Table 1. After 30 days there were significant differences ($p < 0.05$) in growth and survival of postlarvae fed different live and inert foods. The greatest gains in body weight and length were achieved with *Moina* and *Artemia* and the lowest gains with clam meat and egg custard. The specific growth rates of postlarvae fed *Moina* or *Artemia* were significantly higher than those of postlarvae fed other foods. There was no significant difference in specific growth rate between postlarvae fed *Tubifex* worms, clam meat and egg custard.

The percent survival was significantly lower amongst postlarvae fed egg custard or clam meat than among other postlarvae. There was no significant difference ($p < 0.05$) in survival between postlarvae fed adult *Artemia*, *Moina* or *Tubifex* worms.

The proximate and fatty acid compositions of the foods are given in Table 2. *Moina* had a higher protein content than the other foods. The lipid content of *Moina* was lower than that of *Artemia* but higher than that of the other foods. *Moina* had the highest level of n-3 HUFA.

The initial and final proximate body compositions of the postlarvae are given in Table 3. Crude protein, crude lipid and total ash did not significantly differ ($p > 0.05$). The final body compositions did not differ from the initial body composition ($p > 0.05$).

Discussion

The present study suggests that *Moina* is a promising live food source for the nursery rearing of *M. rosenbergii* postlarvae. A similar observation was made by Watanabe et al. (1983) who reported that *Moina* are known to be a suitable live food for raising a variety of fish larvae. Besides its wide distribution in tropical waters, *Moina* can be mass propagated using easily available waste materials (Shirgur and Indulkar, 1987). Alam et al. (1993) reported that the use of *Moina* in feeding *M. rosenbergii* postlarvae not only promotes a better growth rate but also helps the process of recycling organic wastes such

as agro-industrial residues and animal manure.

It has been reported that n-3 HUFA, particularly 20:5n-3 and 22:5n-3, are essential for proper growth, development and survival of marine fishes and crustaceans (Reigh and Stickney, 1989). Several PUFA, such as 18:2n-6, 18:3n-3, 20:5n-3 and 22:6n-3, increase growth and survival in larvae and juvenile crustaceans. In addition, their ability to promote ovarian maturation in brood stock and eggs of better quality has been demonstrated (Fenucci et al., 1981; D'Abramo, 1989; D'Abramo and Sheen, 1993; Querijero et al., 1997). New (1995) reported that 18:2n-6 and 18:3n-3 fatty acids are required by freshwater prawns. Sandifer and Joseph (1976) and Roustaian et al. (2001) pointed out that *M. rosenbergii* juveniles are able to desaturate and elongate 18:3n-3 and 18:2n-6 fatty acids. The bioconversion of fatty acids in *Penaeus japonicus* larvae has also been demonstrated but it was too low to meet the required level for this species (Jones et al., 1979). Diets containing either 22:6n-3 or 20:4n-6 PUFA were equally effective (New, 1995). Reigh and Stickney (1989) observed depressed growth in freshwater prawns fed 18:3n-3 as the only source of dietary lipid. Therefore, the high n-3 HUFA content in *Moina* (10.20%) might have influenced the better growth and survival in the present study.

The conclusion of the present study is that *Moina* is the best food among the live and inert foods examined as foods for *M. rosenbergii* postlarvae. Healthy postlarvae (over 27 mm and 94 mg) can be produced within a short 30 days of nursery rearing by feeding *Moina*. *Moina* is suitable in size and its slow jerky movements, along with its nutritional content, make it a most suitable food organism for indoor nursery rearing of *M. rosenbergii* postlarvae.

References

- Alam M.J., Ang K.J. and S.H. Cheah, 1993. Use of *Moina micrura* (kurze) as an *Artemia* substitute in the production of *Macrobrachium rosenbergii* (de Man) postlarvae. *Aquaculture*, 109:337-349.

Table 1. Growth and survival (\pm standard error of mean) of *Macrobrachium rosenbergii* postlarvae fed different live and inert foods.

	Adult Artemia	Moina	Tubifex worms	Clam meat	Egg custard
Initial avg wt (mg)	5.2 \pm 0.22	5.2 \pm 0.22	5.2 \pm 0.22	5.2 \pm 0.22	5.2 \pm 0.22
Final avg wt (mg)	85.68 \pm 1.80	94.06 \pm 2.81	71.18 \pm 1.56	68.14 \pm 2.51	70.58 \pm 2.65
Wt gain (mg)	80.48 \pm 1.80 ^b	88.86 \pm 2.81 ^c	65.98 \pm 1.56 ^a	62.94 \pm 2.51 ^a	65.38 \pm 2.65 ^a
Body weight increase (%)	1547.69 \pm 34.58 ^b	1708.92 \pm 54.03 ^c	1268.88 \pm 30.04 ^a	1210.42 \pm 48.37 ^a	1257.35 \pm 51.02 ^a
Specific growth rate (%/d)	9.13 \pm 0.07 ^b	9.45 \pm 0.10 ^b	8.46 \pm 0.08 ^a	8.30 \pm 0.13 ^a	8.43 \pm 0.14 ^a
Initial avg length (mm)	7.2 \pm 0.38	7.2 \pm 0.38	7.2 \pm 0.38	7.2 \pm 0.38	7.2 \pm 0.38
Final avg length (mm)	26.48 \pm 0.30	27.91 \pm 0.34	24.39 \pm 0.30	23.65 \pm 0.47	24.32 \pm 0.44
Length gain (mm)	19.28 \pm 0.30 ^b	20.71 \pm 0.34 ^c	17.19 \pm 0.30 ^a	16.45 \pm 0.47 ^a	17.12 \pm 0.44 ^a
Body length increase (%)	267.75 \pm 4.23 ^b	287.70 \pm 4.76 ^c	238.80 \pm 4.11 ^a	228.50 \pm 6.59 ^a	237.78 \pm 6.09 ^a
Survival (%)	92.33 \pm 3.38 ^b	90.33 \pm 1.76 ^b	89.33 \pm 4.37 ^b	73.67 \pm 5.36 ^a	69.67 \pm 6.0 ^a

Values with different superscripts differ significantly ($p > 0.05$)

Table 2. Proximate compositions (%) and fatty acid contents (% of total lipid) of live and inert foods (\pm standard error of mean).

	<i>Adult Artemia</i>	<i>Moina</i>	<i>Tubifex worms</i>	<i>Clam meat</i>	<i>Egg custard</i>
Protein	59.89 \pm 1.53	66.16 \pm 2.36	64.8 \pm 3.2	44.4 \pm 0.5	47.45 \pm 0.8
Lipid	15.77 \pm 0.19	10.46 \pm 0.52	14.0 \pm 1.8	9.9 \pm 0.75	11.87 \pm 1.4
Ash	7.97 \pm 0.16	6.31 \pm 0.48	6.0 \pm 1.2	4.0 \pm 1.0	0.93 \pm 0.4
<i>Fatty acid</i>					
14:0	1.12	1.42	2.23	4.21	0.03
16:0	13.26	8.06	14.69	18.60	0.58
18:0	2.82	3.71	5.75	6.77	0.68
16:1	8.60	12.09	8.24	10.52	0.15
18:1	5.32	6.29	5.07	9.58	1.74
20:1	2.44	2.19	2.99	7.22	0.01
18:3n-3	7.28	5.98	4.54	3.46	0.02
20:4n-6	1.01	3.55	0.96	4.69	0.08
20:5n-3	6.50	9.05	5.33	0.87	0.01
22:5n-3	0.01	0.82	0.86	1.72	0.01
22:6n-3	0.45	0.33	0.11	1.89	0.02
Total n-3 HUFA	6.96	10.20	6.30	4.48	0.04

Table 3. Proximate composition of *Macrobrachium rosenbergii* postlarvae before and after being fed live and inert foods for 30 days (% dry weight \pm standard error of mean).

	<i>Initial</i>	<i>Adult Artemia</i>	<i>Moina</i>	<i>Tubifex worms</i>	<i>Clam meat</i>	<i>Egg custard</i>
Protein	60.1 \pm 1.3	63.4 \pm 1.1	66.2 \pm 2.0	59.8 \pm 1.9	62.9 \pm 0.8	60.5 \pm 2.3
Lipid	8.0 \pm 0.1	9.8 \pm 0.8	9.5 \pm 1.2	8.7 \pm 0.7	8.5 \pm 0.4	9.2 \pm 0.3
Ash	18.2 \pm 0.5	19.4 \pm 0.4	18.9 \pm 0.4	20.4 \pm 0.7	19.3 \pm 0.3	20.1 \pm 0.7
Dry matter	28.9 \pm 1.4	28.3 \pm 0.9	28.0 \pm 0.9	27.4 \pm 0.6	29.0 \pm 1.1	26.5 \pm 1.4

- Ang K.J. and S.H. Cheah**, 1986. Juvenile production of the Malaysian giant freshwater prawn (*Macrobrachium rosenbergii* de Man) using modified static green water system. pp. 141-144. In: *Proc. Int. Conf. on Development and Management of Tropical Living Aquatic Resources*. Aug. 2-5, 1983, Serdang, Malaysia.
- AOAC**, 1984. *Official Methods of Analysis*, 14th ed. Association of Official Analytical Chemists, Washington.
- D'Abramo L.R.**, 1989. Lipid requirements of shrimp. pp. 271-285. In: *Advances in Tropical Aquaculture*. AQUACOP, IFREMER 9.
- D'Abramo L.R. and S. Sheen**, 1993. Polysaturated fatty acid nutrition in juvenile freshwater prawn *Macrobrachium rosenbergii*. *Aquaculture*, 115:63-86.
- Fenucci L.L., Lawrence A.L. and Z.P. Zein-Eldin**, 1981. The effects of fatty acid and shrimp meal composition of prepared diets on growth of juvenile shrimp, *Penaeus stylirostris*. *J. World Maricult. Soc.*, 12:315-342.
- Garces C.L. and J.M. Heinen**, 1989. Supplementary foods for post-larval freshwater prawn, *Macrobrachium rosenbergii*. *J. World Aquacult. Soc.*, 20(1):39A.
- Jones D.A., Kanazawa A. and K. Ona**, 1979. Studies on the nutritional requirements of the larval stages of *Penaeus japonicus* using microencapsulated diets. *Mar. Biol.*, 54:261-267.
- Ling S.W.**, 1969. The general biology and development of *Macrobrachium rosenbergii* (de Man). *FAO Fish. Rep.*, 57(3):589-606.
- Moller T.H.**, 1978. Feeding behaviour of larvae and postlarvae of *Macrobrachium rosenbergii* (de Man). *J. Exp. Mar. Biol. Ecol.*, 35:251-258.
- New M.B.** 1995. Status of freshwater prawn farming: A review. *Aquacult. Res.*, 26:1-54.
- New M.B.**, 1998. Global aquaculture: Current trends and challenges for the 21st century. In: *Anans do Aquacultura Brasil 98*, Vol. I. Nov. 2-6, Recife.
- New M.B. and S. Singholka**, 1985. *Freshwater Prawn Farming. A Manual for the Culture of Macrobrachium rosenbergii*. FAO Fish. Tech. Paper 1/FIRI/T225. 118 pp.
- Querijero B.V.L., Teshima S., Koshio S. and M. Ishikawa**, 1997. Utilization of monounsaturated fatty acid (18:n-9, oleic acid) by freshwater prawn *Macrobrachium rosenbergii* (de Man) juveniles. *Aquacult. Nutr.*, 3:127-139.
- Reddy A.K.**, 1997. Management of freshwater prawn hatcheries and culture possibilities. *Fish. Chimes*, Jan:32-36.
- Reigh R.C. and R.R. Stickney**, 1989. Effect of purified fatty acids on the fatty acid composition of freshwater shrimp *Macrobrachium rosenbergii*. *Aquaculture*, 77:157-174.
- Roustaian P., Kamarudin M.S., Omar H., Saad C.R. and M.H. Ahmad**, 2001. The effect of dietary lipid sources on the *Macrobrachium rosenbergii* larval performance, post-larval production and fatty acid composition. *J. Aqua. Trop.*, 16(3):251-263.
- Sandifer P.A. and J.D. Joseph**, 1976. Growth response and fatty acid composition of juvenile prawn (*M. rosenbergii*) fed a prepared ration augmented with shrimp head oil. *Aquaculture*, 8:129-139.
- Shirgur G.A. and S.T. Indulkar**, 1987. Continuous mass culture of cladoceran *Moina micrura* in plastic pool for daily exploitation. *Punjab Fish. Bull.*, 11(5):43-48.
- Snedecor G.W. and W.G. Cochran**, 1967. In: *Statistical Methods*, 6th ed. Oxford and IBH Publ. Co., New Delhi. 593 pp.
- Tidwell J.H., Schulmeister G., Mahl C. and S. Coyle**, 1997. Growth, survival and biochemical composition of freshwater prawns *Macrobrachium rosenbergii* fed natural food organisms under controlled conditions. *J. World Aquacult. Soc.*, 28(2):123-132.
- Watanabe T., Tamiya T., Oka A., Hirata M., Kitajima C. and S. Fujita**, 1983. Improvement of dietary value of live foods for fish larvae by feeding them on ω 3 highly unsaturated fatty acids and lipid-soluble vitamins. *Bull. Jpn. Soc. Sci. Fish.*, 49:471-479.