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Experimental Study on the Salinity Tolerance of *Macrobrachium idae* Larvae

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ABSTRACT: The 'freshwater' prawn *Macrobrachium idae* Heller tolerates in nature and culture varying salinities typical of a brackish or estuarine environment. It holds promise as an amenable species for aquaculture in rural areas of developing countries. Experiments were conducted on larval survival and to determine optimum environmental conditions. During early development, larvae preferred salinities from 5 to 20 ‰ S. In these salinities all larvae moulted after 24 h; their median tolerance limit (120 h) was 27 ‰ S.

INTRODUCTION

In recent years, aquaculture as an enterprise has assumed global importance. Though *Macrobrachium idae* is a freshwater prawn, it is facultative euryhaline, and abundant during monsoon (October and November) and post-monsoon (January and February) seasons at Parangipettai (Porto Novo, Coromandel coastline, Tamil Nadu, India) in estuarine, backwater and mangrove niches. Its migration into brackish water for spawning and the return of its juveniles upstream to freshwater has been investigated by Visco (1920), Nataraj (1947), Panikkar (1967), and George (1969). The species has a wide scope for aquaculture ventures in tropical regions. In view of its economic importance we have studied responses of larvae to salinity changes.

MATERIAL AND METHODS

Berried *Macrobrachium idae* were collected during December from the estuary and brought to the laboratory for spawning. Prawns were kept in plastic tubs of 40 l capacity, filled with glasswool-filtered clean estuarine water (collected from the same spot as the prawns) of 18 ‰ S and fed freshly-chopped clam meat. Active larvae were sorted out 6 to 8 h after hatching for experiments. The larvae were directly transferred to 9 different test salinities, ranging from 0 to 40 ‰ S (increasing the salinity by 5 ‰ at each step) in 500 ml glass beakers. Each beaker contained 20 larvae and was filled with water of test salinity. For carrying out each experiment, two replicates were run simultaneously with the same number of larvae. A control (18 ‰ S) was run simultaneously. For zero salinity, dechlorinated tap water was used. Salinity adjustments, whenever required, were made using dechlorinated tap water and/or sea water. During the experimental period, aeration was provided and the larvae were fed freshly hatched *Artemia salina* nauplii. All experiments were carried out under normal laboratory light conditions and at room temperature (25° ± 2 C°) for 120 h.

Daily observations were made on larval behaviour and survival. Larval mortality was confirmed only after observing the cessation of heart beat of the moribund zoea under a binocular microscope. Dead larvae were removed immediately. The 'test water' was replenished daily with freshly prepared water of respective salinity. In absence of significant difference between the values of experiment and replicates, all values were pooled for calculating the mean. The mean percentage of mortality of larvae was recorded at different time intervals to determine the median tolerance limits (TLm) after Litchfield and Wilcoxon (1949). Results of experiments conducted in freshwater were not used to obtain dose effect curves.

RESULTS

After 10 d in captivity berried prawn tended to incline to one side of the container. Rapid, discontinuous lashing of their pleopods provided aeration,

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Table 1. *Macrobrachium idae*. Mean percentage survival of larvae reared in different salinities over different exposure periods. At each salinity a total of 60 zoeae were tested

Salinities (S ‰)	Percentage survival after 24 h	48 h	72 h	96 h	120 h	Total number of zoeae surviving after 120 h
18 (control)	100	100	100	100	100	60
0*	100	70	50	20	5	3
5	100	100	100	100	100	60
10	100	100	100	100	100	60
15	100	100	100	100	100	60
20	100	100	100	100	87	52
25	100	100	100	100	67	40
30	100	100	97	93	27	16
35	100	93	87	80	20	12
40	93	57	10	7	0	0

* 0 ‰ = Dechlorinated tapwater

stimulating and accelerating embryonal stretching movements (Katre and Pandian, 1972).

In the different test salinities *Macrobrachium idae* larvae moulted normally 24 h after hatching. The zoeae behaved normally when exposed up to 16 h to 40 ‰ S; thereafter they sank for a brief while to the bottom and again attempted to surface. A moribund condition of 6–10 h preceded death in lethal salinities. During that period, the zoea gradually changed from a 'transparent hue' to an 'opaque white' in colour before they eventually died.

Figure 1 shows the percentage of mean survival (mean of one experiment and two replicates) of *Macrobrachium idae* larvae exposed to different salinities. Figure 2 illustrates the cumulative percentage (calculated for 120 h) of zoea mortality. Table 1 lists the mean percentage of survival in different test salinities at varying exposure times and Table 2 the observed mortality in different salinities and the corresponding 95 % confidence limits.

In 40 ‰ S, mortality began after 20 h; all zoeae had died after 120 h. In 35 ‰ S and in zero salinity, the zoeae approached death from 48 h onward; after 120 h their survival was 20 % and 5 %, respectively. In 30 ‰ S, death began to occur after 72 h and only 27 % of zoeae were alive after 120 h. No mortality was encountered in the range 5–25 ‰ S until 96 h. Beyond 96 h and after 120 h 87 % and 67 % of the zoeae survived in 20 ‰ and 25 ‰ S. No mortality or moribund states were observed in the controls. In salinities of 5, 10 and 15 ‰ S, all zoeae behaved normally over the entire duration of our experiments. Here, the 120 h TLm value was 27 ‰ S (25.5 to 28.6 ‰ S).

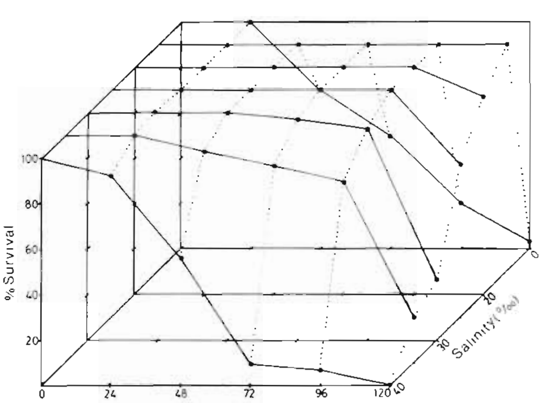

Fig. 1. *Macrobrachium idae*. Percentage of mean survival of larvae exposed to different salinities over different periods of time

DISCUSSION

Our study reveals that the optimum salinity range for larval *Macrobrachium idae*, regarding survival and development, lies between 5 and 20 ‰ S. The best salinity for survival appears to be between 5 and 15 ‰ S. Gravid females appear to prefer a medium salinity of 18 ‰ S for laying and hatching their eggs. Similar findings were reported for *M. rosenbergii* whose larvae and adults are 'euryhaline to a considerable degree' (Goodwin and Hanson, 1974) and tolerated salinities up to 21 ‰ S (Fujimura, 1974; Goodwin and Hanson, 1974). Post larval blood concentrations of

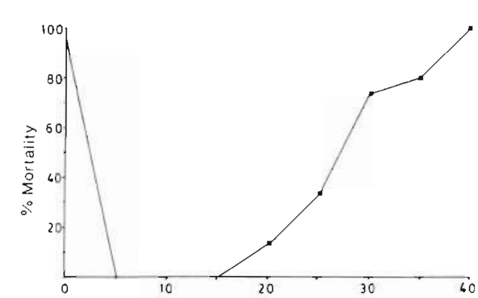

Fig. 2. *Macrobrachium idae*. Cumulative percentage of mortality after 120 h of larvae exposed to different salinities

Table 2. *Macrobrachium idae.* Salinity effects on larvae. Concentrations-effect curve. TL = Tolerance limit

Salinity (‰ S)	No. dead / No. tested	Mortality (%)	Expected values	Difference between observed & expected values	Chi^2
40	60/60	100 (97.4)	92	5.4	0.0380
35	48/60	80	83	3.0	0.0060
30	44/60	73.3	65	8.3	0.0300
25	20/60	33.3	39	5.7	0.0130
20	8/60	13.3	14	0.7	0.0010
15	0/60	0 (0.7)	1.6	0.9	0.0045

TL 16 = 35.5 ‰ S
TL 84 = 20.5 ‰ S
TLm or TL 50 = 27 ‰ S
95% Confidence limit = 28.6 – 25.5 ‰ S
Slope 'S' = 1.316

M. rosenbergii are hyperosmotic to ca 17 or 18 ‰ S, but hypoosmotic at higher salinities; they died within few days at 30 ‰ (Sandifer et al. 1975).

Our study further reveals that at 30 ‰ S *Macrobrachium idae* larvae exhibit signs of mortality after 72 h; between 96 and 120 h, 73 % died. In freshwater, larval mortality began after 48 h and only 5 % of the larvae remained alive after 120 h. Similarly, survival of *M. rosenbergii* larvae was observed to be limited in freshwater to only about 5 d (Goodwin and Hanson, 1974). In *M. idae,* the calculated TLm value (for 120 h) revealed that only 50 % of the larvae survived in 27 ‰ S. Hence, *M. idae* must be classified as euryhaline. It shows a preference for lower salinities for spawning, as well as for the survival, growth and development of its larvae. Commercial cultivation of *M. idae* holds considerable promise in the vast brackish water inland areas of the tropics.

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LITERATURE CITED

Fujimura, T. (1974). Development of a prawn industry, development of a rearing technique for the giant long-legged prawn *Macrobrachium rosenbergii*; Quarterly Progress Reports under the Commercial Fisheries Development Act, National Marine Fisheries Service, March, 1967; Jan., 1968; Feb., 1969

George, M. J. (1969). Systematics – Taxonomic consideration and general distribution. Bull. Cent. mar. Fish. Res. Int. 14: 5–49

Goodwin, H. L., Hanson, J. A. (1975). Aquaculture of the freshwater prawn *Macrobrachium* species. The Oceanic Institute, Waimanalo, Hawaii

Katre, S., Pandian, T. J. (1972). On the hatching mechanism of a fresh water prawn *Macrobrachium idae.* Hydrobiologia 40: 1–17

Ling, S. W. (1969). The general biology and development of *Macrobrachium rosenbergii* (deMan). FAO Fish Rep. 57 (3): 589–606

Litchfield, J. T., Wilcoxon, F. (1949). A simplified method of evaluating dose-effect experiments. J. Pharmaco. exp. Ther. 96: 99–113

Nataraj, S. (1947). Preliminary observations on the bionomics, reproduction and embryonic stages of *Palaemon idae* Heller. Rec. Indian Mus. 45: 86–96

Panikkar, N. K. (1967). Osmotic behaviour of shrimps and prawns in relation to their biology and culture. FAO Bull. Fr. BCSP/67/E/25

Sandifer, P. A., Smith, T. I. J. (1970). Development of a crustacean mariculture programme at South Carolina's marine resources research institute. In: Proceedings of the fifth annual workshop world mariculture society, pp. 431–439

Sandifer, P. A., Hopkins, J. S., Smith, T. I. J. (1975). Observations on salinity tolerance and osmoregulation in laboratory – reared *Macrobrachium rosenbergii* postlarvae (Crustacea: Caridea). Aquaculture 6: 103–114

Visco, P. Jr. (1920). Report of the biologist. Louisiana Department of Conservation. Fourth Biennial Report 1918–1920: 120–130

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