

Effect of Different Salinities on the Survival and Growth of *Artemia* Spp

P. Soundarapandian and G. Saravanakumar

Centre of Advanced Study in Marine Biology, Annamalai University,

Parangipettai 608 502, Tamil Nadu, India

Abstract: The brine shrimp, *Artemia* is gained a unique position in aquaculture system and is given as live feed to over 85% of cultured species around the world. In the present study, three salinities (freshwater, brackish water and seawater) were selected for the biomass production. The initial stocking density was 100 nauplii/litre in all the salinities tested. Before inoculation of *Artemia* nauplii, *Chlorella* was cultured in the rearing buckets and it was used as feed for growing nauplii. The water exchange was carried out once in every two days. The salinity of the tap water (freshwater) was varied between 2-4 ppt and in brackish water was ranged between 28-33 ppt. However, the seawater salinity was ranged between 34-55ppt. The pH of the freshwater, brackish water, and seawater was ranging between 7.8-8.5, 8.2-8.9 and 8.5-9.3 respectively. The temperature was uniform for all three salinities used for the present study (29.32°C). In freshwater, the *Artemia* reached adult stage on 20th day of culture. Likewise the *Artemia* reached adult stage on 17th and 14th day when they were cultured in brackish water and seawater respectively. Higher survival was observed in seawater (80%) followed by brackish water (75%) and freshwater (30%). Maximum size of the adult *Artemia* (1.2cm) was recorded in seawater and minimum size was recorded in freshwater (0.4). From the present study it could be confirmed that seawater salinity was highly suitable for the culture of *Artemia* in laboratory conditions as evidenced by higher survival (80%) larger size (1.2cm) and shorter duration (14 days) to reach adult stage.

Key words: Salinity, *Chlorella*, *Artemia*, Brackish water, brood size, chlorine.

INTRODUCTION

The brine shrimp, *Artemia* is a crustacean that closely related to shrimp belonging to the phylum Arthropoda. *Artemia* is gained a unique position in aquaculture system and is given as live feed to over 85% of cultured species around the world. The recent developments in aquaculture production have further resulted in increased demands for *Artemia*. This *Artemia* has several characteristics, which make it ideal for aquaculture use. It is easy to handle, adaptable to wide environmental condition, non-selective filter feeder and capable of growing at very high densities. Moreover, it is also has high nutritive value, high conversion efficiency, short generation time, high fecundity rate and considerable long life span. *Artemia* distributed mostly in hypersaline lakes, brine ponds and lagoons. Brine shrimp thrive very well in natural seawater and can tolerate the salinity ranges from 3 to 300 ppt. Most of the scientist tried to culture *Artemia* in higher salinities (>70 ppt) for biomass production and the experiments are conducted only salt ponds (Gilchrist, 1960; Arna, 1987; Kulasekarapandian and Ravichandran, 2003). If the culture is in open pond there is a problem of predation. So in order to avoid the predation problem the culture should be performed in controlled conditions. In the present study, culture was practiced in controlled condition with different salinities. The survival, growth and size were also recorded in each salinity.

MATERIALS AND METHODS

Three salinities (freshwater, brackish water and seawater) were selected for the biomass production. Five litre plastic buckets were used for the culture. Each bucket was filled with respective salinity. The initial stocking density was 100 nauplii/liter in all salinities. Before inoculation of *Artemia* nauplii, *Chlorella* was cultured in the rearing buckets and it was used as a feed for growing nauplii. Once the water was changing into light green. It was the time for inoculation. Seawater was treated with chlorine and neutralized with sodium thiosulphate to neutralize the chlorine effect. Brackish water was prepared by diluting the treated seawater with required freshwater. Tap water was used for freshwater experiment. As sea water freshwater also treated before rearing of *Artemia* nauplii. The water exchange was carried out once in every two days. Fifty percent of the rearing water was discarded. Simultaneously the same amount of freshly prepared water was filled with respective salinities. The environmental parameters viz., salinity, temperature and pH were estimated once in two days. At the end of the culture period survival and growth was calculated in each rearing medium. The *Artemia* biomass was harvested once they were reached adult stage. Triplicate was maintained for each salinity.

RESULTS

The environmental parameters of the present study are displayed in table (1). The salinity of the tap water was (freshwater) varied between 2-4 ppt. The brackish water salinity was ranged between 28-33 ppt. However, the seawater salinity was ranged between 34-55ppt. The pH of the freshwater, brackish water and seawater was ranging between 7.8-8.5, 8.2-8.9 and 8.5-9.3 respectively. The temperature was uniform for all three salinities used for the present study (29.32°C).

The size at harvest, duration and survival of *Artemia* biomass is presented in table 2. Higher survival was observed in sea water (80%) followed by brackish water (75%) and freshwater (30%). In freshwater, the *Artemia* reached adult stage on 20th day of culture. Likewise the *Artemia* reached adult stage on 17th and 14th day when cultured in brackish water and seawater respectively. Maximum size of the adult *Artemia* (1.2cm) was recorded in seawater and minimum size was recorded in freshwater (0.4cm).

Table 1: Environmental parameters of *Artemia* nauplii reared in different salinities.

Particulars	Salinity (ppt)	pH	Temperature (°C)
Freshwater	02-04	7.8-8.5	29-32
Brackish water	28-33	8.2-8.9	29-32
Sea water	34-55	8.5-9.3	29-32

Table 2: Harvested size, duration and survival of *Artemia* biomass.

Salinity	Stocking density	Size of the nauplii (μ)	Size at harvest (cm)	Days	Survival%
Freshwater	100	400	0.4±0.01	20±0.02	30±0.01
Brackishwater	100	400	0.9±0.11	17±0.01	75±0.01
Sea water	100	400	1.2±0.01	14±0.01	80±0.02

DISCUSSION

Salinity is important parameters to control growth and survival of *Artemia*. Eventhough *Artemia* is a euryhaline animal it is comfortable when exposed to optimum salinity. In natural environment, temperature, feeding and salinity are important factors influencing *Artemia* populations (Wear and Huslett, 1987). *Artemia* found in natural habitats with salinities from 10-300ppt (Sorgeloos, 1980), but are rarely found in waters lower than 45 ppt. But in the present study apart from seawater and brackish water *Artemia* also cultured in freshwater. *Artemia* not only thrive well in seawater but also in brackishwater (Persoone and Sorgeloos, 1980). *Artemia* survival recorded to be maximum where predators are absent as in the present study. Since the experiment was conducted in controlled conditions no predator populations were encountered.

The *Artemia* reached adult stage in 16-19 days (Kulasekarapandian and Ravichandran, 2003) when it was cultured in salt pond. In the present study also the *Artemia* reached its adult stage from 14 to 20 days when they were cultured in different salinities viz., freshwater, brackish water and seawater. The water was exchanged once in

every two days and the culture was performed outdoor. Because of the high temperature the evaporation of culture medium is naturally high. So there was tremendous increase in the salinity in all culture water. Salinity is a critical parameter affecting the production of *Artemia* biomass (Arana, 1987). The *Artemia* reached adult stage in 20 ppt on 19th day and in 45ppt at 18th day (Soniraj, 2004). In the present observation, *Artemia* attained adult stage in freshwater (2-4ppt) on 20th day, brackishwater (28-33ppt) on 17th day and seawater (34-55 ppt) on 14th day. Reproduction period of *A. parthinogetica* and *A. franciscana* was found to decline with an increase in salinity. In both the species reproductive period was relatively longer in lower salinity ranges (20, 45, 80 and 100 ppt). Maximum life span was at 45 ppt for both the species at 63.3 and 49.5 days respectively. For both the species ‘brood size’ was better at salinity 20, 45, 80 and 100 ppt. In the present study also the ‘brood size’ was better when the animals were cultured in 28-33 and 34-55 ppt respectively. At salinities 20, 45, 80, 100 and 120 ppt the sexual form produced significantly more offspring than asexual strain at 145 and 170 ppt (Soniraj, 2004). *Artemia* abundances have been observed to increase with salinity between 40 and 240ppt and decrease at salinities >240 ppt (MacDonald and Browne, 1989).

Ability of *Artemia* change its appearance under the influence of salinity has been established by Gilchrist (1960), rearing *Artemia* at different salinities concluded that salinity increase results in reduction of brine shrimp body size especially the abdomen. Amat (1980) observed that *Artemia* living in natural environment was usually smaller than laboratory reared. Most of the report says that Adult *Artemia* size was around 1cm. However in the present study, the *Artemia* reached maximum size (1.2cm) when it was reared in seawater followed by brackish water (0.9cm) and freshwater (0.4cm).

pH is one of the vital environmental characteristics, which decides the survival, and growth of *Artemia* under culture; it also affects the metabolism and other physiological process of *Artemia*. In the present study the pH of the rearing medium was 7.8-8.5, 8.2-8.9, and 8.5-9.3 for freshwater and brackish water and seawater respectively.

Water temperature is probably the most important environmental variables in *Artemia* cultures, because it directly affects metabolism, oxygen consumption, growth, moulting and survival. In general, a sudden change of temperature affects the crustacean immune system. Field studies of *A. franciscana* populations were high when the salinity ranges of 42-200ppt and temperature ranges of 25-35°C (Lenz and Browne, 1991). In the present study, temperature was uniform (29-32°C) for all the three salinities tested.

In the present study, higher survival was obtained when the *Artemia* cultured in 35-55 ppt (80%) followed by 28-34ppt (75%) and 2-4ppt (30%). So higher salinity is very much needed for better survival eventhough *Artemia* is euryhaline. Best results for survival and growth

of the Sanfrancisco strain of *Artemia* were found to be about 60 ppt (Douillet, 1987). Under laboratory conditions 13 geological strains of *Artemia* (Vanhaecke *et al.*, 1984) had high survival over a wide range of salinities (35-100ppt). Triantaphyllidis *et al.* (1995) reported that a parthenogenitic population did well at salinities 60 ppt and 100 ppt while at 35, 40 and 80 ppt the survival was less than 50% after 27 days of culture.

From the present study it could be confirmed that seawater salinity was highly suitable for the culture of *Artemia* as evidenced by higher survival (80%), bigger size (1.2cm) and shorter duration (14days) to reach adult stage.

REFERENCES

- Amat, D.F., 1980. Differentiation in *Artemia* strains for Spain. In: Persoone G., P. Sorgeloos, O. Roels and E. Jaspers (Eds.), *The Brine Shrimp Artemia*. Morphology, Genetics, Radiobiology, Toxicology, University Press, Wetteren, Belgium 1: 19-39
- Arana, L.V., 1987. Artemisa aquicultura-shrimp salt and *Artemia* farm in NE-Brazil, *Artemia Newsletter*, 6:8.
- Douillet, P.H., 1987. Effects of bacteria on the nutrition of the brine shrimp *Artemia* feed on dried diets. In: Sorgeloos P., P., D.A. Bengston, W. Declair and E. Jaspers (Eds.) *Artemia Research and Applications*. Ecology, Culturing, Use in Aquaculture, University press Wetteren, Belgium, 3: 295-308
- Gilchrist, B.M., 1960. Growth and form of the brine shrimp *Artemia salina* (L). *Proceedings of the zoological Society*, 134: 221-235
- Kulasekarapandian, S. and P. Ravichandran, 2003. *Artemia* cyst production at Kelambakkam near Chennai. *J.mar.biol.Ass. India*, 45(2): 166-177
- Lenz, P.H. and R.A. Browne, 1991. Ecology of *Artemia* In: Browne, R.A., P. Sorgeloos and C.N. A. Trotman (Eds.), *Artemia Biology*, CRC Press, pp: 237-253
- Persoone, G. and P. Sorgeloos, 1980. General aspects of the ecology and biogeography of *Artemia*. In: Persoone, G. P. Sorgeloos, O. Roels and E. Jaspers (Eds.), *The Brine Shrimp Artemia*, Universa Press, Wetteren, Belgium, 3: 3-24
- Soniraj, N., 2004. Effect of salinity on life span and reproductive characteristics of brine shrimps in the salt pans at Tuticorin. *J.mar.biol.Ass. India*, 46(2):133-140
- Sorgeloos, P., 1980. The use of brine shrimps in aquaculture In: Persoone G.P., Sorgeloos, O. Roels and E. Jaspers (Eds.), *the brine shrimp*, Vol. 3. Ecology, Culturing, Use in Aquaculture, University press Wetteren, Belgium, pp: 25-46
- Triantaphyllidis, G., V. Pouloupoulou, T. I. Abatzopoulos, A.A.P. Perez and P. Sorgeloos- 1995. International study on *Artemia* XLIX. Salinity effects on survival, maturity, growth, biometrics, reproductive and lifespan characteristic of a bisexual and a parthenogenitic population of *Artemia*. *Hydrobiologia*, 302: 215-227
- Vanhaecke, P., E. Siddall and P. Sorgeloos- 1984. International study on *Artemia*. XXXII. Combined effects of temperature and salinity on the survival of *Artemia* of various geographical origins. *J. exp. mar. Biol. Ecol.*, 80: 259-275.
- Wear, R.G. and S.J. Huslett, 1987. Studies on the biology and ecology of *Artemia* from lake Grassmere, New Zealand. In Sorgeloos P., D.A. Bengston, W. Deleir and E. Jaspers (Eds.), *Artemia Research and applications*. Ecology, Culturing, use in Aquaculture. University Press, Wtteren, Belgium 3: 101-126