Bangladesh J. Zool. **38**(1): 1-6, 2010

SURVIVAL AND GROWTH PERFORMANCES OF BRINE SHRIMP (*ARTEMIA FRANCISCANA)* UNDER THREE FEEDING REGIME

Shahana Sultana, Nahid Sultana[1], Parvin Noor[1], M. Sarwoer Alam[1] and M. Niamul Naser*

Advanced Fisheries Research Laboratory, Department of Zoology, University of Dhaka, Dhaka-1000, Bangladesh

Abstract: The present study was conducted to assess the hatching success, survival and growth performances of *Artemia franciscana* cyst under three feeding regime with natural and artificial salt water. For the growth and development of *Artemia* three types of feed, namely *Spirulina, Chlorella* and commercial micro diet were used. Four types of natural and artificial salt waters were used. These were sea water, salt water natural salt solution, analytical salt solution and iodized salt solution. Comparing natural sea water with artificial salt water for the first 24 hours of the experimentation, the highest percentage of hatching was observed in natural sea water (78%) followed by iodized salt solution (43%), natural salt solution (25%) and analytical salt solution (25%). The maximum success of hatching commenced within 18 to 30 hours in all studied media. Beyond this time frame, the cysts which were not hatched out within 70 hours never showed success in hatching. The development of *A. franciscana* was found to be completed with high survival rate in the sea water with *Spirulina* feed. The natural sea water along with *Spirulina* feed at 28º-29ºC temperature and 7.5- 8.0 pH supported the highest hatching rate, survival and growth of *A. franciscana* larvae.

mvi-ms‡¶c: eZgvb M‡elYvc‡Î cvKwZK I KwÎg jeb-cwb‡Z Ges wZb ai‡Yi Lv‡`¨ *Artemia franciscana*-Gi wm‡ói cwi¯dUb mvdj¨, ew× I wU‡K _vKvi ¶gZvi wbaviY Kiv nq| *Artemia*-Gi ew× I ea‡bi Rb¨ wZb ai‡bi Lv`¨ h_v *Spirulina, Chlorella* Ges ewYwR¨K gvB‡µv wdW e¨envi Kiv nq| M‡elYvq Pvi ai‡bi je‡bi Drm Z_v, cvKwZK mg‡`i cwb, mg` AvnwiZ jeb cwb, GbvjvBwUK¨vj jeb cwb I evRviZ-Av‡qvWvBRW jeb cwb e¨envi Kiv nq| m‡ev"P 78% mdj *Artemia*-Gi cwi¯dUb cvIqv hvq mg‡`i cwb‡Z, Zvici 43% Av‡qvWvBRW jeb cwb Ges Aewkó `wU‡Z cvIqv hvq gvÎ 25%| *Artemia*-wm÷ †`qvi 18 †_‡K 30 N›Uvi g‡a¨ cvq m‡ev"P cwi¯dUb m¤úb nq| Z‡e 70 N›Uvi ci Aewkó wm÷ †_‡K KLbB cwi¯dUb n‡Z †`Lv hvq bv| Aci GKwU cix¶vq wZb ai‡Yi Lv`¨ h_v- *Spirulina, Chlorella* Ges ewYwR¨K gvB‡µv wdW e¨envi‡ii g‡a¨ *Spirulina*-q *Artemia*-i †e‡P _vKvi nvi 52% I ^`wnK ew× me‡P‡q ‡ewk| *Chlorella*-q ew× m‡š vmRbK Z‡e me‡P‡q Kg mdjZvmn mívZg mg‡q ew× †_‡g hvq gvB‡µvWv‡q‡U| GB M‡elYvi djvd‡j m¯úófv‡e ‡`Lv hvq †h, 28-29º ‡mj wmqvm ZvcgvÎvq, 7.5-8.0 wcGBP gvÎvi cvKwZK mvgw`K cwb‡Z *Spirulina* Lv‡`¨ *Artemia*-Gi m‡ev"P mdj cwi¯dUb, ew× Ges R‰eb `xN¯wq nq| evsjv‡`‡kI *Artemia franciscana*-Gi ewbwR¨Kfv‡e Drcv`b I we¯vi jv‡f mvdjZv Avkv Kiv hvq|

Key words: Survival, growth, brine shrimp, *Artemia*, feeding regime.

INTRODUCTION

All most every intensive aquaculture system of the world relies on the nauplii of brine shrimp (*Artemia* sp.) as live feed source for shrimp and fish larvae (Sorgeloos and Persoone 1975). The brine shrimp (*Artemia franciscana)* is a minute and relatively primitive form of Crustacea of the subclass Branchiopoda.

*Corresponding author. E-mail: mnnaser@univdhaka.edu [1]Biological Research Division, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dhaka, Bangladesh.

Lack of a true carapace places them in the suborder Anostraca and further in the family Artemiidae. *Artemia* provides good survival and more consistent onsite production than any other larval food in the world. The ease of feeding brine shrimp, *Artemia* and their superior nutritional value ensure that these will be used in hatcheries for many years to come if supplies keep up with demand (Treece 2000). Nutritionally *Artemia* provides high quality protein and has been considered as a premier feed for the culture of the developmental stages of fishes and crustaceans (Kinne 1977). The young nauplii hatching out from the dormant cysts and having a protein reserve of 60%, provide a high level of nutrition to the crustaceans and fish larvae. Nevertheless, adults with a protein content of 58% also constitute an effective feed for their various growing stages (Ahmed and Awal 1994). *Artemia salina* was selected for the present work because its cysts are commercially available, easy to purify and because it tolerates a wide range of salinities (Provasoli and Shiraishi 1959). At present, Golda (*Macrobrachium rosenbergii*) hatcheries are operating all over the country. One of the ideal food sources of Golda hatcheries is *Artemia* larvae. However, it needs salt water to hatch. In addition, *Artemia* shows various rates of mortality during its development.

OBJECTIVES

In this study the survival and growth of *A. franciscana* in laboratory condition was reported in details under three different feeding (Blue green algae, *Spirulina*, Green algae, *Chlorella* and commercial aquarium fish feed) regimes.

MATERIAL AND METHOD

Four types of natural and artificial salt waters were used in this study. These were: Natural media- the water collected from sea at Cox's Bazar, Bangladesh; Artificial media- 38g of each of the following salts were dissolved separately in 1 litre tap water to get the stock solution. Sea salt: natural salt (not purified and used commercially) collected from seabed at Teknaf, Cox's Bazar. Analytical grade salt: NaCl analytical grade, Merk, Germany. Iodized salt: ACI salt limited, Dhaka.

The temperature was maintained at 29°C with pH of 8.3 in all media except for the analytical salt solution where pH was 7.6. Only 0.1 g of *Artemia* cyst was added to each beaker. The salt waters were then aerated continuously by aerator pump, kept it in front of a fluorescent tube light until the study period ended. To reduce the density of hatched cyst after three days, the salt waters were transferred into three conical flasks.

To observe the growth performances, three types of feeds were used. These were natural phytoplankton blue green algae (*Spirulina)*, green algae (*Chlorella)* and aquarium fish feed. The sizes of cyst to larval stage of *Artemia* were measured in terms of length with the help of a micrometer under a compound microscope. The number of cysts and larvae of *Artemia* were counted per ml of salt water with the help of a magnifying glass.

RESULTS AND DISCUSSION

*Hatching: T*he hatching of *Artemia* cyst started within 18-20 hours after inoculation in all the salt waters, e.g. Sea water (SW), Sea salt solution (SS), Analytical salt solution (AS) and Iodized salt solution (IS). The hatching of *Artemia* cyst was found 78%, 25%,43% and 25% in SW, SS, AS and IS solutions, respectively (Fig.1). It was evident that among the four tested salt waters, sea water influenced the highest percentages of hatching at different

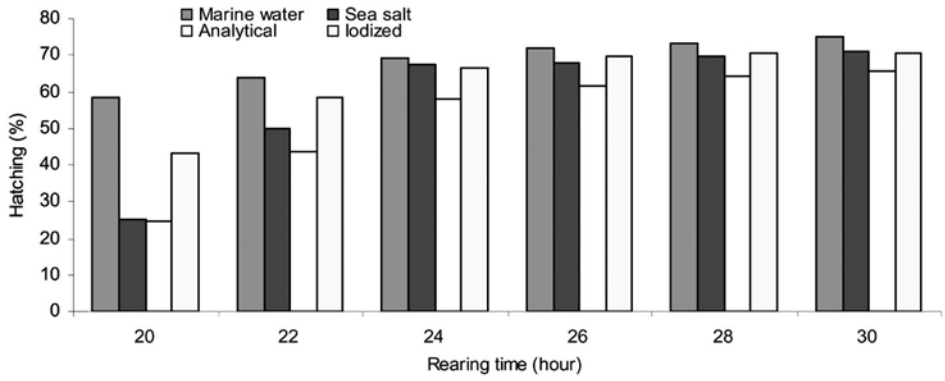

Fig. 1. Hatching rate (%) of Artemia cysts in different salt water sources (upto 30 hours of rearing)

periods of observation. However most of the hatching occurred at 24 hr and followed very small improvement by the next day. Among these, analytical salt solution yielded the lowest percentage of hatching during the period of observation, the other three salt waters showed more or less similar rate of hatching after 24 h of observation. A little higher in the hatching of *Artemia* cyst occurred on the 2nd day of observation in all the salt waters, but almost none on the 3rd day of experiment (Fig. 2).

Initiation of feeding: Feed was supplied on the 3rd day, but the feed was not eaten before the 7th day (Table 1) by any larva reared in the salt waters. However, there were great variations in the survival percentage of larvae under different salt waters. The larvae in SS, AS and IS showed 12, 6 and 10%

survivality on day 5, respectively after inoculation (Table 1), while it was as high as 78% in the sea water (SW) which clearly indicated that SW was the best for *Artemia* culture. Sea water also showed a good percentage of survivality until the last date of observation in this study, while the other three salt waters proved to be detrimental for survival by day 12.

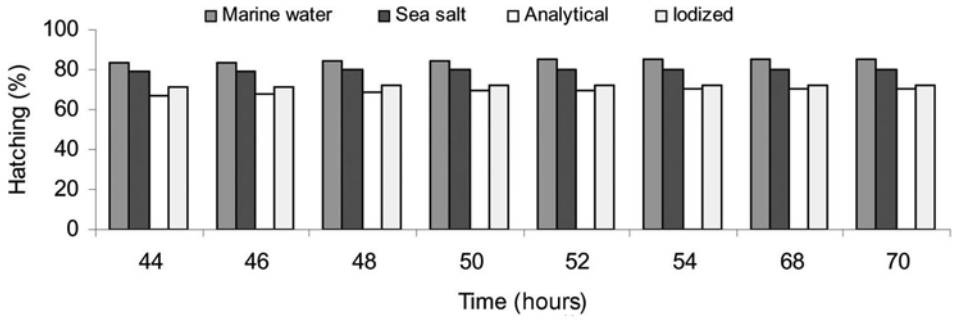

Fig. 2. Hatching rate (%) of Artemia cysts in different salt water sources (*from 44 to 70 hours of rearing).

Table 1. Survival of *Artemia* larvae after 3rd day of inoculation of cysts to media. Feed introduced after 5th day.

Media type	Survival (%) at different days of rearing										
	3rd	5th	6th	7th*	8th	9th	10th	11th	12th	13th	14th
Sea water	78	78	70	60	57	55	50	50	48	35	35
Sea salt solution	25	12	12	10	8	5	4	3	1	0	0
Analytical salt solution	25	6	2	0	0	-	-	-	-	-	-
Iodized solution	43	10	10	7	5	2	1	0	0	-	-

*Day of start feeding by larvae.

Growth of Artemia larvae: The first feed intake was confirmed by the presence of greenish staff in the alimentary canal of the larvae on the 7th day after adding feed in the media on the 3rd day (Table 2). The Fig. 3 clearly indicates that the larvae survived well showing their rapid increase in length in SW, while it could not survive with *Chlorella* and commercial feed after 10th and 12th day of inoculation, respectively. This result again indicates the effectiveness of sea water in *Artemia* hatching.

Morphological changes during feeding

Appearance of eye: The eyes of the larvae are the indicator of the development of larvae. It was observed that the nauplius eye was emerged on day 6 and lateral eye was observed on day 8. Eye became stalked and appeared in all larvae from day 12.

Table 2. Morphological characters of *Artemia* larvae grown under different feeding regime survived in the natural sea water

Parameters of study	Days				
	6th	8th	10th	12th	14th
Spirulina					
a. Length of larvae	0.73 ± 0.25	1.02 ± 0.36	1.48 ± 0.55	1.9 ± 0.4	2.4 ± 0.7
b. Colour of alimentary canal	Brownish	Greenish (with feed)	Greenish (with feed)	Greenish (with feed)	Greenish (with feed)
c. Eye observation	Nauplius	Lateral	Lateral, eye stalk appeared	Lateral, eye stalk appeared	Lateral, eye stalk appeared
d. Budding of thoracopods	4 pair	4 pair	4 pair (Thoracic appendage 4 pair)	8 pair (Thoracic appendage 6 pair)	10 pair (Thoracic appendage 8 pair)
Chlorella					
a. Length of larvae	0.79 ± 0.3	0.87 ± 0.5	0.88 ± 0.2	-	-
b. Colour of alimentary canal	Brownish	Greenish (with feed)	Greenish (with feed)	-	-
c. Eye observation	Nauplius	Lateral	Lateral	-	-
d. Budding of thoracopods	4 Pair	4 Pair	5 Pair	-	-
Commercial feed					
a. Length of larvae	0.91 ± 0.5	0.94 ± 0.4	1.29 ± 0.73	1.3 ± 0.6	-
b. Colour of alimentary canal	Brownish	With feed	With feed	With feed	-
c. Eye observation	Nauplius	Lateral	Lateral	Lateral, eye stalk appeared	-
d. Budding of thoracopods	5 Pair	6 Pair	8 Pair (Thoracic appendage 6 pair)	10 Pair (Thoracic appendage 6 pair)	-

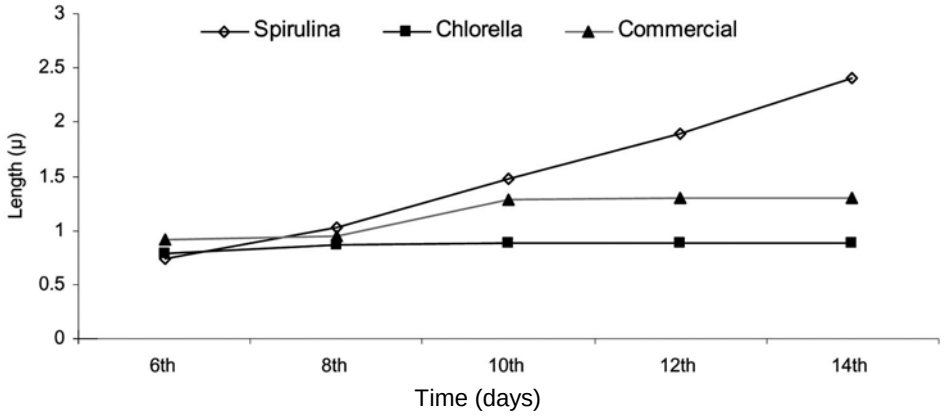

Fig. 3. Growth of *Artemia* under different feeding regime in sea water.

Budding of thoracopods: Budding of thoracopods from where future thoracic appendages emerge was observed on day 6. First thoracic appendages were observed on day 10 and developed day by day to become 11 pairs of appendages on wards.

Colour of alimentary canal: The alimentary canals of the larvae were empty and brownish in colour till day 6 though feed was supplied. Greenish coloration was observed on day 8 in all larvae (Table 2). This greenish colouration was noticed until the end of the experimentation. The good survival was observed on *Spirulina* fed larvae, compared to others.

In this study the most of the *Artemia* hatched within 24 hours after the inoculation of cysts in all types of salt waters, whereas Drewes (2002) found that the cysts of *A. franciscana* needed more than 48 hours to hatch. This might be due to the physical condition of water like temperature (Drewes 2002).

CONCLUSION

In conclusions it can be stated that the filtered natural sea water with *Spirulina* as supplemented feed at 28º-29ºC temperature and 7.5- 8.0 pH can help in maximum hatching of cysts and survival of the larvae of *A. franciscana*.

Acknowledgements: The authors are thankful to Biotechnology Research Centre of University of Dhaka to support this collaborating research. The study also supports two MS research at the Zoology department of University of Dhaka represented by the first two authors.

LITERATURE CITED

AHMED, S.U. and AWAL, S. 1994. Development of *Artemia* culture in Bangladesh. Final Rep. Fish. Res. Inst., Marine Fish. Tech. Sta., Cox's Bazar, Bangladesh, 16p.

DREWES, C. 2002. *Artemia franciscana* ,URL. blc.biolab.udel.edu/Drews/Artemia.rtf (Accessed on 5.12.2009).

KINNE, O. (Ed.). 1977. *Marine Ecology*. Vol. III. Cultivation Part-2. Jhon Willey and Sons. New York, USA.

PROVASOLI, L. and SHIRAISHI, K. 1959. Anexic cultivation of the brine shrimp *Artemia salina*. Biol. Bull. **117**: 347-355.

SORGELOOS, P. and PERSOONE, G. 1975. Technological improvements for the cultivation of invertebrates as food for fishes and crustacean. II. Hatching and culturing of the brine shrimp *Artemia salina* L. *Aquaculture* **6**: 303-317.

TREECE, G.D. 2000. *Artemia production for marine larval fish culture*. Southern Regional Aquaculture Center, SRAC Publication No. 702, 8 pp.

(Manuscript received on May 24, 2008; revised on December 5, 2009)