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Effect of salinity and prey algae on *Artemia sinica* (Anostraca: Artemiidae) growth and survival

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Abstract

The present investigation was carried out to determine the effects of two very important parameters i.e. salinity and micro-algal diets on the growth and survival of *Artemia sinica*. The animal was obtained in encysted form from Bohai Bay P.R. China, after 14 days constantly cultured (rearing trial) in laboratory with five different salinities. At the end of trial (day 14) all the organisms preserved with drops of acetic acid and total length were measured drawing them from the head to the end of the telson with a dissection microscope equipped with a camera. After 14 days of treatment, organisms at 40g/L salinity having average growth length 3.57± 0.43mm were severely affected. All the organisms showed their lowest survival rates at salinity of 50g/L. Almost all animals showed the highest survival level at 90g/L of salinity (100%) with average growth length 6.75± 0.23mm. In the present experiment salinity was inversely proportional to survival. Besides, the present study was also focused to evaluate the food value of three microalgal species (*Isochrysis galbana, Platymonas helgolandica* and *Pavlova viridis)* in terms of growth and maturation of *A. sinica* under laboratory conditions.The highest survival rate (100%) was observed during the feeding trial of *A. sinica* with *Isochrysis galbana*. The next most important diet was *Pavlova viridis*. The feeding of *Platymonas helgolandica* to *A. sinica* was not successful during the trial period. So in the present experiment the order of survival of *A. sinica* against different algae diets was; *I. galbana* >*P. viridis* >*P. helgolandica*.

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Introduction

Genus *Artemia* is present in many hypersaline environments (in inland and coastal hypersaline lakes) ubiquitously, may inhabit chloride, sulphate or carbonate waters and combinations of more than two anions (Stappen 2002; El-Bermawi *et al.,* 2004). The brine shrimp *Artemia* are organisms that can adapt to very diverse living conditions, including salinities as low as 10g/L (Abatzopoulos *et al.,* 2006a, Abatzopoulos *et al.,* 2006b) and high as 340g/L (Post & Youssef, 1977).

Many researchers have recorded the effect of salinity on the survival and growth rate characteristics of bisexual and parthenogenetic *Artemia* populations of different biotopes (Browne & Bowen 1991; Browne & Wanigasekera 2000; Abatzopoulos *et al.,* 2003; Baxevanis *et al.,* 2004; El-Bermawi *et al.,* 2004; Abatzopoulos *et al.,* 2006b; Agh *et al.,* 2008).

Nevertheless, the significance of salinity as a most important factor altering growth and survival of *Artemia* has been little studied world widely up till now.

Artemia is an excellent food source for aquaculture industry including fish and crustaceans. Both *Artemia* nauplii and adults have great advantages of fulfilling the nutritional necessities of a large diversity of organisms (Ali *et al.,* 2014). However, the nutritional worth of on-grown and adult *Artemia* is superior to freshly hatched nauplii, further to that, adults *Artemia* provide supplementary reimbursement as they have been used for induction, strengthening of sexual maturation and increasing of fertilization rates (Ali *et al.,* 2014).

The brine shrimp *Artemia* biomass cultivation is limited to open and controlled cultivation system. The controlled cultivation has great advantages as compared to open cultivation, because outdoors systems are subjected to environmental variables, in result fluctuating culture conditions and growth rates. In contrast, controlled cultivation has very little possibility of environmental variables, thus facilitating production of specific growth stages (i.e. juveniles, pre-adults and adults) and, allowing greater quality control and harvesting that can be controlled to meet the needs and preferences of the predator species (Dhont *et al.,* 1993). The choice of a suitable *Artemia* population for cultivation depends on several factors such as feed conversion efficiency, growth rate and protein content (Sorgeloos, 1980).

The present study was carried out to determine the effects of two very important parameters i.e. salinity and microalgal diets on the growth and survival of *A. sinica* obtained in encysted form from Bohai Bay China, cultured in our laboratory at five different salinities, to provide additional data for a better understanding of their adaptation patterns. The aim of the present study was to evaluate the food value of three microalgal species in terms of growth and maturation of *A. sinica* under laboratory conditions, during the experimental period of 14days. This study could be helpful to improve culture system in aquaculture biomass production.

Materials and methods

Artemia cysts hatching

The cysts hatching method and conditions employed in this experiment were the same as used in the previous experiment (Ali *et al.,* 2014).

Laboratory culture of Artemia

After hatching the neonates of *A. sinica* were moved to glass vessel and washed with pre-filtered and autoclaved seawater to ensure that all coarse debris was removed. Subsequently, 50 active mature nauplii were transferred in triplicates each to 1L glass beakers with 5 different salinities (40, 50, 70, 90 and 110g/L). The organisms were fed with only laboratory cultured algae *Isochrysis galbana*. The water in the experimental vessels with selected salinities was always aerated and renewed every 48 h.

The feeding experiment was performed with selected prey algae including *Isochrysis galbana, Platymonas helgolandica* and *Pavlova viridis*. These algae's were obtained from the College of Fisheries, Ocean University of China, Qingdao. The algae were grown in natural seawater with the addition of f/2 nutrients (Guillard & Ryther, 1962) at 20°C in 3L flasks and harvested when the cultures were in the exponential growth phase to feed the *A. sinica*. The number of animal were the same as in the salinity experiment in triplicates, continually aerated and renewed glass vessels medium every 48 h by adding freshly filtered and autoclaved seawater (31gL^{-1}).

The survival and growth rates of the animals were determined after 14days constantly rearing trial. At the end of trial (day 14) all the organisms preserved with drops of acetic acid and total length were measured drawing them from the head to the end of the telson with a dissection microscope equipped with a camera.

Results

Artemia survival rate with diet

Fig. 1 shows the survival (%) of *Artemia sinica* related to different diets of algae. The highest survival rate (100%) was observed during the feeding trial of *A. sinica* with *Isochrysis galbana*. The next most important diet was *Pavlova viridis*. The feeding of *Platymonas helgolandica* to *A. sinica* was not successful during the trial period. So in the present experiment the order of survival of *A. sinica* against different algae diets was; *I. galbana* >*P. viridis* >*P. helgolandica*.

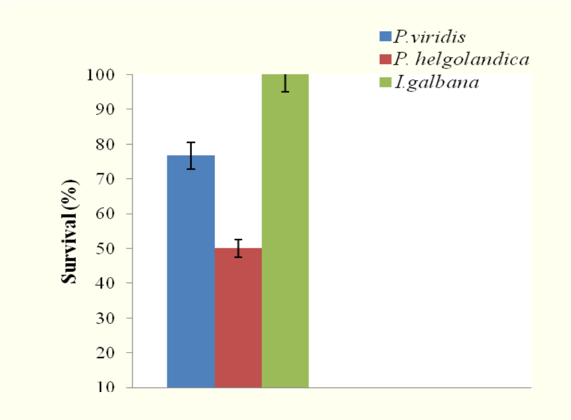

Fig.1. Survival rate of *A. sinica* fed with three microalgal diets (Error bars are mean ± SD, *n*=3).

Artemia survival rate with salinity

The effect of salinity on *A. sinica* survival is shown in fig. 2. The respective means and standard deviation values of growth of the treated animals during the trial period are shown in Table 1. After 14 days of treatment, organisms at 40g/L salinity having average growth length 3.57± 0.43mm were severely affected.

Table 1. Mean values ± standard deviation of total length (mm) of the *Artemia sinica* treated for 14 days in five different salinities.

	Salinity (gL^{-1})				
	40	**50**	**70**	**90**	**110**
Total length (mm ± SD)	3.57 ± 0.43	3.86 ± 0.46	5.65 ± 0.54	6.75 ± 0.23	3.45 ± 0.33

All the organisms showed their lowest survival rates at salinity of 50g/L. Almost all animals showed the highest survival level at 90g/L of salinity (100%) with average growth length 6.75± 0.23mm. So, in the present experiment salinity was inversely proportional to survival. The most optimum concentration level of salinity for the survival of *A. sinica* was 90g/L. So, the experimental animals during the treatment showed higher mortalities rate at salinities under 50g/L and over 90g/L.

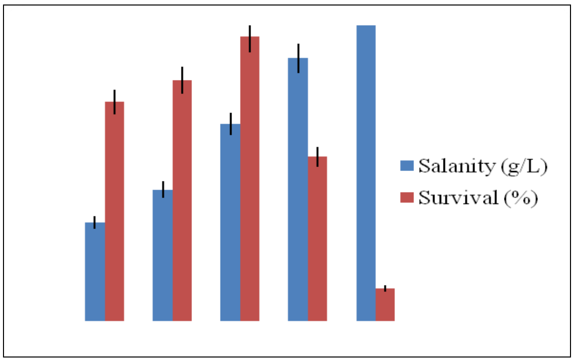

Fig.2. Effect of salinity on *A. sinica* survival (Error bars are mean ± SD, *n*=3).

Discussions

The current results were in agreement with the previous study Liu and Xu. (2010), in which the algal prey *I. galbana* declared as one of the important diet contained high levels of docosahexaenoic acid and eicosapentaenoic acid and was suitable food for Calanoid Copepod *Schmackeria poplesia*.

Although Castro-Mejía *et al.* (2011) studied five *Artemia franciscana* Mexican populations that showed a different behavior and are like populations of *A. salina* and *A. urmiana* (Agh *et al.,* 2008). Agh *et al.* (2008) recorded 100% mortality in bisexual populations reared at salinities from 150 to 200g/L. On the contrary, Abatzopoulos *et al.* (2006b) reported lower survival rate for *A. urmiana* at salinities of 35 and 50g/L, whilst higher survival rates were at 100, 140 and 180g/L of salinity. At higher salinity the survival potential of brine shrimp might be related to their osmoregulatory system function, which improves at salinities ranging from 100 to 120g/L (Triantaphyllidis *et al.,* 1995; Stappen, 2002). Additionally, Tackaert & Sorgeloos (1991) have mentioned a genetically imprinted ecological response, which allows the optimal development of brine shrimp at salinities between 100-180g/L as a way to avoid the presence of predators.

The survival and growth of all living organisms are interdependent. In the present experiment, growth rate was also significantly affected by salinity. Several researchers have reported that growth rate is inversely proportional to salinity (Triantaphyllidis *et al.,* 1995; El-Bermawi *et al.,* 2004; Agh *et al.,* 2008). Triantaphyllidis *et al.* (1995) reported significant differences in *Artemia parthenogenetica* growth in Tanggu (China) populations cultured at different salinities. These authors observed maximum growth of *Artemia franciscana* at 35g/L (10.16±0.85mm). Castro-Mejia *et al.* (2011) recorded 100% mortality of five *Artemia franciscana* Mexican populations at 40g/L salinity, and showed better growth at 120g/L (9.269 ± 0.263mm).

The present study confirmed that growth and survival rates in *A. sinica (*Bohai Bay Brand) were inversely proportional to salinity and did not developed well on salinities between 90-110g/L which supported the findings of the following researchers (Triantaphyllidis *et al.,* 1995; El-Bermawi *et al.,* 2004 and Agh *et al.,* 2008).

The present study also concluded the negative impact of salinity above 100 g/L in laboratory cultures which was in agreement with other researchers (Brown & Wanigasekera 2000; Baxevanis *et al,*. 2004, Agh *et al,*. 2008). In accordance with previous laboratory research on several *Artemia* species it was found that the optimal range for growth and survival in sexual and asexual strains lies between 100-120g/L (Triantaphyllidis *et al.,* 1995, Baxevanis *et al.* 2004, Agh *et al.,* 2008). Probably these salinity tests values can be observed having a similar impact in *Artemia* life span characteristics and reproductive behavior, suggesting a subject for future experiments.

References

Abatzopoulos TJ, Agh N, Stappen G Van, Rouhani Razavi SM, Sorgeloos P. 2006a. Artemia sites in Iran. J. Mar. Biol. Assoc. United Kingdom. **86,** 229-307.

Abatzopoulos TJ, Baxevanis AD, Triantaphyllidis GV, Criel G, Pador EL, G. Stappen V, Sorgeloos P. 2006b. Quality evaluation of Artemia urmiana Günther (Urmia Lake, Iran) with special emphasis on its particular cyst characteristics (International Study on *Artemia,* LXIX). Aquaculture **254,** 442-454.

Abatzopoulos TJ, El-Bermawi N, Vasdekis C, Baxevanis AD, Sorgeloos P. 2003**.** Effects of salinity and temperature on reproductive and life span cha-racteristics of clonal Artemia (International study on Artemia, LXVI). Hydrobiologia **492,** 191-199.

Agh N, Stappen G Van, Bossier G, Sepehri P, Lofti H., V. Rouhani RSM, Sorgeloos P. 2008.

Effects of salinity on survival, growth, reproductive and life span characteristics of Artemia populations from Urmia Lake and neighboring lagoons. Pakistan Journal Biological Science **11,** 164-172

Ali S, Liu G, Li Z, Xu D, Huang Y, Hongju C. 2014. Toxicity of Five Phenolic Compounds to the Brine Shrimp Artemia sinica (Crustacea: Artemiidae). Journal of Ocean University of China **3,** 141-145

Baxevanis AD, El-Bermawi N, Abatzopoulos TJ, Sorgeloos P. 2004. Salinity effects on maturation, reproductive and life span characteristics of four Egyptian Artemia populations. Hydrobiologia **513,** 87-100.

Browne RA, Bowen ST. 1991. Taxonomy and population genetics of *Artemia*, p. 221-235. In R.A. Browne, P. Sorgeloos & C.N.A. Trotman CNA (eds.). *Artemia* Biology. CRC Boca Raton, Florida, USA.

Browne RA, Wanigasekera G. 2000. Combined effects of salinity and temperature on survival and reproduction of five species of *Artemia*. Journal of Experimental Marine Biology and Ecology **244**, 29-44.

Castro-Mejía1 J, Castro-Barrera1 T, Hernández-Hernández LH, Arredondo-Figueroa JL, Castro-Mejía1 G, Lara-Andrade1 R.de. 2011. Effects of salinity on growth and survival in five Artemia franciscana (Anostraca: Artemiidae) populations from Mexico Pacific Coast. Revista Biologia Tropica **59 (1),** 199-206

Dhont, Sorgeloos P. 2002. Applications of *Artemia*. In: T. Abatzopoulos, J. Beardmore, J. Clegg, P. Sorgeloos (Eds.). *Artemia*: basic and applied biology. Kluwer Academic Publishers.

EI-Bermawi N, Baxevanis AD, Abatzopoulos TJ, Stappen GV, Sorgeloos P. 2004. Salinity effects on survival, growth and morphometry of four Egyptian Artemia populations (International Study on Artemia. LXVII). Hydrobiologia **523,** 175—188.

Liu G, Xu D. 2010. Feeding, egg production and laboratory culture of *Schmackeria poplesia* Shen (Copepoda: Calanoida). Aquaculture Research, 41, 1817-1826

Post FJ, Youssef NN. 1977. A prokaryotick intracellular symbiont of the Great Salt Lake brine shrimp Artemia salina (L.). Canadian Journal of Microbiology **23,** 1232-1236.

Sorgeloos P. 1980a. The use of the brine shrimp *Artemia* in aquaculture. In: Persoone G, Sorgeloos P, Roels O, Jaspers E, eds. The brine shrimp *Artemia*, Vol. 1-3. Universa Press, Wetteren, Belgium 25-46.

Stappen GV. 2002. Zoogeography. In: T. Abatzopoulos, J. Beardmore, J. Clegg, P. Sorgeloos (Eds.). *Artemia*: basic and applied biology. Kluwer Academic Publishers.

Triantaphyllidis GV, Poulopoulou K, Abatzopoulos TJ, Pinto-Perez CA, Sorgeloos P. 1995. International study on *Artemia* XLIX. Salinity effects on survival, maturity, growth, biometrics, reproductive and lifespan characteristics of a bisexual and a parthenogenetic population of Artemia. Hydrobiologia **302,** 215-227.

Tackaert W, Sorgeloos P. 1991. Biological management to improve *Artemia* and salt production at Tang Gu saltworks in the People's Republic of China. 78-83. In : Proceedings of the International Symposium "Biotechnology of solar saltfields", Tang Gu, PR China, September 17-21, 1990, Cheng, L. (Ed.), Salt Research Institute, Tanggu, Tianjin, PR China, 283 pp