THE EFFECT OF SALT CONCENTRATIONS ON BRINE SHRIMP HATCHABILITY

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Abstract
Appropriate salt concentration for hatching of brine shrimp at on-farm is a challenge to fish farmers. This experiment thus determined the appropriate salt concentration that gave the best hatching percentage in a completely randomized design experiment of five treatments in triplicate and designated as TI (25ppt), TII (27ppt), TIII (29ppt), TIV (31ppt) and TV (33ppt) salt concentrations respectively while other environmental conditions were kept constant. The results showed significant difference ($p<0.05$) in the brine shrimp hatchability percentage at varying salt concentrations. The hatchability percentages of 25ppt (47.45%), 29ppt (48.61% and 33ppt (45.12%) were significantly ($p<0.05$) higher than that of 27ppt (36.65%) and 31ppt (40.01%) respectively. Therefore, salt concentration of 29ppt will produce the best hatchability of brine shrimp thus recommended to fish farmers for larvae rearing.

Keywords: live, feed, on-farm

Introduction

Artemia is a genus of aquatic crustaceans which is also known as brine shrimp (Amin & Alireza, 2016). Artemia is used in aquaculture system as live feed to over 85% of cultured species around the world (Soundarapandian & Saravanakumar, 2009). Artemia are extremely euryhaline, it tolerates salinities from 3 ppt to 300 ppt, Rajkumar and Babu, (2015) reported that, artemia can survive short periods of time in fresh water, but cannot reproduce in it. Vartak and Joshi (2002) observed that a specific salinity was found to positively influence the cyst production. The complex adaptive response evolved by the brine shrimp Artemia (Crustacean, Anostraca) to thrive in hypersaline lakes, a "forbidden environment" for most organisms which makes artemia the sole macro-planktonic inhabitants of salty lakes (Soundarapandian & Saravanakumar, 2009).

Artemia has been reported to be exploited in commercial quantity in the Great Salt Lake in Utah, USA, for aquaculture purposes (Ruebhart *et al.*, 2008; Dhont & Sorgeloos, 2002). Nevertheless, Artemia is considered as tolerant to very large environmental variations that exist in many salty lakes, achieving very large population sizes. The range of environmental variation is due in some degree to latitude and the associated climatic conditions. Artemia has been reported to flourish all year-round compare with other phyto-zooplanktons which are seasonal (Lenz & Browne, 2003). Fish farmers are however lack the technical know-how on the production of brine shrimp at on-farm with regards to the appropriate salt concentration for its incubation. This research therefore, investigated the effects of varying salt concentration on the hatchability percentage of shelled artemia cyst for aquaculture purpose.

Materials and methods

Experimental location

The research was carried out in the Department of Water Resources, Aquaculture and Fisheries Technology Laboratory, Federal University of Technology Minna, Niger state, Gidan Kwano main campus along Bida express road of latitude 9°31'57.84"N and longitude 6°27'7.96"E.

Experimental materials

Materials used in carrying this experiment included improvised incubator, fresh water, sodium chloride (NaCl), sodium bicarbonate ($NaHCO_3$), LED light bulb (40 watt), shelled artemia, pH meter, conductivity, cysts and air pump/aerator.

Source of artemia cyst, salt and sodium bicarbonate

The shelled artemia cyst was purchased from Gerrit Fluren Hatchery, Kuje Area Council Federal Capital Territory, Abuja. Sodium chloride (NaCl) and sodium bicarbonate ($NaHCO_3$) were purchased from Kure Ultra-modern market, Minna, Niger state.

Experimental Design

Five treatments were used for the experiment in triplicate of randomized design. TI contained 12.5g of salt (NaCl), 2g of sodium bicarbonate and 1g of aretemia cyst. TII contained 13.5g of salt (NaCl), 2g of sodium bicarbonate, and 1g of artemia cyst. TIII contained 14.5g of salt (NaCl), 2g of sodium biocarbonate, and 1g of artemia cyst. T4 contained 15.5g of salt (NaCl), 2g of sodium biocarbonate, and 1g of artemia cyst. T5 contained 16.5g of salt (NaCl), 2g of sodium biocarbonate, and 1g of aretemia cyst.

Hatching of Artemia cysts using the improvised incubator

The incubator was set up in the laboratory. LED Light bulb (40 watt) was used as source of light throughout the incubation period. The salt (NaCl) concentrations viz; 12.5_g (25ppt), 13.5_g (27ppt), 14.5_g (29ppt), 15.5_g (31ppt), 16.5_g (33ppt), and in each was added 2g of sodium bicarbonate ($NaHCO_3$) both of which were dissolved in 500ml of water and were then poured into the incubator bottle in trplicate (Rajkumar and Babu, 2015). After this, the air pumps were switched on and 1g of artemia cyst was poured into the incubation bottles. The air pumps were switched on before adding the artemia cyst to minimize the amount of cyst that would reverse back to the outlet pipes. The incubator was kept at room temperature ranges between 26ºC and 28ºC during the incubation period.

After 24 hours of incubation, artemia nauplii were separated from the hatching wastes (shells). The air pumps were switched off for hatching bottles, cyst shells became floated while the nauplii were settled at the bottom of the bottle. The hatched nauplii were siphoned off within 10–15 minutes and then thoroughly rinsed with freshwater with the aid of muslin sieve while damage or loss of the nauplii were checked accordingly. The unhatched cysts in the non-turbulent area were collected via the outlet pipes due to absent of air in the outlet pipe that would push them back in the bottle.

Water quality parameters

Water quality parameters measured were pH which was monitored with pH meter, conductivity was measured with conductivity meter and dissolved oxygen was taken according to the Winkler method (APHA, 2017).

Data Collection

Nauplii Percentage hatchability

Percentage hatchability was determined by dividing the number of nauplii hatched by the total number of artemia cysts in 1g and multiplying by 100

$$\text{Nauplii hatchability percentage (\%)} = \frac{Number\ of\ hatched\ nauplii}{total\ number\ of\ artemia\ cyst} \times 100$$

Statistical analysis

Data on the effect of salt concentration on hatchability rate percentage of artemia cysts was subjected to one-way analysis of variance (ANOVA) using Minitabs release 14, where differences in means were separated using Turkey Test.

Results

The results of the effect of salt concentration on the hatchability rate percentage of artemia cyst are presented in Table 1. There were significant differences ($p<0.05$) in the hatchability percentage among the salt concentration treatments. The highest hatchability percentage ($p<0.05$) was observed in 29ppt (48.61%) and 25ppt (47.45%) respectively. The hatchability percentage of artemia cyst in salt concentration of 33ppt (45.12%) was significantly higher ($p<0.05$) than those of 31ppt (40.01%) and 27ppt (36.65%) but significantly lower ($p<0.05$) than those of 25ppt and 29ppt respectively. However, the hatchability percentage of artemia cyst of 27ppt (36.65%) was significantly the lowest ($p<0.05$) among salt concentrations. The best hatching was attained in the temperature range of 26-28C while the pH was between 6.56 and 7.24, the best hatching percentage was at 7.03. The dissolved oxygen ranged from 13 mg/l to 16mg/l while the best hatching rate was at 15mg/l.

Table 1: Effect of Salt concentrations on the Hatchability Percentage of Artemia cyst

Salt Concentration (PPT)	Hatchability rate (%)	pH	Dissolved oxygen (mg/l)	SD±
25	47.45^{a} ±4.14	7.56	15	4.65
27	36.65^{b} ±2.62	7.92	13	4.65
29	48.61^{a} ±1.91	8.03	15	4.65
31	40.01^{b} ±4.59	8.13	16	4.65
33	45.12^{ab} ±7.71	8.24	15	4.65

*PPT = Part per thousand, *SD = standard deviation

Mean on the same column having the different superscript are significantly difference from each other ($p<0.05$)

Discussion

The water quality parameters obtained were in the range recommended for reproduction of Artemia. The temperature was in the range of 26ºC and 28ºC throughout the incubation period in agreement with Abatzopoulos *et al*. (2006) who recommended 25ºC and 28ºC for high hatching percentage, pH of 8.03 gave the best hatchability in agreement with the report of (Abatzopoulos *et al.,* 2006) who recommended pH of 8-8.2 for best reproduction while dissolved oxygen was at near saturation 13-16 mg/l. The study showed that salt concentration has significant effect on the hatchability percentage of artemia cyst under the above condition. Twenty-nine (29) ppt salt concentration gave the highest hatchability percentage (48.61%) while 27ppt gave lowest hatchability percentage (36.65%). This is in agreement with the report of RajKumar and Babu (2015) who recorded highest artemia hatchability at 29 ppt by altering salt concentration between 24ppt and 35ppt but is in contrast with the findings of Soundarapandian and Saravanakumar (2009) who reported better hatchability in salt concentration of 35–55ppt a higher salt concentration than 33ppt that gave a low hatchability percentage in this study. Naser *et al*. (2008) reported that higher salinity reduces reproduction of artemia. In addition, the disparity could be due to some other extrinsic factors such light, hydration, cyst disinfection (Abatzopoulos *et al.,* 2006). Shima *et al.* (2011) reported 58.67% Artemia hatchability under light intensity of 2000 Lux illumination and photoperiods of 02L: 22D and 12L:12D and 76.65% survival rate.

Conclusion

Salt concentration of 29ppt gave the highest hatchability percentage of 48.61% of artemia cyst. The salt medium is therefore recommended to fish farmers for production of brine shrimp at on-farm for rearing of fish larvae.

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