Short Communication

Effect of sudden changes in salinity on different stages of parthenogenetic Artemia sp.

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Abstract

Effect of sudden changes in salinity on different life history stages of the parthenogenetic Indian strain of Artemia from salinas of Thoothukkudi was studied. For the experiment, nine ranges of salinity (30 - 110 ppt) with an increase of 10 ppt at each range were prepared with 110 ppt as the control. Different life history stages of Artemia were suddenly introduced to lower salinities from 110 ppt and the survival rates were estimated during 5 days. The experiment showed that adults were more susceptible and nauplii more tolerant to sudden decline in salinity supported by significant two way ANOVA values.

Keywords: Artemia, life history stages, nauplii, effect of salinity

Introduction

Artemia has been found to be a suitable food for a diverse group of cultivable organisms (Sorgeloos 1979, 1980). Existing literature reveals that among the few species utilized as live food, the brine shrimp Artemia comes in for prime consideration (Patra and Mohamed 2003; Baxevanis et al., 2006). Kinne (1977) indicated that more than 85% of the marine animals cultivated so far have been fed with Artemia. For the successful rearing of larvae of marine fishes and crustaceans in hatcheries where intensive aquaculture is practiced, the availability of suitable food is an essential pre-requisite. The cyst of the brine shrimp Artemia forms one of the most important sources of food for the larvae. The demand for good quality Artemia cyst is far more than the present production level and the insufficient cyst supply sometimes is the major bottleneck in the proper functioning of hatcheries the world over (Schauer et al., 1979; Baxevanis et al., 2006).

Several workers (Kristenen and Hulscher-Emeis, 1972; Persoone and Sorgeloos, 1980; Ramamoorthi and Thangaraj, 1980; Scelzo and Voglar, 1980; Bhargava et al., 1987) have observed wide fluctuations in Artemia population in general and in different life history stages. The possible reason attributed for such fluctuations was the sudden decrease in salinity, which may be due to rainfall or dilution of water from other sources. All previous studies have given only circumstantial evidences to the above conclusion and these have not been supported by any experimental work (Clegg and Trotman, 2002). Therefore, it was felt appropriate to study the population variations by changing salinity conditions at short intervals and the present experiment was conducted in different life history stages of parthenogenetic Indian strain of Artemia (Artemia sp.) collected from salinas in Thoothukkudi (8° 46’52”N lat.; 78° 09’25”E long.), Tamil Nadu, India.

Material and Methods

Artemia population containing all developmental stages (nauplii, juvenile, pre-adult and adults - cyst bearing and nauplii bearing) collected at a particular time from a particular salinity range was introduced into a series of salinity ranges at the same time. This
was done with an aim to see how the sudden changes in salinity actually affected the different life history stages. The experiments were carried out at Thoothukkudi Centre of Central Marine Fisheries Research Institute, Tamil Nadu, India.

For the experiment, 9 ranges of salinity (30-110 ppt) with an increase of 10 ppt at each range were prepared by mixing salt collected from the salt pans with freshwater. The prepared media were kept separately in 3 L glass beakers. The different stages of *Artemia* were collected from the salina. During the time of sample collection, salinity at the site was 110 ppt. Each developmental stage was introduced separately into a salinity medium. A uniform stocking density of 50 nos. per beaker of each stage was maintained. All stages were uniformly fed twice a day with rice bran suspension and water in each beaker was renewed every day. Five replicates were maintained for each stage and salinity range. The available maximum salinity 110 ppt. was considered as control. Duration of the experiment was 5 days. Statistical analysis ANOVA (two-way) was conducted to observe the effect of salinity on the developmental stages.

**Results and Discussion**

The life-history stages of *Artemia* reacted differently to different salinity ranges. The mortality rates observed in each stage in the different salinity ranges are given in the Table 1. The experiment showed that the adults were more susceptible to the sudden changes in the salinities especially when they were transferred from the 110 ppt to 30 ppt (mortality rate 99.2%). The preadults were the next severely affected stage with a mortality rate of 76% followed by juveniles (60.8%) and nauplii (16%). The experiments showed that nauplii are the most tolerant to sudden decline in salinity with minimum mortality.

The result of two-way ANOVA is given in Table 2. The ANOVA test in relation to the ranges of salinity (30-110 ppt) vs. percentage of mortality of the total population was found to be highly significant (F=18.93; p<0.01). The mortality rates in different stages of *Artemia* in relation to salinity was also highly significant but at a lower level (F=9.07; p<0.01). The mean comparison in all ranges of salinities on the percentage mortality of the adult vs. pre-adult vs. juvenile vs. nauplii revealed that the salinity affected the survival of all stages of the population in a significant way. The mortality percentage of juveniles and nauplii were comparatively low compared to that of adults and pre-adults.

A sudden change in salinity from 110 to 30 ppt had affected the survival of all stages of *Artemia* with

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Salinity decrease (ppt)</th>
<th>Salinity suddenly reduced by ppt</th>
<th>Percentages of mortality for a period of 5 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adult (T1)</td>
</tr>
<tr>
<td>R1</td>
<td>110 to 30</td>
<td>80</td>
<td>99.2</td>
</tr>
<tr>
<td>R2</td>
<td>110 to 40</td>
<td>70</td>
<td>76.4</td>
</tr>
<tr>
<td>R3</td>
<td>110 to 50</td>
<td>60</td>
<td>64.0</td>
</tr>
<tr>
<td>R4</td>
<td>110 to 60</td>
<td>50</td>
<td>55.6</td>
</tr>
<tr>
<td>R5</td>
<td>110 to 70</td>
<td>40</td>
<td>42.8</td>
</tr>
<tr>
<td>R6</td>
<td>110 to 80</td>
<td>30</td>
<td>33.6</td>
</tr>
<tr>
<td>R7</td>
<td>110 to 90</td>
<td>20</td>
<td>24.0</td>
</tr>
<tr>
<td>R8</td>
<td>110 to 100</td>
<td>10</td>
<td>9.6</td>
</tr>
<tr>
<td>Control</td>
<td>110 to 110</td>
<td>0</td>
<td>2.8</td>
</tr>
<tr>
<td>Mean (R)</td>
<td></td>
<td></td>
<td>45.33</td>
</tr>
</tbody>
</table>

NS-Mean comparisons not significant at 1% level between treatments; pair-wise comparisons in rest of the cases significant at 1% level

T-Population
Effect of sudden changes in salinity on parthenogenetic Artemia sp.

Table 2. Two-way ANOVA - salinity vs. stages of population

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum Sq.</th>
<th>Mean Sq.</th>
<th>F</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>3</td>
<td>9343.024</td>
<td>3114.341</td>
<td>18.93</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>Salinity</td>
<td>8</td>
<td>11932.960</td>
<td>1491.620</td>
<td>9.07</td>
<td>p&lt;0.01</td>
</tr>
<tr>
<td>Error</td>
<td>24</td>
<td>3948.817</td>
<td>164.534</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maintain an internal osmotic medium, in extreme hyperosmotic conditions (Garcia-Saez et al., 1997). The level of Na/K-ATPase increases dramatically from nauplius to the adult stage and its highest activity has been reported in adults (Clegg and Trotmann, 2002).

Sudden drop in salinity due to rainfall or dilution of environment was found to be detrimental to Artemia population (Bhargava et al., 1987). Generally the cysts hatch out and nauplii survive in low saline conditions. Conte et al. (1980) and Conte (1984) established that the nauplii survive better at reduced salinity. The haemolymph of nauplii is maintained better at concentrations and compositions that are considerably lower and qualitatively different from the hyperosmotic medium compared to the adults, with the help of the Na/K-ATPase secreted by the larval ‘neck organ’ (salt gland). Ahl and Brown (1991) reported high fluctuations of Na/K-ATPase activity in Artemia nauplii with the changing saline conditions. Compared to the adults, rapid increase in the synthesis of ornithine carboxylase (ODC) – an enzyme essential for various basic cellular processes including altered cellular osmolarity was reported when nauplii reared in seawater (32 ppt) was rapidly transferred to 4 and 12 ppt (Watts et al., 1996). All these indicate that the nauplii are better adapted to saline conditions and this may be the main reason for the survival of nauplii and high mortality of adults and pre-adults when salinity was suddenly decreased in the present experiment.

References


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