INFLUENCE OF SALINITY ON POPULATION GROWTH OF A ROTIFER, BRACHIONUS PLECTILIS (MULLEN)

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ABSTRACT

The rotifer Brachionus plicatilis plays an important role in prawn hatcheries. It tolerates wide range of salinities. The present experiments were conducted to find the optimum salinity for its mass culture. Experiments conducted on various ranges of salinities starting from 0 to 40 ppt at an interval of 5 ppt revealed that Brachionus plicatilis did not survive at salinities 0 and 40 ppt. The reproductive rate was higher at 5, 10 and 15 ppt salinities as compared to salinities of 20, 25, 30 and 35 ppt. The doubling times of B. plicatilis at various salinities ranged from 0.608 to 315 days. Production rate was fast at 10 ppt followed by 5, 15, 20, 30 and 35 ppt. Optimum salinity studies conducted at 5 to 15 ppt with an interval of 1 ppt showed that the production of 70 individuals per ml was highest at 10 ppt salinity and the doubling time ranged from 1.72 to 1.317 days. Their results indicated that 10 ppt salinity is optimum for mass culture of B. plicatilis. In all the experiments, B. plicatilis was fed with baker's yeast at the rate of 200 ppm.

INTRODUCTION

Intensive hatchery production of most juvenile fishes and crustaceans is still handicapped by the essential requirement for live foods. The live food organisms serve as living capsules of nutrition for sustenance and replacement of tissues as well as maintenance of normal metabolism and optimum growth.

Extensive work has been carried out on the intensive production of phyto and zooplankters. Selected phytoplankters like Skeletonema sp, Chaetoceros sp, Chaetoceros sp, Navicula
sp., Nitchia sp., etc., were cultured separately and used as larval feed for penaeid prawns (Mock and Murphy, 1971; Hudinaga, 1942; Cook and Murphy, 1966). Among the Zooplankters; Artemia nauplii play an important role in the hatchery production of fish and prawn seed (Shigueno, 1972; Hudinaga, 1962; Hudinaga and Kittaka, 1966). Although continuous culture of Artemia nauplii has been developed (Dwivedi et al; 1980) Artemia cysts are expensive, extremely variable in hatching rate and it is difficult to provide adequate quantities for commercial hatcheries, for a dependable and economical method to find out selected zooplanktonic organisms which can substitute Artemia nauplii.

The euryhaline rotifer, Brachionus plicatilis is one of the most common zooplankton used in fish and prawn hatcheries in different parts of the world (Theilacker and Me Master, 1971; Dwivedi and Reddy, 1984; Lub Zens et al, 1987; Juario and Duray, 1983), due to its high nutritive value, small size (120-250μ) and its simple feeding habits. Brachionus plicatilis occurs in nature in wide range of salinities. It is found in backwaters of Bombay, where the salinity ranges from 4 to 35 ppt. The present experiments have been conducted to study the salinity tolerance, optimum range of salinities for reproduction and mass culture of Brachionus plicatilis.

MATERIAL AND METHODS

To study the influence of various salinity ranges on survival and reproduction of B. plicatilis, 2.5 litre capacity cylindrical glass jars were used. The jars were filled with 2.0 litres of 0, 5, 10, 15, 20, 25, 30, 35 and 40 ppt water respectively. The water was filtered through 60μ bolting silk cloth. B. plicatilis collected from the backwaters of Bombay were inoculated at the rate of 50 individuals/litre in all the 9 jars. B. plicatilis was fed with Backer's dry yeast @ 200 ppm. once in a day. The population density of B. plicatilis in all the 9 jars was recorded daily to find out the suitable salinity range for its mass culture.

Doubling time of B. plicatilis was calculated at different ranges of salinities by dividing loge2 by the instantaneous growth rate (K) as followed by Theilacker and Me Master (1971).

\[ K = \frac{\log e N_t - \log e N_0}{t} \]

where No is the number of B. plicatilis in the inoculum, Nt is the final number after time 't' in days. After finding out the suitable salinity range, 5 to 15 ppt from the first set of experi-
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ments, the optimum salinity experiments were conducted in 11 test tubes of 100 ml capacity. The tubes were filled with 50 ml of filtered water. With an interval of 1 ppt for each tube from 5 to 15 ppt, they were inoculated with B. plicatilis at the rate of one individual/ml and fed with baker's dry yeast at the rate of 200 ppm once in a day. The population of B. plicatilis was recorded separately for all the test tubes at an interval of 24 hours.

Doubling time of B. plicatilis was calculated at various salinities by following the method used in the first series of experiments.

RESULTS AND DISCUSSIONS

The experiments performed with salinities from 0 to 40 ppt with interval of 5 ppt revealed that no. B. plicatilis survived at 0 and 40 ppt salinities after 24 hours, but in the rest of the 7 jars, the B. plicatilis survived and the counts were 7, 9, 9, 6, 3, 2, and 1 individuals/ml at 5, 10, 15, 20, 25, 30 and 35 respectively. In these 7 jars a maximum production of 102, 150, 120, 65, 32, 8 and 2 individuals/ml were recorded at salinities 5, 10, 15, 20, 25, 30 and 35 ppt on the 7th, 8th, 8th, 7th, 8th and 7th day respectively (Fig.1). The highest production recorded at

Fig. 1: Population density in 5 to 35 ppt salinities
salinities ranging from 5 to 15 ppt was also observed by the mass culture experiments conducted by Hirayama et al. (1973) and Hirayama and Watanabe (1973) at 12.8 ppt, Lubzens et al. (1987) at 10 ppt and Dwivedi et al. (1985) at 9 ppt.

The reproduction rate of *B. plicatilis* at various salinities ranging from 5 to 35 ppt at an interval of 5 ppt has been calculated and represented in Table 1. The doubling time ranged from 0.608 to 1.315 days. The reproductive rate was faster at salinity 10 ppt followed by 15, 5, 20, 25, 30 and 35 ppt. The doubling times at salinities 5, 10, and 15 ppt were 0.640, 0.608 and 0.626 days respectively, showing not much differences in reproductive rates of *B. plicatilis*. Therefore, the salinities from 5 to 15 ppt were selected at an interval of 1 ppt to find out the optimum salinity for culture.

**TABLE 1: REPRODUCTIVE RATES OF B. Plicatilis AT VARIOUS SALINITIES FROM 0 TO 40 PPT AT A FREQUENCY OF 5 PPT.**

<table>
<thead>
<tr>
<th>Salinity ppt</th>
<th>N₀</th>
<th>Nₜ</th>
<th>t</th>
<th>K</th>
<th>Dₜ</th>
<th>F.C.B.p (No/ml)</th>
<th>Water Volume (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2000</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>204 x 10³</td>
<td>7</td>
<td>1.08</td>
<td>0.64</td>
<td>102</td>
<td>2000</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
<td>290 x 10³</td>
<td>7</td>
<td>1.1389</td>
<td>0.608</td>
<td>145</td>
<td>2000</td>
</tr>
<tr>
<td>15</td>
<td>100</td>
<td>232 x 10³</td>
<td>7</td>
<td>1.1070</td>
<td>0.626</td>
<td>116</td>
<td>2000</td>
</tr>
<tr>
<td>20</td>
<td>100</td>
<td>130 x 10³</td>
<td>7</td>
<td>1.024</td>
<td>0.6769</td>
<td>65</td>
<td>2000</td>
</tr>
<tr>
<td>25</td>
<td>100</td>
<td>60 x 10³</td>
<td>7</td>
<td>0.9138</td>
<td>0.7585</td>
<td>30</td>
<td>2000</td>
</tr>
<tr>
<td>30</td>
<td>100</td>
<td>16 x 10³</td>
<td>7</td>
<td>0.725</td>
<td>0.956</td>
<td>8</td>
<td>2000</td>
</tr>
<tr>
<td>35</td>
<td>100</td>
<td>4 x 10³</td>
<td>7</td>
<td>0.52698</td>
<td>1.3152</td>
<td>2</td>
<td>2000</td>
</tr>
<tr>
<td>40</td>
<td>100</td>
<td>-</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2000</td>
</tr>
</tbody>
</table>

N₀ = Initial No. of *B. plicatilis* in the inoculum
Nₜ = Final No. of *B. plicatilis* after time t
 t = time in days
 K = Instantaneous growth rate
 Dₜ = Doubling time in days
 F.C.B.p = Final concentration of *B. plicatilis*. 
Optimum salinity for mass culture of B. plicatilis: Experiments carried out in eleven 100 ml glass test tubes containing water of 5 to 15 ppt salinity at an interval of 1 ppt, revealed that a maximum production of 70 individuals per ml was obtained at 10 ppt salinity on the 10th day followed by 68, 67, 66, 65, 63, 60, 60, 58, 56 and 52 individuals/ml at salinities 9, 11, 8, 7, 12, 6, 5, 13, 14 and 15 ppt, respectively. The population of B. plicatilis observed during the 20 days period and its peak periods are depicted in Fig. 2.

![Population density in 5 to 15 ppt salinities](image)

**Fig. 2**: Population density in 5 to 15 ppt salinities.

**TABLE 2**: REPRODUCTIVE RATES OF B. Plicatilis AT DIFFERENT SALINITIES FROM 5 TO 15 PPT AT A FREQUENCY OF 1 PPT.

<table>
<thead>
<tr>
<th>Salinity (ppt)</th>
<th>N₀</th>
<th>N₁</th>
<th>t</th>
<th>K</th>
<th>Dₜ</th>
<th>F.C.F. (No./ml)</th>
<th>Volume of water (ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>50</td>
<td>2100</td>
<td>7</td>
<td>0.53</td>
<td>1.3</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>2500</td>
<td>7</td>
<td>0.560</td>
<td>1.2</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td>2600</td>
<td>7</td>
<td>0.564</td>
<td>1.23</td>
<td>52</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>2900</td>
<td>7</td>
<td>0.58</td>
<td>1.19</td>
<td>58</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>50</td>
<td>3100</td>
<td>7</td>
<td>0.589</td>
<td>1.76</td>
<td>62</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>3150</td>
<td>7</td>
<td>0.591</td>
<td>1.1728</td>
<td>63</td>
<td>50</td>
</tr>
<tr>
<td>11</td>
<td>50</td>
<td>3000</td>
<td>7</td>
<td>0.584</td>
<td>1.186</td>
<td>60</td>
<td>50</td>
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<tr>
<td>12</td>
<td>50</td>
<td>2500</td>
<td>7</td>
<td>0.558</td>
<td>1.242</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>13</td>
<td>50</td>
<td>2400</td>
<td>7</td>
<td>0.553</td>
<td>1.253</td>
<td>48</td>
<td>50</td>
</tr>
<tr>
<td>14</td>
<td>50</td>
<td>2100</td>
<td>7</td>
<td>0.533</td>
<td>1.3</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>50</td>
<td>2000</td>
<td>7</td>
<td>0.526</td>
<td>1.317</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>
\[ N_0 = \text{Initial number of } B. \text{ plicatilis in the inoculum} \]
\[ N_t = \text{Final number of } B. \text{ plicatilis after time } t \]
\[ t = \text{Time in days} \]
\[ K = \text{Instantaneous growth rate} \]
\[ D_t = \text{Doubling time in days} \]
\[ F.C.B_p = \text{Final concentration of } B. \text{ plicatilis} \]

The reproductive rates of \( B. \text{ plicatilis} \) at different salinities ranging from 5 to 15 ppt at an interval of 1 ppt is shown in Table 2. Doubling time ranged from 1.1728 to 1.317 days. The results indicated that the reproductive rate was faster at 10 ppt salinity and thus the 10 ppt. salinity is optimum for mass culture of \( B. \text{ plicatilis} \).

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REFERENCES


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