EARLY LARVAL REARING OF WHITE SHRIMP,
Fenneropenaeus indicus
BY FEEDING ENRICHED ROTIFER DIETS

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ABSTRACT
An experiment was conducted from Mysis 3 to Post larva 5 of white shrimp, Fenneropenaeus indicus in plastic troughs (100 liters) by feeding enriched Rotifer diets. Larvae fed with enriched Rotifer in Yeast were considered as control, whereas larvae fed with enriched Rotifer in Cod-liver oil and HUFA were designated as treatment 1 and 2. Artemia nauplii fed larvae were considered as treatment 3. A combination of Artemia and enriched Rotifer in Yeast, Cod liver oil and HUFA were also fed to the larvae and were designated as treatment 4, 5 and 6 respectively. Both the control and treatments were replicated thrice, arranged in a completely randomised design. Larvae fed with enriched Rotifer in Cod liver oil showed higher survival rate when compared to control and other treatments. ANOVA shows significant difference on survival between Control and Treatments. Enrichment of Rotifer in Cod liver oil and Yeast for 12 hours at 30°C is found to be an ideal method to increase survival rate of F. indicus larvae.

Key words: Larval rearing, White shrimp, Enriched Rotifer.

RESUMEN
Se llevó a cabo un experimento con camarón blanco, Fenneropenaeus indicus, desde Mysis 3 a Post larva 5 en comederos de plástico de 100 litros, con alimentación mediante dieta enriquecida de rotíferos. Se usaron como control larvas alimentadas con rotíferos en levadura, mientras que los tratamientos fueron cultivo enriquecido de rotíferos (tratamiento 1) y aceite de hígado de bacalao con HUFA (tratamiento 2). El tercer tratamiento fueron larvas alimentadas con Artemia. Los tratamientos 4, 5 y 6 fueron combinaciones de levadura, aceite de hígado de bacalao y HUFA.

Tanto el control como los tratamientos se realizaron 3 veces utilizando un diseño completamente aleatorizado. Las larvas alimentadas con rotíferos enriquecidos y aceite de hígado de bacalao mostraron una mayor tasa de supervivencia comparada con el control y los demás tratamientos. Se consideró que el cultivo con enriquecido de rotífero combinado con aceite de hígado de bacalao y levadura durante 12 horas a 30°C fue un método ideal para aumentar la tasa de supervivencia de las larvas de F. indicus.

Palabras clave: Cria de larvas, camarón blanco, enriquecimiento de rotíferos.
INTRODUCTION

Rotifers are the most widely used live feed in intensive aquaculture (Srivastava et al., 2011). Its body size makes this organism an appropriate prey at start feeding. It also has high population growth rate at high densities and it feeds by filtrating particles in suspension which makes it easy to enrich with potentially lacking nutrients. Yet the widespread use of these food organisms, there is little information only on commercial usages of HUFA-enriched Brachionus in Fenneropenaeus indicus early larviculture. Emmerson (1984) studied the predation and energetics of Penaeus indicus larvae feeding on Brachionus plicatilis and Artemia nauplii. Donald and Darryl (1988) evaluated the rotifer, Brachionus plicatilis as a substitute for Artemia in feeding larvae of Macrobrachium rosenbergii. Samocha et al., 1989 worked on the effect of feeding two prey organisms, nauplii of Artemia and rotifers, Brachionus plicatilis (Muller), upon survival and growth of Penaeus semisulcatus (de Haan) larvae. Research studies also included enriched rotifers in larval feeding regime (L. vannamei) from Z2 to M3/PL1 at densities 20-40/ml/day (Naessens et al., 1995; Wouters et al., 1997). However, studies on larval rearing in white shrimp, F.indicus are scanty. Therefore a study was conducted to evaluate the efficiency of feeding enriched Rotifer, Brachionus plicatilis in various media on survival of early larvae of Indian white shrimp, Fenneropenaeus indicus an ideal candidate species for coastal aquaculture.

MATERIALS AND METHODS

The experiment was conducted for a period of one week in plastic troughs (50 liters) in the larval rearing section of Fish Farm Hatchery, Faculty of Marine Science. There was control and treatments for the study. Larvae fed with enriched Rotifer in Yeast, Cod liver oil and HUFA were also fed to the larvae and were considered as treatment 4, 5 and 6 respectively. Both the control and treatments were replicated thrice and arranged in a completely randomised design. Uniform size Mysis 3 were produced in the Hatchery and stocked at the rate of 100/liter in each trough. Larvae were fed from Mysis 3 stage to PL5 based on a feeding table designed for larval rearing in the Hatchery (Table 1).

Micro encapsulated feed, Royal Cavier (100 µ) was fed to the larvae at 6:00 AM, 1:00 PM, 6:00PM and 12:00 PM and 50% water exchange was done at every day morning. Required quantity of Rotifer was cultured in the Hatchery. Stock of Rotifer was grown on standard diet (Baker’s yeast) as per the procedure recommended by Theilacker and MacMaster (1971). Rotifer was enriched in Cod liver oil which was procured from Seven Seas, Taiwan and HUFA from Espresso, Taiwan. Enrichment was done for a period of 12 hours by keeping Rotifer in each medium at 30°C. After enrichment, Rotifer was harvested and cleaned with filtered seawater and fed to the larvae as per the feeding table. Upon harvest of post larvae, survival in control and treatment tanks was recorded and compared. One way analysis of variance (ANOVA) was employed to find out the statistical significance on deference in survival between control and treatment means. Duncan’s multiple range tests was done to compare the treatment means.

RESULTS

Data on larval rearing of Mysis are shown in Table 2. Larvae fed with enriched Rotifer in Cod liver oil showed higher survival when compared to control and treatments (Fig.1). Lowest survival was observed in T6 which was fed by a combination of Artemia nauplii and enriched Rotifer in HUFA. Larvae fed with Artemia nauplii alone were found to be healthy and the survival was as good as Control. Combination of Artemia nauplii and enriched

<table>
<thead>
<tr>
<th>Larvae</th>
<th>Rotifer</th>
<th>Artemia</th>
<th>Rotifer+Artemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>M3</td>
<td>10/ml</td>
<td>5/ml</td>
<td>5+3/ml</td>
</tr>
<tr>
<td>PL1</td>
<td>15/ml</td>
<td>5/ml</td>
<td>8+3ml</td>
</tr>
<tr>
<td>PL2</td>
<td>20/ml</td>
<td>10/ml</td>
<td>10+5/ml</td>
</tr>
<tr>
<td>PL3</td>
<td>25/ml</td>
<td>10/ml</td>
<td>12+5/ml</td>
</tr>
<tr>
<td>PL4</td>
<td>30/ml</td>
<td>20/ml</td>
<td>15+10/ml</td>
</tr>
<tr>
<td>PL5</td>
<td>50/ml</td>
<td>20/ml</td>
<td>25+10/ml</td>
</tr>
</tbody>
</table>

Feeding time and feeds

<table>
<thead>
<tr>
<th>Stage</th>
<th>6 AM</th>
<th>10 AM</th>
<th>1 PM</th>
<th>3 PM</th>
<th>6 PM</th>
<th>9 PM</th>
<th>12 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larvae</td>
<td>RC</td>
<td>Live feed</td>
<td>RC</td>
<td>Live feed</td>
<td>RC</td>
<td>Live feed</td>
<td>RC</td>
</tr>
</tbody>
</table>

Table 1: Feeding table for larval rearing.
rotifer did not show high survival rate when compared to Control. ANOVA shows that there is significant difference (p<0.05) in survival between control and treatments.

**DISCUSSION**

The major bottleneck of shrimp larviculture is the rearing or early larval stages (Agh and Sorgeloos, 2005). Larval rearing of shrimp is dependent upon the availability of live food, which is expensive to obtain on a commercial scale. Several reasons can justify why live food is so essential for larval growth. In nature the larvae of shrimp feed on motile prey organisms and encounter problems in accepting inert diets in captivity (Kolkovski, 2001; Sargent et al., 2002). Rotifers and Artemia are the two live feeds most commonly used in shrimp larval rearing. The nutritional effectiveness of a live feed is in the first place determined by its ingestibility and, as a consequence, by its size (Agh and Sorgeloos, 2005). Prey size is particularly important for shrimp larvae that have very small feeding appendages. In these cases, larvae should be fed rotifers as first food because Artemia nauplii are too large. Shrimp larvae can capture with their feeding appendages and therefore prey size is important (Faleiro and Narciso, 2009). In the present study, survival rate in the larvae fed with enriched rotifer in cod liver oil showed highest value when compared to the larvae fed with Artemia nauplii. This shows that shrimp larvae could capture Rotifer effortlessly than Artemia nauplii and thereby it could bring higher survival.

Nutritional quality of prey is an important aspect to consider in shrimp larval rearing. Lipids represent the most important energy source during embryonic development and essential fatty acids, such as the highly unsaturated fatty acids (HUFA) EPA (20:5n-3, eicosapentaenoic acid) and DHA (22:6n-3, docosahexaenoic acid), are extremely important for larval development, especially in improving neural functions (Bell et al., 1995; Sargent et al., 2002). Although nutritional deficiencies in prey quality can be overcome through enrichment with essential fatty acids, high HUFA levels are difficult to accumulate in Artemia nauplii due to their inherent catabolism of DHA. In contrast, rotifers are not selective for the uptake or catabolism of HUFA and high levels of DHA are easily incorporated in these organisms (Dhert et al., 1993). The higher survival in larvae fed with Rotifer enriched with cod liver oil maybe due to the presence of fatty acids in cod liver oil (Faleiro and Narcisco, 2009). Recently Yahyavi and Takami, (2007) reported better survival with cod liver oil enriched rotifer than non-enriched Artemia. Regunathan (2005) researched on differential rotifer enrichment diets for F. indicus larval rearing and concluded that protein selco enriched rotifer could replace non-enriched Artemia from Zoea 2 to Mysis 2 stage with similar survival and till Mysis 3 with non-significant survival compromise.

**Table 2: Survival of post larvae fed with enriched Rotifer diets.**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control M ±SD</th>
<th>T1 M ±SD</th>
<th>T2 M ±SD</th>
<th>T3 M ±SD</th>
<th>T4 M ±SD</th>
<th>T5 M ±SD</th>
<th>T6 M ±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial number</td>
<td>5000±12</td>
<td>5000±12</td>
<td>5000±12</td>
<td>5000±12</td>
<td>5000±12</td>
<td>5000±12</td>
<td>5000±12</td>
</tr>
<tr>
<td>Final number*</td>
<td>1908±74</td>
<td>2294±41</td>
<td>1106±59</td>
<td>1910±98</td>
<td>1307±73</td>
<td>1203±90</td>
<td>504±88</td>
</tr>
<tr>
<td>Survival(%)</td>
<td>38±08</td>
<td>46±11</td>
<td>22±09</td>
<td>38±05</td>
<td>26±09</td>
<td>24±02</td>
<td>10±04</td>
</tr>
</tbody>
</table>

*P<0.05; a,b,c: Means with the same superscript do not differ from each other (Duncan’s test)

![Figure 1: Survival (%) of post larvae fed different diets.](image-url)
Besides prey ingestibility, differences in Brachionus and Artemia nauplii digestibility and nutritional quality may also be important. Crustacean larvae have a poor digestive capacity, probably due to an insufficient enzymatic activity (Hammer et al., 2000; Kolkovski, 2001), which can be improved by exogenous enzymes from preys (Kolkovski, 2001). In carnivorous larvae, prey digestibility is particularly important because they have a short gut retention time, particularly during the early larval stages, making the rapid digestion so critical (D’Abramo, 2002). The digestive capacity of a species varies with the prey and is probably related with their natural diet. In the present study, Artemia nauplii fed larvae were found to be low survival compared to control and other treatments and this may be due to the meager digestibility of Artemia nauplii by post larvae.

This study demonstrated that rotifers are essential for larvae survival and for the development of early larval stages in white shrimp larviculture, but also that enriched rotifers can be successfully used for larval rearing of P. indicus.

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REFERENCE


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