Rotifer as a live feed in finfish mariculture

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Introduction

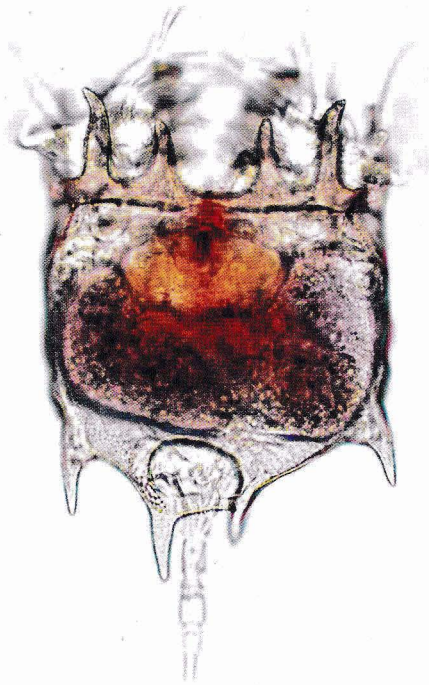
Marine or brackishwater aquaculture in India is mostly restricted to shrimp farming, owing to the high export potential of penaeid shrimp. Farming of shrimp has grown to such an extent that almost entire coastal aquaculture in India is currently dominated by shrimp culture. In spite of this phenomenal growth, the sector is confronted with several issues like diseases, high production costs, environmental pollution and frequent price fluctuations. Existence of frequent problems in shrimp culture has led to questions on the sustainability of the industry as it is solely dependent on a single resource group.

In order to have sustainable and eco-friendly coastal aquaculture operations, species diversification is seen as one of the important components. In spite of having huge mariculture resources, the country is still at the initial stage in marine finfish production with a contribution of only 1.43% to the global farmed marine finfish production. Hence, seed production and farming technology development for different brackishwater and marine finfishes have been initiated in India, which includes mullets (*Mugil cephalus*), milkfish (*Chanos chanos*), pearlspot (*Etroplus suratensis*), cobia (*Rachycentron canadum*), silver pompano (*Trachinotus blochii*), orange spotted grouper (Epinephelus coioides), Indian pompano (*Trachinotus mookalee*), tiger grouper (*Epinephelus fuscoguttatus*) and pink ear emperor (*Lethrinus lentjans*).

Commercial farming of most of the marine finfish species has not yet been established in India owing to several reasons such as availability of seed, larval & grow-out feeds, infrastructure for farming as well as suitable commercially proven technologies. Selection and use of an appropriate larval feed is one of the key factors, which decide the success rate in seed production for marine finfish. Feed with the required nutritional profile, available in suitable size ranges to suit the mouth size of the larvae and that are capable of stimulating a feeding response are the prerequisites of an ideal feed for larvae.

Importance of Live feed for finfish larval rearing

One of the major problems in finfish Mariculture is the larviculture in captivity, as most of the larvae are of altricial type; they generally hatch at an early stage in their development and having very less yolk reserves at hatching. Fish larvae in the size range of 1 mm to 5 mm in total length possess primitive digestive systems. The larval size and mouth gape are very small and the perceptive powers for searching and accepting



Brachionus rotundiformis

external feed is also very less. The period when the yolk reserves are fully exhausted and larvae need to resort to exogenous feeding is the most critical period in the larviculture of most marine finfishes. Moreover, the fish larvae have poor vision and poorly developed olfactory organs at this stage. Therefore, the size of the feed must suit the small mouth size of the larvae and abundantly available in the larval rearing system for easy preying. The larviculture of marine finfish is thus challenging and proper management of live feed is a vital pre-requisite for success, manifested in terms of higher survival and growth of the larvae. Formulated feed often do not meet all these requirements and in most cases, yields lesser larval survival rates when compared to live feed.

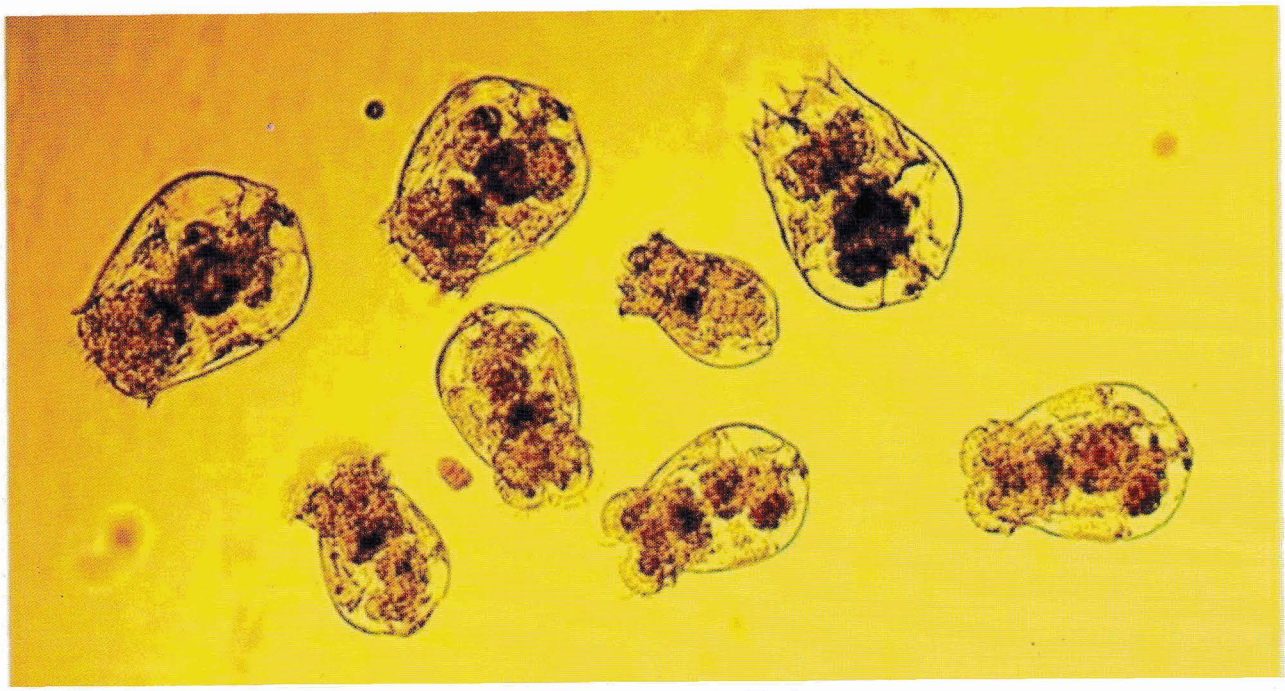
Live feeds are small microorganisms available in nature such as microalgae, rotifers, copepods and *Artemia*. Among the live feeds, microalgae are very important food for the commercial culture of bivalves, crustaceans and other zooplankters. The commonly available zooplankton species such as rotifer, copepods and *Artemia* nauplii are considered to be most suitable feed for marine fin fish larvae. The advantages of using live feed for larval rearing are high palatability, high acceptability, promoting high growth rates and the non contaminating nature of the live feed in the larval rearing tanks. Therefore, the success of a finfish hatchery, especially in the early larval stages is exclusively dependent on the production and supply of high quality live feed organisms in sufficient quantities. However, at present, in India, one of the major impediments in commercial larval rearing of marine organisms is the non-availability of large quantities of suitable live feed organisms at the right time.

Rotifer as live feed

Among all, the first live feed that has been demonstrated successfully as first feed for most of the marine finfish species is the rotifer. It is considered as an excellent food for newly hatched fish larvae due to its small size, slow swimming speed, high calorifc value, parthenogenetic reproduction and ability to be easily enriched with antibiotics and fatty acids. Rotifers are a group of aquatic microscopic invertebrates and are commonly called 'wheel animalcules' as their disc like corona bears resemblance to a pair of revolving wheels due to the synchronized beating of their coronal cilia. The rotifers are well represented in freshwater plankton, but only a few species of them are found in brackish waters and fewer still in the sea.

Our knowledge of this group from Indian waters is rather scanty, despite the fact that during certain seasons they constitute a predominant portion of zooplankton, and play an important role in the food cycle of aquatic system. Further, the high reproductive potential through parthenogenesis is a remarkable biological and ecological feature by which the rotifers are distinguished from all other planktonic zooplankters. The significance of these organisms as first food for early larvae was first indicated by Fujita from Japan, when the *Brachionus plicatilis* group was used as a primary food for red seabream larvae (*Pagrus major*) and since then, the importance of their study as live food organisms has become an attractive subject in intensive research by fishery biologists.

Though considerable information has been accumulated on taxonomy and distribution of rotifers from different parts of India, our present knowledge



Different size groups of *B. rotundiformis*

of the rotifer fauna in India is still inadequate. Till now, eurotatorian fauna of West Bengal is adequately explored and that of Orissa, Punjab, Andhra Pradesh, Kerala and Jammu and Kashmir is moderately known. Except for a preliminary account of the rotifers of Bihar by Sharma in 1992, there is practically no detailed systematic account including the species group, species and subspecies/forms of the rotifer fauna from any of the Indian states. Among the different rotifers, the species belonging to the genus Brachionus, especially *Brachionus plicatilis* and *Brachionus rotundiformis*, were used as the first live food for various marine finfish larvae. However, the brachionids exhibited polymorphism related to extrinsic factors (cyclomorphosis). Because of this polymorphism, the taxonomy of this genus is very confusing to biologists. For example, in earlier literature, in the *Brachionus plicatilis* group, rotifers were named the so-called 'L' (Large) and 'S' (small) types depending on the size of lorica. It has not been distinguished and confirmed, whether these two types are different at the species level or simply they are two extremes of the form (ecomorph) under a single species. Later on, the taxonomic status of these rotifers were reviewed based on the morphological and genetic studies and reclassified this group into two separate species. Now, these rotifers are termed *Brachionus plicatilis* (former 'L' type) and *Brachionus rotundiformis* (including both 'SS' and 'SM' or 'S' by aquaculturists). However, in India no attempts have been made to review the taxonomic status of this group and other rotifers, even though, these rotifers have been reported from the estuaries and backwaters of Kerala by scientists.

Rotifer production

Since seed production and culture practices of several marine finfishes such as Cobia, Silver pompano, Orange spotted grouper, Indian pompano, Tiger grouper, Red Snapper and Pink ear emperor are seriously being promoted in India as additional/alternate species for aquaculture, standardization of mass production techniques of smaller sized rotifers is of prime importance to take this technology forward.

Isolated rotifers can be mass cultured in hatcheries for larval rearing of marine finfishes. Optimum conditions are required for better growth, reproduction and increased productivity of rotifers. The conditions required are species specific and need to be varied accordingly. The major factors that influence the population size in rotiters are temperature, salinity and adequate availability of food. B. plicatilis and B. rotundiformis are more tolerant to temperature and salinity fluctuations.

Optimal conditions for rotifer # culture			
Parameters	Range	Optimum	
Temperature (°C)	26 - 34	28 - 30	Rotifers reared at higher temperatures within their optimum range had better growth and increased productivity
Salinity (gL^{-1})	1 to 97 (depends on species)	25 to 30 (for marine species)	Better to rear them in salinity (± 5 ppt) closer to the larval rearing tanks
Dissolved Oxygen (mgL^{-1})	2 to 5	>4	Mild aeration is enough for mixing. Strong aeration leads to physical damage to rotifers
pH	7.5 to 8.5	8.0 to 8.3	The ammonia levels are influenced by the temperature and the pH of the water. High levels of un-ionized ammonia in the rearing conditions are toxic to rotifers
Total Ammonia (mgL^{-1})	<1	<0.5	

Culture Techniques

Several mass production techniques for rotifers have been developed globally and the most commonly practised techniques are the "1" batch culture and "2" continuous culture method.

1. Batch culture method: Involves harvesting of the entire culture completely and using a major part of the harvest for feeding fish larvae. The remaining part is used as inoculum for continuing the next batch of culture.

2. In the Continuous culture method: Around 25 to 50 % of volume is harvested regularly and the harvested volume is replaced with microalgae and the culture is continued.

In a low density rotifer culture with inoculation density between 50 and 200 nos ml-1 to reach a final density of 300 to 1000 nos ml-1 by using microalgae and / or baker's yeast as food in 3-7 days culture period. Microalgae can be fed to the rotifer singly or in combination of two or more species. Feeding experiment on rotifer with *Nannochloropsis, Isochrysis* and *Chlorella* revealed that there is an increase in neutral lipid and phospholipid content. Rotifer fed with Isochrysis galbana alone was found to have more amount of DHA and less in EPA content, whereas those fed with *Nannochloropsis gaditana* was found to have more EPA content.

Rotifer culture can be carried out in FRP or cement tanks. Rotifers should be inoculated at the rate of 50 nos. ml^{-1} from the maintained stock in the tank with treated seawater. The rotifer cultures should be fed with *Nannochloropsis occulata* with density of 5×10^6 cells ml^{-1}. Sufficient light should be provided with fluorescent tubes (12h L: 12h D). Provide adequate mild aeration and maintained in room temperature (27±1° C). Care should be taken at every step to maintain the required environmental parameters and algal density for mass culture of rotifers. In 4 days it may reach a final density of 200 nos. ml^{-1}.

Commercial products such as Culture Selco® are used as feed/to enrich rotifer. The initial density of 200 to 250 nos ml^{-1} increases to 600 rotifers ml^{-1} in a 4 day culture period. To maximise the productivity/ production of rotifers, high quality and high-density biomass is used as input in mass culture systems. Mechanised and automated continuous culture systems have also been developed for mass production of rotifer by many workers. In these improved techniques all the physico-chemical parameters are maintained at optimal levels with a steady supply of microalgae. Algae and artificial diets are used for production of ultra-high density mass culture of rotifers too.

Readers may kindly contact the author, for references & suggested reading.