Rotifer Enrichment Diets for Marine Finfish Larviculture

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Abstract

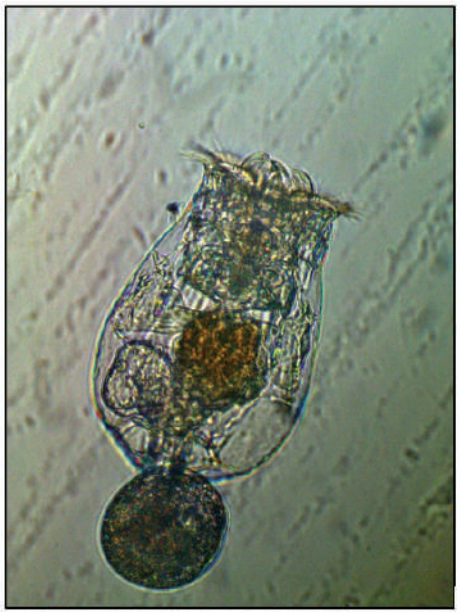
Successful raising of marine fish larvae in aquaculture is strongly dependent on the availability of appropriate and adequate live feed. Rotifers, a common first feed for many marine fish larvae, often lack essential nutrients vital for the optimal growth and survival of fish larvae. However, through enrichment techniques, rotifers can be fortified with essential nutrients, enhancing their nutritional profile and subsequently improving the growth and survival rates of marine fish larvae. This article focuses on the nutrient-rich diets available to enrich rotifers and boost the growth and survival of marine fish larvae.

Keywords: Rotifers, Bio-enrichment, Mariculture, Larval Rearing, Nutritional Benefits

Introduction

Rotifers are microscopic aquatic creatures that play an important role in the early feeding stages of marine fish larvae due to their small size and nutritional composition. Rotifers, on the other hand, are naturally deficient in key nutrients such as omega-3 fatty acids, vitamins, and minerals, all of which are required for fish larval growth. They demonstrate exceptional filter-feeding behaviour, which is critical for their survival. This feeding method uses specialised structures, such as the corona or ciliated feeding apparatus, to generate water currents that draw in suspended particles. The corona, which resembles a rotating wheel or a vortex generator, drives water and particles into the mouth, where food is gathered and taken in. Rotifers feed on a wide variety of microorganisms, including algae, bacteria, and debris, and filter them out of the surrounding water column. This filter-feeding behaviour allows them to eat a variety of foods and survive in nutrient-rich surroundings.

Bioencapsulation, also known as bio-enrichment, is the act of increasing the nutritional status of live food organisms by feeding or incorporating various types of



Rotifer (*Brachionus plicatilis*)

nutrients into them. It entails improving the nutritional value of live-feed organisms through dietary management. Several bio-enrichment approaches have been developed to provide rotifers with vital nutrients. These methods include feeding rotifers nutrient-dense foods, including microalgae, yeast, and commercial emulsions containing essential fatty acids and vitamins. Rotifer bio-enrichment has a major impact on marine fish larval growth. They offer important fatty acids such as EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), which are required for the development of larval nervous systems and overall health. Furthermore, enriched rotifers are high in vitamins and minerals, which promote healthy growth, development, and immunological function in fish larvae. Studies have demonstrated that larvae fed enriched rotifers have better growth metrics, such as body length, weight, and survival rates, than those fed non-enriched rotifers.

Diets for rotifer enrichment

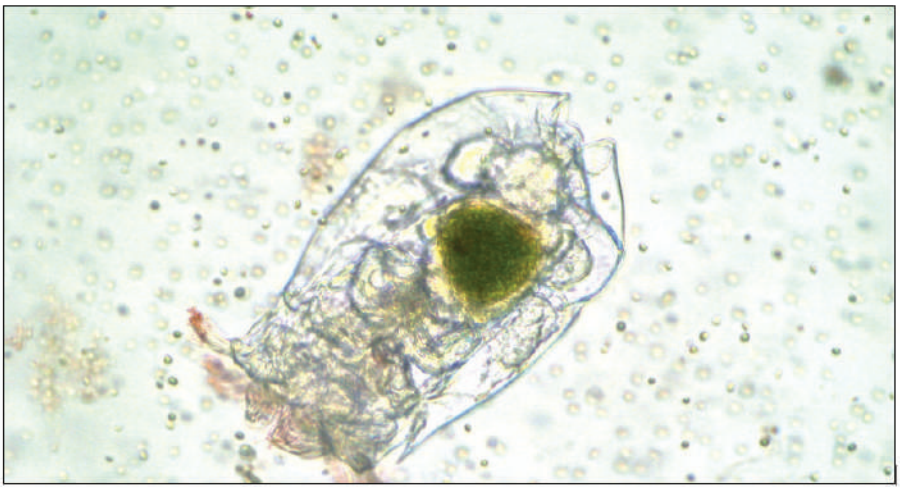
1) Yeast

Yeast is a rich source of protein required for the growth and development of rotifers. *Saccharomyces cerevisiae,* also known as brewer's yeast, is frequently used as ro-

tifer enrichment diets due to its high nutritional value and availability. However, there are some limitations to this enrichment process, such as lack of certain essential nutrients, quality variation, excessive fouling, and microbial growth.

2) Microalgae

Microalgae play an important part in rotifer enrichment by delivering key nutrients such as omega-3 fatty acids, vitamins, and minerals required for the growth and development of marine fish larvae. Several microalgae species are widely used for rotifer enrichment in aquaculture due to their nutritional profiles and compatibility for larval fish diets. Here are some of the most often utilised microalgae for rotifer enrichment.



Rotifer enriched with microalgae

a) Nannochloropsis sp.: Nannochloropsis is a species of microalgae renowned for its high lipid content, notably omega-3 fatty acids like EPA. It is commonly employed in rotifer enrichment diets.

b) Tetraselmis sp.: Tetraselmis is a green microalga that is extensively used in aquaculture due to its high protein, vitamin, and carotenoid content. It serves as an excellent feed for rotifers.

c) Isochrysis sp. (T-ISO): Isochrysis is a genus of microalgae recognised for its high concentration of important fatty acids, particularly DHA, vitamins, and sterols. The Isochrysis T-ISO strain is frequently used in rotifer enrichment diets due to its balanced nutritional composition.

d) Chaetoceros sp.: Chaetoceros is a genus of diatom microalgae that is widely utilised as live feed in aquaculture as it is nutrient-packed and easy to culture.

e) Thalassiosira sp.: Thalassiosira is another genus of diatom microalgae that is commonly employed in aquaculture due to its high nutritional value and appropriateness as rotifer feed.

f) Phaeodactylum tricornutum: Phaeodactylum is a diatom microalgae that contains high levels of EPA and other nutrients.

g) Skeletonema sp.: Skeletonema is a diatom microalgae that has become popular in aquaculture due to its nutritional content and suitability for feeding rotifers.

h) Schizochytrium sp.: Schizochytrium is a marine microalgae that is often utilised in rotifer enrichment for marine fish larviculture due to its high DHA content.

These microalgae species were chosen based on their nutritional value, availability, and suitability for rotifer enrichment diets in aquaculture. Aquaculturists frequently use a variety of microalgae species to offer a balanced and comprehensive diet for rotifers, resulting in optimal growth and nutritional quality for marine fish larvae.

3) Commercial Emulsions

Commercial emulsions designed explicitly for rotifer enrichment are commonly utilised in aquaculture. These emulsions contain essential fatty acids (EPA and DHA), vitamins, pigments, and other nutrients that support larval fish growth and development.

4) Microbial Products

Rotifers' nutritional quality can be improved using microbial products such as probiotics and enzymatic hydrolysates. These products provide readily available nutrients, bioactive peptides, and immunostimulants that are advantageous to larval fish nutrition.

5) Microencapsulated Diets

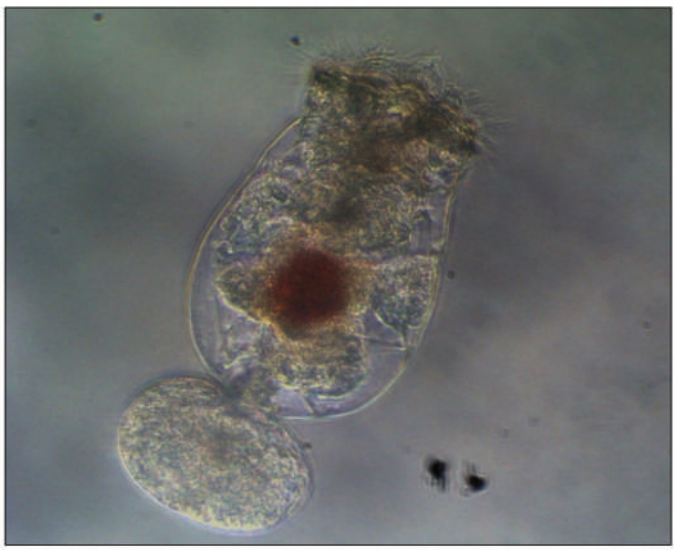
Microencapsulated meals are made up of microscopic particles that include a concentrated blend of nutrients enclosed in a lipid matrix. These diets enable controlled nutrient release, ensuring the long-term enrichment of rotifers.

6) Other Natural Supplements

In addition to the aforementioned feeds, other natural supplements such as fish oil, fish hydrolysates, and egg yolk are utilised to enrich rotifers with critical nutrients, further boosting their nutritional value for larval fish.

Aquaculturists carefully select and blend feeds depending on the nutritional requirements of both rotifers and target fish species in order to optimise the enrichment process and ensure the successful growth and development of marine fish larvae in aquaculture setups.

Commercial products for rotifer enrichment



Rotifer enriched with astaxanthin pigment

Several commercial items are routinely used in aquaculture to enrich rotifers in order to increase their nutritional value for optimal larval fish growth. These products are designed to supply important nutrients such as omega-3 fatty acids, vitamins, minerals, and pigments that marine fish larvae require for optimal health and vitality. Here are some of the well-known commercial items used for rotifer enrichment:

Selco is a well-known brand that offers a variety of products, including a combination of highly unsaturated fatty acids (HUFA), vitamins, and other elements required for fish larval growth. It is often used as a feed supplement for rotifers.

Red Pepper is a complete enrichment product for rotifers that is high in essential fatty acids while also containing well-balanced critical nutrients that are typically absent in yeast-based diets or lipid emulsions. It also contains important vitamins and chelated trace minerals, which influence immunity and collagen tissue growth.

LARVIVA Multigain is a live-feed enrichment diet with all of the nutrients needed by marine fish larvae. It contains the ideal amount and ratio of Omega-3 and -6 fatty acids, as well as a high concentration of vitamins, minerals, immunostimulants, and phospholipids.

Instant Algae provides a variety of microalgae concentrates and enrichment solutions aimed at increasing the nutritional content of live feeds, including rotifers.

RotiGrow Plus and RotiGreen contain microalgae concentrates and other nutritional supplements intended to improve the nutritional value of rotifers and other live feeds for marine fish larvae.

Algamac is a microalgae-based product that enriches rotifers with essential fatty acids, specifically EPA and DHA. It comprises a concentrated blend of microalgal species renowned for their excellent nutritional content and bioavailability.

Many more commercial products are available in the market, and these are supplied by INVE, Belgium, Bern Aqua, Belgium, BioMar, Denmark, Reed Mariculture, California, Aquafauna Bio-Marine, California, Algagen, Florida, Proviron, Belgium, Reefphyto, UK, Easy Reefs, Spain, Necton, Portugal, Shenzhen Qianhai Xiaozao Technology, China, etc. These commercial products offer aquaculturists simple and effective ways to enrich rotifers with critical nutrients, thereby promoting the successful growth and development of marine fish larvae in aquaculture systems.

Challenges and Future Directions

Despite the obvious advantages of bio-enrichment, some problems remain, including cost-effectiveness, scalability, and developing suitable enrichment procedures for various fish species. Future research should concentrate on improving bio-enrichment processes, investigating alternate cost-effective nutrient sources, determining the nutrient transmission rate, and assessing the long-term implications in marine fish larviculture.

Conclusion

Bio-enrichment of rotifers represents a potential approach for improving the growth and survival of marine fish larvae in aquaculture facilities. By fortifying rotifers with essential nutrients, aquaculturists can provide larvae with a nutritionally balanced diet, leading to improved growth rates, survival rates, and overall larval quality. Bio-enrichment strategies require ongoing study and innovation to advance sustainable practices in marine fish larviculture and meet the world's growing demand for seafood.