Cyclops Enrichment Using Algae: Importance, Method and Application in Fish larval Nutrition

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ABSTRACT

The cyclops are important live feed in aquaculture. *Cyclops sp*. is rich in proteins, unsaturated fatty acids, polyunsaturated fatty acids, carotenoids and other essential nutrients bust lacks some essential nutrients. The nutritive value of cyclops enhanced with the help of enrichment process. Firstly, algal strain culture at control temperature (25° C), salinity (30ppt), then mixed with cyclops live feed. Cyclops enriched at temp (17 – 20 °C), salinity (30g/L), and DO (5 – 6 ppm). Enriched cyclops are fed to larval fish. In this article, discuss about how to algal strain culture, cyclops enrichment and feeding to larvae and their impact on fish larvae.

INTRODUCTION

The global aquaculture production reached 228.7 million metric tonnes in 2022 (FAO, 2024). Enhancing global fish production, particularly through fish farming, is essential. The success of this effort largely depends on quality seed application and effective larval rearing, which involves supplying live zooplankton as a primary food source (Jha *et al*., 2006; Akodogbo *et al*., 2015). Fish larval survival is a critical challenge during the early growth stage due to the poorly developed digestive system of the larvae. To overcome this issue, live food plays an important role in Aquaculture. However, most live food lacks some essential nutrient so in order to overcome this issue, live food enrichment is essential, as it helps deliver specific nutrients to target fish larvae, thereby significantly enhancing larval survival.

The zooplanktons are most important in freshwater ecosystems because they are the energy transfer from phytoplankton to fish and the production of Zooplankton depends upon water quality and nutrients. The enriched live zooplankton are responsible for better survival and growth of young fish especially larvae and juvenile (Das *et al*., 2012; Ritu *et al*., 2024). These are more digestible, palatable and nutrient rich than other plankton diet and these are also maintained to water quality (Ogello *et al*. 2017). The cyclops (a copepod) is classified as Zooplankton. Their movement is with the help of water current, but many zooplankton can swim to avoid predators (Dorman, 2006).

Cyclops are important live feed in freshwater Aquaculture due to high nutritional value and importance live feed for fish larvae, important for growth and survival of fish. The use of enriched cyclops as a live feed to improve the growth performance as well as improving larval survival (Ritu *et al*., 2024).

The use of cyclops in *Clarias gariepinus* aquaculture has also showed a positive outcome, with improved growth performance and essential fatty acid profiles when fed with copepods, mixed with artemia (Chepkwemoi *et al*. 2013). *Cyclops sp*. is rich in proteins, unsaturated fatty acids, polyunsaturated fatty acids, carotenoids and other essential nutrients bust lacks some essential nutrients. Therefore, enrichment can be an effective solution in the fish hatcheries to improve the larval survival.

Cyclops (Copepod) (*Khan et al., 2025*)

Cyclops collection

Firstly, collecting the water sample in bottles using a plankton net. The success rate of collection depends on the time of collection, Water depth, and season. The collection of Zooplankton forms the water can be done by the following (A. M. Mudassir., 2024).

- ✓ Plankton net
- ✓ Water bottle

The *chlorococcum sp* is a freshwater microalga that belong to *Chlorophyceae* family, it is capable for supporting the zooplankton nutritive value and larval fish. This microalga ability to produce to carotenoids, astaxanthin, lutein, zeaxanthin, neoxanthin, canthaxanthin etc i.e. important in aquaculture (Lajeetal.2019; Janchot *et al*. 2019; Wannachod *et al*. 2018). The astaxanthin are produced by *chlorococcum* sp, its ability to increased immune function and protection from disease (Ma and Chen, 2001).

Method

1. **Algal strain and culture**:

Various species of algae, namely *Isochrysis galbana, Tetraselmis chuii, Chlorella marina,* and *Nannochloropsis oculata*, were collected from algal collection units or tanks. These algal strains were cultured using commercial ingredients of Conway medium (Walne, 1970).

The microalgae were grown under controlled conditions of 25°C temperature and 30 g/L salinity. The algal strains were harvested during the exponential growth phase and mixed in an equal ratio (1:1:1:1) on a dry matter basis (Seixas *et al*., 2010). After mixing, biochemical analysis was performed, and the mixture was used for feeding purposes.

2. Cyclops culture and enrichment

Steps for cyclops enrichment

- Cyclops are collected from hatchery tanks.
- For enrichment, a stock culture was maintained in cylindrical-conical fiberglass tanks (1 m³) filled with 500 L of filtered seawater. The rearing tanks were covered with nylon cloth to prevent water evaporation. Seawater was filtered using a membrane filter (1 mm).
- Water quality parameters were maintained as follows: (Temperature: 17–20 °C; Salinity: 30–34 g/L; pH: 7–8.5; Dissolved Oxygen (DO): 5–6 mg/L)
- The cultured copepods were harvested, washed, and fed with an equal proportion of algal diet for enrichment.
- The enriched Cyclops were washed with filtered freshwater and were either used directly for feeding fish larvae or frozen at −80°C. (Rizk *et al*., 2018)

Feeding

- After the cyclops enrichment, the fish larvae are collected from the hatchery, and the feeding trials for 15-day-old larvae are shown by using two different live feed like that Artemia metanauplii and cyclops abyssorum divergens, that enriched with mixed algae.
- This feeding trial is assessed by the mouth opening of larvae, providing enriched feed and monitoring larval growth and survival under the control condition.
- The feeding schedule is calculated by enriched Brachionus plicatilis at the rate of 10 – 35 ind. Ml^{-1} according to the larval stage.
- The green water technique is used for feeding strategies at the rate of 0.5×10^6 cell ml^{-1} (El Khodary *et al*., 2020). There are 50% water exchanged before the feeding.
- The fish larvae are fed twice a day and at intervals of seven days, for 6-week fish larvae are sampled to calculate growth parameters.

CONCLUSION

The successful rearing of fish larvae in global aquaculture mainly relies on highly nutritious live food inclusion, as the underdeveloped digestive systems of early-stage larvae require easily digestible prey or food. While Cyclops are naturally served as an excellent live feed due to their palatability and baseline nutritional value, they inherently lack certain critical nutrients required for optimal fish development. By enriching Cyclops with specific mixed microalgal strains cultivated under controlled conditions, hatcheries can significantly enhance the nutritional profile of essential fatty acids, proteins, and immune-boosting carotenoids like astaxanthin. Ultimately, substituting or supplementing traditional feeds with this microalgae-enriched Cyclops diet in the larvae can effectively bridge the nutritional gaps in early larval stages, leading to markedly improved growth performance, enhanced disease resistance as well as higher survival rates for commercial aquaculture hatcheries.

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