Int.J.Curr.Microbiol.App.Sci (2026) *15*(1): 288-293

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 15 Number 1 (2026)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2026.1501.036

Effects of Biotechnologically Cultured Zooplankton Biomass on the Growth and Survival of Carp Larvae and Juveniles

G. A. Okilova[1*], S. B. Buriyev[1], F. Q. Shodmonov[1] and O. I. Radjabov[2]

[1]*Bukhara State University, Uzbekistan*
[2]*Institute of Bioorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan*

**Corresponding author*

Keywords

Zooplankton, biomass, biotechnology, live feed, growth rate, survival.

Article Info

Received:
12 November 2025
Accepted:
18 December 2025
Available Online:
10 January 2026

A B S T R A C T

This study evaluated the effects of biotechnologically cultured zooplankton biomass on the growth, body weight, and survival of carp fry. The experiments were conducted in earthen biological ponds during the 5-30-day developmental stage of the fish. Each pond was stocked with 5000 carp larvae, and the biometric parameters of the control and experimental groups were comparatively analysed. Zooplankton biomass was cultured in a biotechnological growth medium. During the feeding of 5-30-day-old larvae, 50% of the conventional feed was replaced with *Brachionus calyciflorus* and *Moina micrura* biomass. Consequently, the mean live body weight of fish in the experimental group was 12,6% higher than that of the control group, while the survival rate increased from 53,8% to 74,6%. The results demonstrated that biotechnologically cultured zooplankton biomass can effectively replace a portion of conventional and formulated feeds while improving the growth and survival of carp fry.

Introduction

In global aquaculture practice, zooplankton such as *Brachionus*, *Moina*, and *Daphnia* are widely used as live natural feed for rearing fish larvae and fry. Owing to their high contents of protein, lipids, and other biologically active compounds, these organisms play an important biological role in enhancing fish growth, survival, immune competence, and resistance to environmental stressors. However, comprehensive studies on the species composition and ecological characteristics of zooplankton adapted to the hydrochemical conditions of natural water bodies, the identification of promising species for use as live feed, their biotechnological mass culture, and their wider application in aquaculture remain insufficient.

Short-term enrichment of rotifers with marine phospholipids increased their docosahexaenoic acid content and improved the final body weight and growth performance of *Argyrosomus regius* larvae fed these rotifers. Although the enrichment had no statistically significant effect on survival, the findings confirmed that the lipid quality of rotifer biomass is an important factor regulating larval somatic growth (1).

In the treatment receiving live feed enriched with *Chlorella vulgaris*, pikeperch larval survival reached

74,5%, exceeding the values recorded in both the commercial enrichment and control treatments. These findings indicate that modulating the biochemical composition of rotifers through microalgal enrichment can improve the physiological condition of larvae and enhance larviculture efficiency (2).

Sequential feeding of pangasius larvae with *Brachionus angularis* during the first three days, followed by *Moina micrura* during the subsequent rearing period, improved growth and survival compared with the use of a single live-feed species. The identification of an optimal rotifer density of 5-7 individuals mL^{-1} indicates that zooplankton availability should be adjusted according to larval mouth gape and developmental stage (3).

A rotifer density below 1 individual mL^{-1} constrained the development of Brazilian sardine larvae; at 0,1 individual mL^{-1}, survival declined to approximately 20%, while growth was reduced by more than 20%. The economically and biologically optimal density range was estimated at 2,66-5,79 individuals mL^{-1}, indicating that excessively high live-feed densities provide no additional growth benefit (4).

When rotifers enriched with 800 mg mL^{-1} taurine were used as live feed, the growth and survival of *Larimichthys polyactis* larvae increased significantly compared with those of the control group. The elevated taurine content in the larval tissues demonstrated that enriching zooplankton biomass with functional amino acids can enhance the biological value of live feed (5).

Pacific cod larvae fed DHA-enriched *Artemia* biomass exhibited the highest values for body length, body weight, and survival. The optimal DHA level in larval diets was determined to be 4,85-8,50% of total fatty acids, supporting the need to standardize the lipid profile of live feeds (6).

Combined enrichment of *Artemia* with organic selenium and highly unsaturated fatty acids increased the final body weight, specific growth rate, and survival of barramundi larvae. The reduced incidence of skeletal deformities in the enriched treatments indicated that the micronutrient and lipid composition of live-feed biomass also plays an important role in the normal morphological development of fish larvae (7).

Artemia enriched with 300 mg L^{-1} n-3 highly unsaturated fatty acids (HUFA) increased the final body weight and specific growth rate of Asian sea bass larvae reared at 34 °C. The enrichment also improved survival and stress resistance while reducing skeletal abnormalities, indicating that nutritional modification of zooplankton biomass can partially mitigate the adverse effects of elevated water temperature (8).

The use of nutritionally enriched *Brachionus calyciflorus* as a first feed improved the growth, survival, digestive activity, and whole-body fatty acid composition of *Anabas testudineus* larvae. The study demonstrated that culturing and enriching freshwater rotifers under controlled biotechnological conditions represents an effective alternative to conventional first-feeding practices (9).

The use of *Daphnia* biomass cultured under controlled conditions can enhance the natural food base available to fish, reduce formulated feed consumption, and improve overall fish production performance (10)

Providing natural live feed during the early developmental stages is a key factor in achieving high growth performance and survival in fish larvae. In particular, zooplankton composed of rotifers and cladocerans more fully satisfies the physiological nutritional requirements of carp larvae, thereby significantly enhancing their growth and survival. Therefore, increasing zooplankton biomass in natural water bodies through biotechnological methods and ensuring its effective application in aquaculture represent an important scientific and practical priority.

Materials and Methods

In this study, we investigated the effects of zooplankton biomass cultured using 30% UT *Chlorella vulgaris* and organic fertilizers on the production performance of carp larvae and fry. Two critical developmental stages were selected for the experiments: 5-30 and 30-80 days post-hatch. All experiments were conducted in earthen ponds.

The ponds provide favorable conditions for the intensive development of natural food organisms, particularly phytoplankton and zooplankton. The principal biotechnological characteristics of the ponds used in the experiments are presented in Table 1.

The experiment involving 5-30-day-old carp larvae was conducted in ponds with a surface area of 100 m^2. Each pond was stocked with 5000 carp larvae, corresponding

to a stocking density of 50 individuals m^{-2}. This density is considered appropriate for semi-intensive pond culture, as it enables efficient utilization of zooplankton biomass while preventing excessive competition for food among the larvae. The 25-day duration of the initial experiment encompassed the critical developmental period during which carp larvae actively utilize natural food resources. Sampling at 5- and 10-day intervals, respectively, enabled the dynamics of zooplankton biomass and fish growth to be assessed with sufficient scientific and practical accuracy. In addition, conducting the experiments from June to August ensured favorable water temperatures for the rapid development of both carp larvae and zooplankton.

At the "Askar Ota Omad" LLC fish farm, 5-30-day-old carp fry are conventionally reared in specially designed earthen ponds. Their diet consists primarily of wheat flour and wheat bran. In addition, a cattle-manure infusion is introduced into the ponds to stimulate the proliferation of dominant zooplankton and bacterial populations naturally occurring in Lake Zamonbobo water, thereby enhancing the natural food supply available to the fish.

Results and Discussion

In our experiments, the amount of conventional feed used on the farm for feeding 5-30-day-old carp fry was reduced by 50% and partially replaced with biotechnologically cultured zooplankton biomass. For this purpose, biomass of *Brachionus calyciflorus* and *Moina micrura*, cultured separately using 30% UT *Chlorella vulgaris* and organic fertilizer, was used. The cultured live zooplankton biomass was introduced into the pond stocked with 5-30-day-old carp fry. Throughout the experiment, fish growth rate, production performance, and survival were evaluated in comparison with those obtained using the conventional carp-fry rearing method (Figure 1).

According to the experimental results presented in Figure 1, the mean body weight of 10-day-old carp fry was 0,73 g in the control group and 0,89 g in the experimental group. During the first five days, body-weight gain reached 0,47 g in the control group and 0,63 g in the experimental group, indicating that growth in the experimental group was 34% greater than that recorded in the control group. This result may be attributed to the suitability of *Brachionus calyciflorus* biomass for the mouth gape of carp fry, which facilitated efficient feed ingestion and utilization. At 15 days of age, the mean body weight was 1,48 g in the control group and 1,76 g in the experimental group, while the corresponding weight gains were 0,75 and 0,87 g, respectively. At 20 days of age, the mean body weights of the control and experimental groups were 2,53 and 2,94 g, respectively, with corresponding weight gains of 1,05 and 1,18 g.

At 25 days of age, the mean body weight of the fry reached 3,79 g in the control group and 4,31 g in the experimental group, while the corresponding weight gains were 1,26 and 1,37 g, respectively. The higher growth performance observed in the experimental group may be attributed to the efficient assimilation of the high protein and fatty acid contents of the zooplankton biomass by the fry. At the end of the initial experiment, the mean body weight of 30-day-old carp fry was 5,71 g in the control group and 6,43 g in the experimental group. Thus, the experimental treatment resulted in a 12,6% higher mean body weight than that observed in the control group. Feeding 5-30-day-old carp fry with biotechnologically cultured biomass of *Brachionus calyciflorus* and *Moina micrura* was found to significantly enhance the biological effectiveness of natural live feed during the early developmental stage.

In aquaculture practice, the survival of fry during the early developmental stages is directly dependent on the quality and availability of the natural food base. To comprehensively evaluate the biological efficacy of biotechnologically cultured *Brachionus calyciflorus* and *Moina micrura* biomass, the survival rate of 5-30-day-old carp fry was determined at the end of the experiment. The results are presented in Figure 2.

According to the results presented in Figure 2, the survival rate of 5-30-day-old carp fry was 53,8% in the control group and 74,6% in the experimental group receiving biotechnologically produced live feed. Thus, feeding the fry with biotechnologically cultured zooplankton biomass increased survival by 20,8 percentage points, corresponding to a survival rate 1,38 times that of the control group.

The higher survival rate observed in the experimental group may be attributed to the high nutritional value of *Brachionus calyciflorus* and *Moina micrura* biomass. The proteins, essential amino acids, and unsaturated fatty acids contained in these zooplankton species support immune-system development in fish fry and enhance their resistance to various stressors (11).

Table.1 Biotechnological parameters of zooplankton culture in ponds

No.	Parameters	Carp larvae
		5-30 days
1	Type of culture pond	Earthen pond
2	Pond area (m^2)	100
3	Number of larvae stocked (individuals)	5000
4	Sampling interval (days)	5
3	Water source	Lake
4	Experimental period	2 June 2025–27 June 2025
5	Experimental duration (days)	25

Figure.1 Growth performance of 5-30-day-old carp fry

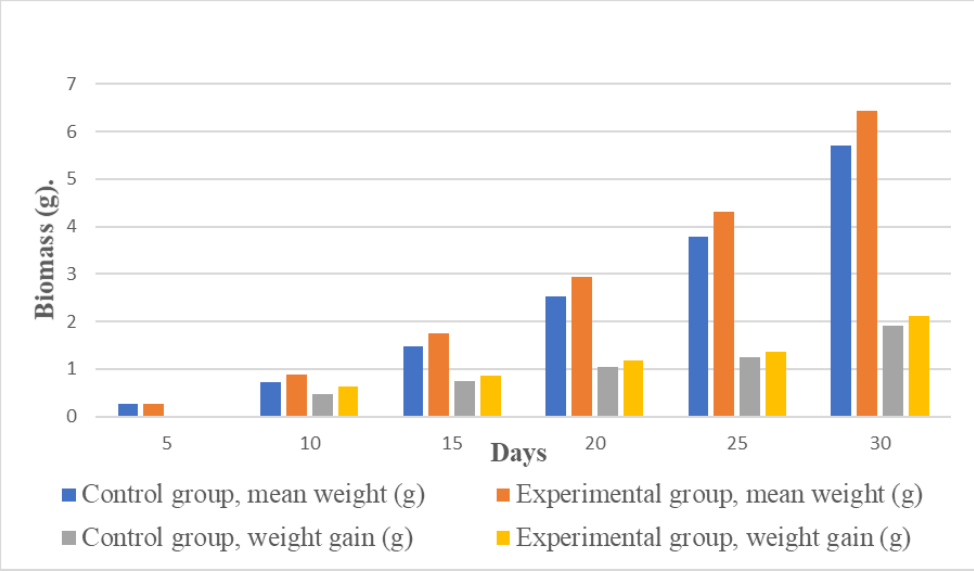
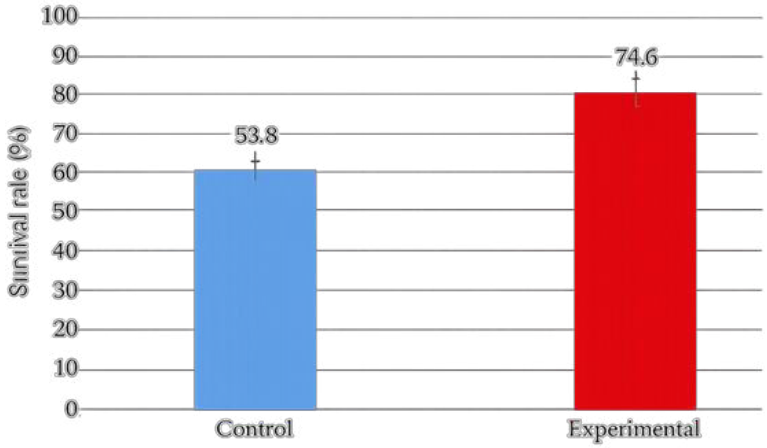


Figure.2 Survival rate of 5-30-day-old carp fry



Consequently, the natural mortality of the fry during the early developmental stage was reduced. In the control group, however, the limited quantity and quality of the natural food base relatively slowed fry growth and resulted in the mortality of weaker individuals; therefore, the survival rate was lower than that observed in the experimental group.

In conclusion, the practical efficacy of zooplankton biomass cultured in biological ponds was demonstrated through feeding trials involving carp larvae and fry. In the rearing of 5-30-day-old carp larvae, the amount of conventional wheat flour- and wheat bran-based feed used on the farm was reduced by 50% and replaced with biotechnologically cultured biomass of *Brachionus calyciflorus* and *Moina micrura*.

As a result, the mean live body weight of the fish increased by 12,6% relative to the control group, while the survival rate increased from 53,8% to 74,6%.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Author contributions

G. A. Okilova: Conceived the original idea and designed the model and wrote the manuscript. Conceptualization, Methodology, Investigation, Resources, Writing - Original Draft Preparation, Supervision. S. B. Buriyev: Designed the model and the computational framework and analysed the data. Methodology, Software, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing - Original Draft Preparation, Writing - Review & Editing, Visualization. F. Q. Shodmonov: Designed the model and the computational framework and analysed the data Software, Validation, Formal Analysis, Investigation, Writing - Review & Editing. O. I. Radjabov: Conceived the original idea and designed the model and wrote the manuscript. Conceptualization, Methodology, Investigation, Resources, Writing - Original Draft Preparation, Supervision.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

References

1. Ghaderpour S., Estevez A. (2020). Effect of short-term rotifer enrichment with marine phospholipids on growth, survival, and composition of meager (*Argyrosomus regius*) larvae. *Frontiers in Marine Science, 7*, Article 579002. https://doi.org/10.3389/fmars.2020.579002
2. Yanes-Roca C., Holzer A., Mraz J., Vesely L., Malinovskyi O., Policar T. (2020). Improvements on live feed enrichments for pikeperch (*Sander lucioperca*) larval culture. *Animals, 10*(3), Article 401. https://doi.org/10.3390/ani10030401
3. Vu N.U., Pham T.H., Huynh P.V., Huynh T.G. (2021). Importance of the freshwater rotifer *Brachionus angularis* for improved survival rate of early life-history stages of pangasius catfish, Pangasianodon hypophthalmus. Aquaculture Research, 52, 783–792. https://doi.org/10.1111/are.14934
4. Sterzelecki F.C., Cipriano F.S., Vasconcelos V.R., Sugai J.K., Mattos J.J., Derner R.B., Magnotti C.F., Lopes R.G., Cerqueira V.R. (2021). Minimum rotifer density for best growth, survival and nutritional status of Brazilian sardine larvae, Sardinella brasiliensis. Aquaculture, 534, Article 736264. https://doi.org/10.1016/j.aquaculture.2020.736264
5. Cho J.H., Kim J.H., Park J.W. (2022). A preliminary study on the effects of taurine-enriched rotifers on the growth and survival of the small yellow croaker *Larimichthys polyactis* larvae. Animals, 12(11), Article 1403. https://doi.org/10.3390/ani12111403
6. Choi J., Han G.S., Byun S.G., Oh H.Y., Lee T.H., Lee D.Y., Lee C.H., Kim H.S. (2022). Effects of dietary docosahexaenoic acid enrichment in *Artemia* feed on the growth, survival, and fatty acid composition of Pacific cod (*Gadus macrocephalus*) larvae. Aquaculture Research, 53(12), 4353–4362. https://doi.org/10.1111/are.15934
7. Pham H.D., Le M.H., Dinh K.V., Siddik M.A.B., Hoang D.H., Ngo M.V. (2022). Effects of enrichment *Artemia* with organic selenium and essential fatty acids on growth performance and fatty acid composition of barramundi (*Lates calcarifer*)

larvae. Regional Studies in Marine Science, 55, Article 102595. https://doi.org/10.1016/j.rsma.2022.102595

8. Pham H.D., Siddik M.A.B., Rahman M.A., Huynh L.T., Nahar A., Vatsos I.N. (2023). Effects of n-3 HUFA-enriched *Artemia* on growth, biochemical response, skeletal morphology and stress resistance of Asian sea bass (*Lates calcarifer*) larvae reared at high temperature. Aquaculture, 574, Article 739732. https://doi.org/10.1016/j.aquaculture.2023.739732
9. Singh P.K., Munilkumar S., Sundaray J.K., Santhanam P., Sharma A., Haque R., Chandan N.K. (2024). Evaluation of enriched freshwater rotifer, *Brachionus calyciflorus*, as first feed on growth performance, nutrient availability and fatty acid composition of Anabas testudineus (Bloch, 1792) larvae. Animal Feed Science and Technology, 309, Article 115901. https://doi.org/10.1016/j.anifeedsci.2024.115901
10. Abdinazarov X.X., Kuchboev A.E., Madumarov M.J. (2020). Dafniyalar baliqlarning tabiiy ozuqa manbai (Daphnia as a natural food source for fish). Xorazm Ma'mun akademiyasi axborotnomasi (Bulletin of the Khorezm Mamun Academy), 2/1(58), 4–6. https://mamun.uz/uploads/journal/files/2020-2-1.pdf
11. Raximov J.R., Rajabov O., Bo'riyev S.B. (2025). Makrofit va zooplanktonlar asosidagi "fitozooprotein" baliq ozuqasining kimyoviy tarkibini o'rganish (Study of the chemical composition of "phytozooprotein" fish feed based on macrophytes and zooplankton). Xorazm Ma'mun akademiyasi axborotnomasi (Bulletin of the Khorezm Mamun Academy), 5(1), 187–191.

How to cite this article:

Okilova G. A., Buriyev S. B., Shodmonov F. Q. and Radjabov O. I. 2026. Effects of Biotechnologically Cultured Zooplankton Biomass on the Growth and Survival of Carp Larvae and Juveniles. *Int.J.Curr.Microbiol.App.Sci.* 15(1): 288-293. **doi:** https://doi.org/10.20546/ijcmas.2026.1501.035