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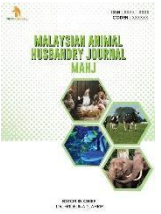

RESEARCH ARTICLE

EFFECT OF INITIAL FEEDING ON COMMON CARP (*CYPRINUS CARPIO*) GROWTH AND SURVIVABILITY

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ABSTRACT

The impact of initial feeding on the growth and survivability of common carp (*Cyprinus carpio*) was assessed using 15 cages, each with a volume of 1 m^3, at the Fisheries Human Resource Development and Technology Validation Center in Janakpurdham, Dhanusha, over a period of 90 days. The experiment utilized a Completely Randomized Design (CRD) with five treatments (control, soybean meal, egg yolk powder, buffalo liver powder, and fish meal powder), each replicated three times. The treatments were administered at 25%, 20%, 15%, and 10% of body weight during the first, second, third, and fourth weeks, respectively, followed by 10% and 5% in the subsequent second and third months. Results during the treatment phase indicated a significant difference in the number of fish harvested across various treatments. Survival rates were significantly higher ($P<0.05$) in fish fed fish meal powder (59.3 ± 0.9^{a}%) and egg yolk powder (57.6 ± 3.1^{a}%) compared to the control treatment, which had a survivability of 42.7 ± 4.3^{d}%. In the post-treatment phase, fish fed with fish meal powder and buffalo liver powder exhibited significantly higher survival rates of 88.0 ± 1.2^{a}% and 88.0 ± 2.0^{a}%, respectively, compared to the control treatment, which had a survivability of 72.0 ± 2.0^{b}%. The highest mean harvest weight was observed in buffalo liver powder during the treatment phase (523.3 ± 8.8^{a} mg) and post-treatment phase (4068.9 ± 2.8^{a}), showing no significant difference from fish meal powder but significantly higher than other treatments ($p<0.05$). A significant difference ($p<0.05$) in specific growth rate and daily weight gain was observed across different treatments during both the treatment and post-treatment phases. This study shows that buffalo liver powder as an initial feed enhances growth performance and survivability in common carp hatchlings. Further research is needed to assess the impact of buffalo liver powder in starter diets.

KEYWORDS

Cyprinus carpio, soybean meal, egg yolk powder, buffalo liver powder, fish meal powder.

1. INTRODUCTION

Aquaculture, referring to the cultivation of aquatic organisms, significantly contributes to the production of sustainable protein sources on a global scale (Boyd et al., 2022). Aquaculture represents one of the fastest-growing sectors in food production, driven by the rising demand and human consumption (Tacon, 2020). In 2018, aquaculture represented approximately half of the 179 million tons of global fish production, supplying 52% of the current fish dietary needs for human consumption (Action, 2020). Carps constitute more than 45% of the total aquaculture production among cultured species (Miao and Wang, 2020). The common carp (*Cyprinus carpio*) is the most extensively cultured freshwater fish and holds significant economic value, accounting for 8% of global fish production (FAO, 2018). This species is recognized as a viable candidate for profitable aquaculture globally, attributed to its significant popularity and adaptability in various environments and nutritional conditions (Ahmed et al. 2019; Yue, 2025). This species is widely cultivated throughout Asia and Europe, playing a crucial role in inland fish production through aquaculture in ponds, dams, reservoirs, lakes, and streams in various regions (Javed and Abbas, 2018; Marković and Poleksić, 2024). The economic value of this species has been enhanced due to growth increments, high meat yield, nonselective habitat utilization, palatable meat, and the feasibility of production in aquaculture settings. The common carp was introduced to Nepal in 1956 and 1957, originating from India and Israel, respectively. The common carp is extensively and semi-intensively cultivated in Nepal due to its inherent capacity to reproduce in confined water bodies without requiring special efforts (Little et al., 2010).

Common carp is a bottom feeder, omnivorous, and feeds on insect larvae, worms, mollusks, and detritus, fresh and decayed vegetation, and accepts formulated feed also (Füllner, 2015). In the initial days post-hatching, common carp hatchlings depend on their Egg Yolk for nourishment before transitioning to a diet comprising zooplankton, phytoplankton, small crustaceans, and insect larvae, as their digestive system remains underdeveloped. Artificial feeding in aquaculture is essential; however, it constitutes 40-50% of the production cost (Zhou, 2018). It facilitates accelerated growth, permits increased stocking density, reduces cultivation durations, and enhances the survival rates of fish seed. The management of fry, particularly in relation to their nutrition, is essential for optimal seed development. Nonetheless, the lack of availability and

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affordability of suitable fish feed has considerably impacted the advancement of aquaculture (Munguti et al., 2024). This study aims to assess the viability of alternative starter diets derived from local sources for managing common carp fry, given that soybean meal, a primary starter diet in Nepal, is expensive to import. Feed inputs for aquaculture production comprise 40–75% of the total production costs and serve as a significant market driver for aquaculture production (FAO, 2018). Aquaculture accounts for 63% and 81% of the global supply of fishmeal and fish oil, respectively (Boyd, 2022). The deficiency of balanced animal protein in fish feed presents a prospective constraint in the aquaculture sector.

Several regions of Nepal have experienced elevated mortality rates in fish farms during the common carp hatchlings and fry stage, caused by insufficient nutrition and management practices. This leads to a deficiency of common carp seed (Yadav et al., 2023). The documentation of growth performance and survival rates of hatchlings and fry of common carp in the fish farms of our country is inadequate. Factors such as infection and the unavailability of a suitable diet contribute to the poor survival rates of fish larvae (Hamre et al., 2013). Various protein sources, including egg yolk powder, fine soybean meal powder, fine fish meal powder, and fine buffalo liver powder, may be optimal for cost-effective feed formulation.

Inadequate nursery management, characterized by substandard feed and insufficient protection, resulted in diminished survivability and growth of common carp, ultimately leading to decreased production performance and increased susceptibility to disease. The feeding system and nursery management techniques must be modified to enhance the availability of high-quality and sufficient feed. Consequently, fish farming can no longer experience a deficiency in fish seed. The substitution of expensive ingredients with more economical protein sources, whether of plant or animal origin, is essential. The study was conducted to assess the production performance of various locally available feeds, with the expectation that these treatments would result in significant differences in growth parameters and survivability of common carp during the nursing phase. The study hypothesized that the implementation of various treatments influences the growth and survivability of common carp.

2. Materials and Methods

2.1 Study area and experimental details

The experiment was conducted in the Cage system of the Nursery pond at the Fisheries Human Resource Development and Technology Validation Centre in Janakpurdham, Dhanusha, from 10 March 2023 to 6 June 2023, spanning 95 days. The location is situated 4 km southeast of Ramanand Chowk in Janakpurdham, at an elevation of 79 m above sea level, near Janakpurdham Airport. The geographical coordinates are 26°43'05" N and 85°54'23" E. Research was carried out in 15 cages, each of $1m^3$ using a Completely Randomized Design (CRD) with 3 replications and 5 treatments. Four distinct types of feeds used as different treatments are shown in Table 1.

Table 1: Different treatments used in the experiment

Treatments	Feed
T_1	Control
T_2	Soybean Meal
T_3	Egg Yolk Powder
T_4	Buffalo Liver Powder
T_5	Fish Meal

2.2 Preparation of feed ingredients

Egg, buffalo liver, soybean, and fish meal were purchased from the nearby market. To prepare the yolk powder, the egg was boiled, and the white albumen was removed. Only the yolks were crushed into fine powder. For buffalo liver powder, the buffalo liver was canned and dried in a hot air oven and ground into a fine powder. Similarly, soybean was roasted to remove their anti-nutritional factors. After cooling at room temperature, the soybean seeds were ground in a mixer. Then, it was sieved with a mesh of 0.1mm. All the feed ingredients were weighed by an electric compact scale (Kerro series P3 BL5002 Max-500g, D=0.01g) and mixed based on treatment details (Paulk et al., 2022).

2.3 Experimental setup

The concrete nursery pond (5 x 5 x 1.5 m^3) was desiccated for one day, disinfected with lime based on the soil's pH, and filled to a depth of 1 m. The nylon hapa (1x1x1 m^3) was sterilised and installed in the nursery pond using bamboo and an appropriate sinker. The hatchlings were initially moved to nylon hapa at a density of 1000 hatchlings per hapa. The experimental meals were administered for four weeks, four times daily, and were allocated weekly as illustrated in Figure 1.

After four weeks, a random sampling of fry was conducted from each cage, with 50 fry of common carp selected and transferred to a cage measuring 1 x 1 x 1 m^3. They were reared on a standard diet, fed twice daily, with the initial feeding amount set at ten % of the average body weight for the first month, subsequently reduced to 5% of body weight from the following month onwards.

2.4 Practices during the study

2.4.1 Feeding

- Zhou et al. (2003) recommended maintaining a feeding frequency of four times daily (7 AM, 10 AM, 1 PM, 4 PM) for 28 days, after which it should be reduced to twice daily for 60 days (Table 2).

Table 2: Feeding type and feeding rate

Days (after stocking)	Feed type	Feeding rate (% BW)
1-7	Experimental feed	25%
8-14	Experimental feed	20%
15-21	Experimental feed	15%
21-28	Experimental feed	10%
29 onwards to 60 days	Normal feed (32% CP pellet) for 1 month	10%
60 days onwards up to 90 days	Normal feed (32% CP pellet) for 1 month	5%

2.4.2 Cleaning and exchange of water

Algae was periodically removed from the hapa. The cage was sanitized during the weekly growth assessment and feed modification. Underground water was extracted into the pond to sustain a depth of 1.5 meters and regulate pond dynamics (Montemezzani, 2017).

2.4.3 Harvesting

The final harvest of common carp fry was conducted after 90 days in the research cage. The fish were extracted using a scooping net. The weight of each fish in the cages was measured using an electronic compact scale (Mohale et al., 2020).

2.5 Data collection protocol

During the treatment period, hatchlings were sampled weekly from each cage using a scooping net, while in the post-treatment phase, fry were sampled biweekly with the same net. The growth performance was evaluated. and growth parameters such as weight (g) measured using an electronic compact scale (Kerro Series P3 BL5002 Max-500g, D=0.01g).

2.6 Water quality parameters

The fundamental factor for growth and disease prevention is superior water quality. Dissolved oxygen (DO), pH, and temperature were measured every day for a duration of 28 days. During the post-treatment period, water quality parameters were assessed weekly using the devices (Table 3).

Table 3: Frequency of water quality parameters measured and instrument used

Parameters	Measured Unit	Instrument Used	Frequency
Temperature	℃	Lutran pH 222	Daily
DO	mg/L	Lutran DO 5519	Daily
pH		Lutran pH 222	Daily

2.7 Growth parameters

Growth analysis was conducted weekly throughout the treatment phase and biweekly during the post-treatment phase. The daily weight gain (DWG), specific growth rate (SGR), and survival rate of fish subjected to various diets over distinct durations were computed using the given formulas.

$$\text{Daily Weight gain (g/day)} = \frac{\text{Mean final weight(g) - Mean initial weight(g)}}{\text{Culture period(days)}}$$

$$\text{Specific growth rate (\%/day)} = \frac{\ln(\text{final weight}) - \ln(\text{initial weight})}{\text{Culture period}} \times 100$$

$$\text{Survival rate (\%)} = \frac{\text{Final harvest number}}{\text{Initial stocking humber}} \times 100$$

2.8 Statistical analysis

A complete randomized design was used to conduct the experiment (CRD). SPSS and MS-Excel were used for data analysis (V 21.0). Using one-way ANOVA, the effects of various feed types on masculinization, survival, daily weight gain (DWG), and specific growth rate (SGR) following treatment were examined independently (SPSS). Mean comparisons were carried out by DMRT for significant differences. Means were expressed as mean±SE for all parameters except %age data (masculinization and survival rate), which are expressed as mean±SD. The accepted level of significance was $p<0.05$.

3. Results

3.1 Proximate analysis

- The proximate analysis of ingredients was conducted to ensure the feed is iso-nitrogenous and iso-caloric. For proximate analysis, each item was weighed at 250g, placed in sealed plastic bags, and labelled accordingly (Table 4). The samples were dispatched to the National Animal Feed and Livestock Quality Management Laboratory, Harihar Bhawan, Lalitpur. The proximate composition of the dietary ingredients, silkworm pupae protein, and others was analysed following the AOAC (1990) protocol and the Kjeldahl and near infrared spectroscopy (NIRS) methods at the National Animal Feed and Livestock Quality Management Laboratory in Hariharbhawan, Lalitpur.

Table 4: Proximate analysis of different ingredients used in the study

S.N.	Ingredients	Crude protein (CP%)	Crude fiber (CF%)	Moisture%	Fat%
1	Egg Yolk Powder	36.36		1.91	54.41
2	Buffalo Liver Powder	61.25	0.75	15	17
3	Fish Meal	67.45	6.60	1.89	14.68
4	Soybean Meal	35.41	6.58	1.88	14.59

Source: (National Animal Feed and Livestock Quality Management Laboratory, Hariharbhawan, Lalitpur, 2023.)

3.2 Growth parameter

3.2.1 Growth parameters during treatment phase

Table 5 presents the stocking weight (MSW), mean harvest weight (MHW), mean weight gain (MWG), survivability rate (SR), daily weight gain (DWG), and specific growth rate (SGR) for five different treatments. The growth parameters of common carp hatchlings fed various feed types over 28 days during the treatment phase are presented in Table 5. No significant differences were observed in mean initial stocking weight (mg/fish) and initial stocking number (1000 ± 0^{a}) between treatments ($p>0.05$). The mean final weight of fish at the end of the treatment phase was highest in the Buffalo liver powder group (523.3 ± 8.8^{a} mg), significantly differing from fish meal (460.0 ± 11.5^{b} mg), Egg Yolk powder (393.3 ± 8.8^{c} mg), soybean meal (313.3 ± 6.7^{d} mg), and control (210.0 ± 11.5^{e} mg) at ($P<0.05$). Egg Yolk powder and fish meal powder differed significantly from buffalo liver powder, which also significantly differed from soybean meal, control ($p<0.05$). However, soybean meal, control, did not differ significantly from each other ($p>0.05$) regarding the final harvest number. A significant difference ($p<0.05$) in specific growth rate (SGR) was observed across treatments. The highest SGR was observed in buffalo liver powder (10.34 ± 0.1^{a} %/day), which was significantly different from fish meal powder (9.74 ± 0.1^{b} %/day), Egg Yolk powder (9.24 ± 0.1^{c} %/day), soybean meal (8.44 ± 0.1^{d} %/day), and control (6.94 ± 0.2^{e} %/day).

Likewise, highest daily weight gain (DWG) was observed in buffalo liver powder (17.7 ± 0.3^{a} mg/day) which was significantly different with different treatments fish meal powder (15.4 ± 0.4^{b} mg/day), Egg Yolk powder (13.0 ± 0.3^{c} mg/day), soybean meal (10.1 ± 0.3^{d} mg/day) and control (6.4 ± 0.4^{e} mg/day) at ($p<0.05$). Survival rates were significantly higher ($P<0.05$) in fish fed fish meal powder (59.3 ± 0.9^{a} %) and egg yolk powder (57.6 ± 3.1^{a} %), followed by buffalo liver powder (49.3 ± 1.5^{b} %) and soybean meal (46.1 ± 1.0^{c} %). The control treatment exhibited the lowest survival rate at 42.7 ± 4.3^{d} %.

Table 5: Average growth parameter of fish during the treatment phase of 28 days

Parameters	Treatment				
	Control	Soybean Meal	Egg Yolk Powder	Buffalo Liver Powder	Fish Meal
Initial stocking number	1000 ± 0^{a}	1000 ± 0^{a}	1000 ± 0^{a}	1000 ± 0^{a}	1000 ± 0^{a}
Initial stocking weight (mg)	30.3 ± 0.2^{a}	29.8 ± 0.4^{ab}	30.2 ± 0.2^{a}	29.7 ± 0.5^{ab}	30.1 ± 0.1^{a}
Final harvest number	447 ± 24^{c}	461 ± 6^{c}	576 ± 18^{a}	493 ± 9^{b}	593 ± 5^{a}
Final Harvest weight (mg)	210.0 ± 11.5^{e}	313.3 ± 6.7^{d}	393.3 ± 8.8^{c}	523.3 ± 8.8^{a}	460.0 ± 11.5^{b}
DWG (mg/fish/day)	6.4 ± 0.4^{e}	10.1 ± 0.3^{d}	13.0 ± 0.3^{c}	17.7 ± 0.3^{a}	15.4 ± 0.4^{b}
SGR (%/day)	6.94 ± 0.2^{e}	8.44 ± 0.1^{d}	9.24 ± 0.1^{c}	10.34 ± 0.1^{a}	9.74 ± 0.1^{b}
Survival (%)	42.7 ± 4.3^{d}	46.1 ± 1.0^{c}	57.6 ± 3.1^{a}	49.3 ± 1.5^{b}	59.3 ± 0.9^{a}

(Mean values with similar superscripts in column are not significantly different, $p<0.05$)

3.2.2 Growth parameters during post treatment phase

The growth parameters of common carp fries fed a normal diet (32% CP pellet) for 60 days during the post-treatment phase are presented in Table 6. Initial stocking numbers (50 ± 0^{a}) did not differ significantly between treatments; however, mean initial stocking weights (mg) were significantly different ($p<0.05$).

The highest initial stocking weight was observed in buffalo liver powder (526.7 ± 16.7^{a} mg), followed by fish meal powder (463.3 ± 8.8^{b} mg), Egg Yolk powder (396.7 ± 12.0^{c} mg), soybean meal (320 ± 5.8^{d} mg), and control (214.0 ± 12.5^{e} mg). At the conclusion of the post-treatment phase, the mean final weight of fish was highest in buffalo liver powder (4068.9 ± 2.8^{a} mg), not significantly different from fish meal powder (3814.7 ± 10.1^{a} mg). However, significant differences were noted with Egg Yolk powder (2527.3 ± 16.3^{b} mg), soybean meal (2443.2 ± 75.7^{b} mg), and the lowest final harvest occurred in the control group (2120.0 ± 16.5^{c} mg) at ($P<0.05$).

Likewise, buffalo liver powder (44 ± 1.0^{a}) and fish meal powder (44 ± 1.0^{a}) were not significantly different with each other but significantly different with Egg Yolk powder (41 ± 1.0^{b}), soybean meal (41 ± 1.0^{b}), control (36 ± 1.0^{c}) in case of final harvest number whereas Egg Yolk powder and soybean meal were not significantly different with each other but significant different was observed with control at ($p<0.05$)in case of final harvest number. The highest daily weight gain (DWG) was recorded in buffalo liver powder (37.3 ± 2.9^{a} mg/day),

which was not significantly different from fish meal powder (35.3±0.2[a] mg/day) but significantly different from Egg Yolk powder (2527.3±16.3[b] mg/day), soybean meal (22.4±0.8[b] mg/day), and control (20.1±0.1[b] mg/day) at ($p<0.05$). Survival rates were significantly higher ($P<0.05$) in fish fed fish meal powder (88.0±1.2[a]%) and buffalo liver powder (88.0±2.0[a] %), followed by those fed egg yolk powder (82.7±2.4[ab] %) and soybean meal (82.7±2.4[ab] %). The control treatment showed the lowest survival rate at 72.0±2.0[b] %.

Table 6: Growth parameters observed on post treatment phase

Parameters	Treatments				
	Control	Soybean Meal	Egg Yolk Powder	Buffalo Liver Powder	Fish Meal
Initial stocking number	50±0.01	50±0.01	50±0.01	50±0.01	50±0.01
Initial stocking weight (mg)	214.0±12.5[e]	320±5.8[d]	396.7±12.0[c]	526.7±16.7[a]	463.3±8.8[b]
Final harvest number	36±1[c]	41±1[b]	41±1[b]	44±1[a]	44±1[a]
Final Harvest weight (mg)	2120.0±16.5[c]	2443.2±75.7[b]	2527.3±16.3[b]	4068.9±2.8[a]	3814.7±10.1[a]
DWG (mg/fish/day)	20.1±0.1[b]	22.4±0.8[b]	22.4±0.3[b]	37.3±2.9[a]	35.3±0.2[a]
Survival (%)	72.0±2.0[b]	82.7±2.4[ab]	82.7±2.4[ab]	88.0±2.0[a]	88.0±1.2[a]

(Mean values with similar superscripts in column are not significantly different, $p<0.05$)

4.2.3 Water quality parameters

4.2.3.1 Treatment phase

Trend of dissolved oxygen, water pH and Water temperature observed during the research period as per the above graph. At the beginning, the temperature was normal, as it was the spring season, and later rose as the seasonal temperature increased during the treatment phase. Dissolved oxygen and pH value were almost in the optimal range throughout the research period without any random fluctuation. All the recorded water quality parameters were in a desirable range as stated by (Schram et al., 2012).

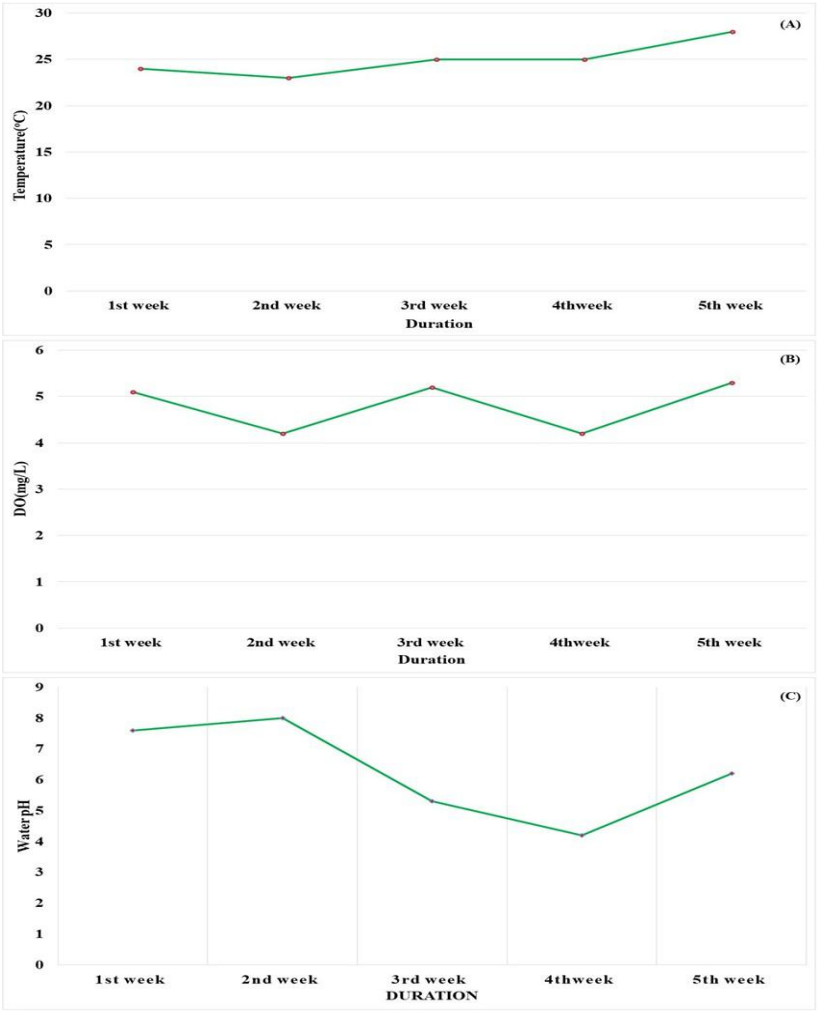

Figure 1 : Weekly Trend of water temperature (A), water dissolved oxygen (B), and water pH (C) during treatment phase of research

4.2.3.2 Post treatment phase

Trend of dissolved oxygen, water pH and Water temperature observed during the research period as per the above graph. At the beginning of post treatment phase temperature was higher than normal as it was summer season. Dissolved oxygen and pH value was almost in the optimal range throughout the research period sometimes it showed random fluctuation.

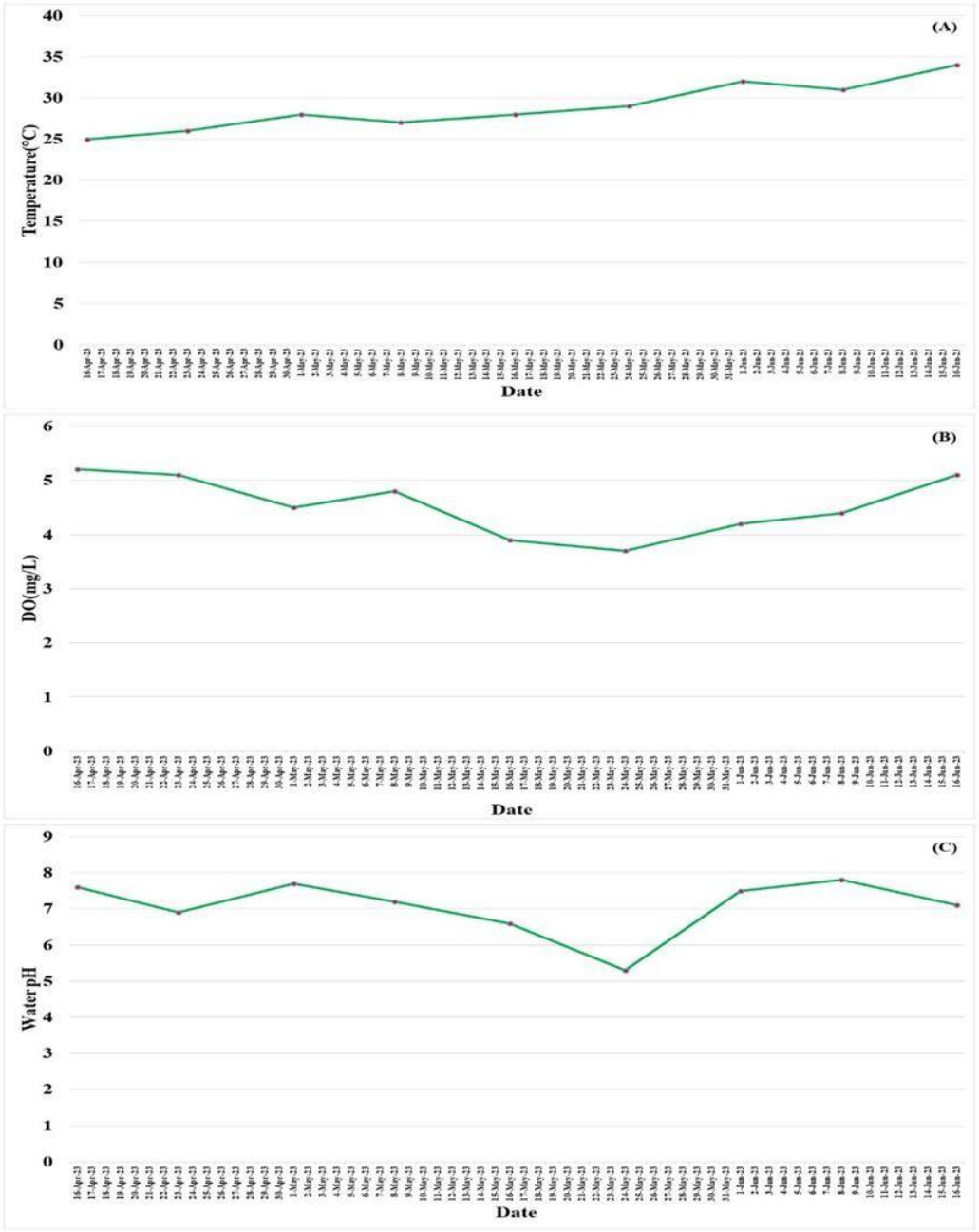

Figure 2 : Weekly Trend of water temperature (A), water dissolved oxygen (B), and water pH (C) during post treatment phase of the research

4. DISCUSSION

Fishes are monogastric animals. Being mono-gastric in nature, their preference and acceptance of feed are very important. Pond aquaculture contributes 86.6% to aquaculture production; carp species are the major fish, which occupy over 95% of total fish production in Nepal (Bhujel et al., 2025; Jha, 2019). Common carp is the main fish species that contributes to total fish production in the country after Mrigal (29.2%), and it contributes 19.2% to total fish production in the country (Jena and Das, 2022). Hatchling management, especially hatchling nutrition, is crucial for seed availability with quantity and quality (Migaud et al., 2013). Laboratory rearing of cyprinid fish larvae for genetic or nutritional experiments is generally carried out with living food (zooplankton from ponds, *Artemia nauplii*). As it is not always possible to find zooplankton of suitable quality and/or quantity, and as the price of brine-shrimp cysts is rapidly increasing, a great deal of effort has been made to develop non-living starter food (Jobling et al., 2012; Ahmad et al., 2022). Although in the last 5-10 years, experimental starter feeds have been developed, alternate diets seem to be necessary in rearing cyprinid larvae (Melaku et al., 2024; Rahmdel and Falahatkar, 2021). In Nepal, there was a shortage of common carp seed. Fry management, especially fry nutrition, is crucial to high seed development. This research mainly focused on the starter diet that helps to improve the performance in growth and survivability of common carp hatchlings. In the present study, the mean final weight of hatchlings during treatment and post treatment hatchlings fed with buffalo liver showed the highest mean final weight similar result was observed as buffalo liver has proved to be a good source of digestible protein for the early stage of fries by (Prasad and Giri, 2017).

Results showed that fish total harvest weight and total harvest number both were found to be highest in fish fed with buffalo liver powder compared with fish fed with soyabean meal, Egg yolk powder, and fish meal as diet. This is similar with finding of Wahyudi et al. (2023), where fish fed with buffalo liver powder has higher mean harvest weight gain compared with no inclusion of buffalo liver powder. Among different treatments of starter diets, higher survivability was in buffalo liver powder and fish meal powder, whereas control showed the least survivability and growth performance. This study reported that using buffalo liver as an alternative protein source for the diet of cyprinid hatchlings showed the best survivability, but when control was done, survivability was reduced (Sezu et al., 2024). Also, the specific growth rate (SGR) in this study was found to be highest in buffalo liver powder, followed by fish meal powder, which is in line with finding of as liver powder is a source of high-quality proteins, vitamins, especially vitamin A and B complex, and minerals, such as iron (Yessimbekov et al., 2021). The depression of growth performance and growth parameters could likely be attributed to several factors, among which the presence of antinutrients will have been important. Presence of anti- nutritional factors lowers the feed intake, which ultimately decreases body nutrient leading to starvation. Analysis also reported a similar reduction in growth performance of rainbow trout when fed with a high fiber diet due decrease in gut passage time and diet digestibility (Biasato et al., 2022).

Protein is a major factor affecting the growth performance of fish. Crude protein content of buffalo liver powder in this study is 61.25 %, which is less than 64.51% recorded by Ncha *et al.* (2015), which might be due to various factors such as its processing, analysis and also to a greater extent due to climatic factors. The protein digestibility of the liver is rich in essential nutrients such as proteins, lipids (including omega-3 fatty acids), vitamins (vitamin A, vitamin B12, etc.), minerals (iron, copper, zinc, etc.), and other bioactive compounds. These nutrients are readily available for digestion and absorption by animals (Kasiga and Lochmann, 2014). No high mortality in our research was recorded, which means that the diet we prepared was not harmful for fish, which is similar to the finding of (Adeshina et al., 2018). The monthly growth trend of common carp fry shows that fry grew steadily until 60 days of culture and exponentially from then on up to 90 days, as focused in Nile tilapia fry by (Pandit and Nakamura, 2010).

All water quality indicators measured in this study were within acceptable limits for common carp growth and reproduction (Tessema et al., 2020). During the treatment phase and post treatment phase of the current study, dissolved oxygen and pH ranged from 5 to 6 mg/L and 8.2 to 9.7, respectively. This range is well-suited for growth and reproduction as commercial cultured common carp as withstand the very low dissolved oxygen (1.5 mg/L), which is considerably below the tolerance level of most of the other culture species (Mohale et al., 2020; Hu et al., 2018; Nagaraja et al., 2025). The temperature range during the treatment phase was between (26.1 to 34.4°C), which is optimum to achieve growth and reproduction (Aydın et al., 2022; Qiang et al., 2021). Buffalo liver powder is a rich source of different nutrients such as phosphorus and nitrogen. These nutrients may accumulate in the water because of overfeeding or inefficient feed utilization, which may cause eutrophication (Biagini and Lazzaroni, 2018). It may lead to an increase of algae and aquatic flora, resulting in the depletion of oxygen and adverse effects on the quality of water (Boyd, 2019). When the egg yolk is not dispersed or used by the aquatic life appropriately, there would be floating films or oily residues on the surface of the water. The films have the potential of hindering the exchange of gases in between the water and the atmosphere, which in turn influences the presence and low levels of oxygen and may lead to stress on the aquatic organisms. The feeding process should be done with great care to minimize the negative effects that may be caused to water quality. The healthy aquatic environment can be maintained by proper feeding habits, which include feeding the aquatic animals with the right quantity of feeds that are efficiently utilized, checking the water quality parameters on a regular basis, and using the right filtration and aeration systems.

5. Conclusion

The investigation of alternative protein sources in fish diets is a matter of significant concern. Fish fed with fish meal powder and egg yolk powder exhibited significantly improved survival rates ($P<0.05$). Nonetheless, the buffalo liver powder used as feed for common carp hatchlings in the study yielded significant daily weight gain, mean weight gain, and survival rate, and improved specific growth rate, surpassing fish meal and egg yolk powder. Buffalo liver powder can be utilized as the primary meal for common carp fry. Consequently, buffalo liver powder may serve as a viable alternate feed source for common carp hatchlings. To ensure excellent growth and maximum survivability, buffalo liver powder is advised. This experiment requires validation through additional testing of the results on a farmer's field.

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