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Effect of *Chenopodium album (Bathua)* leaf meal as supplementary feed on growth and survival of common carp (*Cyprinus carpio)*

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Abstract
The study looked into the growth and survival of common carp fingerlings in relation to Bathua (*Chenopodium album*) leaf meal. Over the course of 60 days, research was conducted on five different concentrations of Bathua (*Chenopodium album*) leaf meal. The different treatments utilized in this trial included T0 (basal diet alone), T1 (5%), T2 (10%), T3 (15%), and T4 (20%), which replaced an equivalent proportion of the basal diet. Feeding rates for fingerlings are 4% of body weight in divided doses of pellets. Morning feeding per day was carried out. The parameters of water quality during the trial were not negatively impacted by the diet supplemented with Bathua *(Chenopodium album*) leaf meal, and only minor differences in the parameters of water quality were observed in different treatments.

The test results showed that the water quality ranged from 26.8 to 27.9 degrees Celsius, from 1300 to 1550 S.cm-1 in electrical conductivity, from 7.4 to 7.7 in pH, from 5.53 to 6.6 mg/l in dissolved oxygen, from 60 to 84.33 mg/l in total alkalinity, and from 371 to 440 mg/l in total hardness. The highest growth metrics during the experiment were, however, weight increase (36.290±0.710 g), percent weight gain (280.337±14.22 %), specific growth rate (1.917±0.193), and gross conversion efficiency (GCE) (0.913±0.026) in value. A food conversion ratio (FCR) of 1.160±0.050 suggests better food use when compared to other treatments.

Keywords: *Chenopodium album, Cyprinus carpio,* Growth Performance, Survival Rate

Introduction
The condition of global fisheries and aquaculture is crucial for providing millions of people with adequate food, nutrition, and jobs. A total of 179 million tonnes of fish are believed to have been produced globally, with a first sale price of USD 401 billion, of which 82 million tonnes, or roughly USD 250 billion, came from aquaculture farming. Humans used 156 million tonnes overall, and the annual supply is said to be 20.5 kg per person. The 22 million tonnes left over were earmarked for non-food purposes, mostly for the manufacture of fishmeal and fish oil. 52% of the fish used for human consumption and 46% of the total fish produced by aquaculture. (FAO, 2020) [10].

A significant segment of the population, especially the nation's fishermen, relies on the fishing industry as a source of income. Fishing is a crucial component of food production that guarantees the nation's nutritional security. India produces roughly 7.7% of the world's fish and is the fourth-largest exporter of fish products worldwide. India produces the third-most fish globally and is the world's leading aquaculture country with 14.73 MMT (DOF, India 2020-21) [8].

The sector of fisheries contributed 1.24% of the country's GDP. The total amount of fish produced in 2019–20 was 141.64 lakh tonnes, with the marine sector contributing 37.27 lakh tonnes and the inland sector contributing 104.37 lakh tonnes (Handbook on Fisheries Statistics, 2020) [12].

Rajasthan has vast and significant water resources (4.23 lakh ha.) for fisheries. But largely underutilized and untapped potential for fish production and livelihood development. 4.23 lakh ha water resources are available but fish production was 1.16 lakh tons in 2019-20 (DOF, India 2020-21) [8].

The common carp is native to Europe and Asia, and has been introduced to every part of the world except the poles. They are the third most frequently introduced (fish) species worldwide, and their history as a farmed fish dates back to Roman times.

Carp are used as food in many areas, but are also regarded as a pest in several regions due to their ability to out-compete native fish stocks. The original common carp was found in the inland delta of the Danube River about 2000 years ago, and was torpedo-shaped and golden- yellow in colour. It had two pairs of barbells and a mesh-like scale pattern. Although this fish was initially kept as an exploited captive, it was later maintained in large, specially built ponds by the Romans in south- central Europe (verified by the discovery of common carp remains in excavated settlements in the Danube delta area). As aquaculture became a profitable branch of agriculture, efforts were made to farm the animals, and the culture systems soon included spawning and growing ponds. The common carp's native range also extends to the Black Sea, Caspian Sea and Aral Sea.

Cyprinus carpio is a freshwater fish species belong to *cyprinidae* family. It has been culture since 475 BC in china. It is native to centre Eurasia continents. It has been considered the words most widely distributed freshwater fish. It is the third most introduced fish species in the word. It is used in both in ponds and captive fisheries because of its potentially rapid growth in eutrophic waters and ability to tolerate adverse environment conditions. It is also highly prized by angles in many countries. As a zooplankton feeder in the juvenile stage and a benthic feeder later on *C.* carpio may contributed considerably to algal blooms. Its feeding behaviour also churns up sediments altering habitats for native species. It may also directly consume the eggs of the other species. It is listed by the Global Invasive species database as one of the words 100 invasive alien species. (Global Invasive Species database species, 2021) [13]

One of the most crucial considerations for effective large-scale fish production is fish feed. Because protein sources account for 64-67% of all fish feeds, research in aquaculture is focused on reducing the cost of the industry. Although fish feed is a crucial component of intensive fish farming, choosing the improper feeds might hurt a farm's ability to turn a profit. Utilizing commercial fish feed pellets is so expensive that it accounts for between 60 and 80 percent of continuing costs for a fish farming operation.

The upright annual herbs *Chenopodium album* and *c. mural* have the distinctive goosefoot-shaped leaves for which the genus is called. The ridged branching stems of the *chenopodium album* have a strong taproot and can grow up to 2 meters tall. They frequently have red stripes on them. Similar in growth shape to *Chenopodium* murale but bushier and more compact, growing to a height of 70 cm, with reddish stem. The leaves of both species vary in colour from light green to dark green, farinose in seedlings, and abaxial surface in mature plants. Perfect green blossoms are tiny branches. The seeds of *C. album* are typically disc-shaped, 1.5 mm in diameter, and have a lustrous, smooth black exterior. The size and shape of C. murale seeds are similar, but they are a dull black colour with a pitted test. In both species, the mature seed is enclosed in a thin, papery shell called the pricarp.

The protein content of *C.album* leaves is high (4.2) and contains considerable levels of important amino acids including lysine and isoleucine as well as calcium and vitamins A and C. The leaves of *C. album* contain high concentrations of vitamins C and carotenoids, according to respectively. Additionally, they are high in iron and fiber. (Food Science Technology).

Material and Methods

Experiment Design

This study was conducted for 60 days, from August 2022 to October 2022, at the Aquaculture Research and Seed Unit Udaipur (Rajasthan). For the experiment, 15 FRP tanks with 225-liter capacities were used. A total number of 150 (*Cyprinus carpio*) fingerlings were obtained from Aquaculture Research and seed production unit, Directorate of Research, MPUAT, Udaipur. Prior to the start of the experiment, the fish was fed on control diet (Groundnut oil cake, rice bran, wheat flour, and mineral mixture in the ratio of 40:40:19:1) for 7 days in order to make the fish acclimatize in the experiment diets and environment. The healthy fingerlings of uniform size were randomly distributed in five experiment group one control group with each of the three replicates following a complete randomized design. The volume of water in each tank was 200 litres. The water was aerated every day for at least 8 hours. Each tank was stocked with 10 fingerlings of *Cyprinus carpio.*

Before adding fish to any of the 15 tanks, 200 litres of filtered groundwater were added and all 15 tanks were properly cleaned. Every experimental tank was covered with nylon net to keep out impurities and prevent fish from jumping out. Throughout the trial, aeration was delivered for at least 8 hours each day by air stone diffusers connected to an aerator. Daily feedings of fingerlings at 4% of their body weight were given one at a time.

At intervals of 15 days, fingerlings' initial and periodic weights were measured to estimate various growth parameters. At intervals of 15 days, the following water quality indicators were also analysed: air and water temperature, dissolved oxygen, pH, total alkalinity, and total hardness. Every fifteen days, faeces and uneaten food were removed using a pipe, and the water level was maintained by refilling. The samples were examined for growth performances and Survival at the conclusion of the experiment after 60 days.

Feed preparation

The basic diet will be made using the GNOC, Rice bran, Wheat flour, and Mineral Mixture (40:40:19:1). *Bathua* plant leaf meal was added to the diet in five different amounts, with equal amounts of the basal diet being replaced by treatments T1 (05%), T2 (10%), T3 (15%), and T4 (20%). During the experiment, a 60-day feeding study was done. Pellets were given to fingerlings in split doses at a rate of 4% of their body weight. One feeding per day was completed.

Table 1: The details experiment diet and treatment are given below

S. No	Treatments	Basel Diet (in %)	*Bathua* leaf meal (in %)	Total (in %)
1	T_0 (Control)	100	00	100
2	T_1	95	05	100
3	T_2	90	10	100
4	T_3	85	15	100
5	T_4	80	20	100

Statistical analysis was performed using a Duncan's multiple Range Test, to determine differences between means of each parameters significant rate of $p < 0.05$ using statistical analysis program (SPSS, 16.0).

Result

The experimental results growth performance of fish and survival of the fish observed during the experimental period are shown here under

Growth performance

The highest weight gain was recorded (36.290±0.710) in T_4 which is followed by (34.466±0.658) in T_3, (33.667±0.543) in T_2, (33.333±0718) in T_1 and lowest (30.700±1.085) being in T_0 (control). The per cent weight gain was observed highest in (280.337±14.221) T_4 followed by (270.033±7.888) in T_3, (259.677±1.152) in T_2, (252.659±21.470) in T_1 and lowest in (242.116±1.588) T0. The SGR was observed highest in (1.917±0.193) T_4 followed by (1.788±0.110) in T_3, (1.645±0.016) in T_2, (1.509±0.307) in T1 and lowest was being in (1.379±0.025) T_0. The value of FCR slowly decreases with increase in the concentration of *Chenopodium album (Bathua))* leaves powder in the diet.

The best value of FCR (1.160±0.050) was found in T4 and lowest (1.230±0.015) in T_0. GCE was significantly different in all treatments. The value of GCE was highest (0.913±0.026) in treatment T_1 and lowest in (0.799±0.022) in T3 as.

Table 2: Growth performance of Common Carp (*Cyprinus carpio)* fingerlings fed with *Chenopodium album* (Bathua) leaves powder supplemented diet

S.No.	Treatments	Net weight gain (g)	%Weight gain	SGR	FCR	GCE
1.	T_0 (Control)	30.800^{a}±1.085	242.116^{a}±1.588	1.379^{a}±0.025	1.097^{a}±0.032	0.799^{a}±0.022
2.	T_1	33.443^{b}±0.718	252.659^{a}±21.470	1.509^{a}±0.307	1.160^{ab}±0.050	0.813^{a}±0.010
3.	T_2	33.886^{bc}±0.5433	259.677^{a}±1.152	1.645^{a}±0.016	1.228^{b}±0.005	0.814^{a}±0.003
4.	T_3	34.566^{bc}±0.658	270.033^{a}±7.888	1.788^{a}±0.110	1.230^{b}±0.015	0.865^{ab}±0.035
5.	T_4	36.090^{c}±0.710	280.337^{a}±14.221	1.917^{a}±0.193	1.252^{b}±0.345	0.913^{b}±0.026

Data expressed as mean ± SE (n=3) Mean value in the same column sharing different superscripts are significantly different ($p < 0.05$).

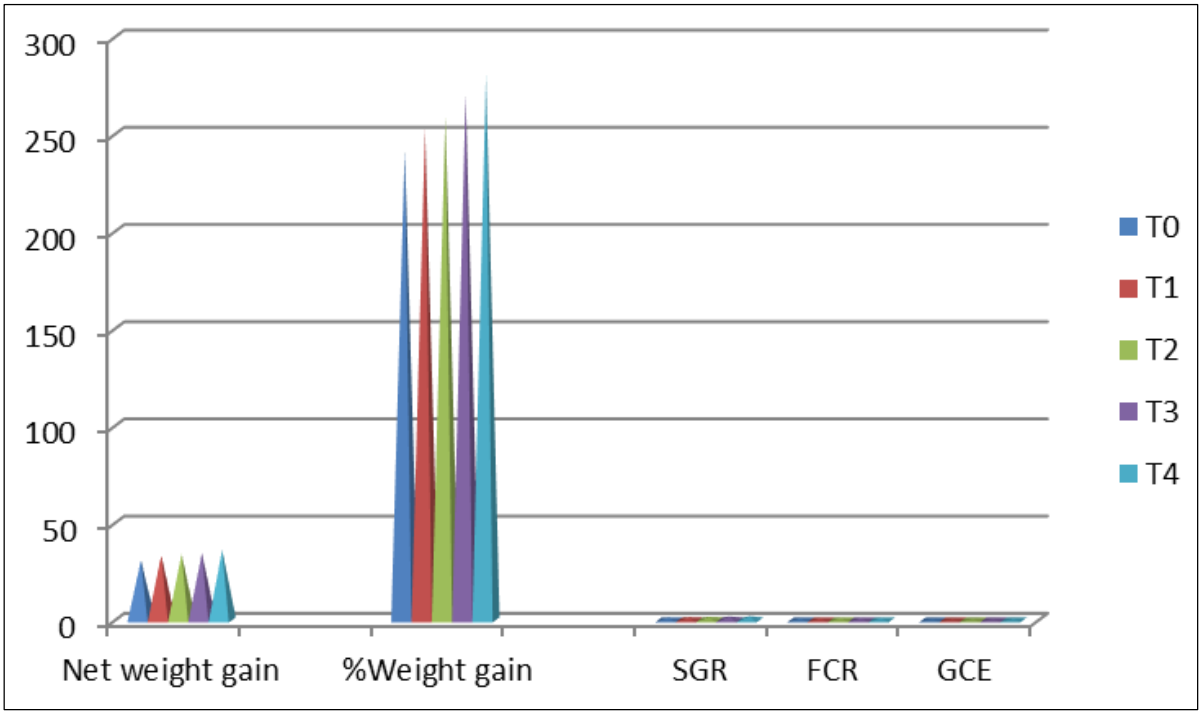

Fig 1: Growth performance of common carp (*Cyprinus carpio)* fingerlings fed with *Chenopodium album* (Bathua) leaves powder supplemented diet

Survival Rate (%)

Due to the good water quality that was maintained in the experimental tanks, test fish had a 100% survival rate at the end of experimental period.

Discussion

The current study examined the addition of *Chenopodium album* (Bathua) leaf meal to fingerling Common carp (Cyprinus carpio) diets. It is obvious that the growth indices of the experimental fish, Common carp, including weight increase, percent weight gain, SGR, FCR, and GCE, were better than the control group in all treatments, supporting the inclusion of *Chenopodium album* (Bathua) leaf meal to fish diets. All of the treatments preserved the water's favourable physic-chemical parameters for fish growth. The findings of the current research study are summarised in Tables 4.1-4.10 and are described below together with their justifications. Varied from 26.8° to 27.86 °C in the current experiment.

Temperature has a significant impact on a variety of physical activities and biological processes that fish engage in. Temperature fluctuations have a direct impact on the physiological growth of fish because they are cold-blooded animals. Common carp fingerlings grow most effectively in the range of 17-26°C, as per Sapkale *et al*. (2011) [16]. During

the current investigation water temperature was 26.8 to 27.86 °C which is similar to reported above finding

In the current analysis, it was found that, within the optimal range of 26.8-27.9°C, the water temperature level was the single most significant theoretical element. pH is a significant factor in the evaluation of the water's quality. The pH of the water has an effect on fish health and growth specifically. The pH range of fish-friendly water in the current study was between 7.3 and 7.8, which is rather alkaline. The pH needs to be between 8.03 and 8.50, according to Choudhary and Sharma. (2018) [6]. This temperature range was determined to be ideal for the growth of fish. The amounts of dissolved oxygen in the various treatments ranged from 5.3 to 7.6 mg/l. For good fish growth and health, the ideal dissolved oxygen range is 5–10 mg/l (Bhatnagar and Devi, 2013) [4].

An indicator of the total number of ions in water is conductivity. Conversely, the water's ability to conduct currents (Ogbeibu and Victor, 1995) [14]. This gauges both primary productivity and fish production. Both dissolved solids and ionic concentrations are important. The conductivity of natural water ranges from 20 to 1500 mhos/cm. The conductivity of freshwater ranges from 50 to 1500 S/cm. According to the current experiment, the EC ranged from 1300 to 1550 mS/cm, which is favourable for fish growth.

Dissolved oxygen is the most essential component of water quality in aquatic ecosystems. It is crucial for both the metabolic control mechanisms and the assessments of the water quality. It directly affects aquatic life. The optimal range for aquaculture, according to is 5.67 to 9.85 mg/l. Similar to the finding previously published, the dissolved oxygen range in the current experimental study was discovered to be 5.53–6.6 mg/l.

Fish producing water bodies should have a hardness level of 64 to 200 mg/l, according to Jhingran (1988) [11]. The hardness is said to be best for higher fish growth if it is between 108 and 200 ppm. Liming is also not required in this situation. The experiment yielded hardness readings between 423 and 511 mg/l. Choudhary and Sharma (2018) [6] came to the conclusion that the current research was consistent with the hardness value of 371.33 to 440 mg/l as being adequate for fish growth.

Alkalinity measures all of the bases in water. In addition to acting as water buffers, it reacts with acids to reduce their effects. The ideal alkalinity range for CaCO3 metabolism and synthesis, according to Stone and Thomforde (2004) [17], is between 50 and 150 mg/l. It was found that the current experiment's alkalinity range ranged from 60 to 84.33 mg/l.

Fish kinds, feed quality, and environmental factors, as well as others, all have a significant impact on fish growth and survival. Fish were fed various amounts of *Bathua (Chenopodium album)* leaf meal applied to the control diet during the current investigation to influence growth. Survival of *Bathua (Chenopodium album)* leaf meal diet demonstrated a significant difference between different treatments at a 5% significance level. The best growth was obtained from T4 in this analysis *Bathua (Chenopodium album)* leaf meal. The best weight increase reported in T_4 was 36.290±.710, and the specific growth rate (SGR) was (1.917±0.193). If we are discussing FCR, T_4 (1.160±0.050) reported a value. T4's reported gross conversion efficiency ratio is (0.865±0.0135).

The feed's protein content ranged from 16.250±0.0529 to 19.496±0.0176. According to such feeding items are categorized as protein sources if they contain greater than 20% crude protein.

The results of the current experimental study's analysis of fish carcasses show that the amounts of crude protein, fat, ash, carbohydrate, and moisture fluctuate significantly ($P<0.05$) Crude protein ranged from 16.093±0.0088 to 16.266±0.0260, fat from 5.133±0.0088 to 5.340±0.2300, ash: 3.836±0.0176 to 4.136±0.0176, carbohydrates: 3.676±0.0120 to 4.026±0.0260 and moisture: 70.723±0.0491 to 71.176±0.0480.In fish carcasses. The fillet of Nile tilapia has a crude protein level of 13.3–15.6 and a moisture content of 79.5–80.9%, according to Alemu *et al*. (2013) [2]. Fish fed with banana peel powder had crude protein levels ranging from 15.76 to 16.47, fat levels ranging from 3.2-4.02, ash levels ranging from 3.3 to 3.6, and moisture levels ranging from 70.40 to 73.15, which is consistent with the results so far.

Conclusion

Feed additives are used in fish diet because for higher production and enhancing resistance towards infectious disease and also they are eco-friendly and have no negative impact on fishes health.

In the current study the Effect of *Chenopodium album* leaves on growth performance and survival of Common Carp has been evaluated.

On the basis of the results obtained in the current research work, it can be concluded that *Chenopodium album* leaf meal supplementation has significantly found to improve the growth and survival performance, proximate composition of experimental Fish.

The incorporation of *Chenopodium album* (Bathua) leaf meal in fish feed was found good acceptability by fish and does not show negative effects on health of *Cyprinus carpio* and on the water quality.

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