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Dietary Neem (Azadirachta Indica) Leaf Extract Enhances Growth Performance and Survival Rate of Rohu (Labeo Rohita) Fingerlings

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Abstract

A significant source of earning, aquaculture has grown rapidly due to the expansion of the global food production industry. The rising trend in fish farming has increased its importance, particularly in maintaining animal health within the industry. Neem, a medicinal herb recognized for its bioactive constituents Flavonoids, terpenoids, coumarins, tannins, alkaloids and sulfurous substances, act as a growth enhancer, and immune modulator against pathogens. This study evaluated the effects of different levels of neem (*Azadirachta indica*) leaf extract (0, 0.1, 0.5, and 1%) incorporated into commercial diets on the growth performance, feed conversion ratio (FCR), and specific growth rate (SGR) of rohu (*Labeo rohita*) fingerlings reared for eight weeks under controlled laboratory conditions. Neem inclusion significantly ($p < 0.05$) improved weight gain, total length, fork length, FCR, and SGR in a dose-dependent manner, with the best performance recorded at 1% inclusion. These findings highlight neem leaf extract as a cost-effective, eco-friendly feed additive for sustainable aquaculture. Statistical analysis indicates that the outcomes of current study leads to increase in body weight gain from 0.55±0.21g to 7.38±1.88g, total body length 0.85±0.21cm to 5.95±1.11cm, fork length 0.25±0.13cm to 4.07±0.38cm, feed conversion ratio 7.49±3.26 to 0.53±0.14, specific growth rate 0.94±0.20 to 2.22±0.37 and 100% survival of fish. All these parameters showed highly significant results at T3 treatment as compared to control group.

Introduction

A significant source of earning, aquaculture has grown rapidly due to the expansion of the global food production industry. The rising trend in fish farming has increased its importance, particularly in maintaining animal health within the industry. Proper nutrition in fish diets not only supports growth but also promotes the health of aquatic species, meeting the demand for human consumption while boosting immune system activity to resist pathogens (Maragathavalli et al., 2012).

Utilizing healthy fish can help address the risk of food shortages, as they provide good quality protein, fats, and minerals crucial for the animals. *Labeo rohita*, generally known as Rohu, is widely farmed commercially in Asia and contributes around 35% to the production of major carp, making it abundant across the continent (Belsare et al., 2018). *Labeo rohita* is an essential source of animal protein, mineral beneficial fat components, vitamins and some essential amino acids that provide healthy diet to animals. Plant origins are the best alternatives to fishmeal due to reduced phosphorus levels, absence of detrimental and growth-inhibiting factors, economical nature and easy accessibility (Rehman et al., 2023).

Fish is an important part of animal proteins, minerals, healthy fats, vitamins, and some essential amino acids, offering a nutritious option for the animal industry (Gultepe et al., 2014). However, improper management and unsanitary conditions in aquaculture can lead to higher mortality rates in fish breeding. While vaccination is an effective method for disease prevention, it can be costly and may not be feasible for all fish species (Giri et al., 2021). Different parts of neem tree are used to protect the environment, growth and survival rate of fish because neem contain meliantroil azadirachtin and nimbin that has been used from ancient time as insecticidal and antiviral agents (Chakrabarti et al., 2012).

Plant-based alternatives offer a more cost-effective solution due to their lower phosphorus content, absence of harmful growth-inhibiting substances, and easy availability. It is studied that neem (*Azadirachta indica*) is a medicinal herb known for its bioactive and biosafety compounds, which act as growth promoters, anti-stress agents, and possess antifungal, antiviral, and anti-cancer properties (Kolkovski, 2013). It also acts as immune-stimulant and activates the immune system (Awad and Awaad, 2017). Various immunostimulatory agents might be categorized up to many classes such as some carbohydrates, animal extracts, lectins, bacterial products, nutritional factors and some cytokines (Divyagnaneswari et al., 2009). Medicinal herbal extracts are rich source of chemo-therapeutic and therapeutic agent that has been provided feasible solutions to aquaculture problems (Citarasu, 2010).

Ultimately, these symptoms lead to the formation of ulcers, liver hemorrhages, fin bleeding, loosening scales, caudal fin detachment, muscle starts bleeding, bloody mucus comes in the rectum, and the production of fluid with blood. The bacteria A. hydrophila exhibited significant pathogenicity against freshwater fish. Researchers have looked into the use of plant materials as agents that boost fish immune response to enhance their health (Ahmad et al., 2024).

In India, neem is often referred to as the "Village Dispensary," playing a key role in controlling diseases of fish and promoting growth and immune response in fish farms. The purpose of this study is to assess medical benefits of neem-extract feed on growth rate of *Labeo rohita*, with the goal of improving fish health and immunity, while enhancing growth rates to meet both health and consumption demands (Brindha et al., 2012)

Fish is a highly perishable product that has been an integral component of human diets since the beginning of time. The primary objectives of the aquaculture industry are to enhance growth and produce high-quality fish. The global population is growing rapidly, with a projected 30% increase by 2050. This increase emphasizes how everyone must consistently have some physical and financial approach to enough

food that is good, nourishing, and meets their needs for productivity and health (Anand et al., 2019).

Aquaculture has played a crucial role in providing food and nutritional protection by cultivating aquatic species. It is the fast growing sector in the food providing sectors, helping to lessen the overexploitation of wild stocks and protect ecosystems from decline. Between 2012 and 2017, inland aquaculture production grew significantly, increasing from 29.9 million tons to 41.9 million tons (Manoj and Vasudevan, 2009). Disease management should focus on environmentally friendly, preventative methods such as using medicinal plants. Because they are affordable, widely accessible, safe, and effective, the usage of medicinal herbs from various families in aquaculture pond management has been increasing recently. Moreover, to manufacture fish devoid of any chemicals that could endanger public health. Similarly, dietary andrographolide demonstrated a significant effect against A. hydrophila diseases compared to the control ones. The findings showed that a diet supplemented with it has a stimulating effect on non-specific immune factors, enhances growth performance, and increases resistance to A. hydrophila diseases in *L. rohita* fingerlings (Basha et al., 2013). One of the great leading therapeutic tree is neem (A. indica). It has a broad range of biologically important functions and is well-known for its insecticidal qualities (Nargis et al., 2013).

The neem (Azadirachta indica) is a large, perennial evergreen tree with eatable fruits and fragrant foliage. Because of its anti-inflammatory, anti-ulcer, and immunological qualities, it has been widely used for a variety of purposes (Kaur et al., 2019). Neem extracts enhance lymphocyte production, release of natural killer cells cytokines and phagocytic activity of fish to enhance immunity against pathogens and stop their attack on fish. There is positive association among growth and immunity of fish with the exposure of diet containing garlic, onion, ginger or neem extract. Leukocytes are the best parameters to evaluate both the health condition and immune performance of fish (Chakrabarti et al., 2012).

Every component of the neem tree has a variety of pharmacological qualities that increase antioxidant activity and are useful against certain bacterial, viral, and fungal illnesses. Neem is also used to combat aquatic parasites as a natural pesticide, insecticide, and molluscicide. Furthermore, neem-based solutions have gained popularity in fish farms as a substitute for harmful pesticides and antibiotics in the management of fish parasites and the defense of fish fry against predators while they are being raised in lakes, rivers, or streams. Because Azadirachta indica extracts effectively boost defense against some fish illnesses and decrease certain infections, their usage in the fish business has grown (Vallejos et al., 2016). The purpose of this research is to evaluate the impact of extract from neem leaves on the growth rate of *Labeo rohita* fingerlings. To assess the survival rate of fingerlings fed with Neem leaf extract. To investigate the optimal concentration of neem leaf extract for promoting FCR and SGR

Materials and Methods

This study was designed to assess the effects of dietary neem leaf extract supplementation on growth performance and survival of *Labeo rohita* fingerlings over a two-month period. The investigation focused on biweekly monitoring of growth metrics including total body weight, standard length, fork length, feed conversion ratio (FCR), specific growth rate (SGR), and survival percentage. Concurrently, key water quality parameters (temperature, pH, electrical conductivity, dissolved oxygen, and total alkalinity) were regularly measured to maintain optimal culture conditions. Prior to the experimental trial, fingerlings were acclimatized for two weeks in glass aquaria under controlled conditions: 12-hour photoperiod, continuous aeration, and maintenance of water quality parameters (pH 7.0, temperature 26±2°C, dissolved

oxygen 5.0±0.3 mg/L). During acclimatization, fish were fed a reference diet to establish baseline physiological conditions

Feed Preparation

The commercially available fish feed was obtained and ground into a powder using an electric grinder. Leaves of neem (Azadirachta indica) were taken from the surrounding area of University Botanical garden and aerated at room temperature till it dry. These dried leaves were ground. A supplemented diet was prepared by adding different concentrations of neem powder mixture into a commercial diet. The group 1 was given basal diet without neem and was considered the control group. The group 2, 3 and 4 were given neem feed at concentrations of 0.1%, 0.5%, and 1% mixed with commercial diet.

Experimental fish collection

Fish seeds were collected from local fish hatchery and transferred to fish laboratory for research. The fingerlings of Labeo rohita were acclimatized for two weeks in aquarium at commercial diet, 12 h light/dark period before starting the trial. These aquaria were covered with net with constant aeration by pumps and waterquality parameters are maintained at standard pH value 7, temperature 26±2°C, and DO of 5.0±0.3 mg/L before initiating the experiment.

Research trial

After the acclimatization period the initial length and weight were measured. Total 120 fish were transferred to aquariums and covered with net. Thirty fish were kept in each aquarium. Four groups were made. The group 1 was given basal diet without neem and was considered the T0 control group. The group 2, 3 and 4 were named as T1, T2 and T3 given neem feed at concentrations of 0.1%, 0.5%, and 1% mixed with commercial diet. The water was filled in each aquarium ¾ part of it. Once in a day the water of all aquariums were changed. All aqauriums were aerated with aerator pumps and stones, the air pressure is controlled by aerator controllers. T0 control group out of four aquarium was fed once in a day with commercial diet only. T1 group was fed by (0.1% neem diet), T2 was fed by (0.5% neem diet) and T3 was fed by (1% neem diet) at the concentration of five percent of their body weight.

Growth parameters

Growth parameters like (total body weight, initial and final body weight of last week, total body length, fork length, feed conversion ratio (FCR), specific growth rate (SGR) and survival of fish along with fluctuating physiochemical parameters (temperature, pH, Electrical conductivity, dissolved oxygen and were noted and calculated as previous practice.

Physiochemical parameters of water

Water samples were collected from each aquarium on weekly basis for limnological study. Digital thermometer is used to measure the solubility of oxygen and it records the temperature of water by fixing the factor of temperature at (ºC). pH meter was used to check the pH of water sample by fixing its range exactly at the pH point of tanks water. Total alkalinity of water was measured by titration method.

Statistical analysis

The collected data were analyzed by One-way analysis of variance (ANOVA) employed to assess significant differences among experimental groups. Minitab software was utilized for all computations, with statistical significance determined at ($p < 0.05$) (Zar et al., 2010)**.**

Results

Neem leaf extract supplementation had a positive effect on all measured growth parameters of *Labeo rohita*. The final weight, total length, and fork length were significantly higher ($p < 0.05$) in the treated groups compared to the control. The most pronounced effects were observed in the T3 group (1% neem),

Average body weight gained by *Labeo rohita* in all treatments

Weekly observations of average weight gain (g) of *Labeo rohita* in control and three treated groups are shown. In T0, T1, T2 and T3, mean of weight was observed to be 0.55±0.21, 1.88±0.39, 4.22±0.43 and 7.28±1.88 respectively. In T0, T1, T2 and T3 maximum value of average weight gain was observed to be 0.8g, 2.4g, 4.8g and 9.6g in 8th week but minimum value of average weight gain was observed to be 0.3g, 1.5g, 3.g and 5.2g in 2nd week respectively. Analysis of variance showed highly significant ($p<0.05$) results that concerned with increase in total body weight of *Labeo rohita* in all treatments.

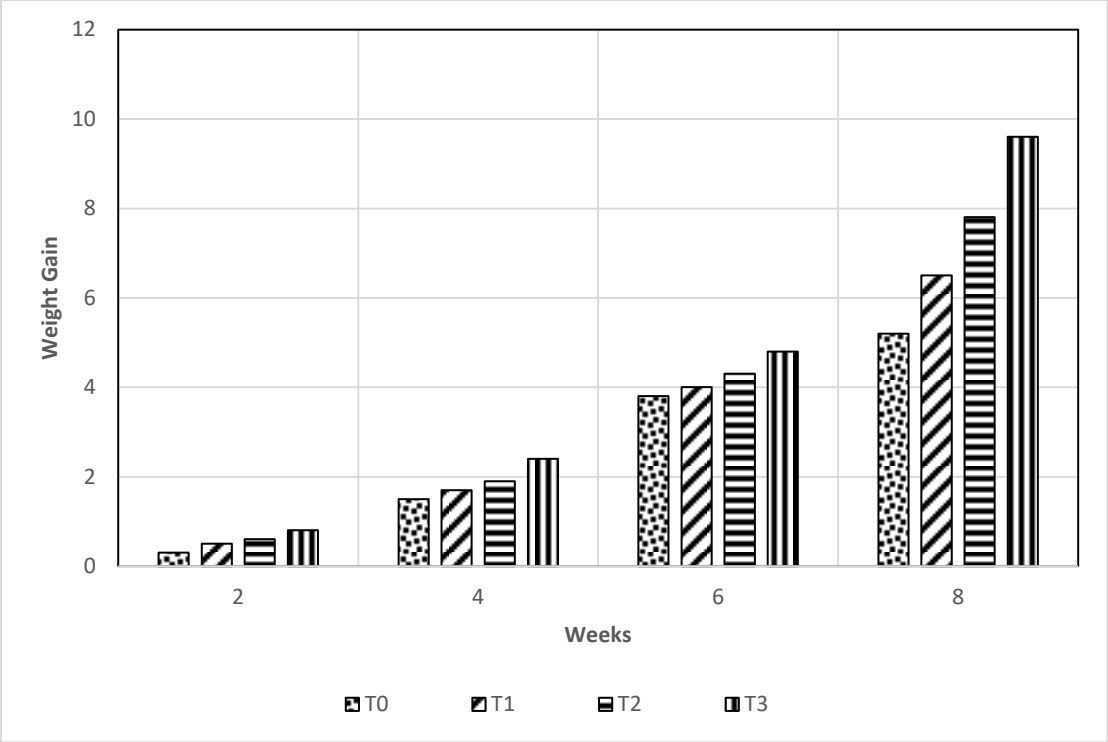

Figure 1: Weekly weight gain of L. rohita fed graded levels of neem leaf extract.

Average body length gained by *Labeo rohita* in all treatments

Weekly observations of average body length (cm) of *Labeo rohita* in control and three treated groups are shown in the figure. In T0, T1, T2 and T3, mean of weight was observed to be 0.85±0.21cm, 12.13±0.29cm, 3.9±0.26cm and 5.95±1.11cm respectively. In T0, T1, T2 and T3 maximum value of average body length gained was observed to be 1.1cm, 2.5cm, 4.2cm and 7.4cm in 8th week but minimum value of average weight gain was observed to be 0.6cm, 1.8cm, 3.6cm and 4.9cm in 2nd week respectively. Figure 2 demonstrate the analysis of variance on weight gained by Labeo rohita in all treatments. Analysis of variance showed highly significant ($p<0.05$) results that concerned with increase in total body length of *Labeo rohita* in all treatments.

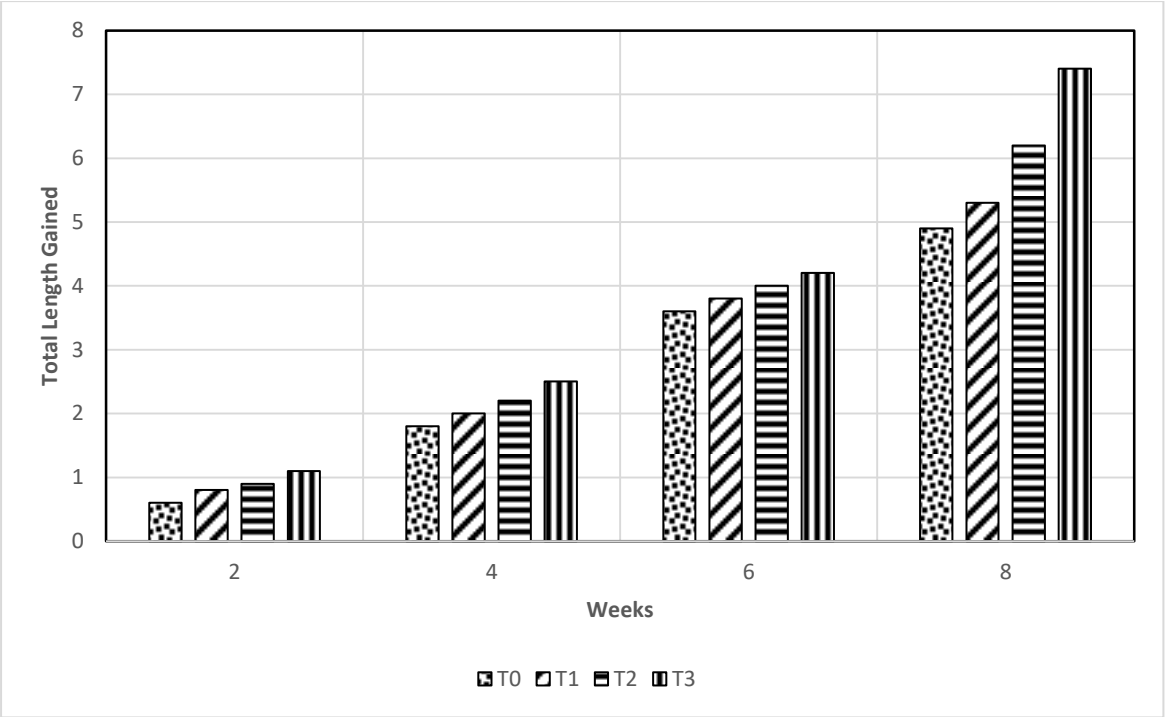

Figure 2: Weekly total length gained across treatments.

Average Fork length gained by *Labeo rohita* in all treatments

Weekly observations of average fork length (cm) of *Labeo rohita* in control and three treated groups are shown in the figure. In T0, T1, T2 and T3, mean of fork length was observed to be 0.25cm, 1.48cm, 2.95cm and 4.07cm respectively. In T0, T1, T2 and T3 maximum value of average fork length gained was observed to be 0.4cm, 1.7cm, 3.3cm and 4.5cm in 8th fortnight but minimum value of average fork length gain was observed to be 0.1cm, 1.3cm, 2.3cm and 3.6cm in 2nd week respectively. Figure 3 demonstrates the analysis of variance on weight gained by *Labeo rohita* in all treatments. Analysis of variance showed highly significant ($p<0.05$) results that concerned with increase in total fork length of *Labeo rohita* in all treatments.

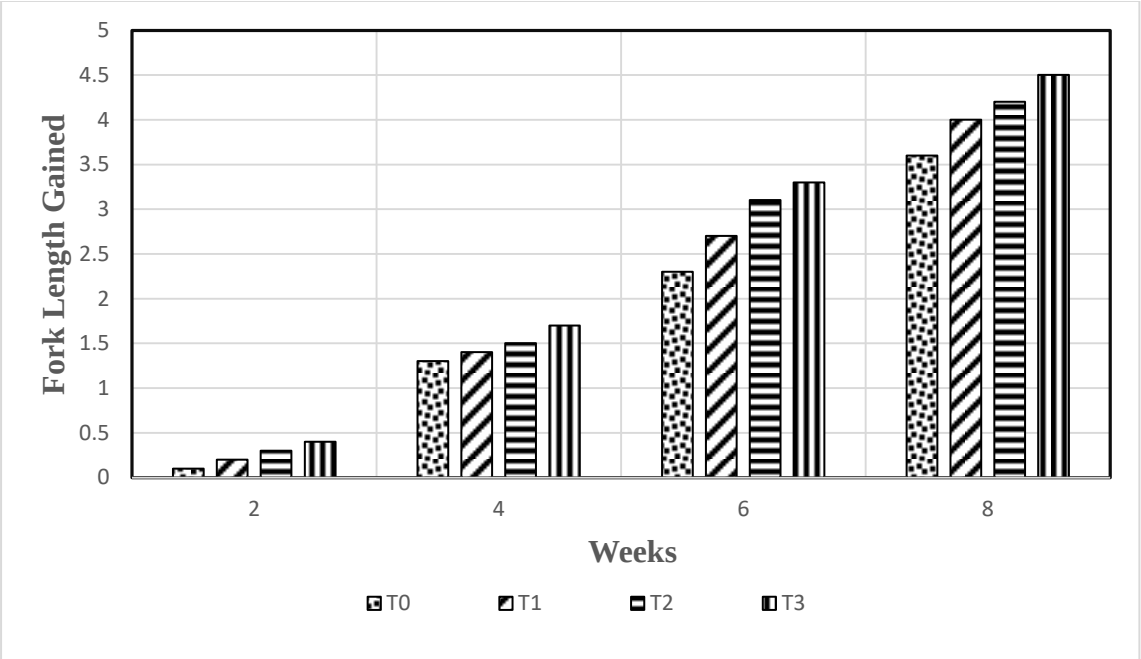

Figure 3: Weekly fork length gain across treatments.

Comparison of FCR in *Labeo rohita* in all treatments

The results presented in Figure indicate a clear effect of neem leaf extract supplementation on the feed conversion ratio (FCR) of *Labeo rohita*. The control group (T0) consistently exhibited the highest FCR values throughout the study, with a mean of 7.49 ± 3.26, indicating poor feed efficiency. In contrast, all neem-treated groups showed substantial improvements. The T3 group (1% neem) achieved the best feed conversion, with a mean FCR of 0.53 ± 0.14, followed by T2 (0.5% neem) with 0.89 ± 0.04, and T1 (0.1% neem) with 1.98 ± 0.38. These results suggest a dose-dependent enhancement of feed efficiency, with higher neem concentrations leading to lower FCR values. The progressive reduction in FCR across weeks further indicates that neem inclusion may have contributed to improved digestion or nutrient utilization over time. Overall, neem leaf extract, particularly at 1% inclusion, appears to promote better growth performance and feed utilization in *Labeo rohita*, highlighting its potential as a natural feed additive in aquaculture**.** Figure 4 demonstrates the analysis of variance on feed conversion ratio of *Labeo rohita* in all treatments. Analysis of variance showed highly significant results that concerned with decrease in feed conversion ratio of *Labeo rohita* in all treatments.

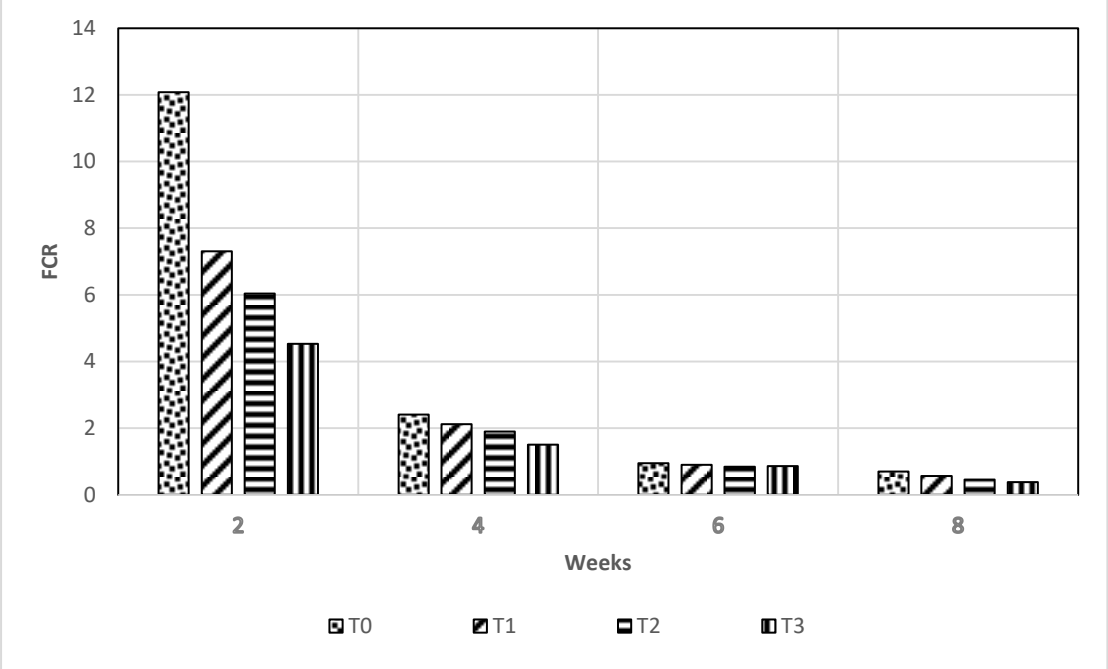

Figure 4: Feed conversion ratio trends during the 8-week trial.

Comparison of SGR in *Labeo rohita* in all treatments

The data reveal that neem leaf extract supplementation had a positive effect on the specific growth rate (SGR) of *Labeo rohita* as compared to the control group. The highest mean SGR was observed in the T3 group (1% neem), with a value of 2.22 ± 0.37, followed by T2 (0.5% neem) at 1.59 ± 0.41, T1 (0.1% neem) at 1.13 ± 0.06, and the lowest in the control group (T0) at 0.94 ± 0.20. This trend indicates a clear dose-dependent improvement in growth performance with increasing neem concentration. The T3 group consistently showed superior SGR across all weeks, particularly during the initial phases of the study (e.g., 2.69 in the first week of March), suggesting that neem at 1% inclusion might enhance metabolic efficiency and nutrient utilization. These findings align with the FCR results, where neem supplementation also improved feed efficiency, and highlight the potential of neem as a natural growth promoter in aquaculture. The figure 5 demonstrates the analysis of variance on specific growth rate of Labeo rohita in all treatments. Analysis of

variance showed highly significant results that concerned with increase in feed conversion ratio of *Labeo rohita* in all treatments.

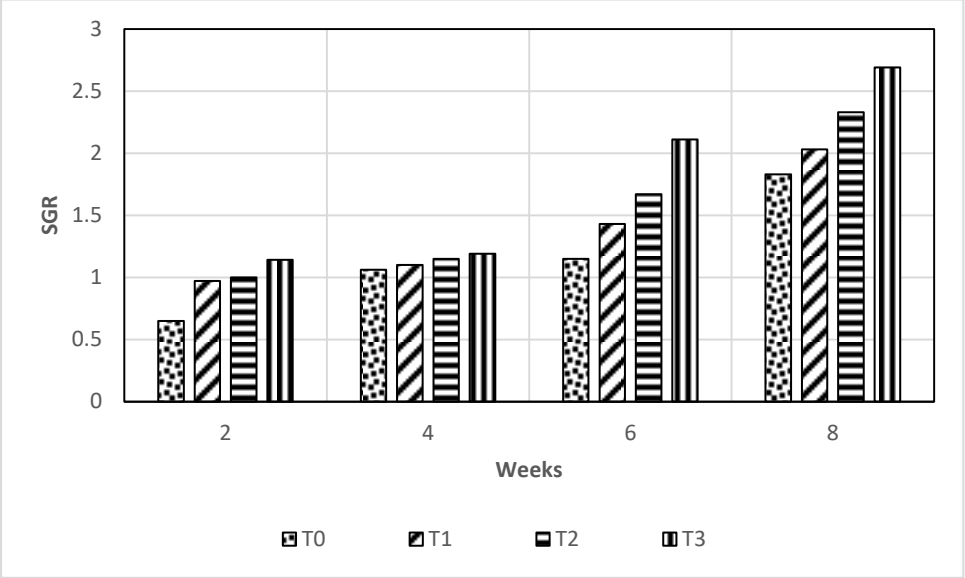

Figure 5: Specific growth rate trends during the 8-week trial.

Discussion

The current study demonstrates that dietary inclusion of neem leaf extract significantly enhances growth performance and feed utilization in *Labeo rohita*. Fish fed neem-supplemented diets exhibited higher weight and length gains, coupled with lower FCRs and higher SGRs. These findings are in agreement with earlier reports that phytochemicals from neem stimulate appetite, enhance gut health, and modulate intestinal-microbiota.

The 1% neem treatment (T3) was the most effective, suggesting that neem's bioactive compounds, particularly azadirachtin and nimbin, likely contributed to improved nutrient assimilation and metabolic efficiency. Improved FCRs reflect the fish's ability to convert feed more efficiently, reducing production costs and environmental waste.

Furthermore, the complete absence of any negative signs or behavioral changes supports the safety of neem at the tested levels. These results support the inclusion of neem as a plant-based growth promoter in sustainable aquaculture practices, especially in regions where synthetic additives are cost-prohibitive or discouraged.

This study examined the effects of dietary neem (Azadirachta indica) leaf extract supplementation on growth performance and survival of Rohu (Labeo rohita) fingerlings under controlled conditions. After a two-week acclimatization period with basal diet, fish were divided into four groups: a control group (T0) receiving neem-free feed and three treatment groups (T1, T2, T3) fed diets containing 0.1%, 0.5%, and 1.0% neem leaf extract respectively. Growth parameters including body weight, standard length, fork length, feed conversion ratio (FCR), specific growth rate (SGR), and survival rate were monitored biweekly. Statistical analysis using one-way ANOVA revealed that the 1.0% neem supplementation (T3) resulted in significantly ($p<0.05$) greater improvements in all growth metrics compared to other treatments. Water quality parameters, particularly temperature, were found to significantly influence growth performance, with optimal results observed at 24-25°C during March. These findings corroborate previous research by Kaur et al. (2023) on temperature-dependent growth patterns in L. rohita. The study demonstrates that neem leaf extract enhances fish growth in a dose-dependent manner, with 1.0% concentration proving most effective for L. rohita fingerlings under the experimental conditions.

According to our study the survival and growth rate of fish was directly proportional to concentration rate of herbs i-e higher the concentration higher the growth rate and survival of fish. The highest growth rate as weight, length and fork length was achieved at higher concentration rate of neem (T3) just as 7.28±1.88g, 5.95±1.11cm and 4.07±0.38cm respectively as compared to other concentrations in T2, T1 and T0 group. The inferences of our study are co related with Oniovosa et al. (2017) whose study investigated that by using neem plant materials that was inoculated with diet of fish had a great effect on fish growth rate and higher concentration of neem increased the growth rate of fish. The study showed the same enhancement trend of growth rate of fish that was observed in our study. The findings of this study demonstrate that higher concentrations of neem extract (T3 treatment) significantly enhanced growth performance and survival rates in Labeo rohita fingerlings under optimal physicochemical conditions, as evidenced by the data presented in Tables. These results align with the work of Naz et al. (2025), who reported similar dose-dependent growth enhancements in fish. Furthermore, our observations corroborate the findings of Chandramohan et al. (2016), who documented comparable growth-promoting and immune-stimulatory effects of ginger supplementation in rainbow trout (Oncorhynchus mykiss) during their 14-day feeding trial. The consistent outcomes across these studies suggest that plant-derived supplements, including neem and ginger, can effectively improve aquaculture productivity by enhancing growth parameters and disease resistance in fish species.

The inferences of our study described that highest specific growth rate 2.92 was noted for T3 treatment at 5% of neem feed. All treatments showed maximum specific growth rate at 8th week of April due to moderate physiochemical parameters such as temperature, pH, dissolve oxygen and total alkalinity of water. but minimum specific growth rate at 2nd week of March due to lowest water quality parameter such as temperature that greatly influence growth performance of fish similar to the results of Ahmadifar (2021). Analysis of variance indicates highly significant ($p<0.05$) results for specific growth rate. the verdicts of the following study are agreed with Basha et al. (2013), who described that impact of dietary herbal extract Andrographis paniculata on specific growth rate, resistance against diseases and non-specific immune system characteristics against infection of in L. rohita fingerlings, indian major carp. They evaluated this herbal extract against different concentrations such as 0%, 0.05%, 0.10%, 0.20%, 0.40% and 0.80% and data was noted for 42 days. The data of this result indicated that herbal extract diet imparts stimulatory impact on specific growth rate and improved the survival of fish along the increase of disease resistance in L. rohita fingerlings against the infection of A. hydrophila. The study results demonstrated that the highest feed conversion ratio (FCR) of 0.54 was achieved with the T3 treatment group receiving 1% neem-supplemented feed (All experimental groups exhibited their maximum FCR values during the 4th week in April coinciding with optimal water quality conditions, particularly favorable temperature ranges as documented in results section. These findings align with previous research by Handeland et al. (2010) regarding environmental influences on feed efficiency. Statistical analysis revealed highly significant differences ($p<0.05$) in FCR among treatment groups. The current results corroborate the work of Gupta and Gupta. (2022), who investigated the effects of herbal supplements (A. radix and L. japonica) on growth performance and feed conversion in juvenile pikeperch. Their weekly assessments similarly demonstrated significant improvements ($p<0.05$) in these parameters with plant-based dietary supplementation, supporting the efficacy of phytogenic feed additives in aquaculture by Giri et al. (2021).

The findings of our study explain that neem had significant effect over immunity and survival rate of fish. The highest survival rate of fish is showed in T3 treatment (1% neem feed) as compared to T0 (control group) that showed low survival rate of fish. Similar results were reported by Kumar et al. (2013) who studied anti parasitic

properties of neem by oral administration against a parasite A. hydrophila of goldfish. He fed the infected goldfish by oral administration of neem at several concentrations for a period of 28 days and data was recorded after 14 and 28-days period. The consequences of this study exhibited that neem was significant to increase the immune response against parasitic attack and survival rate of infected gold fish was increased when fed with neem at higher concentration (1% neem diet).

The outcomes of current study are similar to Harikrishnan et al. (2022) who studied that the fungal pathogen Aphanomyces invadans was inoculated into common carp (Cyprinus carpio) weighing 40 ± 10 g via the intramuscular route at a concentration of 2.5 × 105 cfu ml−1. The infected fish group displayed significant hematological alterations compared to control values, with marked deviations in total erythrocyte count (RBC), total leukocyte count (WBC), hematocrit (Hct), hemoglobin (Hb) levels, and differential leukocyte counts (lymphocytes, monocytes, neutrophils, and eosinophils) observed on days 24 and 36 post-infection ($P < 0.05$). Following therapeutic intervention with daily 5-minute immersion treatments in 1% aqueous neem (Azadirachta indica) leaf extract beginning at day 12, the hematological parameters gradually normalized over the 24-day treatment period, showing no significant difference from control values by the end of treatment ($P > 0.05$) by Kaur et al. (2024). This hematological recovery was accompanied by visible healing of induced lesions, demonstrating the therapeutic potential of neem extract for restoring fish health parameters following infection by Rather et al. (2017).

The results of our study are also similar to Kaur et al. (2024) the effects of dietary supplementation with Azadirachta indica leaf extract on growth performance and body composition of rainbow trout (Oncorhynchus mykiss). A 90-day feeding trial was conducted using four experimental diets containing different levels of neem leaf extract: T1 (5%), T2 (7%), T3 (10%), and a control group T4 (0%). Juvenile trout with an initial average weight of 0.4 ± 0.14 g were stocked at 25 fish per tank, with two replicate tanks per treatment. Results demonstrated significant differences among treatments for key growth parameters including final body weight, weight gain, specific growth rate, and feed conversion ratio ($p < 0.05$) by Anand et al. (2019). The T2 group (7% extract) showed optimal performance, achieving the highest final weight (48.10 g), greatest weight gain (47.70 g), and lowest feed conversion ratio (1.90). Hepatosomatic index, viscerosomatic index, and Fulton's condition factor were also significantly influenced by dietary treatment ($p < 0.05$), though survival rates remained unaffected across groups ($p > 0.05$). Regression analysis indicated an optimal inclusion level of 7.5% A. indica extract for maximum growth performance. These findings suggest that neem leaf extract can serve as an effective dietary supplement for enhancing growth and physiological condition of rainbow trout under controlled culture conditions.

The final observation of growth, survival rate and physio-chemical parameters are explained as follow: T3 treatment (1% neem leaf diet) showed 7.28±1.88 highly significant ($p<0.05$) increase in body weight of *Labeo rohita* as compared to T0 (control group) that showed 0.55±0.21 body weight. In T0 (control group), T1, T2 and T3 maximum weight gain was observed at 8th week of April due to moderate water quality parameters such as water temperature ranges from 24-25^{o}C. T3 treatment (1% of neem diet) showed 5.95±1.11 highly significant ($p<0.05$) increase in total body length of *Labeo rohita* as compared to control group T0 that showed 0.85±0.21 less gain in total body length. in T0 (control group), T1, T2 and T3 maximum length (cm) gain was observed at 8th week of April due to moderate physio-chemical parameters of water.

T3 treatment (1% neem leaf extract) showed 4.07±0.38 highly significant ($p<0.05$) increase in fork length of *Labeo rohita* as compared to control group T0 that showed 0.25±0.13 less gain in fork length, T1, T2 and T3 maximum fork length (cm) gain at the 8th week of April due to moderate physio-chemical parameters of water.

T3 treatment (1% neem leaf extract) showed 0.53±0.14 highly significant decrease in feed conversion ratio of Labeo rohita as compared to control group T0 that showed 7.49±3.26 high feed conversion ratio. In T0 (control group), T1, T2 and T3 minimum feed conversion ratio (cm) was observed at the 8th week of April. A lower FCR indicated higher efficiency, meaning less feed is needed to produce a given output. T3 treatment (1% neem leaf extract) showed 2.22±0.37 highly significant ($p<0.05$) increase in feed specific growth rate of *Labeo rohita* as compared to control group T0 that showed 0.94±0.20 less specific growth rate. In T0 (control group), T1, T2 and T3 maximum specific growth rate was observed at the 8th week of April. Analysis of mortality of fish revealed that T3 treatment (1% neem leaf extract) showed the increased survival rate and no mortality of *L. rohita* fingerlings as compared to T0 (control group).

Statistical analysis indicates that the outcomes of current study leads to increase in body weight, total body length, fork length, feed conversion ratio, specific growth rate and survival rate of fish. All these parameters showed highly significant results at T3 (1% neem diet) treatment. The increasing trend for growth and survival of *Labeo rohita* can be expressed as follows: T3› T2› T1 ›T0

Conclusion

The dietary supplementation of neem (Azadirachta indica) leaf extract significantly improved growth performance, feed conversion ratio, and specific growth rate of *Labeo rohita* fingerlings. Among the tested treatments, 1% neem inclusion yielded the most promising results. Neem leaf extract can thus be considered a potent, natural feed additive for sustainable aquaculture. Further studies may explore its mechanism of action and long-term effects under field conditions. The increasing trend for growth and survival of *Labeo rohita* can be expressed as follows: T3› T2› T1 ›T0.

Declaration

No

Conflict of Interest

Authors have no conflict of interest

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