

Research Article

Effects of selected herb on Growth response, Feed utilization efficiency and hematological parameters of common carp (*Cyprinus carpio* var *communis*) fingerlings

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Article Info

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Received: 19/06/2025

Accepted: 01/08/2025

Published: 03/08/2025

DOI: 10.5281/zenodo.16731876

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Abstract

Four medicinal herbs namely *Rumex obtusifolius*, *Plantago lanceolata*, *Taraxacum officinale* and *Urticadioica* were assessed for the content of nutrients and antioxidant activity by DPPH method. Among them, *Rumex obtusifolius* exhibited the best result in terms of antioxidant activity (85.07%) and nutrient content followed by *Plantago lanceolata*, *Urticadioica* and *Taraxacum officinale* respectively. *Rumex obtusifolius* were selected to be incorporated in the diet of common carp (10±0.05g) and five iso-nitrogenous (crude protein 32%) and Iso-caloric (400 kcal/100g) experimental diets were formulated. *Rumex obtusifolius* powder was incorporated at the rate of (0%) control, (2.5%) for treatment T₁, 5.0% for treatment T₂, 7.5% for treatment T₃ and 10.0% for treatment T₄. Experimental diet were fed to the experimental groups of common carp @ 5% were assessed for the content of nutrients and experimental period of 60 days. Results showed significantly (P<0.05) higher growth performance, hematological parameters and survival rate among the four treatment groups in contrast to the group under control. Highest percentage increase in weight (257.21±1.64), PER (1.17±0), and SGR (2.12±0.01) were observed in treatment group T₃. Also the Better FCR (1.91±0) was noted in T₃. Haematological parameters and the rate of survival showed significant improvement in treatment group T₃. Highest values of RBC (3.11±0.06), Hgb (8.63±0.05) and PCV (41±0.41) were observed in T₃ in contrast to control. There were high survival rates found in all the treatment groups compared to control group and the highest survival rate (97.5±2.5) was observed in T₃. Thus, it may be stated that *Rumex obtusifolius* can be effectively added to feed as a feed supplement to enhance the growth performance, haematological parameters and survivability of common carp fingerlings.

Key words: Common carp, Medicinal herbs, *Rumex obtusifolius*, growth, hematology, survival.

INTRODUCTION

Herbal extracts possess the ability to be applied as key nutritional supplements in aquaculture. Every herb consists of a specific composition and has the ability to affect living organisms in different ways. Alongside of immuno-stimulatory and other benefits, these herbs/ plants were also identified to have stimulatory effect on growth parameters in several types of fish. These parameters include SGR, WG, FCR, FCE etc [17]. Rainbow trout (*Oncorhynchus mykiss*) when given a diet supplemented with ribwort plantain (*Plantago lanceolata*) aqueous methanolic extract, the animals' final weight gain and specific growth rate increased [12]. Considering the innumerable benefits of phytobiotics, aquaculturists inevitably turned to anti-oxidant feed additives in order to overcome problems regarding the elevation of fish physiological fitness as these bioactive compounds present in medicinal herbs can protect cells against xenobiotic and environmental stressors by having strong antioxidant properties [31]. *Epinephelus tauvina* fed a combination of methanolic herb extracts from *Zingiber officinalis*, *Phyllanthus niruri*, *Piper longum*, *Tridax procumbens*, and *Cynodondactylon*, they had a 41% increase in weight compared to the control fish [36]. Likewise, a hybrid grouper (*Epinephelus lanceolata* × *Epinephelus fuscoguttatus*) when provided with dietary dandelion extract of 0.4% had the implications of growth improvement, liver protection and immune stimulation due to its anti oxidant and anti-inflammatory activities [49]. According to the other studies, administering plant extracts enhances nutritional availability and digestibility, increasing feed conversion, hematology, protein synthesis, immune and stress response [48,45,5,6]. Numerous studies demonstrate that adding herbs and herbal products to a fish's diet not only improves the fish's health and resilience to disease, but it can also significantly lower the cost of feed [37]. As an outcome, various locally accessible herbs were chosen for the current investigation to evaluate

their nutritional value and antioxidant property. *Taraxacum officinale*, *Rumex obtusifolius*, *Plantago lanceolata*, and *Urtica dioica* are all locally available herbs in Kashmir valley with great nutritional and medicinal values.

Taraxacum officinale belongs to family *Asteraceae* (Sunflower family), commonly known as dandelion and locally and is a highly valued medicinal plant. It is known for having medicinal properties and has been used to treat a number of diseases. It is rich source of vitamin especially (Vitamin A and C and also minerals [28]. It has a variety of phytochemicals, such as terpenes, polysaccharides, alkaloids, oligosaccharides, flavonoids, and phenolic acids, it is employed to improve immune system, used as liver tonic, treat tract infections, anti-microbial and anti-inflammatory activities [16] it is having innumerable therapeutic properties but the most frequently reported therapeutic effects include hepatoprotection, anti-oxidant and anti-cancer activities.

Rumex obtusifolius belongs to family *Polygonaceae*, commonly known as Dock and locally called as Abuj. It is a perennial herbaceous flowering plant having a worldwide distribution. This plant has been utilized for many years as a therapeutic herb because of its excellent medicinal properties. It has therapeutic indications because it reduces the prevalence of chronic skin illnesses, liver disorders, anemia, and has laxative, diuretic, and soothing effects in addition to cleansing pollutants [16]. This plant has outstanding nutraceutical qualities and is a rich source of bioactive substances with strong antioxidant activity, such as phenolic, flavonoids, and flavonols [39,15].

Plantago lanceolata commonly called as ribwort belongs to family *Plantaginaceae* with worldwide distribution. Because of its bioactive components, this plant is utilized as a remedy in traditional medicine all over the world [32]. It possesses antioxidant qualities Hausmann et al, [18] Its beneficial impact on the healing of wounds,

growth promoting effect in quails [46]. It is also used to suppress upper respiratory inflammation, minimize skin inflammation, as a laxative, and to cure wounds [9].

Urticadioica (stinging nettle), is a perennial plant belonging to genus *Urtica* of family urticaceae has a long history of traditional medicinal uses in many countries of the world. It has a growth promoting effect, immune stimulatory effect, enables the fish to be more resistant against bacterial diseases.

The Kashmir ichthyofauna has been split up into three categories, viz., species of central Asiatic origin, those of Indian origin and exotic species introduced in recent past. The aquaculture practices of J&K is mainly based on carp culture. The experimental fish common carp (*Cyprinus carpio*, L) constitute dominant part of the fresh water fish catch of J&K. It is an exotic species, introduced to India in 1939 and today it is a dominant species of Kashmir waters. Due to its fast growth, tasty flesh, hardy nature, adaptability to cold waters and ease to breed in confined waters, common carp is regarded as best economic species for culture practices

Keeping in view the growth promoting and immuno-modulatory properties of selected herbs and also the importance of experimental fish, The goal of the current investigation was to assess the chemical makeup of the selected herbs. On the basis of chemical composition and antioxidant activity, one of the herb namely *Rumex obtusifolius* was selected. The powder of the herb was incorporated into the diet of common carp at different concentrations to evaluate the growth and haematological parameters.

MATERIALS AND METHODS

Collection of herbs

The four medicinal herbs viz *Rumex obtusifolius* (Abuj), *Plantago lanceolata* (Guli), *Taraxacum officinale* (Handd), and *Urticadioica* (Soi) were selected due to their abundance, free availability and medicinal uses. These herbs are available everywhere in Kashmir valley during summers.

The herbs are highly renowned for their medicinal uses and also used for human consumption. So, for the experimental purpose, these Herbs have been procured from Nunnar area of District Ganderbal, and also from the backyard of the FOFY, Rangil.

Preparation of herbs for evaluation

The collected herbs were cleaned by washing with water. The herbs were dried individually by sun drying for 3-4 days. After sun-drying, herbs were dried once again in hot air oven (UNI-TECH SCALES, Model No. 1.02) overnight at 105⁰C to obtain a fine powder after grinding. The completely dried herbs were grinded in laboratory grinder and sieved into fine powder. The powdered form of herbs was separately stored in air tight and tagged containers.

Chemical analyses of the herbs

The proximate analysis of each herb was carried out at fish nutrition and biochemistry lab, faculty of fisheries, SKUAST-K, according to standard methods of AOAC (1995). The proximate analysis of the herbs was done to assess their crude protein, lipid, carbohydrate, crude fiber, ash and moisture content.

Screening of medicinal herbal extracts for antioxidant characteristics

Free Radicals Scavenging

It was stated that the free radical scavenging activity exhibited action against the stable form of the synthetic product DPPH (2, 2-diphenyl-1-picrylhydrazyl) by the method of Bolyet *al.*, 2016. Three milliliters (3 mL) of DPPH in methanol (0.1 mmol/L) was mixed with 1 mL of the crude extract of medicinal herb in various concentrations (ranging from 0.0078 to 0.5 mg/mL). The mixture was mixed using a Vortex shaker and left to stand in absence of light for 30 min at room temperature. 517 nm was the absorbance measured using a UV-spectrophotometer (Phoenix-2000V UV-VIS, Biotech Engineering Management Co. Ltd. (UK), Nicosia, Cyprus). Percentage inhibition was computed utilizing the following equation:

$$(MA_b - MA_s/MA_b) \times 100$$

Where MA_b = Mean absorbance of the Blank.
 MA_s = the Mean absorbance of the sample. The 50% inhibition capacity of the medicinal herb equivalent of ascorbic acid was calculated by extrapolating the value from the most linear part of the medicinal herb percentage inhibition graph.

Experimental diets

After evaluating the chemical composition and antioxidant activity of each herb, *Rumex obtusifolius* manifested the best outcome of the four herbs hence it was selected to be incorporated in formulating diet for the experimental fish (Common carp). Five iso-nitrogenous (crude protein 32%) and Iso-caloric (400 kcal/100g) diets were formulated in which *Rumex obtusifolius* were added @ 0% for control diet, 2.5% for treatment 1, 5% for treatment 2, 7.5% for treatment 3 and 10% for treatment 4.

Formation and preparation of experimental diets

In Fish Nutrition and Biochemistry Lab, Faculty of Fisheries, Rangil, SKUAST-K, the experimental diets were prepared. Formulation of the diets was done by Pearson's square method. The ingredients used to prepare control diet include fishmeal, chickpeas, Rice bran, wheat bran, linseed oil cake, vegetable oil and vitamin and mineral premix. In the treated groups *Rumex obtusifolius* were added at different inclusion levels. Each ingredient was grinded and filtered to convert them into fine powder. Five types of Diets for experimentation were made using 32% crude protein. In the treated groups, chickpea was replaced by *Rumex obtusifolius* powder as per feed formula while keeping the concentration of other ingredients similar to that of control diet.

The concentration of *Rumex obtusifolius* for different experimental diets is

- 0% for control diet
- 2.5% for Treatment 1
- 5% for Treatment 2
- 7.5% for Treatment 3
- 10% for Treatment 4

The concentration of the chickpea in five experimental diets was changed in accordance with the change in the inclusion level of *Rumex obtusifolius*.

Proximate analysis of diets

The proximate analysis of diets i.e., ash, moisture, crude protein, and ether extract were measured in accordance with standard method of AOAC (1995). The experiment made use of CRD (Completely Randomized Design) for a period of 60 days in the wet lab of Fish Nutrition and Biochemistry, Faculty of Fisheries, Rangil. The experimental setup consisted of 20 circular tubs, divided into 5 treatment groups with 4 replicates for each treatment. 220 *Cyprinus carpio* fingerlings with a mean weight of (10 ± 2) g were randomly distributed in 5 distinct experimental groups, with 4 replicates in each group. 10 fish were placed in every tub. Aeration was provided in each tub with an air stone and a plastic regulator to control the air pressure uniformly in all tubs.

Experimental Fish

The healthy fingerlings of Common carp (*Cyprinus carpio* var *communis*) were bought from National Fish Seed farm (NFSF), Manasbal and transported to the on-campus experimental base at wet lab of Fish Nutrition and Biochemistry, Faculty of Fisheries, Rangil. Prior to feeding trial, the fish fingerlings were acclimatized and kept under starvation to completely evacuate the gut and in order to ameliorate the handling stress they were given a mild salt and $KMnO_4$ treatment on the next day. The fingerlings were domesticated in 4 tubs for seven days to adapt to the experimental diets and conditions. Feeding was done @ 5% of body weight throughout 60 days of experimental period. The daily ration was divided into 2 equal parts and was fed in morning at 9:00 am and in evening at 6:00 pm.

Physio-Chemical analysis of water

According to the APHA's (2012) and Adoni (1985) guidelines, weekly measurements of water quality indicators such as temperature, dissolved oxygen,

pH, ammonia, total alkalinity, and total hardness were made.

Growth Parameters

Sampling for the studies of growth parameters were done fortnightly. Growth parameters such percent weight increase, specific growth rate, feed conversion ratio, protein efficiency ratio and feed efficiency ratio were assessed at the end of the study period.

Blood Parameters

Changes in hematological markers such as packed cell volume (PCV), Hb, and total erythrocyte count (TEC) were examined at the conclusion of the experimental trial. To reduce stress, three fish were randomly chosen from each experimental group and given 50µl of clove oil per liter of water for anesthesia before having their blood drawn. Heparinized syringes were used to draw blood samples from the caudal vein. After the blood sample was obtained, it was promptly placed into EDTA tubes, and shaken well to prevent hemolysis of blood. Samples were then taken to Aquatic Animal Health and Management lab. For the determination of RBC count, Hemoglobin content and Packed cell volume (PCV).

Survival rate

Upon completion of the experimental trial, the number of the fish in each tub was counted after dewatering the tubs, and the rate of survival in each tub was calculated by the formula

$$\text{Survival (\%)} = \frac{\text{Total number of fish harvested}}{\text{Total number of fish stocked}} \times 100$$

Statistical Analysis

One-way ANOVA was used to analyze the results from the proximate analysis of herbs, fish growth, feed utilization efficiency, survival rate, and hemotological parameters. Version 20 of the SPSS software was used for all statistical analysis.

Results

Proximate Analysis of medicinal herbs

The approximate composition of plants namely *Rumex obtusifolius*, *Taraxacum officinale*, *Plantago lanceolata* and *Urticadioica* are presented in the table 2. Moisture, ash, crude protein, crude fiber, lipid content and carbohydrate content analyzed in each herb are represented in percentage. *Plantago lanceolata* had the least percent moisture content of 5.15% while as *Urticadioica* has the highest percent moisture concentration of 8.41%, Moisture content of *Rumex obtusifolius* and *Taraxacum officinale* was 7.98% and 8.38% respectively. The crude fiber recorded the lowest value of 6% for *Urticadioica* while as *Taraxacum officinale* has the highest fiber content of 15%. The crude protein content in *Rumex obtusifolius* is 7.76% which is comparatively higher than *Urticadioica* (6.30%), *Taraxacum officinale* (6.03%) and *Plantago lanceolata* (3.46%) respectively. Lipid content of *Taraxacum officinale* is 9.12% which is higher than *Urticadioica* (6.87%), *Plantago lanceolata* (5.80%) and *Rumex obtusifolius* (4.55%) respectively. Ash content in *Urticadioica* (14.97%) is comparatively higher than *Taraxacum officinale* (14.47%), *Plantago lanceolata* (13.21%) and *Rumex obtusifolius* (10.59%) respectively. The outcomes of the proximate analysis showed that *Rumex obtusifolius* gave the best result in terms of protein content, hence it was selected to be used as growth promoter and antistress in the diet of common carp. Four different concentrations i.e. 2.5%, 5%, 7.5% and 10% respectively were incorporated into the diet of common carp and subsequently protein source chickpea was replaced at same concentration to evaluate effect on growth and survival.

The antioxidant property of medicinal herbs

Different selected medicinal herbal extracts exhibited varying degrees of scavenging capacities based on their concentration. The scavenging capacity increased with the increasing concentration of different herbal extracts. The

maximum concentration (20mg/ml) showed the highest radical scavenging effect and the least concentration (5mg/ml) showed the lowest. The ability to scavenge radicals at a particular concentration (20 mg/ml) for different water-extracted medicinal herbal extracts exhibited different radical scavenging capacity which is statistically significant ($P<0.05$). The most amount of scavenging that was observed in *Rumex obtusifolius* (85%) followed by *Plantago lanceolata* (37.8%), *Urticadioica* (29.9%) and *Taraxacum officinale* (24.7%) (Table 3). Because *Rumex obtusifolius* has a strong ability to scavenge free radicals, it was chosen to be included in the diet of common carp fingerlings in order to monitor their growth and survival.

Proximate analysis of feed

Table 1 displays the approximate content of the various trial diets. In the groups receiving alternative treatments and control viz., T1, T2, T3, and T4, the per cent dry matter content analyzed was 87.0, 87.7, 88.2, 88.5 and 88.5 respectively. Crude protein % content estimated was 32.0 in T0, 32.0 in T1, 32.42 in T2, 32.82 in T3 and 32.82 in T4. The crude fiber % in T0, T1, T2, T3 and T4 estimated was 6.82, 7.03, 7.07, 7.21 and 7.21 respectively. The per cent lipid content estimated was 10.23, 9.82, 9.43, 10.64 and 10.69 in T0, T1, T2, T3 and T4 respectively. The ash content (%) was 6.65, 6.21, 5.79, 5.79 and 5.79 in T0, T1, T2, T3 and T4 respectively and gross energy was in the range of 406 kcal/g-425.95 kcal/g (table 5).

Proximate composition of experimental fish

The proximate composition of *Cyprinus carpio* fingerlings in different experimental groups at the end of the experimental period of 60 days is presented in table 4. The per cent moisture content analyzed in T0, T1, T2, T3, and T4 was 74.93, 70.49, 72.98, 71.08 and 73.95 respectively. The per cent crude protein content estimated in T0, T1, T2, T3, and T4 was 15.4, 16.2, 16.6, 16.0, and 16.9 respectively. The crude fiber % content analyzed in T0, T1, T2, T3, and T4 was 4.7, 4.6, 5.9, 4.4,

and 4.7 respectively. The per cent lipid content estimated in T0, T1, T2, T3, and T4 was 9.89, 10.18, 7.65, 9.36 and 10.62 respectively. And the ash content (%) in T0, T1, T2, T3, and T4 was 1.06, 1.07, 2.33, 1.59 and 1.01 respectively.

Growth Performance and body indices:

Table 5 displays the growth performance and body indices of the experimental groups after the feeding study has been underway for 60 days.

Body weight gain:

To prevent the early fluctuation in body weight, the body weight of each experimental group was measured after every 15 days and expressed as a percentage. There was a significant difference ($P<0.05$) in the weight increase percentage between the treatment groups. The T0 group had the lowest weight growth (185.12 ± 1.86 g) and the T3 group had the highest weight gain (257.21 ± 1.64 g), which differed substantially from the other treatments. While there were no notable differences between the other treatment groups, there was a substantial difference between them and the control group.

Specific growth rate:

The mean of the SGR of the T3 group (2.12 ± 0.01) was significantly higher ($P<0.05$) than other treatment groups. The T0 group had the lowest reported SGR value (1.75 ± 0.01) which differed markedly from all the other treatment groups. The SGR of T1, T2 and T4 were significantly different from both T0 and T3 groups.

Feed conversion ratio:

The FCR of the different experimental groups varied significantly ($P<0.05$). The lowest FCR (1.91 ± 0) was recorded in the T3 group and the highest FCR (2.24 ± 0.01) was recorded in T0 group. Treatment groups T1, T2 and T4 are significantly different from T3 and T0 groups.

Protein efficiency ratio:

The group receiving treatment T3 had a substantially different PER value (1.71 ± 0) compared to the other treatments. The T0 group had the lowest value (0.99 ± 0), which distinguished it significantly from the other experimental groups.

Survival:

Upon completion of the 60-day study period, the T3 group's survival rate (7.5% extract) was observed to be 97.5 ± 2.5 , indicating a significant difference ($P < 0.05$) from the other groups. In the Control group (0% extract), the survival (%) was (75 ± 2.89), (82.5 ± 4.79) in T1 (2.5% extract), (87.5 ± 2.5) in T2 (5% extract), and (90 ± 4.08)% in T4 (10% extract). In T3, the relative survival rate was higher at 100%.

Haematological parameters

Blood haemoglobin

The hemoglobin content varies significantly ($P < 0.05$) between the various experimental groups (Table:6). The T0 group had the lowest value (5.8 ± 0.04), whereas the T3 group reported the highest (8.63 ± 0.05). Significant differences exist between various treatment groups as well as between them and the control group.

Total erythrocyte count (RBC)

A statistically significant ($P < 0.05$) variation in the red blood cell count was noted between the various treatment groups. The T3 group had the greatest RBC count (3.11 ± 0.06), whereas the T0 group had the lowest number (1.89 ± 0.03). The T3 group had the highest values, although the other treatment groups differed from the control groups significantly ($P < 0.05$).

Haematocrit (PCV) %

The haematocrit values of the various treatment groups differ significantly ($P < 0.05$). The T0 group recorded the lowest score (25.75 ± 0.48), whereas the T3 group reported the highest value (41 ± 0.41). The T1 and T3 groups showed significant differences ($P < 0.05$) from the other treatment groups.

Discussion

In the current study, an effort was made to employ a natural medicinal herb in the diet of common carp to reduce stresses like handling stress, inadequate water quality and high livestock density, stress due to confined condition, over

feeding etc. Keeping in mind the ill effects of synthetic medication, herbs were selected to overcome the stress in common carp which intern improve growth and immune parameters of common carp. The medicinal herb can be employed as additives and chemotherapeutics since they are abundant in a variety of nutrients. The primary sources of organic antioxidants and antibacterial substances are medicinal plants.

Since most of the medicinal plants have antioxidant activity which can lessen stress in the fish caused by overcrowding and poor nutrition. The purpose of the current investigation was to ascertain the impact of medicinal herbs on the growth parameters, hematology and survival of the *Cyprinus carpio* var *communis* fingerlings. Among the three medicinal herbs namely *Taraxacum officinale*, *Plantago lanceolata* and *Urticadioica* used in this study, *Rumex obtusifolius* was selected due to its higher nutrient content and antioxidant activity. For determination of antioxidant activity, a technique based on the reduction of 2,2-diphenyl-1-picrylhydrazyl (DPPH) was used. At room temperature, DPPH is stable and generates a violet colour in methanol. When an antioxidant interacts with this free radical, it loses its free radical property due to chain breakdown and turns into light yellow colour. Using the stable free radical (DPPH) the scavenging capacity of the herbal extracts in water to scavenge free radicals was evaluated. The extracts of different herbs showed a varying degree of scavenging capacities. The extract from *Rumex obtusifolius* showed the highest free radical scavenging efficacy, at 85% at a concentration of 20 mg/ml, followed by *Plantago lanceolata* (38%), *Urticadioica* (30%) and *Taraxacum officinale* (25%). To date, almost 268 chemical constituents from about 29 *Rumex* species have been reported. The primary chemical constituents are anthraquinones, flavonoids, tannins, stilbenes, naphthalenes, diterpene alkaloids, terpenes and lignins. These substances have a wide range of pharmacological activities including anti-inflammatory, antioxidant, antibacterial, antitumor

and anti-diabetic properties [20-22]. In addition to significant significance of Rumex in traditional uses, experts also believe that Rumex is a potential effective medicine of many diseases. Different studies have evaluated the presence of high content of bioactive compounds, antioxidant activity and nutritional value in *Rumex obtusifolius* [39]. This study is also reported elevated total phenolic compound content, flavonoids, and tannins in *Rumex obtusifolius* extract.

Proximate composition of medicinal herbs

Proximate analysis of all the selected herbs were carried out, and the best result in terms of nutrient content was shown by *Rumex obtusifolius* followed by *Urticadioica*, *Taraxacum officinale* and *Plantago lanceolata*. Mohammad *et al.*, [27], studied nutritive value and digestibility of *Rumex obtusifolius* and observed high crude protein content of (23.92%) in the vegetative growth and lowest value (6.11%) in maturity stage of this plant. This study is also in agreement with Michal [27], who noticed high content of protein in a hybrid *Rumex* in different periods.

Growth Parameters

When compared to fish fed a control diet, the inclusion of *Rumex obtusifolius* powder in the diets of common carp fingerlings had a substantial effect on the growth indices. When it came to feed conversion ratio, protein efficiency ratio, specific growth rate, and percent weight gain, fingerlings fed the experimental diet containing *Rumex obtusifolius* showed remarkably good growth.

BWG%

Pu *et al.* [35] stated that medicinal plants could improve growth performance in fish. There are several advantages due to bioactive substances on metabolism and their capacity to enhance protein synthesis and activate digestive enzymes. Numerous plants have been studied for their growth-promoting effect in *O. mossambicus* and *C. gariepinus*. There is evidence that these plants enhance growth

performance (weight gain, specific growth rate, feed conversion ratio, and feed intake) in *O. mossambicus* and *C. gariepinus*. In the present study, highest body weight gain% was recorded in the treatment group T₃ and lowest was observed in the control group T₀. Oparaku *et al.* [33] also found that *Z. officinale* powder improved growth performance in *C. gariepinus*. El-Dakar *et al.*, [13] observed similar findings in Gilthead sea bream (*Parusaurata*) and found that feeding basil seeds to significantly increased weight in the treatment groups compared to the control group. According to Dada and Ikuero [10], feeding *Caras gariepinus* brood stock with ethanolic extracts of *Garcinia kola* increased their growth. This shows that in addition to their antimicrobial actions, herbs, spices and different plant extracts have the ability to stimulate the appetite and the digestive system. According to Abbasi [2], *Zingiber officinale* had a favourable impact on the growing outcome of common carp (*Cyprinus carpio*). Garlic supplementation significantly improved Nile tilapia growth performance and weight gain [26]. Common carp fed with a meal supplemented with *Ocimum sanctum* experienced a considerable increase in weight gain [34]. Jian and wu [20] discovered a rise in the weight of common carp fed diets supplemented with a combination of Astragalus root (*Radix astragalin*) and Chinese angelica root (*Radix angelicae sinensis*), which are in line to the results of our study.

Specific Growth Rate

According to the current study, when compared to the control group, the fish in the treatment group (T₃) displayed the highest specific growth rate. (Table:6). The current study's findings are in agreement with Labh and Shakya [23] who demonstrated that incorporation of *Choerospondias axillaris* Roxb in feed of common carp increased specific growth rate significantly. Immanuel *et al.* [19] also noted that acetone extracts from *Cynodon dactylon*, *Aegle marmelos*, *Withania somnifera*, and *Zingiber officinale* increased the specific growth rate of fingerling

tilapia (*Oreochromis niloticus*) than those fed with control diet. According to Mahdavi *et al.*, [24], dietary Aleo Vera supplementation had a beneficial impact on the specific growth rate of common carp. Mohammad [8,29] found that feeding *Cyprinus carpio* with the diet containing Red paprika (*Capsicum annum*) and Turmeric (*Curcuma longa*) significantly increased the specific growth rate of the fish. Similar outcomes were reported when red sea bream (*Pagrus major*) were given the extracts from medicinal plants as growth promoting agents to enhance growth. Tadese *et al.* [43,44,47] reported that herbs are rich in various nutrients and bioactive substances that can promote the growth of aquaculture animals.

FCR

Feed conversion ratio (FCR) is an essential measure of the quality of fish feed. A lower FCR suggests higher utilization of the fish feed. FCR markedly reduced as dietary *Rumex obtusifolius* level was 7.5%. There was a noticeable change in the common carp's FCR. fed with 7.5% *Rumex obtusifolius* in contrast to the control. John Colt and Kenneth Semmens [22] reported that the food conversion ratio (FCR) is one of many available performance parameters that can be used for animal and plant production. Dada and Sonibare [10] who found that feeding diets containing *Chromolaena odorata* extract to *Clarias gariepinus* fingerlings significantly improved their feed conversion ratio. According to Abdelhadi *et al.* [4] *Artemisia cina* @ 3% and *Matricaria*

chamomilla @ 5% improved the FCR of *Clarias gariepinus*, an African catfish. Similarly, the FCR of hybrid tilapia (*Oreochromis niloticus* × *Oreochromis aureus*) fingerlings improved by incorporating increasing levels of dried basil leaves in their diet [13]. According to Shalaby *et al.*, [40], feed conversion ratio of *Oreochromis niloticus* decreased with increasing levels of *Allium sativum* and Chloramphenicol, supplementing the diet of *Oreochromis niloticus* fingerlings with dried fenugreek seeds considerably increased the feed conversion ratio in comparison to the control.

PER

In the current investigation, the treatment group (T3) that received dry *Rumex obtusifolius* powder had a significantly greater protein efficiency ratio than the control group. When Nile tilapia fingerlings were fed 10 g of caraway seed meal/kg feed, a better protein efficiency ratio was observed [7]. According to Ahmed *et al.* [7], the use of cinnamon in a diet for Nile tilapia fingerlings over a period of 12 weeks, gave the ideal outcome in terms of growth performance. According to Syeed *et al.*, [42], feeding common carp with diet enriched with fenugreek considerably increases the protein efficiency ratio of the fish. According to Abdel-Hakim *et al.*, [4], adding 3 grams of garlic per 1g of feed to the diet of Nile tilapia significantly improved weight gain, feed conversion and protein efficiency ratio.

Table 1: Proximate composition and formulation of the experimental diets (% , dry matter basis)

Ingredients	T0	T1	T2	T3	T4
Fishmeal	17.68%	17.68%	17.68%	17.68%	17.68%
Linseed oil cake	24.68%	24.68%	24.68%	24.68%	24.68%
Chickpeas	24.68%	22.18%	19.68%	17.18%	14.68%
<i>Rumex obtusifolius</i>	0%	2.5%	5%	7.5%	10%
Rice bran	12.98%	12.98%	12.98%	12.98%	12.98%
Wheat bran	12.98%	12.98%	12.98%	12.98%	12.98%
Mustard oil	5%	5%	5%	5%	5%
Vit. &min.mix	2%	2%	2%	2%	2%

<i>Proximate composition (% dry matter)</i>					
Chemical composition	Control (0%)	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Dry matter (%)	87.0	87.7	88.2	88.5	88.5
Crude protein (%)	32.00	32.00	32.42	32.82	32.82
Crude fibre (%)	6.82	7.03	7.07	7.21	7.21
Ash (%)	6.65	6.21	5.79	5.79	5.79
Lipid (%)	10.23	09.82	09.43	10.64	10.69
Gross energy (Kcal/g)	406.20	409.53	412.57	425.95	425.95

Table 2: Proximate composition of medicinal herbs

Medicinal herbs	Nutrient parameters (g/100 g of dry weight)				
	Protein	Lipid	Fibre	Ash	Moisture
<i>Plantago lanceolata</i>	3.46%	5.80%	8.5%	13.21%	5.15%
<i>Urticadioica</i>	6.30%	6.87%	6%	14.97%	8.41%
<i>Rumex obtusifolius</i>	7.76%	9.55%	5.5%	10.59%	7.98%
<i>Taraxacum officinale</i>	6.03%	9.12%	15.5%	14.47%	8.38%

Table 3: Antioxidant activity of herbs by DPPH method

Herb	% of inhibition of DPPH activity		
	5(mg/ml)	15(mg/ml)	20(mg/ml)
<i>Rumex obtusifolius</i>	84.05±5.05 ^a	84.44±4.05 ^a	85.07±5.05 ^b
<i>Taraxicumofficinale</i>	21.85 ± 1.33 ^a	23.84 ± 2.33 ^b	24.75 ± 1.35 ^c
<i>Urticadiocia</i>	27.103 ± 3.78 ^a	27.101 ± 3.69 ^a	29.99 ± 3.78 ^b
<i>Plantago lanceolata</i>	30.86 ± 4.61 ^a	32.86 ± 4.60 ^b	37.86 ± 4.66 ^c

The data are expressed using mean±standard deviation. Each analysis was performed thrice (n=3). Different superscripts in each column after the standard deviation, according to Tukey's test, show a significant difference (p<0.05). DPPH is the abbreviation for 2,2-Diphenyl-1-picrylhydrazyl (C₁₈H₁₂N₅O₆).

Table 4: Proximate composition of experimental fish (Common carp)

Chemical composition	Control (0%)	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Moisture content (%)	74.934 ^a ±0.038	70.498 ^a ±0.041	72.981 ^a ±0.045	71.08 ^a ±0.037	73.953 ^a ±0.054
Crude protein (%)	15.400 ^b ±0.090	16.200 ^a ±0.101	16.600 ^a ±0.185	15.200 ^b ±0.038	16.900 ^c ±0.069
Crude fibre (%)	4.7±0.090 ^a	4.6±0.091 ^a	5.9±0.090 ^b	4.4±0.092 ^a	4.7±0.090 ^a
Ash (%)	1.068 ^b ±0.118	1.074 ^b ±0.097	2.335 ^a ±0.545	1.599 ^{ab} ±0.407	1.018 ^b ±0.093
Lipid (%)	9.890 ^a ±0.313	10.189 ^b ±0.252	7.652 ^c ±0.183	9.363 ^a ±0.097	10.622 ±0.352 ^c

The mean±standard deviation is used to express the results. Every analysis was carried out three times (n=3). According to Tukey's test, different superscripts in each column following the standard deviation indicate a significant difference (p<0.05).

Table 5: Growth performance of different experimental groups

Treatments	BWG%	FCR	FER	PER	SGR	SR
T ₀	185.12±1.86 ^a	2.24±0.01 ^e	44.65±0.22 ^a	0.99±0 ^a	1.75±0.01 ^a	75±2.89 ^a
T ₁	199.98±1.75 ^b	2.17±0.01 ^d	46.08±0.16 ^b	1.02±0 ^b	1.83±0.01 ^b	82.5±4.79 ^{ab}
T ₂	222.39±1.21 ^c	2.08±0 ^c	48.05±0.09 ^c	1.07±0 ^c	1.95±0.01 ^c	87.5±2.5 ^{bc}
T ₃	257.21±1.64 ^e	1.91±0 ^a	52.44±0.13 ^e	1.17±0 ^e	2.12±0.01 ^e	97.5±2.5 ^c
T ₄	231.38±1.37 ^d	1.96±0.01 ^b	50.91±0.15 ^d	1.13±0 ^d	2±0.01 ^d	90±4.08 ^{bc}

Data were presented as mean±SE. Significant differences exist between values with various superscripts in the same column (P<0.05)

Table 6: Hematological parameters of different experimental groups

Treatment	RBC's (×10 ⁶ /mm ³)	Hemoglobin (g/100ml)	Haematocrit (PCV) (%)
T ₀	1.89±0.03 ^a	5.8±0.04 ^a	25.75±0.48 ^a
T ₁	2.42±0 ^b	6.4±0.04 ^b	31.5±0.65 ^b
T ₂	2.65±0.03 ^c	6.73±0.05 ^c	34.25±0.48 ^c
T ₃	3.11±0.06 ^e	8.63±0.05 ^e	41±0.41 ^e
T ₄	2.84±0.03 ^d	7.2±0.04 ^d	37±0.41 ^d

Mean values bearing different superscripts in each column vary significantly (P<0.05). Data expressed as mean±SE.

Survival

Mortality may arise from stress related to chemical, biological, and physical disruptions in the parameters of water quality. In the current investigation, the control group's survival rate was 75%, which is comparatively lower than that of the treatment groups given diets supplemented with powdered *Rumex obtusifolius*. *Rumex obtusifolius* was added to treatment group T₃ at a 7.5% inclusion rate, resulting in a maximum survival rate of 97.5. This may be due to the active chemicals in *Rumex obtusifolius*, which function as antioxidants and lessen stress in fish. Mohaptra [30] reported that water hyacinth supplemented diet shows higher survival rate which is in agreement with the current study. Efflong [11] reported 80% survival rate by inclusion of 10% duckweed in the diet. Immanuel *et al.*, observed that feeding tilapia (*Oreochromis mossambicus*) a diet containing acetone extract from four medicinal plants increased the fish's growth, immunological response, and survival rate. Thus, the new study's findings concur with those of the authors who were previously mentioned.

Hematological Parameters

Hematological parameters are the indicators and reflection of the impacts of dietary treatments on

the animal in terms of the type, quality and amounts of feed ingested [14]. All hematological indices examined in this study (Hgb, RBCs, and PCV) for common carp showed a considerable rise. All treatment groups had considerably increased hemoglobin contents than the control group. Table: indicated that the treatment group T₃, which was fed 7.5% *Rumex obtusifolius*, had the highest hemoglobin levels. The RBC count increased in all treatment groups given medicinal herb; treatment group T₃ had the greatest RBC count when compared to the control group. Mehdi *et al.*, [25], reported that combined herbal extract (Coriander, common mallow, and oak acorn) diet when fed to common carp increased RBC's, WBC's, haematocrit, Hemoglobin and mean corpuscular volume in fish. In addition, Syeed *et al.*, [42] noted higher RBC, WBC, Hgb counts in *Cyprinus carpio* fingerlings fed diets supplemented with fenugreek. Similar findings were revealed by Saleh *et al.*, [3] who found the feeding *Echinacea purpurea* to Nile tilapia led to considerably higher total leucocyte counts after challenged with *Pseudomonas fluorescens*. Abasali and Mohamad, [1], reported that addition of ethanol extracts of four plants *Ocimum basilicum*, *Cinnamomum zeylanicum*, *Juglans regia* and *Mentha piperita* to the diet of *Cyprinus carpio*

significantly improved the haematological parameters of fish. Similar results have been reported by Subeena begum and Navaraj [41], who found the *Mystuskeletius* fed with two plants extracts (*Solanum trilobatum* and *Ocimum sanctum*) showed a significant rise in haemoglobin, WBC and RBC levels. Labeorohita fingerlings fed *Mangifera indica* kernels had higher levels of hemoglobin, white blood cells, and red blood cells compared to the control group, as reported by Sahu et al. [38]. Furthermore, some researchers discovered that fingerling Nile tilapia given a diet supplemented with cinnamon had increased hemoglobin and red blood cell counts. Bilal [12] report that rainbow trout given 0.5%–1.0% laurel powder had higher levels of blood leukocytes in all treatment groups; however, this increase was most pronounced in the 0.5% laurel powder treatment group. All the above mentioned works of researchers are in agreement with our study.

Conclusion

Since the herb *Rumex obtusifolius* is profusely available with less economic value it could be applied as a prophylactic measure in fish diets to reduce the stress and the cost of production. The result of the present study strongly suggests that *Rumex obtusifolius* affects growth performance, haematological parameters and survival rates of fish. The findings need to be verified through extensive field trials before being implemented into fish culture practices. Additionally, dose standardization is required in order to maintain significant responses.

Clinical Trial Number: Not applicable

Funding: - None

Conflict of Interest: - None to declare

Reference

1. Abasali, H., & Mohamad, S. (2010). Immune Response of Common Carp (*Cyprinus carpio*)

- Fed with. *Journal of Animal and Veterinary Advances*, 9(13), 1839-1847.
2. Abbasi, G.H., Kamali, A., Soltani, M. and Sharifian, M. 2017. Effects of Zingiberoficinale powder on growth parameters, survival rate and biochemical composition of body in juvenile Common carp (*Cyprinus carpio*). *Iranian Journal of Fisheries Sciences* 16(1): 67-85.
 3. Abdel-Hadi, Y.M., Saleh, O.A. and Akar, A.M. 2008. Study on the use of *Artemisia cina* L. (wormseed plants) and *Allium sativum* (garlic) in the control of Saprolegniosis in egg of *Cyprinus carpio* (Common carp) and *Hypophthalmichthys molitrix* (Silver carp). *Proceedings of the 30th Malaysian Symposium on Microbiology (MSM)*, Aug. 16-19, Kuantan, Malaysia. pp.571-573.
 4. Abdel-Hakim, N., Lashin, M., Ashry, A., & Al-Azab, A. D. (2010). Effect of fresh or dried garlic as a natural feed supplement on growth performance and nutrients utilization of the Nile Tilapia (*Oreochromis niloticus*). *Egyptian Journal of Aquatic Biology and Fisheries*, 14(2), 19-38.
 5. Aćimović, M., & Lončar, B. (2025). Ethnobotanical Review of Wild Edible Plants in Serbia. In *Exploring Traditional Wild Edible Plants* (pp. 233-292). CRC Press.
 6. Aghajanyan, A., Nikoyan, A., & Trchounian, A. (2018). Biochemical activity and hypoglycemic effects of *Rumex obtusifolius* L. seeds used in Armenian traditional medicine. *BioMed research international*, 2018(1), 4526352.
 7. Ahmad, M. H., & Abdel-Tawwab, M. (2011). The use of caraway seed meal as a feed additive in fish diets: Growth performance, feed utilization, and whole-body composition of Nile tilapia, *Oreochromis niloticus* (L.) fingerlings. *Aquaculture*, 314(1-4), 110-114.
 8. Aly, S. A., & Mohamed, M. F. (2010). *Echinacea purpurea* and *Allium sativum* as immunostimulants in fish culture using Nile tilapia (*Oreochromis niloticus*). *Journal of*

- Animal Physiology and Animal Nutrition, 94(5), e31-e39.
9. Baytop, T. (1999). Therapy with medicinal plants in Turkey (past and present) Publication of Istanbul University 312.
 10. Dada, A.A. and Sonibare, O.F. 2015. Effect of dietary administration of the herbal additive siamweed (*Chromolaena odorata*) on growth performance and haematological changes in *Clarias gariepinus* fingerlings. *Journal of Fisheries* 3(1): 221-226.
 11. Effiong BN, Sanni A, Fakunle JO (2009). Effect of partial replacement of fish meal with duckweed (*Lemna paucicostata*) meal on the growth performance of *Heterobranchius longifilis* fingerlings. *Rep. Opin.* 1(3):76-81.
 12. Elbesthi, R., Özdemir, K. Y., Tastan, Y., Bilen, S., and Sönmez, A. Y. (2020). Effects of Ribwort Plantain (*Plantago lanceolata*) Extract on Blood Parameters, Immune Response, Antioxidant Enzyme Activities, and Growth Performance in Rainbow Trout (*Oncorhynchus mykiss*). *Fish physiology and biochem.* 46 (4): 1295-1307
 13. El-Dakar, A.Y., Shalaby, S.M., Nemetallah, B.R., Salch, N.E., Sakr, E.M. and Toutou, M.M. 2015. Possibility of using basil (*Ocimum basilicum*) supplementation in Gilthead sea bream (*Sparus aurata*) diet. *Egyptian journal of Aquatic research* 41: 203-210.
 14. Ewuola, EO, Gbore, FA, Ogunlade, JT, Bandyopadhyay, R, Niezen, J, Egbunike, GN. (2008). Physiological response of rabbit bucks to dietary fumonisin: performance, haematology and serum biochemistry. *Mycopathologia*, 165:99-104.
 15. Feduraev, P., Skrypnik, L., Nebreeva, S., Dzhobadze, G., Vatagina, A., Kalinina, E., Pungin, A., Maslennikov, P., Riabova, A., Krol, O., Chupakhina, G. (2022) Variability of Phenolic Compound Accumulation and Antioxidant Activity in Wild Plants of Some *Rumex* Species (Polygonaceae). *Antioxidants* 2022, 11(2):311.
 16. Gulshan, A.B., Dasti, A., Hussain, S., Atta, M.I., Amin, M., and Khan, D.G. 2012. Indigenous uses of Medicinal plants in rural areas of Dera ghazi Khan, Punjab, Pakistan. *J. Agric. Biol. Sci.* 7:50-762.
 17. Hasani, A.H. (2022). Selected herbs as growth promoters in Aquaculture. *Research in Veterinary Science and Medicine*, 2:3
 18. Hausmann, M., Obermeier, F., Paper, D.H., Balan, K., Dunger, N., Menzel, K., Falk, W., Schoelmerich, J., Herfarth, H., Rogler, G. (2007) In vivo treatment with the herbal phenylethanoid lactone ameliorates intestinal inflammation in dextran sulphate sodium-induced colitis. *Clin Exp Immunol.* 2007 May; 148(2):373-81.
 19. Immanuel, G., Uma, R.P., Iyapparaj, P., Citarasu, T., Peter, S.M., Babu, M.M. and Palevesam, A. 2009. Dietary medicinal plant extracts improve growth, immune activity and survival of *Tilapia Oreochromis mossambicus*. *Journal of Fish Biology* 74: 1462-1475.
 20. Ji, S.C., Cong, G.S., Im, G.S., Lee, S.W., Yoo, J.H. and Taki, K. (2007a). Dietary medicinal herbs improve growth performance, fatty acid utilization and stress recovery of Japanese flounder. *Fisheries Science* 73: 70-76.
 21. Jing Jing, Huizhen Li, Cheng Li, Mengjie Xu, Yana Zhao, Jianlan Cui & Zhijun Zhang (2025). Physicochemical, rheological properties, and hypoglycemic activities of polysaccharides from *Hemerocallis citrina* Baroni leaves and stems. *J. of Food Measure. & Character*, 19, 4755-4768.
 22. John Colt, Kenneth Semmens (2022). Computation of feed conversion ratio (FCR_{plant}) and plant-fish mass ratio (PFRM) for aquaponic systems. *Aquacultural Engineering*, Volume 98, 102260.
 23. Labh, S.N. and Shakya, S.R. 2016. Effects of dietary lassi (*Choerospondias axillaris* Roxb.) on survival, growth and protein profile of Common carp (*Cyprinus carpio* L) fingerlings. *International Journal of Zoolo Studies* 1(5): 36-41.

24. Mahdavi, M., Hajmoradloo, A. and Ghorbani, R. 2013. Effect of *AlOeverta* Extract on Growth Parameters of Common Carp (*Cyprinus carpio*). *World Journal of Medical Sciences* 9(1): 55-60.
25. Mehdi Raissy, Hamed Ghafarifarsani, Seyed Hossein Hoseinifar, Ehab R. El-Haroun, Saeid Shahbazi Naserabad, Hien Van Doan (2022). The effect of dietary combined herbs extracts (oak acorn, coriander, and common mallow) on growth, digestive enzymes, antioxidant and immune response, and resistance against *Aeromonas hydrophila* infection in common carp, *Cyprinus carpio*, *Aquaculture*, 546, 737287
26. Metwally, M. A. A. (2009). Effects of garlic (*Allium sativum*) on some antioxidant activities in tilapia nilotica (*Oreochromis niloticus*). *World Journal of fish and marine sciences*, 1(1), 56-64.
27. Michal Rolinec (2018). Nutritional value of hybrid *Rumex patientia* L. x *Rumex tianschanicus* A. Los (*Rumex OK 2*) in different periods. *Acta fytotechnica et zootechnica*, 21(4):197-200.
28. Modaresi, M., Resalatpour, N. (2012). The Effect of *Taraxacum officinale* Hydroalcoholic Extract on Blood Cells in Mice. *Adv Hematol* 2012;2012:653412.
29. Mohammad, M.A. 2017. Influence of Different Levels of Turmeric *Curcuma longa* and Red Paprika *Capsicum annum* L. supplements on Growth Promoter and Chemical Composition of Common Carp *Cyprinus carpio* L. *Jordan Journal of Agricultural Sciences* 13(1): 55-64.
30. Mohapatra, S. B. (2015). Utilization of water hyacinth (*Eichhornia crassipes*) meal as partial fish protein replacement in the diet of *Cyprinus carpio* fry. *European Journal of Experimental Biology*, 5(5), 31-36.
31. Mohiseni, M. (2017) Medicinal Herbs, Strong Source of Antioxidant in Aquaculture: A Mini Review. *Mod Appl Pharm Pharmacol*. 1(1).
32. Niziol-Lukaszewska, Z., Gawel-Baben, K., Rybczynska-Tkaczyk, K., Jakubczyk, A., Karas, M. and Bujak, T. (2019). Biochemical properties, UV-protecting and Fibroblast growth-stimulating activity of *Plantago lanceolata* L. Extract. *Ind Crop Prod* 138: 111453.
33. Oparaku, N F., Ijem, N and Nduka, JC (2021). Growth performance of *Clarias gariepinus* (African Catfish) juveniles fed *Zingiber officinale* (Ginger) and *Moringa oleifera* bark supplemented diets. *Academia Journal of Medicinal Plants*, 9(9): 147-153.
34. Pavaraj, N.M., Balasubram, V, Baskaran, S. and Ramasamy, P. 2011. Development of immunity by extract of medicinal plant *Ocimum sanctum* on Common carp *Cyprinus carpio* (L), *Research Journal of immunology* :12-18.
35. Pu, H., Li, X., Du, Q., Cui, H., & Xu, Y. (2017). Research progress in the application of Chinese herbal medicines in aquaculture: a review. *Engineering*, 3(5), 731-737.
36. Punitha, S.M.J., Babu, M.M., Sivaram, V., et al. (2008) Immunostimulating influence of herbal biomedicines on nonspecific immunity in Grouper *Epinephelus tautoga* juvenile against *Vibrio harveyi* infection. *Aquaculture International*, 16, 511–523.
37. Ram Prakash Raman (2017). Applicability, Feasibility and Efficacy of Phytotherapy in Aquatic Animal Health Management. *American Journal of Plant Sciences*, 8, 2.
38. Sahu, S., Das, B.K., Mishra, B.K., Pradhan, J. and Sarangi, N. 2007. Effect of *Allium sativum* on the immunity and survival of *Labeo rohita* infected with *Aeromonas hydrophila*. *Journal of Applied Ichthyology* 23: S0-86.
39. Sganzerla, W. G., Schmit, R., Melo, M. D., Azevedo, M. S. Ferreira, P. I., Veeck, A. P. L., Ferrareza, J. P. (2019) *Rumex obtusifolius* is a wild food plant with great nutritional value, high content of bioactive compounds and antioxidant activity. *Emirates Journal of Food and Agriculture*, v. 31, n. 4, p. 315-320.
40. Shalaby, A. M., Khattab, Y. A., & Abdel Rahman, A. M. (2006). Effects of Garlic (*Allium sativum*) and chloramphenicol on growth performance, physiological parameters

- and survival of Nile tilapia (*Oreochromis niloticus*). *Journal of Venomous Animals and Toxins including Tropical Diseases*, 12, 172-201.
41. Subeena begum, S. and Navaraj, P.S. 2016. Dietary supplement of mixture or medicinal plant leaf extracts on immune response of fresh water fish *Mystus keletius*. *International Journal of Applied Research* 2(2): 361-364.
42. Syeed, F., Sawant, P. B., Asimi, O. A., Chadha, N. K., & Balkhi, M. H. (2018). Effect of *Trigonella foenum-graecum* seed as feed additive on growth, haematological responses and resistance to *Aeromonas hydrophila* in *Cyprinus carpio* fingerlings. *Journal of Pharmacognosy and Phytochemistry*, 7(2), 2889-2894.
43. Tabassum, M. (2019). A review on pharmacological and phytochemical study on Bangladeshi medicinal plants (Doctoral dissertation, Brac University).
44. Tadese DA, Song C, .C, et al. (2021). The role of currently used medicinal plants in aquaculture and their action mechanisms: A review. *Rev Aquac*. 00:1– 32.
45. Talpur, A.D., Ikhwanuddin, M. and Ambok Bolong, A.M. (2013) Nutritional effects of ginger (*Zingiber officinale* Roscoe) on immune response of Asian sea bass, *Lateolabrax japonicus* (Bloch) and disease resistance against *Vibrio harveyi*. *Aquaculture*, 400–401, 46–52.
46. Temur, C., Uslu, S. (2019) Effects of Plantain (*Plantago lanceolata*) containing diets of quails on growth performance, carcass characteristics, some blood parameters and mast cell numbers. *Yuzuncu yil Universitesi Tanım Bilimleri Dergisi* 29: 114-120.
47. Tiaieiyu, A. M., Bolaji-Alabi, F. B., Okocha, R. C., Olatoye, I. O., & Adedeji, O. B. (2023). Analyzing the Ability of Various Chosen Medicinal Herbs to Cure Wounds in African Catfish (*Clarias gariepinus*, Burchell 1822). *Journal of Aquaculture & Fish Health*, 12(3).
48. Zare, M., Tran, H.Q., Prokešová, M., and Stejskal, V. (2021) Effects of Garlic *Allium sativum* Powder on Nutrient Digestibility, Haematology, and Immune and Stress Responses in Eurasian Perch *Perca fluviatilis* Juveniles. *Animals* 2021,11, 2735.
49. Zhenzhu Sun , Xiaohong Tan , Zonglu Wei , Qingying Liu , Haobin Mai , Yang Liu , Bo Liu , Yutong Zhuang , Danyang Zou , Wenqiang Zhang , Xinting Liu , Chaoxia Ye (2022). Effects of dietary dandelion extract on the growth performance, serum biochemical parameters, liver histology, and immune and apoptosis-related genes expression of hybrid grouper (*Epinephelus lanceolatus* ♂ × *Epinephelus fuscoguttatus* ♀) at different feeding period. *Fish Shellfish Immunol*, 120: 280-286.