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Dietary medicinal herbs improve survival specific growth rate and some blood parameters in *Schizothorax niger* heckel

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Abstract

The herbs and herbal products added to the feed cure many diseases, promote growth, reduce stress, improves some blood parameters and prevent infections in fish under culture. The addition of herbs and herbal products in fish diet is cheaper and environmentally friendly with low side effect to the fish and consumers. The effects of dietary medicinal herbs on growth was investigated in *Schizothorax niger*. The fish (mean body weight 160.0 ± 0.8 g) were fed fishmeal diets supplemented with either *Massa medicata* (Mm) or *Artemisia capillaries* (Ac), or a mixture of both the herbs (Mix.) and a control diet without medicinal herbs, for 10 weeks. Survival, specific growth rate, feed efficiency, condition factor, Haematocrit levels and hemoglobin levels were higher in fish given herbal diets than fish given the control diet without herbs. Significantly higher serum high density lipoprotein-cholesterol level and lysozyme activity were detected in HM diet groups. However, significantly lower serum alanine aminotransferase and aspartate aminotransferase activities were obtained in all herbal diet groups compared with the control diet group. The lowest survival was obtained in the control group. These results reveal that medicinal herbs in diets enhance growth of *Schizothorax niger*.

Keywords: growth performance, medicinal herbs, juvenile *Schizothorax niger*

Introduction

Schizothorax niger is an important aquaculture species in Kashmir India. Fish of commercial importance are farmed in captivity under controlled conditions to fulfil the demand of white meat for human consumption. In commercial fish farming, the production is maximized by increasing the weight of individual fish. An artificial feed used in the aquaculture improves fish growth with maximum weight in short time. New substances are added in fish feed to improve feed conversion efficiency that result in fish growth. Many studies show that inclusion of herbs in fish diet has positive effect on growth and disease-free fishes. Recently, consumer demand for farm fish has increasingly stressed quality and safety, and the absence of concomitant pollutants, antibiotics, and carcinogens. Therefore, the rearing strategy needs to focus on meal quality through feed hygiene in addition to growth performance, which was often the only focus in the past. This strategy has hastened the search to identify and develop safe dietary supplements and additives that enhance the life activity, health, and immune systems of farm fish. Medicinal herbs are efficacious for growth, health management etc for all aquatic and terrestrial life forms. They are herbal in nature and mainly from vegetables and are popular medicines in Asia including, our Kashmir India. In traditional Indian medicine, several herbs are often administered at the same time, which creates synergistic effects on various biological functions and mechanisms. Medicinal herb treatments are now paid considerable attention for their potential to improve Western medicine. Some studies have been done in which herbs, as dietary additives, were fed to fish. The focus of these studies includes their use as feeding attractants, and their effects on growth, survival, and longevity. In the present study we intended to ascertain whether medicinal herbs included in the diet enhance the growth performance, survival etc. of *Schizothorax niger*.

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Table 1: Formulation and chemical proximate composition of basal diet (% of dry matter)

Ingredients	Basal diet
Brown fish meal	53%
Soybean meal	10%
Wheat gluten	9%
Fish oil	9%
a-Potato starch	6%
Vitamin mixture	4%
Mineral mixture	4%
Proximate analysis (% of dry matter basis)	
Crude protein	49.0
Crude lipid	12.0
Crude sugar	16.3
Crude ash	11.3

Materials and Methods

Dietary formula and proximate composition are given in Table 1. The basal diet was composed of 53% brown fish meal, 10% soybean meal, 9% wheat flour, 9% fish oil, 6% a-potato starch, 4% vitamin mixture, and 4% mineral mixture. Medicinal herbs were added to this diet. We prepared two kinds of medicinal herbs: *Lonicera japonica* and *Ganoderma lucidum*. We also prepared a mixture of the above (HM) containing Mm/Ac in dry weight ratio 2:1. Herbal diets were prepared by adding 0.5 g herb to 100 g basal diet and mixing well with 30 mL tap water. The herbs used in the present study have been recognized for their positive functions on terrestrial animals, fishes and humans. Their supplemental level of 0.5% referred to the usage with these animals. Six moist pellet test diets, including the basal control diet, each 5 mm in diameter, were prepared using a pellet machine and stored at -20 °C until use.

Schizothorax niger with mean body weight 160.0 ± 0.8 g were already present in a fish farm at Anantnag Kashmir India. Two Groups of 10 fishes each were maintained in two different rearing ponds and acclimatized using the control diet for two weeks. The rearing trial was performed in triplicate for each diet. The fish were fed the diets twice a day (10:00 and 15:00 hours) until apparent satiation for 12 weeks.

At the end of the acclimatization and rearing trial, body weight and length were measured in each of the two ponds. Specific growth rate, feed efficiency (weight gain \times 100/feed intake), and condition factor were calculated. After the final weighing, six fish were randomly removed from each diet group, and blood was collected with a heparinized syringe by utilizing many techniques for the collection of blood e.g. Heart punctures, severing of caudal peduncle (Blaxhall and Daisley, 1973; Hatting 1975). Blow was given on the head of the fish and the needle was inserted at an angle of 45° in to the heart and the blood was collected in to the glass tubes already containing EDTA (Ethylene diamine tetra acetic acid). We determined haematocrit value (Ht), hemoglobin level (Hb), serum aspartate aminotransferase (GOT), alanine aminotransferase activities (GPT) and high-density lipoprotein-cholesterol level (HDL-CHO). These values were assayed using commercial kits (sigma-Aldrich-MAK115, India). Liver and viscera were also removed and weighed for calculating hepatosomatic (HSI) and viscerosomatic indices (VSI). Proximate compositions of diet and carcass at the end of the rearing trial were assayed by the AOAC method. Data was analyzed by one-way analysis of variance (ANOVA). When differences were found among dietary treatments, Duncan's multiple range test was used to compare the mean Differences were considered significant at $P < 0.05$.

Table 2: Growth performance and survival rate of red sea bream fed diets containing different medicinal herbs for 12 weeks

Diet groups	Initial	Final	SGR (%)	FE (%)	DFI (%)	Survival rate (%)
Control	21.1 \pm 0.2	58.4 \pm 2.2	1.07 \pm 0.05	56.7 \pm 3.2	2.36 \pm 0.07	81.0 \pm 5.3
Mm	21.2 \pm 0.1	61.2 \pm 1.8	1.12 \pm 0.03	62.8 \pm 1.6	2.28 \pm 0.10	92.0 \pm 2.7
AC	21.2 \pm 0.1	68.9 \pm 2.8	1.25 \pm 0.05	58.5 \pm 3.3	2.65 \pm 0.06	92.0 \pm 2.7
Mix.	22.9 \pm 0.2	79.4 \pm 4.7	1.42 \pm 0.07	71.4 \pm 2.9	2.59 \pm 0.21	93.3 \pm 3.6

Values are mean standard deviation (SD) of three groups of fish ($n = 3$). Within a column, values with different superscripts are significantly different ($P < 0.05$). SGR, specific growth rate; FE, feed efficiency; DFI, daily feed intake.

Results

There was no difference in feed intake among the dietary treatments in the rearing period. Survival of fish fed herbal diets was higher than in the control group, for specific growth rate, the Mix. Diet group was 1.42% and Mm and Ac diet groups were 1.12-1.25%. Rates of Mm and control diet groups were less than 1.12%, significantly lower than other groups ($P < 0.05$). Feed efficiencies of Ac, and Mix. Diet groups were 58-71%, but those of Mm, and control diet

groups were 62-56%. A significant difference in feed efficiency was found among Mix. and Ac and control diet groups (Table 2). The haematocrit value and hemoglobin level showed no differences among the dietary treatments. Serum GOT and GPT activities of Ac, and Mix. Diet groups were lower than the control diet group. Serum HDL-CHO level was higher in Ac and Mix. Diet groups than in the Mm and control diet groups (Table 3).

The HSI and VSI showed no differences among the dietary treatments. The CF of diet HM group was higher than other dietary groups. Carcass moisture, crude protein, crude lipid, and crude ash contents at the end of the rearing trial were approximately 68, 18, 9, and 5.5%, respectively, and showed no significant differences among the dietary treatments (Table 4).

Table 3: Haematology and concentration of plasma GOT and GPT of red sea bream fed diets containing different medicinal herbs for 12 weeks

Diet groups	Haematocrit (%)	Hemoglobin (mg/dL)	GOT (Karmen/mL)	GPT (Karmen/mL)	HDL-CHO (mg/dL)
Control	31.8 \pm 3.3	5.40 \pm 0.92	24.7 \pm 9.1	18.5 \pm 6.4	141.0 \pm 20.7
Mm	32.7 \pm 3.5	6.95 \pm 0.41	10.5 \pm 1.7	20.3 \pm 3.3	117.3 \pm 1.9
Ac	32.7 \pm 2.1	6.85 \pm 0.62	9.7 \pm 3.5	5.8 \pm 0.3	168.4 \pm 32.0
Mix.	31.7 \pm 1.4	7.25 \pm 0.81	8.8 \pm 0.2	6.4 \pm 2.2	213.0 \pm 11.8

Values are mean \pm SD of three group of fish ($n = 3$), with six fish per group per pond. Within a column, values with

different letter superscripts are significantly different ($P < 0.05$).

Table 4: Proximate composition of whole carcass and relative organ weights to somatic weight and condition factor (CF) of red sea bream fed diets containing different medicinal herbs for 12 weeks

Proximate composition of whole carcass (%wet matter basis)	Control	Mm	Ac	Mix.
Moisture	67.61 \pm 1.23	69.18 \pm 0.46	68.79 \pm 2.60	69.08 \pm 2.08
Crude protein	18.71 \pm 1.37	17.91 \pm 0.33	17.42 \pm 0.33	18.56 \pm 0.33
Crude lipid	10.02 \pm 1.41	9.47 \pm 0.58	9.00 \pm 0.34	8.53 \pm 1.07
Crude ash	5.95 \pm 0.30	5.47 \pm 0.47	5.57 \pm 0.65	5.36 \pm 0.32
HIS (%)	1.60 \pm 0.15	1.49 \pm 0.32	1.49 \pm 0.37	1.49 \pm 0.24
VSI (%)	5.99 \pm 0.98	6.16 \pm 1.51	6.21 \pm 0.59	6.60 \pm 1.01
CF	1.77 \pm 0.19	1.82 \pm 0.21	1.90 \pm 0.12	2.38 \pm 0.09

Hepatosomatic index = (hepatic wt/body wt) \times 100.

Viscerosomatic index = (viscera wt/body wt) \times 100.

Condition factor = (fish wt/fish length³) \times 100.

Discussion

There was no adverse influence of herbal diets on survival, weight gain, and feed intake of the fish in the present study. On the contrary, some of medicinal herbs and their mixture in diets induced higher growth performance than the fish fed the control diet. Kim *et al.*, suggested that unknown factors in various medicinal herbs led to favourable results in fish trials. Diet Ac, and Mix. Groups showed higher weight gain and feed efficiency than the control group. Final serum GOT and GPT activities and carcass lipid contents of diet Ac and Mix. Groups were slightly low, but their serum HDL CHO levels were higher than the control group. These changes might indirectly indicate that the herbs promote cellular lipid and fatty acid utilization and metabolism as an energy source, resulting in good growth performance with protein accumulation. It is known that the liver is rich in GOT and GPT and that damage to it may result in high serum GOT and GPT activities. Low serum GOT and GPT activities of diet Ac and Mix. Groups suggest healthy liver with negligible damage, supporting suppressed hepatic amino acid utilization. Ac have been reported to reduce serum GOT and GPT activities in other animals.

The diet Mix. Group was superior in growth performance and serum constituents than other herbal diet groups. The inclusion of herb mixtures in diets often provides cooperative action to various physiological functions, in contrast to a single herb dose. This synergistic effect of herbs has also been reported in other fish including Nile tilapia *Oreochromis niloticus* and rock bream *Oplegnathus fasciatus*. Our results are in accordance to Zeng (1996), who reported that adding 50 mg kg⁻¹ of synthesized allicin to tilapia diet increased more than 2-3% of its weight gain after 45 days of culture. The use of other culinary herbs such as red clover (*Trifolium pratense*), caraway (*Carum carvi*) and basil (*Ocimum basilicum*) have shown positive results as growth promoting agents in *Oreochromis niloticus*. Soltan MA has studied that Garlic supplemented diet improved weight gain (WG) and specific growth rate (SGR) in *Oreochromis niloticus*. Abdel Hakeem *et al.* studied *Oreochromis niloticus* fed with garlic supplemented diets which showed significant improvement in weight gain, feed conversion and protein efficiency. Labeo rohita fed with herbal supplemented diet improved feed consumption resulting in better growth due to high protein synthesis. *O. mossambicus* fed with diet containing Moringa oliefera showed maximum increased weight and specific growth rate. The maximum increase in length was observed in the fishes fed with *Ocimum basilicum* supplemented diet. Red

clover (*Trifolium pratense*) mixed with diet promoted growth in *Oreochromis aureus*. Juvenile pike perch fed on diets supplemented with medicinal plants grew faster than those fed with the control diet. In common carp *Cyprinus carpio* and red sea bream *Pagrus major* diet supplemented with medicinal plants improved growth. The use of Ginseng herb (Ginsana G115) in diet enhanced the growth in *Oreochromis niloticus* fingerlings.

From the results of this study, we concluded that *Schizothorax niger* achieve increased survival, weight gain, feed efficiency etc. dietary addition of a mixture of two herbs, Mm and Ac. In consideration of economical relevance, cheaper herbs and a lower dietary level are desirable. The herbs used in this study are popular and easy to obtain from markets in India.

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