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CONTENTS

Growth Performance of *Schizothorax richardsonii* fingerlings with different feeding strategies

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ABSTRACT: The objective of the present study was to enumerate the effects of feeding volume on growth rate of *Schizothorax richardsonii* fingerlings. A 30-days experiment was conducted to study the feed conversion ratio (FCR) of *S. richardsonii* fingerlings. FCR was calculated of the three treatments, T1 (basal fish feed), T2 (Periphyton) and in T3 (both periphyton and basal fish feed). Twenty fingerlings of 0.35 g average body weight were randomly stocked in each treatment. The feed was given at a rate of 4% of the wet body weight of the fingerlings. The fingerlings fed with both periphytons along with basal feed of treatment T3 showed significantly higher average body weight (0.51gm) as compared to other two treatments. The study revealed that FCR showed significant result with the lowest FCR value (0.07) and were positively correlated with average weight gain of the fingerlings in the case of third treatment (T3), These results showed that in captive condition the feeding preference of S. *richardsonii* fingerlings was basal fish feed and periphyton under coldwater conditions.

Key words: Basal fish feed, growth, FCR, periphyton, *Schizothorax richardsonii*

A key challenge confronting the globe today is how to feed the world's growing human population (estimated to reach 9.6 billion by 2050) with insufficient space available for farming. From a socioeconomic standpoint, increasing feed efficiency (FE) in animal agriculture should result in less rivalry for raw materials between humans and animals, as well as more food for humans, particularly the poorest, boosting their access to proteins and balanced nutrition.

In commercial aquaculture, feeding is essential, especially when it influences fish growth, health, and production costs (Cho *et al.*, 2003; Khan and Abidi 2010; Tian *et al.*, 2015).
Various culturable finfish species have been the subject of studies to determine the impact of feeding rate on growth, survival, feed intake, and body composition, among other factors such as common carp (Desai and Singh, 2009), mangrove red snapper (Abbas and Siddiqui, 2009), pigfish (Oberg *et al.*, 2014), blunt snout bream (Tian *et al.*, 2015), hybrid sturgeon (Luo *et al.*, 2015).

Fish growth is extensively influenced by a variety of parameters, including food type, food intake, feeding rate, feeding frequency, and the ability to absorb nutrients (Gelineau *et al.*, 1998; Akbulut *et al.*, 2013). The feed conversion ratio (FCR) is a useful tool for assessing the acceptability and suitability of artificial fish feed. Assessment of FCR is important to select new fish species with high potential for aquaculture to develop this growing industry. The snow trout, *S. richardsonii*, is a small indigenous coldwater fish known as Asela. It is a member of the family Cyprinidae, subfamily Schizothoracinae, and is found throughout the Himalayan and sub-Himalayan regions. *S. richardsonii* thrives in coldwater streams, lakes, and rivers and is commercially valuable due to its food value. As a result, it is frequently cultivated in the Himalayan hilly regions. *S. richardsonii* have a high commercial value, and their flesh is well-liked by humans. Furthermore, snow trout has a high market value and is a viable candidate species for diversification of Iranian aquaculture (Aghili, 2013; Rahdari *et al.*, 2014). As a result, the purpose of

this study was to examine the effects of feeding rate on the growth performance, feed conversion, and body composition of fingerling snow trout.

MATERIALS AND METHODS

Experimental procedure and procurement of periphyton and fish fingerlings

The field experiment was conducted at the ICAR-Directorate of Coldwater Fisheries Research (DCFR), Bhimtal, Uttarakhand, India; The experiment was designed for a field study of 30 days and conducted in the rectangular plastic tanks having the volume of length = 75 cm, width = 50 cm, height = 30cm; containing 112 L water in each tank. Natural periphyton was collected from a pond at DCFR which was grown on substrate of bamboo poles and plastic sheet, submerged in the water of the treatments T2 and T3, and was the main source of the food to the fingerlings in T2. The fingerlings of experimental fish were also collected from Sirodi stream located at Bhowali, district Nainital, Uttarakhand, and transferred in experimental tanks (T1, T2, and T3) along with replicates. In each experimental tank, twenty healthy fingerlings were stocked and measured for average initial size which was as 4.5 $\pm$ 0.2 cm in length and 0.35$\pm$ 0.2 gm in weight.

Preparation of experimental diets

For the field experimentation, three treatments and diets were prepared. (Table 1)**.** The basal feed ingredients taken were rice polish, wheat flour, mustard oil cake, fish meal and vitamin-mineral mixture, targeting the protein level of 28% (Table 2).

Feeding procedure and sampling

Feed was offered at 4% of wet body weight of fingerlings twice a day. Fingerlings were taken from each replicate on weekly basis for recording wet weight (g). The feed was stopped one day before the weight was recorded. The mean weight of fingerlings in each aquarium was calculated to work out the feeding rate for the next week. Following

Calculation

WG (g) = Final wet weight (g)-Initial wet weight (g)

$$FCR = \frac{\text{Feed intack (Dry weight in g)}}{\text{Body weight gain (wet weight in g)}}$$

Water quality Parameters

The water quality parameters like water temperature, pH, dissolved oxygen and free carbon dioxide were monitored daily while parameters like total alkalinity, level of ammonia, nitrite, nitrate were recorded fortnightly.

Statistical Analysis

The experimental data were subjected to one way ANOVA (analysis of the variance) to calculate the means and standard error values using IBM SPSS 26 software for the following analysis. Duncan's multiple range test was performed for post-hoc comparison of means for observing significant differences at a 5% probability level ($P<0.05$). The analyzed data were represented as means ± standard error.

RESULTS AND DISCUSSION

The proximate composition of basal feed and natural periphyton was analyzed by the AOAC method (1995) (Table 3)**.** The growth trend of *S. richardsonii* in terms of weight on basal fish feed (T1) during 1st and 2nd week was moderate. However, during the 3rd and 4th week, the fingerlings attained sharp growth. The growth pattern of *S. richardsonii* fingerlings with periphyton (T2) was different from the basal feed (T1). In the 1st week the fingerlings showed slow growth. In 2nd week the growth was somewhat similar to growth trend observed during 1st week. During 3rd and 4th week, fingerlings showed weight gain but not as good as treatment T1 and T3, the weight gain in treatment T2 was less in comparison to the other two treatments. The growth trend of *S. richardsonii,* fingerlings on basal fish feed given along with periphtyon (T3) showed sharp growth during the entire 4th week period and this growth

Table 1: Experimental feeding pattern in three treatments

Treatments	Feed type
T1	Feeding with only basal feed diet
T2	Feeding with only natural periphyton based diet
T3	Feeding with basal feed and natural periphyton based diet both

Table 2: Ingredient's composition in preparation of basal fish feed

Ingredients	Ingredients composition (%)
Rice polish	45
Wheat flour	3
Mustard oil cake	45
Fish meal	5
Vit. mineral premix	2

Table 3: Proximate composition of periphyton biomass and basal fish feed (%)

Parameters (%)	Basal feed	Periphyton biomass
Moisture	14.8	93
Crude Protein	28.15	27.18
Crude Fat	6.5	5.1
Crude Fibre	14.76	8.8

Table 4: Statistical results of Net weight gain in *S. richardsonii* fingerlings on weekly basis

Treatments	Weeks			
	1st	2nd	3rd	4th
T1	0.37 ± 0.02^{c}	0.4 ± 0.02^{c}	0.51 ± 0.01^{b}	0.64 ± 0.04^{a}
T2	0.36 ± 0.01^{c}	0.4 ± 0.01^{cb}	0.44 ± 0.01^{b}	0.56 ± 0.02^{a}
T3	0.38 ± 0.01^{d}	0.46 ± 0.04^{c}	0.6 ± 0.01^{b}	0.89 ± 0.01^{a}

Data expressed as Mean ± SE. Alphabetic subscripts (a, b, c, d) indicates significant differences within a row ($p \leq 0.05$).

Table 5: FCR of *S. richardsonii* fingerlings fed with experimental diets

Treatments	FCR
T1	0.13 ± 0.01^{b}
T2	0.23 ± 0.02^{a}
T3	0.07 ± 0.01^{c}

Data expressed as Mean ± SE. Alphabetic subscripts (a, b, c, d) indicates significant differences within a row ($p \leq 0.05$).

was higher than T1 and T2. The higher growth of fingerlings on basal fish feed and periphyton (T3) indicted that the response of the fish on T3 was better than T1 and T2. Statistical analysis revealed that the effects of three ingredients on average body weight of *S. richardsonii* among four weeks were significant ($P<0.05$). The weight gain was significantly higher

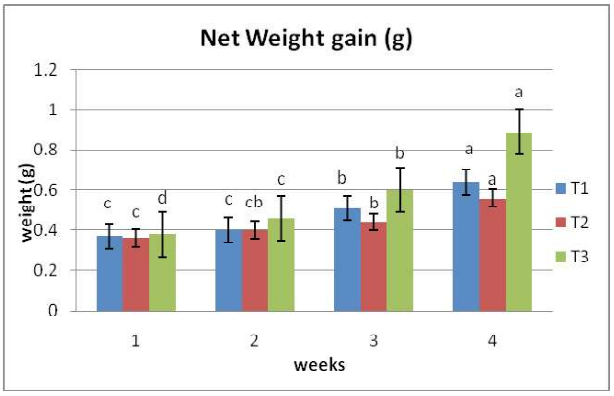


Fig. 1: Net Weight gain in *S. richardsonii* fingerlings fed with experimental diets

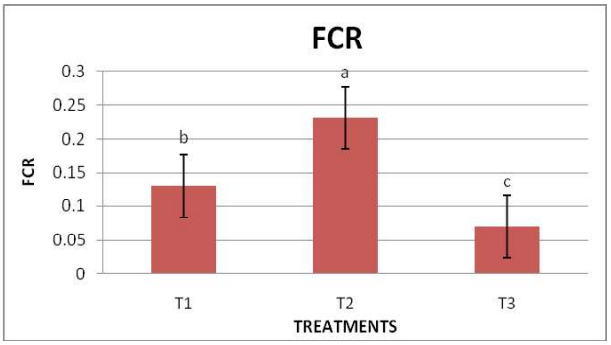
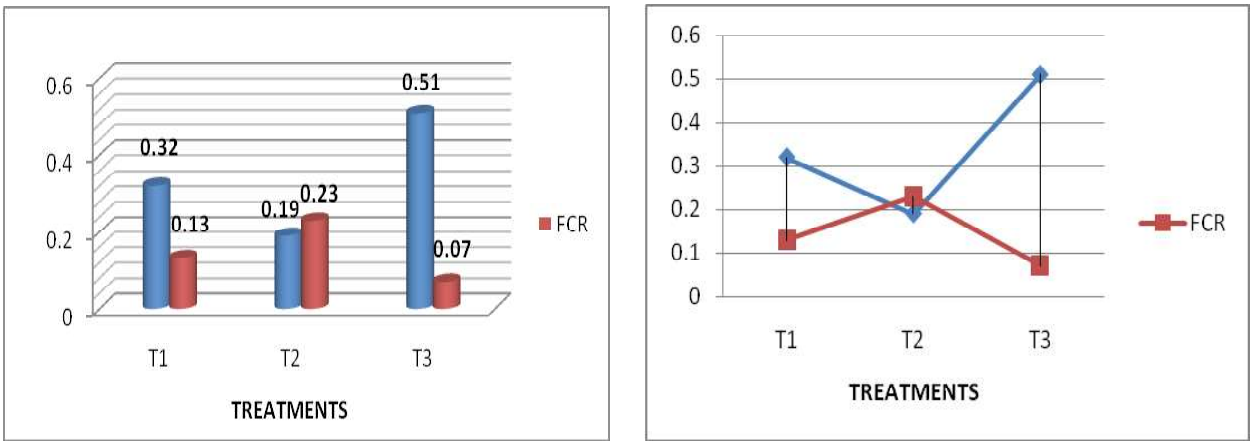


Fig. 2: FCR of *S. richardsonii* fingerlings fed with experimental diets

in T3 (0.51g), followed basal fish feed (0.32 g) and periphtyon (0.19 g). The interaction between weeks and treatments was also highly significant (Table 4, Fig1). Multiple comparison of mean values of three treatments showed that the growth of fingerlings was significantly higher on T3, followed by T1 and T2. Fig.2 represents the trend followed by the FCR values of *S. richardsonii* fed on three treatments. The highest FCR value was recorded in treatment T2 (0.23) while the lowest value was recorded in T3 (0.07) (Table 5). Lower FCR value indicated that the fingerlings had converted this ingredient more efficiently into flesh as compared to periphyton. Statistical analysis revealed that FCR values of *S. richardsonii* on three ingredients differed significantly ($P < 0.05$).

The overall growth pattern of fingerlings *S. richardsonii* remained highest for basal fish feed along with periphyton (T3) followed by basal fish feed (T1) and Periphyton (T2). Also, the FCR of



(a) (b)

Fig. 3 a and b: FCR and Average fish weight gain (g) relation of *S. richardsonii* fingerlings fed with experimental diets

the fingerlings of the 3 treatments were positively correlated with the average fish weight gain. (Fig 3 a and b)

The recorded physicochemical parameters in the experimental tanks were in optimum range and permissible limits. Observed water quality parameters were observed as temperature (18-24.4p C), dissolved oxygen (6.0 to 8.4 mg/l), pH (7.0-7.6), total alkalinity (80-152 mg/l), free carbon dioxide (nil to 2 mg/l.), Ammonia (nil to 0.035mg/l), Nitrite-N (nil to-0.035mg/l and Nitrate-N (nil to 0.15mg/l).

Feeding rate is considered as an important factor for affecting growth in fish. Proper determination of optimal values for this factor is necessary for a better aquaculture production. In the present study, the feeding strategies had significant effects on the growth, weight gain and FCR of *S. richardsonii* among the three different treatments. Kisan, 2000 stated that the fermented feed is very rich in nutrient as compared to the non fermented feed and has better results in fish growth. The Net weight gain of *S. richardsonii* was recorded highest when fed with both basal fish and periphyton diet in treatment T3. Determining the food-conversion ratio (FCR) is a common method for estimation of the nutritional value. In present study, the FCR of the fingerlings in T3 was the lowest i.e., 0.07, lower FCR value indicated better food utilization. The calculated FCR value in present study are in the conformity of the previous study with feeding strategy conducted by Kunjwal *et.al.* (2020) where the FCR of the fish pooled in the raceway R1 was 6.85, while it was 3.74 for the fish of the raceway R3. The study reported that the low value of FCR of the fishes of R3 may be due to the combined effect of natural and artificial feeding. The lower the FCR value, higher the weight gain obtained from the feed. When applied to aquatic animals, this FCR is generally lower than that of land animals. In the present study the growth pattern of fingerlings *S. richardsonii* remained highest for basal fish feed along with periphyton (T3) Also the FCR of the fingerlings of the 3 treatments were positively correlated with the average fish weight gain. The correlations recorded in the present study were similar to the results given by Gélineau *et al.* (1998), who reported that the feed intake, protein intake and FCR were positively correlated with average fish weight gain in rainbow trout (*Oncorhynchus mykiss*) fed on demand with self-feeders.

CONCLUSION

It is concluded from the results of this field study that lower FCR value indicated that the fingerlings had converted the ingredient more efficiently into flesh as compared to periphyton. Also, both basal fish feed and periphyton given together to a fish can be economical and productive, also it can reduce the cost of basal feed (artificial feed) when given with the periphyton depending on the feeding habits

of the species. Also, basal fish feed and periphyton supplementation shows a positive effect on the growth and survival of fish without deteriorating the water quality.

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