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Effect of duckweed (*Lemna minor*) supplemented diet on growth performance and proximate composition of *Labeo rajasthanicus* (Datta and Majumdar, 1970) fingerlings

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Abstract
The present study was conducted to evaluate the effect of duckweed *(Lemna minor)* supplemented diet on the selected aspects of growth and proximate composition of *Labeo rajasthanicus* fingerlings. The net weight gain, percent weight gain, specific growth rate (SGR), food conversion ratio (FCR), and gross conversion efficiency (GCE) in fingerlings fed with different levels of duckweed (*Lemna minor*) mixed diets. The highest value of Net weight gain (2.02g ±0.0246), percent weight gain (5.131% ±0.0512), SGR (0.714% ±0.0071), FCR (4.416 ±0.0787) and GCE (0.239 ±0.0024) were reported in T_2 (*Lemna minor*) as compared to other experimental diets including control. The best and safe levels of supplementation of duckweed (*Lemna minor*) in the feed of *Labeo rajasthanicus* fingerlings in the present study were found to be at 20% duckweed.

Keywords: Growth, duckweed (*Lemna minor*), proximate composition of fish

Introduction
Indian fisheries and aquaculture, is an important food production sector providing nutritional food security, employment livelihood support, earning foreign exchange to millions of people and giving major contribution in agricultural exports. The global fish production of 179 million tonnes (contributed by fisheries and aquaculture) in 2018, with aquaculture representing 46% and 53% of non-food uses (including deficiency to fish meal and fish oil) are renounced. India is now the second largest fish producing country in the world after China (FAO, 2018) [10]. The total fish produced during 2017-18 was 12.59 million metric tonnes (MMT) with a contribution of 8.90 MMT from inland fisheries and 3.69 MMT from the marine sector. Notably annual average growth rate of fisheries India was 10.14% in 2017-18 (Handbook of Fisheries Statistics, 2019) [11]. Rajasthan is considered as one of the largest state of India by area. The state has ample number of freshwater water resources as it has 4.23 lakh ha freshwater area besides 0.30 lakh ha area as rivers and canals, 0.80 lakh ha waterlogged area, 2.70 lakh ha reservoirs and 0.40 lakh ha area of ponds and tanks at full tank level. Average fish production of the state is reported to be 200 kg/ha (DoF, Rajasthan and Yadav *etat.* 2020) [12, 17]. *Labeo rajasthanicus,* locally known as sarsi, is one of the important minor carp which is native and endemic to South Rajasthan. Among the carps, it is a very important alternate species merits for diversification in freshwater aquaculture in our country as visibly it has good market value in some regions of India. This species also has potential for inclusion in composite culture (Lal *et al*., 2015) [13]. Moreover, this fish has been reported from the two rivers, Tidi and Chambal and also from Jaisamand Lake. *L. rajasthanicus* has been recorded from rocky substrates with shelter and higher depth (5-20 m), with relatively low water flow (Lal *et al*., 2015) [13]. *Labeo rajasthanicus* has been taken an experimental fish for the present study. The fish species was reported for the first time in western region of Rajasthan from Jaisamand Lake (Datta and Majumdar, 1970) [6].

Materials and methods
Experimental Fish:
The fingerlings of *Labeo rajasthanicus* (Datta and Majumdar, 1970) [6] were used for the experiment. The stock of *Labeo rajasthanicus* fingerlings of almost similar size was procured from the Aquaculture Research and Seed unit of DOR, MPUAT, Udaipur.

Basal diet
The basal (control) diets were prepared by mixing different ingredients (Table 1).

Table 1: The details of the ingredients used for basal diets (%)

S. No.	Ingredients	Amount (%)
1	Soybean meal	20
2	GNOC	30
3	Rice bran	40
4	Corn flour	5
5	Wheat flour	4
6	Mineral mixture	1
7	Duckweed	0
8	Total	100

Experimental Diet
Carp feed was formulated using groundnut cake, rice bran, soybean meal, wheat flour, corn flour, mineral mixture and duckweed (*Lemna minor*). The fresh *Lemna minor* from a natural water body near Jaisamand was collected for use. The duckweeds so collected were cleaned, air-dried and powdered before use. The details of different ingredients and the treatment are given in (Table 1). The treatment tank T_0 considered as control which was without duckweed (*Lemna minor*), while groups T_1, T_2, T_3, and T_4 were supplicated with duckweed (*Lemna minor*) and added at @ 10,20, 30 and 40 % to the basal diet respectively replacing an equal amount of basal diet.

Experiment Design
The experiment was conducted for 56 days at the Wet Lab, Department of Aquaculture, College of Fisheries, MPUAT, and Udaipur. A total number of 250 *Labeo rajasthanicus* (sarsi) fingerlings were obtained from fish seed production unit DOR, MPUAT, Udaipur. The obtained seed was found healthy and free from any infection. These were stocked in rectangular FRP tanks of 225 liters capacity. After one weeks of acclimatization, fish with an average body weight of 4.11gm (±0.1) were divided into five groups. Before the introduction of fish, every tank was washed and disinfected using $KMnO_4$. 10 fishes were randomly distributedin each tank. Bore well water was used to fill the plastic tank. Every week siphoning was done in the tanks for partial water exchange. The fingerlings were fed @3-4% body weight twice a day in the morning 10 am and evening 5 pm for 56 days. The growth parameters were monitored at weekly intervals.

Growth measurements: Following growth parameters were assessed during current study.

Weight Gain:
Weight gain = final weight- initial weight

$$\%\text{ weight gain in g} = \frac{(Final\,Weight - Initial\,Weight)}{initial\,weight} X100$$

Specific growth rate (SGR)

$$\text{SGR }(\%) = \frac{(LnWt - LnWo)}{t} X100$$

Where,
Wt = Final weight
Wo= Initial weight
t = time duration

Food Conversion Ratio (FCR)

$$\text{FCR} = \frac{Weight\ of\ food\ given(g)}{Weight\ gain\ of\ fish(g)}$$

Gross conversion efficiency (GCE)

$$\text{GCE} = \frac{Weight\ gained(g)}{Food\ given(g)}$$

Survival rate
It is the numbers of fish that survive during the experimental period which is expressed as a percentage of the stocked fish. It is determined by deducting the dead fish number in the course of the culture period from the stocked fish and then it is expressed as a percentage (Charo-karisa *et al*., 2006) [3]. The survival rate of experiment fish was predicated according to following formula:

$$\text{Survival rate} = \frac{Nt\ X\ 100}{No}$$

Where, Nt = Final number of fishes
No = Initial number of fishes

Proximate composition of experimental fish and diet
The proximate composition of experimental fish and experimental diet were analysed as per the standard methods of AOAC (1970) [1]. The proximate composition of feed was estimated before starting of the experiments.

Statistical analysis
The mean values of the all examined parameters (such as Growth performance indices, survival and enzyme activity) and further calculation were done in the MS excel of version 2007 and ANOVA was also performed with the same.

Results and Discussion
In the current study, the growth parameters and proximate composition of fish show significantly high (P<0.05) with weight gain (2.02 g), percent weight gain (49.16%), specific growth rate (0.714%), and gross conversion efficiency (0.239) were recorded highest in T_2. The lower value of these parameters was recorded in T_0. The fishes in T_2 show higher food utilization with lower food conversion ratio (4.416) compared to control and other treatments (Table 3). The results are in close proximity with the findings of Bisht and Panday (2013) [2] who found higher SGR as compared to the control in *Labeo rohita* fed with *Bacillus subtillis* incorporated diets for period of 90 days. Sahu *et al.*(2007) [15] and Dhawan and Kaur (2002) [9] also found that the provision of each additional input, including fertilization such as cow dung, urea and single super phosphate and supplementary feed affected fish growth. Romos *et al.* (2013) [14] conducted an experiment to evaluate the effect of dietary supplementation of multi-species (*A. bacillus sp.*, *Pediococas sp.*, *Enterococcus sp.*, *Lactobacillus sp.*) and single-species probiotics (*B. pediococcus acidilactici*) on growth performance and gut microbial composition of rainbow trout (*Onchorhynchus mykiss*). The results showed that dietary

supplementation changed the gut microbial composition and improved growth in the fish. De Silva and Davy (1992) [7] stated that the digestibility of fish plays an important role in lowering the FCR value by efficient utilization of food. Further, the food digestibility depends on the daily feeding rate, its frequency and the type of food used (Chiu, 1989) [5]. The wastage of food may also lead to poor feed utilization and higher FCR.

The wastage of food may also lead to poor feed utilization and higher FCR. In the present study, the best GCE (0.239) was recorded in the treatment T_2 followed by T_3 (0.229), T_1 (0.225), T_4 (0.217) and the lowest in control (0.203). Suzer *et al.* (2008) [16] in his study investigated the influence of commercial probiotic supplementation on the larval stages of Gilthread sea bream (*Sparus aurata*, L.).

At the end of experiment, 100% survival rate of test fishes was observed owing to good water quality maintained in the experimental tanks. The survival rate of each fish group at dietary duckweed (*Lemna minor*) levels or among different sizes of *Labeo rajasthanicus*was found unaffected.

Proximate composition indices of *L. rajasthanicus* did not show any significant difference after feeding of Lemna minor but the higher crude protein value was noticed in T2 group.

Table 2: Estimation of proximate compositions of *Labeo rajasthanicus* fish

Treatments	Moisture (%)	Crude protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)
Control	76.91	14.93	3.42	3.11	1.63
T_1	77.30	14.96	3.22	2.74	1.79
T_2	76.38	15.37	3.39	3.00	1.86
T_3	76.76	15.20	3.41	2.87	1.77
T_4	76.80	15.06	3.42	2.97	1.76
SEm±	0.1636	0.1424	0.0393	0.0532	0.0321
CD (P= 0.05)	0.4932	0.4291	0.1184	0.1603	0.0967

Table 3: Summery of growth parameters of *Labeo rajasthanicus* fingerlings in different treatments

Treatments	Growth parameters				
	Net weight gain (gm)	Weight gain (%)	SGR	FCR	GCE
Control	1.68	40.70	0.610	5.308	0.203
T_1	1.89	45.89	0.674	4.655	0.225
T_2	2.02	49.16	0.714	4.416	0.239
T_3	1.93	46.95	0.687	4.559	0.229
T_4	1.80	43.88	0.650	4.832	0.217
SEm±	0.0246	0.5601	0.0070	0.0787	0.0024
CD(P=0.05)	0.0742	1.6884	0.0210	0.2371	0.0073

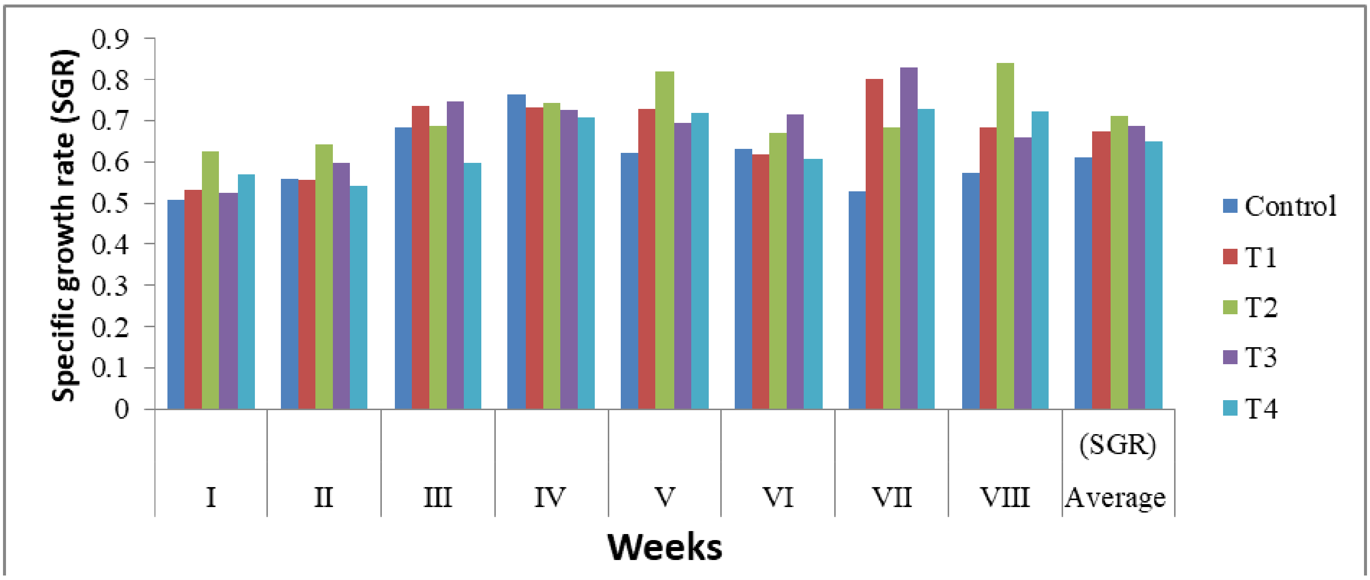

Fig 1: Weekly Specific Growth Rate (SGR) of *Labeo rajasthanicus* fingerlings fed with different levels of duckweed (*Lemna minor*) mix diets

Conclusion

From the result obtained in the present study, it can be concluded that the inclusion of the duckweed (*Lemna minor*) @ 20% in the diet of *Labeo rajasthanicus* is certainly useful to get better fish growth performance with aqua friendly rearing environment.

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