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Effect of partial replacement of fish meal with moringa leaf meal in the diet of *Labeo rohita* FRY

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Abstract
The experiment on "Effect of partial replacement of fish meal with moringa leaf meal in the diet of *Labeo rohita* fry" was conducted during September to November, 2019 in the wet laboratory of College of Fisheries Science, Veraval. The objective of present study was to find out the effect of partial replacement of fish meal with moringa leaf meal in the diet of *L. rohita* fry. In this experiment, the data pertaining to growth, survival rate, feed conversion ratio and protein efficiency ratio of *L. rohita* fry at partial replacement of moringa leaf meal were evaluated. *L. rohita* fry (Avg weight 0.058g) were stocked at a density of 10 nos/ aquaria in all 20 aquaria. Five experimental diets were formulated and prepared. Approximately 35% protein level was maintained in all the diets. Diet prepared without moringa leaf meal protein (control diet) and other four diets containing 5%, 10%, 15% and 20% moringa leaf meal protein were prepared and fed to *L. rohita* fry at 10% body weight two times in a day for 60 days. Highest mean weight gain, SGR, PER and lowest FCR were recorded in control diet (T1). 100% Survival rate was recorded in treatment including control diet. The result of present investigation revealed that partial replacement of fish meal with moringa leaf meal significantly reduces the mean weight gain, SGR and PER and increases the FCR of *L. rohita* fry.

Keywords: *Labeo rohita*, moringa leaf meal, partial replacement, fish meal

Introduction
Aquaculture in India is mainly dominated by Indian major carp (Panigrahi *et al.*, 2014) [10]. The contribution of aquaculture to the global production of capture fisheries and aquaculture combined has risen continuously reaching 46.8 percent in 2016 up from 25.7% in 2000. Global aquaculture production in 2016 was 110.2 million tonnes. In 2016, inland aquaculture was 64.2 percent of the world's farmed food fish production ascompared with 57.9 percent in 2000. Finfish farming still dominates inland aquaculture accounting for 92.5 percent of total production from inland aquaculture (Anon., 2018) [1]. Fish meal is currently one of the major sources of animal protein. Fish meal is considered the most desirable animal protein ingredient. It constitutes a nutritionally complete diet for fish due to its high protein content and digestibility as well as palatability thus serves as an excellent source of essential fatty acids and energy. Fish meal replacement by plant protein has been considered an attractive way to achieve low cost aqua feed formulation (Panigrahi *et al.*, 2014) [10]. Among all Indian major carps, *Labeo rohita* is the most popular and delicious food fish in Asia and rich in protein content. Rohu supplies the highest percentage of protein among all Indian major carps. Carp culture forms the backbone to freshwater aquaculture practice in India. *Labeo rohita* is one of the most cultured indigenous fish in Indian subcontinent contributes to about 35% of the total Indian major carp production. The leaves of moringa are rich in carotenoids, minerals, ascorbic acid and iron. Moringa leaves provide 260 g/kg protein (Yuangsoi and Masumoto, 2012) [15]. The leaves are the protein source with an adequate profile of amino acids. As cost of feed depend on protein ingredients so a need for cost effective source of protein is essential for fish feed to reduce the production cost. Though fish meal is very costly source of protein for feed so moringa leaf meal can provide a alternative source of protein at an effective cost along with an adequate profile of amino acids. Therefore, the present study was undertaken to find out the effect of partial replacement of fish meal with moringa leaf meal on growth and survival of *Labeo rohita* fry.

Materials and Methods
Expiremental fish: *Labeo rohita* was selected for the present experiment. The rationale of its selection was that it has excellent growth rate, easy availability, wide distribution, commercial

importance and tastiest among the indian major carp. *Labeo rohita* fry were brought to College of Fisheries Science, Veraval from Commercial Fish Hatchery and acclimatized for 15 days period in laboratory condition on the supplement feed containing groundnut oil cake and rice bran in order to habituate them for artificial feeding. Thereafter, during experimental period of 60 days, the fishes were fed with formulated artificial diets @ 10% body weight/day. The weight of fish were measured after fortnight interval during experimental period and based on increase in body weight of fry their ration was re-adjusted @ 10% of their body weight. The fishes were fed twice in a day.

Expiremental diets

The present expirement was undertaken to utilize the fish meal and moringa leaf meal to prepare the expiremental diet. The ingredients used that is wheat flour, tapioca flour, animal oil, plant oil, vitamin and mineral premix. The ingredients were procured from local market. The moringa leaves were freshly plucked from branches of tree from local area. Then leaves were sun dried for 4-5 days. Then leaves were grounded to make powder through mixer grinder. Five diet were formulated in which fish meal was replaced with moringa leaf meal at 0%, 5%, 10%, 15% and 20% levels. The diet were fortified with vitamins and minerals.

Experimental procedure

The experiment was conducted in a completely randomized design (CRD) with five treatments and four replications. In T1 diet was prepared without moringa leaf meal (100% fishmeal protein), T2 diet contain 5% moringa leaf meal protein, T3 diet contain 10% moringa leaf meal protein, T4 diet contain 15% moringa leaf meal protein and T5 diet contain 20% moringa leaf meal protein. *L. rohita* fry were stocked at a density of 10 nos/ plastic aquarium tanks (2x2x1 feet) filled with 35 liters of filtered fresh water. Continuous aeration was provided throughout the experimental period in order to maintain dissolved oxygen level in each aquarium. Water quality was maintained by regular replenishment of 10% of bottom water from each tank. Before morning and evening feeding tank were siphoned out by small tube to remove waste and uneaten feed. The experimental study was conducted for 60 days. The parameters such as weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio was calculated according to the formula given by Manivannan and Saravanan (2012) [8]. The formula are as follows:

Mean weight increment = Final average body wt – Initial average body wt

$$\text{SGR (\%/day)} = \frac{\text{Final body weight} - \text{Initial body weight}}{60} \text{ X } 100$$

$$\text{Survival (\%)} = \frac{\text{No. of fish survived after rearing}}{\text{No. of fish stocked}} \text{ X } 100$$

$$\text{FCR} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

$$\text{PER} = \frac{\text{Weight gain (g)}}{\text{Protein intake (g)}}$$

The water quality parameters such as pH, DO, temperature, hardness were analyzed through standard methods.

Statistical analysis

One way Analysis of Variance (Snedecor and Cochran, 1968) was applied to test the significance of the treatments. The experimental treatments that differed significantly were determined by one factor CRD design.

Results and Discussion

In the present study, the ingredients of experimental diets at different proportion include moringa leaf meal, fish meal, wheat flour, tapioca flour, fish oil, plant oil and vitamins & minerals premix are shown in Table 1. The growth performance of fry fed with moringa leaf meal are shown in Table 2.

Table 1: Percentage composition of moringa leaf meal based experimental feed

Ingredients	Percentage inclusion of moringa leaf meal.				
	(0%)	(5%)	(10%)	(15%)	(20%)
Sterilized fishmeal	67.39	64.02	60.65	57.28	53.91
Moringa leaf powder	0.00	5.96	11.92	17.88	23.84
Wheat flour	11.30	10.01	8.71	7.42	6.12
Tapioca powder	11.31	10.01	8.71	7.42	6.13
Fish oil	4.00	4.00	4.00	4.00	4.00
Sunflower oil	4.00	4.00	4.00	4.00	4.00
Vitamins and minerals	2.00	2.00	2.00	2.00	2.00
Total	100	100	100	100	100

Table 2: Growth performance (g) of *L. rohita* fry fed moringa leaf meal based feed for 60 days (±S.E).

Treatments	Replication	Initial wt	Final wt	SGR	FCR	PER	Survival (%)
T1	R1	0.06	1.26	2.10	1.71	1.68	100
	R2	0.06	1.22	2.03	1.71	1.68	100
	R3	0.05	1.26	2.10	1.60	1.80	100
	R4	0.06	1.21	2.01	1.64	1.75	100
	Mean	0.058±0.02	1.24±0.01[a]	2.06±0.02[a]	1.66±0.02[c]	1.73±0.02[a]	100
T2	R1	0.07	0.69	1.15	2.22	1.32	100
	R2	0.05	0.75	1.25	1.92	1.52	100
	R3	0.06	0.73	1.22	1.96	1.49	100
	R4	0.05	0.75	1.25	1.86	1.57	100

	Mean	0.058±0.04	0.73±0.01^{b}	1.22±0.02^{b}	1.99±0.07^{a}	1.48±0.05^{c}	100
T3	R1	0.07	0.69	1.15	1.95	1.51	100
	R2	0.07	0.68	1.13	1.96	1.51	100
	R3	0.06	0.69	1.15	1.86	1.60	100
	R4	0.06	0.70	1.17	1.85	1.59	100
	Mean	0.065±0.03	0.69±0.00^{c}	1.15±0.00^{c}	1.90±0.02^{a}	1.55±0.02^{bc}	100
T4	R1	0.05	0.64	1.07	1.79	1.64	100
	R2	0.06	0.62	1.03	1.85	1.60	100
	R3	0.06	0.63	1.05	1.79	1.64	100
	R4	0.05	0.62	1.03	1.83	1.60	100
	Mean	0.055±0.03	0.63±0.00^{d}	1.05±0.00^{d}	1.81±0.00^{b}	1.62±0.01^{b}	100
T5	R1	0.05	0.44	0.73	1.94	1.53	100
	R2	0.06	0.42	0.70	2.08	1.43	100
	R3	0.05	0.44	0.73	2.04	1.45	100
	R4	0.06	0.41	0.68	2.12	1.40	100
	Mean	0.055±0.03	0.43±0.00^{e}	0.71±0.01^{e}	2.05±0.04^{a}	1.45±0.02^{c}	100

The present study was carried out to evaluate the effect of partial replacement of fish meal with moringa leaf meal on growth of *L. rohita* fry. It could be seen from the result that the growth rate was lower in 15% and 20% moringa leaf meal replaced feed compared to 5% and 10% moringa leaf meal replaced feed. Slower growth rate was observed in diet prepared with 20% supplementation of moringa leaf meal. Hussain *et al.* (2018) [5] reported that the mean weight gain decreases with increase in moringa leaf meal inclusion level in diet for *L. rohita*.

Puycha *et al.* (2017) [2] revealed that final body weight and weight gain were significantly reduced by moringa leaf meal incorporation resulting in reduced specific growth rate. Richter *et al.* (2003) [13] concluded that moringa leaf meal can be replaced upto 10% in diet of nile tilapia without any significant reduction in growth. Idowu *et al.* (2017) [6] revealed that at higher incorporation levels of moringa leaf meal the growth performance reduces due to presence of anti-nutrients such as phenol, tannins and saponins.

The experiment conducted to evaluate the effect of partial replacement of fish meal with moringa leaf meal on feed conversion ratio of *L. rohita* revealed that partial replacement of fish meal with moringa leaf meal was significantly affected on the feed conversion ratio of *L. rohita*. Hussain *et al.* (2018) [5] revealed that the FCR increases with the increases in the inclusion level of moringa leaf meal. Ganzon-Naret (2014) [3] reported that FCR increases with increase in inclusion level of moringa leaf meal in diet prepared for *Lates calcarifer*.

The survival rate was 100% during the entire experimental period. Yuangsoi and Masumoto (2012) [15] investigated replacement of fish meal with moringa leaf meal in *Cyprinus carpio* diet and revealed 100% survival rate. The PER was lowest in treatment T5 that was 20% inclusion level of moringa leaf meal in the expiremental diet prepared. The experiment reveales that replacement of fish meal with moringa leaf meal could be done at much low level of inclusion that is moringa leaf meal inclusion of 5% would be optimum for the growth of *L. rohita* fry. The plant based feed can also reduced the cost of carp feed hence can be proved economically suitable.

Conclusion

Based on the present study it was observed that weight gain and specific growth rate were recorded higher in control diet (T1) of *L. rohita*. Survival rate was 100% in all treatment diets. Higher protein efficiency ratio was recorded in control diet (T1) and all the treatment were significantly different. Lowest feed conversion ratio was recorded in control diet (T1) and all the treatment were significantly different. Among all the diets containing moringa leaf meal T2 diet (5% moringa leaf meal protein) showed higher weight gain and specific growth rate. Protein efficiency ratio and Feed conversion ratio were good in diet containing 15%moringa leaf meal protein (T4). It may be concluded from the present study that partial replacement of fish meal with 5% moringa leaf meal protein in diet increases weight gain and specific growth rate of *L. rohita* fry.

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