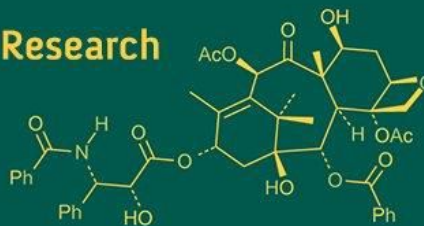


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Dharambir Singh
Associate Professor,
Department of Zoology and
Aquaculture, CCS Haryana
Agricultural University, Hisar,
Haryana, India

Nikita Punia
Research Scholar, Department
of Zoology and Aquaculture,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Ram Niwas
Assistant Professor, Computer
Section, CCS Haryana
Agricultural University, Hisar,
CCS Haryana, Hisar, Haryana,
India

Pooja
Research Scholar, Department
of Zoology and Aquaculture,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Corresponding Author:
Nikita Punia
Research Scholar, Department
of Zoology and Aquaculture,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Assessing the effect of different feed combination on growth performance of *Labeo rohita* and *Cirrhinus mrigala*

Dharambir Singh, Nikita Punia, Ram Niwas and Pooja

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Abstract

Aquaculture plays an vital role in ensuring global food security. Of the 795 million people, or roughly one in nine, are affected by hunger and malnutrition. Aquaculture industry is expanding day by day which leads to high demand of protein sources for feed preparation. By 2025, it is estimated that 73.15 million tons of aqua feed will be needed to meet the estimated levels of production of fed species. The unconventional plant ingredients are rich in protein and energy, making them potential substitutes for traditional feed sources for major carps. The objectives of this study were to assess the potential impacts of various feed combinations on the growth performance of fingerlings. Feed ingredients are combined to form the mixture according to different treatments with the major ingredients being Soyabean, Groundnut, Rice polish, Wheat bran and Rice bran. All the feed combination were found to have more growth promoting effect in comparison to control. Various water quality parameters (Table 7) like dissolved oxygen, salinity, TDS, pH, ammonia, nitrate, alkalinity and hardness were measured periodically and were found within optimum range.

Keywords: Unconventional, malnutrition, aquafeed

1. Introduction

The world's population is expected to keep increasing, with estimates predicting it will reach 9.5 billion by 2050. Aquaculture plays an vital role in ensuring global food security. Of the 795 million people, or roughly one in nine, are affected by hunger and malnutrition. Aquaculture industry is expanding day by day which leads to high demand of protein sources for feed preparation. By 2025, it is estimated that 73.15 million tons of aquafeed will be needed to meet the estimated levels of production of fed species (D'Abramo, 2021) [3]. FAO statistics revealed that out of total fish production share of aquaculture is increased from about 30% in the early 2000s to over 50% in more recent years. This can be achieved by using nutritionally balanced formulated feeds made from locally available ingredients, which could enhance aquaculture production and profitability, particularly when fish are raised in high-density conditions (Siddiqua & Khan, 2022) [8]. Manufacturing industries greatly depends on Fish meal as a dietary protein source but its rising cost is unlocking the potential of various plant-based protein sources (Carter & Hauler, 2000) [2]. Feed constitutes 50-60% of total operating cost thereby greatly affecting growth and performance of aquaculture industry (Dani *et al.*, 2017) [4]. Production of fish meal is also a major problem nowadays due to the sustainability issue of marine capture fisheries. Studies have investigated and thereby motivated to use the various plant sources such as soyabean, groundnut, mustard, rice bran, wheat bran in feed preparation for aquaculture practices. These plant sources have high protein and carbohydrate content along with a good balance of essential amino acids. Proper nutrient balance in diet is important for better health and production in fisheries sector (Bandara & Tharindu Bandara, 2018) [1]. Soybean meal is well known for high amino acid content and consistent quality. Therefore, while choosing ingredients for feed preparation the digestibility of protein and energy requirement should be primarily considered. Formulation of lost cost diet with readily available plant sources are the most promising alternatives to fish meal. Carp species primarily dominate Indian freshwater aquaculture (Rasal & Sundaray, 2020) [7]. Among these, Indian major carps (IMCs), such as catla (*Catla catla*), rohu (*Labeo rohita*), and mrigal (*Cirrhinus mrigala*), are the most important and highly

desired fish species for aquaculture in India due to their high market demand and economic significance (Surasani *et al.*, 2022) [9]. As market demand for these fish continues to rise, there is a pressing need to boost its production, necessitating the use of nutritionally balanced and cost-effective aquaculture feeds. Protein sources are essential while also keeping feed costs within affordable limits (Rani Scholar *et al.*, 2020) [6]. The unconventional plant ingredients are rich in protein and energy, making them potential substitutes for traditional feed sources for major carps (Rahman *et al.*, 2006) [5]. The objectives of this study were to assess the potential impacts of various feed combinations on the growth performance of fingerlings.

Table 1: Component, protein

Component	Protein	Carbohydrate	Fat	Moisture
Soyabean	36-40%	30-35%	18-20%	8-10%
Groundnut	25-30%	10-20%	40-50%	5-7%
Rice polish	12-15%	50-60%	15-25%	10-15%
Wheat Bran	12-15%	50-60%	3-5%	10-15%
Rice Bran	12-15%	40-50%	15-20%	10-14%

2. Materials and Methods

2.1 Experimental diets: Feed ingredients are combined to form the mixture according to different treatments with the major ingredients being Soyabean, Groundnut, Rice polish, Wheat bran and Rice bran. The experimental diets were prepared using Pearson's square method. Various water quality parameters (Table) like dissolved oxygen, salinity, TDS, pH, ammonia, nitrate, alkalinity and hardness were measured periodically. The composition and formulation of experimental diet is as follows:

Table 2: Groundnut, mustard

Sr. No.	Treatment (1:1)	Feeding rate & Frequency
1.	Groundnut Oil Cake + Rice Bran	@ 3% body weight and twice a day
2.	Mustard Oil Cake + Rice Polish	
3.	Rice Polish+ Wheat Bran	

2.2. Feeding trials

The feed was given in the form of paste to fingerlings twice a day on a rigid schedule (9.00 A.M & 5.00 P.M) @ 3% of total fish Biomass, 6 days a week to all groups of fishes in each aquarium. Prior to next feeding, half of the water was changed every day to maintain good water quality. Only mustard oil cake was given to control group in the same manner.

After 90 days, effect of different feed combination on the mean values of gain in live body weight and length of *Labeo rohita* in all the four treatments were found different. The maximum gain in the live body weight and length of *Labeo rohita* fed with Groundnut oil cake +Rice Bran @ (1:1) was recorded 73.93 gm and 17.54 cm followed by 65.84 gm and 15.31 cm with Mustard oil cake +Rice Polish and 62.50 gm and 14.14 cm with Rice Polish +Wheat Bran. All the feed combination were found to have more growth promoting effect in comparison to control (53.27 gm and 12.16 cm). Fish fingerlings exhibited significant gain in weight and length. (Table 3, 4).

2.3 Analysis of water quality parameters

(A) Temperature, Electrical conductivity, Salinity, Total Dissolved Solids (TDS) - All these water parameters are measured using Microprocessor COND-TDS-SAL meter (LT-51).

(B) pH: pH was recorded by using Sunpu biochemical kit based on the calorimetric method.

(C) Dissolved oxygen (D.O.): Estimation of D.O. and total hardness was done by modified Winkler's method (APHA 2005).

(D) Total hardness (TH): Total hardness of water was calculated by volumetric method (APHA, 2005).

$$TH (CaCO_3 \text{ mg/l}) = \frac{\text{Volume of titrant used (ml)}}{\text{Volume of sample (ml)}} \times 1000$$

(E) Total alkalinity (TA):

TA of water was determined by volumetric method (APHA 2005) and calculated using this formula:

$$PA (CaCO_3 \text{ mg/l}) = \frac{A}{\text{Volume of sample (ml)}} \times 1000$$

$$MOA (CaCO_3 \text{ mg/l}) = \frac{B}{\text{Volume of sample (ml)}} \times 1000$$

$$TA (CaCO_3 \text{ mg/l}) = PA + MOA$$

(F) Ammonical-Nitrogen (NH₃-N) and Nitrite-Nitrogen (NO₂-N): These were also estimated calorimetrically using Sunpu biochemical kit.

2.4 Calculations Statistical Analysis

3. Results

Table 3: Effect of different feed combination on weight gain in fingerlings (*Labeo rohita*)

Treatment (1:1)	Weight (gm) at interval of 30 days				Mean
	0	30	60	90	
Groundnut oil cake +Rice Bran	6.667	25.553	48.600	73.937	38.689
Mustard oil cake +Rice Polish	6.543	22.937	43.880	65.847	34.802
Rice Polish +Wheat Bran	6.413	20.197	41.603	62.503	32.679
Control (Mustard oil cake)	6.383	18.643	36.873	53.270	28.793
C.D (at 0.05%) = 0.596, SE(d) = 0.291, SE(m) = 0.206, F =403.018, D.F=3, Significance = 0.000, at treatment					

Table 4: Effect of different feed combination on length gain in fingerlings (*Labeo rohita*)

Treatment (1:1)	Length (cm) at interval of days				Mean
	0	30	60	90	
Groundnut oil cake +Rice Bran	6.310	7.320	10.815	17.540	10.496
Mustard oil cake +Rice Polish	6.470	6.955	9.700	15.310	9.609
Rice Polish +Wheat Bran	6.125	6.880	8.800	14.145	8.988
Control (Mustard oil cake)	5.620	7.115	7.675	12.165	8.144
C.D (at 0.05%) =0.621, SE(d) =0.291, SE (m) =0.205, F =23.378, D.F=3, Significance = 0.000, at treatment					

Table 5: Effect of different feed combination on weight gain in fingerlings (*Cirrhinus mrigala*)

Treatment (1:1)	Weight (gm) at interval of days				Mean
	0	30	60	90	
Groundnut oil cake +Rice Bran	6.240	14.457	32.850	55.727	27.318
Mustard oil cake +Rice Polish	6.167	12.310	25.053	45.990	22.380
Rice Polish +Wheat Bran	6.027	10.900	21.130	42.147	20.051
Control (Mustard oil cake)	6.000	9.873	18.057	38.480	18.103
C.D (at 0.05%) =0.733, SE(d) =0.358, SE (m) =0.253, F =246.26, D.F=3, Significance = 0.000, at treatment					

Table 6: Effect of different feed combination on length gain in fingerlings (*Cirrhinus mrigala*)

Treatment (1:1)	Length (cm) at interval of days				Mean
	0	30	60	90	
Groundnut oil cake +Rice Bran	5.610	6.310	8.610	16.505	9.259
Mustard oil cake +Rice Polish	5.490	6.335	7.120	14.810	8.439
Rice Polish +Wheat Bran	5.555	6.220	6.790	13.390	7.989
Control (Mustard oil cake)	5.300	5.555	6.020	11.800	7.169
C.D (at 0.05%) = 0.579, SE(d) = 0.271, SE (m) = 0.191, F =20.77, D.F=3, Significance = 0.000, at treatment					

Table 7: Water quality parameters during study period

DAYS	D.O	Salinity	TDS	pH	Ammonia	Nitrate	Alkalinity	Hardness
0 day	5.29-5.63	0.12-0.17	95.2-98.75	7.3-7.6	0	0	153.33-159.12	104.67-109.33
15 day	5.17-6.23	0.17-0.22	98.78-101.02	7.37-7.53	0.4-1.3	0.93-1.87	171.00-179.0	119.33-120.12
30 day	5.83-6.03	0.21-0.24	210.08-267.00	7.3-7.47	0.4-2.1	1.00-2.37	172.00-175.00	121.63-136.67
45 day	5.33-5.71	0.22-0.29	112.83-129.83	7.2-7.19	0.13-0.73	0.61-1.77	171.12-265.00	131.00-127.32
60 day	5.37-6.20	0.24-0.30	108.17-128.17	7.43-7.67	0.5-1.11	0.77-1.98	178.23-230.00	111.67-139.67
75 day	6.10-7.10	0.22-0.27	118-130.67	7.5-7.8	0.48-1.13	0.77-1.53	177.35-275.65	123.67-139.95
90 day	6.37-7.21	0.25-0.33	116.33-148.17	7.7-7.8	0.6-1.23	0.73-1.49	174.62-281.21	126.31-138.00

Various water quality parameters (Table 7) like dissolved oxygen, salinity, TDS, pH, ammonia, nitrate, alkalinity and hardness were measured periodically and were found within optimum range.

4. Discussion

After 90 days effect of different feed combination on the mean values of gain in live body weight and length of *Labeo rohita* in all the four treatments were found to be different. The maximum gain in the live body weight and length of *Labeo rohita* fed with Groundnut oil cake +Rice Bran @ (1:1) was recorded 73.17 gm and 17.44 cm followed by 65.49 gm and 15.10 cm with Mustard oil cake +Rice Polish and 62.0367 gm and 13.98 cm with Rice Polish +Wheat Bran. All these feed combination were found to have more growth promoting effect in comparison to control (52.37 gm and 11.94cm). Fish fingerlings exhibited significant gain in weight and length. (Table 3&4).

The effect of different feed combinations on the mean values of gain in live body weight and length of *Cirrhinus mrigala* after 90 days was different for all four treatments. Gain in live body weight and length of *Cirrhinus mrigala* was recorded maximum (55.750 gm and 16.365 cm) with Groundnut oil cake +Rice Bran @ (1:1), followed by 45.930 gm and 14.560 cm with Mustard oil cake +Rice Polish and 42.147gm and 13.185 cm with Rice Polish +Wheat Bran @ (1:1.) All the three treatments had growth promoting effect and recorded data reveals significant gain in weight and

length in fingerlings when compared with control (38.280 gm and 11.595 cm). Various water quality parameters (Table) like dissolved oxygen, salinity, TDS, pH, ammonia, nitrate, alkalinity and hardness were measured periodically and were found in optimum range.

5. Conclusion

After 90 days, significant differences were observed in the gain in live body weight and length of *Labeo rohita* and *Cirrhinus mrigala* across four feed treatments. The highest growth in *Labeo rohita* was achieved with Groundnut oil cake + Rice Bran (1:1), recording 73.17 g and 17.44 cm, while *Cirrhinus mrigala* exhibited maximum growth with the same feed, achieving 55.75 g and 16.365 cm. Other combinations also showed growth-promoting effects compared to the control. Regular monitoring of water quality parameters ensured optimal conditions for fish growth. The study highlights the effectiveness of specific feed combinations in enhancing fish growth and productivity.

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