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Influence of cadmium toxicity and organic feeds on growth performance of fresh water fish *Labeo rohita* (Hamilton, 1822)

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Abstract
A freshwater fish *Labeo rohita* were collected and treated from commercial fish farms in and around Cudalore from June 2019 to October 2019. The fishes were fed with control and experimental diet and growth performance such as ABW, ABL, body weight gain and specific growth rate were thoroughly studied adopting standard procedures. The result indicating that there was significant variation in growth parameters of control and experimental diet. The fish fed with live feed organism mixed diet have higher increment in body weight, length, weight gain and specific growth rate and cadmium treated fishes stunted the growth and infected the tissue organisms. The study reveals the fact that the aqua feed with live organism is more suitable for fish culture practice and heave metals are very dangerous for fish and environments.

Keywords: *Labeo rohita*, cadmium, live feed organism, protein and carbohydrates

Introduction
In the environmental waste heavy metals still pose immense health hazards to aquatic organisms. Unlike other classes of pollutants, which can be biodegraded and destroyed completely, metals are non-biodegradable (Wepener *et al*., 2001) [19] and can neither be created nor destroyed. However, these metals might be altered into more toxic forms or complexed to more stable and less toxic compounds (Viljoen, 1999) [18]. Metals are naturally found in aquatic ecosystems by a wide range of natural and anthropogenic sources (Wepener *et al*., 2001) [19] and with anthropogenic being either domestic or industrial (Biney *et al*., 1994) [4].
Fish is a fairly valuable item of human nutrition which gaining greater recognition. The fishes obtain their entire nutritional requirements through the food they consume (Pillay, 1990) [14]. Untreated wastes of industrial, technological and agricultural origin containing various metallic compounds often contaminate natural waters. Heavy metals due to their bio-accumulative and non-biodegradable properties constitute a major group of aquatic pollutants. These metals particulates enter the aquatic medium through effluents discharged from tanneries, textiles, metal finishing, mining, dyeing and printing industries, ceramic and pharmaceutical industries etc. (Azmat and Talat, 2006).
Rohu or roho labeo is a species of the carp family and is a natural inhabitant of freshwater and is present in the rivers of Asian countries (India, Bangladesh, Burma Pakistan, and Nepal). In India this species is mostly available in the province of Tamil Nadu and due to its non-oily nature; it is widely consumed as food. Fish is an important source of balanced and easily digestible protein, carbohydrates, polyunsaturated fatty acids, minerals i.e. copper, iodine, potassium, phosphorus, iron, and vitamin A and D. The Rohu fish has a spindle-shaped body measuring up to 1 m in length and weighing about 20-25. kg. The dorsal side of the body is blackish in colour and the ventro-lateral sides are silvery. The body, like that of Bhetki, is distinguishable into a conspicuous head, trunk and postnatal tail. Fish proteins have a high biological value and contain all the essential amino acids and are an excellent source of lysine. The food and feeding habits of fish is important and vital need for production of the fish. Food and feeding habits of fish are important biological factors for selecting a group of fish for culture in ponds to avoid competition for food among themselves and live in association and to utilize all the available food (Dewam and Saha, 1979). So, the knowledge of food and feeding habits help to select such species of fish for culture and produce an optimum yield by utilizing all the available potential food of the water bodies without any competition. Feeding is the dominant activity of the entire life cycle of fish (Royce, 1972) [16]
The growth of the fish mainly depends on the nutritional quality of the diet provided to them (Jayaprakash and Euphrasha, 1997). Generally live feed is rich in protein, carbohydrates, vitamin, minerals and fats. (Singh *et al.*, 1994) [17]. Protein and fats is the most expensive component in fish feed and also the most important factor affecting growth performance of fish (Luo *et al.*, 2004) [11]. Reducing the feed costs and improve growth rate could be a key factor for the successful development of aquaculture (Kalsoom *et al.*, 2009; Muhamed Yagoob *et al.*, 2010; Ahmed *et al.*, 2012; Pankajkumar *et al.*, 2013) [9, 13, 1]. The impact of artificial diets and live feed on growth of fishes have been extensively studied by many workers (Yahya Bakhtiyar *et al.*, 2001; Manivannan and Saravanan, 2012; Javaid Iqbal *et al.*, 2013). The present investigation was aimed to study the effect of live feed organism mixed diet on the growth performance of freshwater fish *Labeo rohita*.

Materials and Methods

Freshwater fish *Labeo rohita* were collected from June 2019 to October 2019 at commercial fish farms in and around Cudalore, Tamil Nadu, India. The fishes were brought to the laboratory in alive condition acclimated and reared in glass tank (75 × 24 40 cm) for 7days. The fishes were grouped into two groups namely control and experimental group consist of 20 fishes each, one group fed with formulated feed and another with live feed organism×mixed diet. Continuous aeration was done with help of aerator. The water in both aquaria were changed every alternate days. The experiments were conducted in 15 day intervals for 55days in replicate.

Experiment diet and feeding for Labeo rohita

Cadmium, rice bran, Grass powder, fish meal and tapioca flour were used to prepare control diet. The ingredients were ground well to a fine powder and mixed thoroughly with of water to obtain smooth dough. This was extruded through a pelletizer, the pellets were dried and then stored in dry airtight container at 28°C. Along with formulated feed ingredients, 10 per cent of live feed organisms Daphnia biomass was added and mixed well then pelletized, this is considered as experimental feed.

Growth parameters

During the feeding trial, growth performance of the fish was evaluated using Halver's Procedure (1972). The fishes in each tank weighed individually to the nearest 0.1 mg at 15 days interval. The length of the fish was also measured and average body weight and length were calculated. From the data the following parameters were determined and tabulated.

$$\text{Body weight gain (BWG)} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

$$\text{Specific growth rate (SGR)} = \frac{\text{In(Final weight} - \text{Initial weight)}}{\text{Number of days}} \times 100$$

Chemical analysis

The proximate composition of feed were analyzed for crude protein, carbohydrate and crude fat extracted according to the standard method of AOAC (1999) [2].

Statistical analysis

Standard deviation and one way analysis of variance (ANOVA) was used to determine whether significant variation between the treatments existed.

Results and Discussion

In the present study, cadmium, rice brawn groundnut cake, fish meal tapioca flour and biomass live feed were treated.

The maximum growth was experimental sites of rice brawn powder treated fishes when compared with control respectively (Table.2). The proximate composition of the food ingredients used during the experiments was analyzed and given in the table 4. The proximate composition of control diet (F1) and experimental diet (F2) showed a slight variation were observed when compared with control. The growth performance of *Labeo rohita* fed with control and experimental diet is given in the table 4. The increase in weights and lengths were used as measures of growth.

The growth parameters of fish showed significant variation in control and experimental diet. The fish fed with live feed organism mixed diet have higher increment in weight (ABW) when compared to the control fed fish. The average body length (ABL) was found to be high in experimental diet (F2) and low in control diet (F1).The heavy metal cadmium treated fish growth was not increased, and body weight was decreased when compared with control than others. The maximum growth was observed in rice brawn treated fish when compared with control than others respectively.

Table 1: Standard levels and maximum range of concentrations of heavy metals (µg/g wet weight) in fish described in literature.

Organization/Country	Heavy Metal		
		Cromium (Cr)	
FAO (1983)		30	
FAO/WHO limits (1989)		30	
Turkish guidelines (Dural *et al.*, 2007)		20	
Range of metal in present study		0.313-13.17	

All tissue concentrations are in µg/g wet weight.

Table 2: Composition of ingredients in the control and experimental diet

Ingredient	w/%	
	Control feed	Experimental feed
Control	25±0.75	29±0.87
Cadmium	09±0.27	11±0.33
Rice bran	40±1.2	35±1.05
Groundnut cake	35±1.05	30±0.09
Fish meal	15±0.45	15±0.45
Tapioca flour	09±0.27	09±0.27
Biomass of live feed	-	10±0.3

± Standard deviation

Table 3: Proximate composition of control and experimental diet

Feed ingredient	Control feed (%)			Experimental feed (%)		
	Protein	Fat	Carbohydrate	Protein	Fat	Carbohydrate
Control	11.32±0.33	0.32±0.01	4.32±0.12	13.54±0.40	0.85±0.02	3.98±0.11
Cadmium	10.00±0.3	0.37±1.11	2.31±0.06	09.21±0.27	0.34±0.009	1.54±0.04
Groundnut cake	15.32±0.45	0.59±0.01	5.68±0.17	14.85±0.44	0.51±0.01	4.87±0.146
Rice bran	13.00±0.39	0.76±	4.84±1.14	2.62±0.07	0.66±0.01	4.23±0.126
Fish meal	7.22±0.21	1.07±0.02	2.69±0.08	7.22±0.21	1.07±0.03	2.69±0.08
Tapiaco flour	6.35±0.19	1.17±0.03	6.75±0.20	1.35±0.04	1.17±	6.75±0.20
Biomass of live feed	-	-	-	2.66±0.07	1.71±0.05	2.12±0.06

± Standard deviation

Table 4: Growth performance of *Labeo rohita*, fed with control feed and experimental feed

	Days	body weight (G)	Total length (cm)	Body weight (G) increased in 10 days	Total length (cm) increased in 10 days	Body weight Gain	Specific growth rate
Control	Initial	13.9 ± 0.39	8.6 ± 0.24	-	-	-	-
	15th	19.6 ± 0.54	10.4 ± 0.29	5.7	1.8	41.00	17.40
	25th	27.0 ± 0.68	12.4 ± 0.35	7.4	2.0	37.75	20.01
	35th	36.3 ± 0.79	14.2 ± 0.41	8.5	2.1	31.48	20.14
	45th	46.9 ± 0.97	16.7 ± 0.46	10.6	2.2	29.20	23.60
	55th	58.1 ± 1.26	19.0 ± 0.52	11.2	2.3	23.88	24.15
Experimental	Initial	14.1 ± 0.41	8.8 ± 0.23	-	-	-	-
	15th	21.3 ± 0.68	11.1 ± 0.31	7.3	2.3	51.77	19.87
	25th	29.5 ± 0.75	13.6 ± 0.43	8.2	2.5	38.49	21.04
	35th	38.7 ± 1.05	16.1 ± 0.49	9.2	2.5	31.18	22.19
	45th	50.6 ± 1.24	18.7 ± 0.55	11.9	2.6	30.74	24.76
	505	64.2 ± 1.42	21.4 ± 0.61	13.6	2.7	26.87	26.10

± Standard deviation

The body weight gain (BWG) ranged from 23.88 to 41.00 mg in control diet (F1) and 26.87 to 51.77 mg in experimental diet (F2). The specific growth rate (SGR) showed a slight variation in fish fed with both control (F1) and experimental diet. SGR in control diet fluctuated from 17.40% to 24.15% day^{-1} and 19.87% to 29.54% day^{-1} in experimental diet. In the present study, the differences in growth of fish *Labeo rohita* could be attributed to the quality of feed, ingestion and digestion. The experiment diet contain rice brawn resulted in better growth than control diet.

Similar observations reported by earlier workers (Jayaprakash and Enphrasha, 1997). Singh *et al.* (1994) [17] stated that the live feed is rich in protein, carbohydrate and fats along with various types of vitamins and minerals.

Protein is the most important factor affecting growth performance of fish and fish cost (Luo *et al.*, 2004) [11]. Kaur and Bains (2005) [10] obtained better growth with rice brawn diet for *Labeo rohita*. BWG and SGR were found to high when fish fed.

Fig 1

The feed conversion ratio was highest on blood meal diet than rice bran and rice bran mixed diet (Kalsoom *et al.*, 2009) [9]. Mohamad *et al.* (2010) observed that floating feed had much lower value of FRC than sinking feed. Manivannan and Saravanan (2012) recorded significant variation in growth performance of fish *Labeo rohita* fed with different diet. A significant increase in average body weight, FCR and grass fish production of fish fed with Tokyo when compared with rice bran diet (Ahmed *et al.*, 2012) [1]. The plant fed ingredient soybean and sunflower meal mixed diet gave good growth performance in *Labeo rohita* (Rehman *et al.*, 2013). In the present investigation indicated that the fish were fed with rice brawn, followed by groundnut cake, tapioca floor, fish meal and live feed organism have better growth and weight gain of labeo rohita fish when compared with control. Hence it suggested that the rice brawn, is more suitable for fish culture practice, when compared with groundnut cake, tapioca flour, fish meal, and live feed organism than control.

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