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Influence of Flower Supplemented Meals on Growth and Pigmentation of the Fish, *Oreochromis mossambicus*

J Felicitta[*1], R Sornaraj[1]
1. Research Department of Zoology and biotechnology, Kamaraj College, Tuticorin-628003, Tamil Nadu, India.

ABSTRACT

The effect of Marigold flower meal and Hibiscus flower meal on growth and Coloration of *Oreochromis mossambicus* was investigated. Different Concentrations of Marigold flower powder and *Hibiscus rosa sinensis* flower powder (5%, 10%, 15%, 20% and 25%) were added to basal diet and given to *O. mossambicus* and its impact on growth and colouration was estimated. Ten treatment groups in triplicate and a separate control for each group were maintained. After 28 days, fish consumed the diets supplemented with flower powders showed a significant ($p<0.05$) growth performance and coloration than those fed with the control diet. The highest weight gain (4.85±0.02) best FCR, SGR, Survival and total carotenoids were recorded in (25%) in both the flowers studied. The observed better weight gain, FCR and SGR were 4.85g, 1.19 and 2.22% respectively in Marigold flower diet and 4.83g, 1.22 and2.327% respectively in Hibiscus diet. The highest total carotenoids in fin, skin and muscle were 0.424mg/100mg, 0.394mg/100mg and 0.350mg/100mg respectively in 25% Marigold incorporated diet and 0.372mg/100mg, 0.351mg/100mg and 0.331mg/100mg respectively in 25% Hibiscus incorporated diet. Among the two flowers studied, 25% Marigold flower powder incorporated diet induced the growth and colouration in *O. mossambicus* to a greater extent.

Keywords: Marigold, Hibiscus, Growth, Total Carotenoid, *Oreochromis mossambicus.*

*Corresponding Author Email: drjfelicita@gmail.com
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INTRODUCTION

In aquaculture, hormones, antibiotics and other drugs have been used to quicken the growth, fecundity and resistance against diseases. In view of the fact, that they give side effects, they are not suggested, even if they give desirable results. In place of chemicals, usage of herbal products in aquaculture is gaining interest of the fish farmers. Many herbal products have the characteristics of growth promoting ability. Aquaculture has been a promising activity for the last 20 years worldwide. This inspiring enhancement has been attained by some practices which damage human and animal health[1]. Consumers and non-target organisms in the environment are affected by the incessant use of antibiotics[2, 3]. Fish food has a direct role on growth, reproduction and coloration of fish. Carotenoids are the vital pigments seen in birds, insects, fish and crustaceans. Fish can't synthesize carotenoids *de novo*[4]. They obtain coloration from dietary carotenoids. There is a direct relationship exists between fish coloration and carotenoids[5]. The natural pigments of the diets improve the color of ornamental fish to some extent[6]. Carotenoid accumulation on fish is affected by their kinds and dietary concentration[7]. The color improvement can be done by administration of carotenoid enriched feed.

For the sake of improving color of the skin and muscle of farmed fish, synthetic carotenoids are generally added in commercial feeds. In view of the deteriorating effects of synthetic pigments on the environment, the researchers are emphasizing the need for natural pigments or coloring agents. Since the aqua feed industry seeks a natural eco-friendly source of pigment to improve coloration and to enhance growth, there is a great potential for use of natural plant based carotenoids. It paves the way to many aqua feed industries to uphold their products as natural with shifting away from synthetic colorants. Recent efforts have focused on plant materials as a valuable substitute for chemicals used in aquaculture.

A wide variety of low molecular weight secondary metabolites have been isolated from plants. These compounds facilitate the plant to interact with the environment and may act against physiological and environmental stress as well as predators or pathogens. The herbs in the animal feeds enhance the flavor of the food and can therefore influence eating patterns, secretion of digestive fluids and total feed intake. Addition of artificial carotenoid source in fish feed increases the feed production costs[8, 9]. But this problem can be eliminated by using plant source as an effective substitute for high cost carotenoid sources. Several authors have proved that plant sources can be used to improve fish color and growth[10,11]. In the present study, an attempt was made using different concentrations of Powdered Marigold flowers and *Hibiscus rosa sinensis*

flowers incorporated diet on growth and coloration of Tilapia.

MATERIALS AND METHOD

Preparation of flower powder

Marigold and Hibiscus flowers were bought from local market, chopped into small pieces by using a sterilized sharp knife and dried in shade. Finally, the dried petals were ground and sieved to get a nice powder and stored in plastic containers. The powder was kept away from sun light to restore its original quality. Different concentrations of these powders were used to prepare experimental diets for fish.

Experimental diets

The feed stuffs like wheat flour, rice bran, tapioca flour, prawn meal, ground nut oil cake were obtained from local market. Experimental diets were formulated for 40% protein content. The feed formulation was given in the table 1. The feed ingredients were thoroughly mixed and different concentrations of flower powder were added. A dough was made by adding water. Pellets were formed by using pelletizer. The feed which was devoid of flower powder was considered as control. Eleven different pelleted feeds were formulated for the experiment as follows:

Table 1: Feed formulation of experimental diets (g/100g) used in the study

Ingredients	C	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}
Fish meal	26	25	25	25	25	25	23	23	23	23	20
Ground nut oil cake	27	25	25	25	25	23	28	24	24	22	22
Rice bran	16	14	12	11	10	8	10	10	10	10	9
Wheat flour	14	14	10	10	8	6	16	15	12	10	10
Tapioca flour	13	13	14	10	8	9	14	14	12	11	10
Marigold	-	5	10	15	20	25	-	-	-	-	-
Hibiscus	-	-	-	-	-	-	5	10	15	20	25
Multivitamin	1	1	1	1	1	1	1	1	1	1	1
Oil	1	1	1	1	1	1	1	1	1	1	1

C-control diet; **E_1**-5% marigold diet; **E_2**-10% marigold diet; **E_3**-15% marigold diet; **E_4**-20% marigold diet; **E5**-25% marigold diet;**E_6**-5%Hibiscus diet; **E_7**-10% Hibiscus diet; **E_8**-Hibiscus diet; **E_9**-Hibiscus diet; **E_{10}**-Hibiscus diet.

C - Control feed.

E1 - Diet supplemented with 5% marigold flower powder.

E2 - Diet supplemented with 10% marigold flower powder

E3 - Diet supplemented with 15% marigold flower powder

E4 - Diet supplemented with 20% marigold flower powder

E5 - Diet supplemented with 25% marigold flower powder

E6 - Diet supplemented with 5% Hibiscus flower powder

E7 - Diet supplemented with 10% Hibiscus flower powder

E8 - Diet supplemented with 15% Hibiscus flower powder

E9 - Diet supplemented with 20% Hibiscus flower powder

E10 - Diet supplemented with 25% Hibiscus flower powder

Experimental design

Oreochromis mossambicus fingerlings of uniform sized group were procured from a commercial aqua farm, Thoothukudi, Tamil Nadu, India. They were acclimatized in the laboratory for a week. The fish were segregated into eleven groups of 10 fish each. Triplicates were maintained. Fish were fed by hand *ad labitum* twice a day at 9:00 and 17:00hrsfor 28 days of experimental period.

Estimation of growth

The Initial weight of the fishes was observed on the starting day of the experiment. Every week end the weight gain of the fishes was estimated using digital monopan balance with two digital accuracy. The other parameters related to growth were also observed during the entire period of the study. The Growth parameters were calculated based on the following formulae:

Weight gain = Final weight – Initial weight.

Percentage weight gain= (Final weight –Initial weight /Initial weight)×100.

FCR = Feed intake (g)/Weight gain (g).

ADG (g/fish/day) = (Final weight –Initial weight)/Experimental days

SGR = (log final weight – log initial weight)*100/Experimental days

Estimation of total carotenoids[12]

30-50 mg of muscle, skin and fin sample was taken from the fish. The sample was homogenized with 20 ml of acetone by mortar and pestle for one hour. The content was filtered in What-man filter paper No:1 and the filtrate was read at 475 nm in U.V. Spectrophotometer.

Statistical analysis

All experiments were performed in triplicates and the results are expressed as mean values with standard deviation. Data were subjected to Student's't' distribution to test the level of significance 5% level of significance level ($p<0.05$) was taken into account.

RESULTS AND DISCUSSION

Growth parameters

The growth performance of *Oreochromis mossambicus* fingerlings fed with the experimental

diets in terms of Weight Gain, Percentage Weight Gain (PWG), Specific Growth Rate (SGR), Feed Conversion Ratio (FCR) and Survival Rate is presented in Table 2. Even though all the feeds were accepted by fish and were utilized for growth, diet C had the least performance and E5 showed the best performance. Johnson and Banarji,[13] reported a growth increase in *Labeo rohita* fed with herbal supplement diet. A maximum of 86.3% of weight gain was recorded in group of fish fed 25% marigold meal (E5) and 25% of hibiscus meal (Weight gain 79.1%) than the control. In both the flower powder in the diet, the weight gain percentage decline gradually as the percentage of flower powder feed decreased. The values of Average Daily Gain (ADG) in all groups treated with Marigold meal and Hibiscus meal at all concentrations were higher than that of control and it also showed an increasing trend than the control as the concentration of the flower in the meal increased.Torrissen[14] showed that carotenoids supplied in the diet increased the growth rate in Atlantic salmon. Several researches have reported positive effects on growth for different fish fed diets supplemented with carotenoids[15]. The highest growth rate was reported in *Amphipriono cellaris* fed with marigold meal[16]. In the present study the highest flower content diets 25% Marigold petal meal and25% Hibiscus flower meal showed better performance in terms of weight and it was supported by Sinha *et al.*,[17]. The better FCR values observed with flower meal supplemented diets suggested that addition of flower powder improved feed utilization in tilapia. In practical terms, this means that use of flowers could reduce the amount of feed necessary for animal growth, which could result in production cost reductions. Better FCR was observed in fish fed with 25% marigold petal meal (1.19±0.06). This result is in agreement with Ezhil *et al.*,[18] who reported that the marigold petal meal increased the growth rate of red swordtail fish. The carotenoids present in both the flower supplements used in this study induced the growth as well as the coloration of the fish studied. Higher weight gain, SGR increased significantly ($p<0.05$) with increasing marigold flower powder from 5% to25%. As far as the survival rate is concerned there was no much difference observed among fishes fed with different concentrations of diet. The diet with least concentration of flower powder showed 10-20% mortality in both marigold and hibiscus feed (Table 2).

Table 2: Growth performance of *O.mossambicus* fed with different experimental diets for 28 days. The values indicated are the Mean±SD of three observations.

Treatment	Initial weight (g)	Final weight (g)	Weight gain (g)	PWG (%)	ADG (g)	FCR	SGR (%)	Survival (%)
C	6.01±0.08	8.35±0.05	2.34±0.04	38.9±0.1	0.0836±0.04	2.27±0.02	1.175±0.01	100
E_1	5.94±0.09	9.00±0.08	3.06±0.08	51.5±0.3	0.1092±0.01*	2.19±0.01*	1.484±0.02	90
E_2	6.01±0.04	9.35±0.06	3.54±0.02	58.9±0.1	0.1264±0.06*	2.14±0.04*	1.578±0.01	100
E_3	6.24±0.05	9.95±0.07	3.71±0.03	59.5±0.2	0.1325±0.02*	2.01±0.09*	1.666±0.04	100
E_4	5.56±0.04	9.99±0.03	4.43±0.01	79.6±0.4	0.1582±0.01	1.32±0.07	2.092±0.02	90
E_5	5.62±0.03	10.5±0.04	4.85±0.02	86.3±0.2	0.1732±0.02	1.19±0.06	2.222±0.01	100
E_6	6.29±0.08	8.98±0.08	2.69±0.04*	42.8±0.2	0.0961±0.01*	2.24±0.05*	1.271±0.04	80
E_7	6.19±0.03	10.1±0.09	3.91±0.06	63.2±0.3	0.1396±0.06*	1.84±0.06	1.748±0.06	90
E_8	5.59±0.02	9.69±0.03	4.10±0.07	73.3±0.8	0.1464±0.07*	1.69±0.02	1.964±0.06	90
E_9	5.59±0.09	10.0±0.04	4.41±0.04	78.9±0.9	0.1575±0.02	1.52±0.11	2.077±0.08	100
E_{10}	6.11±0.08	10.9±0.05	4.83±0.03	79.1±0.6	0.1725±0.01	1.22±0.02	2.327±0.04	100

PWD-Percentage weight gain; ADG-Average daily gain; SGR-Specific growth rate FCR-Feed conversion ratio.

The values with the asterisk (*) in the same column are not significantly ($p<0.05$) different from the control.

Table 3: Total carotenoids observed in fin, skin and muscle of control and experimental fish (mg/100mg).the values indicated are the Mean±SD of three observations.

Samples	C	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}
Fins	0.267± 0.03	0.298± 0.04	0.314± 0.01	0.356± 0.05	0.416± 0.05*	0.424± 0.09*	0.284± 0.06	0.308± 0.03	0.327± 0.06	0.352± 0.05	0.372± 0.04
Skin	0.251± 0.04	0.274± 0.02	0.291± 0.02	0.321± 0.04	0.352± 0.03*	0.394± 0.07*	0.269± 0.03	0.278± 0.08	0.319± 0.05	0.334± 0.06	0.351± 0.04
Muscle	0.237± 0.02	0.259± 0.02	0.272± 0.03	0.289± 0.05	0.314± 0.04	0.350± 0.07	0.255± 0.06	0.274± 0.04	0.298± 0.06	0.321± 0.03	0.331± 0.07

The values with the asterisk (*) in the same row are significantly different from the control.

Total carotenoids

Total carotenoid content in skin, fins and muscle of *O. mossambicus* increased with increasing concentrations of Marigold and Hibiscus meals than the control diet(Table 3). Fins showed maximum coloration. It was followed by skin and muscle in all treatments. E5 significantly ($p<0.05$) enhanced the coloration in fins, skin and muscle of Tilapia. E5 was followed by E10. The carotenoid content in fins, skin and muscle of fish fed with diets supplemented with different concentrations of marigold petals and Hibiscus flower differ from that of fish fed with control diets. Total carotenoid content in skin, fins and muscle of fish fed with 25% marigold was 0.424 mg/100mg, 0.394 mg/100mg and 0.350mg/100mg respectively after experimental period. Carotenoid content in experimental fish body was significantly higher ($p<0.05$) than those of the control group in all the diets incorporated with the flower powders. As the concentration of the diet increased, the carotenoid content was also increased significantly ($p<0.05$). This result was supported by Jha *et al.*,[19] and Buyukcapar *et al.*,[20] who studied marigold flower supplementation on Snow trout and red pepper supplementation on rainbow trout respectively. The maximum carotenoid level was observed in E5 (0.042, 0.394 and 0.350 in fin, skin and muscle samples respectively) which was followed by E10 (0.372, 0.351 and 0.331 in fin, skin and muscle samples respectively).

CONCLUSION

The growth performance and coloration of *O. mossambicus* was studied using Hibiscus flower and Marigold flower supplemented diets. The significantly ($p<0.05$) different weight gain (g), percent weight gain (%) average daily gain (g) feed conversion ratio and specific growth rate were reported in E5 (25% Marigold diet). It was followed by E10 (25% Hibiscus diet). The maximum carotenoid contents in fin, skin and muscle samples were also reported in 25% Marigold supplemented diet. According to the results of the present study, 25% marigold diet was recommended for *O. mossambicus* for better growth and coloration.

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