
INFLUENCE OF BOTANICAL ADDITIVES ON THE GROWTH AND COLOURATION OF ADULT GOLDFISH, *CARASSIUS AURATUS* (LINNAEUS)

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ABSTRACT

The present investigation was designed to study the effect of three botanical additives (coriander, mint and amaranth leaves) on the growth and body colouration of an ornamental goldfish. The experiment was conducted in adult goldfish for a period of 60 days. The pigment sources were added to the basal diet at 1, 3 and 5 per cent levels respectively. The fishes were fed at the rate of 5 per cent level of body weight. Two fold increase in growth was observed in amaranth fed fishes at 1 per cent concentration when compared to control. In the coriander fed fishes, the mean weight gain were higher at 3 per cent level followed by 1 per cent level. In the mint fed fishes, the better weight increment was noticed at 1 per cent level. The percentage of colour obtained in adult goldfish were high in amaranth fed fishes at 1 per cent level and 3 per cent level when compared to other treatments and control. The present investigation concluded that, amaranth and mint at 1% level enhanced the growth and colouration in adult goldfish.

Key words: Goldfish, colour, growth, plant pigment, carotenoids

INTRODUCTION

Ornamental fishes are nowadays rapidly gaining importance because of their aesthetic value and also due to their immense commercial value in the export trade world over. Attractive colouration determines the commercial value of ornamental fish. Pigmentation in the skin is responsible for colouration in the fish. Carotenoids are the primary source of the pigmentation on the skin of fishes. In natural environment, the fishes meet their carotenoid requirements by ingesting aquatic plants or through their food chains. But, fishes cannot synthesize carotenoid *de novo*. Carotenoids are responsible for many of the red, orange and yellow hues of plant legumes, fruits and flowers. The colour enhancing diets should contain additional natural pigments to enhance the colours of ornamental fishes. Goodwin

(1951) established that fish do not possess the ability to synthesize carotenoids. The carotenoid pigmentation of fish results from the pigment present in the diet (Hata and Hata, 1973; Steven, 1948). Many studies have proved that the fish can be pigmented by including processing wastes and plant sources (Ibrahim et al., 1984; Boonyaratpalin and Phromkunthong, 1986; Ahilan and Prince Jeyaseelan, 2001). The present experiment was carried out to find out the influence of botanical additives on the growth and colouration of goldfish *Carassius auratus*.

MATERIAL AND METHODS

The experimental fishes were procured from local Aquarifarm. The experimental set up comprised three separate units. Each unit possessed

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six cement tanks for three different concentrations (1, 3 and 5 per cent), having two replications. Two cement tanks were separately maintained for control groups. Healthy adult fishes weighing between 3.935 and 4.953 g were stocked at the rate of 10 per tank.

The prepared pelleted feed was fed to the adult goldfish at the rate of 5 per cent of the body weight. The fishes were fed with the experimental diet at three different concentrations (1, 3 and 5 per cent). The control diet was given to control group fishes. Feeding was done twice a day viz. morning and evening. The daily allowance was divided into two equal portions and given at 08.00 h and 17.00 h. Sampling was carried-out once in a fortnight and the growth parameters were measured and recorded. The physico-chemical parameters such as temperature, dissolved oxygen, ammonia, nitrite, and pH in all the experimental tanks were estimated. Standard methods were employed for the analysis of the water quality parameters.

Colouration studies

The colour intensity on the skin of goldfish was also ranked using Salmofan (Roche, Basle Switzerland). Total carotenoid on the skin of the fish was estimated by Olsen's method (1979).

RESULT AND DISCUSSION

The data regarding the growth of adult goldfish fed with 3 different botanical additives at three different concentrations are presented in Table 2.

The mean weight of the adult goldfish on the first day of stocking in the control was 4.535 g. The initial mean weight of the coriander fed fish group at 3 different concentrations viz. 1, 3 and 5 per cent were 4.788, 3.935 and 4.440 g and the initial mean weight in the mint were recorded to be 4.726, 4.953 and 4.860 g respectively. The mean weight of the amaranth fed fishes were 4.487, 4.796 and 4.629 g respectively.

At the end of the experiment i.e., on the 60th day, the mean weight of the control fishes were found to be 6.124 g and in the coriander fed fishes the mean weight were observed to be 6.341, 5.874 and 5.677 g in 1, 3 and 5 per cent concentrations respectively. In the mint fed fishes, the mean weight were recorded to be 6.560, 6.139 and 6.124 g in 1, 3 and 5 per cent levels and in the amaranth fed fishes those were observed to be 6.975, 7.072 and 5.429 g. The mean weight gain in the fishes fed with control diet was observed to be 1.467 g.

The mean weight gain of the fishes fed with coriander were found to be 1.553, 1.939 and 1.237 g at 1, 3 and 5 per cent concentrations respectively. In the mint fed fishes, the mean weight gain were recorded to be 1.834, 1.186 and 1.264 g at 1, 3 and 5 per cent concentrations respectively. The mean weight gain of 2.487, 2.276 and 0.800 g were observed in the fishes fed with amaranth at 1, 3 and 5 per cent concentrations respectively. The specific growth rate of the fishes were also worked out and presented in the Table.

The water temperature of the experimental tanks varied between 25-26°C at 8 a.m. and 26-28°C at 5 pm. The water pH fluctuated from 7 to 8. The dissolved oxygen content showed variation from 4 to 6 mg/l. The nitrate level of 0.001 to 0.007 mg/l was recorded in experimental tanks. The presence of ammonia was in trace level throughout the experimental period.

Carotenoid content on the skin of adult goldfish (*Carassius auratus*)

The total carotenoid content on the skin of goldfish in all the treatments and control were estimated before and after the completion of the experiment using Olsen's method and presented in Table 3.

Colour scoring by Salmofan

The colour on the skin of adult goldfish was ascertained using salmofan. The percentage of colour obtained by the goldfish was also calculated and the results are presented in Table 3.

In this investigation, amaranth incorporated feed at 1 per cent level showed higher mean weight gain (2.487g) followed by coriander fed fishes at 3 per cent level (1.939g). The present work confirmed that the carotenoids do play a role in the growth of goldfish. Similar observation was made by Tveranger (1986) in rainbow trout offspring using 10 per cent krill meal as a source of carotenoid. Thongrod *et al.* (1995) stated that carotenoids influenced the growth of fishes and crustaceans. The adult goldfish fed with coriander incorporated feed at 3 per cent level showed better mean weight gain (1.939g) and specific growth rate (0.668g) when compared to other coriander incorporated feeds and control. Sommer *et al.* (1992) recorded that in trouts, the addition of carotenoid rich micro algae *Haematococcus pluvialis* enhanced the growth. Boonyratpalin and Unprasert (1989) observed a positive effect of dietary carotenoid on the growth of red tilapia. The mean weight gain of coriander fed fishes at 5 per cent level was lesser than the control. It might be due to the high level of incorporation of carotenoids in the feed. Kowsalya *et al.* (2001) found that the total carotenoid content of amaranth, coriander and mint leaves were 29.064 mg/100g, 36.720 mg/100g and 29.057 mg/100g respectively on the basis of dry weight (sundried). Fey *et al.* (1980) reported the enhancement of colour in male gourami when fed with carotenoid as a pigment source. Peimin *et al.* (1999) reported that spirulina induced the growth and body colour of crucian carp.

More than three fold increase in the total carotenoid content on the skin of adult goldfish was observed at 3 per cent level than the control. These group showed a dark colour pattern than the control. Ronneberg *et al.* (1979) used *Haematococcus pluvialis* as a safe natural source of astaxanthin derived from a microalgae which resulted in extensive pigmentation in koi and tropical fishes. In mint fed groups, a significant difference was observed between 1 per cent level and control. The higher concentrations (3 and 5 per cent levels)

showed lesser growth than the control. This might be due to the excess levels of carotenoid which reduced the growth rate of fishes. Mint incorporated feed at 3 per cent level improved the colouration and 1 per cent level enhanced the growth.

A significant difference between the treatment and control was observed at 1 per cent and 3 per cent levels in amaranth fed fishes. Phromkunthong (1988) reported that the addition of spirulina (carotenoid source) was effective in producing deeper colouration in fancy carp.

According to Boonyaratpalin and Unprasert (1989), the rate of colour development seemed to depend on the amount and nature of carotenoid present in the pigment source/ingredient. The percentage of colour development was higher in coriander fed fishes and this could be directly attributed to the higher level of carotenoid content in the particular ingredients. Hence, the present investigation confirmed the observation made by Boonyaratpalin and Unprasert (1989) in the red tilapia and also the observation made by Ako *et al.* (1999) in velvet swordtail *Xiphophorus helleri*, rainbow fish *Pseudomugil turcatus* using spirulina as a carotenoid source. The present investigation also confirmed the study conducted by Tanaka *et al.* (1976) in goldfish using crab waste as a carotenoid source and Kamata *et al.* (1990) who observed the colour development in rainbow trout when fed with *Adonis aestivalis* as a pigment source.

The present study concluded that the botanical additives such as coriander, mint and amaranth had a positive role in the growth and colour development of goldfish.

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Table 1

List of feed ingredients used

Sl. No	Ingredients	Percentage of inclusion			
		Control	Experimental diet 1 (1%)	Experimental diet 2 (3%)	Experimental diet 3 (5%)
1.	Fish meal	16 %	16 %	16 %	16 %
2.	Groundnut oil cake	16 %	16 %	16 %	16 %
3.	Sesame oil cake	16 %	16 %	16 %	16%
4.	Soya flour	16 %	16 %	16 %	15 %
5.	Rice bran	18 %	17 %	16 %	15 %
6.	Tapoica flour	17.5 %	17.5 %	16.5 %	16.5 %
7.	Vitamin & Mineral mixture	0.5 %	0.5 %	0.5 %	0.5 %

(The botanical additives such as amaranth (*Amaranthus* sp.), coriander (*Coriandum* sp.) and mint (*Mentha* sp.) were used at three different concentrations viz. 1, 3 and 5 per cent).

Table 2

Effect of different botanical additives on the growth of adult goldfish (*Carassius auratus*)

Treatment	Conc. (%)	Mean weight (g)					Mean weight gain (g)	Weight gain per day (g)	Specific growth rate	P value
		1 st day	15 th day	30 th day	45 th day	60 th day				
Coriander	1	4.788 ±0.04	5.175 ±0.10	5.585±0.23	5.980±0.15	6.345 ±0.09	1.553	0.0259	0.468	4.68 x 10 ⁻⁶
Coriander	3	3.935 ±0.02	4.459 ±0.05	4.941±0.07	5.402±0.04	5.874 ±0.16	1.939	0.032	0.668	
Coriander	5	4.440 ±0.08	4.697 ±0.12	5.025±0.08	5.362±0.08	5.677 ±0.25	1.237	0.021	0.410	
Mint	1	4.726 ±0.04	5.182 ±0.17	5.667±0.25	6.129±0.21	6.56±0.20	1.834	0.031	0.547	0.0021
Mint	3	4.953 ±0.10	5.200 ±0.06	5.515±0.02	5.815±0.09	6.139 ±0.12	1.186	0.020	0.358	
Mint	5	4.86 ±0.10	5.186 ±0.03	5.528±0.07	5.823±0.03	6.124 ±0.04	1.264	0.021	0.385	
Amaranth	1	4.487 ±0.02	5.101 ±0.11	5.745±0.06	6.393±0.01	6.975 ±0.09	2.487	0.042	0.735	0.0016
Amaranth	3	4.796 ±0.12	5.375 ±0.11	5.980±0.14	6.54±0.07	7.072 ±0.16	2.276	0.038	0.648	
Amaranth	5	4.629 ±0.19	4.785 ±0.12	5.031±0.11	5.243±0.11	5.429 ±0.09	0.800	0.013	0.267	
Control	-	4.535 ±0.04	4.916 ±0.05	5.284±0.15	5.645±0.01	6.002 ±0.11	1.467	0.0245	0.467	

Table 3

Effect of botanical additives on the colouration and Carotenoid content on the skin of adult goldfish

Sl No	Treatment	Concentration (%)	Total carotenoid (μ g/g)		Colouration	
			Initial	Final	Colour score (Salmofan)	% of colour obtained
1.	Coriander	1	3.256	9.924	30	80
		3	3.256	10.612	34	90
		5	3.256	6.7169	30	80
2.	Mint	1	3.256	7.418	29	70
		3	3.256	11.320	34	90
		5	3.256	6.171	29	80
3.	Amaranth	1	3.256	5.040	34	90
		3	3.256	7.020	34	90
		5	3.256	6.056	30	70
4.	Control	-	3.256	3.892	20	50

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