EFFECT OF BOTANICAL ADDITIVES ROSE PETALS AND ORANGE PEELS ON GROWTH AND PIGMENTATION OF GOLDFISH (*CARASSIUS AURATUS*)

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ABSTRACT: Ornamental fish keeping is established as an important part of aquaculture farming. The quality of ornamental fish can be enhanced using biological products. Botanical additives are cheap and easily available so they can also be suggested as an enhancer for the growth and coloration of ornamental fish. The aim of the present study was to assess the effect of orange peels and rose petals on growth, performance and Carotenoid concentration in ornamental fish species goldfish (*Carassius auratus*). The experiment was carried out for a period of two months at the Department of Fisheries and Aquaculture, UVAS Ravi campus Pattoki. Fish were categorized into three groups: Group I (control), Group II and Group III (experimental). The feed of control was normal fish feed while Group II and Group III were treated with 20g/100g of orange peels and rose petal powder respectively. The total body weight, length, and Carotenoid concentration were determined in fish. However, all the Physico-chemical parameters of water such as temperature, pH, Total dissolved solids and dissolved oxygen were also recorded during the study period. It was noticed with controlled Physico-chemical parameters of water carotenoid concentration; body weight and length were enhanced with botanical additives. It was concluded botanical additives used in present research could improve the growth of goldfish (*Carassius auratus*).

Keywords: Botanical additives, Carotenoid, Goldfish, Ornamental, Quality.

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INTRODUCTION

Ornamental fish keeping is an important part of aquaculture farming. It is not only a popular hobby but also a very good business. World trading of ornamental fish is making it a multimillion-dollar industry (FAO, 2007). The industry is also getting attention in Pakistan. According to one estimate 20 species of ornamental fishes were imported live into Pakistan from Southeast Asian countries (Ahmed, 1996). *Carassius auratus* commonly known as goldfish is fresh water and an ornamental fish. It is native to Eurasia, especially found in East Asia (Takada et al., 2010). Health and nutrition of the ornamental fish are the two main aspects that decide trade and prosperity in the ornamental fish industry. Coloration is one important factor determining the market value of ornamental fish (Kalinowski et al., 2005; Mukherjee et al., 2009). Ornamental fish' pigment is one of the most important quality criteria dictating their market value (Kestemont et al. 1990; Shahidi et al. 1998; Paripatanamont et al. 1999; Rezende et al. 2012). Kaur and Shah, (2017) described skin coloration plays a vital role in deciding the aesthetic value. In ornamental fish trading, faded fish fails to attract the attention of the buyers. So, the use of natural products is increasing to improve health and coloration of the ornamental fish. According to Mukherjee *et al.* (2009) the use of turmeric mixed fish feed can promote carotenoid pigment of fantail guppy *Poecilia reticulata*. It is reported in the study that the use of turmeric results in maximum pigment concentration in caudal fin, muscle of the fish and betterment in specific growth rate. Ramamoorthy et al. (2010) also used fish feed with carrot, hibiscus, marigold and rose and reported these products have ability to enhance color in *Amphiprion ocellaris*. Several studies supported that natural feed additives act as stimulator to enhance body coloration even though they are also available throughout the kingdom (Goodwin, 1984; Halten et al. 1997; Annu, 1999; Gouveia et al., 2002; Gupta et al., 2007; Weeratunge and Perera, 2016). Industrial expansion of freshwater ornamental fish culture has been hindered by the lack of suitable live feeds for feeding the fish at the various production stages (Lim et al., 2003). Moreover, a number of studies also reports on the importance of orange peel and rose petals as both are rich source of natural carotenoids along with various essential nutrients. Anthocyanin is found in rose petals and vitamin C, vitamin B6, folate, and calcium are found in orange peels (Sinha and Asimi, 2007; Chedea et al., 2010; Pailan et al., 2012; Boukroufa et al., 2017; Rubashvili et al., 2018; Wan et al., 2018; Murador et al., 2021). The study is novel as it focused on the importance of natural sources of carotenoids rather than synthetic carotenoids to improve the growth of ornamental fish. So,

the present study was designed to evaluate growth performance and coloration of goldfish (*Carassius auratus*) with varying fish feed. The goldfish (*Carassius auratus*) was fed with a supplemented diet (orange peels and rose petals) on weekly basis to assess growth performance and coloration.

MATERIALS AND METHODS

Placement of the experimental setup and keeping of fish: The present study was carried out using rose petal and orange peels as feed of goldfish, (*Carassius auratus*) and their effects on growth and coloration was recorded. The experimental setup was designed in three glass aquariums for a period of two months in the Department of Fisheries and Aquaculture, UVAS Ravi campus Pattoki (Fig. 1).

The goldfish used in this study was of 30-35g and purchased from a local commercial ornamental fish farm of Lahore, Punjab, Pakistan. The fish were acclimatized to the laboratory conditions for 15 days and starved for 2 days before taking initial weight.

Experimental design: Thirty fish were divided randomly into three aquariums of 50 L capacity each having 5 pairs of fish. Each aquarium was properly labelled as Group 1 (Control), Group II was further divided into Experimental group I and Experimental group II. Each group fish was fed with three types of formulated diets as control (Group I) provided with the normal diet and experimental group I and II were fed with orange peels 20g/100g and rose petal 20g/100g respectively. All the groups were provided with feed two times a day. The orange peel and rose petal feed was prepared by drying the contents and later, finely grinded with the help of a grinder machine.

Growth parameters and Carotenoid Analysis: At the start of experimental trial, the total wet weight of fish in each treatment was determined by weighing in an electronic balance. Then fish were weighed on a weekly basis throughout the trial. While, to evaluate the carotenoid concentration in muscle and caudal fin of fish from each treatment group was selected frequently after 15 days, sacrificed and total carotenoid concentration was estimated by methods of Olson (1979).

Figure 1: An experimental design in the Department of Fisheries and Aquaculture, UVAS Ravi campus Pattoki

Study of Physicochemical factors: Temperature, pH, Total dissolved solid (TDS) and dissolved oxygen of water surface in each aquarium was recorded with the help of Dissolved Oxygen Meter (ADWA kft 107525) by fixing the temperature factor at 0 ˚C, range of salinity in µS/cm, TDS and oxygen each in mg/L unit

Statistical analysis: The data thus obtained was subjected to statistical analysis by using "SPSS" version 21.0. The variation for various parameters and carotenoid concentrations in muscle and caudal fin were tested by using Analysis of variance (ANOVA).

RESULTS

The present study was conducted to see the effect of orange peels and rose petals on goldfish *Carassius auratus* for two months duration. Fish were fed with three types of diets, control diet (Group I), orange peels (Experimental Group I) and rose petals (Experimental Group II) diet at 4 % of body weight. The data regarding carotenoid concentration on alternate weeks and physicochemical parameters were recorded daily and their average values were recorded on weekly basis. The initial and final average weights of *Carassius auratus* were 30.22 and 30.63 g in control Group I while, the initial and final average weights of experimental group I were 30.21 and 32.29 g respectively. In experimental group II initial and final average weights were recorded as 30.15 and 32.06 g respectively. It was noticed values of initial weights of control and treated groups were highly non-significant by one-way ANOVA. However, the values of final average weight and weight gain were significantly different in control and experimental groups. The initial and final average lengths of goldfish were observed 13.20 and 14.18 respectively in control group with minimum and maximum increase in length was 0.01 and 0.03 respectively. In Experimental Group I and Experimental Group II initial and final average lengths were 13.31 and 14.39 and 13.53 and 14.51 respectively. Statistical analysis showed that *Carassius auratus* gained best average total length of 14.51 in Experimental Group II and values of final total lengths and average increase in total length were highly significant (Table 1).

Avg. wt: average weight; Avg. L: Average length; Exp.: Experimental: In muscle of control Group I the maximum concentration of carotenoid was observed at wavelength 380 nm (52.31 µg/g) and minimum concentration was recorded at 500 nm (28.8 µg/g). Analysis of muscle of *Carassius auratus* in experimental group I revealed that maximum concentration was 82.08 at 380 nm while, the minimum value was observed as 28.8 at 500 nm. The maximum concentration of carotenoid in muscle of *Carassius auratus* of experimental group II was 110.6 µg/g at wavelength 380 nm and minimum was 28.8 µg/g at a wavelength of 500 nm (Table 2).

Table 1: Weekly increase in body weight (g) and length of fish under different treatments.

Week	Group I Control		Exp. Group I		Exp. Group II	
	Avg.wt	Avg. L	Avg.wt	Avg. L	Avg.wt	Avg. L
1st Week	30.22	13.20	30.21	13.31	30.15	13.53
9th Week	30.63	14.18	32.29	14.4	32.06	14.51
Difference	0.41	0.98	2.08	1.09	1.91	0.98

Table 2: Analysis of carotenoid concentration (µg/g) in muscles in different fish groups.

No. of	Group I Control		Exp. Group I		Exp. Group II	
Weeks	380 nm	500 nm	380 nm	500 nm	380 nm	500 nm
Week 1	43.12	28.8	43.12	28.8	44.36	28.8
Week 3	42.67	34.67	44.36	40.24	64.24	63.37
Week 5	52.31	45.45	66.52	64.26	74.28	70.51
Week 7	33.46	37.87	73.6	62.43	80.02	84.48
Week 9	36.23	32.51	82.08	73.76	110.6	112.44

Analysis of variance was applied, and a highly significant difference was noticed in all treatment groups with control. The carotenoid concentration in caudal fin of goldfish *Carassius auratus* of control group revealed that maximum concentration was 24.58 µg/g at 380 nm while the minimum value was 16.32 µg/g at 500 nm. The analysis of carotenoid content in caudal fin of goldfish in experimental group I at various wavelengths revealed that maximum concentration was 54.37 µg/g and 9.76 µg/g at wavelength of 380 nm and 500 nm respectively. The analysis of carotenoid content in caudal fin of goldfish in experimental Group II at various wavelengths revealed that maximum concentration was 82.60 at wavelength of 380 nm and minimum was 17.56 at a wavelength of 500 nm. A comparison of carotenoid concentration in caudal fin of goldfish in all treatments at wavelength of 380 nm showed that maximum carotenoid concentration was high in experimental Group II as compared to all other groups (Table 3). Analysis of variance showed a significant difference is present in control and treated groups at 0.05 level of significance.

The most important physic-chemical parameters of water which were studied temperature pH, dissolved oxygen and total dissolved solids daily for entire experimental period and average of these parameters was calculated on weekly basis. The average water

temperature, pH, dissolved oxygen, TDS and salinity were almost same in all treated groups during the experimental conditions. Statistical analysis showed that values were non-significant among different treatments groups at 0.05 significance level (Table 4).

Table 3: Analysis of Carotenoid concentration (µg/g) in caudal region in different fish groups

No. of	Group I Control		Exp. Group I		Exp. Group II	
Weeks	380 nm	500 nm	380 nm	500 nm	380 nm	500 nm
Week 1	22.80	17.56	22.80	17.56	22.80	17.56
Week 3	21.43	19.23	17.28	09.76	29.92	32.25
Week 5	24.58	23.11	37.36	30.52	41.12	34.81
Week 7	22.87	21.62	47.72	43.39	46.12	43.32
Week 9	19.71	16.32	54.37	46.73	82.60	66.36

Table 4: Average values ± SD of temperature, pH, TDS and dissolved oxygen.

Recorded Parameters	Group I Control	Exp. Group I	Exp. Group II
Temperature	24.4±0.01	23.4±0.00	25.6±0.01
pH	7.26±0.05	7.16±0.06	7.26±0.07
TDS	1324±5.1	1321±5.0	1324±5.1
Dissolved Oxygen	7.10±0.13	7.13±0.0.14	7.15±0.15

DISCUSSION

Carassius auratus is a traditional ornamental fish and its body size, shape and color are the features that affect the commercial price (Paripatananont *et al*., 1999; Gouveia *et al*., 2003; Gouveia and Rema, 2005). In the present studies, maximum weight gain, length and carotenoid concentration in goldfish *Carassius auratus* was observed that fed with orange peels and rose petal supplemented diet for a period of 2 months. Highest weight gain was observed in experimental Group I and length was observed in experimental Group II. These results were in line with the findings of Ahilan *et al.* (2008); Pailan *et al*. (2012) and Vasudhevan *et al.* (2013) who reported that botanical additives have a positive role in growth of goldfish *Carassius auratus.* However, Wang *et al.* (2006) reported controversial results, and no effect of feed additives noticed on survival, growth, pigmentation, and antioxidant capacity of characins *Hyphessobrycon callistus*, an ornamental fish.

Carotenoid concentration in muscle and caudal fin was increased suggestively in both experimental groups. Ezhil *et al*. (2008) reported that feed with marigold petals increased the growth rate and pigmentation of red swordtail (*X. helleri*.). Their results were like the results of present study. The results were also like Asimi, (2009) who reported that natural color enhancers cause growth and increased skin coloration in goldfish. Results of present research work are also in lined to the work of Sinha and Asimi (2007) and Arulvasu *et al*. (2013) who reported that feed with *Rosa rubiginosa* petals increased the growth of (*X. helleri*) and color concentration was also enhanced. Jha *et al*. (2012) reported that marigold petals and beetroot meals have an encouraging effect on growth and pigmentation on snow trout. Mukherjee *et al*. (2009) reported that turmeric meal improved body weight and coloration in *Poecilia reticulata.* One study also reports that the aesthetic value of goldfish is enhanced with its color intensity which improved using botanical feeds. However, use of five different feeds no change in growth and efficacy were recorded (Yeşilayer et al., 2011). Astaxanthin is a botamical feed product obtained from algae and has ability to enhance pigmentation in goldfish (Paripatananont et al., 1999).

Various physical attributes of water, i.e. water temperature play a key role in over metabolism of water bodies. Other parameters, like pH, Dissolved oxygen and TDS were of great importance to all aquatic organisms and were more and less same in all parameters (Table 4). Overall temperature range was 23.4 to 25.6 ºC which was suitable to the growth of *Carassius auratus*. Bhatnagar and Devi (2013) reported the prominent effect of water quality parameters (physic-chemical) on the growth of fish and other metabolic functions. Similarly various other studies also report that aquaculture greatly affected by the change of physical and chemical parameters of water (Keremah et al., 2014; MacIntyre et al., 2008; Mukherjee and Jana, 2007).

Conclusion: It was concluded by the results of this study that the use of botanical additives such as rose petals and orange peels help to develop coloration and growth of ornamental fish. So, these botanical additives can be used to improve growth and coloration in goldfish. Moreover, these botanical feed additives are cheap and easily available resources which are easy to manage for the fish

owners. This will promote aquaculture industry particularly with reference to ornamental fish keeping in Pakistan. These botanical additives can be helpful to improve the color of ornamental fish and can increase the demand and interest of buyers.

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Conflict of Interest: Authors declare there is no conflict of interest.

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