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Carrot Waste Supplemented Diet Induced Growth and Carotenoid Changes in Fresh Water Ornamental Fish Peacock Cichlid (Aulonocara Hansbaenschi)

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ABSTRACT

An attempt has been made to evaluate the effects of diets containing 0%, 2%, and 4% of carrot waste supplemented diets on the growth and carotenoid changes in peacock cichlid (Aulonocara hansbaenschi). For this isonitrous (37% protein) diet supplemented with carrot waste diet (CWD), 0%, 2%, and 4% were prepared and offered to the experimental fish at 5% body weight ad libitum for a period of 40 days. The results indicated that in the skin and muscle tissue of experimental fish, the growth and carotenoid content were found to vary between control diets and also during various time intervals of the experimental period. The result indicated that incorporation of 4% diet of CWD in the diet was found to enhance the growth and coloration in peacock cichlids.

KEYWORDS: Carotenoid, CWD (Carrot waste diet), Peacock cichlid, Aulonocara hansbaenschi..

1. INTRODUCTION

The pigments in ornamental fish are one of the most important quality criteria indicating the market value. Varieties of carotenoid pigments are used in fish diets for colour enhancement. The most promising carotenoids proved to be successful in enhancing colour is astaxanthin, which shows marked improvement in colour in most species of brightly coloured ornamental fishes like tetras, cichlids, gourami, gold fish, koi, tiger bark, and many other species. Colour is one of the major factors which determines the price of aquarium fish in the world market (Saxena, 1994). Since skin colour in ornamental fishes can be enhanced by feeding them diets supplemented with pigments, the objective of this study of this study was to measure the effectiveness of artificially supplementing pelleted fish feed with natural occurring carotenoid pigments to enhance skin colour in the peacock cichlid. According to (Mait et al., 2017), the different synthetic carotenoids include (-carotenoid, canthaxanthin, zeaxanthin, and astaxanthin) and natural carotenoids such as plant materials, bacteria, algae, crustaceans, microalgae, are most commonly used as colour enhancers.

Additionally body colouration can correlate with behavioral and physiological traits that are of advantages in contest situations, such as aggressiveness, boldness, endurance or over all overall levels of activity cichlids,(Schweitzer et al;2015). This was also the case in the cichlid fish Tropheus sp. "black" sensu (Konings, 2019.). body colour, together with developed parental and territorial behaviour patterns, and remarkarkable feeding specializations.

Adaptive radiation to proceed in just a few species in the great lakes of east Africa (Fryer and Iles et al.,1972) (Turner et al., 1994)(Barlow et al., 2000). (Teral et al., 2006). Cichlids are among the most colourful of freshwater fishes. Used tomato (solanum lycopersicum) as a natural carotenoied source in pigmentation Among natural vegitable pigment source (Gokoglu M,et al.,2020). Carrot is one of the important root vegitables rich in bioactive compounds i.e, carotenoids along with several other functional components having significant health promoting properties(Sharma et.al.,2012). The total carotenoid content in the edible portion of the carrot root ranges from 6–55 mg/100g (Simon and Wolff, 1987) with -carotene (44–79% of total carotenoids, 5.3–10mg/100g) as a major component (Holland et al., 1991). Carrots, alone or in combination with other natural antioxidants, are found to induce better growth, enhance colour intensity, and improve the health of ornamental fish in a natural way. Therefore, the present study was conducted to assess the effect of a supplemented diet with carrot waste meal on growth enhancement and carotenoid changes in peacock cichlid fish. (Sinha, A. and Asimi, O.A. 2007) Because fish cannot synthesise carotenoids, they must obtain them through their diet in order to achieve their natural skin pigmentation.Attractive colour is the most in-demand quality criteria for the market value of ornamental high-value species such as goldfoish (Sinha & Asimi, 2007) Overall results for natural orange-red skin coloration development, speed of skin colour change, feed formulation carotenoid profile, survival and growth demonstrated that the VibraGro feed should be a suitable diet for juvenile Red Oranda goldfish reared in a well-water culture system, Choubert GJR,et al.,(2008).

2. MATERIALS AND METHODS:

Freshwater ornamental fish (Peacock cichlid) weighing (2.15+ 0.03g) were collected from the commercial aquarium. The fishes were reared in laboratory conditions in 200 litre glass tanks at the rate of 5 fishes per tank in triplicate and fed with control and experimental diets, augmented respectively with carrot waste meal (CWD) at the rates of 0%, 2% and 4%. For these, different experiments were performed at different feeding durations, such as 10, 20, 30, and 40 days. The skin and muscle tissues were obtained from control and experimental diets.

2.1 Feed Formulation:

In the current study, a 37% protein diet was used as the basis diet for CWD supplementation.Fresh feed ingredients were procured in dry form using ingredients such as dried fish meal, shrimp waste, rice bran, wheat flour, tapioca flour, fish oil and vitamin mix mixtures The feed was formulated using the square method of feeding compounding. The ingredients were mixed in three different proportions. The control as well as the experimental diets was kept at room temperature to avoid the carotenoid loss. The dried pellets were stored individually in airtight plastic containers for further use.

2.2 Experimental set up:

In the present study, CWD carotenoid changes were analysed in peacock cichlids belonging to the 1st, 2nd and 3rd groups were fed on diets (F, F, and F) with seaweed levels of 0%, 2%, and 4% respectively. Fishes were fed an allotted experimental diet of 5% of their total body weight per day. Feeding was done daily at 8 h. The unfed was removed after 4 h of feeding.

2.3 Growth Parameters:

At the beginning of the experiment, the total wet weight of the fish in each group was determined by weighing them on an electronic balance. All the fish in each group were weighed at the end of the experiment.

Absolute growth rate (g) = final weight minus starting weight

Specific growth rate (%) = final weight - initial weight/days of rearing×100 Estimation of total carotenoids:

The total amount of carotenoid present in the tissue sample was estimated spectrophotometrically as follows. Before quantification, the carotenoid was extracted from the sample by using a carotenoid sample was diluted to an appropriate volume so as to obtain an optical density value of 0.8 or less. The appropriate solvent is used. After proper dilution, the optical density was measured at 444nm.

2.4 Statistical analysis:

The results obtained in the present study were subjected to statistical analysis (Mean SD). spss11.5 was used for statistical analysis. A one-way ANOVA was applied to find out the significant differences among average values of total carotenoid content and the difference between the mean treatments was tested with the Tukeys test (zar et al.,1986).

3. Results:

The result on growth responses of P. cichlids fed control and experimental diets for 10, 20, 30, and 40 days were found to be influenced by diet variation.However, the overall growth registered a definite trend. The overall growth responses of P. cichlids clearly indicated the dietary variation. Carrot meal fed fishes (P. cichlids) experimental diets had high growth rates (GR) ranging from 5.60.133 to 14.65 0.167 g(40 days 4% diet) when compared to the low value recorded in the 0% diet fed group in 40 days . Also, SGR values were high in the experimental diet (4%) fed fishes. The total carotenoids in the skin tissues of P. cichlid fishes were found to be different after feeding (0%, 2%, and 4%) concentrations of diet. In the skin tissues of P.cichlid extracted in an acetone solvent system, the experimental fish were fed with carrot-supplemented diets for different feeding durations.

Table 1.Formulation and composition of the experimental diets and other proximate compositions (. /. dry matter basis)

Ingredients	Diet (carrot waste content)		
	F1	F2	F3
	0%	2%	4%
carrot waste meal	30.5	32.5	34.5
Fish meal	30.5	30.5	30.5
shrimp waste	30.5	30.5	29.5
rice bran	2.9	1.9	1.9
wheat flour	2.9	1.9	1.9
Tapioca flour	2.9	2.9	1.9
vitamin mix	-		
fish oil	-	-	-

F1=control diet; F2=diet with =2% ; and F3=diet with =4%

Table: 1a. Dietary supplementation of carrot waste on growth parameters of peacock cichlid fish. Each value is the mean and S.D of three replicates.

Feed	Experimental Duration (Days)	Experimental fish	
		AGR (g)	SGR)%)
Control	0	2.41±0.301ab	6.03±0.188c
	10	2.52±0.078ab	6.56±0.143c
	20	2.86±0.119ab	7.14±0.311c
	30	3.47±0.097a	8.68±0.030c
	40	4.17±0.080a	10.43±0.65a
2%	0	2.14±0.088c	5.3±0.204c
	10	2.47±0.197c	6.18±0.131b
	20	3.25±0.018b	7.24±0.145ab
	30	4.76±0.133ab	7.85±0.68ab
	40	5.79±0.174a	8.36±0.08a
4%	0	2.24±0.124c	5.6±0.133d
	10	3.25±0.065b	8.13±0.128c
	20	3.42±0.145b	8.55±0.132c
	30	5.26±0.64ab	11.35±0.275b
	40	6.36±0.73a	14.65±0.165a

Each value is a mean ±SD of six replicaters mean values in coloumns with different superscripts are significantlydifferent ($p<0.05$)

Table: 2 Total Carotenoid content in the skin tissue of peacock cichlid fish fed with carrot waste meal (different con. 0%, 2%, and 4%) supplemented diet for different days and extracted in acetone and dimethyl either solvent system. Each value is the mean of three individual estimates.

Fish Species	Solvent System	Experimental duration (Days)	Total Carotenoid Content (Mg/wet tissue)		
			0%	2%	4%
Peacock cichlid	Acetone	0	0.35±0.33d	1.38±0.09c d	1.60±0.24 c
		10	2.16±0.08c	2.35±0.04c	3.92±0.16 c
		20	3.48±0.02b c	3.86±0.11b c	4.63±0.13 bc
		30	3.56±0.03b	4.65±0.12b	6.54±0.09 b
		40	4.25±0.44a	7.24±0.13a	8.71±0.07 a
	Dimethyl / either	0	0.63±0.57c d	0.27±0.16d	1.46±0.02 d
		10	1.26±0.37c	2.58±0.58c	2.77±0.10 c
		20	2.81±0.64b c	4.16±0.131 bc	4.27±0.13 b
		30	3.54±0.38b	4.78±0.14a b	5.45±0.12 8ab
		40	4.21±0.44a	6.35±0.47a	6.76±0.01 8a

Each value is a mean ±SDof six replicaters mean values in coloumns with different superscripts are significantlydifferent($p<0.05$)

Table: 3 Total carotenoid content in the muscle tissue of peacock cichlid fish fed with carrot meal waste (different con. 0%, 2%, and 4%) supplemented diet for different days and extracted in acetone and dimethyl either solvent system. Each value is the mean of three individual estimates.

Fishspecies	Solvent System	Experimentalduration (Days)	Total Carotenoid Contend (mg/wet tissue)		
			0%	2%	4%
Peacock cichlid	Acetone	0	0.57±0.86b	0.75±0.44c d	0.68±0.05a
		10	1.21±0.057 ab	1.81±0.17c	2.15±0.07a b
		20	1.47±0.39a b	2.34±0.05b c	2.48±0.067a b
		30	2.31±0.44a	2.81±0.16a b	3.15±0.05a
		40	2.54±0.16a	3.26±0.14a	3.87±0.17a
	Dimethyl / either	0	0.28±0.21b	0.67±.033b c	0.84±0.02b c
		10	0.95±0.05b	1.35±0.16b	1.48±0.04b
		20	1.18±0.09a b	1.64±0.28a b	1.85±0.05b
		30	1.46±0.01a	1.83±0.35a	2.16±0.048a b
		40	2.15±0.17a	2.25±0.16a	2.81±0.123a

Each value is a mean ±SD of six replicaters mean values in coloumns with different superscripts are significantlydifferent ($p<0.05$)

3. DISCUSSION:

Abbas and colleagues (2020).The natural catrone source used in the study gave a positive result. In the 84-day feeding trial with the goldfish juveniles (Carassius auratus) lutein was used as a natral pigment source. And astzxthin and cethaxanthin were used as sythentic pigment sources at the rate of 50mg/kg. In items of carotene concentration, the group containing astaxathin and canthaxathin shows the highest effect. In the study of ornamental fish, Pseudocgromis fridmani, synthetic astaxanthin (Carophyil Pink) and herbal astaxanthin (Haematococcus pluvialis) were compared. The colour was increased as the rates increased in both synthetic astaxanthin and natural astaxanthin. Herbal astaxanthin was found to be more effective than synthetic astaxthine (Jiag, J., Nuez-Ortin, W., 2020) As a result of 8 weeks of feeding with synthetic astaxanthin and haematococcus pluvialis added feed, there was no difference in golden pompano (trachinotus ovatus) in terms of FBW WG and SGR (xiel et al.,2020). SGR, FCR, and CF values increased in a 60-day feeding study of sword fish (Xiphophorus beams) with 50/1,000 mg/g and 100/1,000 mg/g Lantana glass flower added, and a significant increase in carotenoid of fish was determined by increasing rates of Lantana glass flower (p.05).It was seen that the pigment source added to the feed had a positive effect (zutshi ,b.,& madiyappa,r.(2020).

Anthocyanin poweder (extracted from beetroot prll and red cabbage)was added to the feeds at the rate of 400mg/kg in the 45-day feed with orange sword tail fish (xiphophorus helleri). As a result of the experiment,it was determined that the colour change in the skin of the fish was quite high compared with the control group. Jorjan et al.,(2019). Improved fish growth has been found in pigment supplemented diets as carotenoids are known to play a positive role in the metabolism of fish and might have improved nutrient utilization, leading to improved growth (Amar et al. 2001). The present results clearly indicated that diets, supplemented with carotenoid feed ingredients supported the growth performance of P. cichlids. Further, by displaying better AGR values, the efficiency of the experimental diets was also enhanced. This was much more obvious in those fish fed a carrot meal 4% diet.

In the present study also, it is clear that carotenoids do play a role in fish growth, as increasing levels of carrot meal(2% and 4%) resulted in positive effects on growth, in terms of increased weight gain. However, a few of the earlier reports suggested the role of carotenoids only in colour enhancement without having much effect on fish growth (Kop et. al., 2010; Mirazaee et.al., 2013; Seyedi et.al.,2013). The result of the present study revealed maximum colour enhancement in terms of carotenoid content at 5% incorporation level of carrot meal as compared to both low (0% and 2%) and high incorporation level (4%) diets.

These results concluded that the carrot meal has a positive effect on growth as well as the colour performance of P. cichlid (AULONOCARA HANSBAENSCHI). In other words, carotenoids may help to integrate the empirical and theoretical perspectives underlying the bewildering diversity of colourful fishes, especially cichlids. Also, one of the greatest challenges in the ornamental fish industry is to replicate the accurate natural colour of the fish in the captive environment. Numerous propagated operations failed to successfully market the fish due to faded color. Various products have been introduced to alleviate this problem, but none has performed so effectively and consistently as carotenoid pigment. Varieties of carotenoid pigments are used in fish diets for colour 102 enhancement. Astaxanthin, one of the most promising carotenoids for colour enhancement, has shown significant improvement in most species of brightly coloured ornamental fishes such as Tetras, Cichlids, Gouramis, Goldfish, Koi, Danios, and many others. Also, attractive colouration determines the commercial value of ornamental fish. The pigmentation of the skin is responsible for the colouration of the fish. In their natural environment, fish get their carotenoids from aquatic plants or through their food chains. The colour enhancing diets should contain additional natural pigments to enhance the colours of ornamental fish.

4. CONCLUSION:

These results concluded that the carrot meal has a positive effect on growth as well as the colour performance of P. cichlid (AULONOCARA HANSBAENSCHI). In other words, carotenoids may help to integrate the empirical and theoretical perspectives underlying the bewildering diversity of colourful fishes, especially cichlids. Also, one of the greatest challenges in the ornamental fish industry is to replicate the accurate natural colour of the fish in the captive environment. Numerous propagated operations failed to successfully market the fish due to faded color. Various products have been introduced to alleviate this problem, but none has performed so effectively and consistently as carotenoid pigment. Varieties of carotenoid pigments are used in fish diets for colour 102 enhancement. Astaxanthin, one of the most promising carotenoids for colour enhancement, has shown significant improvement in most species of brightly coloured ornamental fishes such as Tetras, Cichlids, Gouramis, Goldfish, Koi, Danios, and many others. Also, attractive colouration determines the commercial value of ornamental fish. The pigmentation of the skin is responsible for the colouration of the fish. In their natural environment, fish get their carotenoids from aquatic plants or through their food chains. The colour enhancing diets should contain additional natural pigments to enhance the colours of ornamental fish.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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