World Journal of Fish and Marine Sciences 5 (4): 445-448, 2013
ISSN 2078-4589

DOI: 10.5829/idosi.wjfms.2013.05.04.72165

Effect of Placement Carrot (*Daucus carota*) and Red Pepper (*Capsicum annuum*) in Diets on Coloration of Jewel Cichlid (*Hemichromis bimaculatus*)

Sajjad Mirzaee, Meysam Mohammad Beygi and Hamed Nekoubinand Ali Shabani

Faculty of Fisheries Science, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

Abstract: A 60 days feeding experiment was carried out on jewel cichlid (*Hemichromis bimaculatus*) to investigate the effects of carrot (*Daucus carota*) and red pepper (*Capsicum annuum*) as natural pigment material on coloration of jewel cichlid.180 fish were divided into 3 groups with triplication each. Three types of experimental feed were prepared; the first group was added carrot, the second,two redpepper to provide 60 mg of total pigments kg^{-1} in diets and control feed do not have any pigment material. Fish were fed by 2% of their live weight. Total carotenoid content of the fish was determined spectrophotometrically at the end of the experiment. Carotenoid amount in the fish samples fed with red pepper and carrot diets were 0.450±0.43and 0.488±0.60 mg g^{-1}, respectively. Consequently a significant difference was found between individuals fed by natural pigment material and those by unpigmented feeds ($p \leq 0.05$). It was demonstrated that natural pigment substance have an impact on coloration of jewel cichlid and the groups did not exhibit any distinctions in growth.

Key words: Carotenoid · Natural Pigment · Total Carotenoid · Pigmentation

INTRODUCTION

Pigmentation is one of the important quality attributes of the fish for consumer acceptability. Carotenoids are responsible for pigmentation of muscle in food fish and skin color in ornamental fish [1]. Astaxanthin is the main carotenoid pigment of red-pink coloredaquatic animals, being widely used in aquacultural processes because it is a standardized and chemically stable product with a high carotenoid concentration [2]. Dietary natural pigments are obtained from fruits, vegetables and flowers [3]. Carotenoidsare synthesized from geranyldiphosphate by all photosynthetic organisms [4]. Therefore, several investigations have been conducted involving employment of natural carotenoid material to pigment aquatic organisms [5-7].

There is no study on the effect of natural pigments on the color of jewel cichlid,therefore, this study was undertaken to determine the effect of natural pigment source on the skin coloring in jewel cichlid. The jewel cichlid's skin comes in many different color combinations. These fish were bright pink with blue patches in color, when first imported tend to preserve their original pigments as long as they ingest pigment added feeds. Carrot is natural beta carotene source and red pepper is dark red color due to its capsantine in it content, being used for flesh pigmentation of salmonids given capsorobin in it [2, 8, 9], both of which are cheaply available considering their high level of carotene.

This study was designed for this purpose, by using carrot and red pepper as natural carotenoid agents. Experimental diets tested whether due to their vary features, they could have any positive effects as pigment sources in pigmentation of parrot jewel cichlid or not.

MATERIALS AND METHODS

In this research, 180 Jewel cichlids (*Hemichromis bimaculatus*) were used. Their average living weight was 0.11±0.05 g and average total length was 1.1±0.3 cm. Their colors are bright pink with blue patches in the skin. Their sex was not taken into consideration. In this study,

Corresponding Author: Sajjad Mirzaee, Faculty of Fisheries Science, Gorgan University of Agricultural Sciencesand Natural Resources, Gorgan, Iran. Tel:+98 918 8749913.

a random design with three treatments and triplicates were utilized. Nine aquaria were used. There were 20 fishes in each aquarium, which had dimensions as 40×25×25 cm and working volume 15 L. two pieces of air pump and one sponge filter were used in the aquaria for filtrationand air flow. While water temperature was measured every day, the pH values were measured every 2 days for observing water parameters. Average water temperature and pH value were measured 26.50±0.30°C and 7.8±0.1 as the result of the measurements, respectively.

The experimental diets were formulated to meet the nutritional requirements of jewel cichlid and prepared with used laboratory type pellet machine.The feed that used for the feeding of jewel cichlid fish includes 50% Crude Protein (CP), 4% Crude Fat (CF), 2% Crude Cellulose (CC) and 9.5% ash. So, only the pigment source show differences in the feed, which were prepared as 3 groups; carrot and red pepper was added in 1st group and 2nd group, respectively. The feed of 3th group was separated as the control group and no pigment material was added into it. All diets except the control diet were formulated to include 60 mg kg^{-1} of each respective pigment source. The fish were fed daily at 2% of their total biomass, distributed in two rations at 09:00 and 17:00 h for 60 days. Total carotenoid content of fish (skin and flesh) was determined at the end of the experiment spectrophotometrically [10, 11].

Statistical analysis consisted of one-way ANOVA, using the probability level of 0.05. After ANOVA, significant differences among means were determined by Duncan's multiple range test. All statistical analysis was performed using SPSS 16.0 for Windows.

RESULTS AND DISCUSSION

Carotenoids are known to have a positive role in the intermediary metabolism of fish [12, 13]. Coloration is controlled by the endocrine and nervous system, butdietary sources of pigment also play a role in determining the color of fish. Although synthetic pigment sources used in many countries, there is a search for alternative coloring materials, because they are expensive and add about an extra 10-15% to the cost of feed [14]. Plant materialcontaining thepigment is one of the more favorite of these alternative materials both because effects nutritive quality and its being a good source of carotenoid [15]. Some research purpose that red pepper has been used as carotene source in pigmentation of fish [2, 6, 7, 9, 16]. And also Yanar and Tekelioglu [11] suggested that carrot has been used as a carotene source of diets in aquarium fish. In this research, all experimental diets were equally accepted by fish. All the three groups are approximately similar in final body weight ($p \geq 0.05$). Growth parameters of the studied fish were shown in the Table 1. In this study, no mortality was observed.

Also carotenoids, could enhance nutrient utilization and may ultimately result in improved growth [17], the carotenoid-supplemented diets did not appear to have any effect on jewel cichlid growth performance. These results are in accordance with another study carried out with cichlid, Oscar, red porgy juveniles, red porgy and Guppy fish [14, 15, 18-20].

The coloration areas in all the pigment materials were nearly the same. First, it was observed that it started from the ends of dorsal, anal and tail fins and then spread to abdomen. The spectrophotometer analysis was made for the color change in the skin and flesh of the studied fish, which were fed on the feed that included different colorants and the obtained results are represented in the Table 2.

At the beginning of this study, it was found that all fish coloration was 0.291±0.08 mg g^{-1}. It was determined that the fish fed on the feed that included carrot and red pepper had significantly brighter pink color with 0.488±0.60 mg g^{-1} and 0.450±0.43 mg g^{-1} respectively ($P<0.05$).It was also observed that coloration was less inthe control group (0.308±0.15 mg g^{-1}). Fish fed with the carrot and red pepper diets presented significantly higher ($p \leq 0.05$) color average values compared to the control group at the end of the experiment.

The absorption and accumulation of astaxanthin in the fish is higher than the other carotenoids [8]. Astaxanthin was efficiently utilized for deposition and coloration of the skin in cichlid, Oscar, red sea bream and Australian snapper [14, 15, 21-23]. Rate of retention of dietary carotenoids in fish depends on the efficiency of absorption from the digestive tract, transport capacity, deposition mechanisms in the various tissues, metabolism and rate of excretion. Yanar and Tekelioglu [11] and Hata and Hata [24], reported that after absorbing and oxidizing different forms of carotenoids, goldfish accumulate them in the form of astaxanthin in tissues, especially skins. Similarly jewel cichlid fish was found to be able to accumulate various carotenoids in the form of astaxanthin in that the study established total carotenoid content in their flesh and skin.

Table 1: The growth performance of the jewel cichlid

Parameters	1st (carrot)	2nd (red pepper)	3rd (control)
First body weight (g)	0.11±0.05	0.11±0.05	0.11±0.05
Final body weight (g)	1.9±0.7	2.1±0.9	1.9±0.3
First total length (cm)	1.1±0.3	1.1±0.3	1.1±0.3
Final total length (cm)	3.1±0.8	3.3±1.1	3.2±0.6

All values are mean ±SD. (n=3).All values were not significantly different (P>0.05).

Table 2: Total carotenoid content in the skinsandflesh of the jewel cichlid

Parameter	1st (carrot)	2nd (red pepper)	3rd (control)
Total carotenoid content (mg g^{-1})	0.488 ± 0.60^{a}	0.450 ± 0.43^{a}	0.308 ± 0.15^{b}

All values are mean ±SD. (n=3). Different superscript letters indicate significant differences between treatments (P<0.05).

REFERENCES

1. Gupta, S.K., A.K. Jha, A.K. Pal and G. Venkateshwarlu, 2007. Use of natural carotenoids for pigmentation in fishes. Natural Product Radiance, 6(1): 46-49.
2. De La Mora, I.G., A.J.L. Figueroa, P.J.T. Palafox, B.I.D.A. Soca and V.J.E. Carter, 2006. Comparison of red chilli (*Capsicum annuum*) oleoresin and astaxanthin on rainbow trout (*Oncorhyncus mykiss*) fillet pigmentation. Aquaculture, 258: 487-495.
3. Mangels, A.R., J.M. Holden, G.R. Beecher, M.R. Forman and E. Lanza, 1993. Carotenoid content of fruits and vegetables: An evaluation of analytic data. J. Am. Diet Assoc, 93: 284-296.
4. Giuliano, G., R. Aquilani and S. Dharmapuri, 2000. Metabolic engineering of plant carotenoids. Trends Plant Science, 5: 406-409.
5. Kamata, T., G. Neamtu, Y. Tanaka, M. Sameshima and K.L. Simpson, 1990. Utilization of Adonis aestivalis as a dietary pigment source for rainbow trout Salmosalar. Nippon Suisan Gakkaishi, 56: 783-788.
6. Carter, J.V., J.T.P. Palafox and R.P. Islas, 1994. Bioensayo de pigmentacion de truchaarcoiris (*Oncorhynchus mykiss*) con extractos de chileancho (*Capsicum annum*). Arch. Latinoamericanos Nutr., 44: 252-255.
7. Yanar, M., M. Kumlu, Y. Celik, Y. Yanar and N. Tekelioglu, 1997. Pigmentation of Rainbow Trout (*Oncorhynchus mykiss*) with carotenoid from red pepper. Bamidgeh, 49: 193-198.
8. Torrisen, O.J., R.W. Hardy and K.D. Shearer, 1989. Pigmentation of salmonids-carotenoid deposition and metabolism. CRC Crit. Rev. Aquat. Sci., 1: 209-225.
9. Gurocak, B., 1983. Ksonto fillerden Kirmizi Biberin (*Capsicum annuum*), Yumurta Sarisive Deri Pigmentlerine Etkisi. Ankara Universitesi, Ziraat Farkultesi Yayinlari. Ankara Turkiye, 947: 24.
10. Choubert, G. and T. Storebakken, 1989. Dose response to astaxanthin and canthaxanthin pigmentation of rainbow trout fed various dietary carotenoids concentrations. Aquaculture, 81: 69-77.
11. Yanar, M. and N. Tekelioglu, 1999. Dogalve Sentetik Karotenoyitlerin Japon Baliklarin in (Carassiusauratus) pigmentasyonu Uzerine Etkisi. Turk. J. Vet. Anim. Sci, 23: 501-505.
12. Tacon, A.G., 1981. Speculative review of possible carotenoid functions in fish. Prog. Fish Cult., 43(4): 205-208.
13. Segner, H., P. Arend, K. Von Poeppinghaussen and H. Schmidt, 1989. The effect of feeding astaxanthin to Oreochromisniloticus and Colisalabiosa on the histology of the liver. Aquaculture, 79: 381-390.
14. Kop, A. and Y. Durmaz, 2008. The effect of synthetic and natural pigments on the colour of the cichlids (Cichlasomaseverum sp., Heckel 1840). Aquac. Int., 16: 117-122.
15. Ghiasvand, Z. and M. Shapouri, 2006. The effect of synthetic and natural pigments on the colour of the Albino Oscar (*Astronotusocellatus* sp., Agassiz, 1831). Scientific Information Database (SID). Journal of Marine Biology, 1: 75-83.
16. Peterson, D.H., H.K. Jager and G.M. Savage, 1966. Natural coloration of trout using xanthophylls. Trans. Am. Fish. Soc., 95: 408-412.
17. Amar, E.C., V. Kiron, S. Satoh and T. Watanabe, 2001. Influence of various dietary synthetic carotenoids on bio-defense mechanisms in rainbow trout, *Oncorhynchus mykiss* (Walbaum). Aquaculture Research, 32(Suppl. 1): 162-163.
18. Chebbaki, K., 2001. Efecto de la nutricio´nsobre la coloracio´n de la piel y la calidaddelfilete en bocinegro, Pagruspagrus. Master Thesis. II International Master in Aquaculture, Universidad de las Palmas de Gran Canaria, Spain, pp: 93.

19. Kalinowski, C.T., L.E. Robaina, H. Ferna´ndez-Palacios, D. Schuchardt and M.S. Izquierdo, 2005. Effect of different carotenoid sources and their dietary levels on red porgy (Pagruspagrus) growth and skin colour. Aquaculture, 244: 223-231.
20. Mirzaee, S., A. Shabani, S. Rezaee and M. Hosseinzadeh, 2012. The Effect of synthetic and natural pigments on the color of the Guppy fish (*Poecilia reticulate*). Global Veterinaria, 9(2): 171-174.
21. Lorenz, T.R., 1998. A review of astaxanthin as a carotenoid and vitamin source for sea bream, pp: 052.
22. Booth, M., R. Warner-Smith, G. Allan and B. Glencross, 2004. Effects of dietary astaxanthin source and light manipulation on the skin colour of Australian snapper Pagrusauratus (Bloch and Schneider, 1801). Aquaculture Research, 35: 458-464.
23. Kop, A., Y. Durmaz and M. Hekimoglu, 2010. Effect of Natural Pigment Sources on Coloration of Cichlid (*Cichlasomaseverum* sp. Heckel, 1840). Journal of Animal and Veterinary Advances, 9(3): 566-569.
24. Hata, M. and M. Hata, 1972. Carotenoid pigments in gold fish-IV. Carotenoid metabolism. Bulletin of the Japanese Society of Scientific Fisheries, 38: 331-338.