ENHANCEMENT OF COLOR OF PLATY FISH (*Xipophorus maculates)* BY USING CARROT PEELS AS SOURCE OF CAROTENOIDS

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ABSTRACT

Color is one of the major factors which determines the price of aquarium fish in the market world over. Ornamental fishes are acceptable to buyers if they have striking and vibrant colors. The pigmentation of fish results from the pigments in the feed. People involved in the trade of ornamental fish are constantly exploring methods of enhancing skin coloration for which the use of dietary supplements with carotenoids is recommended. The aim of this research was to develop a feed using a cheap source of carotenoid for enhancing the skin color of Platy fish which could reduce the feed cost of aquarium fish hobbyists. In this study, carrot peel was used as a carotenoid source very successfully and the fish skin color was enhanced.

Keywords; Platy fish (*Xipophorus maculates*), Carotenoids, Carrot peels, color enhancement

Introduction

Platy is a common freshwater fish native to the East, North and Central America. Platy fish grows to a maximum length of 7.0cm. Sexual dimorphism is slight. The male's caudal fin being more pointed and anal fin of the male has evolved into a gonopodium. The female platy fish's anal fin is fan-shaped (Froese, 2006). Platy is polymorphic for a large number of pigment pattern. Red patterns and certain bold black marking composed of macro-melanophores are sex linked. This species possesses two types of males XY and YY and three types of females WX, WY and XX. In platy fish the lower two thirds of the dorsal fins are bright orange red with the most intense coloration along with the fin rays above the base of fin. Orange pigment cell are also present the dorsal fin. Platy are omnivorous and its diet include both plants and small animals such as Crustaceans, Insects and Annelids worms in nature. They have developed multitude of color varieties (e.g. orange, red, dark red and red/black) which has made it a choice for common aquarium fish for hobbyists. Platys are easy to keep and well suited to a common aquarium. They prefer a pH range 7.0 - 8.0 and temperature range18^{o}C to 25^{o}C. They reach to maturity in three to four months and breed readily, the female give birth to about 20-40 young at a time (Froese, 2006). Carotenoids also called tetra terpenoids, are yellow, orange and red pigments that are produced by plants and algae as well as several bacteria and fungi. Carotenoids give characteristic color to different vegetables, fruits and flowers (Moran and Jarvik, 2010). Carotenoids from food can be stored in the fatty tissue of animals and cooking of carotenoids containing vegetables in oil increases carotenoids bioavailability (Mashurabad *at el*, 2017). There are 1,100 known carotenoids which can be further categorized in to two classes. Xanthophyll (which contain oxygen) and carotenes (which are purely hydrocarbons and contain no oxygen). All are derivatives of tetraterpenes, meaning that they are produced from 8 isoprene molecules and contain 40 carbon atoms. In general carotenoids' wavelength range from 400- 550 nanometer (violet to green light) which cause the compounds to be deeply colored yellow, orange or red (Livengood *et al*, 2014). Carotenoids and their isomers especially alpha-carotenoids, beta-carotenoids, leiten and zeaxanthin are also present in different fruits and vegetables. Carotenoids and their isomers are discovered in different vegetables and fruits which is used as source of food for ornamental fish. Most of the green leafy vegetables and fruits such as carrots, strawberry, pumpkins, sweet potato, Chinese flowers etc (Khoo *et al*, 2011). Carotenoids are responsible for many yellow, orange and red hues in animal's especially ornamental fish. Carotenoids based coloration is influenced by diet because they cannot prepare their own feed (Sefc *et al*, 2014). Pigmentation in ornamental fish is dependent upon the carotenoids. Ornamental fish have chromatophore cell which is color producing cell but their color is due to carotenoids and they cannot prepare their own carotenoids requirements, so they are given carotenoids feed by outside (Yabuzaki, 2017).

Ornamental fishes need complete supplement of the food which fulfill their requirements. The color of the ornamental fish is dependent on their food because they cannot prepare color producing pigment (carotenoids), hence a carotenoid containing food is required for the ornamental fishes. Prepared feed available in market is generally too much costly. Aim of the present study was to make cost effective, proteinaceous and color enhancing feed for ornamental fishes by using carrot *(Daucus carota*) peel waste as cheap carotenoid source. Carrot contains high quantities of alpha-carotene and beta-carotene and is a good source of vitamin K and vitamin B6. Raw carrots are 88% water, 9% carbohydrates, 0.9% protein, 2.8% dietary fiber, 1% ash and 0.2% fat. The carrot gets its characteristic bright orange to red color from beta carotene, and lesser amount of alpha-carotene, gamma-carotene, lutein, and zeaxanthin (Afzal *et al*, 2005).

MATERIALS AND METHODS

Feed Formulation

In feed formulation following ingredients were used per 100 grams of feed. The feed contained **33.714 %** of total crude proteins.

Soya bean seeds	36 grams
Fish meal	35 grams
Carrots	14 grams
Vitamin premix	03 grams
Mustard oil cake	04 grams
Wheat flour	08 grams
Total	**100 grams**

Feed preparation

The carrot peel was removed and dried at room temperature in shade for 2 weeks. Each ingredient was ground separately in a grinding machine and changed into powdered form. Then all the powdered items were mixed with 5-10% molasses (diluted in water). Kneaded well forming dough-like mixture. The dough was then converted into spaghetti or vermicelli shape by passing it through a mincing machine. These feed spaghettis were then dried in an oven (GallenKamp Company Japan) at 60c for two days. After drying, they were passed through 1.5mm mesh in a grinding machine, and finally, the powdered feed was prepared. The commercial feed has different varieties such as sunrise goldfish feed, Tetra Glow fish feed, and Osaka fish feed (Winner ISPNF Fish feed company, Tokyo Japan). We used goldfish feed (protein is 30%), and tetra goldfish feed (protein is 32%).

Color categorization was done based on visual grading on a scale from 1 to 10

Fig 3.1 Powdered form of feed

Fig 3.2 Experimental tanks

RESULTS AND DISCUSSION

There were three experimental groups and one control group. Total of 40 platy fish were distributed equally in four aquaria. Initially, they were weighed. The feed was given 3% of their body weight throughout the experiment. A total of seven readings were taken on weekly basis by using an android phone camera (Samsung S8 edge plus having 12megapixel camera) for comparison of color.

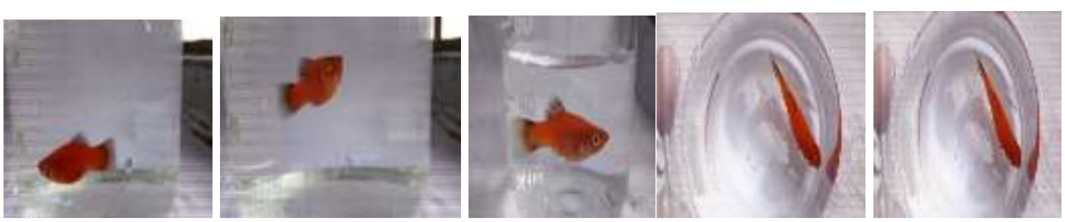

Table 4.1 Average grading of color characterization in platy fish

Readings	1 (Control)	2 (Experimental)	3 (Experimental)	4 (Experimental)
R 1	10	10	10	10
R 2	9.7	9.9	10	10.1
R 3	9.6	10	10.11	10.2
R 4	9.8	10.2	10.12	10.11
R 5	9.7	10.12	10.28	10.25
R 6	9.6	10.3	10.14	10.43

R 7	9.67	10.16	10.3	10.43
Total	68	71.2	70.96	71.52
Average	9.7	10.17	10.14	10.22

Aquarium fish pigmentation is a must for market acceptability which depends on carotenoids. As fish are unable to synthesize carotenoids which are responsible for the pigmentation of muscles and skin color, therefore they rely on diet for their need of carotenoids. The maximum yield and purity of β-carotenes extracted from carrot peel are 1.17 mg/100 g wet sample and 96%, respectively (Jayesree, 2021). Valorization of carrot peel waste by water-induced hydro colloidal complexation for extraction of carotene and pectin,

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along with carotenoids necessary amount of protein is maintained i.e. 33.714% (Table -1) which is mandatory for fish growth and reproduction. Carrots peels contain about 0.9% of carotenoids in dry matter (Ref???)

color of the control tank and experimental tank fish were almost similar, but the color of the experimental group fish got enhanced and they appeared of much shining and darker color than the control tank fish . The color fluctuation graph and Table clearly showed that the experimental feed contained a suitable and sufficient number of carotenoids and proteins. The feed seem suitable as the digestibility of the fish feed was very well and their feces were normal. No undigested food was seen in the aquaria.

The experimental feed is cost-effective and can easily be prepared at home by aquarists Experimental feed would cost 7.36 times less than commercial feed. In terms of actual expenditure, the cost of experimental feed was PKR 230/Kg as compared to commercial feed which cost PKR

1700/Kg. The best quality of the feed developed, is that all the ingredients were easily available in the local market. The fish showed a positive response in terms of color pigmentation gain with the passage of time. Therefore, it is concluded that these feed formulations can be used in aquaculture conditions and will be a substitute for expensive ornamental fish feed. Hence our research findings are in compliance with the research carried out by earlier people as stated.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the feed formulations if used in the ornamental fish culture at a large scale would be a better substitute for expensive fish feed imported from China, hence this formulation would certainly save the foreign exchange. It is also concluded that high-priced and environmentally nonfriendly fish meals, used as a protein source and essential ingredient, could easily be replaced with cheaper plant sources with almost similar rather better results in maintaining and enhancing the colors of ornamental fish.

Since this work was done in the laboratory, in small aquaria, therefore, it is recommended that the same experiment may be performed on large scale in hatcheries/ponds conditions to get a better understanding and accurate pigmentation levels.

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