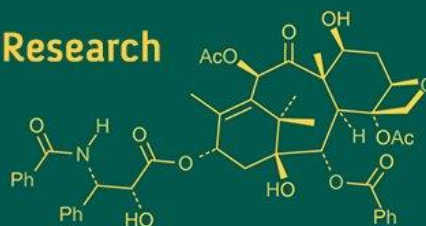
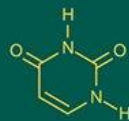


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693

ISSN Online: 2617-4707

NAAS Rating (2026): 5.29

IJABR 2026; 10(8): 580-585

www.biochemjournal.com

Received: 09-06-2026

Accepted: 11-07-2026

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Effect of ripe papaya pulp powder on fin colouration of Tiger Oscar fish, *Astronotus ocellatus*

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DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i8h.9662>

Abstract

The presence of carotenoids, which activate fish colouring, is a major factor in the market value of ornamental fish. The goal of the current feeding experiment was to determine how papaya pulp powder meal affected the fin colouring of Tiger Oscar, *Astronotus ocellatus*. In a confined setting, papaya pulp powder was added to five different experimental diets in different amounts (C- 0g/100g, T₁- 1g/100g, T₂- 2g/100 g, T₃- 3g/100 g, T₄- 4g/100 g, and T₅- 5g/100 g). Eighteen glass aquaria (L 60 cm x W 30 cm x H 30 cm) were randomly filled with fifteen fish each tank. The experiment was conducted in triplicate for 90 days. The feed was given at 2% of body weight with equal split doze at 09:00 and 17:00 hours. To maintain a healthy state, any uneaten food and waste were syphoned out on daily basis and water was replaced with fresh water at a rate of 10% to 15% every three days. The carotenoid level variation was observed at 380, 450, 475 and 500 nm wavelength. Following the experiment, it was observed that all five treatments had considerably higher total carotenoid concentrations (TCC) in the fin of Tiger Oscar at 90 days than the control group ($p < 0.05$). From this experiment, it can be concluded that Tiger Oscar's fin coloration was significantly higher ($p < 0.05$) in T₃ group i.e. 3 g/100 g of papaya pulp powder to their diet.

Keywords: Ornamental fish, *Astronotus ocellatus*, papaya pulp powder, tiger oscar and carotenoids

Introduction

The Tiger Oscar (*Astronotus ocellatus*), commonly known as the velvet cichlid, is a large Neotropical species from the Cichlidae family (Kullander, 1986; Soares *et al.*, 2011) [1, 2]. Because of its strong market demand and distinctive interaction features, the Oscar is a founding species in the ornamental fish business from a commercial standpoint. Color has a big impact on the overall selection of any pet fish. Fish rely on dietary carotenoids to preserve their natural color because their bodies are unable to produce color. Fish that exhibit "chromatic excellence" are therefore highly valued by the industry, which prompts exporters to use specialized finishing diets enhanced with natural or synthetic pigments to guarantee their products satisfy the aesthetic standards of foreign retailers (Lall & Tibbetts, 2009) [3]. Fish and many other animals have pigment-containing, light-reflecting cells called chromatophores (Fujii *et al.*, 2000) [18]. Melanin (black/brown), pterins, and carotenoids (yellow/orange/red) are the pigments that accumulate in the skin chromatophores and mediate ornamental fish coloration. Fish are capable of the endogenous synthesis of melanin, pteridines and guanine. However, fish are biologically incapable of the synthesis of carotenoids (Das & Biswas, 2020) [4]. These pigments are controlled by genetics, nutrition, and environment. Fish must either eat carotenoids from natural sources (such as algae and krill) or artificial supplementation because they are unable to generate them. Carotenoids can be produced by plants, phytoplankton (microalgae), zooplankton, and crustaceans, while other species must either obtain carotenoids from their diet or modify the dietary carotenoid precursors through metabolic activities because they are unable to biosynthesize them (Maoka 2011) [5]. Dietary carotenoids also able to promote the animal's immune system and general physiological health in addition to acting as potent antioxidants (Colomes *et al.*, 2020; Wang *et al.*, 2018). Several studies have demonstrated that fish can be coloured by adding natural carotenoids to their diets (Kurnia *et al.*, 2019; Paul *et al.*, 2024) [6, 7, 9, 19].

The current study sought to determine how different papaya pulp powder concentrations affected the ornamental fish *Astronotus ocellatus* fin colouring in lab settings.

Materials and Methods

Experiment site

The experiment was conducted at the Sasya Shyamala Krishi Vigyan Kendra (SSKVK), which is located at Arapanch, PO: Sonarpur, Dist. South 24 Parganas, Kolkata:700150 (Latitude: 22.467519° N & Longitude: 88.419551° E).

Collection and acclimatization of fish

Adult Tiger Oscar (*Astronotus ocellatus*) of uniform size of the same breeding batch were collected from the stock of Sasya Shyamala Krishi Vigyan Kendra (SSKVK), Arapanch, PO: Sonarpur, Dist. South 24 Parganas, Kolkata:700150. The fish were given a brief bath treatment at the experimental site in a 3 ppm KMnO₄ solution for three to five minutes as a precaution. After that, they were carefully moved to the rectangular acclimatization tanks, which were filled with tap water devoid of chlorine, so they could acclimate to the lab setting. Before the fish were stocked, the tanks were filled with water that had been held for four days. The fish were fed pelleted feed at a rate of 2% of their body weight (without papaya powder) in two equal portions at 09:00 and 17:00 for three weeks duration.

Preparation of experimental Aquariums

Twelve identical-sized glass aquariums (L 60 x W 30 x H 30 cm) were used for five sets of experiments, each with a triplicate, and one set was maintained as a control throughout the experimental period. The aquariums were filled with 40 litres of tap water each after being cleaned, dried, and disinfected with KMnO₄. Then fifteen acclimatized fish were transferred to each experimental aquarium tank with constant aeration. The experiment was carried out for 90 days.

Application of feed in different doses

Two groups of fish were employed in the experiment: the treatment group and the control group. The fish in the control group were fed regular diets free of papaya pulp powder. Papaya pulp powder was fed to fish in the treatment group in different proportions (T₁ = 1%, T₂ = 2%, T₃ = 3%, T₄ = 4%, and T₅ = 5%). This experiment was carried out in triplicate. Both groups received two identical meals at 09:00 and 17:00 for 90 days, with a feeding rate of 2% of body weight. To maintain the animals healthy, faeces and leftover feed were syphoned out every seven days, and fresh water was introduced to the tank every three days interval at a rate of 10% to 15%.

Estimation of Total Carotenoid Content (TCC)

The procedure for estimation of TCC was followed as described by Olson (1979) for estimation of total carotenoid content in fin. The samples were placed in the spectrophotometer to determine each sample's light absorbance value. Four different wave lengths were used (i.e., 380 nm, 450 nm, 475nm and 500 nm) for this study based on previous research works. The UV- VIS Spectrophotometer (Shimadzu- UV-1900i) was used to calculate the total carotenoid content of the fin. The total carotenoid content was calculated as:

$$\text{Total Carotenoid Content} = \frac{\text{optical density}}{0.25 \times \text{sample weight (g)}} \times 10$$

Where, 0.25 = Extinction coefficient, 10 = Dilution factor.

Statistical analysis

The carotenoid content in Tiger Oscar's (*Astronotus ocellatus*) fin were statistically analyzed using a multivariate ANOVA model. Microsoft Excel 2021 was used to graphically display the data, while SPSS (version 27.0) was used for statistical analysis. The statistical findings were interpreted at 5% level of significance.

Results and Discussion

Carotenoid concentration in fin observed at 380nm wavelength

The effects of the five experimental diets and the control diet on *A. ocellatus* fin coloration were evaluated at fifteen-day intervals. The fluctuation in the fin's total carotenoid concentration (µg/g) at 380 nm is depicted in figure 1. The fin's carotenoid value was 0.234±0.07 µg/g at zeroth day. But at 90 days, the carotenoid content in fin was peaked in T₅ (5.553±0.11) µg/g and T₄ (5.312±0.09) µg/g and followed by T₃ (4.807±0.12) µg/g, T₂ (4.021±0.06) µg/g, T₁ (3.912±0.06) µg/g and C (2.511±0.06) µg/g. There was no significant difference between T₅ and T₄. All treatments had little effect on fin coloration until day 15, but meals with papaya pulp powder significantly improved coloration starting on day 30. From the 60th day forward, the control (C) diet showed a slight rise in the carotenoid concentration of fin, but gradual rapid increase for other treatments. Xu et al. (2006) did an experiment on goldfish, where the effect of dosage of the diets on the colour of goldfish was not completely evident until Day 60. Sehgal et al., (2022)^[8] fed *Spirulina platensis* to *Carassius auratus* in a similar experiment that corroborates the findings of this study. Paul et al. (2024)^[9] found similar result in banded cichlid (*Heros severus*) feeding them ripe papaya pulp powder. According to Schiedt et al. (1985)^[10], reductive metabolite pathways were developed from muscle to skin and fins to produce pigmentation. This may be the cause of T₅'s greater carotenoid deposition from muscle to fin in comparison to other concentrations. Table -1 shows the Concentration of carotenoid content (µg/g) at 380nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets.

Carotenoid concentration in fin observed at 450nm wavelength

Figure 2 shows the overall variance in the fin's carotenoid content at 450 nm. The results showed that the total carotenoid content of fish rose with all five concentrations of papaya pulp powder added to the meal. The fin's carotenoid content was determined to be 0.557±0.13 µg/g on zeroth day, but at the end of the experiment i.e on day 90, it had increased to 17.05±0.18 µg/g. The highest levels of carotenoid accumulation were found in T₃ (17.052±0.18), followed in descending order by T₄ (16.875±0.12) µg/g, T₅ (15.585±0.12) µg/g, T₂ (15.541±0.12) µg/g, T₁ (8.867±0.13) µg/g and C (7.718±0.15) µg/g.

There was not so much significant difference between T₃ and T₄. Lowest Carotenoid content was observed in control at final day of the experiment. C. Vasudhevan et al. (2015)^[11] got a similar outcome study focusing on the colouration of platy fish (*Xiphophorus maculatus*),

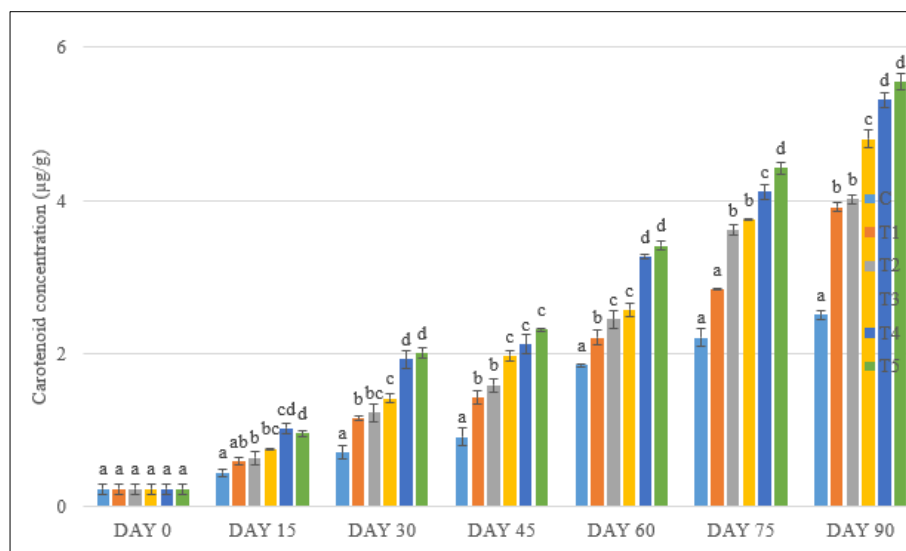


Fig 1: Carotenoid content (µg/g) in fin at 380nm wavelength for different treatments

where the fins carotenoid accumulation increased by giving azolla diet. Maiti et al., (2017) ^[12] also observed similar results on use of beetroot (*Beta vulgaris*) as a natural pigment source for the rosy barb (*Pethia conchonius*) where the carotenoid content in fin increased. Paul et al. (2024) ^[9] found similar result in banded cichlid (*Heros severus*) feeding them ripe papaya pulp powder. For 120 days, koi carp (*Cyprinus*

carpio) fries were tested with meals containing 1%, 3%, 5%, 7%, and a control with 0% carrot feed. In contrast to 1%, 3%, and 7% carrot meal, the results revealed the highest color intensity at the 5% level of carrot powder integration. (Jain et al., 2019) ^[20]. Table-2 shows the the Concentration of carotenoid content (µg/g) at 450nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets.

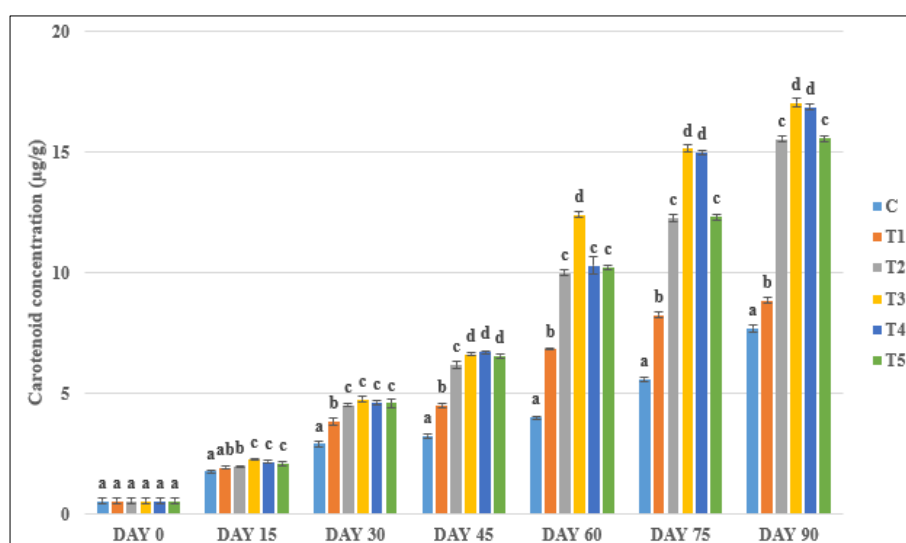


Fig 2: Carotenoid content (µg/g) in fin at 450nm wavelength for different treatments

Carotenoid concentration in fin observed at 475nm wavelength: At a wavelength of 475 nm, the total carotenoid content in the fin of *Astronotus ocellatus* was also determined (Figure 3). The results generally showed that when papaya pulp powder was added to the meal at any of the five concentrations, the fish's total carotenoid content rose. Over the course of the experiment, the carotenoid concentration in fin rose from 0.352 ± 0.11 µg/g to 6.356 ± 0.06 µg/g from zeroth day to 90th day. From 45th to 60th day there was a jump in carotenoid values of treatment fishes but not so much for the fishes given 0% papaya pulp powder. In this case also there was not so much significant difference between T₃ and T₄. T₁ and T₂ also shown no such difference too. Concentration of T₅ was lower than T₃ and T₄. T₃ (6.356 ± 0.06) µg/g and T₄ (6.011 ± 0.12) µg/g had the highest carotenoid concentration on day 90, followed by T₅

(5.815 ± 0.03) µg/g, T₂ (5.923 ± 0.05) µg/g, T₁ (5.848 ± 0.02) µg/g, and C (3.165 ± 0.01) µg/g. This could be because so many carotenoids were absorbed from the papaya and deposited in the fin instead of any other location. By giving discus fish a diet that included synthetic astaxanthin, Song et al. (2017) ^[13] discovered precisely the same results that are pertinent to the investigation. However, Kim et al. (2012) ^[14] found that adding spirulina powder, paprika powder, astaxanthin, and canthaxanthin did not boost the carotenoid concentration of fancy carp (*Cyprinus carpio*). Therefore, it may be said that different species had different levels of dietary carotenoids and their effects. Table-3 shows the the Concentration of carotenoid content (µg/g) at 475nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets

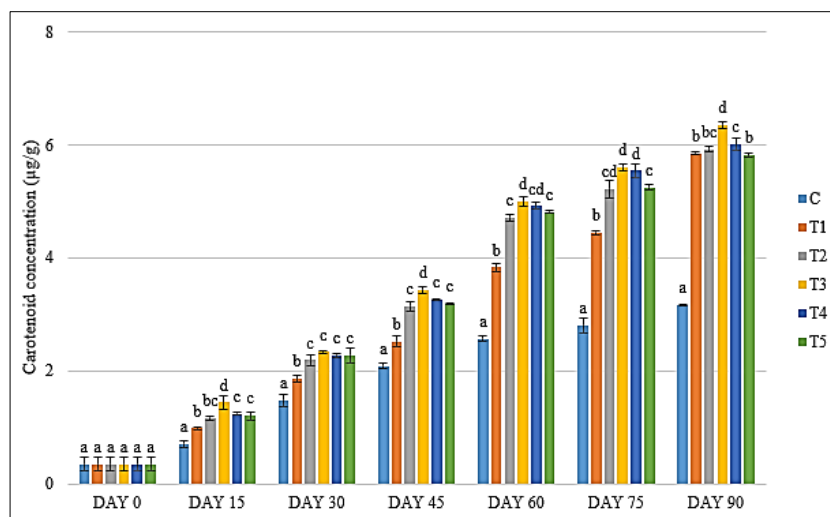


Fig 3: Carotenoid content (µg/g) in fin at 475nm wavelength for different treatments

Carotenoid concentration in fin observed at 500nm wavelength: The fin's total carotenoid concentration (TCC) was assessed at 500 nm, as shown in Figure 4. The carotenoid content of the fin was 0.12 ± 0.03 µg/g at zeroth day. By the end of the study i.e at day 90, however, the fin's carotenoid content had risen to 3.834 ± 0.05 µg/g from 0.124 ± 0.03 at zeroth day. In this case there was no significant difference between T₃, T₄, T₅ and T₂ at day 90, although highest carotenoid content was found in T₃ among those. The highest number of carotenoids found in T₃ was (3.834 ± 0.05) µg/g, which was followed in descending order by T₄ (3.551 ± 0.02) µg/g, T₅ (3.529 ± 0.05) µg/g, T₂ (3.471 ± 0.10) µg/g, and T₁

(2.824 ± 0.06) µg/g. The least number of carotenoids was found in C (2.347 ± 0.02). The carotenoid content between Control and T₁ was insignificant. The investigation's results are in line with those of Patel et al. (2023) [15], who fed a diet containing spinach powder to three spot gouramis (*Trichopodus trichopterus*) in a similar experiment. When banded gourami, *Trichogaster fasciata*, were fed a dose of turmeric powder at a concentration of 45 mg/50 g, Mukherjee et al. (2009) [16] likewise saw a similar outcome. Table-4 shows the the Concentration of carotenoid content (µg/g) at 500nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets

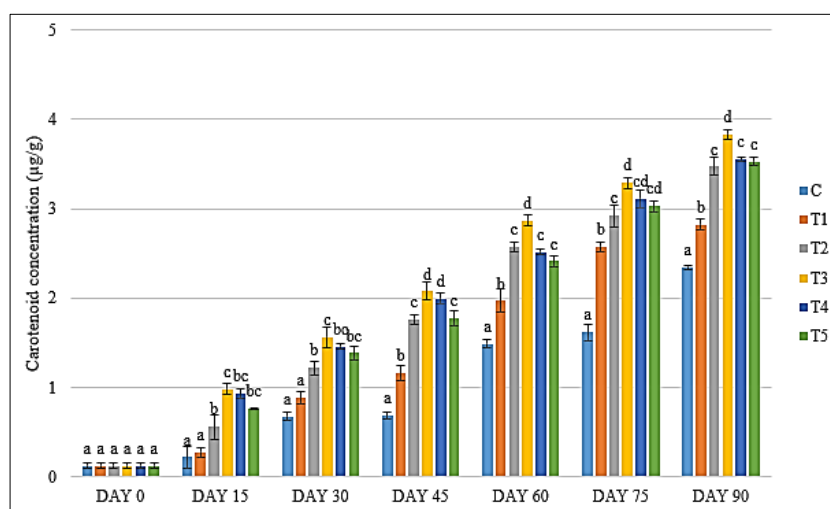


Fig 4: Carotenoid content (µg/g) in fin at 500nm wavelength for different treatments

The experiment examined how papaya pulp powder in the diet affects the coloration of fin of *A. ocellatus*. A statistical analysis was conducted to assess the impact of different diet doses of papaya pulp powder on the fin color. One-way ANOVA was also performed. The one-way ANOVA yielded a significant 'p' value ($p < 0.05$). The study found that feeding papaya pulp powder to Tiger Oscar influenced their fin color. At 380nm wave length, 5% papaya pulp powder in the diet led to the maximum carotenoid deposition in fins. At 450nm, 475nm, and 500nm wave lengths, a meal containing 3% powdered papaya pulp significantly increased the carotenoid concentration of fins, surpassing other concentrations.

Overall Control, T₁ and T₂ displayed substantially reduced fin coloration than T₃, T₄, and T₅. According to Mirzaee et al. (2013) [17], for carotenoids to be deposited, they must be absorbed from the digestive tract and transported to a particular tissue. The diet that contains powder may absorb the greatest number of carotenoids, which travel from the digestive tract to the fin. Consequently, Tiger Oscar were fed 3% where highest rise in carotenoid levels in their fins was seen with papaya pulp powder. As a result, it is said that adding 3% papaya pulp powder to the food is the best amount to improve the color of the Tiger Oscar (*A. ocellatus*) fins.

Table 1: Concentration of carotenoid content ($\mu\text{g/g}$) observed at 380nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets.

Days/Treatment	C	T ₁	T ₂	T ₃	T ₄	T ₅
Initial day	0.234 ^a ±0.07	0.234 ^a ±0.07	0.234 ^a ±0.07	0.234 ^a ±0.07	0.234 ^a ±0.07	0.234 ^a ±0.07
15th day	0.448 ^a ±0.05	0.594 ^{ab} ±0.05	0.641 ^b ±0.09	0.756 ^{bc} ±0.01	1.023 ^{cd} ±0.06	0.961 ^d ±0.04
30th day	0.711 ^a ±0.09	1.158 ^b ±0.02	1.232 ^{bc} ±0.12	1.414 ^c ±0.06	1.925 ^d ±0.12	2.012 ^d ±0.06
45th day	0.913 ^a ±0.12	1.428 ^b ±0.08	1.589 ^b ±0.09	1.972 ^c ±0.06	2.124 ^c ±0.12	2.318 ^c ±0.02
60th day	1.852 ^a ±0.02	2.212 ^b ±0.09	2.451 ^c ±0.12	2.575 ^c ±0.09	3.269 ^d ±0.03	3.414 ^d ±0.06
75th day	2.213 ^a ±0.12	2.843 ^a ±0.01	3.617 ^b ±0.07	3.751 ^b ±0.01	4.112 ^c ±0.09	4.427 ^d ±0.08
90th day	2.511 ^a ±0.06	3.912 ^b ±0.06	4.021 ^b ±0.06	4.807 ^c ±0.12	5.312 ^d ±0.09	5.553 ^d ±0.11

Mean values within same column with different superscripts differ significantly ($p < 0.05$); Data are expressed as mean±SE (n=3)

Table 2: Concentration of carotenoid content ($\mu\text{g/g}$) observed at 450nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets.

Days/Treatment	C	T ₁	T ₂	T ₃	T ₄	T ₅
Initial day	0.557 ^a ±0.13	0.557 ^a ±0.13	0.557 ^a ±0.13	0.557 ^a ±0.13	0.557 ^a ±0.13	0.557 ^a ±0.13
15th day	1.776 ^a ±0.04	1.945 ^{ab} ±0.05	1.975 ^b ±0.04	2.253 ^c ±0.03	2.183 ^c ±0.04	2.111 ^c ±0.10
30th day	2.923 ^a ±0.12	3.847 ^b ±0.15	4.523 ^c ±0.07	4.763 ^c ±0.12	4.647 ^c ±0.09	4.612 ^c ±0.17
45th day	3.253 ^a ±0.08	4.523 ^b ±0.09	6.181 ^c ±0.14	6.646 ^d ±0.08	6.734 ^d ±0.06	6.561 ^d ±0.11
60th day	4.013 ^a ±0.06	6.834 ^b ±0.03	10.013 ^c ±0.12	12.403 ^d ±0.12	10.307 ^c ±0.36	10.232 ^c ±0.08
75th day	5.617 ^a ±0.09	8.262 ^b ±0.14	12.261 ^c ±0.15	15.137 ^d ±0.15	14.985 ^d ±0.10	12.331 ^c ±0.12
90th day	7.718 ^a ±0.15	8.867 ^b ±0.13	15.541 ^c ±0.12	17.052 ^d ±0.18	16.875 ^d ±0.12	15.585 ^c ±0.12

Mean values within same column with different superscripts differ significantly ($p < 0.05$); Data are expressed as mean±SE (n=3)

Table 3: Concentration of carotenoid content ($\mu\text{g/g}$) observed at 475nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets.

Days/Treatment	C	T ₁	T ₂	T ₃	T ₄	T ₅
Initial day	0.352 ^a ±0.11	0.352 ^a ±0.11	0.352 ^a ±0.11	0.352 ^a ±0.11	0.352 ^a ±0.11	0.352 ^a ±0.11
15th day	0.714 ^a ±0.06	0.982 ^b ±0.03	1.163 ^{bc} ±0.04	1.442 ^d ±0.12	1.245 ^c ±0.02	1.204 ^c ±0.07
30th day	1.478 ^a ±0.11	1.861 ^b ±0.05	2.189 ^c ±0.09	2.334 ^c ±0.03	2.273 ^c ±0.04	2.275 ^c ±0.13
45th day	2.086 ^a ±0.05	2.524 ^b ±0.09	3.142 ^c ±0.08	3.432 ^d ±0.06	3.263 ^c ±0.02	3.185 ^c ±0.02
60th day	2.567 ^a ±0.05	3.829 ^b ±0.08	4.715 ^c ±0.06	5.001 ^d ±0.09	4.916 ^d ±0.06	4.813 ^c ±0.03
75th day	2.803 ^a ±0.13	4.446 ^b ±0.04	5.216 ^{cd} ±0.15	5.613 ^d ±0.06	5.543 ^d ±0.12	5.248 ^c ±0.05
90th day	3.165 ^a ±0.01	5.848 ^b ±0.02	5.923 ^{bc} ±0.05	6.356 ^d ±0.06	6.011 ^c ±0.12	5.815 ^b ±0.03

Mean values within same column with different superscripts differ significantly ($p < 0.05$); Data are expressed as mean±SE (n=3)

Table 4: Concentration of carotenoid content ($\mu\text{g/g}$) observed at 500nm wavelength in the fin of *Astronotus ocellatus* fed with different experimental diets.

Days/Treatment	C	T ₁	T ₂	T ₃	T ₄	T ₅
Initial day	0.124 ^a ±0.03	0.124 ^a ±0.03	0.124 ^a ±0.03	0.124 ^a ±0.03	0.124 ^a ±0.03	0.124 ^a ±0.03
15th day	0.221 ^a ±0.12	0.278 ^a ±0.05	0.563 ^b ±0.14	0.987 ^c ±0.06	0.932 ^b ±0.05	0.765 ^{bc} ±0.01
30th day	0.678 ^a ±0.05	0.887 ^a ±0.07	1.221 ^b ±0.08	1.563 ^c ±0.12	1.458 ^{bc} ±0.03	1.387 ^{bc} ±0.08
45th day	0.684 ^a ±0.04	1.163 ^b ±0.08	1.763 ^c ±0.05	2.076 ^d ±0.10	1.993 ^d ±0.06	1.775 ^c ±0.08
60th day	1.491 ^a ±0.05	1.971 ^b ±0.13	2.573 ^c ±0.05	2.871 ^d ±0.06	2.514 ^c ±0.03	2.413 ^c ±0.06
75th day	1.619 ^a ±0.09	2.576 ^b ±0.05	2.923 ^c ±0.12	3.291 ^d ±0.06	3.115 ^{cd} ±0.10	3.031 ^{cd} ±0.06
90th day	2.347 ^a ±0.02	2.824 ^b ±0.06	3.471 ^c ±0.10	3.834 ^d ±0.05	3.551 ^c ±0.02	3.529 ^c ±0.05

Mean values within same column with different superscripts differ significantly ($p < 0.05$); Data are expressed as mean±SE (n=3)

Conclusion

The pigmentation of aquarium fish affects their pricing on the international market. The color of the fins is crucial for ornamental fish. Papaya pulp powder can be easily incorporated as feed ingredients and is easily available in local stores. On a larger scale, the current study has effectively accomplished its goals and produced some significant results. The results of the study will be useful in comprehending how papaya pulp powder affects *Astronotus ocellatus* fin color. When fish were fed a meal enriched with 3 g/100 g of papaya pulp powder in comparison to other treatments, the study's findings showed a highest increase in the total carotenoid content in the fin ($p < 0.05$). Therefore, it can be concluded that in order to achieve the best pigmentation in aquarium Tiger Oscar (*Astronotus ocellatus*), feed supplemented with 3 g/100 g of papaya pulp powder is required.

References

- Kullander SO. Cichlid fishes of the Amazon River drainage of Peru. Swedish Museum of Natural History; 1986.
- Soares MGM, Almeida RG, Junk WJ. The trophic status of the fish fauna in Lago Camaleão, Amazon. Amazoniana. 2011.
- Lall SP, Tibbetts SM. Nutrition, feeding, and behavior of fish. Veterinary Clinics: Exotic Animal Practice. 2009;12(2):361-372.
- Das AP, Biswas SP. The effect of ripe papaya, *Carica papaya*, as natural carotenoids meal on body pigmentation and growth performance in banded gourami, *Trichogaster fasciata*. International Journal of Aquatic Biology. 2020;8(2):83-90.
- Maoka T. Carotenoids in marine animals. Marine Drugs. 2011;9:278-293.

6. Colomes A, Baron M, Castille R. Effects of dietary carotenoids on the growth and skin coloration of ornamental fish. *Aquaculture Research*. 2020;51(4):1520-1532.
7. Wang YJ, Li J, Zhou QC. Dietary carotenoids in ornamental fish: a review of their functions and metabolism. *Reviews in Aquaculture*. 2018;10(3):560-575.
8. Sehgal HH, Sehgal GK, Dhawan J. Dietary supplementation of *Spirulina platensis* enhances body colouration of shubunkin gold fish, *Carassius auratus* (Linn.) even in high-alkalinity rearing water. *Journal of Applied Ichthyology*. 2022;38(2):223-231.
9. Paul P, Sau SK, Pradhan A. Influence of papaya pulp powder on fin pigmentation of an ornamental fish banded cichlid, *Heros severus*. *International Journal of Advanced Biochemistry Research*. 2024;8(3S):595-600.
10. Schiedt K, Leuenberger FJ, Vecchi M, Glinz E. Absorption, retention and metabolic transformations of carotenoids in rainbow trout, salmon and chicken. *Pure and Applied Chemistry*. 1985;57(5):685-692.
11. Vasudhevan I, James R, Pushparaj A, Asokan K. Effect of *Azolla filiculoides* on growth, coloration and leucocytes count in goldfish, *Carassius auratus*. *International Journal of Plant, Animal and Environmental Sciences*. 2013;3(1):211-219.
12. Maiti MK, Bora D, Nandeesha TL, Sahoo S, Adarsh BK, Kumar S. Effect of dietary natural carotenoid sources on colour enhancement of koi carp, *Cyprinus carpio* L. *International Journal of Fisheries and Aquatic Studies*. 2017;5(4):340-345.
13. Song X, Wang L, Li X, Liu W, Zhang D. Dietary astaxanthin improved the body pigmentation and antioxidant function, but not the growth of discus fish (*Symphysodon* spp.). *Aquaculture Research*. 2017;48(4):1359-1367.
14. Kim YO, Lee SM. Effects of dietary inclusion of spirulina, astaxanthin, canthaxanthin or paprika on the skin pigmentation of red- and white-colored fancy carp *Cyprinus carpio* var. koi. *Korean Journal of Fisheries and Aquatic Sciences*. 2012;45(1):43-49.
15. Patel KD, Yusufzai SI, Dabhi RM, Parmar HV. Effect of spinach (*Spinacia oleracea*) on pigmentation, growth and survival in the three spot gourami, *Trichopodus trichopterus* (Pallas, 1770). *Journal of Experimental Zoology, India*. 2023;26(2):2217-2222.
16. Mukherjee A, Mandal B, Banerjee S. Turmeric as a carotenoid source on pigmentation and growth of fantail guppy, *Poecilia reticulata*. *Proceedings of the Zoological Society*. 2009;62(2):119-123.
17. Mirzaee S, Beygi MM, Shabani A. Effect of placement carrot (*Daucus carota*) and red pepper (*Capsicum annuum*) in diets on coloration of jewel cichlid (*Hemichromis bimaculatus*). *World Journal of Fish and Marine Sciences*. 2013;5(4):445-448.
18. Fujii R. The regulation of motile activity in fish chromatophores. *Pigment Cell Research*. 2000;13(5):300-319.
19. Kurnia A, Nur I, Muskita WH, Hamzah M, Patadjai RS, Balubi AM, et al. Improving skin coloration of koi carp (*Cyprinus carpio*) fed red dragon fruit peel meal. *AACL Bioflux*. 2019;12(4):1045-1053.
20. Jain A, Kaur VI, Hollyappa SA. Effect of dietary supplementation of carrot meal on survival, growth and pigmentation of freshwater ornamental fish, koi carp (*Cyprinus carpio* L.). *Indian Journal of Animal Nutrition*. 2019;36(4):405-413.