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The Effect of Adding Carrot Flour (*Daucus carota*) to Commercial Feed on Increasing the Brightness of the Body Color of Goldfish (*Carassius auratus*)

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ABSTRACT

One type of freshwater ornamental fish that is popular and in demand is the goldfish (*Carassius auratus*) because it has an attractive color that appears on its body, so food is needed that can trigger the appearance of attractive fish colors. The purpose of this study was to determine the effect of giving carrot flour and the right dose to increase the brightness of the color and growth of goldfish. The research design used was a completely randomized design (CRD) with an experimental method, four treatments, and three replications. The treatments tested were 0% carrot flour + 100% commercial feed (A), 5% carrot flour + 95% commercial feed (B), 10% carrot flour + 90% commercial feed (C), and 15% carrot flour + 85% commercial feed (D). The parameters observed were an increase in color brightness, absolute weight gain, feed conversion ratio, survival rate, and water quality (temperature, DO, and pH). The addition of carrot flour can improve the color brightness of goldfish but has no significant effect on absolute weight growth, feed conversion ratio, or goldfish survival. Water quality parameters measured during the study were still within a reasonable range for goldfish rearing.

Keyword: brightness, carrot meal, commercial feed, goldfish (*Carassius auratus*)

INTRODUCTION

Ornamental fish are one of the fish commodities that have potential in the fisheries industry (Nurlaili *et al*., 2021). The shape and color of ornamental fish are in great demand by consumers, thus attracting the attention of ornamental fish lovers and opening profitable business opportunities (Tolon, 2018). Among the various types of freshwater ornamental fish, goldfish (*Carassius auratus*) are some of the most popular because of the attractiveness of their body color. Therefore, feed is needed that can stimulate the emergence of attractive body colors (Diansyah *et al*., 2019). The beautiful color of this ornamental fish comes from the presence of chromatophore cells in the epidermis layer (Rahman *et al*., 2021).

One of the problems in cultivating goldfish (*C. auratus*) is the decline in the quality of the fish's body color, which has an impact on decreasing its selling value. The decrease in color performance of fish bodies is largely caused by using feed with low beta-carotene content (Rahman *et al*., 2021). Beta-carotene is a precursor to vitamin A, which plays an important role in enhancing the natural color of ornamental fish. In addition, beta-carotene also functions as an antioxidant to protect cells from damage caused by free radicals, improve the immune system, and help the healing process of various diseases (Ma *et al*., 2021). As the main source in the pigmentation process, beta-carotene plays an important role in providing color to various ornamental fish

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species, especially those with red, yellow, and other colors, especially in fish that live in tropical areas (Budi and Mardiana, 2021). Carrot flour is a natural source of beta-carotene, which can improve the quality and brightness of color in ornamental fish, such as koi and goldfish. Beta-carotene, an active substance found in carrots, plays an important role as a color brightness-enhancing agent (Gul *et al*., 2015).

Research on increasing color brightness in ornamental fish with the addition of carrot flour has been widely conducted. Budi and Mardiana (2021) conducted a study on increasing the growth and brightness of the color of koi carp (*Cyprinus carpio*) by utilizing carrot flour in feed, with the best dose of 5%. Similar to the research conducted by Fernando *et al*. (2019), the best dose to increase color brightness in betta fish (*Betta splendens*) is 5%. Meanwhile, in the study of Maolana *et al*. (2017) on the effect of adding carrot juice in feed on the color brightness of koi fish (*C. carpio*), which gave the highest color intensity value with a dose of 40%. This study aims to determine the effect of carrot flour and the right dosage to improve the brightness of the color and growth of goldfish (*C. auratus*).

MATERIALS AND METHODS

Time and Place

This research was conducted for 40 days from March to April 2024 at SPP Rea Polewali, Polewali Mandar Regency, West Sulawesi Province.

Experimental Design and Feed Preparation

The container used in this study was an aquarium measuring 7 × 19 × 15 cm with a volume of 3 L. The container was first cleaned by filling it with water and brushing it until it was clean. Then, the container was dried, and then the container was filled with 3 L of clean water for goldfish cultivation. The water used came from a drilled well around the research location. The test fish used were goldfish measuring 2–3 cm. The test fish seeds used came from ornamental fish traders in Polewali Mandar Regency. In this study, the maximum test fish density was one fish/L. During the maintenance period, the goldfish were fed 2 times a day with a dose of 3% of the total biomass with each treatment, namely A = Commercial feed (100%); B = Carrot flour 5% + commercial feed 95%; C = Carrot flour 10% + commercial feed 90%; D = Carrot flour 15% + commercial feed 85% (Diansyah *et al*., 2019).

The experimental feed was prepared in several stages. Fresh carrots were cleaned and then cut into small pieces to facilitate the grating process. Grated carrots were dried for three to five days until dry. Once dry, the ingredients were ground using a blender to become carrot flour. This carrot flour was then mixed with commercial feed that had been ground through a re-pelleting process.

Furthermore, water is added with a ratio of 30 mL per 100 g of feed to obtain an elastic consistency suitable for molding. The mixture is formed using a plastic tray and then dried in the sun until completely dry. The resulting feed is then ready to be applied in the experiment. The feed used in treatment A (control) is commercial feed without the addition of carrot flour, while the 5% dose contains 5 g of carrot flour plus 95 g of feed, the 10% dose with 10 g of carrot flour plus 90 g of feed, and the 15% dose contains 15 g of carrot flour plus 85 g of feed.

Qualitative Value of Fish Color

Observations on color performance were carried out every 07:00 before feeding. The range of cluster values published by Mustari *et al*. (2022) was used to obtain the average body color value of the sample fish. The assessment

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or weighting of color was carried out by panelists (5 people) with the help of color measuring paper. The score/value on the color paper starts from 1, 2, and 3 to the largest value, namely 30, with a color gradation from yellow and orange to dark red. The quantitative and qualitative values are 1-2 (pale yellow), 3-5 (bright yellow), 6-8 (yellowish orange), 9-11 (light orange), 12-14 (bright orange), 15-18 (dark orange), 19-21 (reddish orange), 22-24 (less bright red), 25-28 (bright red), and 29-30 (dark red) (Mustari *et al*., 2022).

Measurement parameters

During the rearing period, several parameters were carried out to determine the effectiveness of cultivation such as; growth, Feed convention rate and survival rate of goldfish using the formula according to Tarigan *et al*. (2025).

$$AWG = final\ body\ weight - initial\ body\ weight$$

$$FCR = \frac{Total\ amount\ of\ feed\ given}{(Final\ body\ weight + Weight\ of\ dead\ fish) - initial\ body\ weight}$$

$$SR(\%) = \frac{(\ Final\ number\ of\ fish)}{initial\ number\ of\ fish} x\ 100$$

Water Quality

The water quality measured in this research includes temperature, degree of acidity (pH), and dissolved oxygen or DO (dissolved oxygen). Measurements of temperature, pH, and DO were carried out twice a day, namely at 08:00 am and 17:00 pm.

Data Analysis

The data obtained in the form of absolute weight growth of fish, feed conversion, and fish survival were analyzed statistically using one-way Analysis of Variance (ANOVA). Data that showed a significant effect (95% confidence level) were continued with the W-Tuckey test. Water quality data were analyzed descriptively based on the viability of goldfish (*C. auratus*).

RESULTS AND DISCUSSIONS

Qualitative Value of Fish Color

The results of observations of color performance assessments in carp showed that carrot flour increased the brightness of the color in carp (Table 1). The increase in the qualitative value of the brightness of the body color of fish with the addition of carrot flour experienced different increases in value.

Table 1. Qualitative values based on panelist observations according to the color measuring instrument

Treatments	Qualitative Value		Mean Qualitative Value
	Initial	End	
A1	Bright orange	Less bright red	Dark orange
A2	Dark orange	Less bright red	Orange red
A3	Bright orange	Less bright red	Dark orange
B1	Light orange	Less bright red	Dark orange
B2	Light orange	Dark orange	Bright orange
B3	Light orange	Bright orange	Light orange
C1	Light orange	Dark orange	Bright orange
C2	Light orange	Dark orange	Bright orange
C3	Light orange	Dark orange	Bright orange
D1	Light orange	Dark orange	Bright orange
D2	Bright yellow	Yellowish orange	Yellow orange
D3	Bright orange	Dark orange	Dark orange

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The best increase in color brightness was obtained in treatment C with an average qualitative value of bright orange. This is thought to be caused by the beta-carotene needs of carp having been met. The same thing was reported by Darsiani *et al.* (2023), aquatic organisms have limitations in retaining beta-carotene compounds in their bodies, so only at certain doses can they have a better impact. Even at excessive doses, can it interfere with eye growth and development. Zutshi & Madiyappa (2020) also reported something similar: giving beta-carotene at the right dose to swordtail fish (*Xiphophorus helleri*) can support the brightness of its body color. A similar thing was reported by Kop *et al.* (2010), the addition of carrot flour to the feed as a supplier of beta-carotene nutrients can increase the brightness level of the body color of cichlids (*Cichlasoma severum*). Meanwhile, the lowest increase in brightness was obtained in treatment D with an average qualitative value of yellowish orange to dark orange. It is suspected that the fish are unable to utilize the beta-carotene contained in the feed that is given excessively high. This is in accordance with research conducted by Budi and Mardiana (2021), which stated that the treatment of adding carrot flour with a dose above 5-10% did not affect increasing the brightness of koi fish (*Cyprinus rubrofuscus*) because the fish will excrete excess coloring agents. According to Lestari *et al.* (2019), fish take longer to break down beta-carotene compounds into color pigments if the amount of beta-carotene content in the feed is high. According to Wahyu and Chadijah (2023), fish species can show different beta-carotene metabolism results.

Growth and Feed Convention Rate

Absolute weight gain is the increase in fish weight during the maintenance period. Fish growth during the cultivation period is influenced by the effectiveness of fish in utilizing feed for growth. One indicator to determine feed effectiveness can be measured through the feed conversion ratio (FCR) (Li *et al*, 2014). The growth and FCR values are in Table 2. The highest average absolute weight gain and FCR were obtained in treatment B with values of 0.700 g and 1.345, while the lowest absolute weight gain was in treatment D with a value of 0.377 and an FCR value of 2.058. This value does not show a significant difference between treatments ($P > 0.05$).

Table 2. Growth, feed concention ratio, and survival rate of gold fish

Treatment	A	B	C	D
AWG (g)	0,467±0,116[a]	0,700±0,300[a]	0,633±0,182[a]	0,377±0,137[a]
FCR	1,859 ± 0,0002[a]	1,345 ± 0,003[a]	1,793 ± 0,001[a]	2,068 ± 0,001[a]
SR (%)	100 ±0[a]	88,9 ± 19,3[a]	100 ± 0[a]	100 ± 0[a]

The feed conversion rate value, if the value is small, indicates that the amount of feed given is more effective for fish growth (Li *et al.*, 2014). The conversion value is influenced by environmental conditions, where a good environment for fish habitat can affect the metabolic process in utilizing existing energy so that it can grow optimally (Zulkhasyni *et al.*, 2017). Beta-carotene is used more by fish to increase color brightness. The same thing was reported by Harpaz & Padowicz (2007), that the addition of beta-carotene to feed does not affect the growth of ornamental fish because ornamental fish fed with beta-carotene sources are thought to utilize the coloring agent more to improve their body color. This statement is

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in line with that stated by Fernando *et al.* (2019), which states that carrot flour as a feed additive aims to produce ornamental fish so that their physical appearance, especially their color, becomes more attractive. This is different from the statement of Rahmayanti *et al.* (2023) that carrot flour also contains protein and other nutrients needed for body growth. The same thing was stated by Bachetta *et al.* (2019) that beta-carotene, which is a provitamin A, can support the growth of organisms.

The low growth and high FCR in treatment D are thought to be caused by the high fiber content in the feed due to the addition of 15% carrot flour, with a fiber content reaching 9.67% (Purewal *et al.*, 2023). This is supported by the statement of Syam *et al.* (2024) that high fiber content in feed will result in decreased digestibility. Continued by the statement of Meilisza *et al.* (2021), fiber is a material that is difficult to digest. High fiber content will make fish use more energy to digest fiber. Added by Lestari *et al.* (2022), high-fiber feed causes decreased digestibility of feed, so the amount of feed consumption is limited.

Survival Rate

Survival rate is the chance of an individual to survive within a certain period. Survival is a measure of successful cultivation (Takril *et al.*, 2021). The survival rate of goldfish in this study can be seen in Table 2. The survival value in treatments A, C, and D had an SR value of 100%, and the lowest value was obtained in treatment B with a value of 88.89%. This value does not show a significant difference between treatments ($P > 0.05$). According to Niron *et al.* (2023), goldfish that have a survival rate of >80% are still in the good category. Furthermore, Krisna & Anwar (2024) reported that the survival rate of goldfish larvae and fry in the range of 75 - 89% is still classified as good. This is because the survival of organisms is supported not only by the nutrients in the feed given but also by several supporting factors, such as environmental factors (Canosa & Bertucci, 2023).

Water Quality

Water quality is the most important factor in fish farming, including goldfish farming, to support fish growth and survival (Kelany *et al.*, 2024). The temperature range measured during the study ranged from 27.8 to 28.9 ºC. This range is still within the limits that goldfish can tolerate. According to Gouveia & Rema (2005), goldfish live well at an optimal temperature of 22 to 30 ºC. According to Fitriana *et al.* (2013), water temperature is very important for fish because it affects the solubility of gases in water, such as oxygen and carbon dioxide, fish growth, and body metabolism in fish. According to Abram *et al.* (2017), at suboptimal temperatures, fish can be attacked by diseases, parasites, bacteria, and viruses.

The results of DO (dissolved oxygen) measurements during the study ranged from 5.7 to 6.0 ppm. Goldfish can survive with a DO value of 2.6 in several days (Cameron *et al.*, 2013). According to Erlangga *et al.* (2019), goldfish can still tolerate an oxygen content of 2 ppm, but if the range is smaller, it can cause toxic conditions for fish. Irawan *et al.* (2019) added that in minimal oxygen conditions, it can interfere with the metabolism, growth, and reproduction of aquatic animals.

The pH range measured during the experiment ranged from 6.2 to 7.4 ppm. This range indicates a good value for the growth of goldfish. The pH value that can be used as a reference for goldfish ranges from 6 to 9 (Mulyana *et al.*, 2023). In minimal conditions, pH can affect other water quality parameters (physics, chemistry, biology) (Supriatna *et al.*, 2020), which can then interfere with the

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growth of aquatic animals (Irawan *et al*., 2019).

CONCLUSION

The addition of carrot flour to commercial feed can increase the brightness of the body color of goldfish with the best dose in treatment A, which is 10% carrot flour + 90% commercial feed. However, it did not show a significant effect on growth, FCR and survival.

AUTHORS' CONTRIBUTIONS

Each author's contribution is as follows: DD, AF, MA, and DY collected the data research, prepared the manuscript, and designed tables and graphs. DD, AH, DL, FN, CRM and YM: processing data, writing manuscripts, and proofreading manuscripts. All authors contributed to the final manuscript.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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