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THE EFFECT OF ADDING BANANA KEPOK (*Musa paradisiaca*) PEEL EXTRACT ON THE COLOR BRIGHTNESS OF GOLDFISH (*Carassius auratus*)

Pengaruh Penambahan Ekstrak Kulit Pisang Kepok *(Musa paradisiaca)* Terhadap Kecerahan Warna Ikan Maskoki *(Carassius auratus)*

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ABSTRACT

Goldfish is a fish commodity whose demand continues to increase every year by ornamental fish lovers because of its beautiful color. However, the color fading of goldfish causes the market price of goldfish to decline. This research aims to analyze the effect of adding kepok banana peel extract (Musa paradisiaca) on the brightness of goldfish (Carassius auratus). The method used in this research was a Completely Randomized Design (CRD) with 4 treatments and 3 replications. Where P1 (Without the addition of Kepok banana peel extract), P2 (Kepok banana peel extract 10 ml/kg feed), P3 (Kepok banana peel extract 20 ml/kg feed), and P4 (Kepok banana peel extract 30 ml/kg feed). The results of the research on the level of fish color brightness were obtained in the P3 treatment with a dose of 20 ml/kg feed and the best absolute weight growth was in P4 with a weight increase of 0.84 g, the best absolute length growth was obtained in P4 with a result of 0.99 cm, and the growth rate the best daily was at P4 with a growth rate of 0.69%. The results of the highest feed conversion ratio were found in P4, namely 21.60. Meanwhile, the best survival was found in P1 and P3 with a percentage of 100%.

Keywords: Goldfish, cartonoid, banana kapok, brightness of color.

ABSTRAK

Ikan maskoki merupakan salah satu komoditas ikan yang permintaannya terus meningkat setiap tahunnya oleh pencinta ikan hias karena warnanya yang indah. Tetapi terjadinya pemudaran warna pada ikan maskoki menyebabkan harga pasaran maskoki menurun. Penelitian ini bertujuan untuk menganalisis pengaruh penambahan ekstrak kulit pisang kepok (*Musa paradisiaca*) terhadap kecerahan ikan maskoki (*Carassius auratus*)**.** Metode yang digunakan pada penelitian ini yaitu Rancangan Acak Lengkap (RAL) dengan 4 perlakuan 3 ulangan. Dimana P1 (Tanpa penambahan ekstrak kulit pisang kepok), P2 (ekstrak kulit pisang kepok 10 ml/kg pakan), P3 (ekstrak kulit pisang kepok 20 ml/kg pakan), dan P4 (ekstrak kulit pisang kepok 30 ml/kg pakan). Hasil penelitian pada tingkat kecerahan warna ikan diperoleh pada

perlakuan P3 dengan dosis 20 ml/kg pakan dan pertumbuhan bobot mutlak terbaik berada pada perlakuan P4 dengan pertambahan bobot 0,84 g, pertumbuhan panjang mutlak terbaik diperoleh perlakuan P4 dengan hasil 0,99 cm, dan laju pertumbuhan harian terbaik berada pada perlakuan P4 dengan angka pertumbuhan 0,69%. Hasil dari rasio konversi pakan tertinggi terdapat pada perlakuan P4 yakni 21,60. Sedangkan kelangsungan hidup terbaik terdapat pada perlakuan P1 dan P3 dengan persentase 100%.

Kata Kunci: Ikan maskoki, karetonoid, pisang kapok, kecerahan warna

INTRODUCTION

Global demand for ornamental fish continues to increase in line with the growing number of hobbyists and the development of the high-value aquaculture industry. Ornamental fish farming is a promising sector because it combines economic aspects with the aesthetic value of the product. Goldfish (Carassius auratus) are among the species with high market demand, primarily determined by their morphological diversity and the quality of their body coloration. Decreased color intensity or brightness is known to correlate with low consumer acceptance, ultimately impacting their commercial value (Solihah et al., 2015). Color is one of the main parameters determining the quality of ornamental fish from a market perspective. This characteristic plays a crucial role in shaping consumer preferences because it directly influences the product's visual appeal. Therefore, the level of brightness and stability of pigmentation are important indicators closely related to consumer acceptance and commercial value (Malide et al., 2020).

Carotenoids are a group of lipophilic pigments that produce a spectrum of colors ranging from yellow to orange. Within cells, these pigments are generally found associated with chlorophyll in chloroplasts, but they can also accumulate in chromoplasts or be stored freely as deposits in lipid droplets (Juniarti & Hasnelly, 2016). Maoka (2011) stated that most aquatic animals have limited ability to synthesize carotenoids in their bodies, so their pigment supply is highly dependent on dietary intake. Therefore, supplementing carotenoid sources in feed formulations is an important strategy to support improved color quality and intensity.

Various approaches have been developed to maintain and enhance the color quality of ornamental fish, one of which is through the addition of natural carotenoid-rich ingredients to the feed. These sources can be derived from both plant and animal sources, which serve as primary precursors in the pigmentation process. Several studies have reported the use of various natural carotenoid sources, such as dragon fruit peel and mangosteen peel (Purba et al., 2021), shrimp head flour (Indarti et al., 2012), carrots, pumpkin, and Spirulina sp. (Khairunnisa et al., 2020) and other materials that show potential for enhancing the brightness and color intensity of ornamental fish.

However, among these carotenoid sources, banana peel is readily available, affordable, and abundant compared to other carotenoid sources. Banana peel contains 45 mg of carotenoids per 100g dry weight (Aprilia & Kurniawati, 2016). Based on the description above, this study aims to analyze the effectiveness of supplementation with kepok banana peel extract (Musa paradisiaca) as a natural carotenoid source in increasing the color intensity of goldfish (Carassius auratus).

RESEARCH METHODS

Place and Time

This research was conducted for 40 days and took place in the Seed Laboratory of the Faculty of Agriculture, Samudra University.

Tools and Materials

The equipment used in this study included 12 aquariums for maintenance, a digital scale, an aerator, millimeter paper blocks, M-TFC paper, a blender, a sieve, a sieve, stationery, and label paper. Water quality measurements were performed using a DO meter, pH meter, and thermometer. The materials used included goldfish fry, banana peel extract, progol, and pellet feed.

Research Design

The research method used in this study was an experimental method. A completely randomized design (CRD) was used with four treatments and three replications. The treatments applied in this study were different doses of banana peel extract. The basis for determining the dose was based on research by Nurul (2024). The treatments in this study were:

P1 : Without adding banana peel extract/kg feed (control).
P2 : Addition of banana peel extract 10 ml/kg feed.
P3 : Addition of banana peel extract 20 ml/kg feed.
P4 : Addition of banana peel extract 30 ml/kg feed.

Research Procedures

1) Making Banana Peel Extract

The banana peels used were ripe Kepok banana peels from the sale of "lumer" or "crispy" bananas. Prior to the extraction process, the banana peels were first dried in the sun for approximately seven days until they reached a completely dry condition to facilitate the next processing stage. The dried sample was then ground using a blender to a fine powder. The powder was then macerated using 70% ethanol for 3x24 hours. After the soaking period was complete, the solution was filtered and the resulting filtrate was concentrated using a rotary evaporator to produce a concentrated liquid extract. The liquid extract was then placed in a bottle and applied to the feed according to the treatment dosage. The feed was then air-dried until dry before use.

2) Mixing Extracts in Feed

The feed used was commercial pellets with a diameter of 2 mm and a protein content of 35%. The feed fortification process was carried out by adding progol as much as 5 g/kg of feed as a binding agent. Banana peel extract was measured according to the treatment dosage (0, 10, 20, and 30 ml), then diluted with 125 ml of distilled water. The solution was put into a spray bottle and applied evenly to the surface of the feed. After the mixing process, the feed was air-dried until it reached a dry condition, then stored in a closed container or plastic bag at room temperature until used.

3) Container Preparation

The containers used for the test fish rearing activities were 12 aquariums. Before use, all containers were cleaned to remove dirt and then dried. Each aquarium was then labeled according to the results of the randomization design. The containers were filled with 15 liters of water per unit, equipped with an aeration system, and left for 24 hours before stocking the fish.

4) Preparation of Test Fish

Before treatment began, the goldfish were acclimatized for four days to minimize stress from changes in their rearing environment. After the adaptation period, fish measuring 4-5 cm in total length were stocked at a density of 10 per tank. All test fish were obtained from ornamental fish traders located in Langsa City, Aceh Province.

5) Goldfish Maintenance

Goldfish are reared for 40 days to allow the pigment cells to optimally utilize the β-carotene content in the feed. The feed consists of pellets with a 35% protein content, fed to the fish using the satiation method. Feeding is done three times daily: at 8:00 AM, 12:00 PM, and 4:00 PM.

6) Water Quality Management

To maintain water quality during goldfish maintenance, water changes are performed weekly, amounting to 50% of the total water in the aquarium. During the water changes, the aquarium walls are cleaned by scrubbing and siphoning, which is done daily in the morning before feeding. Siphoning is done using a hose to minimize residual dirt on the aquarium floor. Water quality parameters observed include temperature, pH, and dissolved oxygen (DO) levels, which are measured at D-0, D-10, D-20, D-30, and D-40.

7) Test Biota Sampling

After the acclimatization process was completed, the test fish were reared until they showed normal conditions without any signs of stress. Next, initial data collection (D-0) was carried out in the form of body weight and color brightness levels. Weight measurements were carried out by taking fish from each rearing container and weighing them using a digital scale. Subsequent sampling activities were carried out at ten-day intervals, namely at D-10, D-20, D-30, and D-40. Evaluation of the color brightness of the goldfish was carried out at the beginning and end of the research period using a colorimeter that had previously been calibrated with a white standard.

Observed Parameters

1) Brightness of Goldfish Color

Goldfish color intensity was assessed using the Modified Toca Color Finder (M-TCF) color card (Indarti et al., 2012). The observed test fish were placed on the standard sheet, and then a color score was determined based on the visual match between the fish's body color and the gradation on the card. The evaluation was conducted by 15 panelists who met the criteria for not experiencing color blindness. The Toca Color Finder used is as shown in Figure 1.

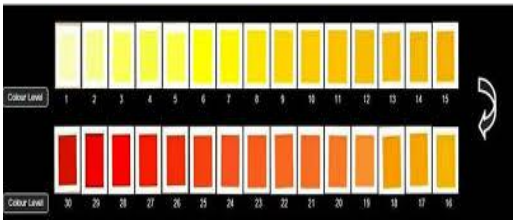

Figure 1. Toca Color Finder (TCF)
Source*:* Haser (2015)

2) Daily Growth Rate

The daily growth rate can be calculated using the formula according to (Effendie, 2002), namely:

$$\text{LPH} = \frac{(Ln\ Wt - Ln\ Wo)}{t} \times 100$$

Description:
LPH = Daily Growth Rate (%/day)
Wt = Final fish weight of the study (g)
Wo = Initial fish weight of the study (g)
t = Maintenance period (days)

3) Absolute Weight Gain

The absolute weight gain of goldfish is calculated using the Effendie (2002) formula, namely:

$$W = Wt - W0$$

Description:
W : Increase in fish biomass (g)
Wt : Initial weight of test fish in the study (g)

Wg : Final weight of test fish in the study (g)

4) Absolute Length Growth

Absolute length growth is the change in the average length of goldfish fry measured using a ruler. Absolute length growth can be measured using Effendie's (2002) formula, namely:

$$P = Pt - Po$$

Description:
P : Absolute length growth (cm)
Pt : Length of fish at the end of maintenance (cm)
Po : Length of fish at the start of rearing (cm)

5) Survival Rate (SR)

Calculation of fish survival using the formula according to Goddard (1996), as follows:

$$SR = \frac{Nt}{No} \times 100$$

Description:
SR : Survival rate (%)
Nt : Number of live fish at the end of maintenance (tail)
No : Number of fish at the start of maintenance (tail)

6) Feed conversion ratio

The feed conversion ratio can be calculated using the Tacon (1987) formula, namely:

$$FCR = \frac{F}{(Wt - Wd) - Wo}$$

Description:
FCR : Feed conversion ratio
F : Amount of feed given (g)
Wt : Final fish weight at maintenance (g)
Wd : Weight of fish that died during rearing (g)
Wo : Initial weight of fish for maintenance (g)

7) Water Quality

Water quality observations included temperature measured with a thermometer, dissolved oxygen (DO) measured with a DO meter, and acidity (pH) measured with a pH meter. Water quality measurements were conducted at the beginning and end of the research.

Data Analysis

Data obtained during the study were analyzed using ANOVA (Analysis of Variance) to determine the effect of all treatments. If there were differences in the treatments, Duncan's test was performed at a 95% confidence interval. Water quality data were analyzed descriptively.

RESULT

Brightness of Goldfish Color

The results of the increase in color brightness in goldfish over 40 days show that there was an increase in color in each treatment in Table 1.

Table 1. Increase in color brightness in goldfish (Carasius auratus) with kepok banana peels (Musa paradisiaca).

Treatment	Brightness
P1	1,83±0,55[a]
P2	1,93±0,66[a]
P3	3,40±0,34[b]
P4	3,36±0,11[b]

Note: Different letters in the same column indicate significantly different treatment effects (P<0.05). The data listed are the average value and standard deviation.

Observations showed that the addition of kapok banana peel extract to feed affected the color brightness of goldfish (Carassius auratus). The highest average brightness score was obtained in treatment P3 (20 ml/kg feed) at 3.40±0.34, followed by P4 (30 ml/kg feed) at 3.36±0.11. Meanwhile, treatment P2 (10 ml/kg feed) and the control P1 each showed lower values, at 1.93±0.66 and 1.83±0.55, respectively. Statistical analysis showed that treatments P3 and P4 were significantly different (P<0.05) compared to P1 and P2, as indicated by different superscript letters in the table. However, there was no significant difference between P3 and P4, or between P1 and P2 (P>0.05).

Visual observations presented in Figure 2 show an increase in color intensity at the end of the rearing period, particularly in treatments P3 and P4. The color change appeared brighter and more even compared to the control treatment. In contrast, the color change in P1 and P2 was relatively lower compared to the higher dose treatments.

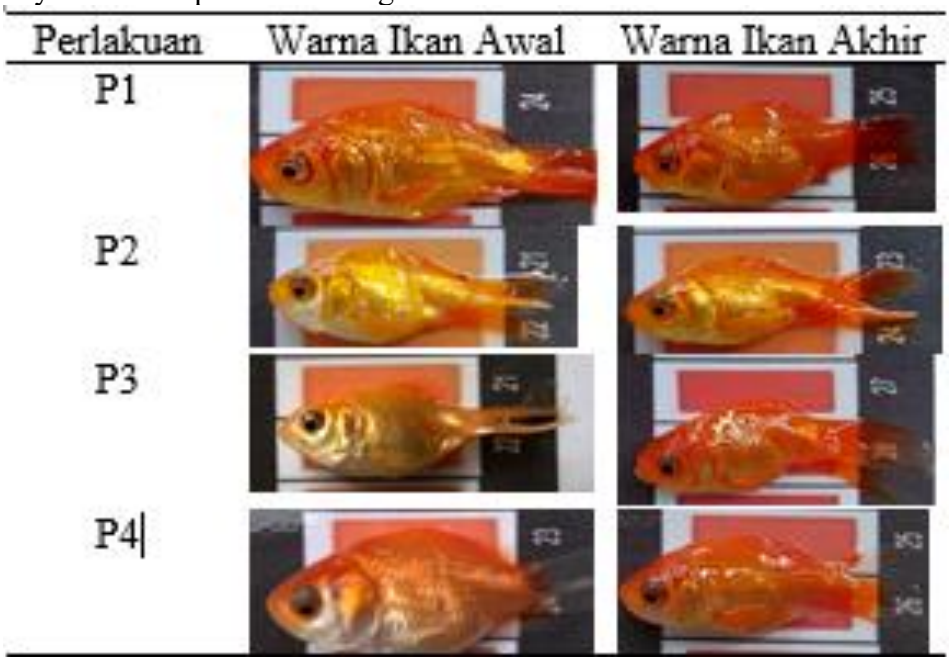

Figure 2. Comparison of the color brightness of goldfish (Carassius auratus).

Growth Performance

The results of observations of daily growth rate (DGR), absolute weight gain (DGR), absolute length gain (FGR), and feed conversion ratio (FCR) are presented in Table 2.

Table 2. Results of daily growth rate (DGR), absolute weight gain (DGR), absolute length gain (FGR), and feed conversion ratio (FCR))

Parameter	Treatment			
	P1	P2	P3	P4
LPH (%/Day)	0,60±0,23[a]	0,70±0,11[a]	0,86±0,04 [a]	0,57±0,21 [a]
PBM (g)	0,75±0,26[a]	0,70±0,14[a]	0,96±0,02[a]	0,74±0,17[a]
PPM (cm)	0,49±0,10[a]	0,62±0,01[a]	0,69±0,14[a]	0,66±0,11[a]
RKP	1,49±0,09[a]	1,47±0,12[a]	1,34±0,04[a]	1,38±0,08[a]

Note: Numbers followed by the same letter are not significantly different according to the Duncan's Multiple Range Test (DMRT) at α = 5%. The data listed are the mean and standard deviation.

Based on the ANOVA test, it was shown that the administration of banana peel extract at different doses had no significant effect (P>0.05) on the daily growth rate, absolute weight growth, absolute length growth, and feed conversion ratio of goldfish. This indicates that banana peel extract containing carotenoids did not affect the growth of goldfish in this study.

Survival Rate (SR)

ANOVA analysis showed that adding kepok banana peel extract to feed had no significant effect (P>0.05) on goldfish survival.

Table 3. Goldfish Survival Rate

Treatment	SR (%)
P1	93,33±5,77[a]
P2	86,66±11,54[a]
P3	86,66±5,77[a]
P4	76,66±11,54[a]

Note: The same letters indicate a treatment effect that is not significantly different (P>0.05). The data listed are the average value and standard deviation.

Water Quality

Water quality measurements during maintenance can be seen in Table 4.

Table 4. Water Quality During Maintenance

Parameter	Treatment				Quality standards (SNI, 2018)
	1	2	3	4	
pH	6,1 - 7,9	6,3 - 6,8	6,1 - 7,1	6,2 - 7,3	6,0-7,8
DO (mg/l)	5,5 - 6,9	5,8 - 7,2	5,3 - 6,8	5,9 - 7,1	>5
Suhu (C^{o})	26,5 - 29,1	26,2 - 28,9	26,5 - 28,8	26,6 - 29,2	26-30

Based on the results of water quality maintenance, measurements were carried out, indicating that the water quality remained in good condition. The pH, dissolved oxygen, and temperature values for each treatment ranged from 6.1 to 7.9, 5.5 to 7.2 mg/L, and 26 to 29 °C, respectively. These water quality results are within the 2018 Indonesian National Standard (SNI) standards.

DISCUSSION

The significant color increase in goldfish during the P3 and P4 treatments was due to the addition of natural ingredients containing β-carotene, which can help develop pigmentation in goldfish. This is supported by Malini et al.'s (2018) statement that carotenoids are one of the main substances that can trigger the pigmentation process in ornamental fish. The increase in red and orange color in goldfish during the study was influenced by the carotenoid content in banana peel extract, as ornamental fish are unable to perceive color pigmentation other than black and white without the aid of carotenoid-containing ingredients. According to Aprilia and Kurniawan (2016), several easily available carotenoid sources include banana peels, which contain 45 mg of carotenoids per 100g of dry weight.

The difference in color brightness in goldfish is due to differences in carotenoid absorption between treatments. This aligns with Solihah et al.'s (2015) statement that fish differ in their absorption of administered carotenoids. The high carotenoid absorption in treatment P3 is thought to be due to the carotenoids being provided in accordance with the needs of goldfish. While the low brightness level in treatment P4, with the addition of 30 ml of banana peel extract

to the feed compared to treatment P3, which was given 20 ml of banana peel extract, was due to an inappropriate dosage. This aligns with Azuri's (2018) statement, which states that carotenoid use must be considered in terms of dosage. Meanwhile, Fathurrahman et al. (2020) stated that color change in fish depends on the amount of dye in the feed, and an appropriate dosage is required, neither too much nor too little.

Meanwhile, in treatment P1 without the addition of banana peel extract, the color enhancement process in goldfish was very slow due to the absence of additional ingredients that could provide carotenoids for synthesizing red, orange, and yellow pigments. This is because color formation in goldfish in this study was influenced by the amount of carotenoids contained in the feed consumed. This is in accordance with the statement of Yasir and Qin (2010), who stated that the color formation in ornamental fish is greatly influenced by the amount of carotenoids contained in the feed, which can aid the pigmentation synthesis process. In line with research (Junaidi and Setyono, 2020), the addition of banana peel powder to feed affects the brightness level of nemo fish. The highest color increase was achieved when adding 15% banana peel powder to the feed, resulting in a brightness value of 26.30.

The addition of banana peel extract to the feed had no significant effect on the growth performance of goldfish because the feed consisted of pellets mixed with banana peel extract, unlike feed mixed with banana peel flour. This is in line with research by Purba et al. (2021), which stated that koi carp fed pellets containing carotene had no effect on their growth performance. The addition of carotenoids to the feed did not affect the growth of ornamental fish, as ornamental fish fed carotene-based feed are thought to utilize the dye to enhance their body color (Barus et al., 2014).

Based on the research results, the addition of banana peel extract to the feed did not affect the feed conversion ratio (FCR) of goldfish fry (Table 2). The FCR value in this study was considered good because it was low, ranging from 1.34 to 1.48. A good FCR value indicates that the feed is utilized by the fish for growth. This aligns with the opinion of Marzuqi et al. (2012), which states that feed efficiency indicates the extent to which the fish can utilize the feed. A low feed efficiency value indicates that fish require more feed to gain weight because only a small portion of the feed's energy is used for growth. Furthermore, not all of the food consumed by fish is used for growth. Most of the energy from food is used for maintenance, with the remainder for activity, growth, and reproduction.

Table 3 aligns with the statement by Fitryaningsih et al. (2013) who stated that feed with a good shape and color can stimulate appetite in fish. Uly et al. (2017) stated that one factor that can influence fish survival is the condition of the fish itself. Effendie (2002) stated that fish survival is influenced by biotic and abiotic factors. Biotic factors include age, competitors, parasites, and the fish's ability to adapt, while abiotic factors include the physical and chemical properties of the water.

Water quality plays a crucial role in fish life because it serves as a living medium. Mustafa et al. (2016) stated that water quality is a determining factor in successful cultivation, because water is the living medium for fish. According to BSN (2018), suitable water quality for cultivating goldfish (Carassius auratus) is a temperature of 26-30 ºC, pH 6.0-7.8, and DO of more than 5 mg/l. The presence of dissolved oxygen in the medium needs to be maintained so that the fish's respiration process continues to run normally. Water quality management is carried out by providing aeration to the cultivation medium to increase the oxygen supply. This is in accordance with the opinion of Islami et al. (2017), who stated that maintaining water quality can be done by means of a water drainage system (siphon) and the use of aeration. These activities are useful for reducing ammonia levels caused by feces, urine, and accumulated food waste. Ammonia is toxic to fish, therefore the quality of the cultivation medium needs to be maintained for the survival of the fish.

CONCLUSION

The conclusion of this study is that the addition of banana peel extract to feed significantly affected the color changes in goldfish (Carrasius auratus) fry. However, the daily growth rate, absolute weight gain, absolute length growth, survival rate, and feed conversion ratio did not significantly affect the color changes. The best result, with a brightness level of 3.40%, was found with the use of banana peel extract at a dose of 20 ml/kg of feed (P3).

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