

## **THE EFFECT OF ADDING BEETROOT (*Beta vulgaris*) EXTRACT TO ARTIFICIAL FEEDING ON THE COLOR BRIGHTNESS OF GOLD FISH (*Carassius auratus*)**

Pengaruh Penambahan Ekstrak Umbi Bit (*Beta vulgaris*) Pada Pakan Terhadap Kecerahan Warna Ikan Komet (*Carassius auratus*)

**Pina Wulandari, Dewi Putri Lestari, Septiana Dwiyaniti\***

Aquaculture Study Program, Faculty of Agriculture, University of Mataram

*Pendidikan Street No. 37, Mataram, West Nusa Tenggara, Indonesia*

\*Corresponding author: [antiseptiana@unram.ac.id](mailto:antiseptiana@unram.ac.id)

(Received January 15<sup>th</sup> 2026; Accepted February 19<sup>th</sup> 2026)

### **ABSTRACT**

This study aims to analyze the effect of adding beet extract (*Beta vulgaris*) to feed on the brightness of the color of comet fish (*Carassius auratus*). This study was conducted in maintenance activities at the Production and Reproduction Laboratory, Faculty of Agriculture, University of Mataram and used an experimental method with a completely randomized design (CRD) which included 4 treatments and 3 replications. P1: Without adding beet extract (Control) (1000 grams of feed), P2: adding 50 ml of beet extract + 1000 grams of commercial feed, P3: adding 100 ml of beet extract + 1000 grams of commercial feed, and P4: adding 150 ml of beet extract + 1000 grams of commercial feed. The commercial feed used was pro vite feed containing 30% protein mixed with beet extract according to the treatment. The color brightness level of goldfish was measured at the beginning and end of the study for 2 fish per treatment using a colorimeter. A colorimeter is a tool used to measure the brightness level of goldfish in brightness values (L\*) in the form of white, reddish (a\*), yellowish (b\*), hue, and chroma. We found that the addition of red beet extract to goldfish feed significantly affected color brightness, absolute weight, absolute length, survival rate, and water quality. These results indicate that the best treatments were obtained in treatments P3 and P4. In treatment P3, the brightness values obtained were Brightness 69.14 and Hue 93.04, while in treatment P4, the brightness values obtained were Redness 10.42, Yellowness 38.59 and Chroma 45.62.

Keywords: Beetroot Extract, Comet Fish, Color Brightness, Carotenoids

### **ABSTRAK**

Penelitian ini bertujuan untuk menganalisis pengaruh penambahan ekstrak bit (*Beta vulgaris*) pada pakan terhadap kecerahan warna ikan komet (*Carassius auratus*). Penelitian ini dilakukan dalam kegiatan pemeliharaan di Laboratorium Produksi dan Reproduksi, Fakultas Pertanian, Universitas Mataram dan menggunakan metode eksperimen dengan rancangan acak lengkap (RAK) yang meliputi 4 perlakuan dan 3 ulangan. P1: Tanpa penambahan ekstrak bit (Kontrol) (1000 gram pakan), P2: penambahan 50 ml ekstrak bit + 1000 gram pakan komersial, P3: penambahan 100 ml ekstrak bit + 1000 gram pakan komersial, dan P4: penambahan 150 ml

ekstrak bit + 1000 gram pakan komersial. Pakan komersial yang digunakan adalah pakan pro vite yang mengandung 30% protein dicampur dengan ekstrak bit sesuai perlakuan. Tingkat kecerahan warna ikan komet diukur pada awal dan akhir penelitian untuk 2 ekor ikan per perlakuan menggunakan kolorimeter. Kolorimeter adalah alat yang digunakan untuk mengukur tingkat kecerahan ikan komet dalam nilai kecerahan ( $L^*$ ) dalam bentuk putih, kemerahan ( $a^*$ ), kekuningan ( $b^*$ ), hue, dan chroma. Kami menemukan bahwa penambahan ekstrak bit merah pada pakan ikan mas secara signifikan mempengaruhi kecerahan warna, berat absolut, panjang absolut, tingkat kelangsungan hidup, dan kualitas air. Hasil ini menunjukkan bahwa perlakuan terbaik diperoleh pada perlakuan P3 dan P4. Pada perlakuan P3, nilai kecerahan yang diperoleh adalah Kecerahan 69,14 dan Rona 93,04, sedangkan pada perlakuan P4, nilai kecerahan yang diperoleh adalah Kemerahan 10,42, Kekuningan 38,59 dan Kroma 45,62.

Kata Kunci: Ekstrak Bit, Ikan Komet, Kecerahan Warna, Karotenoid

## INTRODUCTION

Comet fish (*Carassius auratus*) is a freshwater ornamental fish commodity that has quite a high demand and relatively stable prices on the market. This is because comet fish have various color patterns such as white, yellow, red, a combination of these colors, besides that, their shape and movements are interesting, and they can be kept in ponds or aquariums (Umasugi *et al.*, 2023). According to statistics from the Ministry of Maritime Affairs and Fisheries (KKP), ornamental fish production increased by 12.6% in 2022. This indicates a high demand for ornamental fish in Indonesia.

Apart from that, the selling value of comet fish can be influenced by the brightness of its body color, the brighter the color, the higher the selling value of comet fish. The beautiful colors of comet fish can be caused by the presence of pigment cells (chromatophores) located in the epidermis layer. If the color of a goldfish fades, it can be due to a lack of pigment in its feed. Feed plays a significant role in color formation in goldfish, which is one of the causes of the decline in body color quality (Batubara *et al.*, 2023; Tania *et al.* 2018). So it is necessary to increase pigment, one of which is by adding feed ingredients containing pigments to increase the brightness of the color of comet fish.

Ornamental fish breeders utilize carotenoid compounds as pigments that can increase the brightness of ornamental fish colors. One of the natural pigments that can be used is beetroot, beetroot (*Beta vulgaris* L.) is a plant that has a root shape similar to tubers, including from the Amaranthaceae family. Beetroot is widely loved by the public because it has the potential to be beneficial as a natural dye. Beetroot is a plant that contains pigments in the form of carotenoids as much as 90.44 mg/kg (Dermawan *et al.*, 2023). The results of previous research conducted by (Isnaini *et al.*, 2022) showed that the addition of purple sweet potato extract can affect the increase in color brightness of koi fish with the highest value in treatment P4 (commercial feed 300 mg/gr) which can produce the best color brightness level of 12. This can be proven by the increase in color caused by the fish having absorption of the dye and the dose given.

## METHODS

### Time and Place

This research was conducted for 45 days from September 16 – October 30, 2024 which took place at the Fish Production and Reproduction Laboratory, Faculty of Agriculture, University of Mataram. Meanwhile, the preparation of extracts and analysis of carotenoid content were carried out in the Analytical Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, University of Mataram, and the checking of fish color quality was carried

out in the Bioprocess Laboratory, Faculty of Food Technology and Agroindustry, University of Mataram.

## Research Methods

This study used an experimental method with a completely randomized design (CRD), which included four treatments and three replications, resulting in a total of 12 experimental units. the treatment tested was the addition of beetroot (*Beta vulgaris*) extract to the feed, as follows:

1. P1: without adding beetroot extract (control) (1000 grams of feed)
2. P2: Adding 50 ml of beetroot extract + 1000 grams of commercial feed
3. P3: Adding 100 ml of beetroot extract + 1000 grams of commercial feed
4. P4: Adding 150 ml of beetroot extract + 1000 grams of commercial feed

## Research Procedures

### 1. Preparation of Beetroot (*Beta vulgaris*) Feed Raw Materials

#### a. Beetroot Flour Making Process (*Beta vulgaris*):

Beetroot flour is made by cleaning and peeling the beetroot, then splitting it and slicing it thinly. the beetroots are then dried in the sun for 3-4 days. afterward, the dried beetroots are ground using a blender and sieved through an 80mesh sieve (Nurali *et al.*, 2023).

#### b. Process of Making Beetroot Extract (*Beta vulgaris*):

The process of making beetroot extract is carried out by weighing 1000 grams of beetroot flour and putting it into a maceration bottle, then adding 6 liters of 70% ethanol and macerating for  $\pm$  24 hours. Then the results of soaking (maceration) the beetroot are filtered using filter paper and the filtering results are continued with a hot extraction process, namely filtrate. The filtrate is taken and then evaporated using a rotary evaporator at a temperature of 50°C until the solvent disappears or a thick extract is formed.

#### c. Feed Preparation:

The feed used in this study was pellet feed in the form of hi pro vite 781-2 pt which contains 30% protein. Before adding beetroot extract to the feed, the feed to be used is first weighed according to the treatment dosages, namely 50 ml, 100 ml, and 150 ml. then, the beetroot extract is mixed with the commercial feed until evenly distributed. Then the feed that has been mixed with beetroot extract is dried using an oven at a temperature of 60°C for 24 hours.

## 2. Implementation Stage

**a. Container Preparation:** The implementation of research activities began with the preparation of containers for efforts to prevent contaminating microorganisms in the maintenance container. The containers to be used were first cleaned using detergent and rinsed with water, then dried for 24 hours. The containers used in this study were 12 54x36x28 cm containers with a capacity of 45 liters, filled with water to a height of 20 cm and provided with strong aeration. The aeration equipment was connected to a blower to supply oxygen to the containers.

**b. Test Biota Selection:** The fish used in the research were comet carp fingerlings measuring 3-4 cm in length and weighing 0.4-1.7 grams. each treatment consisted of 15 comet carp fingerlings. Therefore, the total number of fingerlings required for all treatments was 180.

**c. Acclimatization:** Acclimatization is the process by which fish adapt to their new environment to prevent them from dying easily due to stress. Acclimatization lasts for 5 hours to adjust to the new environmental conditions or research environment. During the acclimatization process, the fish are fasted.

**d. Feeding Techniques:** Feeding was carried out three times daily during this research. during the study, the test fish were fed at a rate of 3% of their total weight. The frequency of feeding is 3 (three) times a day at 09.00, 13.00 and 17.00 WITA.

## Research Parameters

The parameters observed during the research activities are as follows:

### 1. Carotenoid Content Analysis

Carotenoid content was calculated using the formula according to Henry & Gime (1993):  
$$\text{Carotenoids } (\mu\text{mol/g}) = \frac{((A_{480} + 0.114 \times A_{663} - 0.638 \times A_{645}) \times V \times 103)}{(112.5 \times 0.1 \times 103)}$$

Where:

A<sub>480</sub> = absorbance at a wavelength of 480 nm

A<sub>663</sub> = absorbance at a wavelength of 663 nm

A<sub>645</sub> = absorbance at a wavelength of 645 nm

V = extract volume (ml)

### 2. Colorimeter

The color brightness test for comet fish was conducted at the beginning and end of the study. The initial test used two comet fish as the initial sample, while the final test used two comet fish from each treatment as the final sample. The color brightness test of comet fish can be carried out using a calibrated colorimeter test using a white color reference. A colorimeter equipped with a white base examines the subject under its sensor lens. The color system used is based on the Hunter Lab colorimetric system, which is used for a marking system characterized by three values, namely L\* (Lightness), a\* (redness), and b\* (yellowness), Hue and Chroma. These values, L, a, and b, have a scale that indicates the level of color being tested (Yanti *et al.*, 2023).

### 3. Comet Fish Growth

Absolute growth is the average growth rate of comet fish seeds during maintenance, which is calculated using the Effendie (1979) formula in, which is as follows:

#### a. Comet Fish Weight Growth

$$W = W_t - W_o$$

Where:

W = Absolute Growth

W<sub>t</sub> = Average fish weight at the end of cultivation (g)

W<sub>o</sub> = Average fish weight at the beginning of cultivation (g)

#### b. Comet Fish Length Growth

$$L = L_t - L_o$$

Where:

L = Absolute growth (cm)

L<sub>t</sub> = Average fish length at the end of cultivation (cm)

L<sub>o</sub> = Average fish length at the beginning of cultivation (cm)

### 4. Survival Rate

The formula used to determine the survival percentage of test fish according to Effendi (1997) in Takril,

$$SR = \frac{N_t}{N_o} \times 100\%$$

Where:

SR : Survival Rate (%)

N<sub>t</sub> : Number of fish at the end of the cultivation period

N<sub>o</sub> : Number of fish at the beginning of the cultivation period

### 5. Water Quality

The water quality measured in this study was temperature, dissolved oxygen, and pH, measured every 9 days for 45 days.

## 6. Data Analysis

The data obtained from the results of this study include colorimeter weight growth, length growth and survival rate. After that, all data will be analyzed statistically using Analysis of Variance (ANOVA) at a significance level of 5%. If the results obtained are significantly different, further analysis is carried out using the Duncan test at a significance level of 5%. For the analysis parameters of carotenoid pigments and water quality, descriptive tests were used. The data were analyzed statistically using analysis of variance (ANOVA) at a significance level of 5%. If the results obtained are significantly different, further analysis is carried out using the Duncan test at a significance level of 5%. The results show that beetroot extract can increase the brightness of the color of goldfish.

## RESULTS

### 1. Results of Carotenoid Content Tests in Feed Mixed with Beetroot Extract and Antioxidant Content in Feed

The results of the carotenoid test on feed containing beetroot extract used in this study are presented in Table 1.

Table 1. Carotenoid Test Results

No	Sample Test Code	Carotenoid Levels ( $\mu\text{mol/l}$ )
1	P1	17.18
2	P2	18.79
3	P3	22.71
4	P4	30.83

Description: Results of Food Chemistry and Biochemistry Laboratory Tests

### 2. Color Brightness Level

The results of the test on the brightness level of the color of comet fish before and after being given the treatment of adding beetroot extract. On day 0 before being given the treatment feed showed lower results compared to after being given the treatment feed after 45 days of maintenance using a colorimeter shown based on the lightness value ( $L^*$ ) which is white, redness ( $a^*$ ) red, yellowness ( $b^*$ ) yellow, hue and chroma.

- a. **Lightness ( $L^*$ ):** The results of the ANOVA test showed that the effect of adding beetroot extract to the feed had a significant effect ( $P < 0.05$ ) on the Lightness ( $L^*$ ) value of comet fish. The results of the Duncan test showed that the Lightness ( $L^*$ ) value of comet fish in treatment P4 (150 ml) was significantly different from P1 (commercial feed), but not significantly different from P2 (50 ml) and P3 (100 ml). So the addition of beetroot extract at a dose of 100 ml showed better lightness results than the control feed.
- b. **Redness ( $a^*$ ):** The results of the ANOVA test showed that the effect of adding beetroot extract to the feed had a significant effect ( $P < 0.05$ ) on the redness value ( $a^*$ ) of comet fish. The results of the Duncan test showed that the redness value ( $a^*$ ) of comet fish in the treatment with the addition of beet extract was significantly different from the P1 treatment (commercial feed). So the addition of beetroot extract at a dose of 150 (ml) showed better redness results than the use of control feed. There was an increase in redness ( $a^*$ ) along with the increase in the dose of beetroot extract.
- c. **Yellowness ( $b^*$ ):** The results of the ANOVA test showed that the effect of adding beet root extract to the feed had a significant effect ( $P < 0.05$ ) on the yellowness value ( $b^*$ ) of comet fish. The results of the Duncan test showed that the yellowness value ( $b^*$ ) in the treatment of adding beetroot extract was significantly different from the P1 treatment (commercial

feed). So the addition of beetroot extract at a dose of 150 (ml) showed better yellowness results than the use of control feed. There was an increase in yellowness along with increasing doses of beetroot extract.

- d. Hue:** The results of the ANOVA test showed that the effect of adding beetroot extract to the feed had a significant effect ( $P < 0.05$ ) on the hue value of comet fish. Based on the results of the Duncan test, the hue value of comet fish in treatment P4 (150 ml) was significantly different from treatments P1 (commercial feed) and P2 (50 ml), but not significantly different from treatment P3 (100 ml). So, adding a dose of beetroot extract with 100 ml of tuber extract showed better chroma results than using control feed.
- e. Chroma:** The results of the ANOVA test showed that the effect of adding beetroot extract to the feed had a significant effect ( $P < 0.05$ ) on the chroma value of comet fish. The results of the Duncan test showed that the chroma value of comet fish in treatment P4 (150 ml) showed significantly different results from treatments P1 (commercial feed), P2 (50 ml) and P3 (100 ml). So the addition of beetroot extract at a dose of 150 (ml) showed better chroma results than using control feed. There was an increase in chroma along with the increase in the dose of beetroot extract.

**a. Absolute Weight**  
The ANOVA results showed that feeding with the addition of different beetroot extracts had a significant effect ( $P < 0.05$ ) on the absolute weight of comet fish. The results of the Duncan test showed that the absolute weight of comet fish in treatment P4 (150 ml) was significantly different from treatments P1 (commercial feed) and P2 (50 ml), but was not significantly different from treatment P3 (100 ml). So, giving beetroot extract can increase the absolute weight of comet fish where the results are higher than the results given control feed.

### **3. Absolute Length**

The ANOVA results showed that feeding with the addition of different beetroot extracts had a significant effect ( $P < 0.05$ ) on the absolute length of comet fish. The results of the Duncan test showed that the absolute length of comet fish in treatment P4 (150 ml) was significantly different from P1 (commercial feed) and P2 (50 ml), but was not significantly different from treatment P3 (100 ml). The addition of beetroot extract at a dose of 100 ml showed better absolute length results than the use of control feed.

### **4. Survival Rate**

The ANOVA results showed that feeding with the addition of different beetroot extracts had a significant effect ( $P < 0.05$ ) on the survival rate of comet fish. The results of the Duncan test showed that the survival rate of comet fish in the P4 (150 ml) treatment was significantly different from the P1 (commercial feed) treatment, but was not significantly different from the P2 (50 ml) and P3 (100 ml) treatments. So the use of beetroot extract resulted in higher survival than when given control feed.

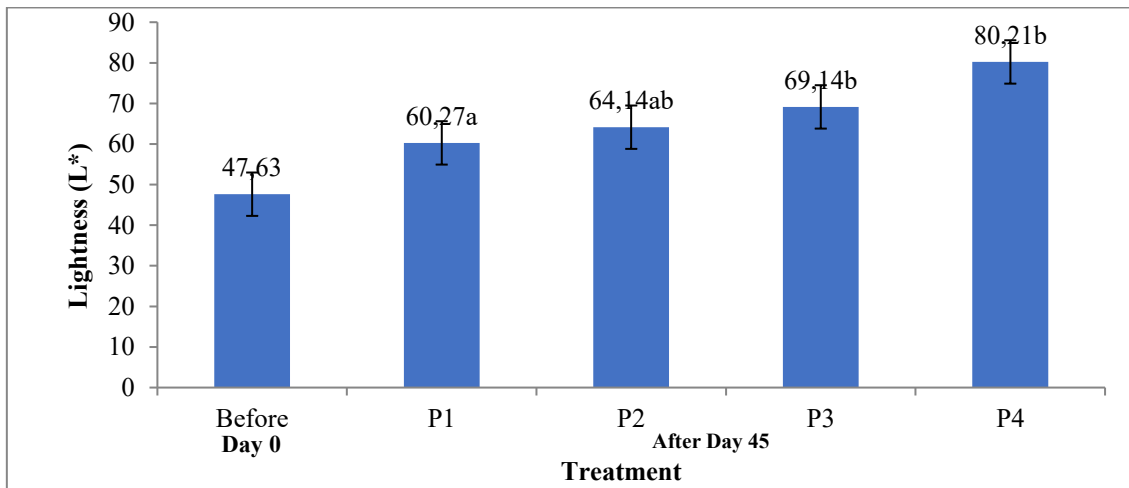


Figure 1. Lightness Value (L\*) of Comet Fish (*Carassius auratus*)

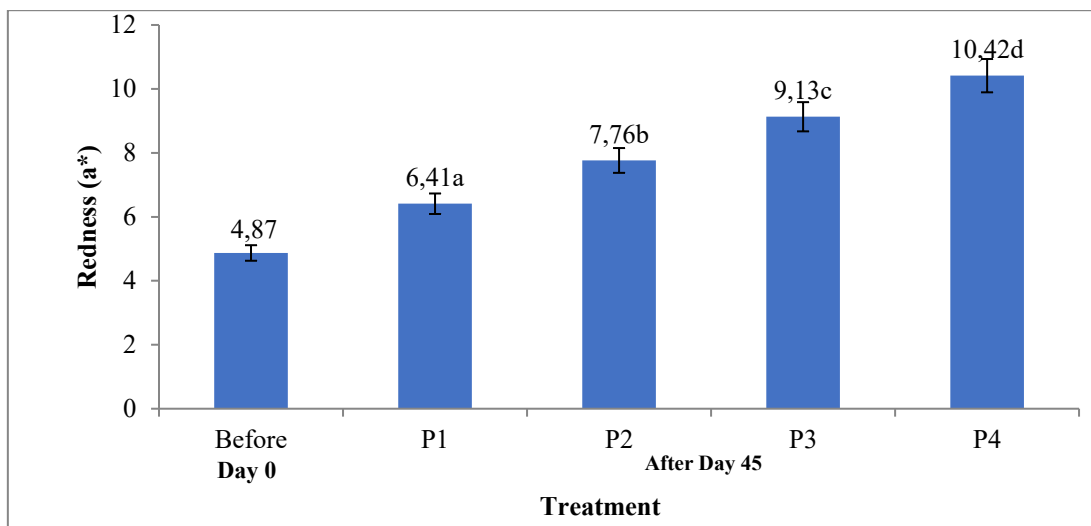


Figure 2. Redness Value (a\*) of Comet Fish (*Carassius auratus*)

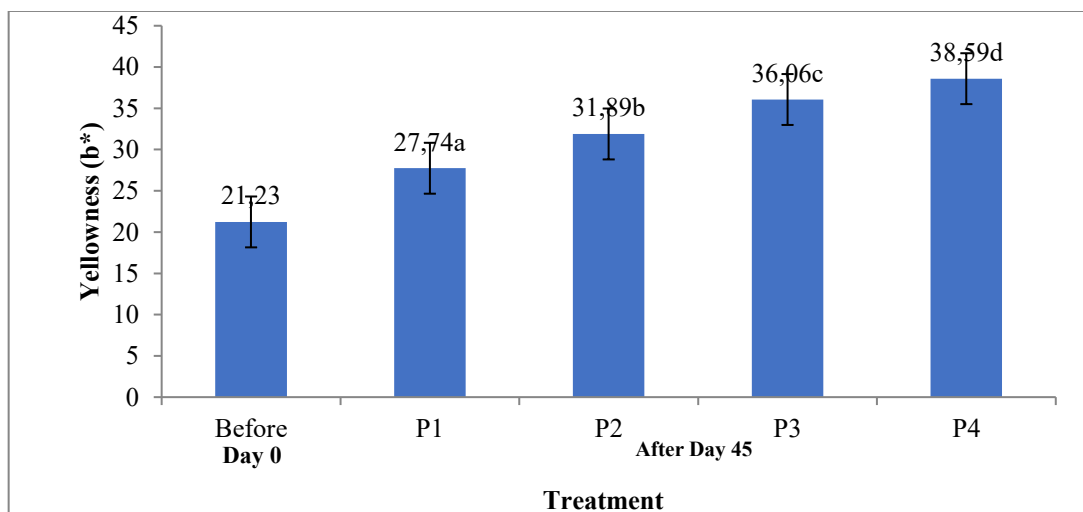


Figure 3. Yellowness Value (b\*) of Comet Fish (*Carassius auratus*)

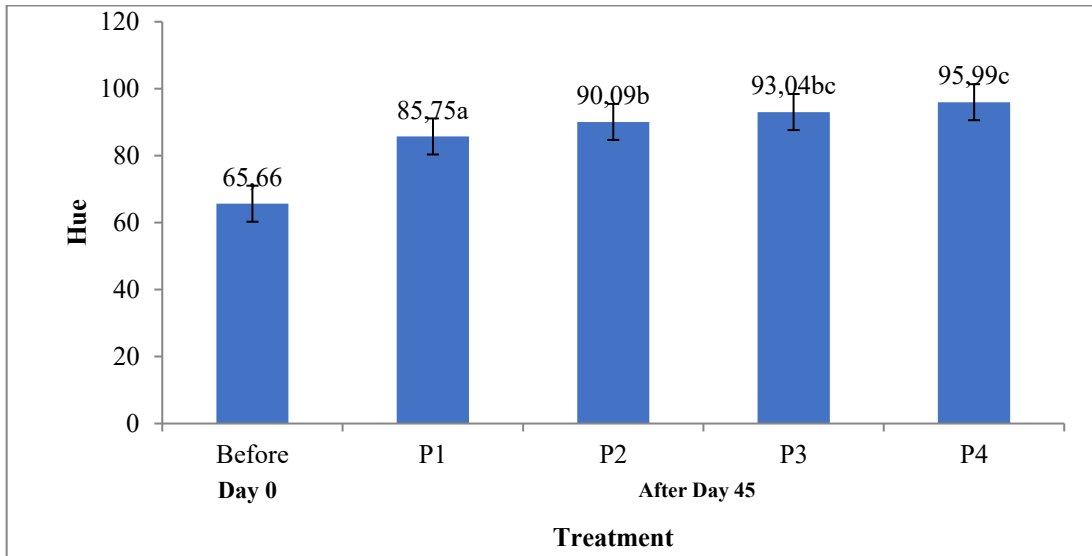


Figure 4. Hue Value of Goldfish (*Carassius auratus*)

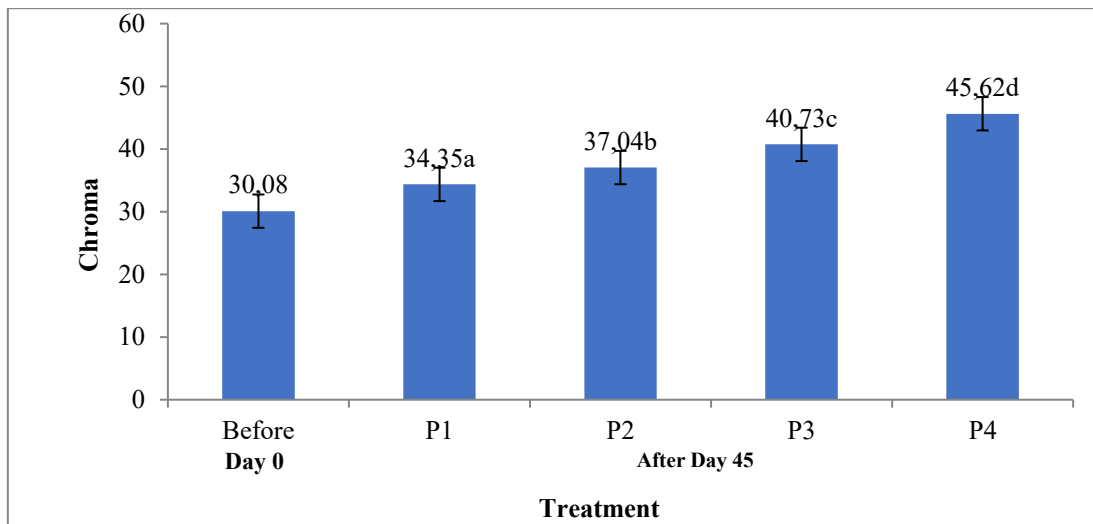


Figure 5. Chroma Value of the Goldfish (*Carassius auratus*)

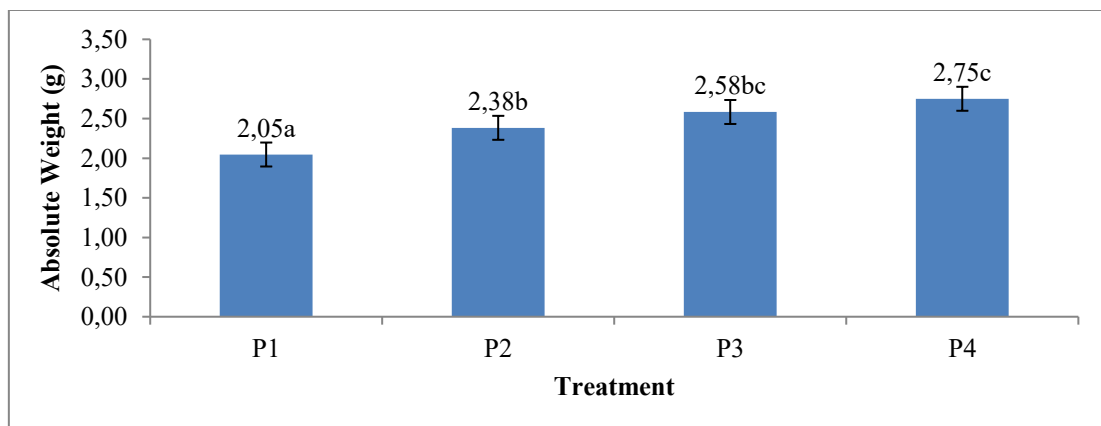


Figure 6. Absolute Weight Value of Comet Fish (*Carassius auratus*)

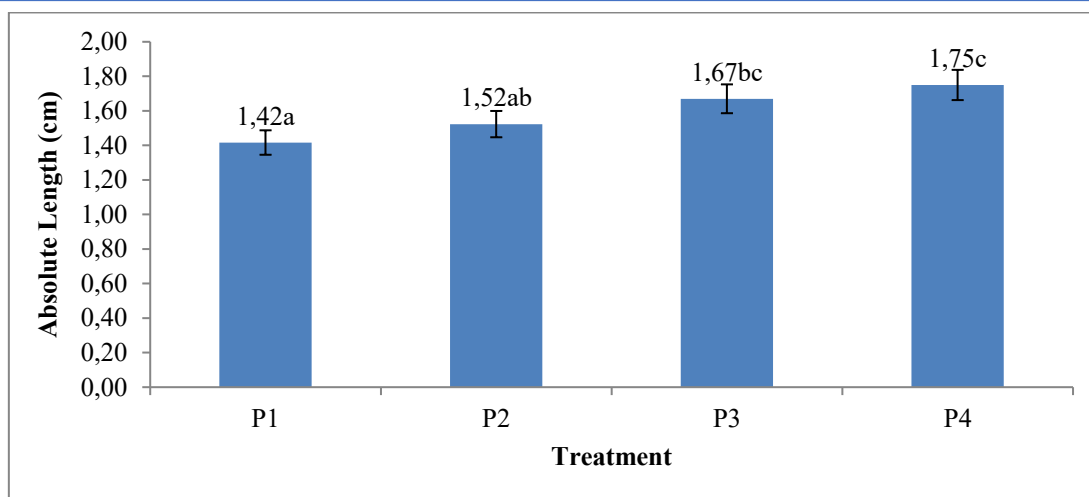


Figure 7. Absolute Length Value of Comet Fish (*Carassius auratus*)

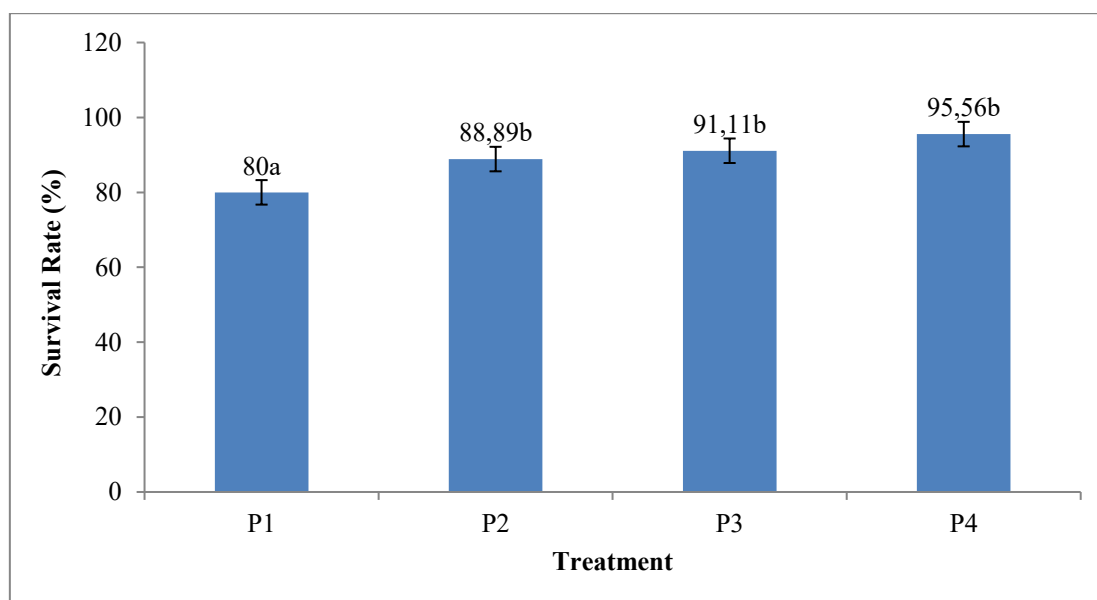


Figure 8. Survival Rate Value of Comet Fish (*Carassius auratus*)

Table 2. Water Quality Parameters

Treatment	Temperature (°C)	DO (mg/L)	pH
P1	29.4 – 31.6	6.5-7.5	7.2-7.9
P2	29.8 – 31.5	6.6-7.5	7.2-7.8
P3	29.7 – 31.6	6.4-7.5	7.3-7.9
P4	29.7 – 31.3	6.6-7.6	7.1-7.9
Reference	18-31°C (Mu'minin, 2019)	>5 mg/L	6.5-8.0 (Amalia <i>et al.</i> , 2023)

## DISCUSSION

The lowest carotenoid test results occurred in p1 (control) at 17.18  $\mu\text{mol/l}$  and the highest carotenoid value was found in P4 (150 ml) at 30.83  $\mu\text{mol/l}$  after adding beetroot extract. This shows that the higher the dose of beetroot extract added to the feed, the higher the total carotenoids. this is in accordance with the statement by Maolana *et al.* (2017) who stated that the higher the percentage of carrot juice given to the treatment feed, the higher the increase in carotenoid value in the feed. According to Sari *et al.* (2022), the higher the carotenoid or pigment content in the fish's body, the brighter the color of the fish. According to Andriani *et*

*al.* (2018), carotenoids are also natural components that form color pigments and can have a fairly good effect on ornamental fish.

The lightness value ( $L^*$ ) is the brightness level of a product which is measured on a scale of 0-100, indicating from dark to light colors. So the higher the lightness value ( $L^*$ ) of a product being tested, the more it shows a tendency for brighter colors. According to Ayuningsih *et al.* (2024), the lightness value ( $L^*$ ) represents brightness with a value range of 0 for dark and 100 for bright, according to the recommendations of the International Commission on Illumination. The lightness ( $L^*$ ) value of comet fish in this study increased with the addition of beetroot extract. This indicates that adding 100 ml of beetroot extract (P3) to the feed is the optimal dose for increasing the color brightness of comet fish, thereby meeting their carotenoid needs. This is in line with the statement Lumbessy *et al.* (2024) which states that the best color brightness in ornamental fish can be obtained by providing the right dose of color pigment, neither too little nor too much.

The Redness ( $a^*$ ) value indicates the color level from green to red with a value range of -80 to +100. Negative values indicate that the sample will tend to show a green color and conversely, positive values indicate that the sample will show a red color (Amalia *et al.*, 2023). Based on the research results, the redness value ( $a^*$ ) before treatment was 4.87, but there was an increase after adding beetroot extract with a range of 6.41-10.42. The value obtained shows that the body of the comet fish has a positive value, which means the color is red. The addition of beetroot extract at a dose of 150 ml is the best dose that can influence the color changes that occur in the body of comet fish during the maintenance period. This is in line with the statement of Malini *et al.* (2018) who stated that adding pigmentation materials to feed can increase the color pigment compounds in the fish's body, and can strengthen the coloring substances in its body.

The Yellowness value ( $b^*$ ) with a value range of -70 to +70 indicates a blue to yellow color. If the sample shows a negative value, the sample will be blue, and vice versa, if the sample tends to show a positive value, the sample tends to be yellow. The results of this study show that the Yellowness ( $b^*$ ) value in all treatments gave positive results ranging from 21.23-38.59, which indicates that the color of the comet fish's body tends to be orange-yellow. The Yellowness value ( $b^*$ ) before treatment was 21.23, this proves that the basic color of the comet fish is yellow. The best yellowness value was found in P4, showing an increase of 38.59, due to the addition of 150 ml of beetroot extract to the feed given containing carotenoids so that the comet fish could increase the color of its body. This is in line with Indarti *et al.* (2012), who stated that carotenoid content can increase the number of chromatophore cells in fish. Chromatophore cells are pigment cells that are round and spread throughout the epidermal cell layers of fish skin. The dermal granules that are spread in the cells can cause the cells to absorb perfectly so that there is an increase in the color of the scales which causes the color of the scales on the fish to become clearer and brighter.

The hue value is a value that indicates the more dominant wavelength of a product. The higher the hue value produced, the more the product obtained will show color changes, namely from red, red-yellow to blue-green (Permatasari, 2021). Based on the research results, the hue value ( $L^*$ ) of comet fish at the beginning of the research before being given treatment was 65.66, the comet fish showed a yellow color. According to, who stated that the Hue value ranges from 0-90, this proves that there is a color change from red to orange to yellow. The best hue value after being given beetroot extract at a dose of 100 ml ranged from 93.04, which indicated that the comet fish were yellow to orange. This is in line with the statement according to Tasuib *et al.* (2022) which states that the lower the Hue value, the yellow the fish color will be, conversely, the higher the Hue value, the yellow-orange the fish color will be. According to Sasmitaloka *et al.* (2019) the hue degree value is in the range of  $0^\circ$  (red-purple),  $90^\circ$  (yellow),  $180^\circ$  (bluish-green) and  $270^\circ$  (blue).

Chroma value is a color level based on sharpness which functions to define the color of a product that is shiny or dull to show color intensity. The chromatic value shows a percentage ranging from 0% to 100% as the sharpest or shiny to opaque color. Based on the research results, the chroma value of comet fish before maintenance was 30.38. However, after 45 days of maintenance, there was an increase in the chroma value of comet fish in all treatments with the addition of beet extract ranging from 34.35-45.62%. This shows that the best chroma value was found in treatment P4 (150 ml) at 45.62%, presumably because the fish showed a dense color. This is in accordance with the statement by Loelianda *et al.* (2017) which states that the higher the value of the object, the more intense the color (chroma), the more concentrated the color. Chroma value indicates the presence of carotenoid accumulation in pigment cells (Chromatophores). Chroma value indicates the presence of carotenoid accumulation in pigment cells (Chromatophores). According to Sukarman *et al.* (2017), the chroma value indicates the color density so that the higher the Hue value or type of color produced, the more intense the color produced by the fish's body.

Based on the research results, it shows that the lowest absolute weight is P1 at 2.05 g, while P4 at 2.75 g produces the highest absolute weight. The high absolute weight of comet fish is due to the beet extract given which has nutritional content. This is in accordance with the statement of which states that the nutritional content in feed can be utilized well by fish, so that it can increase the absolute weight of the fish. Beetroot contains protein, carbohydrates and fat which are useful for growth. Other minerals are also contained in beetroot such as calcium, iron and phosphorus. According to, growth rate depends on the amount of feed consumed, as well as the ability of the fish to utilize the feed.

The results of the study showed that the addition of beetroot extract to comet fish feed provided the highest absolute length growth in P4 of 1.75 cm and the lowest value in P1 of 1.42 cm. The absolute length of the comet fish is in accordance with the additional dose of beet extract given. This is in line with the statement of which states that the increase in length and weight of fish during the study was directly proportional, meaning that the longer the body, the more the body weight of the fish increased. This is in line with the statement of Prayoga *et al.* (2012) which states that changes in the growth of both length and weight parameters are directly proportional, the longer the body, the greater the weight of the fish's body.

Providing beetroot extract in comet fish feed can affect the survival rate of comet fish with a survival rate ranging from 80-95.5%. The survival rate of this comet fish is considered good. A brief acknowledgement section may be given after the conclusion section just before the references. The acknowledgments of people who provided assistance in manuscript preparation, funding for research, etc. should be listed in this section. All sources of funding should be declared as an acknowledgement. Authors should declare the role of funding agency, if any, in the study design, collection, analysis and interpretation of data; in the writing of the manuscript. If the study sponsors had no such involvement, the authors should so state. In this study, there were different changes in the level of color brightness in each treatment. The best yellowness value was found in P4, showing an increase of 38.59, due to the addition of 150 ml of beetroot extract to the feed given containing carotenoids so that the comet fish could increase the color of its body. This is in line with Indarti *et al.* (2012), who stated that carotenoid content can increase the number of chromatophore cells in fish. Chromatophore cells are pigment cells that are round and spread throughout the epidermal cell layers of fish skin. The dermal granules that are spread in the cells can cause the cells to absorb perfectly so that there is an increase in the color of the scales which causes the color of the scales on the fish to become clearer and brighter.

Temperature is one of the factors that influences appetite, feed effects, metabolism, and growth. Based on the results of temperature observations obtained during 45 days of raising comet fish, it ranged between 29.4-31.6°C. The temperature range obtained is included in the

optimal temperature for the growth and survival of comet fish. This is supported by the statement by Hafiz *et al.* (2020) who stated that this temperature value is within the tolerance limits of comet fish. The optimal temperature for keeping fish so that the energy used is still working is between 18-31°C so that temperature has an important role in increasing the growth and survival of comet fish.

Dissolved Oxygen (DO) is an important variable in determining water quality which is needed by fish for metabolic processes. The DO value during 45 days of maintenance ranged between 6.5-7.5 mg/L, which is still within the optimal range for the life of comet fish. According to Solihah *et al.* (2015), a value of >3 mg/L is a good value and is useful for the growth and survival of fish.

The degree of acidity (pH) is a chemical parameter that helps maintain water stability. The acidity level (pH) value during 45 days of maintenance ranged from 7.2-7.9. The acidity level (pH) value is still in the normal range, namely 6.5-8.0 (SNI, 2017). The pH value of water can affect the growth of biota in it and can even cause death. According to Nirmala *et al.* (2013), the pH that is lethal for fish is less than 4 and more than 11, while a pH of less than 6.5 and more than 9.5 can affect fish growth within a few hours.

The addition of beetroot extract to comet fish feed has a significant effect on the level of color brightness (lightness, redness, yellowness, hue, and chroma), absolute weight, absolute length, and survival rate of comet fish. The best treatment was obtained in P3 with an extract value (100 ml beetroot extract + commercial feed) and treatment P4 with an extract value (150 ml beetroot extract + commercial feed). In treatment P3, the brightness value obtained was Lightness 69.14 and Hue 93.04, while in treatment P4, the brightness value obtained was Redness 10.42, yellowness 38.59 and chroma 45.62.

## CONCLUSION

The conclusion of this study is that the addition of beetroot extract to comet fish feed has a significant effect on the level of color brightness (lightness, redness, yellowness, hue, and chroma), absolute weight, absolute length, and survival rate of comet fish. And the best performance was obtained in P3 with an extract value (100 ml beetroot extract + commercial feed) and P4 treatment with an extract value (150 ml beetroot extract + commercial feed). In the P3 treatment, the Lightness brightness value was 69.14 and Hue 93.04, while in the P4 treatment, the Redness brightness value was 10.42, yellowness 38.59 and chrome 45.62.

## ACKNOWLEDGEMENT

The author would like to express deepest gratitude to Ms. Dewi Putri Lestari, S.Pi., M.P. and Septiana Dwiyanti, S.Pi., M.Si. as supervisors for their advice, guidance, suggestions, support, and motivation provided during the research. He would also like to thank parents for their support and prayers. Finally, the author would like to thank friends who have helped and accompanied during the research.

## REFERENCES

- Amalia, B. R., Lumbessy, S. Y., & Dewi, R. S. (2023). Brightness of koi fish (*Cyprinus carpio* L.) color when given a combination of red dragon fruit peel flour (*Hylocereus polyrhizus*) and mangosteen (*Gracinia mangostana* L.). *Teuku Umar University Aquaculture Journal*, 7(2), 48-55. <https://eprints.unram.ac.id/43155/2/BAIQ%20RIZKI%20AMALIA%20ARTIKEL.pdf>
- Andriani, Y., Maesaroh, T. R. S., Yustiati, A., Iskandar, I., & Zidni, I. (2018). Color quality of oranda goldfish (*Carassius Auratus*) seeds at various levels of spirulina platensis flour supplementation. *Chimica Et Natura Acta*, 6(2), 49-55. <https://doi.org/10.24198/cna.v6.n2.16341>

- Ayuningsih, D. O., Hakim, L., Suryantoro, A., Mafruhah, I., Hassan, S., Gravitiani, E., ... & Hakim, A. I. (2024). Impacts of environmental quality and employment resilience during the coronavirus disease 2019 recession and recovery. *Global Journal of Environmental Science & Management (GJESM)*, 10.
- Batubara, J. P., Sinaga, M. A., Laila, K., & Panjaitan, P. (2023). Effectiveness of adding purple sweet potato flour (*Ipomoea Batatas* L) to artificial feed to increase the color brightness of goldfish (*Carasius auratus*). *Fisheries Journal*, 13(1), 254–265. <https://jperairan.unram.ac.id/index.php/JP/article/view/473>
- Dermawan, I. G. N. P., Dewi, I. K., & Tedjamartono, F. G. D. (2023). Effectiveness of red bites fruit (*Beta vulgaris*) as a mouthwash to reduce halitosis. *Interdental Jurnal Kedokteran Gigi*, 19(1), 49–54. <https://doi.org/10.46862/interdental.v19i1.6094>
- Hafiz, M., Mutiara, D., Kusuma Haris, R. B., Pramesthy, T. D., Mulyani, R., & Arumwati, A. (2020). photoperiod analysis on color brightness, growth, and survival of comet fish (*Carassius auratus*). *Journal of Fisheries Sciences and Aquaculture*, 15(1), 1–9. <https://doi.org/10.31851/Jipbp.V15i1.4287>
- Indarti, S., Muhaemin, M., & Hudaidah, S. (2012). Modified toca color finder (M-TCF) and chromatophore as color brightness estimators of comet fish (*Carasius auratus*) fed with different proportions of shrimp head flour (TKU). *E-Journal of Aquaculture Engineering and Technology*, 1(1), 9–16. <https://jurnal.fp.unila.ac.id/index.php/bdpi/article/view/99>
- Isnaini, N., Istyadji, M., & Yulinda, R. (2022). The effect of adding natural pigments from purple sweet potato extract (*Ipomoea batatas* L) to Feed in Color Brightness and Growth of Koi Fish Fry (*Cyprinus Carpio*). *Juster: Journal of Science and Applied Sciences*, 1(3), 57–68. <https://doi.org/10.57218/juster.v1i3.358>
- Loelianda, Nafi, A., & Wiwik, S. W. (2017). Substitution of Yellow Pumpkin (*Cucurbita moschata* durch) and Karo Pedang (*Cacavalia ensiormis* L.) Flour for Wheat Flour in Cake Making. *Jurnal Agroteknolog*, 11(1), 1–10.
- Lumbessy, S. Y., Ayuningsih, E., & Lestari, D. P. (2024). The Effect of Dried Bloodworms (*Chironomus* Sp.) On the Color Brightness of Guppy Fish (*Peocilia reticulata*). *Journal Of Fisheries Science and Technology*, 4(1), 39–61. <https://doi.org/10.55678/Jikan.V4i1.1301>
- Malini, D. M., Dewi, T., & Agustin, R. (2018). The effect of adding Spirulina fusiformis flour to feed on the color brightness level of Desak Koi Fish (*Cyprinus carpio* L.). *Pro-Life Journal*, 5(2), 579–588. <https://ejournal.uki.ac.id/index.php/prolife/article/view/712>
- Maolana, V., Madyowati, S. O., & Hayati, N. (2017). The effect of adding carrot juice (*Daucus carota* L.) in feed on color improvement in koi fish (*Cyprinus carpio*) breeding in gandusari village, gandusari district. *Techno-Fish Journal*, 1(2), 78–85. <https://doi.org/10.25139/tf.v1i2.1046>
- Mu'minin, K. H. O. E. R. U. L. (2019). *Pengaruh Jarak dan Waktu terhadap Hasil Pengujian Suara Klakson* (Doctoral dissertation, Politeknik Keselamatan Transportasi Jalan).
- Nirmala, K., Hastuti, Y. P., & Yuniar, V. (2013). Toxicity of mercury (Hg) on survival and growth rate, hemato- and histopathological parameters of oreochromis niloticus. *Jurnal Akuakultur Indonesia*, 11(1), 38–48. <https://doi.org/10.19027/jai.11.38-48>
- Noblet, J., & Henry, Y. (1993). Energy evaluation systems for pig diets: A review. *Livestock Production Science*, 36(2), 121–141.
- Nurali, E. J. N., Ruindungan, E. T. P., Taroreh, M. I. R., Rawung, D., & Ossoe, J. J. E. (2023). Development snack bar composite flour of goroho banana (*Musa acuminata*), purple yams (*Ipomoea batatas* L.) and green bean (*Vigna radiata*). *Jurnal Agroekoteknologi Terapan (Applied Agroecotechnology Journal)*, 4(1), 54–66. <https://doi.org/10.35791/jat.v4i1.46478>

- Permatasari, N., Ashari, F. R., & Ismail, N. (2021). Contribution of perceived social support (peer, family, and teacher) to academic resilience during COVID-19. *Golden Ratio of Social Science and Education*, 1(1), 01-12.
- Prayoga, H. H., Rostika, R., & Nurruhwati, I. (2012). enrichment of maggot-containing feed with shrimp head flour as a source of carotenoids on the color appearance and growth of rainbow kurumoi (*Melanotaenia parva*) Seeds. *Jurnal Perikanan dan Kelautan*, 3(3), 201–205. <https://www.neliti.com/publications/10700/pengkayaan-pakan-yang-mengandung-maggot-dengan-tepung-kepala-udang-sebagai-sumbe>
- Sari, M. P., Khotimah, K., & Ramonda, L. (2022). Growth response and color brightening enhancement of cupang fish (*Betta* sp.) fed yellow pumpkin extract (*Cucurbita moscheta* durch). *Journal of Global Sustainable Agriculture*, 3(1), 46–50. <https://ojs.um-palembang.ac.id/index.php/JGSA/article/view/3999>
- Sasmitaloka, K. S., Banurea, I. R., & Widowati, S. W. (2019). Study of instant yellow rice and characteristics. *Jurnal Agroindustri Halal*, 5(2), 188–195. <https://doi.org/10.30997/jah.v5i2.1936>
- Solihah, R., Buwono, I. D., & Herawati, T. (2015). The Effect of Adding Pumpkin Flour and Shrimp Head Flour on Improving the Color Quality of Goldfish (*Carassius auratus*). *Jurnal Perikanan Kelautan*, 6(2), 107–115. <https://jurnal.unpad.ac.id/jpk/article/view/10000/4590>
- Sukarman, S., Astuti, D. A., & Utomo, N. B. P. (2017). Color quality evaluation of wild and cultured clownfish (*Amphiprion Percula* Lacepède 1802). *Journal of Aquaculture Research*, 12(3), 231–239. <https://doi.org/10.15578/jra.12.3.2017.231-239>
- Takril, & Ramli, S. (2019). Survival and growth of tilapia (*Oreochromis niloticus*) against lighting levels. *Siganus: Journal of Fisheries and Marine Science*, 1(1), 16–20.
- Tania, N., Permana, A., & Supiyani, A. (2018). Total carotenoids of albino sumatran fish (*Puntius tetrazona*) fed with additional shrimp head flour. *Bioma*, 14(1), 1–9. [https://doi.org/10.21009/Bioma14\(1\).1](https://doi.org/10.21009/Bioma14(1).1)
- Tasuib, A. R., Jasmanindar, Y., & Pasaribu, W. (2022). Effect of giving a mixture of carrot flour (*Daucus carota*) and marigold flour (*Tagetes erecta*) on the color of clownfish (*Amphiprion ocellaris*). *Journal of Fisheries Sciences and Aquaculture*, 17(2), 12–19. <https://doi.org/10.31851/Jipbp.V17i2.7965>
- Umasugi, S., Umagapi, B., & Galela, N. (2023). Business prospects of comet fish (*Carassius Auratus*) cultivation in buru district. *Uniqbu Journal of Exact Sciences*, 3(3). <http://www.ejournal-uniqbu.ac.id/index.php/ujes/article/view/260>
- Yanti, F. D., Abidin, Z., & Lestari, D. P. (2023). (*Amphiprion oscelaris*) on different commercial pellets color brightness, growth rate, and survival of clownfish (*Amphiprion oscelaris*) Fed With Different Commercial Pellets 1–14. [https://eprints.unram.ac.id/43183/2/FERONICA%20DAMMA%20YANTI\\_C1K01807\\_3\\_intek%20akuakultur.pdf](https://eprints.unram.ac.id/43183/2/FERONICA%20DAMMA%20YANTI_C1K01807_3_intek%20akuakultur.pdf)