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EFFECTIVENESS OF PAPAYA JUICE ADDITION *(Carica papaya L.)* WITH DIFFERENT DOSES ON COLOR BRIGHTNESS LEVELS AND LIFE VERSITY OF KOI FISH *(Cyprinus rubrofuscus)*

Efektivitas Penambahan Sari Buah Pepaya *(Carica papaya L.)* dengan Dosis Berbeda Terhadap Tingkat Kecerahan Warna dan Kelangsungan Hidup Ikan Koi *(Cyprinus Rubrofuscus)*

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ABSTRACT

Koi fish (*Cyprinus rubrofuscus*) is one type of freshwater ornamental fish that is very popular and favored by the public, this fish is known for its varied color beauty, such as red, white, yellow and black. The beauty of color is one of the main factors that determine the selling price of ornamental fish in the market. Ornamental fish farmers often experience color problems in ornamental fish that are less attractive. The addition of carotenoid sources in feed can affect the formation of color brightness in ornamental fish. The purpose of the study was to determine the effect and the right dose of the addition of papaya juice (*Carica papaya* L.) in feed by giving different doses to the level of color brightness and survival of koi fish (*Cyprinus rubrofuscus*). this research is in the form of experimental research with experiments using RAL consisting of 5 treatments and repeated 3 times. Treatment A (control), treatment B (10 ml/kg feed), treatment C (20 ml/kg feed), treatment D (30 ml/kg feed) and treatment E (40 ml/kg feed). The test animals used during the study were koi fish fry 4-5 cm in size as many as 150 fish, with a stocking density of 1 fish / 2 liters of water. Maintenance was carried out for 30 days with a frequency of feeding 3 times a day at 5% of the body weight of the fish. Papaya juice is given by spraying on the feed according to the dose of each treatment. The results showed that the addition of papaya juice with different doses did not affect the color and survival of koi fish (*Cyprinus rubrofuscus*). The highest brightness value was obtained in treatment E with the addition of papaya juice as much as 40 ml/kg feed.

Keywords: *Cyprinus rubrofuscus*, Papaya, *Brightness*, *Survival rate*, *Color*

ABSTRAK

Ikan koi (*Cyprinus rubrofuscus*) merupakan salah satu jenis ikan hias air tawar yang sangat populer dan digemari oleh masyarakat, ikan ini dikenal karena keindahan warnanya yang

bervariasi, seperti merah, putih, kuning dan hitam. Keindahan warna menjadi salah satu faktor utama yang menentukan harga jual ikan hias di pasaran. Para pembudidaya ikan hias sering mengalami permasalahan warna pada ikan hias yang kurang menarik. Penambahan sumber karotenoid dalam pakan mampu mempengaruhi terbentuknya kecerahan warna pada ikan hias. Tujuan dari penelitian yakni untuk mengetahui pengaruh dan dosis yang tepat dari penambahan sari buah papaya *(Carica papaya L.)* pada pakan dengan pemberian dosis yang berbeda terhadap tingkat kecerahan warna dan kelangsungan hidup ikan koi (*Cyprinus rubrofuscus*). penelitian ini berbentuk penelitian eksperimental dengan percobaan menggunakan RAL yang terdiri dari 5 perlakuan serta diulang sebanyak 3 kali. Perlakuan A (kontrol), perlakuan B (10 ml/kg pakan), perlakuan C (20 ml/kg pakan), perlakuan D (30 ml/kg pakan) dan perlakuan E (40 ml/kg pakan). Hewan uji yang dipakai saat penelitian yaitu benih ikan koi ukuran 4-5 cm sebanyak 150 ekor, dengan padat tebar 1 ekor/ 2 liter air. Pemeliharaan dilaksanakan selama 30 hari dengan frekuensi pemberian pakan 3 kali sehari sebesar 5% dari berat tubuh ikan. Sari buah pepaya diberikan dengan cara disemprotkan pada pakan sesuai dosis masing-masing perlakuan. Hasil penelitian menunjukan bahwa penambahan sari buah pepaya dengan dosis berbeda tidak berpengaruh terhadap warna dan kelangsungan hidup ikan koi (*Cyprinus rubrofuscus*). Nilai kecerahan tertinggi diperoleh pada perlakuan E dengan penambahan sari buah pepaya sebanyak 40 ml/kg pakan.

Kata Kunci: *Cyprinus rubrofuscus*, Pepaya, Kecerahan, Kelangsungan Hidup, Warna

INTRODUCTION

Koi fish (*Cyprinus rubrofuscus*) is a type of freshwater ornamental fish that is very popular and favored by the public, both in Indonesia and in various other countries. This fish is known for its beautiful colors, such as red, white, yellow, and black. The beauty of the color is one of the main factors that determines the price and selling value of ornamental fish on the market (Seran *et al.*, 2022).

A common problem encountered by ornamental fish farmers is the color of ornamental fish that is not attractive. The quality of the color of ornamental fish is one of the factors that greatly influences the selling price of ornamental fish on the market, the brighter the color of the ornamental fish, the more attractive the fish, the higher the selling price. Carotenoids are compounds that form red or yellow pigments on the surface of the fish's skin. The use of beta carotene in feed has an impact on the formation of pigmentation of the skin of ornamental fish, thus increasing the sharpness of the ornamental fish's body pattern. Natural sources of beta carotene are found in many vegetables and fruits, including papaya (Aini *et al.*, 2021).

Papaya fruit (*Carica papaya* L.) is a fruit that can be a source of beta carotene at a very cheap price and almost throughout Indonesia. Ripe papaya fruit has an orange color which indicates a high beta carotene content, papaya fruit containing beta carotene can increase the brightness value of the color in ornamental fish. Fajar (2023), stated that the addition of papaya fruit extract to commercial feed can increase the pigmentation of the skin of koi fish (*Cyprinus rubrofuscus*). Another study conducted by Rahayu & Puspitasari, (2020) stated that papaya fruit has a beta carotene content of 20.722 µg/100g papaya weight, so papaya fruit is one of the fruits that has the ability to produce and store carotene. The use of papaya fruit extract in commercial feed in an effort to increase the brightness and survival of koi fish is certainly influenced by various factors, one of which is the addition of papaya fruit extract. The administration of papaya fruit extract varies depending on the type and size of the fish.

Studies that have been conducted on the addition of papaya fruit extract content to feed to increase the brightness of ornamental fish include, research by Seran *et al.*, (2022), on the addition of papaya fruit extract (*Carica papaya* L.) to butan feed on the brightness of clownfish

(*Amphiprion ocellaris*), showing the treatment of increasing the dose of papaya fruit extract in artificial feed, with the best concentration of 15 mg/g. Research by Aini *et al*., (2021), on the effect of adding papaya fruit flour (*Carica Papaya* L.) to feed on increasing the brightness and growth performance of goldfish (*Carassius auratus auratus*), showed the results of the study of adding papaya fruit flour with the best concentration of 25%. Simbolon *et al*., (2021), conducted a study using papaya fruit extract, obtained the best results for the brightness of koi carp (*Cyprinus rubrofuscus*) with a concentration of P3 (30 ml/kg). The purpose of this study was to determine the effect and appropriate dosage of adding papaya juice with different doses on the level of color brightness and survival of koi fish (*Cyprinus rubrofuscus*).

RESEARCH METHODS

Time and Place

This research was conducted for two months from September-October 2024 at the Tatelu Freshwater Aquaculture Center (BPBAT), Tatelu Village, Dimembe District, North Minahasa Regency, North Sulawesi Province.

Tools and Materials

The tools used in this study were aquariums as maintenance containers as many as 15 pieces with a size of 60x40x40 cm, M-TCF paper to measure fish color, aerator for oxygen supply, digital scales to measure the weight of fish seeds, digital calipers to measure the length of fish seeds, scoops to take fish seeds, cameras function to take documentation, writing instruments to record observation data, filter cloth, biosprai to spray feed, blender to smooth papaya fruit, measuring cup to measure the volume of papaya fruit juice and water quality tools namely thermometer, pH meter, and DO meter. The materials used during the study were 150 koi fish seeds measuring 3-4 cm, water, 100ml of California papaya fruit juice and 5 Kg of commercial fish pellets.

Research Procedures

The first step is to prepare the koi fish maintenance container by cleaning the aquarium first using water and a mixture of salt, then brushing it to avoid parasites, then drying the aquarium for one day. After the koi fish maintenance aquarium is clean, the container is filled with fresh water with a volume of 20 liters in each container, labeled as a marker, and aerated to supply oxygen. Aeration is put into the aquarium container before the fish are put in, this aims to stabilize the oxygen in the maintenance container.

Fish seeds used as research material are koi fish seeds (*Cyprinus rubrofuscus*) with a size of 3-4 cm. Koi fish are acclimatized first, then the koi fish are fasted for 24 hours to remove dirt in the body. Then the fish are weighed and measured for length and then put into the aquarium. Before taking measurements, the fish will be put into water containing ice cubes with a temperature of 18˚C-19˚C so that the fish do not experience stress during the measurement. Next, the measured fish are spread with a density of 1 fish/2 liters of water (Susilawati *et al.,* 2022). Finally, 10 koi fish seeds will be spread in each aquarium.

Papaya juice is made by washing 1 kg of ripe papaya, then peeling and pureeing the papaya using a blender. Then the papaya puree is squeezed and filtered using a filter cloth/gauze. The papaya juice obtained is ready to use according to the treatment dose.

The feed used in this study was commercial feed STP PA Gold with a particle size of 0.8-1.0 mm, a minimum protein content of 40%, a minimum fat of 8%, crude fiber of 3%, ash content of 11% and water content of 11%. The feed was weighed as much as 1 kg for each treatment, then the feed was sprayed with papaya juice according to the dose in the treatment. The feed was sprayed evenly, after that the feed was aired for 60 minutes, the feed was packed

in plastic that had a label according to each treatment and the feed was ready to be given to the test fish seeds.

Koi fish will be kept for 30 days with feeding carried out 3 times a day, namely at 08.00, 12.00, and 16.00. Feed is given at a dose of 5% of the fish's body weight. Observations of the level of color brightness and water quality were carried out on the first day, the 10th day, the 20th day, and the 30th day. The water quality parameters used were temperature, pH, DO, ammonia, nitrite and nitrate. Observations of survival, weight growth and length growth of fish were carried out at the beginning and end of the study.

Research Design

This research is in the form of experimental research with a completely randomized design (CRD) consisting of 5 treatments and repeated 3 times. The research conducted is a modification of the research (Simbolon *et al.*, 2021), namely:

Treatment A = (Control)
Treatment B = (1 kg pellets + 10 ml papaya juice)
Treatment C = (1 kg pellets + 20 ml papaya juice)
Treatment D = (1 kg pellets + 30 ml papaya juice)
Treatment E = (1 kg pellets + 40 ml papaya juice)

Observation Parameters

Color Brightness Level Measurement

Observation of the color brightness level in koi fish using a modified Toca Color Finder (TCF). The color of the koi fish was observed by 5 panelists with an age range of 17-19 years, who did not have visual impairments such as nearsightedness or color blindness. Observations were made by focusing the original color of the fish on a sheet of color measuring paper that had been numbered 1 (lowest) to 7 (highest). Before taking measurements, the fish were placed in water containing ice cubes at a temperature of 18˚C-19˚C, this aims to reduce the stress level of the fish during measurement.

Survival

Survival can be determined using the Effendie (2002) method in Rosid *et al*., (2019), namely:

$$SR = \frac{Nt}{N0} \times 100\%$$

Description:
SR : Survival (%)
Nt : Number of final live fish seeds (tails)
N0 : Number of initial live fish seeds (tails)

Absolute Weight Growth

Absolute weight growth was determined using the Weatherley method (1972) in Fernando *et al.*, (2019), namely:

$$W = Wt - W0$$

Description:
W : Absolute weight growth (g)
Wt : Final fish weight of maintenance (g)
W0 : Initial fish weight of maintenance

Absolute Length Growth

Absolute length growth was determined using Zonveld (1991) in (Iswandi *et al.*, 2016), namely:

$$W = Wt - W0$$

Description:
W : Absolute weight growth (g)
Wt : Final fish weight of maintenance (g)
W0 : Initial fish weight of maintenance

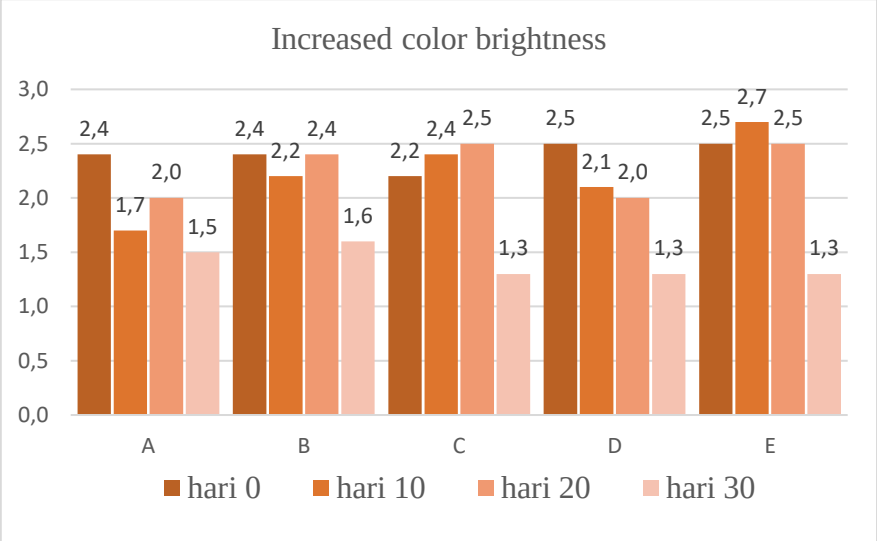
Data Analysis

The observation data were tabulated into one and analyzed using ANOVA using SPSS 23 software to determine whether the research conducted had a real influence or not. If there was a real influence, the Duncan test would be continued.

RESULT

Color Brightness Level

The addition of papaya juice (*Carica papaya* L.) with different doses on the color level of koi fish (*Cyprinus rubrofuscus*) showed varying color changes. Based on the results of the analysis of variance (ANOVA), the addition of papaya juice had no significant effect (P>0.05). The results of observations on the brightness level of koi fish can be seen in the picture below.



Survival Rate

Survival is the percentage of the number of fish at the beginning of the study until the end of the study. In the study that was carried out for 30 days, the percentage of survival of koi fish (*Cyprinus rubrofuscus*) can be seen in Figure 2 below.

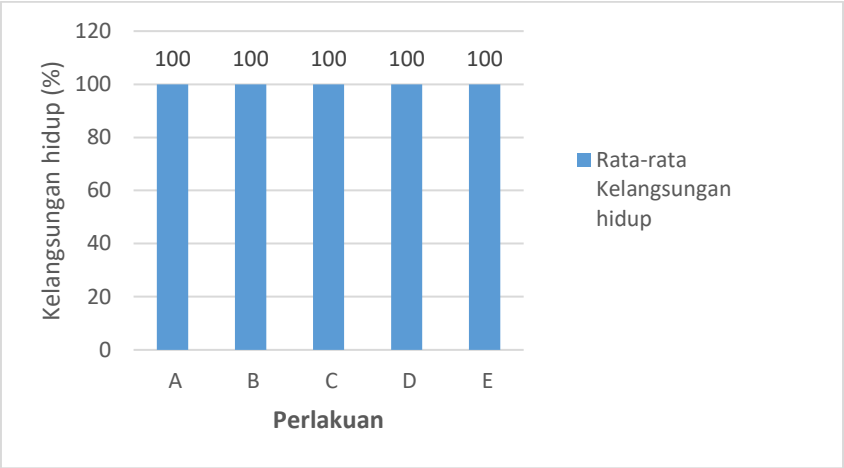


Figure 2. Survival Graph

Absolute Weight Gain

The results of the study of the absolute weight growth of koi fish seeds based on the results of the analysis of variance (ANOVA) stated that the provision of pepya fruit juice with various doses in the feed had no significant effect (P>0.05) on the weight growth of koi fish. The results of the average data on the absolute weight gain of koi fish seeds can be seen in Figure 3 below.

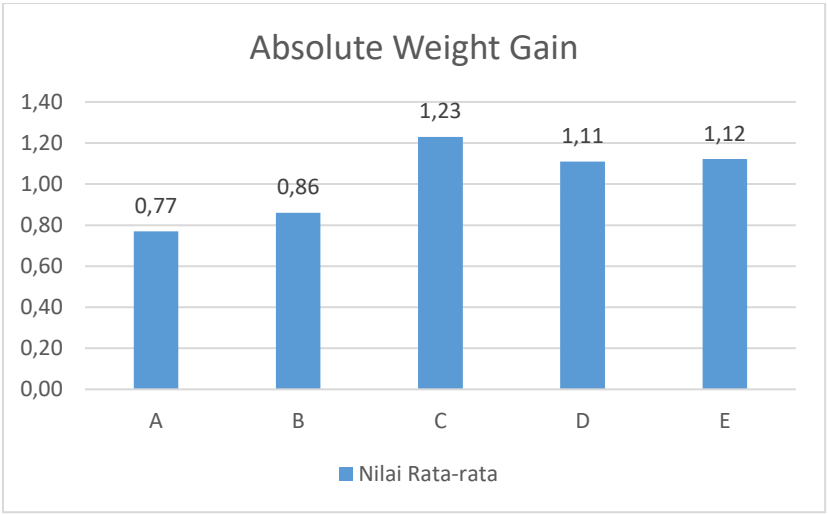


Figure 3. Absolute Weight Growth Graph

Absolute Length Growth

The results of the study on the absolute length growth of koi fish seeds based on the results of the analysis of variance (ANOVA) showed that in general the addition of papaya juice with different doses in the feed had no significant effect (P>0.05) on the growth of koi fish length. The average results of the absolute length growth of koi fish seeds can be seen in Figure 4 below.

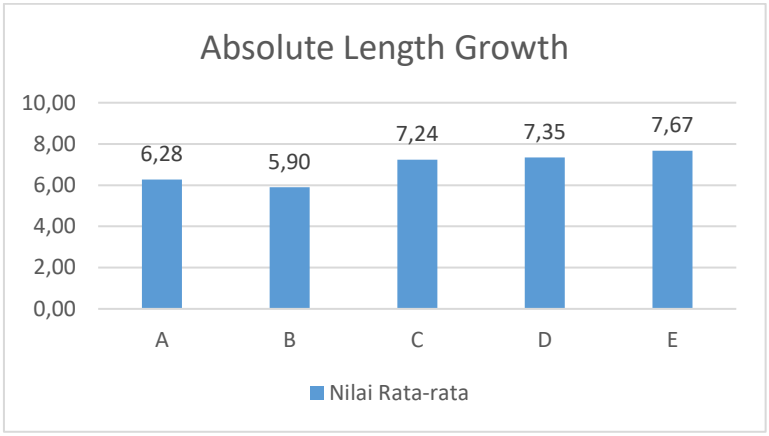


Figure 4. Absolute Length Growth

Water Quality

Temperature

Temperature data collection was carried out every 10 days, namely in the morning and evening during the research. The results of the temperature measurements carried out can be seen in Figure 5 below.

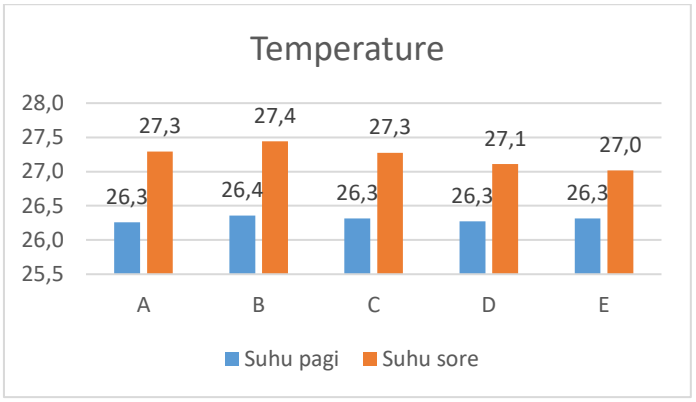


Figure 5. Temperature Graph of Each Treatment

Acidity Level (pH)

From the research that has been carried out, the data obtained from measuring the acidity level (pH) can be seen in Figure 6 below.

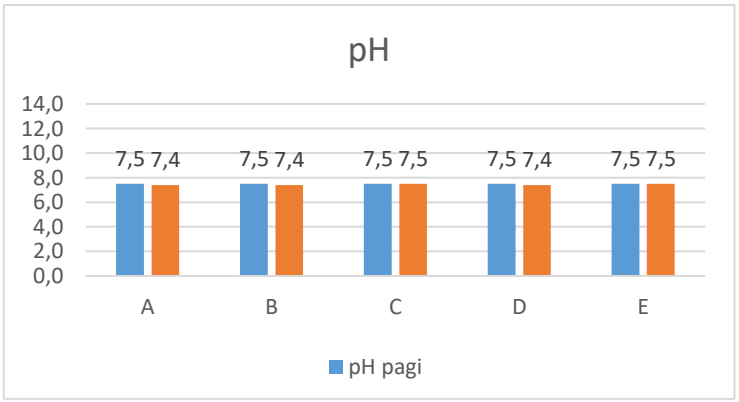


Figure 6. Temperature Graph of Each Treatment

Dissolved Oxygen (DO)

From the research that has been carried out, data on the results of dissolved oxygen (DO) measurements were obtained which we can see in Figure 7 below.

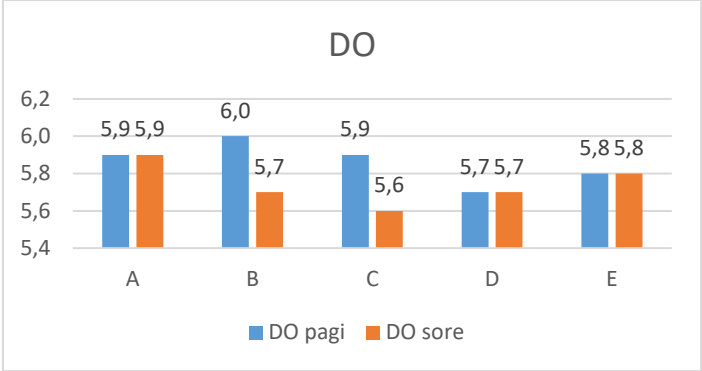


Figure 7. Graph of DO of Each Treatment

Ammonia

Based on the research that has been conducted, the results of ammonia measurements were obtained which can be seen in Figure 8 below.

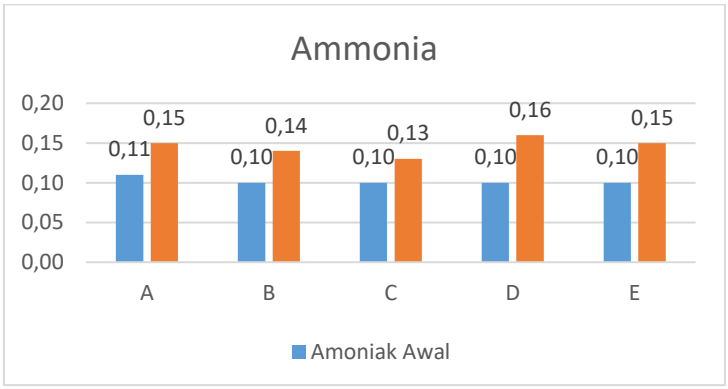


Figure 8. Ammonia Graph of Each Treatment

Nitrite

After conducting research, the results of taking water quality parameters in the form of nitrite can be seen in Figure 9 below.

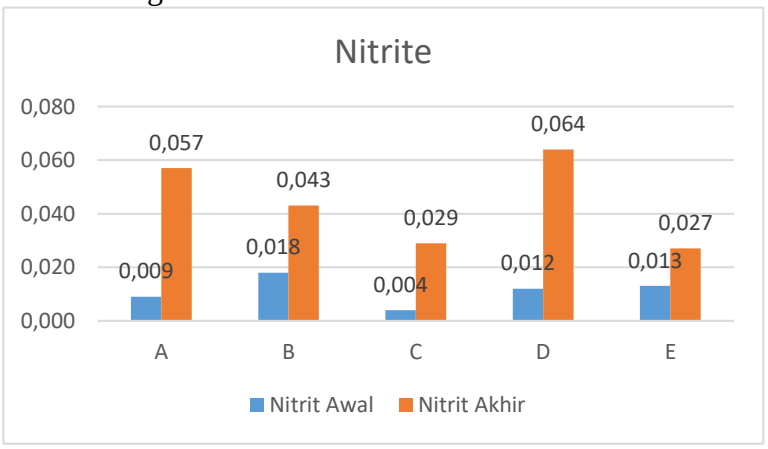


Figure 9. Graph of Nitrite of Each Treatment

Nitrate

The results of the research on water quality parameters in the form of nitrate can be seen in Figure 10 below.

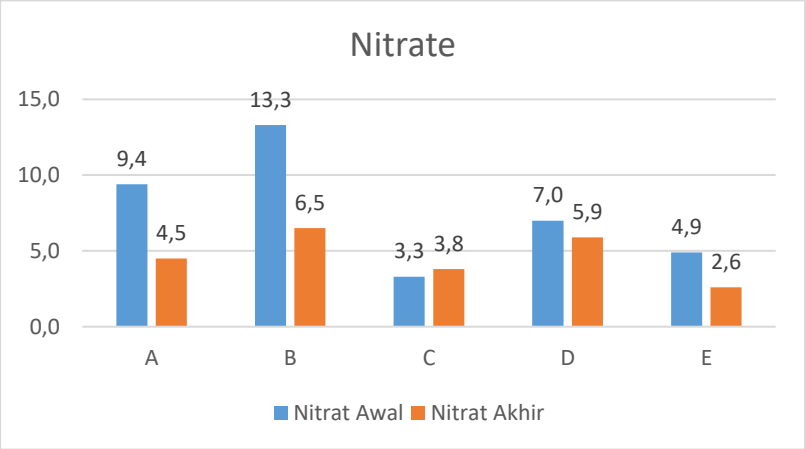


Figure 10. Nitrate Graph of Each Treatment

DISCUSSION

The results of the study showed the average color change value for each treatment. On the 10th day of color observation, the highest color change occurred in treatment E with an average value of 2.7 and C with an average value of 2.4. Then in treatments B, D and A the color decreased. The color decrease occurred because the koi fish in treatments B, D, A were thought to have experienced post-observation stress, so the fish's response to food was less. On the 20th day of observation, changes in the color of the koi fish occurred in each treatment, the koi fish experienced an increase in color compared to previous observations, the highest increase was in treatments E and C with the same average value, namely 2.5, then treatment B was 2.4 and the lowest value was in treatments D and A with a value of 2.0. On the 30th day of monitoring, each treatment experienced a significant decrease in color, the average value for treatment B was 1.6, treatment A 1.5 and the lowest value was found in treatments C, D and E with a value of 1.3.

The low increase in the color of koi fish (*Cyprinus rubrofuscus*) is influenced by the level of carotenoid content in the feed which can only be partially utilized by the fish, this causes the chromatophore cells to not be evenly distributed to the skin and results in the fish's skin looking pale. According to Sari *et al.*, (2012), stated that the high and low color intensity is due to changes in the chromatophore cells. Disruption of the metabolic process in the digestion of chemical and enzymatic processes causes a decrease in the pigmentation mechanism of the koi fish seed body so that the color value on the 30th day of observation decreased. Evidenced by the increasing number of koi fish seed feces at the bottom of the aquarium at the end of the study. According to Putri *et al.*, (2024), stated that disruption of the metabolic process in the fish's digestive system can affect the chemical and enzymatic processes including the pigmentation mechanism of the koi fish body color.

Another factor that can affect the color of koi fish is genetic factors, the koi fish seeds used in this study came from parents that could change color over time, the koi fish parents that were initially yellow will slowly change color to pale yellow to silver. The character or nature of the color is influenced by genetic factors in the chromatic elements and is an inherited trait. Color is a qualitative characteristic obtained from parents (male and female) or from their ancestors. According to Dwiastuti *et al.*, (2024), that indicators that can change the intensity of

color in fish are internal factors, namely age, size, genic, gender and fish skills when digesting nutrients in feed.

The results of the survival study showed that the survival rate in all treatments was 100%. This happened because during the study the test fish did not die. Survival data showed that koi fish (*Cyrinus rubrofuscus*) obtained nutrients that could support their living needs and good water conditions during the study. The high survival value is due to the ability of koi fish seeds to adapt in a controlled environment. According to Hamsir *et al.*, (2024) stated that the high survival percentage can be caused by several factors, namely good water quality during maintenance, low density and low stress levels on the seeds.

The addition of papaya juice did not have a significant effect on the growth of koi fish weight. The highest absolute weight growth at the end of the maintenance period was treatment C, which reached 1.23 grams. The absolute weight increase was greatest in treatment A, which was only 0.77 grams. Treatment C obtained the best average value due to sufficient nutritional needs, so that during the maintenance period the nutrients could be properly absorbed by the koi fish. Fish growth is influenced by the protein content in feed, protein acts as a new structure former for fish development and can replace damaged tissue. According to Malide *et al.*, (2018) stated that nutrients in feed can be digested well by fish so that the body weight of the fish increases.

The absolute length growth of koi fish showed no significant effect. The highest absolute length growth was obtained in treatment E, reaching 7.67 mm, and the lowest absolute length growth was obtained in treatment B, reaching only 5.90 mm. The length growth of koi fish is influenced by the provision of feed given during the study. Providing feed containing nutrients and nutrition that are appropriate for the development period of koi fish (*Cyprinus rubrofuscus*). According to Marasabessy, (2020) one of the things that can increase the growth of length and weight of fish is the protein content in the feed given during maintenance. The increase in the average length growth of koi fish was highest in treatment E because it was influenced by the nutrient content of the feed digested by the fish. The amount of nutritional requirements in the feed used during the study was a minimum of 40% protein. According to Apriliani *et al.*, (2021) the provision of carotenoids in feed has no effect on the length growth of koi fish (*Cyprinus rubrofuscus*). Thus, the body length of koi fish grows and increases normally with age.

The results of observations of water quality in the maintenance container showed that the water quality was at the optimal limit for maintaining koi fish. The temperature range in the maintenance container during the study obtained was 26.3˚C-27.4˚C. Based on SNI 7734, (2017) that the ideal temperature range for maintaining koi fish is between 20˚C-28˚C. The temperature during the study was quite stable and did not experience significant fluctuations, because the maintenance media was in a closed room so that the temperature fluctuations that occurred were within normal limits. According to Andayani *et al.*, (2022), The optimal temperature during the study can affect the metabolic processes of the fish's body. These processes include fish growth, appetite, and physical activity such as swimming speed. The pH during the study ranged from 7.4-7.5, this pH value is suitable for the maintenance and survival of koi fish, in accordance with what Arifin, (2016) said that the pH range that is suitable and optimal for aquaculture is generally 6-8. During the maintenance of koi fish, the pH value remains stable and does not experience a significant decrease.

The pH value of water functions as an indicator of whether the water quality is good or bad, because the pH value has a significant impact on the life of aquatic organisms. A pH value that is too acidic can cause fish mortality which is characterized by irregular fish behavior, faster moving operculum, and fast swimming movements on the surface of the water. A pH value that is too alkaline can also cause fish growth to slow down (Fazil *et al.*, 2017).

The results of DO measurements during the study were in the range of 5.6-6.0 ml/L. According to Zahra *et al.*, (2023), the dissolved oxygen content that is good for fish health and cultivation is> 5 mg/l. Dissolved oxygen (DO) is used for the process of fish respiration, body metabolism to the aerobic oxidation process of organic and inorganic waste. Lack of oxygen can cause stress, increased susceptibility to disturbances, and disrupted fish growth. The decrease in oxygen content is caused by the activity of other organisms that breathe underwater and the decomposition of organic compounds. Insufficient oxygen requirements will cause fish health to decline due to low feed consumption.

The ammonia results at the beginning of the study were in the range of 0.10-0.11 mg/l, while at the end of the study the ammonia value ranged from 0.13-0.16 mg/l. The increase in ammonia levels in water can be caused by the accumulation of feces and leftover feed in the maintenance water. According to Fazil *et al.*, (2017), ammonia is a metabolic waste substance that settles and is toxic to fish. Ammonia levels during the study were still relatively good for maintaining koi fish (*Cyprinus rubrofuscus*). According to Gunawan *et al.*, (2020), ammonia levels are relatively safe for aquatic organisms at <1 mg/l. Nitrite measurements at the beginning of each treatment were in the range of 0.004-0.018 mg/l, and nitrite levels at the end of the study were in the range of 0.027-0.064 mg/l. Nitrite levels at the beginning and end of the study were still within normal limits and could still support the maintenance of koi fish (*Cyprinus rubrofuscus*). According to Andayani *et al.*, (2022), that the maximum range of nitrite that is good for koi fish is 0.2 mg/l. High nitrite levels in water can reduce the capacity of aquatic biota blood to capture O_2, this is because nitrite will react quickly with hemoglobin, causing the fish mortality rate to increase (Samsundari & Wirawan, 2014). Nitrite levels at the beginning of the study showed a range of values of 3.3-19.3 mg/l, while the results of nitrate levels at the end of the study were in the range of 2.9-6.5 mg/l. Nitrobacter bacteria can convert nitrite into nitrate so that the aquatic environment and maintenance become stable. The nitrate content during the study was still within the optimal limits for maintaining koi fish (Cyrinus rubrofuscus). According to SNI 7734, (2017), the maximum nitrate level in the koi fish water environment is 60 mg/L.

CONCLUSION

The addition of papaya juice (*Carica papaya* L.) with different doses did not affect the color and survival of koi fish (*Cyprinus rubrofuscus*). The addition of papaya juice (*Carica papaya* L.) in treatment E (40 ml) was the best dose in improving the color of koi fish (*Cyprinus rubrofuscus*) and the addition of papaya juice (*Carica papaya* L.) to the feed provided the best survival rate in all treatments.

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