Addition different algae (Spirulina) flour to artificial feed on color quality and growth of Koi fish (Cyprinus carpio-Koi)

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Abstract. Ornamental fish is one of the fisheries commodities that can be used as a source of foreign exchange income, and has its own beauty to attract the interest of ornamental fish lovers. One of the things that determines beauty in many species of ornamental fish is color. Color is a parameter to determine the value of ornamental fish, which is a brighter color, the higher the value of fish. Spirulina sp. Flour has a high carotenoid and protein content, each of which plays a role in increasing color intensity and growth. The purpose of this study was to determine the effect of concentration Spirulina flour to the color quality and growth of koi fish (Cyprinus carpio). The method used was experimental with Completely Randomized Design (CRD) using 4 treatments, 5 replications. The dose of feed used is (Control), (dose 1%), (dose 3%) and (dose 5%). Color quality measurement using Adobe Photoshop CS8 software. The frequency of twice-daily feeding for each treatment resulted in color quality with the best value (3.0200 %), absolute length growth (0.9780 cm) and absolute weight growth (3.7240 grams).

1. Introduction

Ornamental fish is one of the fisheries commodities that can be used as a source of state foreign exchange opinions, and has its own beauty to attract the interest of ornamental fish lovers. One of the things that determines beauty in many species of ornamental fish is color. Stated that color is a parameter to determine the value of ornamental fish, namely the brighter the color, the higher the value of the fish. [1].

Koi fish can experience a decrease in color, States that ornamental fish generally fade when maintained in an aquarium. [2]. Breeding efforts to increase the selling value and brightness of fish skin color can be done by increasing fish nutrition[3].

Addition of Spirulina sp. Flour carried out to increase the intensity of the color of koi fish, carotenoid content and protein found in Spirulina sp. very potential, so it is necessary to do research on the effect of Spirulina sp flour on the color intensity and growth of koi fish (Cyprinus carpio) [4].

2. Materials and methods

2.1 Research preparation

This research was conducted in the Wet Laboratory and PSDKU Instrument Laboratory of Airlangga University in Banyuwangi. The material used in this study is Koi Fish (Cyprinus carpio) measuring 8-10 cm with a weight of ± 10 grams / head as many as 100 head, commercial feed, progl, Spirulina flour and water. The equipment used in this study were 20 aquariums measuring 30x40x50 cm, aeration, aeration
hose, aerator, volume pipette, drop pipette, measuring cup, ruler, analytical scales, spatulas, test tubes, ovens, HP cameras, Adobe Photoshop applications CS6, DO meter, pH paper, thermometer and sample bottle.

2.2 **Research implementation**
This research was conducted using a completely randomized design method (CRD) consisting of 4 treatments and 5 replications using different dosing methods on feed. These treatments included:

- **P0** : Feed without adding Spirulina Flour
- **P1** : Feed added 1% Spirulina sp. Flour in 100 grams of feed
- **P2** : Feed added 3% Spirulina sp. Flour in 100 grams of feed.
- **P3** : Feed added 5% Spirulina sp. Flour in 100 grams of feed

Color quality sampling data was collected at the end of the study with visual color diversity parameters. Observation of the brightness level of koi fish is seen from the percentage of RGB in the Adobe Photoshop CS6 application.

Absolute length growth is the difference in the total body length of the fish at the end of the study with the total length of the fish body at the beginning of the study. Absolute length calculations can be calculated by formulas [6]:

\[
L_{m} = L_{t} - L_{0}
\]

**Note:**
- \(L_{m}\)  = absolute length growth (cm)
- \(L_{t}\)  = total length of fish at the end of treatment (cm)
- \(L_{0}\)  = total fish length initial maintenance test (cm)

2.3 **Absolute weight growth**
Absolute weight growth is the difference in the total body weight of the fish at the end of the study with the body weight of the fish body at the beginning of the study, the calculation of absolute weight can be calculated by the formula [6]:

\[
W_{m} = W_{t} - W_{0}
\]

**Note:**
- \(W_{m}\)  = Absolute weight growth (grams)
- \(W_{t}\)  = total test fish weight at the end of treatment (gram)
- \(W_{0}\)  = Test total fish weight at the beginning of maintenance (gram)

2.4 **Data analysis**
The results of color brightness parameters, fish weight and fish length were analyzed using variance analysis (ANOVA) and 95% confidence level (P <0.05). If there is a real difference, then it is followed by Duncan's multiple distance test) (Kusriningrum, 2012). Data on water quality observations were analyzed descriptively with the help of Microsoft Excel 2010.
3. Result and discussion

3.1. Results

There was a change in the color of koi fish in each treatment. The highest color change of koi occurs in dose 1% with a value of 3.0200a ± 2.1355 followed by dose 3% with a value of 2.1060b ± 1.4892, and than dose of 5% with the value of 1.4620bc ± 1.0338 and the lowest is control with a value of 1.2340c ± 0.8726. Dose 1% treatment obtained the best results for color quality in koi with a value of 3.0200a ± 2.1355. This shows that the lower concentration has fulfilled the need for koi fish for carotenoids contained in Spirulina flour [7]. The carotenoid content in 1% Spirulina flour has fulfilled the need for koi fish for carotenoids to increase the brightness of the body color. These results are in accordance with the study of [7], that the addition of 1% Spirulina paste gave the best results in increasing the brightness of red on Kohaku koi fish. In addition, the results of research also showed that the addition of Spirulina flour as much as 1.2% in artificial feed gave the best results for the increase in color intensity in fish chefs (Carassius auratus).

Table 1. Color quality of koi fish given different Spirulina Flour doses for 30 days

| Concentration adding Spirulina sp in feed (%) | Color ± SD      |
|---------------------------------------------|----------------|
| 0%                                          | 1.23c ± 0.87   |
| 1%                                          | 3.02a ± 2.13   |
| 3%                                          | 2.10b ± 1.49   |
| 5%                                          | 1.46bc ± 1.03  |

Growth is influenced by several factors, namely internal factors and external factors, as well as internal factors including offspring, endurance and ability to use food, while external factors include physical, chemical and biological characteristics. Food factors and water temperature are the main factors that can influence fish growth [9].

Study with different doses of Spirulina flour, showed that the highest absolute weight growth was found in treatment 5% with a value of 4.7400 grams and the highest absolute long growth was found in 3% treatment with a value of 0.9780 cm. Whereas the absolute growth of the desired weight is found in the treatment 0% with a value of 2.8680 grams and the absolute long growth is deposited in treatment P1 with a value of 0.4480 cm. The factor that allows the high growth of koi fish is that Spirulina has a fairly high nutritional value and is complete, which in addition contains carbohydrates and fats, there are also various kinds of vitamins and minerals [10]. Fish need foods that contain protein in the range of 20-60%, while optimum needs range from 30-36%.

Table 2. The absolute growth of koi fish given Spirulina flour with different doses for 30 days

| Concentration adding Spirulina sp in feed (%) | Absolute weight (g) ± SD |
|----------------------------------------------|--------------------------|
| 0%                                           | 2.87b ± 2.03             |
| 1%                                           | 2.76a ± 1.95             |
| 3%                                           | 3.72ab ± 2.63            |
| 5%                                           | 4.74c ± 3.35             |
Description: Different superscript letters in the same column show differences (P < 0.05). P0: Spirulina flour 0%, P1: Spirulina flour 1%, P2: Spirulina flour 3%, P3: Spirulina flour 5%.

Table 3. Growth of the absolute length of koi fish given Spirulina Flour with different dosages for 30 days

| Concentration adding Spirulina sp in feed (%) | Absolute length (cm) ± SD |
|---------------------------------------------|---------------------------|
| 0                                          | 0.68± ± 0.48              |
| 1                                          | 0.45± ± 0.32              |
| 3                                          | 0.98a± ± 0.69             |
| 5                                          | 0.92a± ± 0.65             |

Description: Different superscript letters in the same column show differences (P < 0.05). P0: Spirulina flour 0%, P1: Spirulina flour 1%, P2: Spirulina flour 3%, P3: Spirulina flour 5%.

4. Conclusion
Addition of Spirulina dose 1% the best results are obtained during preparation 1% and giving artificial doses with different doses Spirulina can increase the growth of koi fish. Obtained from the amount determined during dose 3% processing and the highest obtained during 5% preparation.

5. References
1. Highnam, K and Hill, L 1969 The Comparative Endocrinology of the Invertebrates London: Edward Arnold Ltd 21-222 p
2. José Luis Arredondo-Figueroa, Jesús Trinidad Ponce-Palafox, Keiko Shirai-Matsumoto, Ángel Pérez-Zavaleta, Irene De Los Ángeles Barriga-Sosa and Arturo Ruiz Luna 2012 1868 Aquaculture Research 44 (6): 966-973
3. Lalith K Dammannagoda, Ana Pavasovic, David A Hurwood and Peter B Mather 2013 Aquaculture Research 46 3 626-636
4. Mosig, J 1998 The Australian Yabby Farmer 2nd Edition Landlinks Victoria 187 hal
5. Nayaka and Ikeda 1993 Comprehensive Survey of Endogenous Regulators of Crustacean Moulting Suntory Institute for Bioorganic Research (SUNBOR): Shimamoto-cho, mishima-gun, Osaka Japan 428 hal
6. Sirin and Y Mazlum, (2016, Astacus leptodactylus, Aquaculture Nutrition 23 (4) (805-813)
7. Wickins, J F, and Lee, D O’C 1992 Crustacean Farming United Kingdom: Blackwell Science Ltd 16 p
8. Bold, HC and MJ Wynne 1985 Introduction to the Algae: Structure and Reproduction Prentice-Hall Inc United States of America 718 hal
9. Ezhil, J, C Jeyanthi and M Narayanan 2008 Xiphophorus helleri Turkish journal; of Fisheries and Aquatoc Sciences 8 99-102
10. Belay, A 1997 Mass Culture of Spirulina Outdoor – The earthrise farms experience, Physiology, Cell-biology and Biotechnology New York

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