



## **Effect of Spirulina Flour on Changes of Color Intensity in Angelfish (*Pterophyllum scalare*) Strain Three Color**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author WL designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors RMR and AR managed the analyses of the study. Author RGH managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Ornamental fish is a fishery commodity that has promising business opportunities. Ornamental fish will have a high selling value if they have bright and brilliant colors. The advantage of ornamental fish is in the intensity of the color on its body. This study aims to analyze the levels of Spirulina added in feed which can increase the color intensity of the Angelfish juvenile. The method used was an experimental method Completely Randomized Design, consisting of five treatments and four replications. The parameter observed was an increase in color on the head of the fish and analyzed using Kruskal-Wallis. The results showed that giving 3% spirulina flour in commercial feed could provide the best color improvement for angelfish with an increase in color value by 3, and if discontinued addition of spirulina flour can reduce the brightness level of the angelfish.

**Keywords:** *Angelfish; carotenoids; spirulina flour; color intensity; survival rate; Pterophyllum scalare.*

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## 1. INTRODUCTION

Ornamental fish is a fishery commodity that has promising business opportunities, especially for tropical regions [1]. Ornamental fish will have a high selling value if they have bright and brilliant colors. The advantage of ornamental fish is in the color intensity of the body [2]. One of the well-known ornamental fish is Angelfish (*Pterophyllum scalare*). This fish is preferred because it has a distinctive appearance with a combination of various colors that make it has its own charm.

Color is one of the factors in assessing the beauty of ornamental fish. Color must be improved and maintained its quality. The effort made to get evenly bright colors in the fish is to add a source of pigments to the feed [3]. Feed containing certain pigments or dyes, such as carotene, can be added to commercial feed so the effect can increase the amount pigment in angelfish and the color fish will be better and clearer or brighter. Carotenoids are dyestuff-forming components that can give ornamental fish a red or yellow color [4]. One source of carotenoids is the algae spirulina [5].

Spirulina is a blue-green microalgae containing high protein nutrients, so it is widely used as a natural feed [6]. Spirulina sp contains phycocyanin, chlorophyll-a and carotene. Carotene is composed of xanthophyll (37%),  $\beta$ -carotene (28%) and zeaxanthin (17%) [7]. Spirulina is a widely distributed microalgae, can be found in various types of environment, either in brackish, marine or fresh waters [8]. Spirulina flour in industry has been widely used, one of which is in fish feed ingredients to improve color quality, because it has high  $\beta$ -carotene content. Therefore this study aims to determine the optimum concentration of spirulina flour in commercial feed which can increase the color intensity of Angel fish (*Pterophyllum scalare*).

## 2. RESEARCH AND METHODS

### 2.1 Time and Place Research

This research was conducted from february 2020 to march 2020 at the laboratory of building 4, faculty of fisheries and marine sciences, padjajaran university, indonesia.

### 2.2 Materials and Methods

The equipment used in this study was an aquarium with a size of 30x40x40 cm<sup>3</sup> with a density of 5 fish per aquarium, aeration

equipment, Toca Color Finder, digital scale, pelletizer, bowl, thermometer, Dissolved Oxygen (DO) meter, and pH meter. 75 juvenile angelfish (*Pterophyllum scalare*) from Sukabumi, West Java, Indonesia with a size range of 4-5 cm, were used. The commercial feed with the brand Matahari was given to fish twice a day as much as 3% of the fish weight. Fish were maintained in optimal water conditions. The method used was an experimental method Completely Randomized Design (CRD), consisting of 5 treatments and 3 replications. The treatments given in the experiment were as follows: (A) Commercial feed without spirulina flour (control), (B) Commercial feed with the addition of 1% spirulina flour, (C) Commercial feed with the addition of 3% spirulina flour, (D) Commercial feed with the addition of 5% spirulina flour, (E) Commercial feed with the addition of 7% spirulina flour. Observation of changes in color intensity was carried out every 10 days for 30 days. After 30 days, commercial feed was given without the addition of spirulina flour for 10 days. Color observation was investigated using the Toca Color Finder (TCF). The assessment starts from the smallest value of 1 to the largest value of 5, with a gradation of color intensity from faded yellow (TCF Code 301) to orange (TCF Code 305).

Color observations were made on the head of the fish. The measurement of fish color was carried out by three panelists who had an understanding of the color of ornamental fish and had no visual problems (color blindness and farsightedness) and had conducted training in advance. Observations were made visually by comparing the color of the fish with the Toca Color Finder. The results of the data were then analyzed using the Kruskal-Wallis test. If there were significant differences, then Test Z was conducted. Additional data regarding weight gain observation were analyzed using F test with a 95% confidence level to determine the effect of treatment upon the parameters. If the treatment had a significant effect ( $F_{count} > F_{Table}$ ) then it was continued by Duncan's multiple distance test with a 95% confidence level, to find out significant differences. Observation of SR (survival rate) and water quality were analyzed in a comparative descriptive manner.

## 3. RESULTS AND DISCUSSION

### 3.1 Color Intensity Level

Based on the research carried out for 30 days, the addition of spirulina flour showed an

increase in the color value of Angelfish (*Pterophyllum scallare*) (Fig. 1.)

The graph in Fig. 1 shows that on the 10th day there was an increase in the color value of treatment B, C, D, E. The increase in color brightness that occurs shows that carotenoids and color pigments in food can increase the brightness of the fish color [9]. In the control treatment (A) did not show an increase in color, this is because the fish's body does not synthesize carotenoids without additional external additives in the feed [10].

Observations on the 30th day showed that the color value of the fish continued to increase (Table 1). The highest color score was found in treatment C which was the addition of 3% spirulina flour to the feed with a color enhancement value of 3, then the second highest color value was treatment D with a color enhancement value of 2.7. Color values in treatment B, C, D, E continued to increase until the 30th day this is because the use of color supplements in the form of artificial carotenoids mixed with commercial feed will greatly improve the color quality of fish [11].

Based on the results of the Kurskal-wallis test, it was known that there were significant difference in the treatment without the addition of spirulina flour to the treatment with added spirulina. The results presented in Table 2 showed that the highest increase in color intensity of angelfish occurred in treatment C, the addition of 3% spirulina flour, but not significantly different from treatment D and E, with the addition of spirulina flour 5% and 7%. In general, aquatic animals, especially fish, cannot produce their own pigments, these pigments must be obtained from outside their bodies. Pigmentation in fish is not only affected by the absorption and distribution of carotenoids in fish. There is an influence on the age and physiological condition of the fish, the type of feed and the environment in which they live [12].

### 3.2 Post Treatment

After 30th day, the treatment (adding spirulina to commercial feed) was discontinued and replaced with feeding without the addition of carotenoids to see if the fish can retain their color or not, if the external intake of carotenoids is stopped.

The results showed that the feed that was not given carotenoids had a significant effect on

decreasing the brightness of the angelfish. The color of fish produced from feed containing carotenoids is temporary, if the intake of carotenoids in the feed is stopped, there will be a decrease in fish color, but there is no information on the length of time to maintain the color intensity after stopping carotenoid intake [13,14]. Fish should get carotenoids in feed regularly to increase color intensity [15].

### 3.3 Growth

Observation of absolute weight is a supporting parameter that was observed to determine the effect of spirulina flour added to artificial feed on the growth of angelfish. The average growth of the absolute weight of fish in this study gave no significant difference (Table 3).

The highest growth of angelfish during the study occurred in treatment E (7.0% spirulina flour) of 0.82 g and C (3.0% spirulina flour) of 0.66 g, while the lowest was in treatment A (Control without spirulina flour). This shows that the growth of angelfish was not hampered by the addition of spirulina flour.

Carotenoids do not inhibit the growth of the angelfish, but can increase the color intensity of the angelfish. The addition of carotenoids in feed can improve nutrition or feed nutrition and can increase fish appetite so that it can increase fish weight during the study [16].

### 3.3 Survival Rate

The results showed that the addition of spirulina flour to commercial feed had no significant effect on the survival rate of the angelfish (*Pterophyllum scalare*) strain three color.

Based on Table 4. all treatments have a SR of 100%, because the carotene content in spirulina flour as a source of color pigment in feed does not endanger fish health. Carotene naturally functions as the basic ingredient of vitamin A, supports thermoregulation or the process of regulating body temperature thereby affecting fish health [17]. In addition, carotene also plays a role in protecting fish against light and can help in the metabolism of the oxygen cycle [18].

### 3.5 Water Quality

Observation of water quality was one of the parameters that must be observed, because water quality is one of the factors that influence cultivation activities. Water quality parameters

observed in this study were temperature, DO, and pH. Observation of water quality in the study was carried out every 10 days. The results are presented in Table 5.

that determine the color quality of ornamental fish are the quality of fish (70%), water (20%), and other factors (10%) [19]. Water quality during the research is in the optimal range and meets Indonesian national standards Ref. [20] SNI 7241 (2006). Average value of water quality; pH 7.09-7.51, DO 4.1-5.6 and temperature 26.25 °C.

Water is said to be the biggest factor to improve the color quality of ornamental fish. The factors

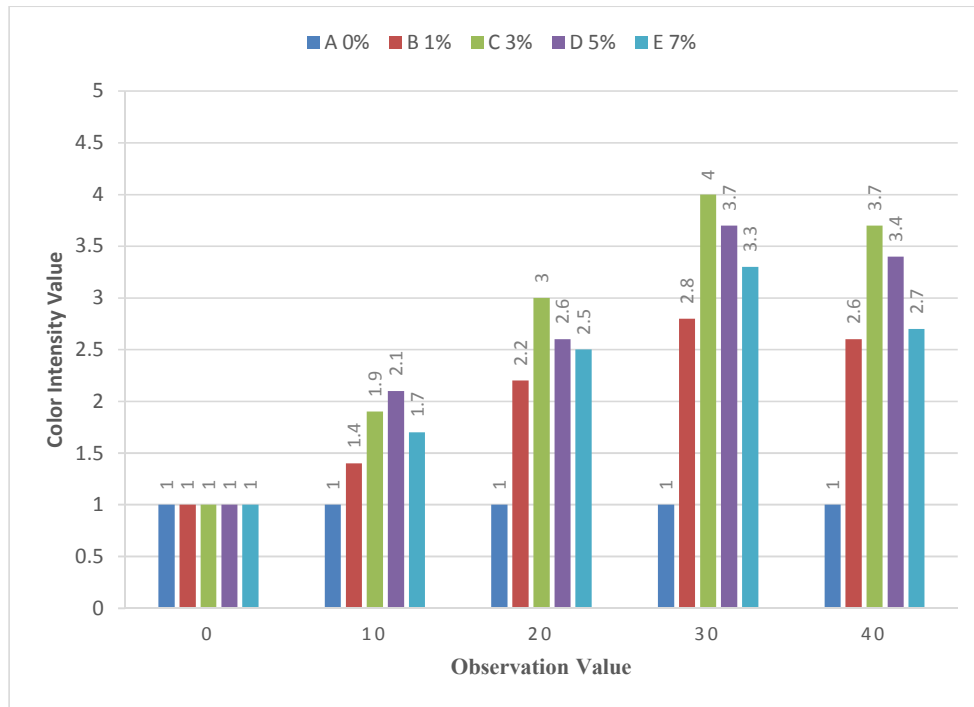



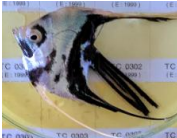






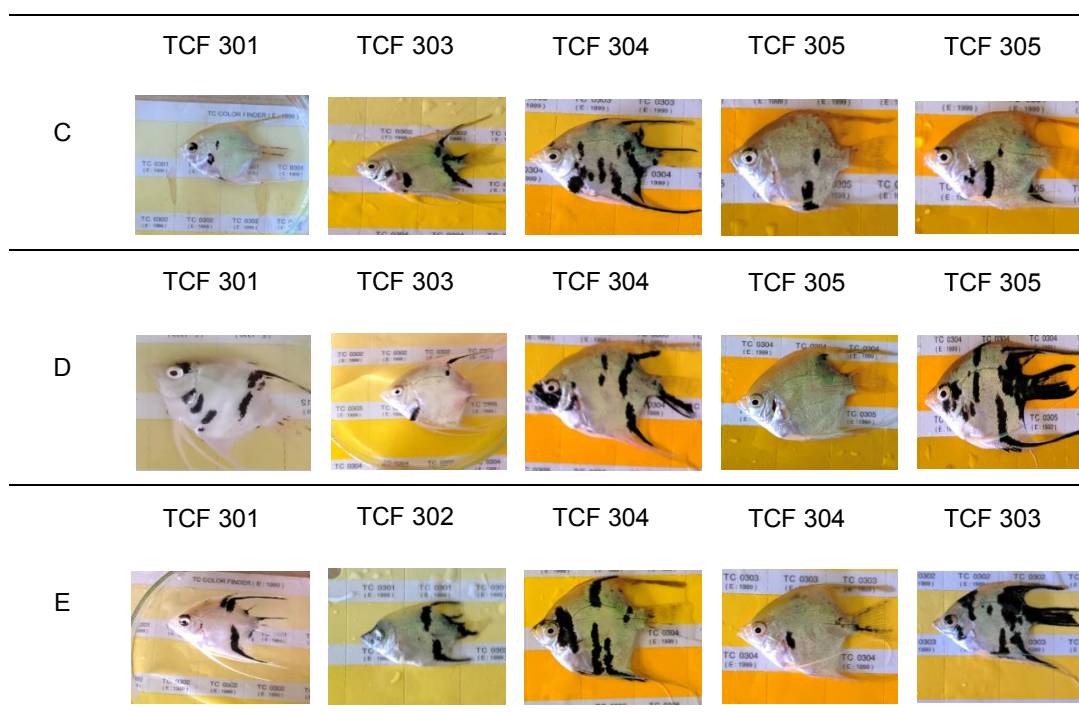


Fig. 1. Graph of increasing color intensity of angelfish from different treatments

Table 1. Increased color of angelfish during the study

Treat ment	Day 0	Day 10	Day 20	Day 30	Day 40 (Post treatment)
	TCF 301	TCF 301	TCF 301	TCF 301	TCF 301
A					
	TCF 301	TCF 301	TCF 302	TCF 303	TCF 303
B					



**Table 2. Average color improvement in angelfish**

Treatment	Increase in color intensity value
A. No Spirulina powder (Control)	0 ± 0 <sup>a</sup>
B. Addition of 1% spirulina powder	1,8 ± 0,64 <sup>b</sup>
C. Addition of 3% spirulina powder	3 ± 0,76 <sup>c</sup>
D. Addition of 5% spirulina powder	2,7 ± 0,59 <sup>c</sup>
E. Addition of 7% spirulina powder	2,3 ± 0,54 <sup>bc</sup>

Description: Numbers followed by the same letter notation mean there is no real difference with a 95% confidence level

**Table 3. Absolute weight growth**

Treatment	Average (Gram)
A. No spirulina powder(0%)	0,52 ± 0,14
B. Addition of 1% spirulina powder	0,64 ± 0,34
C. Addition of 3% spirulina powder	0,66 ± 0,30
D. Addition of 5% spirulina powder	0,56 ± 0,13
E. Addition of 7% spirulina powder	0,82 ± 0,27

**Table 4. Survival rate of angelfish (*Pterophyllum scalare*) strain three color**

Treatment	Survival rate (%)
A. No spirulina powder(0%)	100
B. Addition of 1% spirulina powder	100
C. Addition of 3% spirulina powder	100
D. Addition of 5% spirulina powder	100
E. Addition of 7% spirulina powder	100

**Table 5. Observation results of water quality for angelfish (*Pterophyllum scalare*) strain three color**

Parameter	Results	Reference (SNI 7241 2006)
Temperature (°C)	26,25	25 – 32
DO (ppm)	4.1 – 5.6	>4.00
pH	7.09 – 7.51	5.50 – 9.00

#### 4. CONCLUSION

Addition of 3% spirulina flour in commercial feed can provide the best color improvement for angelfish by increasing the color intensity value by 3 and if it is stopped the addition of spirulina flour in the feed can reduce the brightness level of the angelfish (*Pteriophyllum scalare*) strain three color.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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