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# CARROT STARCH ADDITION EFFECT ON ARTIFICIAL FEED TOWARDS COLOR ENHANCEMENT OF SWORDTAIL FISH (*XIPHOPHORUS HELLERI*)

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KeyWords
Carrot Flour, Color, Swordtail Fish, Toca Color Finder



ABSTRACT

This study aims to determine the effect of carrot starch in enhancing the color brightness and to figure the optimal concentration of carrot starch added to artificial feed to enhance the color brightness of swordtail fish. This research was conducted at Hatchery Building 4 Faculty of Fisheries and Marine Sciences of Padjadjaran University from May to June 2018. The research method used is a Completely Randomized Design experiment consisting of five treatments and three replications. The carrot starch addition treatment used 0%, 2.5%, 5%, 7.5%, and 10% of carrot starch based on the feed amount. The parameters observed is color value by using Toca Color Finder as the main data while increased weight and survival rate act as supporting data. The color observation data were analyzed using Kruskal-Wallis analysis, if there were significant differences, Z test would be performed. The weight gain was analyzed using Analysis Off Variance (ANOVA). F test was performed in order to figure the effect of treatment upon the parameters, if there is a significant difference then Duncan's Multiple Range Test (DMRT) would be performed. The results concluded that the addition of 10% carrot starch is the best treatment, resulting in 6.78 color brightness value enhancement on the tail and 7 color brightness value enhancement of the swordtail fish head.



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## Introduction

The world of ornamental fish trade is beginning to get serious attention from the public since the shift in the pattern of fish consumption which was originally from fulfilling food needs turned to spiritual satisfaction. Through the opportunities that exist, the owners of capital and farmers in Indonesia take advantage of this opportunity to gain maximum profit. The ornamental fish business is used as the main livelihood and is no longer a source of additional income (Lesmana 2002).

One type of ornamental fish is swordtail fish. Swordtail fish is easier to cultivate, has a variety of colors, has a unique shape and has economic value that is not too expensive, but with the addition of external beta-carotene sources can increase its economic value. This fish comes from the United States and is one of the ornamental fish that has long been introduced. This fish treatment is actually very easy because swordfish have a high tolerance for changes in water quality. But to get optimal results, water quality must be maintained (Satyani and Deden 2009).

One of the reasons that make ornamental fish in the public's interest is color. The presence of pigment cells or chromatophores in the dermis on the scales, outside and below the scales causes the appearance of color in fish (Wayan et al. 2010). Pigment cells classified into five basic color categories, namely erythriophora which produces red and orange, xanthofora which produces yellow, melanofora which produces black, leukofora which produces white, and iridofora which can reflect light reflection. Fish can only synthesize black and white pigments. The red, orange and yellow colors cannot be synthesized by the fish's body, so the amount of carotenoids present in the feed greatly affects the color formation in ornamental fish (Wayan et al. 2010).

Feed greatly affects the growth and health of fish. Not only that, the feed can also function to increase the color value, so that it is better to feed it with the addition of certain ingredients to increase the color value of ornamental fish. Feed that contains pigments or certain dyes such as carotene, if given together with artificial feed will be able to increase the amount of pigment in the chef, so that the color of the chef will be clearer or brighter (Bachtiar 2002).

The color of ornamental fish can be maintained by providing food containing color pigments. The source of color pigments can come from synthetic or natural substances. One source of natural pigments can be obtained from carrot flour (Lesmana 2002). Carrots are a source of natural pigments that produce beta carotene which can increase the color value of ornamental fish. Carrots are rich in beta carotene so that they can increase the value of red as well as the use of Spirulina added to the feed (Sunarno 2012).

The high carotenoid content makes carrots can be used as a natural food coloring material for fish. In addition, beta carotene in carrots also acts as a vitamin A precursor (Ikawati 2005).

## Methode

The research method used in this study was an experimental method using a Completely Randomized Design (CRD) consisting of five treatments which were repeated three times.

The treatments given in the experiment are as follows:
Treatment A: Without the addition of carrot flour (Control)
Treatment B: Adding carrot flour with a concentration of 2.5%
Treatment C: Adding carrot flour with a concentration of 5%
Treatment D: Adding carrot flour with a concentration of 7.5%
Treatment E: Adding carrot flour with a concentration of 10%

Observation parameters

1. Colour Observation

Observation of color changes is done every 10 days for 40 days. The taking of fish is done by sampling three fish in each aquarium. The parameter tool used is Toca Color Finder, a color comparison tool. Assessment starts from the smallest value of 1 to the biggest score of 10 with gradations of color from faded orange to deep red.

The color measurement of the test fish was observed by five panelists who had an understanding of the color of ornamental fish and were not visually impaired (color blind and nearsighted), and had done training first. Observations were made visually by comparing the original color of the fish in the Toca Color Finder (Table 1).

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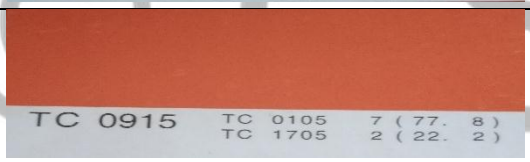
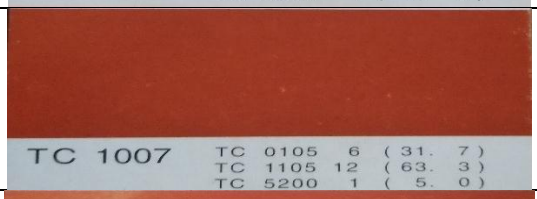
Table 1. TCF Colour Code Used

| No | Picture TCF | Note |
|---|---|---|
| 1 |   | Score 1<br>Code TCF 0615 |
| 2 |   | Score 2<br>Code TCF 0715 |
| 3 |   | Score 3<br>Code TCF 0815 |
| 4 |   | Score 4<br>Code TCF 0816 |
| 5 |   | Score 5<br>Code TCF 0915 |
| 6 |   | Score 6<br>Code TCF 1006 |
| 7 |   | Score 7<br>Code TCF 1007 |
| 8 |   | Score 8<br>Code TCF 1017 |
| 9 |   | Score 9<br>Code TCF 1116 |

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| No | Picture TCF | Note |
|---|---|---|
| 10 |   | Score 10<br>Code TCF 1117 |

Color observation data on the fish head and head were analyzed using the Kruskal-Wallis test, if there were significant differences then Test Z. Weight gain observation data were analyzed using F test with a 95% confidence level to determine the effect of treatment on the parameters. If the treatment has a significant effect (F count> F table) then it is continued by Duncan's multiple distance test with a 95% confidence level to find out which treatment has a significantly different effect. Data from observation of SR parameters and water quality were analyzed in a comparative descriptive manner.

2. Observation of Absolute Growth of Swordtail Fish

Absolute growth in weight is expressed as the difference in fish weight measured at the end of the study and at the beginning of the study. Absolute growth is calculated by the Effendi (2004) formula, namely:

$$W_m = W_t - W_0$$

Note :
$W_m$ : Absolute weight growth of fish (g)
$W_t$ : Fish weight at time t (g)
$W_0$ : Fish weight at time 0 (g)

3. Survival Rate Observation

Survival Rate (SR) or the survival rate of fish is a comparison of the number of fish that lived at the end of maintenance with the total number of fish stocked at the beginning of maintenance (Effendi 2004).

$$SR = Nt/No \times 100\%$$

Note:
SR : Survival Rate (%)
Nt: Number of fish at the end of maintenance (head)
No: Number of fish at the beginning of maintenance (head)

4. Water Quality parameter

Good water quality is an important factor in improving the color quality and health of ornamental fish. Fish will live healthy and have excellent appearance in an environment with suitable water quality (Mulyadi et al 2014).

Water quality measurements include temperature, pH, and DO (Dissolved Oxygen). Water quality measurement is done every 10 days.

## Result & Discussion

**The Level of Tail Colour Changes of Swordtail Fish**

Based on the results of research that has been carried out for 40 days shows that the addition of carrot flour increases the color score of swordfish (Figure 1).

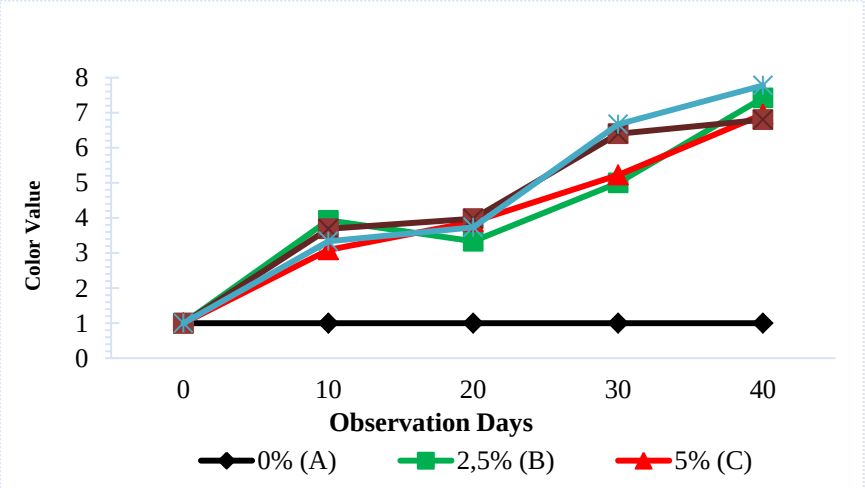

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Figure 1. Various Treatment Color Improvement Charts on the Head of Swordtail Fish

Observations on the 10th day were seen to have begun to increase in color values in treatments B, C, D, and E. In the control treatment or without the addition of carrot flour there was no increase in color values this was due to fish that were not fed with containing rubberenoid, cells the chromatophores will not spread throughout the skin and will cause pale-skinned fish (Sari et al 2012).

Table 2. Figure Comparison of Tail Color of Plati Sword in Early and Late Research

| Treatment | Early Research | Late Research |
|---|---|---|
| A (0%) |  |  |
| B (2,5%) |  |  |
| C (5%) |  |  |

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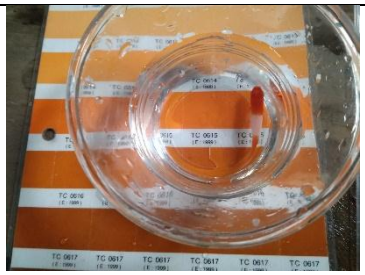
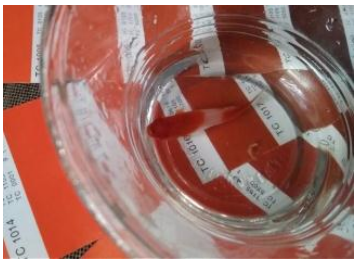
| Treatment | Early Research | Late Research |
|---|---|---|
| D (7,5%) |  |  |
| E (10%) |  |  |

On the 40th day there was an increase in the value of orange in each treatment added with carrot flour (Table 2), the highest color score was found in treatment E (carrot flour 10%) with an average score of 6.67. Color change values in treatments B, C, D, and E continue to increase until the 40th day. The increase in color value still continues to occur because sword swordfish still need carotenoids in their feed to be synthesized into orange to red, besides the fish's absorption and metabolism work optimally because the concentration given is in accordance with the fish's ability to synthesize carotenoids in flour carrot. The same thing also happened in Maesaroh's (2017) study, where the increase in color of oranda goldfish fed with the addition of Spirulina platensis still continued to increase until the 40th day and experienced stability on the 50th to 60th days.

Table 3. Average Color Value on the Tail of the Swordtail Fish

| Treatment | Increase in Color Brightness Value |
|---|---|
| A (No carrot starch) | $0^{a}$±0 |
| B (Addition of 2.5% carrot starch) | $6.42^{bc}$ ±0.78 |
| C (Addition of 5% carrot starch) | $5.96^{b}$±1.17 |
| D (Addition of 7.5% carrot starch) | $5.80^{b}$ ±0.63 |
| E (Addition of 10% carrot starch) | $6.78^{c}$±0.64 |

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

Based on the results of the Kruskal-wallis test showed that there were significant differences in the treatment without addition of carrot flour to all treatments added to carrot flour (Table 5). The results presented in Table 4 show that the highest increase in the color of swordtail fish was in the treatment of 10% carrot flour and the lowest in the treatment without the addition of carrot flour.

Treatment without addition of carrot flour did not increase. This is because the body of the fish cannot synthesize the rubberenoid without any additions from outside. In the opinion of Maulid (2011), which states that aquatic animals cannot synthesize rubberenoid in their body and therefore must be able to trigger external pigments in the form of feed.

Treatment B (2.5% carrot flour has a higher color enhancement value compared to treatment C (5% carrot flour). This is due to differences in fish absorption capacity of beta carotene. In accordance with the study of Jannah et al. (2015) which states that color botia fish for all treatments experienced fluctuating changes, this was caused by the provision of different sources of carotene in the feed given to each treatment, response to different feeds, and differences in the absorption capacity of botia against carotene substances contained in the feed.

As the concentration of carrot flour increases, the color changes increase. This is supported according to Satyani and Sugito (1997), changes in color of fish depend on the amount of color composition in the feed. Required doses of the right color pigment source, not excessive and not lacking to obtain the best color appearance in fish. The right dose of color material will clarify the color

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patterns of the fish's body.

The mechanism of increasing color values indicates in a brighter direction basically influenced by chromatophore cells located in the epidermal layer (Wallin 2002). Chromatophores are cells that contain pigments under endocrine control, chromatophores can alter the spread of pigments in pigment cells (collected or dispersed) in minutes or seconds (Isnaeni 2006). In addition to the type of carotene in the color cell (chromatophores), the color of the fish is also influenced by the movement of pigment granules in cells that are controlled by the nervous system and two chemicals produced by nerves. Epinephrine (adrenaline) is a neurohormone that causes pigments in chromatophore cells to collect in the center of the cell. If the pigment granules gathered in the middle of the cell will cause the animal to lose color. The spread of pigment in the chromatophore is regulated by acetylcholine which is released by nerve cells. Acetyl choline causes the color pigment in the chromatophores to spread so that the color of the fish becomes bright and clear (Pardosi et al. 2014).

**The Level of Color Change on the Head of the Swordtail Fish**

Observation of color changes in the head of the swordtail fish during the study showed an increase in the color score on day 20 until day 30 and on day 40 the color tends to be stable (Figure 2). The highest increase in color score occurs in treatment E (carrot starch 10%) with an average color score of 10 at the end of the study. This is due to the amount of carotene sources added to treatment E which is thought to be appropriate to increase the color of the body of swordtail fish. Feeding that contains carotene with the right amount regularly will be directly proportional with an increase in fish color (Lesmana 2002).

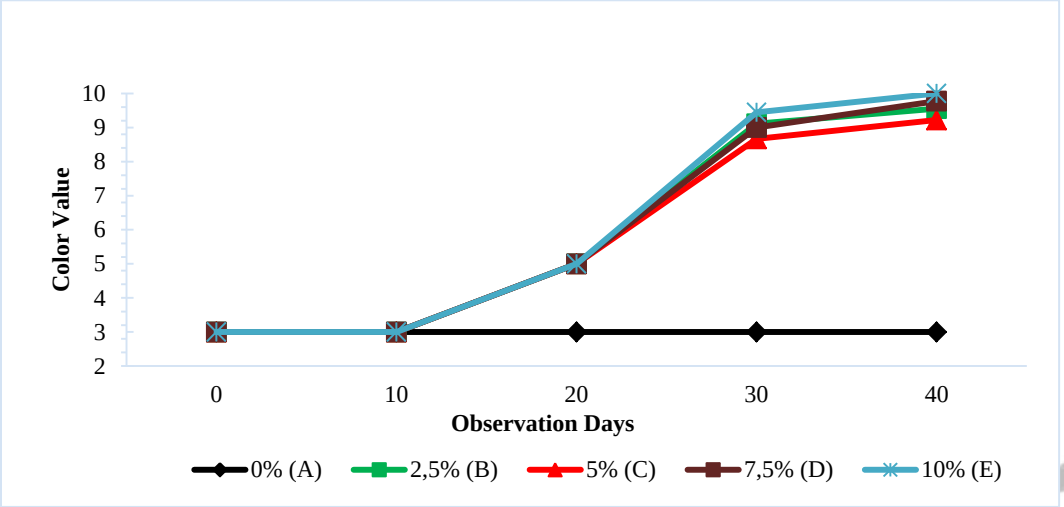

Figure 2. Various Treatment Color Improvement Charts on the Head of Swordtail Fish

Observations on the 10th day showed that there had been no increase in color on the head of the swordtail fish. This happens because the initial color of the fish head has shown a score of 3.

Table 4.Figure Comparison of Tail Color of Plati Sword in Early and Late Research

| Treatment | Early Research | Late Research |
|---|---|---|
| A (0%) |  |  |

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| Treatment | Early Research | Late Research |
|---|---|---|
| B (2,5%) |  |  |
| C (5%) |  |  |
| D (7,5%) |  |  |
| E (10%) |  |  |

The results of observations on the 40th day (Table 4) showed the highest color changes found in treatment E (carrot starch 10%) with an average score of 10 and the lowest is in treatment A (without the addition of carrot starch) with the average score of 3. The change of color score in treatment C, D, and E continue to increase until the 30th day. This is similar to the part of the fish tail which also increases its color value.

Table 5. Average Color Value on the Head of the Swordtail Fish

| Treatment | Increase in Color Brightness Value |
|---|---|
| A (No carrot starch) | $0^{a}$±0 |
| B (Addition of 2.5% carrot starch) | $6.56^{b}$±0.78 |
| C (Addition of 5% carrot starch) | $6.22^{b}$±1.17 |
| D (Addition of 7.5% carrot starch) | $6.78^{bc}$±0.63 |
| E (Addition of 10% carrot starch) | $7.00^{c}$±0.64 |

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

Based on the results of the Kruskal-wallis test, it showed that there were significant differences in the treatment with no addition of carrot starch and all treatments with carrot starch (Table 7). The results presented in Table 5 show that the addition on 2.5% carrot starch experienced a color increase of 6.56, then the addition of 10% carrot starch experienced a color increase of 7. This is similar to what happens to fish tails. Pinandoyo (2005) stated that ornamental fish business is not enough to rely only on efforts to spur ornamental fish production, but it needs to be accompanied by efficient steps about the beauty in color on the appearance. There is

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an improvement in the quality of feed, especially nutrition and the content of raw material sources that have the potential to produce pigments, one of which is carrots.

Absorption and metabolism of swordtail fish to carotene substances contained in 10% carrot flour works optimally because the concentration given is suitable with the ability of the fish to synthesize carotenoids.

**Growth**

Observation of absolute weight is a supporting parameter observed to determine the effect of carrot flour added to commercial feed on the growth of swordtail fish. According to Handajani dan Widodo (2010), growth is an increase in volume and weight in a certain time. Fish growth is closely related to protein availability in feed. The average growth of absolute fish weight in this study gave different results (Table 6).

Table 6. Absolute Weight Growth

| Treatment | Average (Gram) |
|---|---|
| A (No carrot starch) | $0.38^{a}$±0.26 |
| B (Addition of 2.5% carrot starch) | $0.96^{b}$±0.39 |
| C (Addition of 5% carrot starch) | $1.10^{b}$±0.12 |
| D (Addition of 7.5% carrot starch) | $1.56^{c}$±0.06 |
| E (Addition of 10% carrot starch) | $1.58^{c}$±0.23 |

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

The highest growth of swordtail fish during the study was in treatment E (10% carrot starch) of 1.58 grams and the lowest treatment is treatment A (without the addition of carrot flour) of 0.38 grams. The addition of higher carotenoid concentration has an effect on increasing weight growth. This shows that the growth of swordtail fish is not hampered by the addition of carrot starch. Based on the results of Huda's research (2013) which states that carotenoids do not inhibit the growth of koi fish, but can brighten the color of koi fish. These results also show that the addition of carotenoids in feed can increase nutrient and increase fish appetite so that it can increase fish weight during the observation (Yunisari dkk. 2014).

Swordtail fish with the care of adding carrot starch has a greater body weight growth than without the addition of carrot starch. Similar findings were reported by Sulawesty (1997) who stated that feed added with carotenoids produces higher growth than feeds with no addition of caratenoids.

Mudjiman (2007) explains that in getting optimal growth, it is necessary to balance protein, carbohydrate fat, vitamins and minerals in feed. a high quantity of feed dose does not mean it can cause higher growth. In this case there are feeds that are used by fish and there are also those that are not used so that they are just wasted. To achieve optimal growth, we need artificial feed with quality and quantity that is suitable with what fish needs. In addition, the frequency given must be considered so that the feed provided benefits maximally and efficiently.

**Survival Rate**

Survival Rate (SR) is a comparison rate between fish that live at the end and the number of fish at the beginning of treatment, in the cultivation of mortality it is a determination for the success of the business.

The results of the research on SR swordtail fish showed that the addition of carrot starch to commercial feed did not give a significant effect on the level of SR of swordtail fish. SR is influenced by internal factors which include gender, offspring, age, reproduction, disease resistance and external factors including water quality, stocking density, number and composition of complete amino acids in feed (Hepher 1988).

Table 7. Survival Rate of Swordtail Fish

| Treatment | *Survival Rate* (SR) |
|---|---|
| A (No carrot starch) | 100% |
| B (Addition of 2.5% carrot starch) | 100% |
| C (Addition of 5% carrot starch) | 100% |
| D (Addition of 7.5% carrot starch) | 100% |
| E (Addition of 10% carrot starch) | 100% |

Based on table 5, all treatments have 100% SR. This is presumably because carotene content in carrot flour is not only being a source of color pigments but also does not endanger fish health. Satyani dan Sugito (1997) report that besides functioning as a color

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pigment, carotene plays a role in protecting fish against light and can help in the metabolism of the oxygen cycle. Carotene also naturally functions as a basic ingredient of vitamin A, supports thermoregulation or the process of regulating body temperature, helps the formation of egg yolks in the process of reproduction, and affects the health of fish (Bachtiar 2002).

**Water Quality**

Observation of water quality is one of the parameters that must be observed, because water quality is one of the factors that influence cultivation. Water quality parameters observed in the study were temperature, pH, and DO. Observation of water quality in the research is conducted every 10 days. The results are presented in Table 8.

Table 8. Water Quality Observation Results for Swordtail Fish

| Parameter | Results | Reference ( Johnson dan Basolo 2003) |
|---|---|---|
| temperature (ºC) | 25 | 10-30 |
| DO (ppm) | 3.9-4.0 | > 2 |
| pH | 6.67-7.72 | 7.0-8.1 |

a. Temperature

The results obtained from temperature observations during the study are still within safe limits. Jhonson dan Baloso (2003) assert that the optimum temperature for the maintenance of swordtail fish is 10-33$^{o}$C while the averagetemperature during the study is still in the range of 25$^{o}$C. The results of temperature observations during the study were not significantly different in each treatment, because temperature observations were carried out at the same time and the study site was in a closed place so that the outdoor conditions that often changed did not affect the research container

b. Acidity (pH)

The results of pH analysis during the study found that all treatments ranged from 6.67 to 7.72. The pH value during this study is still within reasonable limits. Measurement results at the beginning of the study on pH levels showed a value of 6.67 (outside the optimum limit) and then increased. This is due to the high metabolism in fish during the study. Jhonson dan Baloso (2003) describe that the optimal pH in the treatment of swordtail fish ranges from 7.0 to 8.1.

c. Dissolved Oxygen (DO)

Dissolved oxygen is the amount of oxygen in milligrams which is contained in a liter of water (ppm). The observations of DO during the study found that the average DO of each treatment during the study ranged from 3.9 to 4.0 ppm. From the average results of each treatment during this study it can be said that dissolved oxygen is still within the tolerance limit for the treatment of swordtail fish. According to Johnson dan Basolo (2003), the optimal DO for treatment of swordtail fish is about more than 2 ppm.

## Conclusion

Based on the results of the study, the following conclusions are obtained:

1. The addition of carrot starch into commercial feed has an effect on the increase of the color score of swordtail fish.
2. The provision of carrot starch by 10% for 40 days into the feed can bring the best color score in swordtail fish with an increase in color score of 6.78 in the tail and 7 in the fish head.

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