Effect of addition of pro-enzymes and *Spirulina* flour on growth and color intensity of betta fish (*Betta* sp)

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Abstract. Betta fish is one of the ornamental fish that has high economic value because it has features such as the beauty of the body color, the uniqueness of the shape of the fins so that it is very attractive to ornamental fish lovers. Attractiveness value of ornamental fish can be measured from their brilliant color, shape and physical completeness, behavior, and health conditions. Color is one deciding factor that ornamental fish is in demand by consumers, so that farmers need to maintain the color of ornamental fish by providing food containing color pigments. The aim of this study was to obtain a mixture of effective doses of pro-enzyme *Spirulina* flour in feeding to increase growth and color intensity of betta fish. The results showed that the highest absolute weight growth was found in treatment B (5 grams) of pro-enzyme *Spirulina* flour 2.154 followed by treatment C 1.554 (7 grams), treatment A 0.844 (3 grams), and treatment D 0.002 (0 grams). The highest level of color change occurred in treatment A (dose of 3 grams) while the lowest color change rate was found at treatment D (0 grams).

1. Introduction

Betta fish is a species of popular freshwater ornamental fish that commonly loved by ornamental fish community. Culture of betta fish is developing quite rapidly because they are easy to maintain. However, these ornamental fish enthusiasts prefer male than female because male fish have aesthetic value and color that are nicer and more attractive and have higher profits [1].

Betta fish have many body forms, especially in the shape of the tail, such as the type of crown (crown tail), full tail and slayer. These ornamental fish also have price differences between male and female fish. Male fish themselves have a higher or higher price [2]. This is because male fish have the advantages in morphology and color so that they have higher aesthetic values. Female fish have a less attractive color, fat belly, and short caudal and anal fins, so the selling price of female fish is lower than male fish. There are more male fish enthusiasts, so it is more effective and profitable if only the male is produced and maintained [3].

*Spirulina* is a microalgae that can be used as natural food for fish seeds, both sea and freshwater fish. Carotenoids are pigments that are naturally present in plants and some photosynthetic organisms such as algae and several types of fungi and bacteria. One food source that contains carotenoid types of astaxanthin is *Spirulina* sp. *Spirulina* that can be used to increase the brightness of fish colors [4]. Freshwater ornamental fish fed with *Spirulina* sp, resulted in a shinier color [5]. *Spirulina* produces various bioactive compounds that have high economic value, such as carotenoids [6]. *Spirulina*
increases the red color of fish. More specifically, *Spirulina* especially brightens the yellow, red, and orange colors [7]. The aim of this study was to obtain effective doses of *Spirulina* pro-enzyme flour in feed to increase growth and color intensity of betta fish.

2. **Material and methods**

2.1. **Research time**

This research was conducted from August to November 2020, with a maintenance period of 4 (four) months, in which observing the color of the fish was carried out every week.

*Test fish*

The test fish used were red betta fish seeds, 2 months old male, obtained from ornamental fish cultivators.

*Test feed*

The test feed used was a commercial pellet form mixed with pro-enzyme and *Spirulina* and then fed to the reared fish.

*Feed making*

Preparation of feed, namely commercial feed weighing 45 grams, then adding 10 grams of pro-enzyme and *Spirulina* flour according to the treatment dose then sprayed with 100 ml of water then the feed is dried in the sun to dry then the feed is repackaged according to the treatment, then the feed is given to the fish.

2.2. **Research methods**

This research was carried out using an oral feeding method by administering pro-enzymes and carrot extract in pellet form feed. This study used 4 treatments with 3 replications. The treatments tried were as follows:

- **Treatment A**: 45 grams of pellet feed, 10 grams of pro-enzyme with a mixture of 3 grams/100 ml *Spirulina* distilled water
- **Treatment B**: 45 grams of pellet feed, 10 grams of pro-enzyme with a mixture of 5 grams/100 ml distilled water
- **Treatment C**: 45 grams of pellet feed, 10 grams of pro-enzyme with a mixture of *Spirulina* 7 grams/100 ml distilled water
- **Treatment D**: 25 gram pellet feed, without the enzyme-po and *Spirulina* mixture (control)

The maintenance container used was 12 units of 5 liter capacity aquarium. Before the aquarium was used, it was first washed for avoiding disease pathogens such as bacteria and fungi. Then water was filled into the aquarium. The water used had been deposited in the tub. Watered aquarium was equipped with aerator. 3 fish were kept in each container. Feeding was administered with a frequency of 2 times a day, they were in the morning at 08.00 and afternoon at 16.00 local time. Observation of fish color was done following the Toca Color Guide method.

2.3. **Data analysis**

The data analyzed were data on growth of absolute weight and color intensity of betta fish. To calculate absolute net weight growth, a formula according to [8] is used as follows:

\[ W = W_t - W_o \]

where: \( W = \) absolute weight growth (grams), \( W_t = \) final weight of fish (grams), \( W_o = \) fish initial weight (grams)

Whereas analyzed data on feed efficiency follows the formula [9]:

\[ (W_t + D - W_o) \]
where: \( W_t = \) The final weight of the fish, \( W_o = \) Fish initial weight, \( D = \) Weight of dead fish, \( F = \) Weight of feed given

3. Results

3.1. Absolute weight growth

The results of the absolute weight growth analysis are presented in following Figure 1.

![Figure 1. Graph of absolute weight growth of betta fish.](image)

The results showed that the highest absolute weight growth was found in treatment B (5 grams) of enzyme-po, *Spirulina* flour 2.154 followed by treatment C 1.554 (7 grams), treatment A 0.844 (3 grams), treatment D 0.002 (0 grams). Based on this study results, dose of 5 grams was best or most effective dose in accelerating betta fish growth (absolute weight growth).

3.2. Feed efficiency

The results of biomass observations, feed efficiency of betta fish seeds during the 45 days of the study are presented in Figure 2.

The results showed that the value of biomass, feed efficiency at a treatment dose of 3 grams of *Spirulina* gave the optimum value and was not significantly different \((P > 0.05)\) treatment C, B, but significantly different from treatment dose D.
3.3. Color intensity
Changes in the intensity of the color of the Betta fish in each treatment are presented in the following figure. While the development of color intensity in Betta fish can be seen in Figure 3.

Figure 2. Feed efficiency graph

Figure 3 shows that the level of color change occurred in treatment A dose of 3 grams at week 3 was 2.2, week 4: 3.5, week 5: 3.8, week 6: 4.7, and week 4: 7.5. Whereas in treatment B the dose of 5 grams and treatment C the dose of 7 grams experienced a change at week 3 to week 7 with the value in treatment B was 4.8 and treatment C was 4.6. The lowest color change rate was at treatment D at 0 grams that there was no visible color change from the first week to week 7.
4. Discussions

4.1. Absolute weight growth
From the physiological properties, feed dose has an important role in fish growth. To trigger optimal growth, it requires quantity and quality standards. Feed needs to contain sufficient protein, which means that the fish food meets adequate nutritional needs for life. Another factor that allows the high growth of Betta fish by giving doses of 5 grams can be caused, because the dosage of feed containing *Spirulina* flour + pro-enzyme has a fairly high and complete nutritional value, where in addition to containing carbohydrates and fat there are also various kinds of vitamins and minerals in it. the complete amount with protein content ranges from 56-62% per 3 grams [10]. it goes on to say that fish growth can occur when there is excess energy and amino acids from food after being used by the body for metabolism, movement of body parts or replacement of cells that are no longer used.
4.2. **Feed efficiency**  
The results showed that the value of biomass, feed efficiency at a treatment dose of 3 grams of *Spirulina* gave the optimum value and was not significantly different (P> 0.05) treatment C, B, but significantly different from treatment dose D. Biomass is the weight of all Betta fish seeds that are still alive at the end of maintenance. The biomass value is strongly influenced by the survival rate of the population, while the feed efficiency is influenced by the protein content of the feed. Feed efficiency is the proportion of increased fish biomass to the amount of feed consumed by fish [11]. The high value of feed efficiency obtained in betta fish seeds fed with pro-enzyme with *Spirulina* flour indicates a better feed quality so that the fish can utilize optimally.

4.3. **Color intensity**  
Changes in the brightness of the betta fish color are influenced by several factors. According to [12], there are two factors, namely internal factors and external factors. Internal factors originating from the body of the fish that are fixed in nature, such as age, size, sex, genetics, and the ability of fish to absorb nutrients in food. External factors that come from outside the fish body are water quality, light, and foods that contain high nutrients and color pigments.

The addition of *Spirulina* flour in the feed at the 3 grams dose treatment showed the optimal dose and the best dose because it gave the highest brightness level of betta fish color compared to other treatments. [13], stated that adding pigment to feed has a maximum limit in the sense that if the addition of pigment into the feed is in excess, at a certain point it will not provide a better color change and may even decrease the color value. In order to obtain the best color appearance in fish, the dosage of the source of the color pigment must be correct [14].

In principle, fish will absorb carotenoids in food directly and can be used as pigment-forming to increase color changes in fish bodies. On the other hand, pigmentation is also influenced by hormones and the central nervous system [15]. The pituitary gland can also produce Melanin Depressing Hormone (MDH) which affects color fading and Melanin Aggregating Hormone (MAH) which can affect color appearance [12].

5. **Conclusions**  
Addition of *Spirulina* flour + Enzyme-pro at a dose of 5 grams (treatment B) is an effective dose to stimulate absolute weight growth in betta fish. The level of color change occurred at a minimum dose of 3 grams (treatment A).

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