The effect of different feeding on growth, feed conversion ratio and feed efficiency in synodontis (Synodontis eupterus) seed

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Abstract. Synodontis fish is a ornamental freshwater fish that has high economic value and is popular with the community because of its upside-down swimming habit. This encourages farmers to increase production output. The resulting production depends on the maintenance method, which starts from the seeding stage. One of the influential factors in hatchery activities include the availability of feed for seed. This research was carried out on December 23, 2019, until January 23, 2020 at Research Institute for Ornamental Fish Culture, Depok, West Java, which aimed to determine the growth, feed conversion ratio and feed efficiency of synodontis fish seed with different feeds. The method used in this study was sampling the length and body weight of the fish which was carried out once a week in 5 aquariums with different feeding treatments. The monitoring results showed that the synodontis fish seed experienced growth (length and weight) every week. However, the given feed was not efficient because it had an FCR value was > 2.0 and an feed efficiency value was <50%. As for the best feed, it is given to synodontis fish seed in the form of natural food (Chironomus sp.) which have high value of growth rate.

1. Introduction

One of the things that are popular with people in the field of freshwater fisheries is cultivating ornamental fish. Freshwater ornamental fish cultivation has good prospects, because the market potential is still very open, both domestic, regional and international markets [1]. Synodontis fish is a freshwater ornamental fish that is favored among the community. Synodontis fish belong to the catfish group of the Mochokidae family with the order Siluformes [2]. According to Azmi [3] the name synodontis comes from the Greek, namely "syn" means together and "odon" means teeth because these synodontis fish like to group together and have mandibular teeth. This fish is known for the beauty of its dorsal fins which are upright and elongated, so that it is often called the featherfin catfish and can swim in an upside-down position. With such uniqueness, this fish has a high economic value both inside and outside the country.

The economic value and market opportunities are quite high, encouraging freshwater ornamental fish cultivators to increase the production of synodontis fish (Synodontis eupterus). The resulting production depends on the maintenance methods that have been applied. The hatchery stage is a very important stage in production, because it is a key stage in the entire cultivation activity itself.
in line with what was expressed by Dikurahman and Kadari [4] that good seed production (hatchery) is needed, so that it can fulfill the high demand for sustainable cultivation especially in enlargement of fish.

The success rate of fish hatcheries is influenced by many factors, one of which is the availability of feed for seed. It is known that there are two types of feed needed in cultivation activities, namely natural food and artificial feed. Natural food is generally microorganisms or microorganisms that live in water. According to Arief et al. [5] The availability of natural food has an important role in fish farming, especially in the seed stage. Unlike natural feed, artificial feed is food that is deliberately made from several raw materials with the help of tools. The raw materials commonly used in the manufacture of feed are animal and vegetable raw materials by taking into account the nutritional content, characteristics and size of the fish that will consume the feed [6].

Feed is an expensive and important component in aquaculture, because feed has a function to meet the energy needs needed by fish [7]. Thus it is very necessary to carry out a feed management in aquaculture activities. According to Hanief [8], feeding management is an effort to maximize the use of feed for growth, with feeding management it is hoped that the feed given can be used by fish effectively and efficiently so as to produce optimal fish growth.

This research is in order to find out the growth, feed conversion ratio and efficiency of feed utilization in synodontis fish seeds with different feeding at the Research Institute for Ornamental Fish Culture, Pancoran Mas, Depok, West Java. The benefits of this research can increase and apply knowledge and skills in the management of natural and artificial feeding in synodontic fish seeding (Synodontis eupterus) at the Research Institute for Ornamental Fish Culture, Pancoran Mas, Depok, West Java.

2. Material and methods
2.1 Time and Place
This research has been conducted for one month, starting from December 23, 2019 to January 23, 2020 at the Research Institute for Ornamental Fish Culture, Pancoran Mas, Depok, West Java.

2.2 Research Tools and Materials
This study used several tools including aquarium size 80 x 40 x 30 cm³, syringe 1 ml, sapon hose, aeration hose, aeration stone, sandpaper, basin, millimeter block, digital scales, and Slide. As for the ingredients used in this study are salt, Oxytetracyclin is used for the prevention of bacterial and fungal attacks, Phenoxyethanol is used as an anesthetic during sampling, fish feed includes: Pellets sunk with trademark Feng Li (Premium) FL-2 fine and Chironomus sp. (Bloodworms) chopped.

2.3 Container Preparation
The container used is an aquarium made of glass with a size of 80 x 40 x 30 cm³ as much as 5 pieces. The aquarium is cleaned using sand paper from corner to corner to side followed by rinsing the aquarium using clean water. The next step is to dry the aquarium for ± 1 day with the aim of sterilize the aquarium from bacteria and fungi. Dry aquariums are filled using clean water with a height of ± 10 cm.

2.4 Maintenance of Seed
The rearing stage of the seed begins when the larvae have the same shape as the parent and already have complete or perfect organs [9]. The process of maintaining synodontis fish seed is carried out by maintaining water quality and providing good feed. The seed maintenance stage was carried out in 5 aquariums with the following treatments:

a) Aquarium A which is fed in the form of 100% artificial feed, with the total fish at the beginning of maintenance as many as 25 tails;
b) Aquarium B which is fed in the form of 100% natural feed, with the total fish at the beginning of maintenance of 29 tails;
c) Aquarium C which is fed in the form of 100% natural feed, with the total fish at the beginning of maintenance as many as 28 tails;

d) Aquarium D which is fed in the form of 50% natural feed coupled with 50% artificial feed, with a total of 29 fish at the beginning of maintenance; and

e) Aquarium E which is fed in the form of 100% artificial feed, with a total of 26 fish at the beginning of maintenance.

2.5 Feeding
The feed given for synodontic fish seed is sinking pellets with the trademark Feng Li (Premium) FL-2 which is mashed with a protein content of 41% (Minimum) and Chironomus sp. (Blood worms) were chopped with a protein content of 51.15% [10]. Feeding is done as much as possible (ad-satiation). In the ad satiation method, cultivants are fed until they are full until they are not showed reactions when fed [11]. The frequency of feeding is 2 times a day, namely in the morning at 07.00 WIB and at night at 19.30 WIB. With an optimal feeding dose of ± 4 grams / day due to the small amount of leftover feed each morning.

2.6 Water Quality Management
Each seed rearing container is equipped with recirculation to maintain the oxygen content in the water in order to meet the needs of fish life. Not only that, to maintain water quality it is necessary to sipon ± 10-15% every morning to clean dirt (feces). Water quality monitoring by means of secondary data collection which is done once a month, this is done with the assumption that within one month of maintenance, there is no drastic change in the quality of water used as a medium for synodontis fish cultivation. Measurement of water quality consists of several test parameters, namely dissolved oxygen, temperature, pH, ammonia (NH3), and also Nitrite (NO2).

2.7 Growth Monitoring
Growth monitoring of synodontis fish seed was carried out by means of sampling which was carried out once a week. The first step of sampling fish seed is to move them from the aquarium to a small tub filled with water using a seser. Furthermore, synodontis fish seed (Synodontis eupterus) were anesthetized using phenoxy ethanol at a dose of 0.3 ml / L of water. Then proceed with measuring the body length of the fish using millimeter blocks and body weight of the fish using analytical scales. Then proceed with recording the results using writing instruments.

2.8 Data Analysis
The parameters measured were growth, FCR and EPP by measuring length using a millimeter block with an accuracy level of 0.1 mm and body weight of fish using analytical scales with an accuracy level of 0.1 gr.

a. Growth Rate or GR, can be calculated using formula [12]:

\[ GR \ (\text{Gram/day}) = \frac{W_t - W_o}{t} \]

b. Specific Growth Rate or SGR, can be calculated using formula [13]:

\[ \text{SGR} \ (%) = \frac{\ln (W_t) - \ln (W_o)}{t} \]

c. Absolute length growth, can be calculated using formula [14]:

\[ \text{LM} \ (\text{mm}) = L_t - L_o \]

d. Specific Length Growth Rate or LPSS, can be calculated using formula [15]:

\[ \text{LPPS} \ (%) = \frac{\ln (L_t) - \ln (L_o)}{t} \]
e. Survival Rate or SR, can be calculated using formula [16]:

\[ \text{SR} (\%) = \frac{N_t}{N_0} \times 100\% \]

f. FCR or Feed Conversion Ratio, can be calculated using formula [17]:

\[ \text{FCR} = \frac{F}{(W_t + D) - W_o} \]

g. EPP or Efficiency of Feed Utilization, can be calculated using formula [17]:

\[ \text{EPP} (\%) = \frac{(W_t + D) - W_o}{F} \times 100\% \]

With the following description:

- \(W_t\) = Fish weight at end of maintenance (grams)
- \(W_o\) = Fish weight at the beginning of maintenance (grams)
- \(L_t\) = Length of fish at end of maintenance (mm)
- \(L_o\) = Length of fish at the beginning of maintenance (mm)
- \(t\) = Length of Maintenance Time (days)
- \(N_t\) = Number of fish at the end of maintenance (tail)
- \(N_o\) = Number of fish at the beginning of maintenance (tail)
- \(F\) = Total Weight of Feed given to fish (grams)
- \(D\) = Total Weight of Dead Fish (grams)

3. Results and discussion

Based on research that has been done for 30 days and sampling is done every 1 week. The results obtained are growth rate, specific growth rate, absolute length growth rate, specific length growth rate, fish survival rate, feed conversion ratio, and feed utilization efficiency presented in Figure 1 through Figure 7.

3.1 Growth

Observations of the length growth of synodontis fish seed in 5 aquariums showed that all the fish reared with different feeds experienced an increase in length every week. The best length gain is Aquarium E, where Aquarium E has an absolute length growth of 0.981 mm. This is because the growth in fish has different levels, according to the ability of fish to digest and utilize the feed that has been given optimally [18].

![Absolute length growth rate (mm)](image)

**Figure** 1. Absolute length of synodontis fish seed
Figure 2. Specific length growth rate (LPPS) of synodontis fish seed

In contrast to the absolute length calculation, the calculation of the specific length growth rate of synodontis fish seed at Research Institute for Ornamental Fish Culture Depok, actually shows that Aquarium B has a good increase in length growth every day, which is indicated by an increase in the LPPS value at each sampling. It could be assumed that the seed have been able to adapt to the feed so that the seed can consume the feed properly and affect the specific length growth rate. As stated by Karimah et al. [19] Fish growth is strongly influenced by the type and quality of feed given. Good quality feed will produce fish growth and high feed efficiency.

Based on the calculation of Growth Rate (GR), it can be known that only in Aquarium C there is an increase in the weight of growth every week. unlike Aquarium C, other aquariums such as Aquariums A, B, D, and E tend to experience increased growth in the second week. This could happen, because according to Dharmaraj and Dhevandaran [20] it was stated that in the early stages of growth of ornamental fish, the nutrients obtained were used more for growth in the fish itself, whereas if the ornamental fish were larger, the nutrients obtained were used to increase the growth of ornamental fish color quality.

Figure 3. Growth rate (GR) of synodontis fish seed.
Similar to calculations on growth rates, calculations at specific growth rates also show that fish reared in Aquarium C have a significant increase in growth. This can happen, presumably, natural food that is given easy and can be digested by synodontis fish seed and this feed is one of the favorite foods of fish. Niode et al. [21] stated that natural food is the initial and main feed for fish seed because it has sufficient nutritional content and is easy for fish to digest.

From the calculation of GR, SGR, and LPPS, which shows the yield per day of synodontis fish seed, it can be seen that natural feed gives better results than artificial feed. Where the GR and SGR calculations show that the best results are shown in the fish reared in aquarium C which are given 100% natural feed. In the LPPS calculation the best results are shown by aquarium B which is given 100% natural food. In contrast to the LM which shows the difference between the body length of the fish on the 20th day of maintenance and the length of the fish's body on the 1st day of maintenance, the best results are Aquarium E which is given 100% artificial feed.

3.2 Fish Survival Rate

The survival rate or commonly abbreviated as SR can be interpreted as the percentage of seed that are alive until the end of the rearing period.
Based on the calculation results (Figure 5.) the survival rate of synodontis fish seed at Research Institute for Ornamental Fish Culture, Pancoran mas, Depok, showed that the highest survival rate of synodontis fish seed was found in seed raised in Aquarium A, then Aquariums E, C, D, and B. It is known, that feeding affects the survival rate of synodontis fish. The survival rate of fish is influenced by several factors, including external factors and internal factors [22]. Internal factors that affect the health of fish, quality of broodstock and offspring. External factors include the condition of the culture environment, water quality, stocking density of fish, feed given and pests and diseases that attack fish.

3.3 Feed Conversion Rate & Feed Utilization Efficiency
The conversion ratio and feed efficiency are needed to determine and show that the fish are able or unable to utilize feed and how efficiently the feed can be used by fish. The results obtained during the Research can be seen in Figure 6 and 7.

![Feed Conversion Ratio](image)

**Figure 6.** Conversion ratio for synodontis fish seed

![Efficiency of Feed Utilization](image)

**Figure 7.** Feed efficiency in synodontis fish seed

Based on the results above, it shows that the value of feed efficiency is inversely related to the feed conversion ratio obtained. The best results of conversion and efficiency of feed utilization are seed that are reared in Aquarium A. According to Radona et al. [23] The high value of feed efficiency obtained indicates that the quality of the feed is better so that the fish can utilize it optimally. Not only that, the
results obtained also indicate that the conversion value and feed efficiency obtained cannot be said to be good because it has a feed conversion value > 2.0 and the feed utilization efficiency value does not exceed 50%. This is supported by Craig and Helfrich [24] who stated that the FCR that is considered good for most fish species is between 1.5 - 2.0 while the efficiency of feed utilization is considered good if the yield obtained is more than 50% and the most the maximum is 100% (but in fish, it cannot be fully utilized 100%).

3.4 Water Quality

The measurement of water quality obtained secondary to the test laboratory of The Research Institute for Ornamental Fish Culture, Pancoran Mas, Depok, West Java, can be seen in Table 1. Based on the results obtained, it can be known that the water quality is still within the optimal value range, so it is still good for sinodontis seeds.

| Parameter                  | Value | Optimum standard                  |
|----------------------------|-------|-----------------------------------|
| Dissolved oxygen (mg/l)    | 5.01  | 5-7                               |
| Temperature (°C)           | 27.8  | 22-27                             |
| pH                        | 6.41  | 6.8                               |

3.5 Pests and Diseases

When implementing the Research at Research Institute for Ornamental Fish Culture, Pancoran Mas, Depok, there were no pests and diseases found in synodontis fish. This is because the media used for aquaculture has good water quality, and prevention is carried out by administering Oxytetracycline or OTC at a dose of 0.01 gram / L after each water replacement is carried out. This statement is supported by Juwana [26] who stated that, Oxytetracycline is an effort to prevent the development of microorganisms that have resulted in resistant and harmful bacterial strains. Based on the results of identification and inventory of several types of freshwater ornamental fish conducted by Sumiati and Aryati [27], it was shown that ectoparasites attacking Synodontis fish reached 14.5% with the monogenea parasite Dactylogyrus around 20.08% of the infected samples.

4. Conclusion

Synodontis fish seed that are fed chopped blood worms (Chironomus sp.) And artificial feed branded Feng-Li which are crushed experience growth (length and weight) every week. However, the feed given is not efficient because it has an FCR value > 2.0 and an EPP value <50%. Not only that, if it is viewed from the calculation of growth, the survival rate of the fish and the values of FCR and EPP, it shows that natural feed is more dominant, shows better results than artificial feed. This is because synodontis fish seed are still unable to adapt to artificial feed even though efforts have been made to make the size of the feed according to the mouth openings of the synodontis fish seed.

5. References

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