Effects of Feeding Frequency on Growth Performance and Feed Conversion Ratio of Gurami Sago (*Osphronemus goramy*) Fingerlings in A Recirculating Aquaculture Pond System

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Abstract. Gurami sago, *Osphronemus goramy* is the result of newly released domesticated species in 2018. This freshwater fish is endemic in Indonesia, and has a high market price. This study investigated the effects of different feeding frequencies (one, two, three and four meals per day) on growth performance and feed conversion ratio of gurami sago fingerlings over a period of 90 days. The experiment took place in a recirculating aquaculture pond system consisting of twelve rearing units. One-hundred eighty (180) gurami sago fingerlings (with an average initial weight: 2.57±0.73 g and length: 5.77±0.55 cm) were used in the study. Fifteen gurami sago fingerlings were cultured in each pond, and randomly distributed into four experimental treatments with three replicates. Fish were fed at a feeding rate of 5.0% body weight/day throughout the duration of the study. Fish were sampled every 30 days to evaluate growth in weight and length, and feeding was withheld for 24 h prior to sampling. Results indicated that feed ration of three meals per day had the highest growth performance of fish compared with feed rations of either one, two or four meals per day. Feed conversion ratio (1.92±0.14), protein efficiency ratio (13.82±1.22%) and survival (82.22±3.85%) were also better at a feeding ration of three meals per day.

Keywords: Gurami sago. feeding frequency. feed utilization. growth. survival

1. Introduction

Environmental factors, genetic, food including feeding frequency of aquatic organisms have significant roles in fishery management because they are crucial towards increased survival, growth and feed conversion [1,2,3,4]. Feed management in terms of optimizing feeding frequency is essential in the culture of freshwater fishes and it has become one of the crucial areas of research in the field of aquaculture. Giant goramy (*Osphronemus goramy*) is a widely-cultured species all over the world including Indonesia especially in Lima Puluh Kota District. It is locally known as gurami sago based on the Decree of the Ministry of Marine Affairs And Fisheries Republic of Indonesia 2018 [5,6,7]. This fish has tolerance to handling and is resistant to diseases [8], efficient conversion of natural, controllable reproduction. high marketability as ornamental fish and fish consumption [4,5], tolerates poor water quality [9,10,11] but grows slowly. Therefore, numerous studies have been focused on the
feed utilization of fish species to reduce excessive expenses and tremendous savings in feed cost. Overfeeding and waste food decrease the water quality, which disturbs the fish metabolic system.

To increase the growth of fish, management of feed is needed so that the feed given can be utilized by fish properly. The amount of the daily feed intake, frequency and timing of the feedings and presentation of the predetermined ration so as to produce optimal fish growth, high feed efficiency, survival and low FCR [12,13,14]. Optimal feeding frequency may vary depending on species [15,16,17,18,19,20], age, size [9,13], environmental factors [21, 22,23], metabolic system [24] and feed quality.

It was in view of this paucity of information that the present study was carried out to investigate the influence of feeding frequency on the growth performance and feed conversion ratio of gurami sago fingerlings in a recirculating aquaculture pond system for a period of 90 days. In this study, a low-cost feed was formulated using a locally-available ingredient, water lettuce, *Pistia stratiotes* L and was supplied to the fish at different feeding frequencies for 90 days.

### 2. Materials And Methods

#### Experimental diet

Fish feed was formulated on dry matter basis (g 1000-1) in one batch to supply the calculated protein level of 25% with fermented vegetable flour, *Pistia stratiotes* L (Table 1) providing the majority of dietary protein (Table 2). A mixture of minerals and vitamins were added to the ingredients (fish meal, rice brawn, tapioca flour and corn oil) of diet (Table 2). All the dry powdered materials were thoroughly mixed.

#### Table 1. Nutrient composition of vegetal flour, *Pistia stratiotes* L

| Nutrient compositions | Vegetable flour, *Pistia stratiotes* L (%) |
|-----------------------|------------------------------------------|
|                       | Before fermentation | After fermentation |
| Moisture              | 0,00                     | 0,00                               |
| Ash                   | 10,97                    | 4,67                               |
| Crude protein         | 26,30                    | 39,21                              |
| Crude fat             | 6,16                     | 4,37                               |
| Karbohydrat           | 56,49                    | 51,58                              |
| Crude fiber           | 12,89                    | 9,94                               |

#### Table 2. Ration composition protein levels of 25%

| Ingredients     | Amount (g) | Protein level (%) |
|-----------------|------------|-------------------|
| Vegetable flour | 350        | 13.72             |
| Fish meal       | 100        | 7.57              |
| Rice brawn      | 490        | 4.39              |
| Tapioca flour   | 58         | 0                 |
| Mineral mix     | 1          | 0                 |
| Corn oil        | 1          | 0                 |
| **Total**       | **1,000**  | **25.68**         |

#### Experimental Procedure

The experiment took place in a recirculating aquaculture pond system provided with twelve rearing units of 160 x 75 x 50 cm. The gurami sago fingerlings of average body weight were distributed in to 12 groups of 15 fish in each group with an average initial weight and length of the fish were 2.57±0.73 g and 5.77±0.55 cm. The four treatments were run in three replicates (namely, daily and timing feeding frequencies of **FQ1** (once/day; 09.00am); **FQ2** (twice/day; 09.00 am & 5.00pm).
Water quality was monitored every 30th day for temperature, pH, dissolved oxygen and total alkalinity. The study was carried out for 90 days. All fish were collected separately from each replicate experimental rearing unit and weighed to assess the growth performance of fish at the end of the experiment.

Calculations and Statistical analyses

Weight gain = Final weight (g) – Initial weight (g)

Pertumbuhan panjang mutlak = Panjang akhir (mm) – panjang awal (mm)

Specific Growth Rate (SGR %/day) = [(ln Wf – ln Wi)/T] x 100

(Wang et al., 2005)

Food Conversion Ratio (FCR) = total feed intake (g)/total wet weight gain (g)

(Chong et al., 2004).

Protein Efficiency Ratio (PER) = Wet weight gain (g)/Total protein intake

Survival (%) = (final number of fish / initial number of fish) x100

(Effendi, 1979)

All data were subjected to one-way ANOVA to determine significant differences due to effects of dietary treatments, and two-way ANOVA to determine the significant differences due to levels of protein, lipid and their interaction. Post Hoc was analyzed by Tukey’s HSD test with statistical significance determined at P < 0.05. All statistical analyses were carried out using the software SPSS (version 17. SPSS Inc. Chicago IL. USA).

3. Result and Discussion

The results of growth performance parameters of the experimental fish at different feeding frequencies during the study period are shown in Tables 3, Figures 1 and 2. Significant differences (P<0.05) were recorded in the average weight and length of the fish among treatments.

Table 3. Effects of feeding frequencies on growth and FCR parameters (mean ± SE) of gurami sago during the restricted feeding period.

| Feeding frequencies | FQ1 (once/day) | FQ2 (twice/day) | FQ3 (thrice/day) | FQ4 (four times/day) |
|---------------------|---------------|----------------|-----------------|---------------------|
| Initial weight (g)  | 2.57±0.73     | 2.57±0.73      | 2.57±0.73       | 2.57±0.73           |
| Final weight (g)    | 6.83±0.55a    | 9.12±0.43b     | 13.82±1.34c     | 10.27±0.55d         |
| Weight gain (g)     | 4.26±0.56a    | 6.55±0.40b     | 11.25±1.22c     | 8.42±0.52d          |
| Length gain (cm)    | 1.57±0.28a    | 2.40±0.32b     | 3.31±0.33c      | 2.87±0.32d          |
| SGR (%)             | 1.65±0.221a   | 2.55±1.53b     | 4.37±0.47c      | 3.20±0.20d          |
| FCR                 | 4.55 ± 0.80a  | 2.92 ± 0.43b   | 1.92 ± 0.14b    | 2.02 ± 0.16d        |
| PER                 | 6.83 ± 0.56a  | 9.12 ± 0.40b   | 13.82 ± 1.22c   | 10.65±0.42d         |
| SR (%)              | 62.22 ± 3.85a | 73.33 ± 6.67b  | 82.22 ± 3.85b   | 77.12±3.20d         |

Mean values (mean ± standard error) in the same rows with different superscript are significantly different (p<0.05)
Growth and feed response parameters are presented in Table 3. At the end of the feeding trial, there were significant differences in body weights among the different treatments, final fish weights and weight gain increased in all groups in relation to increasing feeding frequencies. The highest mean weight (11.25±1.22 g) was recorded at FQ3 and 8.42±0.52 g at FQ4 followed by 6.55±0.52 g at FQ2 and FQ1, respectively. Daily growth rate decreased with decreasing feeding frequency (Figure 1 and 2). Maximum mean specific growth rate (SGR) of 4.37% day⁻¹fish⁻¹ and 3.20% day⁻¹fish⁻¹ were recorded for treatment FQ3 and FQ4, respectively; whereas the minimum mean SGR was recorded as 1.65% day⁻¹fish⁻¹ in treatment FQ1. The mean specific growth rate also decreased with decreasing of feeding frequency. Feed consumption and growth rates appeared to increase with increasing feeding level up to FQ3, though further increase in feeding level resulted in significant increase. It shows that this feeding frequency is optimal for the condition of this trial suggesting that both growth and feed utilization are most efficient at this level of feeding. The feeding must be carefully controlled so that the optimal frequency of feeding will provide maximum growth [25].

The best mean FCR, PER and survival were recorded at FQ3 and FQ4 whereas the lowest was recorded at FQ1. Feed conversion ratio is high at FQ3 although there is significant difference between FQ1, FQ2 and FQ4 in terms of food conversion ration. There was significant difference in food conversion ratio, PER and survival across treatments. The fish takes about 6-8 hours to digest the food eaten [15]. Feeding at the right time will be increase fish growth because it can maximize the efficiency of feed utilization. The effects of feeding frequency on fish growth and feed conversion ratio with daily feeding frequencies thrice/day until five times have been studied for several species as
African catfish [13,21,27,31,32], Nile tilapia [3,16], Atractosteus tropicus Gill [14], Macrobrachium nipponense [29], Salvelinus malma [30], Lutjanus johnii [34].

But, fish fed twice and once per day had the highest growth performance compared to fish feed with three and four meals/day for Russian sturgeon [26], African catfish [28]. Feeding once and twice a day, fish showed the lowest growth which might have been due to the nutrient requirement for maintenance. It appears that a large proportion of nutrient in the diet was used to maintain life, and only a small proportion was available for growth [16]. Fish are able to utilize nutrients efficiently especially protein; thus, increasing the growth of fish [33]. Increased feed digestibility and increased water quality are the benefits of using the correct feeding frequency.

4. Conclusion

Based on the results of the present study it can be concluded that gurami sago fingerlings can be fed thrice a day for maximum benefits on growth and feed conversion. These results will contribute to improve the technology of early-stage culture of the species and can have an economic impact on their production systems through proper food optimization.

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