The effects of different feeding rates on the growth of silver rasbora (Rasbora argyrotaenia)

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Abstract. This study was purposed to know the effects of feeding rate on growth and feed conversion ratio and obtain the optimal feeding rate in silver rasbora (Rasbora argyrotaenia) culture. The study was conducted on January-March 2019 in the aquaculture facility and laboratory of Universitas Airlangga, Banyuwangi Campus. A total of 400 silver rasbora fry with a total length of 2.5 ± 0.5 cm and body weight of 266.1 ± 9.51 mg was obtained from the aquaculture facility of Universitas Airlangga, Banyuwangi Campus. There are 5 feeding rate treatments (4 replicates) in this study including at satiation, 1 %, 3 %, 5 %, and 7 % from fish biomass. All treatments and replication were conducted on 20 glass aquaria (30 x 40 x 50 cm³) with a 20 fish/aquarium stocking density for 40 days. Based on the results, the feeding rate significantly (P < 0.05) effect to all parameters. The optimum feeding rate in this study is 3 %, where lower feeding consumption obtained the same growth with other treatments.

1. Introduction

Silver rasbora (Rasbora argyrotaenia) is found in the Philippines, Malaysia, Cambodia, Thailand, and Indonesia in its native habitat [1,2]. Silver rasbora is a newly domesticated species in Indonesia with commercial significance as a food and ornamental fish [3,4]. Because culture output is restricted, wild silver rasbora catches are still the primary means of meeting market demands [5–7]. Aquaculture of silver rasboras is still progressing, and more fundamental information about its farming techniques is needed to prevent over-capture in the wild [8–12].

In the husbandry of many species, feeding management is essential knowledge [13,14]. For optimal fish growth, a good feeding technique entails giving an efficient feedstuff at the appropriate time, in the right amounts, and in the proper form [15]. Inefficient production results from both overfeeding and underfeeding. Overfeeding cause's poor water quality (lower dissolved oxygen and higher ammonia content), reduced feed utilization, and increased susceptibility to infection as a result of stress caused by poor water quality [16–18]. Underfeeding, on the other hand, has a direct effect on the production period since growth is slowed when the fish population is partially malnourished [19–22]. The use of optimum feeding regimes can shorten the production period, enhance feed conversion, increase the rearing media (water quality), and improve fish size uniformity till harvest [18,22–25]. These regimens differ according on the species, size/age/stadia, diet mix, and raising media [26–29]. Fish growth and productivity are dependent on controlling the amount of feed necessary to achieve maximum growth, which may be accomplished by varying feeding rates [30]. Feeding rates also vary by species and during different stages of fish growth, and successful fish culture necessitates the
establishment of appropriate feeds and feeding rates [31]. In the previous study, feeding rates have revealed an influence on growth of tambaqui (Colossoma macropomum) [25], juvenile gilthead sea bream (Sparus auratus) [32], Clarias gariepinus [14], tropical bagrid catfish (Mystus nemurus) [17], striped snakehead (Channa striata) [31], and Nile tilapia (Oreochromis niloticus) [30]. Meanwhile, there have never been any researches on the effect of feeding rate on silver rasbora. Farmers may effectively minimize costs, optimize production, and manage other aspects such as individual size variation and water quality, all of which are essential in the raising of fish, by optimizing feeding rates [31]. As a reason, the purpose of this research is to see how varied feeding rates affect growth of silver rasbora.

2. Materials and methods
2.1. Time and place
This research was carried out in Airlangga University's Banyuwangi Campus's laboratory and aquaculture facilities from February to March 2019 (East Java, Indonesia).

2.2. Fish origin and acclimation
The fry were acquired from Airlangga University's Banyuwangi Campus's silver rasbora breeding program. All of the fish were acclimated for one week in 20 glass aquaria (30 x 40 x 50 cm³; 30 fish/ aquarium). During all acclimation, the fish were fed commercial dry pellets (PF-1000, Prima Feed™, Indonesia; size 1.3-1.7 mm; crude protein 39-41%; crude lipid 5%; moisture 6%; ash 15%; water 15%) twice a day on ad satiation. Temperature (25-28 °C), pH (7.5-7.8), dissolved oxygen (6.8-7.0 mg/l), and total ammonia nitrogen (0.000-0.087 mg/l) were all measured every day during the experiment.

2.3. Experimental design
Fish feeding experiments were separated into 5 feeding rates treatments, each with 4 repetitions including 20 fish (initial body weight can see in table 1.). Feeding rate experiments were carried out are ad satiation (T1), 1 % from biomass (T2), 3 % from biomass (T3), 5 % from biomass (T4), and 7 % from biomass (T5). Fish were fed 3 times daily at 07.00 AM, 12.00 AM, and 04.00 PM. All feeding rate trial groups were fed commercial dry pellets that were the same during the acclimation phase. The trials were 40 days and each treatment had a 100% survival rate. The weight of the fish was measured every 10 days.

2.4. Observed parameters and data analysis
The effects of feeding rate on growth were assessed by using the following formula to calculate the parameters:

BWG (g/fish) = (BWf - BWi)
BG (g) = (Nf BWf - Ni BWi)
SGR (%/day) = (ln BWf - ln BWi) / t
FCR = FC/(Nf BWf - Ni BWi)

Where BWG, BG, SGR, and FCR are body weight gain, biomass gain, specific growth rate, and feed conversion ratio; BWf and BWi are the initial mean of body weight (g) and the final mean of body weight (g); Ni and Nf are the initial number and the final number of fish; t is the trial duration in days.; FC is amount of feed consumption during trial.

The distribution and homogeneity of the data were checked; all of the data showed a normal distribution and variance homogeneity. With SPSS 17.0 software, the data was statistically analysed using the analysis of variances (ANOVA) test with a 95% confidence level; if it was significantly different, continued with the Duncan Multiple Range Test (DMRT).
3. Results and discussion
Feeding rate is one of the main factors affecting fish growth, so determining the optimal feeding rate (OFR;%) is very important in aquaculture [33]. Table 1, shows the growth of silver rasbora fry raised at various feeding rates. Different feeding rates had a significant influence (P < 0.05) on all parameters, according to the results. Between treatments, the average of final body weight (BWf), body weight gain (BWG), biomass gain (BG), and specific growth rate (SGR) exhibited a comparable trend. T1, T3, T4, and T5 did not differ significantly (P > 0.05); T2 had the lowest value when compared to the other treatments. The highest feed consumption (FC) was showed in T5 and the lowest was observed in T2. Meanwhile, the best FCR was occurred in T3 and the worst was seen in T5.

As the feeding rate increases, growth until it reaches the optimal point, then it will decrease if the feed dose exceeds the optimal point [30]. Excessive feeding levels will lead to nutrient depletion, while low doses of feed can cause starvation and slow growth [34]. The results showed that the optimum feeding rate for fry of silver rasbora was observed in T3 (3% feeding rate) with BWG 0.15 ± 0.02 g/fish, BG 4.64 ± 0.61 g, SGR 1.20 ± 0.15 %/day, and the best FCR 2.14 ± 0.26. Meanwhile, the higher feeding rate treatment does not produce better growth and FCR. Low feeding rate of fish have a tendency to improve their digestion in order to obtain more nutrients [35]. Feeding rates vary depending on the species and developmental stage of the fish [31]. During the first growth phase in cages, the optimal feeding regimen for tambaqui (Colossoma macropomum) is 10% BW/day divided into 3 meals/day [25]. Feeding rates of 2.3% and 0.6% BW/d are recommended for gilthead sea bream (Sparus auratus) juvenile as optimum and maintenance rations [36]. In a static system, feeding African catfish at 5% body weight every other day resulted in the optimum growth and nutrient use [14].

![Table 1](image)

Table 1. The initial average body weight (BWi), the final average body weight (BWf), body weight gain (BWG), biomass gain (BG), specific growth rate (SGR), feed consumption (FC), and feed conversion ratio (FCR) of silver rasbora (Rasbora argyrotaenia) fry reared with different feeding rate for 40 days.

| Parameters    | Treatment |
|---------------|-----------|
|               | T1        | T2        | T3        | T4        | T5        |
| BWi (g/fish)  | 0.27 ± 0.02 | 0.28 ± 0.01 | 0.25 ± 0.01 | 0.27 ± 0.01 | 0.27 ± 0.02 |
| BWf (g/fish)  | 0.42 ± 0.02<sup>a</sup> | 0.32 ± 0.01<sup>b</sup> | 0.41 ± 0.02<sup>a</sup> | 0.41 ± 0.03<sup>a</sup> | 0.40 ± 0.04<sup>a</sup> |
| BWG (g/fish)  | 0.15 ± 0.01<sup>a</sup> | 0.04 ± 0.02<sup>b</sup> | 0.15 ± 0.02<sup>a</sup> | 0.13 ± 0.02<sup>a</sup> | 0.13 ± 0.03<sup>a</sup> |
| BG (g)        | 4.59 ± 0.42<sup>a</sup> | 1.25 ± 0.48<sup>b</sup> | 4.64 ± 0.61<sup>a</sup> | 3.98 ± 0.75<sup>a</sup> | 3.97 ± 0.95<sup>a</sup> |
| SGR (%/day)   | 1.12 ± 0.16<sup>a</sup> | 0.35 ± 0.14<sup>b</sup> | 1.20 ± 0.15<sup>a</sup> | 0.99 ± 0.14<sup>a</sup> | 1.00 ± 0.22<sup>a</sup> |
| FC (g)        | 13.39 ± 0.80<sup>a</sup> | 3.07 ± 0.10<sup>b</sup> | 9.84 ± 0.28<sup>d</sup> | 18.26 ± 1.36<sup>b</sup> | 24.82 ± 2.06<sup>a</sup> |
| FCR           | 2.93 ± 0.21<sup>c</sup> | 2.80 ± 1.22<sup>cd</sup> | 2.14 ± 0.26<sup>d</sup> | 4.66 ± 0.60<sup>b</sup> | 6.52 ± 1.56<sup>a</sup> |

Values (mean ± SD, n = 5) with different superscripts in the same row are significantly different (P < 0.05). T1, T2, T3, and T4 are ad satiation, 1 %, 3 %, 5 %, and 7 % from biomass feeding rate treatment.

4. Conclusion
The feeding rate significantly (P < 0.05) effect to growth and feed conversion. The optimum feeding recommend to apply on silver rasbora fry rearing is 3 % where resulting best feed conversion ratio.

5. References
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