Growth Performance of Giant Gourami (*Osphronemus goramy*) Fingerlings Cultured in Circular Containers with Water Current

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Authors' contributions

This work was carried out in collaboration among all authors. Author RS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors Iskandar and BSIB managed the analyses of the study. Author WL managed the literature searches. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

This research aims to determine the application of different water currents in a round container that can provide the most optimal effect on the growth rate of giant gourami *(Osphronemus goramy)* fingerlings. The method used in this research was an experimental method using a completely randomized design (CRD), which consists of three treatments and four replicates The treatment was the use of aeration stone in a round container A (control), B (water current 0.1 m s^{-1} in a round container) and C (water current 0.1 m s^{-1} combined with a venturi in a round container). The fish size used in this research was 2-3 cm obtained from Gourami and Nilem Breeding Centre, Singaparna, West Java Province. Fish were kept in water gallons with a volume of 19 L. Each gallon contained 30 fish. The feeding rate was 5% from biomass. The feed was given three times daily. Every ten days the weight data were collected and used for adjusting the feeding rate. The water quality during the research (40 days) was observed every seven days while survival rate, absolute weight growth, daily growth rate, feed conversion ratio and feed efficiency were observed every ten days. Based on the results of the research, the best reuslt was treatment C (water

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current of 0.1 m s⁻¹ combined with venturi in a round container) had the highest survival rate (SR) of 58%, absolute weight growth (3.5 g), daily growth rate (1.69%), feed conversion ratio (2.01) and feed efficiency (50%).

1. INTRODUCTION

Gourami fish *(Osphronemus goramy)* was one of the types of aquaculture that was included in 10 types of commodities which was the target of a 353% increase in aquaculture production in 2009-2014 launched by the Indonesian Ministry of Maritime Affairs and Fisheries.

Gourami production in 2010-2013 showed a positive performance, with an average increase of 15.74% per year. Seen from the performance achievement of the annual target that the achievement of gourami production has been able to exceed the target set with an average achievement of 138.8% except for 2013 where production has not been able to reach the target (69.42% of the target) as well as the value Figures production which only reached 99.18% [1].

The growth rate was a factor that can determine the success of a business, because slow growth causes high production costs, coupled with risks during a long maintenance time so that the production results obtained can be less [2].

One environmental factor that can affect the growth and survival of fish was currents. The movement of water causes an even distribution of oxygen, besides that the current can supply natural food evenly so that the distribution of natural food becomes more evenly distributed and does not converge at one point so there was no competition between fish. Also, with the flow of water, fish metabolic residues will be carried out therefore, improving the water quality [3].

Fish scientifically do like the flow of water [4]. Dynamic conditions in flowing water will provide stimulation for fish to move. Swimming activity is very correlated with a lot of oxygen demand, but not to indicate fatigue for fish that keep moving. Thus, oxygen demand becomes very high, because fish require a lot of energy while or during its movement. Fish that have more mobile activity will have better flesh cohesiveness compared to static fish and are less mobile. Muscles that are trained more will have better performance than those who were not trained [5].

Containers or ponds commonly used for gourami culture include ponds (soil, walls and plastics) [6] Maintenance of fingerlings in controlled containers must be equipped with aeration for oxygen supply and avoid direct contact with rainwater, by using circular ponds aimed at high stocking densities and more even or efficient distribution of feed.

The use of currents in circular media to increase gourami productivity was not well known. Therefore, it was necessary to conduct environmental engineering research to accelerate the growth of gourami by providing currents to the maintenance media in a round shape.

The purpose of this study was expected to be able to determine the flow pattern administration in a round container which can give the most optimal influence on the growth rate of gourami (*Osphronemus goramy*) fingerlings.

2. MATERIALS AND METHODS

2.1 Time and Place of Research

This research was conducted in August 2019 - February 2020. The research site was conducted at the PSDKU UNPAD Pangandaran campus.

2.2 Research Tools and Materials

The tools used in this study were Gallon with a capacity of 19 Liters as many as 12 pieces, blowers, PVC pipes with L and T connections, water pumps, venture, stop tap, water quality checker (thermometer, DO meter), ammonia test kit. pH meter, scales, millimeter blocks, 2 pieces of fiber, aerated hose and aeration stones. While the materials used in this study were 2-3 cm gourami fingerlings, which were obtained from Gourami and Nilem Breeding Centre, Singaparna, West Java Province and commercial pellets with 35% protein content obtained from fish feed shops.

2.3 Research Methods

The method used in this study was a Completely Randomized Design (CRD) with three treatments

and each treatment used four replications. Each treatment uses different tools, namely Treatment A uses aeration stone in a round container (control), B gives a current of 0.1 ms^{-1} in a round container, C gives a current of 0.1 ms^{-1} in a combined round container with venture. The maintenance of the test animals was carried out for 40 days using gallons as a maintenance container containing 15 L water with each container containing 30 gourami fingerlings the density of gourami fingerlings was 2 fish-tails/liter. Feeding was carried out three times a day at 08.00, 12.00 and 16.00 WIB. The amount of feed given was adjusted to the feeding rate (FR), which was equal to 5% of gourami biomass and adjusted to its growth every ten days.

In this study gallons as containers were designed to produce a constant rotating current. Water has flowed at a current of 0.1 ms^{-1} with a recirculation system using a pump consisting the inlet, outlet and faucet. The inlet was located on top of the maintenance container water column while the outlet was at the bottom of the maintenance container, the tap was used to produce the current speed, so that the current speed can be adjusted. The following was a pipe design model to generate current in the maintenance container, can be seen in Fig. 1.

2.4 Observation Parameters

The parameters observed were water quality (Thermometer, Dissolved Oxygen, pH and Ammonia), survival rate, absolute weight growth, daily growth rate, feed conversion ratio and feed efficiency. The data obtained were analyzed using analysis of variance (ANOVA) with the F test at a 95% confidence interval, which was used to determine whether the treatment had a real effect or not. If the treatment has a significant effect, then a further test with the Duncan test was conducted, while the water quality data were analyzed descriptively.

2.4.1 The degree of survival mathematical formulas

The survival rate of test animals can be determined by using formula according to [7]:

$$SR = \frac{Nt}{No} \times 100\%$$

Explanation :

SR : Degree of survival (%)

Nt: Number of living fish at the end of treatment (individual)
N_0: The number of fish at the beginning of treatment (individual)

2.4.2 Weight absolute growth mathematical formulas

Calculation of absolute weight growth is done using the Effendie [8]:

$$G = Wt - W_0$$

Explanation :

G: Growth absolute weights
Wt: The average weight of the fish at the end of the study (g)
W_0: Weight average at the beginning of the research (g)

2.4.3 Daily growth rate mathematical formulas

Daily growth rate measurement using formula [7]:

$$LPH = \frac{lnWt - lnWo}{t} \times 100\%$$

Explanation :

LPH: Daily growth rate of weights
Wt: Average weight at the end of treatment (t-day)
W_0: Average weight of initial treatment (dat 0)
T: Observation duration (days)

2.4.4 Feed conversion ratio mathematical formulas

Conversion of feed calculated using the formula [9]:

$$FCR = \frac{F}{(Wt + D) - Wo}$$

Explanation:

FCR: Feed conversion ratio
F: The amount of feed given (g)
Wt: Weight of test fish at the end of the study (g)
D: The weight of dead fish (g)
W_0: Weight of test fish at the beginning of the research (g)

2.4.5 Effeciency of feeding mathematical formulas

Calculate feed efficiency with the formula [10]:

$$EP = \frac{(Wt + D) - Wo}{F} \times 100\%$$

Explanation:

EP: Efficiency of feeding
Wt: Biomass at the end (g)
D: Bonylip barb biomass that died during the research (g)
W_0: Biomass at the beginning (g)
F: Amount of feed given during the research (g)

3. RESULTS AND DISCUSSION

3.1 Water Quality

The results showed that establishing a water current can improve water quality. The water quality parameters observed during this research were temperature, pH, dissolved oxygen and ammonia (Table 1).

3.1.1 Temperature

Based on the results of temperature measurements during the study conducted every seven days, did not provide a significant difference in each treatment, which was the range of 26.20-26.30°C. based on these values the test results indicate a good enough value for gourami culture. This is by [11] where the optimal temperature value for gouramy culture was 25-30°C.

The C treatment (giving a current of 0.1 ms^{-1} in a round container combined with a venturi) had the highest average temperature for each calculation of 26.1-26.5 °C. The lowest average temperature in treatment A (control) is 26.1-26.3 °C. High temperatures will increase the metabolic process so that it will increase the residual yield of metabolism in water. [12] states that an increase in temperature will also reduce DO because oxygen use increases with an increase in metabolism.

3.1.2 Dissolved oxygen

Based on the test results in research activities showed differences in DO in several treatments shows that DO in treatment A (control) had the smallest value during maintenance ranging from 7.1-7.3 mg/L and the highest DO value was found in treatment C (giving a current of 0.1 ms^{-1} in a round container combined with venturi) was 7.4-7.6 mg/L this was because treatment C has more micro bubble size oxygen levels that were affected by venturi, therefore DO values in all treatments can be said to be good enough for gourami culture, where the optimum value for gourami fish was > 3 mg/L [11].

High DO can stimulate growth in fish, because a high oxygen supply causes a high metabolic rate [13]. Also, according to [3] with the flow of oxygen supply will be evenly distributed and there was an exchange of oxygen in the air with toxic content in water. In Table 1, the highest DO was seen in treatment C (giving a current of 0.1 ms^{-1} in a round container combined with a venturi).
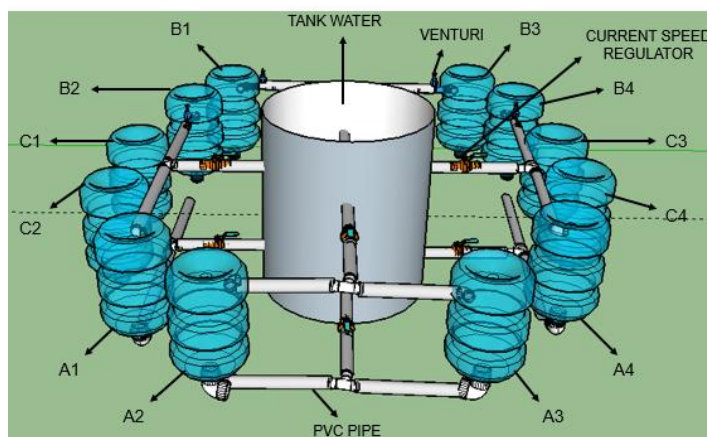

Fig. 1. Model design of pipes in maintenance containers explanation: A. Current treatment. B. Flow treatment using venture devices. C. Control treatment

Table 1. Data on water quality parameters and optimum range

Treatment	Parameter			
	Temperatur (ºC)	DO (mg/L)	pH	Amonia (mg/L)
A (Control)	26.1 – 26.3	7.2 – 7.3	7.1 – 7.8	0
B (Water current)	26.,1 – 26.4	7.3 – 7.5	6.5 – 7.7	0
C (Water current + ventury)	26.1 – 26.5	7.4 – 7.6	7 – 7.8	0
Quality Standards	25-30	>3	6.5-8.5	<1
Souch	*[11]	*[11]	*[11]	*[14]

3.1.3 pH

pH measurements were carried out every week, have different data from each treatment. The pH value can be influenced by temperature, DO and alkalinity. According to [15], each organism has a different pH tolerance range. The pH value during research activities ranged from 6.5-7.8. This value shows the optimum value for gourami culture according to [11]. The optimum pH range for gourami fingerlings was 6.5-8.5. The higher the pH value, the ammonia toxicity level will increase [16]. Water conditions that were very acidic or basic will endanger the survival of the organism because it will cause metabolic and respiratory disorders. According to [17], an increase in pH above neutral will increase the concentration of ammonia which was also very toxic to the organism.

3.2 Survival Rate

The results of the calculation of the survival rate for 40 days of maintenance showed the highest survival rate in treatment A (control) of 80%, then treatment C (giving a current of 0.1 ms^{-1} in a round container combined with venturi) of 58% and treatment B (giving current in a round container of 0.1 ms^{-1}) of 49.17%. The survival rate of gourami fingerlings was significantly different for each treatment with the best treatment for treatment A. Observation results of gouramy survival rate can be seen in Fig. 2.

Most deaths were found in treatment B (giving a current of 0.1 ms^{-1}). This was thought to be due to the gourami's original habitat not in the current waters so that the fish could not survive when given additional currents, according to [18] The gourami likes calm waters, this was proven when the gourami was very easily maintained in a pond.

Fish that died in treatment A (control) as many as 19 (80%) tails, this number was the least number of deaths compared to treatments B and C. The death was suspected because the treatment given was closer to their natural habitat or without current.

3.3 Absolute Weight Growth

The growth rate was the absolute growth difference that was measured based on the time sequence according to [19]. Based on observations, the absolute value of growth was shown in Fig. 3.

Treatment C (giving a current of 0.1 m s-1 in a round container combined with a venturi) had the greatest absolute growth of the sample, followed by treatment B (giving a current of 0.1 ms^{-1}) and the smallest absolute growth value is treatment A (control). In the measurement of absolute weight growth in the first ten days the average value in treatment A was 0.9 g where this number is the lowest compared to the other two treatments and the highest reaches 1.13 g for treatment C. In the last measurement on the 40th day the value the average growth of treatment A was still smallest at 2.7 g and as high as treatment C (giving a current of 0.1 ms^{-1} in a round container combined with a venturi) of 3.5 g. Duncan test results with an error level of 5%, showed that each treatment was significantly different.

3.4 Daily Growth Rate

The daily growth was the percentage increase in growth each time interval [20]. The daily growth rate value of gourami fingerlings can be seen in Fig. 4.

Daily growth rate of gourami fingerlings during research activities showed the highest value in treatment C (giving a current of 0.1 ms^{-1} in a round container combined with a venturi) with a value of 1.69%, then followed by treatment B (giving a current of 0.1 ms^{-1}) with a value of 1.61% and the lowest treatment was in treatment A (control) with a value of 1.53%. Increased fish growth can be seen from the daily growth rate [21]. Duncan test results with an error level of 5%, showed that each treatment was significantly

different and the best treatment was treatment C, this was thought to be related to the value of feed efficiency obtained in the treatment of currents given the addition of venturi devices. The higher the efficiency of feed, the higher the feed can be utilized by fish [22].

3.5 Feed Conversion Ratio

According to Iskandar and Elrifadah [23], Feed conversion was a comparison between the amount of feed given and the amount of weight produced. FCR calculation results can be seen in Fig.5.

In the graph of the results of research conducted, the highest FCR obtained in treatment A was 2.46, then in treatment B was 2.12 and treatment C had the lowest value of 2.01. Duncan test results with an error level of 5% indicate that treatment C was not significantly different from treatment B but it was significantly different from treatment A. The lower the FCR value, the better the feed given. The best FCR value was in treatment C (giving a current of 0.1 m s-1 in a round container combined with a venturi) of 2.01. This means that to produce 1 g of meat requires 2.01 g of feed. That was, the more efficient the feed was turned into the meat [8]. [24] states that the lower the value of feed conversion, the better because the amount of feed spent to produce a certain weight was small.
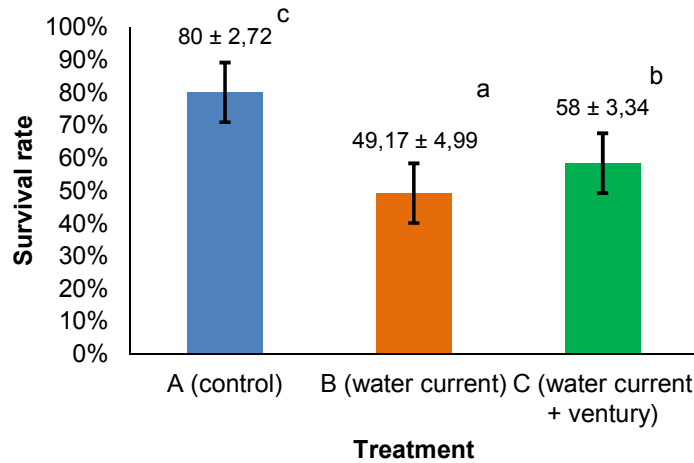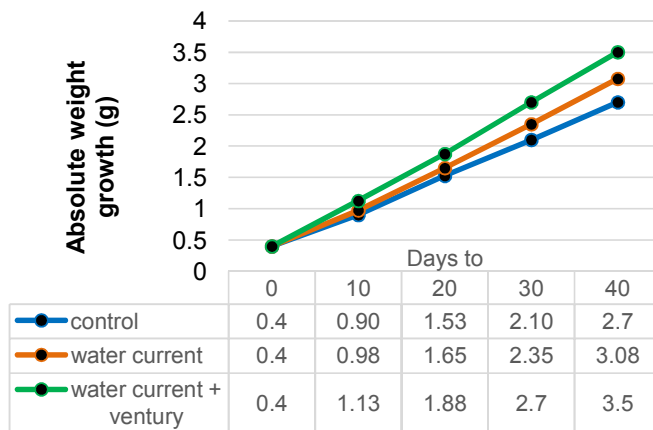

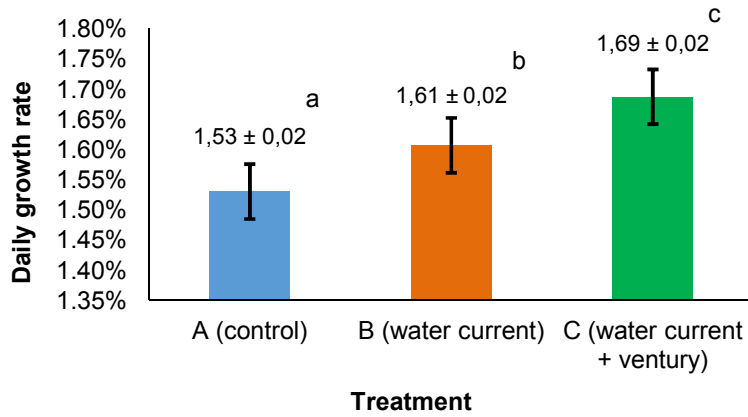**Fig. 2. Survival rate graphic**

Fig. 3. Absolute weight growth graphic
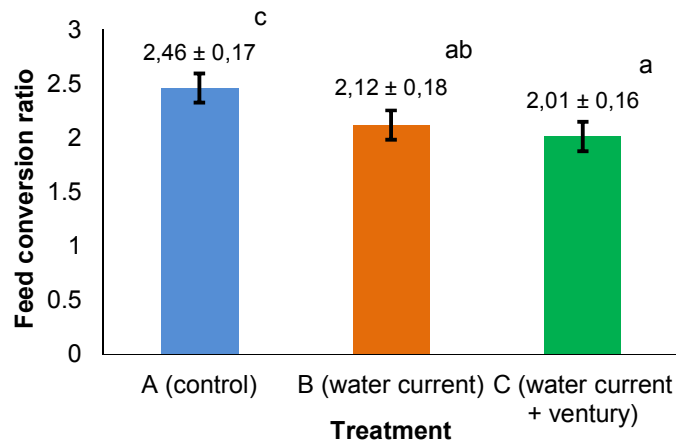
Fig. 4. Daily growth rate graphic

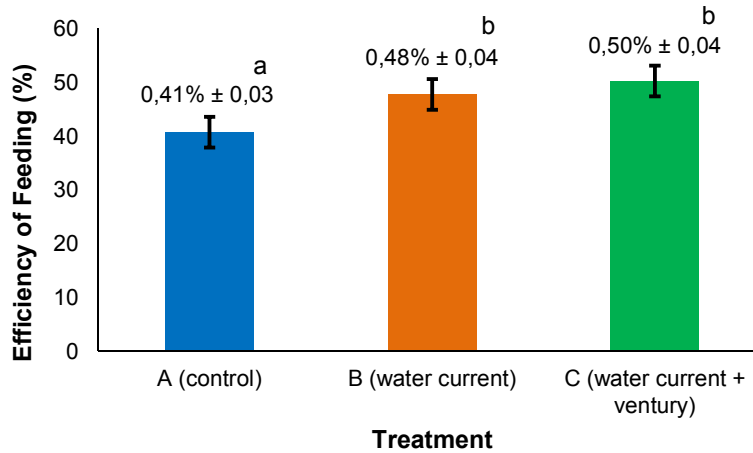**Fig. 5. Feed conversion ratio graphic**

Fig. 6. Effecienci of feeding graphic

3.6 Efficiency of Feeding

The value of feed efficiency can be obtained through the results of a comparison between the growth of fish weights with the amount of feed consumed by fish during maintenance. Based on research conducted the highest feed efficiency was found in treatment C with a value of 50%, then followed by treatment B with a value of 48% and the smallest amounted to 41% contained in treatment A. Duncan test results with an error level of 5%, it showed that treatment A was significantly different from treatment B and C but treatment B was not significantly different from C. The greater the value of feed efficiency, means the more efficient the fish used the food consumed for its growth [22].

The high feed efficiency in treatments B and C was presumably because the feed provided was more utilized by fish, this was because the feed was spread evenly by the current and not at one point so there was no competition between fish. Besides, high levels of dissolved oxygen (DO) in treatments B and C affect the metabolism of fish that was fast for growth, so that more fish use better feed. This under the statement of Wheaton (1942), high DO can stimulate growth in fish, because high oxygen supply causes a high metabolic rate. The value of feed efficiency was also directly proportional to the value of the FCR in the maintenance media.

4. CONCLUSIONS

The results of this research can be concluded that the best treatment is treatment C (giving a current of 0.1 m s-1 in a round container combined with venturi) which has an absolute weight growth value of 3.5 g, a daily growth rate of 1.69%, FCR 2.01 g and feed efficiency 50%.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/59479