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Effect of Different Filters on Growth and Survival of Cachama *(Colossoma macropomum)* in the Recirculation System

Pengaruh Filter yang Berbeda pada Pertumbuhan dan Kelulushidupan Ikan Bawal Air Tawar (Colossoma macropomum) pada Sistem Resirkulasi

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Abstract

The recirculation system, in principle, is the reuse of water that has been removed from cultivation activities. Cachama (*Colossoma macropomum*) is a relatively high economic value fishery commodity. This study aimed to obtain the best filter dose for water quality on the survival of cachama. The experimental method used a completely randomized design with six permitted treatments and three replications. The treatment used was P0 (without filter) with P1 (100% charcoal filter), P2 (100% zeolite filter), P3 (50% charcoal and 50% zeolite filter), P4 (25% charcoal and 75% zeolite filter), and P5 (75% charcoal and 25% zeolite filter) the fish kept for 50 days. The results of this study showed that the best treatment was P4 (25% charcoal and 75% zeolite filter), which resulted in a recent weight growth of 6.12 g, static length growth of 4.86 cm, growth rate specific growth of 2.08%, survival of 100%, and food conversion ratio of 1.95. Providing 25% charcoal and 75% zeolite filters affects water quality, growth, and survival rate.

Keywords: Charcoal, Filter, Water quality, Zeolite.

Abstrak

Sistem resirkulasi pada prinsipnya adalah penggunaan kembali air yang telah dikeluarkan dari kegiatan budidaya. Bawal air tawar (*Colossoma macropomum*) merupakan komoditas perikanan dengan nilai ekonomis yang relatif tinggi. Tujuan dari penelitian ini adalah untuk mendapatkan dosis filter terbaik untuk kualitas air pada kelangsungan hidup bawal air tawar. Metode yang digunakan adalah metode eksperimen dengan menggunakan rancangan acak lengkap dengan 6 perlakuan yang diizinkan dan 3 ulangan. Perlakuan yang digunakan adalah P0 (tanpa filter) dengan P1 (filter arang 100%), P2 (filter zeolit 100%), P3 (filter zeolit 50% dan zeolit 50%), P4 (filter arang dan zeolit 75%), dan P5 (filter arang 75% dan zeolit 25%) ikan dipelihara selama 50 hari. Hasil penelitian ini menunjukkan bahwa perlakuan terbaik adalah P4 (filter arang dan zeolit 25%) yang menghasilkan pertumbuhan bobot badan baru sebesar 6,12 g, pertumbuhan panjang statis sebesar 4,86 cm, pertumbuhan spesifik laju pertumbuhan sebesar 2,08%, kelangsungan hidup sebesar 100%, dan rasio konversi pangan sebesar 1,95. Pemberian filter 25% arang dan 75% zeolit berpengaruh terhadap kualitas air, pertumbuhan, dan tingkat kelangsungan hidup.

Kata kunci: Arang, Filter, Kualitas air, Zeolit.

1. Introduction

Cachama (*Colossoma macropomum*) is a relatively high economic value fishery commodity. At first, cachama was traded as an ornamental fish, but because it has fast growth and a good taste in meat, people made cachama as a food fish. From the side, the cachama's body looks rounded (oval) with a ratio between length and height of 2:1. When cut vertically, the cachama has a compressed body shape with a ratio between body height and width of 4:1. This body shape indicates that the movement of cachama is not fast like catfish or grass carp, but slow like carp and pond fish.

According to Rizky et al. (2015). The development of the aquaculture industry to increase production is limited by several factors, namely limited water, land, and environmental pollution. Water as a medium for raising fish must always be considered for its quality. The effort that can be made to overcome the above problems is to apply an aquaculture recirculation system. The recirculation system, in principle, is the reuse of water that has been removed from cultivation activities. The recirculation system's primary focus is eliminating ammonia as a product of fish metabolism. Recirculation can be analyzed by observing the water quality and how long it takes to change the water for the system. Some filters that can be used include zeolite and charcoal.

According to Silaban et al. (2012), zeolite is an aluminosilicate mineral compound with good adsorption capacity and a cation exchange capacity value of 200-300 cmolc/100 g. There are various kinds of zeolite, and one of them is natural zeolite type clinoptilolite, which has a high affinity for ammonia and has been successfully used as ammonia cleaner in freshwater aquaculture systems. Charcoal zeolite can also be a filter to improve water quality. Charcoal is a porous solid containing 85–95% carbon, produced from materials containing carbon by heating at high temperatures. Charcoal can be made by burning the charcoal material tightly closed so that only the carbonization process occurs.

2. Material and Method

2.1. Time and Place

This research was carried out from August to October 2022 at the Experimental Pond, Faculty of Fisheries and Marine, Universitas Riau, Pekanbaru. This research was conducted for 50 days with regular observations.

2.2. Methods

The experimental design used in this study was a one-factor, Completely Randomized Design (CRD), and as a factor in this study were different filters in fish farming containers, with six treatments, three replicates, and 18 units of fish rearing containers needed. The experimental method used a completely randomized design with six permitted treatments and three replications. The treatment used was P0 (without filter) with P1 (100% charcoal filter), P2 (100% zeolite filter), P3 (50% charcoal + 50% zeolite filter), P4 (25% charcoal + 75% zeolite filter), and P5 (75% charcoal + 25% zeolite filter) the fish kept for 50 days. The treatment level in this study refers to Pratama et al. (2020) research in which the water in the aquarium flows through the pump directly into the pipe and then into the recirculation filters media, namely zeolite, sand, and fibers. After going through the filter, the filtered water immediately re-enters the maintenance media, namely the aquarium. The weight of each filter container (Rizky et al., 2015). The filters used during the study were 600 g each with a volume of 30 L of water.

2.3. Procedures

2.3.1. Preparation of Research Containers

The research container used is a round bucket with a volume of 100L filled with water as high as 40 cm or 60 l of water as many as 18 units. Preparation of the container starts with washing the container using soap and washed thoroughly. Washing and cleaning the container is helpful to clean the dirt that sticks and ensure the container is in good condition to avoid disease. Then, the cleaned bucket is sterilized with enough PK dissolved in water until the water of each container is filled.

The water in the container is left for 3-4 days, then the water mixture is discarded, and the container is washed with water until clean and dried and then filled with water; the water used has been precipitated before ± 3 days. Each container is filled with 60 L of water, and a water pump is installed, which helps supply oxygen and form a filter system in the maintenance container. The design of the container for this study is to use a bucket with a volume size of 100 L, which is added with a rectangular gutter at the top of the bucket to accommodate the filter and then fill the wood charcoal and zeolite filter, which is about 4-6 cm in size which functions for the process of raising cachama seeds and with additional foam as a filter for the water that comes out. A water pump is also added so the bucket container can be recirculated in a filter container containing charcoal and zeolite and then channeled back to the maintenance container.

2.3.2. Preparation of Test Fish

Cachama seeds used in this study are 4-6 cm in size. The seeds have been selected with the criteria of uniform size, active movement, and no defects or wounds. The seeds are stocked in the morning or evening because there is no fluctuation in water temperature. Seed stocking is done with acclimatization so that fish can adapt to the new environment slowly or so that the new environment does not stress fish. According to Taufiq et al. (2016), before being used, the test fish were acclimatized for 24 hours; during acclimatization, the fish were not given food. After acclimatization, the test fish were taken randomly and put in a basin with 20 fish in each container.

2.3.3. Maintenance of Test Fish

Maintenance of cachama was carried out for 50 days with a frequency of feeding three times a day at 08:00 WIB, 12:00 WIB, and 16:00 WIB. The feed was PF-800 commercial pellets with 39-41% protein content. The stocking density of the reared fry was 1 fish/3 L of water in each container. The container used is a bucket with a volume of 100 L. A total of 360 cachama seeds were used for 18 units of research containers. The cachama fry was reared for 50 days in a controlled container.

2.3.4. Sampling

Sampling was conducted to determine the growth of test fish during the study. Sampling was done six times on the first maintenance day, days 0, 10, 20, 30, 40, and 50. Sampling in the form of measurements of body length and body weight. The sampling technique is random sampling, where fish are taken randomly and then measured with 50% of the total fish in one container. The tools used to measure body weight are analytical scales with accuracy of two numbers behind the comma, measuring fish length using millimeter paper or ruler, and measuring the degree of survival. Fish tests were carried out at the beginning and end of the study. In contrast, temperature and pH measurements were carried out every ten days in the morning and evening. Then, the measurement of dissolved oxygen, ammonia (NH_3), nitrate, and phosphate were carried out at the beginning, middle, and end of the study.

2.4. Parameter Measured

Parameters measured were water quality (temperature, pH, DO, and ammonia), absolute weight growth, absolute length growth, specific growth rate, survival rate, and feed conversion ratio.

2.4.1. Absolute Weight Growth

Absolute weight growth was calculated using the Effendie (2002) formula, namely:

$$W = Wt - W0$$

Description:

W = Absolute weight growth of test fish (g)
Wt = Average weight of test fish at the end of the study (g)
W0 = Average weight of test fish at the beginning of the study (g)

2.4.2. Absolute Length Growth

Absolute length growth was calculated using the formula of Zonneveld et al. (1991), namely:

$$L = L0 - Lt$$

Description:

L = Absolute length growth (cm)
L0 = Average length of test fish at the beginning of the study (cm)
Lt = Average length of test fish at the end of the study (cm)

2.4.3. Specific Growth Rate

Specific growth rate (SGR) was calculated using the formula from Zonneveld et al. (1991), namely:

$$SGR= (LnWt-LnWo)/t\times100\%$$

Description:

SGR = Specific daily growth rate (%/day)
LnWt = Average fish weight at the end of the study (g)
LnWo = Average fish weight at the beginning of the study (g)
t = length of rearing (days)

2.4.4. Survival Rate

Survival rate will be calculated at the end of the observation, where the number of test fish at the end of the study is divided by the number of test fish at the end of the study. The survival rate was calculated using the Effendie (2002) formula, namely:

$$SR= Nt/No\times100\%$$

Description:

SR = Survival rate (%)
No = Number of test fish at the beginning of the study (fish)

Nt = number of test fish at the end of the study (fish)

2.4.5. Feed Conversion Ratio (FCR)

Feed conversion is the feed required to produce 1 kg of fish biomass. The smaller the feed conversion value, the better and more profitable it is. The calculation of the feed conversion ratio (FCR) is done using the formula from Effendie (2002), namely:

$$FCR= F/(Wt+D)-Wo$$

Description:

FCR = Feed conversion ratio
Wo = Biomass weight of test fish at the beginning of the study (g)
Wt = Biomass weight of test fish at the end of the study (g)
D = Total weight of dead fish (g)
F = weight of feed given (g)

2.5. Data Analysis

The data that has been obtained is tabulated and analyzed using the SPSS application, which includes Analysis of Variance (ANOVA), used to determine whether the treatment has a significant effect on the growth of absolute seed weight (g), total length growth of seeds (cm), specific growth rate of seeds (%/day), and seed survival (%). If the statistical test shows a significant difference between the treatments, a follow-up test is carried out in the Newman Keuls Study. Water quality data is displayed in tabular form and analyzed descriptively.

3. Result and Discussion

3.1. Water Quality

Water quality is a critical factor in supporting fish growth and survival. The water used during the research is sourced from drilled wells containing inorganic compounds such as magnesium, iron, and other heavy metals. According to Mugiyantoro et al. (2017), groundwater contains high levels of iron, manganese, and magnesium. The high content of iron, manganese, and magnesium can be reduced by filtering the water using a filter. The filter tool uses silica sand, zeolite, and charcoal as media. These materials help filter impurities, binding elements of iron (Fe), manganese (Mn), and magnesium (Mg), and clarify and eliminate odors in water. The study measured several water qualities: pH, temperature, dissolved oxygen, and ammonia. The results of measuring the water quality of each parameter during the survey can be seen in Table 1.

Table 1. Water quality during research

Parameters	P0	P1	P2	P3	P4	P5
Temperature (^{0}C)	27.7-29.8	27.6-28.5	27-28.4	P27.1-28,2	27-28.2	27-28.4
pH	6.1-7,1	6.2-7.1	6.1-7	6.1-7.1	6.1-7	6.1-7.1
DO (mg/L)	5.9-6.4	5.2-6.8	5.2-6.5	5.8-6.8	5.4-6.8	5.1-6.8
Ammonia (mg/L)	0.0004-0.0060	0.0004-0.0025	0.0006-0.0033	0.0004-0.0024	0.0002-0.0011	0.0008-0.0033

Based on the data from the water quality sampling results during the research, it is generally good enough to support the growth of cachama. The temperature during the study ranged from 27-29.8^{o}C. This shows that the water temperature in this study was average and good for the growth and survival of cachama. This is based on the statement of Taufiq et al. (2016) that the optimum temperature range for cachama is 29-31 ^{o}C. The pH during the study ranged from 6.1-7.1. This pH value is relatively good for the life of cachama. DO during the survey ranged from 5.2 to 6.8. This dissolved oxygen value is considered very good for cachama farming activities and other types of freshwater fish because it is still above one ppm.

During the study, ammonia ranged from 0.0002-0.0060. This was still relatively low because ammonia can be filtered by charcoal and zeolite. According to Mugiyantoro et al. (2017), activated charcoal filter odors clarify and filter metals in water in the water filter process. Zeolite also functions as a cation binder to filter inorganic compounds and kill bacteria in water. In addition, zeolite has pores of molecular size to filter molecules of a specific size. Zeolite is a hydrated alumino-silicate compound with sodium, potassium, and barium cations. Zeolite has a negative charge, which causes it to be able to bind cations. Zeolite is also often referred to as a molecular mesh because it has pores of molecular size to filter molecules of a specific size. In this water filter process, zeolite can kill bacteria and bind the metal content contained in water.

3.2. Cachama Growth

Results of measurements of absolute weight, absolute length, and specific growth rate of cachama during research can be seen in Table 2. Observations on the absolute weight growth of cachama ranged from 5.54 – 6.12 g, where P4 (25% charcoal filter and 75% zeolite) resulted in the highest total growth weight of 6.12 g. The results of the Analysis of Variation (ANOVA) test showed that filtering with different filters had a significant effect on the absolute weight growth of cachama (P <0.05). The results of the Student Newman-Keuls test showed that the P0 treatment (without filter) was significantly different from P4(25% charcoal filter and 75% zeolite) because the feed given can be appropriately utilized by fish and the rest of the feed can be filtered properly by the filter so that it affects the growth of fish weight, the statement of Mulyadi et al. (2014) which states that in addition to adequate feed, water quality in the rearing medium is also very supportive of fish growth.

Table 2. Absolute weight, absolute length, and specific growth rate of cachama

Treatment	Absolute Weight (g)	Absolute Length(Cm)	Specific Growth Rate (%)
P0	5.54±0.03a	4.20±0.03a	2.02±0.00a
P1	5.67±0.01b	4.43±0.04b	2.03±0.00b
P2	5,96±0,02d	4.41±0.02b	2.07±0.00d
P3	5.98±0.01d	4.58±0.01d	2.07±0.00d
P4	6.12±0.02e	4.86±0.02e	2.08±0.00e
P5	5.79±0.03c	4.51±0.03c	2.05±0.00c

The length growth of the cachama is also affected by water quality and the weight growth of the cachama because water quality affects the growth of the cachama. The study found that the absolute length growth of cachama fingerlings varied in each treatment. At P0 (without filter), it produced the lowest whole length, namely 4.2 cm, while at P4 (with charcoal 25% filter and 75% zeolite), it produced the highest total length, 4.86 cm. Applying a 25% charcoal filter and 75% zeolite on P4 gave the best result, with a length of 4.86 cm. Filtering can increase the growth of the optimum absolute length of fish. This is based on Nazara's (2018) statement that the increase in fish length is in line with the increase in fish weight. If the feed given to fish during maintenance can be used optimally, there will be an increase in the length of the fish and fish weight. Setiaji et al. (2014) added that fish growth is a complex biological process with many influencing factors, including fish can grow well if the nutrients in the feed digested and absorbed by the body are more significant than the amount needed to maintain the body. Observations on the specific growth rate of cachama (Table 2) range from 2.02% -2.08%, which in treatment P0 (without filter) resulted in the lowest specific growth rate of 2.02%/day. P4 (25% charcoal filter and 75% zeolite) produced the highest specific growth rate of 2.08%/day. The results of the Analysis of Variation (ANOVA) test showed that different filters had a significant effect on the specific growth rate of cachama (P <0.05). Newman-Keuls showed that the P0 treatment (without filter) was significantly different from P1 (100% charcoal filter), P2 (100% zeolite filter), P3 (50% charcoal filter and 50% zeolite), P4 (50% charcoal and zeolite filter). 25% charcoal filter and 75% zeolite, and P5 (75% charcoal filter and 25% zeolite).

3.3. Feed Conversion Ratio and Survival Rate

The results of measuring the feed conversion ratio and survival of cachama during the study can be seen in Table 3.

Table 3. Feed conversion ratio and survival of cachama

Treatment	Feed conversion ratio	Survival rate (%)
P0	2.14 ± 0.02^{d}	100±0.00
P1	2.09 ± 0.00^{c}	100±0.00
P2	1.99 ± 0.01^{b}	100±0.00
P3	1.99 ± 0.00^{b}	100±0.00
P4	1.95 ± 0.01^{a}	100±0.00
P5	2.06 ± 0.01^{c}	100±0.00

Observations on the conversion ratio of cachama feed in Table 3 show that the conversion ratio of cachama feed ranges from 1.95% to 2.14%, where P0 (without filter) produces the highest FCR, namely 2.14%. In comparison, at P4 (without filter), 25% charcoal filter and 75% zeolite had the lowest feed conversion ratio, 1.95%. The results of the ANOVA test showed that the provision of different filters had a significant effect on the feed conversion ratio of cachama (p<0.05). The results of the Student-Newman-Keuls test showed that the P4 treatment (25% charcoal filter and 75% zeolite) was significantly different from P0 (without filter), P1 (100% charcoal filter) P2 (100% zeolite filter), P3 (50% charcoal and 50% zeolite filter), and P5 (75% charcoal and 25% zeolite filter). Metabolic processes in fish will affect the value of the feed conversion ratio. The low value of the FCR at P4 (25% charcoal filter and 75% zeolite) is due to the presence of digestibility and absorption in the feed, which is greater than the other treatments so that the amount of feed consumed by the fish is more optimal. The energy that will be produced is incredible and can be utilized to increase fish growth. Ihsanudin et al. (2014) stated that if the value of feed conversion is low, it indicates that the feed quality is good. The feed quality could be better if the feed conversion value is high.

The results of the ANOVA showed that the application of different filters had no significant effect on the survival rate of the cachama (p> 0.05). The survival rate obtained in this study was 100%. Applying different filters to cachama resulted in a higher survival rate than the study by Kelabora & Sabariah (2010), with an 88% survival rate of cachama with other treatments. This shows that the addition of a filter affects the survival of fish. cachama. From the results of observations during the study, cachama, which was given a filter, faked its more active movements and a higher response to feed, indicating the fish's health was in good condition. This is presumably due to the influence of good water quality on fish health. According to Sawitri (2018), the high survival rate and lack of significant difference between treatments can be caused by the water quality of the fish-rearing media, which is the conditions and stocking density needed by the fish to grow optimally.

4. Conclusions

The results of this study indicate that applying different filters affects growth performance, survival, and water quality for cachama. The treatment that produced the best growth was the administration of 25% charcoal filter and 75% zeolite, which resulted in an absolute weight growth of (6.12g), an absolute length growth of (4.86cm), a specific growth rate of (2.08%), survival of (100%), and FCR of (1.95). Water quality parameters during the research were, temperature ranged from (27-29.8^{o}C), water pH ranged from (6.1-7.1), dissolved oxygen content (DO) went from (5.2-6, 8 mg/L), and ammonia ranging from (0.0002-0.0060 mg/L). As for the values for water quality parameters during the study, they still support the growth and survival of cachama.

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