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Combination of Filter Media with Blood Shells on Water Quality and Growth of Asian Redtail Catfish (*Hemibagrus nemurus*) in the Recirculation System

Kombinasi Media Filter dengan Cangkang Kerang Darah terhadap Kualitas Air dan Pertumbuahn Ikan Baung (Hemibagrus nemurus) dalam Sistem Resirkulasi

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Abstract

This study aims to determine the effect of combining blood clam shell (*Anadara granosa*) filter media on water quality in the recirculation system for Asian Redtail catfish (*Hemibagrus nemurus*) maintenance. The study was conducted from December 2025 to February 2026 at the Cultivation Technology Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau, using a Completely Randomized Design (CRD) experimental method with four treatments and three replications. The treatments consisted of P0 (control without blood clam shell), P1 (150 g/25 L of water), P2 (200 g/25 L of water), and P3 (250 g/25 L of water). The results showed that the use of blood clam shells as a filter medium was able to maintain water quality during cultivation, with a temperature range of 24–28.6°C, pH 2.16–7.94, DO 4.96–6.47 mg/L, TDS 22–1038 mg/L, ammonia 0.015–1.429 mg/L, and nitrate 0.0604–21.2729 mg/L. The best treatment was obtained at P3, with a final fish length of 16.8 cm, SGR of 3.60%, feed efficiency of 93.45%, and the lowest FCR of 1.07. The fish survival rate ranged from 87–96%.

Keywords: *Hemibagrus nemurus, Anadara granosa*, Recirculation system

Abstrak

tian ini bertujuan mengetahui pengaruh kombinasi media filter cangkang kerang darah (*Anadara granosa*) terhadap kualitas air pada sistem resirkulasi pemeliharaan ikan baung (*Hemibagrus nemurus*). Penelitian dilaksanakan pada Desember 2025 s/d Februari 2026 di Laboratorium Teknologi Budidaya, Fakultas Perikanan dan Kelautan Universitas Riau menggunakan metode eksperimen Rancangan Acak Lengkap (RAL) dengan empat perlakuan dan tiga ulangan. Perlakuan terdiri atas P0 (kontrol tanpa cangkang kerang darah), P1 (150 g/25 L air), P2 (200 g/25 L air), dan P3 (250 g/25 L air). Hasil penelitian menunjukkan bahwa penggunaan cangkang kerang darah sebagai media filter mampu menjaga kualitas air selama pemeliharaan, dengan kisaran suhu 24–28,6°C, pH 2,16–7,94, DO 4,96–6,47 mg/L, TDS 22 1038 mg/L, amoniak 0,015–1,429 mg/L, dan nitrat 0,0604–21,2729 mg/L. Perlakuan terbaik diperoleh pada P3 dengan panjang akhir ikan 16,8 cm, SGR 3,60%, efisiensi pakan 93,45%, dan FCR terendah 1,07. Tingkat kelulushidupan ikan berkisar 87–96%.

Kata kunci: *Hemibagrus nemurus, Anadara granosa*, sistem resirkulasi

1. Introduction

Asian redtail catfish (*Hemibagrus nemurus*) is a freshwater fish commodity with high economic value and good cultivation prospects in Indonesia. This fish is commonly found in rivers, lakes, reservoirs, and swamps, with a selling price ranging from IDR 60,000 to 75,000 per kilogram (Sukendar et al., 2021). In addition to its high economic value, catfish is also popular among the public because its flesh is thick, soft, boneless, and rich in protein, making it a potential nutritious food source. However, in intensive cultivation, water quality is often compromised by the accumulation of leftover feed and fish waste, which can inhibit growth and lead to fish mortality.

One way to maintain water quality is to implement a Recirculating Aquaculture System (RAS). This system works by recirculating the culture water through a filtration process, thereby improving water-use efficiency and maintaining stable water-quality parameters such as pH, temperature, dissolved oxygen, and ammonia. In a recirculating system, the filter media play a crucial role in the physical, chemical, and biological filtration processes.

One natural material with potential use as a filter medium is the shell of the blood cockle (*Anadara granosa*). According to Awang et al. (2007), blood cockle shells contain approximately 98.7% Calcium Carbonate ($CaCO_3$) and 1.3% other minerals such as magnesium, sodium, phosphorus, and potassium. The high $CaCO_3$ content makes blood cockle shells potential adsorbents and pH-neutralizers for water (Maryam, 2006). Furthermore, Mohamed et al. (2012) reported that blood cockle shells contain approximately 97% $CaCO_3$, which is effective in absorbing heavy metals. Research by Aslia (2014) also showed that using cockle shells as a filter medium can improve water quality and increase the productivity of farmed fish. Based on this description, this study was conducted to determine the effect of using blood cockle shells as a filter medium on water quality in in recirculating catfish system.

2. Material and Method

2.1. Time and Place

This research was conducted from December 2025 to February 2026 at the Aquaculture Technology Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau.

2.2. Methods

The method used in this study was a Completely Randomized Design (CRD) with four treatment levels and three replications, resulting in 12 experimental units. Each treatment was randomly assigned to each experiment. These treatment levels were based on previous research by Rahimawati et al. (2019) using blood clam shells (*A.granosa*), with treatments varying in media mass. The study showed that a media volume of 8 grams/liter significantly reduced water contaminant levels. Therefore, the treatment applied in this research phase was the difference in weight of blood clam shells as a water filter medium, as follows: The treatments consisted of P0 (control without blood clam shells), P1 (150 g/25 L of water), P2 (200 g/25 L of water), and P3 (250 g/25 L of water).

2.3. Procedures

The study used 12 aquariums (60 × 40 × 40 cm**,** 25 L each) arranged in a recirculating system. The aquariums were sterilized using 5 ppm Potassium Permanganate (PK) for 24 hours (Rachmawati et al., 2015). The filtration system consisted of blood clam (*A. granosa*) shells, zeolite, and bioballs as mechanical, chemical, and biological filters. The blood clam shells were cleaned, boiled for 20–30 minutes, air-dried, and broken into coarse fractions before use. The blood clam shell treatments included P1 = 150 g, P2 = 200 g, and P3 = 250 g per 25 L of water (Rahimawati et al., 2019). Asian redtail catfish measuring 7 cm were stocked at a density of 25 individuals per container (Purba et al., 2021), acclimatized for 7 days, and maintained for 56 days. Feed was provided three times daily at 5% of biomass (Hidayat et al., 2013; Lasena et al., 2017). Observations included growth, survival, and water quality (temperature, pH, DO, and ammonia) measured at the beginning, middle, and end of the study.

2.4. Data Analysis

2.4.1. Water Quality

The water quality parameters measured include temperature, pH, dissolved oxygen (DO), Total Dissolved Solids (TDS), ammonia, and nitrate. Temperature was measured with a thermometer, pH with a pH meter, DO with a DO meter, and TDS with a TDS meter based on the water's electrical conductivity. Ammonia (TAN) was measured using a spectrophotometer based on the sample absorbance and a calibration curve (Alaerts & Santika, 1984), while nitrate (NO_3) was measured using a test kit by comparing the sample color with a color standard.

2.4.2. Fish Weight Growth

Absolute weight growth is calculated using the Effendie (2002) formula, namely: W = Wt – W0

Description:
W = Absolute weight gain 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)

2.4.3. Absolute Length Growth

The formula used to calculate absolute length growth of seeds can be calculated using the formula proposed by Effendie (1997) as follows: L = Lt – L0

Description:
L = Fish length growth
Lt = Fish length at the end of maintenance (cm)
L0 = Fish length at the beginning of maintenance (cm)

2.4.4. Specific Growth Rate (SGR)

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

$$SGR = \frac{LnWt - LnWo}{t} \times 100\%$$

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 = Maintenance period (days)

2.4.5. Feed Efficiency (EF)

The formula used to calculate feed utilization efficiency is as proposed by Zonneveld et al. (1991):

$$EP = \frac{(Wt+D)-W0}{F} \times 100\%$$

Description:
EP = Feed Efficiency (%)
W0 = fish biomass weight at the beginning of cultivation (g)
Wt = Fish biomass weight at the end of cultivation (g)
D = Dead fish weight (g)
F = Amount of feed consumed during cultivation (g)

2.4.6. Feed Conversion Ratio (FCR)

The calculation of the feed conversion ratio (FCR) is performed using the formula from Effendie (1997):

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

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)

2.4.7. Survival Rate (SR)

The survival rate is calculated using Effendie (1997) formula: $SR = \frac{Nt}{No} \times 100\%$

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)

3. Result and Discussion

3.1. Water Quality

In a study on the use of blood clam shells to improve water quality in the cultivation of catfish, the measured water quality parameters were temperature, pH, DO, TDS, ammonia, and nitrate. The results of the water quality measurements during the study are shown in Table 1.

The results of the study indicate that using blood clam shells as a filter medium in a recirculation system affects the water quality in Asian redtail catfish cultivation. The temperature during the study ranged from 24–28.6°C, and DO ranged from 4.96–6.47 mg/L, thus remaining within the optimal range for fish growth (Boyd, 2018). The

low nitrate values indicate that filtration and nitrification are functioning well (Timmons & Ebeling, 2018). More obvious differences were seen in pH, TDS, and ammonia. The use of blood clam shells increased and stabilized pH due to the calcium carbonate ($CaCO_3$) buffering capacity (Boyd, 2018). The TDS value increased with increasing shell dosage due to mineral dissolution, but remained within the tolerance limits of freshwater fish (Timmons & Ebeling, 2018). The best treatment was P3 because it showed the lowest ammonia and nitrate levels and a more stable pH than the other treatments. The low ammonia levels in P3 indicate that blood clam shells are effective as a filtration medium and substrate for nitrifying bacteria in suppressing the accumulation of nitrogen waste

Tabel 1. Water quality measurement range during the study

Parameter	Measurement Results			
	P_0	P_1	P_2	P_3
temperature	24-27,8	24,6-28,2	24-28,1	24-28,6
pH	2,3-5,95	2,23-6,29	2,28-6,97	2,16-7,94
DO	4,96-6,25	5,12-6,47	5,2-6,43	5,06-6,4
TDS	24-683	23-792	23-846	22-1038
Ammonia	0,026-1,4291	0,038-0,2364	0,015-0,0911	0,019-0,056
Nitrate	0,0604-21,2729	0,0813-7,1063	0,0729-3,3875	0,0979-2,0958

3.2. Fish Growth

The results of the study on the absolute weight and length growth of catfish fry showed an increase in each treatment using different amounts of blood clam shells. Data on the average weight and length of catfish are presented in Table 2.

Table 2. Absolute weight growth, absolute length and specific growth rate of Asian redtail catfish (*H. nemurus*)

Treatment	Absolute Weight (g)	Absolute Length (g)	Specific Growth Rate (%)
P_0	11,66±1,25^a	3,0±0,35^a	2,56±0,21^a
P_1	17,68±0,21^b	5,8±0,15^b	3,16±0,03^b
P_2	18,78±0,81^b	5,9±0,61^b	3,21±0,08^b
P_3	23,63±3,61^c	9,1±0,30^c	3,60±0,20^c

The results showed that Asian redtail catfish growth increased across all treatments, as reflected in weight, length, and specific growth rate (SGR). The best treatment consistently performed in P3, producing the highest absolute weight (23.63±3.61 g), the highest absolute length (9.1±0.30 cm), and the highest SGR (3.60±0.20%), which were significantly different ($P<0.05$) from those of the other treatments. The high growth in P3 is thought to be due to the use of blood clam shells as a filter medium, which improves water quality by increasing pH, absorbing nitrogen compounds, and providing a substrate for nitrifying bacteria. The $CaCO_3$ content in the shells also acts as a buffer, stabilizing the rearing environment, thus supporting fish metabolism and growth. Several previous studies support these findings, indicating that stable water quality in recirculating systems can improve growth and feed utilization efficiency in cultured fish (Kordi & Tancung, 2018). In addition, the use of shell-based filtration media has also been reported to improve fish production performance by improving water quality and the nitrification process (Insani & Rahmatsyah, 2021).

3.3. Feed Efficiency, Feed Conversion Ratio, and Survival Rate

Based on the results of the research, feed efficiency, feed conversion ratio, and survival rate of cat Asian redtail catfish fish fry showed an increase in each treatment using different amounts of blood cockle shells. Asian redtail catfish feed efficiency data are presented in Table 3.

Table 3. Feed efficiency, feed conversion ratio, and survival rate of Asian redtail catfish (*H. nemurus*)

Treatment	Feed Efficiency (%)	Feed Conversion Ratio	Survival Rate (%)
P_0	51,85±3.21^a	1,93±0.12^a	89±8.32^a
P_1	77,47±0.57^b	1,29±0.01^b	96±4.00^a
P_2	75,99±5.29^b	1,32±0.08^b	87±6.11^a
P_3	93,45±2.08^c	1,07±0.02^c	91±12.85^a

The results showed that using blood cockle shells as a filter medium in a recirculating system affected the Feed efficiency and FCR of Asian redtail catfish. The highest feed efficiency value was obtained in P3 (93.45±2.08%), while the lowest was in treatment P0 (51.85±3.21%). This indicates that P3 is most effective in increasing feed utilization by fish. Correspondingly, the lowest FCR value was observed in P3 (1.07±0.02), followed by P1 (1.29±0.01), P2 (1.32±0.08), and the highest in P0 (1.93±0.12). The low FCR in P3 indicates more efficient feed utilization for fish growth.

This is thought to be due to the blood cockle shells' ability to improve water quality through physical and biological filtration, reduce nitrogenous waste, and provide a substrate for nitrifying bacteria. A more stable

environment improves digestion, metabolism, and nutrient absorption, resulting in more efficient feed utilization (Pratama et al., 2020; Sari et al., 2019). For the survival rate (SR), all treatments were not significantly different (P>0.05), with a range of 87–96%, with the highest in P1 (96±4.00%). However, overall, all treatments remained high and suitable for cultivation, indicating that the recirculation system and use of filter media did not reduce fish survival rates (Effendie, 2002; Azhari & Tomasoa, 2018; Hapsari et al., 2020).

4. Conclusions

The results of the study showed that the use of blood clam shells as a filter media in the maintenance of Asian redtail catfish was able to maintain water quality at a temperature range of 24–28.6°C, pH 2.16–7.94, DO 4.96–6.47 mg/L, TDS 22–1038 mg/L, ammonia 0.015–1.429 mg/L, and nitrate 0.0604–21.2729 mg/L which still supported fish life. The best treatment was obtained in P3, with a final length of 16.8 cm, SGR of 3.60%, feed efficiency of 93.45%, and the lowest FCR of 1.07. Meanwhile, the survival rate ranged from 87% to 96% and did not differ significantly between treatments. In general, P3 exhibited the best growth performance and feed efficiency among the treatments.

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