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Ammonia Reduction by Different Thickness Coral Shard Filter in Cultivation of Catfish (*Pangasius* sp.)

Desi Maria Sabu[1,a,*], Ade Yulita Hesti Lukas[1], Yuliana Salosso[1]

[1]Aquaculture Department, Faculty of Animal Husbandry, Fisheries and Marine Science, University of Nusa Cendana, Kupang, Indonesia.

[a]desimariasabu14@gmail.com
[*]Corresponding author

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ABSTRACT

Catfish (*Pangasius* sp.) is a consumption fish that is quite popular and has a selling value. Fish have tolerance standards for water quantity and quality, so water as a living medium should be managed in aquaculture. One of the water quality parameters that affect the survival of cultured fish is ammonia (NH_3). Ammonia at high concentrations can adversely affect fish, such as reducing the ability of the blood to carry oxygen, damage to body tissues, fish susceptible to disease, inhibiting growth and death. This research aimed to determine the thickness of the coral shard filter, which effectively reduces ammonia (NH_3) in catfish culture. This research was conducted at the Dry Fisheries Laboratory, Faculty of Animal Husbandry, Fisheries and Marine Science, University of Nusa Cendana. The research started from February 2022 - April 2022. The implementation of this research used a Completely Randomized Design (CRD) with 4 treatments and 3 replications, namely: without coral shards filter (A), treatment using a coral shard filter with a thickness of 5 cm (B), coral shard filter with a thickness of 10 cm (C) and coral shard filter with a thickness of 15 cm (D). Results show that filter coral shards treatment with 5 cm thickness can reduce the concentration of ammonia in the cultivation of fish catfish from a score beginning research of 0.02 mg/L to 0.018 mg/L in the end research.

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1. Introduction

Catfish is one type of consumption fish with a selling value and is favoured by the community. The craze for catfish is its delicious taste and contains high protein and low cholesterol (Djauhari et al., 2017). The Directorate General of Aquaculture (2012) stated that catfish can be used as a promising commodity to be developed into domestic commodities to foreign export commodities. Mahardhika Nindya Kharisma et al. (2017) said that economically catfish have business opportunities to be developed into commercial businesses, so increased production of catfish cultivation can increase demand and open up more significant opportunities for catfish cultivation.

Indeed, in aquaculture activities, water quality is essential in supporting aquaculture production (Pratiwi, 2014). Fish have tolerance standards for water quantity and quality, so water as a living medium should be managed in aquaculture. One of the water quality parameters that affect the survival of cultured fish is ammonia (NH_3). Ammonia at high concentrations can adversely affect fish, such as reducing the ability of the blood to carry oxygen and damage to body tissues; fish are susceptible to disease, inhibiting growth and death (Akbar et al., 2013; Norjanna et al., 2015). Ammonia is an inorganic nitrogen compound produced from the decomposition of organic matter. Organic matter is sourced from aquaculture activities' feed and fish metabolism residues (faeces). The feed has properties that tend to dissolve quickly, settle and decay. The feed will be metabolized and used for two purposes: growth and maintenance, and other feed will produce feed and metabolic waste (Hastuti, 2011). To reduce the impact caused by feed residues and metabolism, one is to apply a recirculation system cultivation equipped with a filter.

A recirculation system equipped with a filter is one of the technological innovations that can overcome water quality problems, including reducing ammonia concentration in aquaculture containers. Filters are used because the recirculation system is ineffective in reducing ammonia (Norjanna et al., 2015). Another benefit of implementing this system is to save water because there is a circulation of water from the cultivation container to the filter and then back to the cultivation container, and filtering of feed residues and fish metabolism occurs so that the water does not quickly become cloudy. The coral shard filter was effective in reducing ammonia concentrations. The rate of reduction and thickness of the coral shard filter has not been known in the research of Norjanna et al., (2015). Therefore, this research aimed to determine the thickness of the coral shard filter, which effectively reduces ammonia in catfish aquaculture.

2. Material and methods

This research was conducted for 2 months, from February to April 2022, in the Dry Fisheries Laboratory, Faculty of Animal Husbandry, Fisheries and Marine Science, University of Nusa Cendana. Ammonia analysis (NH_3) was conducted at the Environmental Laboratory, Department of Environment and Forestry, Kupang.

2.1 Material

The tools that supported this research were a water pump (KT-1200S), thermometer, pH meter, analytical balance, and net. The materials used in this research were catfish, coral shards, and commercial pellet feed.

2.2 Method

This research used a completely randomized design (CRD) with 4 treatments and 3 replications. The treatment in this research refers to the research of Norjanna et al. (2015) regarding the reduction of ammonia in the recirculation system with the use of a filter which found that coral shards as a filter were effective in reducing ammonia compared to zeolite and charcoal. The treatment in this research was as follows.

Treatment A: Recirculation system without coral shards filter
B: Coral shard filter with a thickness of 5 cm (1.125 cm^3: 36 L)
C: Coral shard filter with a thickness of 10 cm (2.250 cm^3: 36 L)
D: Coral shard filter with a thickness of 15 cm (3.375 cm^3: 36 L)

2.3 Maintenance

This research used an aquarium of 40 cm x 30 cm x 40 cm, with as many as 12 pieces. Glued filter case on the part of the aquarium. Size filter container 15 cm x 15 cm. Filter case made a hole from limited filter thickness to channel out water. Every receptacle cultivation is filled with water as high as 30 cm, so the volume of water for each aquarium is 36 L.

The catfish used is 7-10 cm in size. Each aquarium was filled with 15 fish. The feed used in the research is commercial feed, given 3 times a day in the morning, afternoon, and evening as much as 5% of the biomass.

During the research, the filter was washed on day 30. According to Priono & Satyani (2012), the filter dirt, like remainder feed and dust on cultivated water, must be washed over a specific time because it could congest water flow so that dissolved oxygen (DO) content can decrease on receptacle cultivation. Every 15 days, a weighted catfish sampling was carried out, and the number of fish taken for sampling was 5 fish/aquarium. Adjustments to the feed dose were calculated based on data on the average weight of the fish samples measured every 15 days.

Tested water quality parameters are ammonia (NH_3), DO (mg/L), and pH. Ammonia measurements were carried out at baseline and the end of the research Prasetyo (2018). Measurement to DO and pH did every 10 days.

2.4 Parameters

2.4.1 Absolute Weight Growth (W)

Absolute weight growth during maintenance was calculated using the formula:

$$W= W_t-W_0$$

Information:

W = Absolute weight growth (g)
Wt = The end of average weight (g)
W_0 = The beginning average weight (g)

2.4.2 Survival Rate

During maintenance, calculated using the formula:

$$SR= \frac{Nt}{N0}x100\ \%$$

Information:

SR = Survival rate (%)
Nt = number of live fish at the end of the research (tails)
N_0 = number of live fish at the beginning of the research (tails)

2.5 Data Analysis

The research data were analyzed using analysis fingerprint variance (ANOVA) using SPSS software with 95% confidence and if treatment showed a significant difference followed by Duncan's test.

3. Results and Discussion

3.1. Concentration of Ammonia (NH_3)

The concentration of ammonia in the waters comes from the rest of the feed and the results of fish metabolism (feces). Feed and feces are organic materials containing protein, which will be broken down into polypeptides, amino acids, and ammonia in cultivation media (Zidni et al., 2017). Ammonia concentration by each treatment is presented in Figure 1.

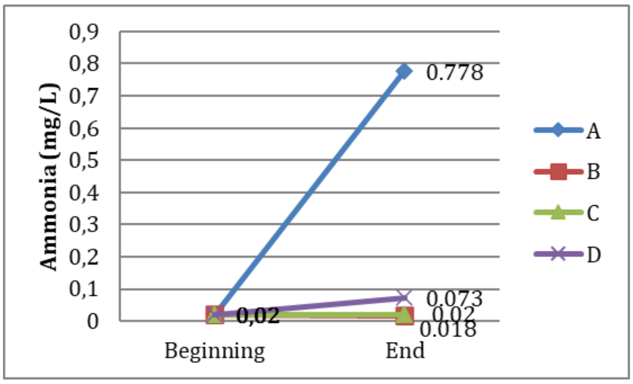

Figure 1. Ammonia concentration

The final results showed that the ammonia concentration in treatment A was 0.778 mg/L higher than the treatment using a coral shard filter with a thickness of 5 cm (0.018 mg/L), coral shard filter with a thickness of 10 cm (0.02 mg/L) and coral shards with a thickness of 15 cm (0.073 mg/L). The increased ammonia concentration in treatment A was caused by not using an additional filter, so ammonia filtering did not occur. Sources of ammonia are derived from feed residues and metabolism. If not handled during maintenance, the ammonia content will increase because the growth of catfish is getting bigger, increasing the amount of feeding, increasing metabolism, and food residue that settles or dissolves. Nurhidayat et al. (2012) stated that the increased concentration of ammonia in the cultivation container was due to the length of maintenance and the absence of microorganisms that utilized the rest of the feed and metabolism.

Wahyuningsih & Gitarama (2020) stated that the ammonia concentration in cultivation media should not exceed 0.05 mg/L. However, the catfish species have a fairly wide range, namely 0.73-3.10 mg/L (Boyd, 2001). However, ammonia has a sub-lethal effect. Namely, when at the same concentration for an extended period, it can kill fish and damage aquatic life. Ammonia can diffuse from the water through the gill epithelium into the blood and move to the tissues. The effects of ammonia cause stunted growth, decreased resistance to disease, decreased blood cells, reduced blood oxygen levels, organ structural damage, and poor feed conversion (Wahyuningsih & Gitarama, 2020).

Treatment using a coral shards filter with a thickness of 5 cm (B), a coral shards filter with a thickness of 10 cm (C), and a coral shards filter with a thickness of 15 cm showed that it could suppress the rate of ammonia in catfish culture at the end of the research. Coral shards can be used as filters that work both physically and chemically. Physically, the concentration of ammonia tends to be stable because the rest of the feed and fish metabolism have been filtered in the coral shard filter container before returning to the culture container so that the process of organic matter to form inorganic material, namely ammonia in the catfish culture container can be minimized. Chemically, coral shards have a porous surface as a place for nitrifying bacteria to breed. The role of nitrifying bacteria is to utilize ammonia so that the concentration of ammonia does not increase. This supports the statement of Norjanna et al. (2015) that the porous surface of coral shards allows bacteria to live to help the ammonia reduction process. Hastuti (2011) reported that nitrifying bacteria work by converting ammonia into nitrite and nitrate, which are harmless to catfish. Sudarno (2012) stated that nitrifying bacteria utilize ammonia as an energy source for reproduction.

3.2. Dissolved Oxygen

Score start of DO from highest to lowest that is treatments A (7.3 ± 0.2), B (6.2 ± 0.6), C (6, 8), and D (5.3 ± 0.05). Height DO value on treatment A because rate more water flows fast and big compared with B, C, and D. The filter thickness causes the rate more water flow slow and small because of long contact between the water in the filter to return water on receptacle cultivation. This follows the statement by Afrinaldi et al. (2014) that high water discharge will produce high oxygen in receptacle cultivation.

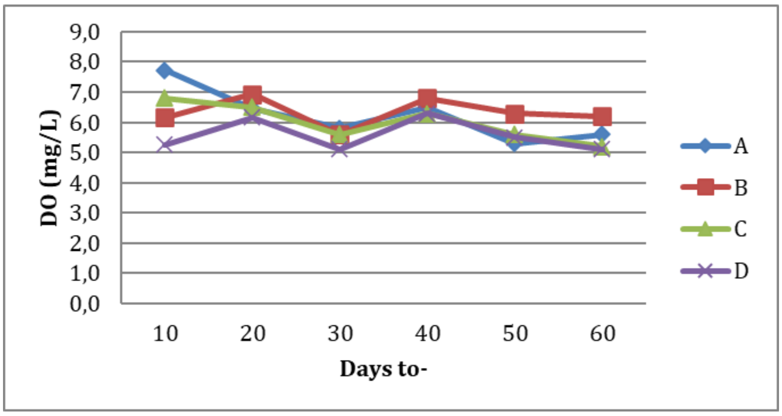

Figure 2. DO value of different treatments of coral shard filter thickness.

Results ANOVA test against DO value on end research show the different thickness of coral shards filter in the recirculation system has no significant difference (P >0.05) to DO content. By systematic highest DO value in treatment B (6.2 mg/l), followed by treatment A (5.6 mg/l), C (5.2 mg/L), and D (5.1 mg/l). Manunggal et al. (2018) stated that the DO value of 3 mg/l was good enough to support the life of catfish. The DO value during the research was 5-7 mg /L in each treatment. The relatively stable oxygen content in each treatment was due to using a recirculation system which caused turbulence in water movement, so the DO content tended to be stable. This supports the statement of Afrinaldi et al. (2014) that using a recirculation system can maintain DO stability in cultivation containers.

3.3. pH

The pH value on day 10 in each treatment had the same range, namely 7. As seen in Figure 3, the pH value at the 40th day to end research on treatment A tended to decrease suspected consequence accumulation of remainder feed and feces on receptacle cultivation. This thing supported by the statement by Supriatna et al. (2020) that high organic matter content, respiration processes and decay of organic substances can cause a decrease in pH value. A low pH value can lower the pH of fish blood, reducing the blood's function to transport oxygen.

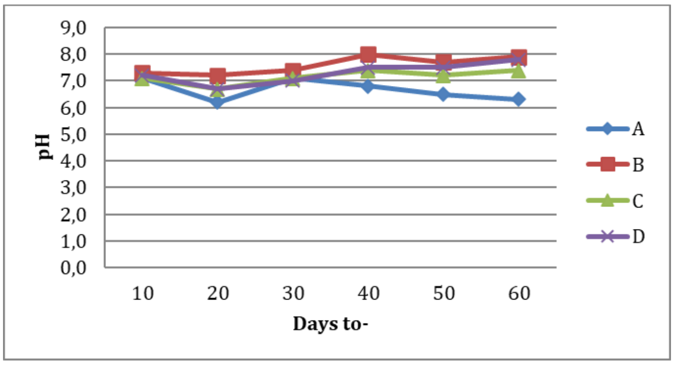

Figure 3. The pH value of the treatment of different coral shards filter thickness.

Results ANOVA test against pH value at end research showing that different thickness of coral shards filter in the recirculation system has a significant difference (P <0.05) to score pH. Based on the results analysis test Duncan continued treatment A was different and significant to treatments B, C, and D. Treatment A has more pH value small than treatment using a filter of coral shards. The thing is that coral shards have content calcium and magnesium, which can act as a buffer (*buffer*) to maintain the pH value Zulfa (2019). Although the pH value showed a significant difference, catfish could tolerate this value. According to Addiyanto et al. (2012), a suitable pH range for catfish is 6-8.

Table 1. Duncan's test pH value

pH				
Duncan [a]				
Treatment	N	Subset for alpha = 0.05		
		a	b	c
A	3	6.3667		
C	3		7,4000	
D	3		7.7667	7.7667
B	3			7.9333
Sig.		1,000	0.073	0.376

3.4. Growth Weight Absolute (W) &

Table 2. Weight data absolute and fish survival rate catfish during research

Treatment	Absolute Weight growth (g)	Survival rate (%)
A	34.42 ±6.02	91 ±10.15
B	28.14 ±1.64	91.11 ± 15.4
C	32.40 ±9.38	95.5 ± 7.7
D	29.76 ±5.15	91.11 ± 7.7

The growth weight of absolute catfish on treatment A was 34.42 g, treatment B was 28.14 g, treatment C was 32.4 g, and treatment D was 29.76 g. The results of the research that tested ANOVA on the weight of catfish for 60 days of research stated that the different thickness of coral shards filter in the recirculation system has no significant difference ($P > 0.05$) to absolute weight growth of catfish. By systematic treatment A seen to have weighed taller than treatments B, C, and D using a fraction filter coral. This was suspected because treatment A had cloudy water and tended to be conditioned dark. Fish catfish are naturally nocturnal and active in dark conditions, so the feed given could be utilized well. Mahardhika et al. (2017) convey that fish cultivated catfish in condition bright are more like keeping quiet on base, while in dark conditions, fish catfish showing act more active and little keep quiet on base.

The survival rate of catfish is an important part that provides information on the success of aquaculture. The survival rate is the percentage of the number of fish that live until the end of the rearing in the same rearing tank. The survival rate value from the research is presented in Table 2. The highest survival rate value of catfish was in treatment C (95.5 %), then treatment B (91 ± 10.15), D (91±10.15), and A (91±10.15). The ANOVA results showed that the thickness of the coral shards filter had no effect ($P < 0.05$) on the survival rate of catfish. The survival rate value of catfish in this research was relatively the same. According to SNI (2002), the survival rate of catfish in the recommended rearing class is 80%-95%. The average value of the catfish survival rate in this research was 92,12 %, so it was considered good. A controlled culture medium is one factor that affects the survival rate of catfish. The ammonia concentration in this research was in the range that catfish could tolerate. Sari et al. (2021) stated that qualified ammonia can support a better fish survival rate. Catfish are classified as fish with muscular endurance to adapt to unfavorable environmental conditions.

4. Conclusion

The results show that the coral shard filter with 5 cm thickness in a volume of 36 L can reduce ammonia from an initial score of 0.02 mg/L to 0.018 mg/L at the end of the research.

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