Different Activated Carbon As Adsorbent In Reducing Total Hardness: The Impact To Oxygen Consumption Rate Of Nile Tilapia *Oreochromis niloticus*

D. Sanjayasari[1] and N. Andriyani[2]

[1)]Department of Aquatic Resources Management, Science and Engineering Faculty
Jendral Soedirman University, Purwokerto 53123, Indonesia
Email: sanjaya_cer@yahoo.com
[2)]Department of Aquatic Resources Management, Science and Engineering Faculty
Jendral Soedirman University, Purwokerto 53123, Indonesia

ABSTRACT

The study was to determine the effectiveness of two different activated carbons in reducing total hardnessas one of principal component in water quality and also their affect to oxygen consumption rate in Nile Tilapia. The present of Ca and Mg in water has become essential as micronutrient for aquaculture. Unfortunately it became a threat when the level was above average.Aactivated carbon from agriculture waste became one of solution to solve high hardness in the water. The treatments were P0 (control with no carbon active), P1 (coconut shell) and P2 (rice husk). The research was used Completely Randomized Design (CRD) with five replications. The result showed water quality parameters still in range with pH 6-8 and temperature of 28^{0}C. Meanwhile, the best result of total hardness reduction was expressed significantly (P<0,01) 78,9% by P2 rise husk activated carbon. The same result was expressed by P2 treatments (P<0,01) in oxygen consumption rate of Nile Tilapia. Based on the research concluded that rise husk activated carbon gave the best performance in reducing water hardness and increasing oxygen consumption efficiency of Nile Tilapia.

Keywords: activated carbon, hardness, oxygen consumption, Nile Tilapia

INTRODUCTION

Background

Water quality is one of important factor to maintain in aquaculture system. It supports fish to grow and affiliates them to culture. One of parameter in water quality which needs to be concerned is hardness. Hardness is the total amount of calcium and magnesium which dissolved in the water (Barus, 2002).The standard of hardness in the water as aquaculture requirements are 70 to 140 ppm (Tancung, 2004). The high hardness in the aquaculture water system could contribute to low production of the fishes. Hence, the energy of the fish will be used to adapt in the water condition (Fariduddin*et.al*, 2010).

High hardness in aquaculture water system happens in Darmakradenan Village, Ajibarang Banyumas Regency. One of aquaculture commodity from this village is Nile Tilapia. Unfortunately those fishes could not grow properly caused by the water condition. The high hardness condition caused by limestone production in the village. Limestone contains 95% of calcium carbonate (Haris, 2006). One of the solutions to reduce hardness is by using activated carbon from agriculture waste product; such as coconut shell and rice husk. Activated carbon is pores material contains 85- 95% carbon which produces by activated carbon material in high temperature (Siagian, 2011). The method of hardness reduction by using activated carbon is called absorbtion.

The using of agriculture waste product saves the environment and become part of integrated fish farming system. The result of hardness reduction could affect to nile tilapia culture especially in oxygen consumption rate. The purposes of this research were to measure effectiveness of two activated carbons in reducing total hardness and its effectiveness to oxygen consumption rate.

METHODS

Preparation of activated carbon

Rice Husk Activated Carbon

The preparation of fire wood to become fervour, the next step it was closed by funnel and on top of it was put with dry rice husk wait until become rice husk coal. To activate the rice husk coal by soaked it with Natrium Hydroxide (NaOH), filtered and washed with distillates water the method according to Yuliati and Susanto (2011).

Coconut Shell Activated Carbon

ut shell, and closed it with iron plat. The coal will shell coal by soaking it in activator solvent HCl

and KOH for 10 hours, filtered and washed with distillates water, the method according to Purwanigsih (2000).

Water Sample

The water sample was taken from Darmakradenan Village, Ajibarang, Banyumas Regency. The method was used purposive sampling in several aquaculture pond approximately 200 L in homogenous condition. The water sample was then brought to the Fisheries and Marine Laboratorium, UNSOED Purwokerto.

Nile Tilapia as animal testing object to measure total hardness and oxygen consumption rate

The measurement place of total hardness was used 15 recirculatory aquariums, mean while oxygen consumption rate was used aquarium chamber. The total hardness of water sample is analyzed not only after treatments but also before treatments to see the reduction. Each aquarium with recirculatory system which had been filled with activated carbon 10% from total amount of water (Susetyaningsih*et.al*, 2009). After 2,5 hours water sample was taken to be analyzed total hardness after treatments. There were 15 aquarium chambers which had been cleaned and sanitized. The capacity of each aquarium is 10 L. The weight of nile tilapia around 15 to 17 g, there was one fish per each aquarium. The fishes had been acclimated for 48 hours before treatments. They were fasting for 24 hours before treatments (Goenarso*et.al*, 2003).

Oxygen consumption rate was measured according to Huang (1975) method in Mardin ((2011). The aquarium chamber was full aerated, then wait up to 15 minutes until there was no bubble. The analysis of dissolved oxygen were measure before and after the duration of treatments (around (1 hours).

Variables

Total hardness and oxygen consumption rate was then counted with equation, according to to Alaerts and Santika (1984) and Huang (1975) in Mardin (2011).

$$CaCO_3\,(ppm) = \frac{A \times 1{,}0009 \times 1000}{B} \times f \quad \ldots\ldots (1)$$

Where $CaCO_3$was expressed total hardness in ppm, mean while*A* was amount of EDTA solvent which used in titration method (ml), *B*was amount of water sample (ml), *1,0009*was constantan, and *f*was different factor in EDTA.

$$OCR = \{(DO_0 - DO_t)/W \times t\} \times V \quad \ldots\ldots (2)$$

Where *OCR* expressed oxygen consumption rate (mg O_2/ Weight (g)/ hours), $DO_0$was dissolved oxygen before treatments, DO_t was dissolved oxygen after treatments, *W* expressed body weight of the fish (g), *t*was measurements period (hours) and *V* was water volume in the aquariums.
Supported water quality parameter were pH and temperature, measure with pH meter and thermometer.

Data Analysis

The research was used completely randomized design (CRD) with three treatments and five replications. The treatments were P0 (without activated carbon or control), P1 (with coconut shell activated carbon) and P2 (with rice husk activated carbon). The data were analyzed with ANAVA in Minitab 16.

RESULTS AND DISCUSSION

Water quality parameters based on pH and temperature

The result of water quality parameters based on pH and temperature could be seen in Table 1. Temperature parameter showed in stable condition 28^0C. It caused by sampling time around 9.00 WIB. In aquaculture management system, temperature had important role in fish metabolism. It gave stable value which still in standard range for aquaculture (Jaya, 2011). The result for pH value showed significant decrease in (P1) coconut shell activated carbon, from 8 up to 6-7. It showed that P1 treatments could adsorb and stabilize the pH in the high hardness water sample. This condition also still in the range of aquaculture standard of nile tilapia (Jaya, 2011).

Table 1. Water quality parameter before and after treatments

Treatments	Water quality parameters					
	pH			Temperature (^{0}C)		
	Before	After	Standard	Before	After	Standard
P0	8	7-8		28	28	
P1	8	6-8	7-8	28	28	28-32
P2	8	7-8		28	28	

Source: Temperature and pH Standard (Jaya, 2011)
P0 = without activated carbon (control), P1= with coconut shell activated carbon, P2 = with rice husk activated carbon.

Total Hardness

The result of total hardness showed that before treatments the amount was 294,26 ppm, and the most optimum decrease (P<0,01) after treatments showed in P2 (rice husk activated carbon) could be seen in Table 2.

Table 2. Total hardness and percentage of hardness decrease for each treatments

Treatments	Total hardness		Standard	Hardness decreases (%)
	Before	After		
P0	294,26±0^a	293,11±0,04^a		0,39±0,0001 ^{a}
P1	294,26±0^a	152,58±4,27^b	70-140 ppm	48,15±0,0145^b
P2	294,26±0^a	60,38±11,32^c		79,48±0,0385 ^{c}

Source: Standard of total hardness for aquaculture (Tancung, 2007)
^{a,b,c} Mean value within a row with unlike superscript letters were significantly difference (P<0.01)
P0 = without activated carbon (control), P1= with coconut shell activated carbon, P2 = with rice husk activated carbon.

Based on Table 2., P2 treatments showed the best response in decreasing total hardness up to 60,38 ppm or 79,48%. Compare to coconut shell activated carbon, rice husk activated carbon had more silica and carbon up to 15-22% of SiO_2. Its carbon had 95% silica with high porosity and wide surfaces because of cellular structure. Rice husk also contain syloxsan (Si-O-Si) and silanol (Si-OH) (siriluk and Yuttapong, 2005).Adsorbtion mechanism started with silanol on the surfaces and siloxsan in the inside of rice husk activated carbon. Silanol will bind the ionic compound which less benefit to the water continued by siloksan in side of rice husk did the same procedures in binding useless ionic compound.

Based on Table 2., showed that total hardness which decrease by P2 treatments below the standard for aquaculture management system, in the other hand it become safer to consume by human. It needs to measure the amount of rice husk activated carbon which used in the resirculatory aquariums to full fill the aquaculture standard, this research used 10% of total water.

Oxygen Consumption Rate of Nile Tilapia

The result of oxygen consumption rate could be seen in Pict 1.The best performance on oxygen consumption rate showed by P2 treatments with 0,118 mg O_2/w/hours.

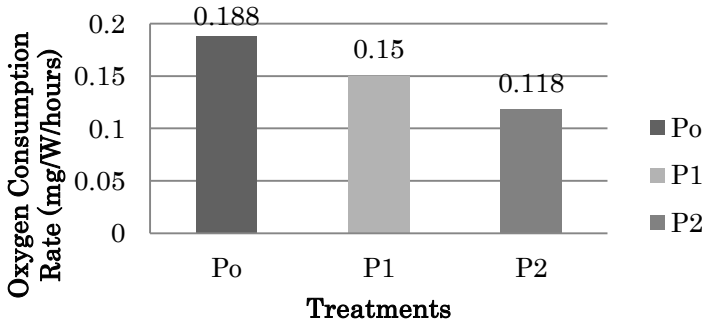

Figure 1. Oxygen consumption rate per treatments P0 (without activated carbon), P1 (coconut shell activated carbon) and P2 (rice husk activated carbon).

Based on Fig 1, showed that P0 treatments had the highest oxygen consumption rate compare to other treatments. It showed that the fish need to get extra oxygen in the habitat with high hardness. In P<0,01) of oxygen consumption rate, it caused ilable than in P0 and P1 treatments. The more

active the fish the more oxygen the fish need, because of its adaptation with the environment (Fathuddin*et.al*, 2002).

CONCLUSION

The best treatment to reduce total hardness and give the best performance of oxygen consumption rate in Nile Tilapia is rice husk activated carbon.

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