The dynamics of total organic matter (tom) on sangkuriang catfish (*clarias gariepinus*) farming at upt ptpbp2kp and the effectiveness of freshwater bivalve (*anodonta woodiana*) in reducing the total organic matter with varying density

The dynamics of total organic matter (tom) on sangkuriang catfish (*clarias gariepinus*) farming at upt ptpbp2kp and the effectiveness of freshwater bivalve (*anodonta woodiana*) in reducing the total organic matter with varying density

D Arfiati[1]*, C D G Putra[1], A H Tullah[1], S W A Permanasari[1] and A W Puspitasari[1]

[1] Faculty of Fisheries and Marine Science, University of Brawijaya, Malang, Indonesia.

*Corresponding author: d_arfiati@yahoo.com

Abstract. Fish farming activities often leave organic waste which can degrade the water quality. The efforts to decrease the amount of organic matter biologically is needed such as the use of aquatic animals for reducing harmful residues. The purposes of this study were to observe the dynamics of total organic matter (TOM) on Sangkuriang Catfish (*Clarias gariepinus*) farming and to understand the varying density of freshwater bivalve (*Anodonta woodiana*) to decrease the total organic matter (TOM) on the residual of Sangkuriang Catfish (*Clarias gariepinus*) farming activity. This study employed the survey and experimental method. The survey results, the total organic matter from *inlet to outlet* increases about 319% of Sangkuriang Catfish (*Clarias gariepinus)* farming, and for the experimental results, the best treatment of freshwater bivalve (*Anodonta woodiana*) surface based covered was obtained at 75% with decreasing was about 88% total organic matter (TOM) by immersion for 16 hours.

1. Introduction

Aquaculture is defined as cultivation of fish, shellfish (oysters, mussels, clams, and crustaceans), or plants (seaweed and algae) in inland or coastal areas which is related to the maintenance process to increase the fish production [1]. Recently, the aquaculture sector has been numerous in the total fish production in the world [2]. Ponds are usually used for aquaculture production system which about 40% of the world production not only for freshwater fishes but also all crustaceans are cultured in ponds. Ponds, with the intensive system, will accumulate the organic level during culture cycle because of much from external inputs (feeds and fertilizers) [3].

Total Organic Matter (TOM) is an important else of sediment parameter and a primary source of food for benthic organisms and necessary for structuring the composition of the benthic fauna. The amount of organic matter will lead to contamination in the sediments. When sediments contain a large amount of organic matter which means the contaminants will be in a particle form, While sediments contain a small amount of organic matter, the contaminants will present in the pore water [4]. Absolutely, an attempt for diminishing the total organic matter which exceeds the limit is needed such as biologically way which does not give an adverse effect.

Anodonta woodiana is a kind of freshwater bivalve which lives in bottom waters and relatively settled. *Anodonta woodiana* also called by Kijing Taiwan or Chinese pond mussels is a filter feeder organism which is able to be a bioindicator in a polluted environment. Pollutants which enter inside the

body of this freshwater bivalve would be analyzed the profile of hemocyte (THC and DHC), and there is found a hyaline cell which is an indicator for foreign objects [5,6,7]. The purposes of this study were to investigate the dynamics of Total Organic Matter (TOM) on Sangkuriang Catfish (*Clarias gariepinus*) at UPT PTPBP2KP, Kepanjen, Malang and to observe the effective density of freshwater bivalve (*Anodonta woodiana*) for decreasing on the residual of Sangkuriang Catfish (*Clarias gariepinus*) farming activity at UPT Freshwater Fisheries Sumberpasir laboratory, University of Brawijaya, Malang, East Java.

2. Methodology

2.1. Material

UPT PTPBP2KP Kepanjen, Malang, East Java, Indonesia (112°17' to 112°57' EL dan 7°44' to 8°26' SL). The chosen areas were determined into 3 stations were an *inlet,* Sangkuriang Catfish (*Clarias gariepinus*) pond, and *outlet.* Station 1 was *Inlet* station located in the entrance point of water storage before it flowed into the Sangkuriang Catfish pond with sampling once a day. Sangkuriang Catfish pond was the station 2, with the length area of this study is approximately 2 m x 3 m and the depth of the pond is 1.5 m with a total pond is 10 units. The sample in the station 2 was taken 2 times a day, those were at morning (before feeding) and at noon (after feeding). And the station 3, was *outlet* located in the exit point of water from residual of Sangkuriang Catfish sampling conducted once a day. For Freshwater bivalve (*Anodonta woodiana*) treatment was conducted at UPT Freshwater Fisheries Sumberpasir laboratory, University of Brawijaya, Malang, East Java.

2.2. Method

2.2.1. Sample preparation

Water sample for measuring the total organic matter (TOM) in the three stations (*inlet,* Sangkuriang Catfish, and *outlet*) by using water sampler, then put into a 1.5 liters bottle and keep into a coolbox with ice until use to avoid degrading of organic matter by decomposer bacteria. The sample was taken each week along five weeks. Freshwater bivalve (*Anodonta woodiana*) is a biofilter animal which used in this study were taken from a fish pond in UPR Sumber Mina Lestari, Dau, Malang City, East Java. Then, the freshwater bivalve was acclimatized in the freshwater about 24 hours without feeding before using for the experiment.

2.2.2. Physical and chemical parameters

Physical and Chemical Parameters assay in this study was applied to obtain the water quality status in the water sample. For water, physics assay was temperature (alcohol thermometer), and for chemical, the assay was pH (*Testr* 30), Dissolved Oxygen (DO) (Lutron DO-5510), Ammonia (Spectrophotometer UV-vis) and TOM ($KMnO_4$). Temperature, pH and DO were assayed *in-situ,* while Ammonia and TOM were assayed *ex-situ* at UPT Freshwater Fisheries Sumberpasir laboratory, University of Brawijaya, Malang. This measurement was carried out in triplicate and was checked in every week until five weeks.

2.3. Animal experiment

Freshwater bivalve (*Anodonta woodiana*) size was used in this study was 8 to 9 cm. The 25 tanks on 106.76 cm^2 each were filled with 10 L water of residual of Sangkuriang Catfish (*Clarias gariepinus*) farming activity from Sumberpasir laboratory. Thus, were separated into 5 groups, those were A group was 0% with no freshwater bivalve as a control; B group was 100% freshwater bivalve-coverage with a total of 20 organisms; C group was 75% freshwater bivalve-coverage with a total 15 organisms; D group was 50% freshwater bivalve-coverage with a total of 10 organisms; and E group was 25% density of freshwater bivalve with total 5 organisms. Each group was performed in five replication followed by [8] TOM assay was checked by different time points. Each group was checked in every 4 hours starts from the zero hours to the sixteenth hour. The decrement of TOM was assayed conventionally by using $KMnO_4$ as an oxidizing agent.

2.4. Data analysis

The data analysis was used in this study was determined by one-way analysis of variance (ANOVA) in Sigmaplot ver 12.0 followed by Tukey's test. Data are explained as a mean ± standard deviation which significant differences required $p < 0.05$.

3. Results and discussion

3.1. Physico-chemical assay on UPT PTPBP2KP Kepanjen

The physicochemical assay was conducted to obtain the water quality status in the water sample. Based on the physical and chemical analysis, the average of temperature was 27.2 to 28.0°C; pH was 7.0 to 7.3; DO was 4.5 to 6.5 mg/L; Ammonia was 0.1 to 0.3 mg/L (Table 1).

Table 1. The physicochemical assay results.

No.	Parameters	Week	*Inlet*	Sangkuriang catfish pond		*Outlet*
				Before feeding	After feeding	
UPT PTPBP2KP Kepanjen						
1.	Temperature (°C)	1	27.3	28.0	29.4	27.7
		2	26.8	27.3	27.3	27.5
		3	27.8	28.1	30	27.5
		4	28.3	27.7	29.1	28.0
		5	26.0	26.4	27.0	26.5
2.	pH	1	7.1	7.0	7.0	7.1
		2	7.2	6.4	7.0	7.0
		3	7.3	7.0	7.0	7.2
		4	7.1	7.0	7.2	7.0
		5	7.8	7.2	7.1	8.3
3.	DO	1	5.5	4.16	4.28	4.09
		2	5.71	3.59	4.27	4.10
		3	5.54	4.25	4.23	5.09
		4	7.36	4.41	5.41	3.38
		5	8.35	6.00	6.30	5.86
4.	Ammonia	1	0.081	0.342	0.176	0.336
		2	0.072	0.176	0.225	0.550
		3	0.080	0.245	0.151	0.324
		4	0.044	0.133	0.072	0.116
		5	0.016	0.195	0.165	0.218
5.	TOM	1	34.13	93.96	72.89	97.33
		2	29.07	88.48	62.36	94.80
		3	32.68	90.59	69.10	77.10
		4	26.54	94.38	62.36	107.44
		5	17.46	68.75	44.97	69.87

Value describes the means with five replication.

Based on Indonesian Government Regulation Number 82 of 2001 (Aquaculture standard), the standard of physical and chemical parameters was pH 6 to 9; DO ≥ 3 mg/L; Ammonia ≤ 0.02 mg/L. The temperature relativity in this study was good enough. The relative temperature of African catfish *Clarias gariepinus* was 27.1 to 27.3°C [9]. pH and DO were appropriate to standard for aquaculture, but ammonia exceeds the standard for aquaculture. TOM analysis on Sangkuriang Catfish (*Clarias gariepinus)* at UPT PTPBP2KP Kepanjen showed different results. The difference of TOM level was caused by the differences of aquaculture activity. TOM level in the *inlet* always smaller than TOM in

the Sangkuriang Catfish pond or and in the *outlet*. In the *inlet* the average of TOM was 27.98 mg/L, then in the Sangkuriang Catfish pond the average of TOM was 87.23 mg/L (before feeding) and 62.34 mg/L (after feeding), on *outlet* was 89.31 mg/L. TOM has a strong correlation with ammonia when ammonia increase due to TOM level which increases. Naturally, Ammonia arising in the water because of the microbiological decomposition of nitrogen compound on the organic matter [10]. Therefore, the increasing of TOM from the *inlet to outlet* was about 319%. On the *inlet*, the total organic matter was not too high because the water resource was from groundwater with sedimentation treatment before streamed to the Sangkuriang Catfish pond. In the Sangkuriang Catfish pond showed the different result in before and after feeding with before feeding higher than after feeding, it might be caused the organic matter in the pond before feeding was supplied by the excretion from its fish and another organic matter such as phytoplankton and benthic. [11] explained that Plants, animals, and microorganisms can be recognized as organic matter. Almost all organisms use carbohydrates as a source of energy but some the bacteria like to consume fewer molecules like nucleic acids and proteins. And the causes of an organic matter after feeding was lower than before feeding is because the fish were fed by 0.5 kg per day with density was 30 fish with each body weight 1 kg, which means only 1.7% of body weight. this percentage was not beyond the standard of daily feed of fish was 2% body weight [12]. Mostly, the aquaculture system often limits the capacity for self-purification. These systems are considered low stability and continuous exchange of matter and energy which can decrease the internal entropy [13]. On the *outlet*, occurred the accumulation of organic matter, thus making TOM will be the highest value. TOM with a small amount in the pond is necessary, but when TOM exceed the standard, it can be harmful to aquatic organisms because of the development of anaerobic conditions at the sediment-water. Therefore, organic compounds are often decomposed to decrease as like NO_2, H_2S, NH_3, and CH_4 which is toxic to fish in low concentrations [14].

3.2. Analysis of TOM after freshwater bivalve Anodonta woodiana treatment

Total Organic Matter (TOM) is a compound that contains an organic material such as dissolved, suspended and colloidal ingredients. [15] explained that the illustration of organic matters formed in the water ecosystem is when the solar energy trapped by plants for photosynthesizing, then the plants fed by herbivores and the herbivores eaten by carnivores. These ways are leading to an accumulation of feces and dead plants and animal bodies in the pool. The high level of organic matter in the waters will give a risk for balancing of water organism. Recently, in several countries, waste disposal of the concentrated organic matter is called pollution, including remaining of aquaculture activity [16,17]. In this study, TOM level from remaining of Sangkuriang catfish (*Clarias gariepinus*) allowed the decrement by freshwater bivalve (*Anodonta woodiana*) as an organic feeder. Figure 1. showed that on A group (control) there was a significant decreased of TOM after the fourth hour to sixteenth hour from 53.8 ± 0.00 mg/L to 13.39 ± 2.10 mg/L which means 75% decrease level. It happened because the organic matter suspended on the bottom of the tank without freshwater bivalve helped. For the B group, the TOM was decreased from 53.8 ± 0.00 mg/L to 9.61 ± 2.77 mg/L in the fourth hour to sixteenth hours which means 82% decrease. C group showed the highest decrement of TOM from 53.8 ± 0.00 mg/L to 6.57 ± 1.38 mg/L which means 88% on the fourth hour to sixteenth hour. For D and E groups showed that both groups occurred deflation of TOM with percentages 83% and 84% with TOM value were 53.8 ± 0.00 mg/L to 8.85 ± 2.36 mg/L and to 8.34 ± 1.70, respectively. For all treatments, reported that the treatment with freshwater bivalve inside showed the higher result for reducing the TOM compared to control (no freshwater bivalve). Freshwater bivalve has a strong influence on ecosystem processes in the freshwater system. Thus, can be an important filter feeder which directly impacts on benthic processes with burrow in the sediments [18].

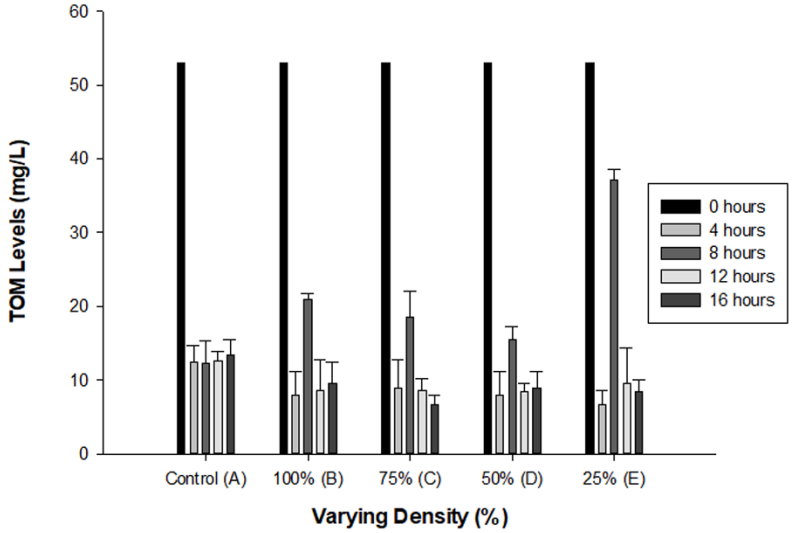

Figure 1. Tom Levels (mg/L) after treatment with varying density of Freshwater Bivalve (*Anodonta woodiana*) and varying time points. All treatment data followed by standard of deviation (STD) as the error bars is P<0.05.

4. Conclusion

Total Organic Matter (TOM) on the Sangkuriang Catfish (*Clarias gariepinus*) achieved the highest value was 319% at *outlet* and the freshwater bivalve *(Anodonta woodiana*) can be used as agent of TOM degradation with varying density of freshwater bivalve (*Anodonta woodiana*) was 75% (C group) as the most effective group with decreasing value of TOM was about 88% in 16 hours immersion compared to all treatments. For the future, the massive application is needed to confirm this hypothesis.

5. References

[1] FAO 2012 *www.fao.org/fishery/aquaculture/en*
[2] Bjornsdottir R, Oddsson G V, Thorarinsdottir R I and Unnthorsson R 2016 *Water* 8(8) 319
[3] Beristain B T 2005 *Organic Matter Decomposition in Simulated Aquaculture Ponds*
[4] Trannum, H C, Brakstad F and Neff J 2006 *Sediment Characterization and Parameter Estimation* ERMS Task 3 ERMS Report no. 12
[5] Choi H J, Hwang J Y, Choi D L, Do Huh M, Hur Y B and Lee N S 2011 *Korean J. Parasitol.* **49(3)** 229
[6] Kartikaningsih H, Suryanto A and Arfiati D 2016 *IOP Conference Series: Earth Environ. Sci.*
[7] Wijayanti D A, Hertika A M S and Yanuwiadi B 2018 J. *Exp. Life Sci.* 8(1) 7-14
[8] Federer H 2014 *Geometric Measure Theory* (Netherland: Springer)
[9] Amisah S, Oteng M and Ofori J 2009 *J. App. Sci. Environ. Manag.* 13(1)
[10] EPA 2011 *Integrated Water Quality Report Monaghan & Louth River Water Monitoring-Description of Parameters* Appendix 7: Information on Water Quality Parameters
[11] Agah H, Rahmanpour S and Sheijooni F N 2013 *J. Persian Gulf.* 4(13) 31-7
[12] Avnimelech Y, Mozes N, Diab S and Kochba M 1995 *Aquaculture* 134(3-4)
[13] Piedrahita R H 2003 *Aquaculture* 226(1-4) 35-44
[14] Boyd C E, and Bowman J R 1997 *Pond Bottom Soils* In: Egna H S and Boyd C E (Ed), Dynamics of Pond Aquaculture (New York: CRC Press, Boca Raton) pp 135-162
[15] Wotton R S and Malmqvist B 2001 *AIBS Bull.* 51(7) 537-544
[16] Davis J T 1993 *Survey of Aquaculture Effluent Permitting and 1993 Standards in the South* (Southern Regional Aquaculture Center)
[17] Ostrensky A and Boeger W A 2008 *Aquicultura no Brasil: o Desafio é crescer* 135-158

[18] Vaughn C C and Hakenkamp C C 2001 *Freshwater Biol.* **46(11)** 1431-1446