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Short Communication

The Effectiveness of *Filopaludina javanica* and *Sulcospira testudinaria* in Reducing Organic Matter in Catfish (*Clarias* sp.) Aquaculture Wastewater

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Abstract

The residual or wastewater from the cultivation process that is discharged directly into common waters can reduce the quality of the waters because it contains a lot of organic material from organism feces and feed residue, so, water quality management is needed. The objective of this study was to determine the ability of *Tutut Jawa* and *Susuh Kura* snails to reduce total organic matter in catfish culture waste. The research method was the experiment with 2-factor Factorials Completely Randomized Design. The first factor was the time measurement (4, 8, 12, and 16 hours) and the second factor was the abundance of the *Tutut Jawa* and *Susuh Kura* snails (100%, 75%, 50%, 25%, and control). The *Tutut Jawa* snails were taken from the pond at UPR Sumbermina Dau. The results obtained in the treatment with the addition of *Tutut Jawa* snail, the total organic matter content decreased at quality during the study was in a condition that could tolerate the *Tutut Jawa* snails and freshwater 75% snail density by 90% (from 68.75 mg/L to 5.31 mg/L) at the 12th hour. The treatment with the addition of *Susuh Kura* at a density of 25%, the total organic matter content was decreased by 87% (from 72.48 to 9.35 mg/L) at the 8th hour. The conclusion is that the addition of *Tutut Jawa* snail and / or *Susuh Kura* can reduce the total organic matter content to the water quality standard.

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1. Introduction

Catfish is a freshwater fish that is widely consumed by the community to meet their nutritional needs. Catfish is widely cultivated with intensive cultivation. Intensive cultivation is cultivation using a large area, high stocking density, and high pellet feeding (Negara *et al.*, 2015). A cultivation activity with good management will still produce a waste from leftover feed and fish feces. For example, if one cultivation pond is given 100 kg of pellet feed, 25% of feed is used for fish growth, 25% of feed is used for fish metabolism and 50% of feed produces waste consisting of 10% uneaten feed, 10% in the form of suspended waste, and 30% of waste from fish metabolism (Setiawan *et al*., 2016). The waste from the remaining intensively cultivated feed that was disposed into common waters consisted of 1-5% of dry feed, 5-10% of moist feed, and 10-30% of wet feed. The remaining feed results in cultivation waste producing waste with an organic material content of around 33.7-46.8% (Sulistiyarto, 2016). If the remaining aquaculture waste with high organic matter content is disposed without management into public waters, it will cause organic pollution and decrease water quality (Srithongouthai and Tada, 2017). Waste that is disposed directly can easily contaminate the surrounding water. Emissions removed can reduce dissolved oxygen, produce hyper-nutrification and eutrophication, increase sedimentation loads, and cause variation in planktonic and benthic communities (Islam and Yasmin, 2017).

Gastropods are important organisms in aquatic ecosystems because they can take advantage of detritus and organic matter in the waters (Fadhilah *et al*., 2013). The *Tutut Jawa* snail (*Filopaludina javanica*) is a freshwater snail in the Mollusca phylum, gastropod class, and Viviparidae family. These snails are found in the upper reaches of rivers (Tanjung, 2015). The *Tutut Jawa* snail (*Filopaludina javanica*) is animal that consumes organic material that has been broken down by detritus (detritus feeder). The presence of organisms from the gastropod class in an aquatic ecosystem can reduce the presence of organic matter in the waters (Sari *et al*., 2016). *Susuh Kura* (*Sulcospira testudinaria*), a freshwater gastropod, is classified as a suspension feeder that has gills with long filaments as plankton traps and suspensions carried by water flow. Gastropods as suspension feeders are thought to be an alternative to reduce levels of total organic matter in waters (Suwignyo *et al*., 2005). Gastropods will absorb and eat organic materials or leftovers from feces or fish food that have undergone an overhaul. Organic materials will be used by gastropods for growth. The gastropod organisms namely *Telescoplum* sp. and *Cerithidea* sp. can reduce levels of waste from laboratory-scale milkfish maintenance. Animals that eat organic material and fall to the bottom of the perennial can be used as organisms to reduce the level and buildup organic matter. The use of gastropods in sewage treatment will not affect changes in water quality such as pH, temperature, and dissolved oxygen. (Khalil *et al*., 2016).

Organic matter in catfish ponds has increased from inlet to outlet at the initial of 28.01 mg/L to 89.33 mg/L respectively (Arfiati *et al*., 2018). Bacillus subtilis bacteria can reduce levels of organic matter by 84% from the initial level of 52.61 mg/L to 13.03 mg/L, but it takes 5 days of treatment (Anggraini *et al*., 2019). Thus, it is necessary to manage catfish culture waste with treatment in a short time.

The Tutut Jawa (*F. javanica*) and *Susuh Kura* snails (*S. testudinaria)* are organisms that act as biofilters that use organic materials as food. Therefore, there is a need for research on the management of cultivation waste intensively to reduce organic matter by using *Tutut Jawa* (*F. javanica*) and *Susuh Kura* snails (*S. testudinaria)*. The objective of this study was to determine the ability of *Tutut Jawa* (*F. javanica*) and *Susuh Kura* snails (*S. testudinaria*) to reduce total organic matter in catfish culture wastewater, so that they could be used as a solution to reduce levels of organic matter before aquaculture wastewater was discharged into common waters.

2. Materials and Methods

2.1 Research Time and Location

This research was conducted at the Laboratory of UPT Air Tawar Sumberpasir, Malang from January to March 2018. *Tutut Jawa* (*F. javanica*) and *Susuh Kura* snails (*S. testudinaria*) were collected at UPR Sumber Mina Lestari, Dau, Malang. The survey was carried out to determine the types of freshwater gastropods that were found in the sampling location. Temperature measurement was also carried out to determine the location of the study that matched the conditions of the sampling location.

2.2 Research Procedure

The first research procedure was to collect and sort *Tutut Jawa* (*F. javanica*) and *Susuh Kura* snails (*S. testudinaria*) in the UPR Sumbermina pond, Dau, Malang. The organisms were then acclimatized to avoid water contamination from their natural habitat and gastric emptying. Acclimatization was carried out on media with a diameter of 10.5 cm, then filled with clean water as much as 2 liters, and allowed to stand for 24 hours. The *Tutut Jawa* snails (*F. javanica*) were 1.7 to 2.2 cm in size while *Susuh Kura* snails (*S. testudinaria*) were more than 3 cm in size. The second step was after acclimatizing for 24 hours, the *Tutut Jawa* (*F.javanica*) and *Susuh Kura* snails (*S. testudinaria*) conchs were put into a different treatment tub with 2 liters volume each of catfish aquaculture wastewater. Wastewater in the treatment was taken from the catfish aquaculture pond intensively with a stocking density of 1,500 individuals with a maintenance period of 40 days.

This study was based on differences in the density of organisms in the presence of five different treatments, namely control without organisms, density 50, density 38, density 25, and density 13. The number of *Tutut Jawa* (*F. javanica*) and *Susuh Kura* (*S. testudinaria*) snails in one pond are ± 250 individuals. Determination of the number of individuals in each treatment used the Slovin formula according to Anita *et al*. (2013) as follows:

$$n = \frac{N}{1 + N(a^2)}$$

Information :
n = Number of samples
N = total population
$\alpha^2 = 0.05$

Based on the calculation of the Slovin formula, it was found that a density of 100% was 50 individuals, a density of 75% was 38 individuals, a density of 50% was 25 individuals, and a density of 25% was 13 individuals. Each treatment was repeated 5 times to obtain 25 experimental units. Furthermore, the total organic matter content was measured by the titration method and water quality parameters (temperature, dissolved oxygen, and pH) every 4 hours, 8 hours, 12 hours, and 16 hours. Temperature parameters and dissolved oxygen were measured using a DO meter, while pH was measured using a pH paper

2.3 Total Organic Matter Procedure

Organic material in wastewater is measured using the titration method. According to Ni'ma *et al*. (2014), 50 ml of water sample was added to erlenmeyer, after which 5 ml of H_2SO_4 was added and then homogenized. The next step was to add 0.01 N $KMNO_4$ as much as 4.75 ml homogeneous and heated for 10 minutes until the temperature reached 70^oC then removed from heat. When the temperature had dropped to 60^oC, slowly add 0.01 N sodium oxalate until it was colorless. Furthermore, it was titrated with $KMNO_4$ 0.01 N until it turned pink and recorded how many ml of titrant (x ml), then did the same procedure for 50 ml of distilled water and recorded how many ml of titrant (y ml). The next step was to calculate the total organic matter content with the followi

$$TOM\ (mg/L) = \frac{(x - Y)x\ 31{,}6x0{,}02\ x\ 1000}{ml\ sampel}$$

Information :
- x: ml of titrant for sample water
- y: ml of titrant for distilled water
- 31.6: one-fifth of the molecular weight of $KMnO_4$ because each mole of $KMnO_4$ releases five oxygens in this reaction
- 0.01: N $KMnO_4$
- 1000: Convert from liters to milliliters

2.4 Data Analysis

In this study, statistical analysis was also carried out using factorial ANOVA test to determine the effect of each treatment on reducing the total organic matter content in catfish culture waste and to determine the best time to decrease the total organic matter content.

3. Results and Discussion

The measurement results of total organic matter in catfish culture wastewater were 68.75 mg/L for treatment with the addition of *Tutut Jawa* snails (*F. javanica*) and 72.48 mg/L in wastewater for the addition of *Susuh Kura* snails (*S. testudinaria*). The measurement results of total organic matter for 16 hours of observation in the treatment with the addition of *Tutut Jawa* snail (*F. javanica*) with a density of 50 individuals had a 90% reduction percentage from the initial level of 68.75 mg/L to 7.02 mg/L (Figure 1 and 2). The total organic matter content in the treatment with a density of 38 individuals and 25 individuals had the same percentage decrease, namely 88% from the initial level of 68.75 mg/L to 8.09 mg/L. Meanwhile, the treatment with a density of 13 individuals had a percentage reduction of 87% from the initial level of 68.75 mg/L to 8.34 mg/L and control with a percentage of 84% from the initial level of 68.75 mg/L to 11.12 mg/L.

The results of measuring the levels of total organic matter in the treatment with the addition of *Susuh Kura* snails (*S. testudinaria*) with a density of 50, 38, and 25 individuals had the same percentage reduction, namely 69% from the initial level 68.75 mg/L to 22.25-22.27 mg/L. Meanwhile, the treatment with a density of 13 individuals had a percentage decrease of 73% from the initial level of 68.75 mg/L to 19.21 mg/L and control with a percentage of 63% from the initial level of 68.75 mg/L to 26.54 mg/L. The highest percentage reduction with the addition of *Tutut Jawa* snails (*F. javanica*) was found in treatment with a density of 38 individuals at 12th hours, namely 92% from the initial level of 68.75 mg/L to 5.31 mg/L. Meanwhile, the lowest percentage reduction treatment was found in the treatment with a density of 25 individuals at 4th hour, namely 84% from the initial level of 68.75 mg/L to 19.47 mg/L. The highest percentage reduction with the addition of *Susuh Kura* snails (*S. testudinaria*) was found in treatment with a density of 13 individuals at the 8th hour, namely 87% from the initial level of 72.48 mg/L to 9.35 mg/L. Meanwhile, the lowest percentage reduction treatment was found in the treatment with a density of 50% with number of organisms for 25 individuals at 12th hours and control treatment without organisms at the 16th hour, namely 63% from the initial level of 72.48 mg/L to 26.54 mg/L.

Organic matter content at zero hour of organic material had not undergone decomposition. The levels of organic matter began to decrease at the 4th hour because before the treatment of the *Tutut Jawa* snails (*F. javanica*) and *Susuh Kura* snails (*S. testudinaria*), their stomachs were emptied so that the snails consumed large amounts of organic matter. The decrease in organic matter at the 8th hour was due to it was reabsorbed and digested by the snails. The organic matter had increased at the following hour, it was possible that the snails began to excrete feces and their metabolic results. Control treatment also has a high percentage of organic matter reduction that is caused by endogenous bacteria in active waste under controlled conditions.

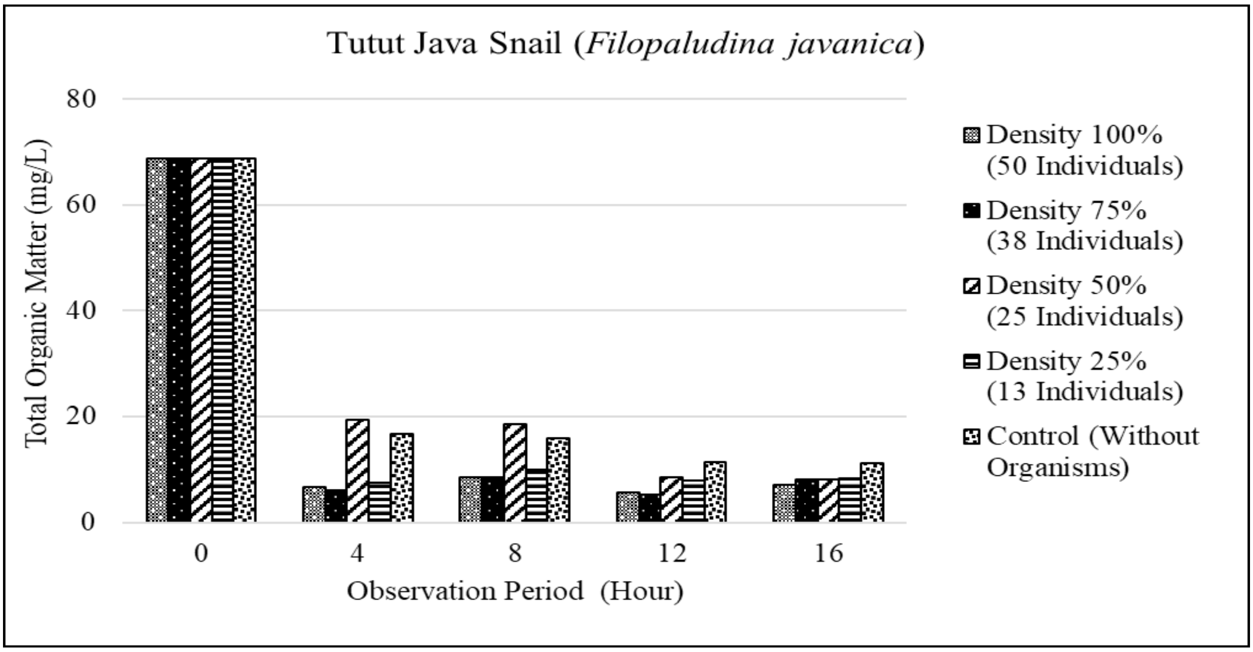

Figure 1.The results of measurement of total organic matter in catfish (*Clarias* sp.) aquaculture wastewater with Tutut Java snails (*Filopaludina javanica*)

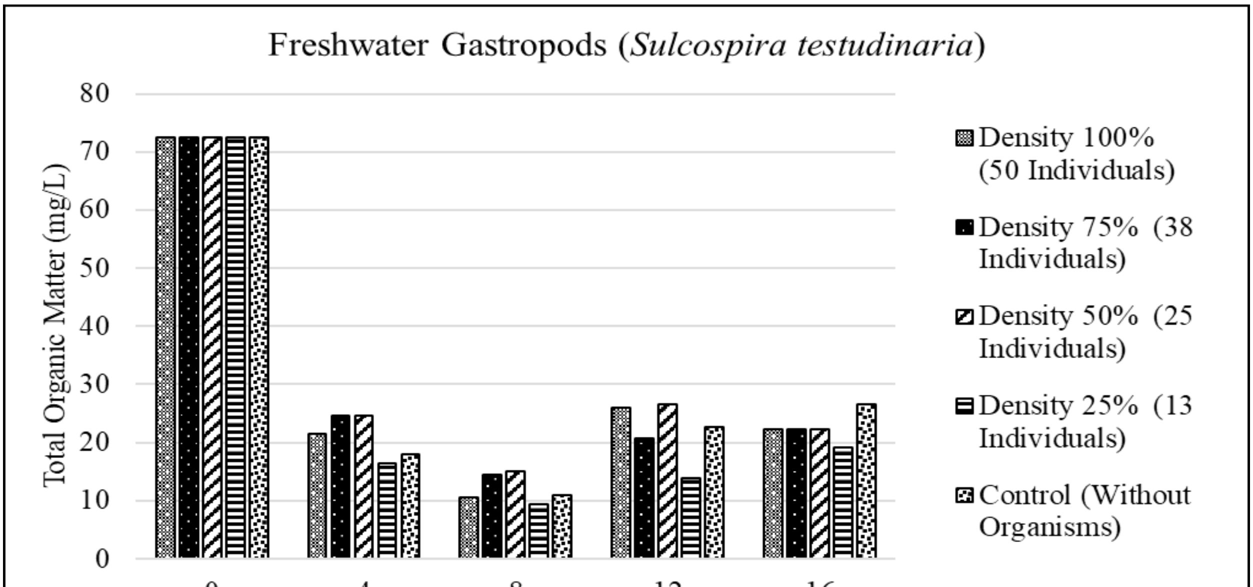

Figure 2.The results of measurement of total organic matter in catfish (*Clarias* sp.) aquaculture wastewater with freshwater gastropods (*Sulcospira testudinaria*)

Tabel 1. The water quality Measurement

Organism	Treatment	Parameters		
		Temperature (°C)	Dissolved Oxygen (mg/L)	pH
Tutut Jawa Snail (*Filopaludina javanica*)	Density 100% (50 Individuals)	19-20.7	5.80 – 6.98	7.13-7.33
	Density 75% (38 Individuals)	19.1 -20.3	5.90-6.76	7.16- 7.39
	Density 50% (25 Individuals)	19 – 20.4	5.86-6.66	7.18-7.37
	Density 25% (13 Individuals)	18.9 – 20.5	5.76-6.62	7.20-7.36
	Control (Without Organisms)	19.1 – 20.8	5.92-6.78	7.20-7.40
Susuh Kura Snail (*Sulcospira testudinaria*).	Density 100% (50 Individuals)	20-25	7.3-9.6	7.07-7.40
	Density 75% (38 Individuals)	19.5-25	7.3-9.3	7.10-7.44
	Density 50% (25 Individuals)	20-25	7.3-9.4	7.04-7.43
	Density 25% (13 Individuals)	19.5-25	7.6-9.3	7.06-7.49
	Control (Without Organisms)	19.5-25	7.4-9.2	7.06-7.46

The significance value of the observation time from factorial ANOVA in the treatment with the addition of *Tutut Jawa* snail (*F. javanica*) obtained was 0.046 which was smaller than 0.05 and the organism density treatment factor obtained was 0.000 less than 0.05, so it meant that the time factor and organism density affected the reduction of total organic matter. The interaction between time and treatment density signification value of 0.602 was greater than 0.05, so it did not affect the decrease in total organic matter. In the treatment with the addition of *Susuh Kura* snails (*S. testudinaria*), the significance value of the time factor was obtained 0.000 less than 0.05, so that the time factor affected the decrease in total organic matter.

The organism density treatment factor obtained was 0.059, greater than 0.05, so that the organism density factor did not affect the decrease in total organic matter. The interaction between time and treatment density signification value of 0.857 was greater than 0.05, so it did not affect the decrease in total organic matter. Duncan test was carried out to determine which treatment could reduce the total organic matter content to the lowest level and the fastest time. Duncan test results showed that the most effective treatment to reduce the total organic matter content in aquaculture wastewater was treatment with the addition of *Tutut Jawa* snail (*F. javanica*) with a density of 38 individuals at the 12th hour with a total organic matter content of 5.31 mg/L, while the treatment with the addition of *Susuh Kura* (*S. testudinaria*) was found in the treatment with a density of 13 individuals) at the 8th hour of 9.35 mg/L.

The results of temperature measurements in the treatment with the addition of *Tutut Jawa* snail (*F. javanica*) ranged from 18.90° C to 20.80° C, while the treatment with the addition of *Susuh Kura* snails (*S. testudinaria*) ranged from 19.5° C to 25° C (Table 1). The results of the dissolved oxygen measurement in the treatment with the addition of *Tutut Jawa* snail (*F. javanica*) ranged from 5.80 to 6.98 mg/L, while the treatment with the addition of *Susuh Kura* snails (*S. testudinaria*) ranged from 7.3 to 9.6 mg/L. The results of pH measurements in the treatment with the addition of *Tutut Jawa* snails (*F. javanica*) ranged from 7.13 to 7.40, while the treatment with the addition of *Susuh Kura* snails (*S. testudinaria*) ranged from 7.04 to 7.46.

Levels of organic matter that is allowed in the aquatic environment range from 10-60 mg/L (Indriyastuti *et al*., 2014). Macrozoobenthos is closely related to the presence of organic matter contained in waters as a source of nutrients. However, if the organic matter content exceeds the tolerance threshold, it is considered as a pollutant (Choirudin *et al.,* 2014). Gastropods utilize organic material as food through a food filtering system which is known as a filter feeder (Gea *et al*., 2020). Gastropods collect food with the posterior part of the leg attached to the substrate and the anterior to form a funnel that captures material by ciliary motion. The captured organic material is tied with a lender pedal, collected at the bottom of the funnel, and digested using the jaw and radula (Saveanu and Martín, 2013). The optimal time to reduce the total organic matter is 8 hours. In the next hour, the total organic matter would rise again due to the organism's metabolic process. Total levels of organic matter in water can come from the metabolism of aquatic organisms (Riniatsih, 2016). Furthermore, the wastewater could be discharged into public waters or reused for cultivation after soaking the waste to reduce organic matter for 8 hours.

The total organic matter content during the observation in the treatment with the addition of *Tutut Jawa* snail (*F. javanica*) ranged from 5.31 to 19.47 mg/L and treatment with the addition of *Susuh Kura* snail (*S. testudinaria*) ranged from 9.35 - 26.55 mg/L. This is in accordance with the Decree of the State Minister for population an Environment Number 2 of 1988 concerning wastewater Quality Standards which states that the total organic material quality standardfor waters is 80 mg/L (Supriyantini *et al*., 2017). Increasing the content of organic matter in waters can also increase the types of organisms that are able to withstand polluted waters, one of which is *Tubifex* sp. High organic matter causes dissolved oxygen in the water to be low, in this condition, organisms such as *Tubifex* sp. can live well (Fisesa *et al*., 2014).

Organisms such as shellfish and gastropods can live in waters with temperatures of 11°C to 29°C (Purnomo *et al*., 2014). In general, gastropods need temperatures of more than 20°C to be able to grow and develop properly (Erlinda *et al*., 2015). Water conditions with dissolved oxygen levels between 6.2 to 10 mg/L are favored by organisms from the gastropods class (snails) (Sahin and Albayrak, 2017). Gastropod organisms have a certain pH range in their survival. The ideal pH value for aquatic organisms is between 7 to 8 (Igho *et al*., 2015). The composition of organic matter can cause a decrease or increase in water pH because when the decomposition process occurs, organic matter will produce acid (Yuningsih *et al*., 2014).

4. Conclusion

The addition of Tutut Jawa snails (*F. javanica*) and Susuh Kura snails (*S. testudinaria*) to catfish aquaculture wastewater treatment with different numbers of individuals can reduce levels of organic matter to a level that is in accordance with water quality standards. Therefore, to reduce the total organic matter can use Tutut Jawa snails (*F. javanica*) for 12 hours and Susuh Kura Snails (*S. testudinaria*) for 8 hours. The Tutut Jawa snail can reduce organic matter by 92% (68.75 mg/L to 5.31 mg/L) and the Susuh Kura snail by 87% (72.48 mg/L to 9.35 mg/L). The Tutut Jawa snails and Susuh Kura snail can be used as organisms in the processing of aquaculture waste because they have filter feeder properties, namely filtering organic matter in the water column.

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Authors' Contribution

Author Contribution All authors have contributed to the final manuscript. The contributions of each author are as follows, Shofiyatul Lailiyah, Neni Dyah Kusumaning Arum, and Catur Budi Noviya collected data. Shofiyatul Lailiyah compiled the manuscript, Diana Arfiati and Asus Maizar Suryanto Hertika revised the article.

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