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Pengaruh Zeolit terhadap Kadar Amonia Air Budidaya Ikan Nila dengan Sistem Resirkulasi

Effect of Zeolite on Water Ammonia Levels in Tilapia Cultivation with Recirculation System

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ABSTRAK Pemeliharaan ikan nila (*Oreochromis niloticus*) dengan padat tebar tinggi dan pemberian pakan dapat menyebabkan penurunan kualitas air akibat akumulasi limbah metabolisme seperti ammonia yang bersifat racun bagi ikan yang dipelihara. Oleh karena itu diperlukan filter zeolit yang dapat menurunkan kadar amonia sehingga tidak berbahaya bagi kelangsungan hidup ikan. Penelitian ini dilakukan pada bulan Februari-April 2020, di Laboratorium Mutu Lingkungan Budidaya, Fakultas Perikanan dan Kelautan Universitas Riau. Tujuan penelitian ini adalah untuk menentukan pengaruh penggunaan filter zeolit terhadap kadar ammonia pada media pemeliharaan Ikan nila (*O. niloticus*) dan menemukan dosis yang sesuai dalam penggunaan filter zeolit. Metode yang digunakan adalah eksperimen dengan Rancangan Acak Lengkap (RAL) satu faktor yang terdiri dari empat taraf perlakuan. Perlakuan yang digunakan adalah pemberian filter zeolit dengan dosis yang berbeda, yaitu P0: Kontrol tanpa penggunaan filter, P1: Penggunaan zeolit 5,68 g/L, P2: Penggunaan zeolit 11,37 g/L, P3: Penggunaan zeolit 17,05 g/L. Perlakuan yang terbaik adalah P3 dengan dosis zeolit 17,05 g/L dengan nilai TAN 0,2616 mg/L, kadar Ammonia 0,0018 mg/L dan nilai reduksi TAN 59%. Tingkat kelulushidupan tertinggi pada P3 yaitu 88,88 %. Nilai kualitas air pada saat penelitian yaitu suhu 27-29°C, pH 6,7-7,0, O2 terlarut 6,2-6,9 mg/L.

Kata kunci: Ammonia; filter; media budidaya; *Oreochromis niloticus*; zeolit

ABSTRACT Culture of tilapia (*Oreochromis niloticus*) with high stocking density and feeding can cause a decrease in water quality due to the accumulation of metabolic waste such as ammonia which is toxic for fish rearing. A zeolite filter is needed which can reduce ammonia levels until it is not harmful to fish survival. This research was conducted in February-April 2020 at the Aquaculture Environmental Quality Laboratory, Fisheries and Marine Faculty of Riau University. The purposed of this study was to determine the effect of using zeolite on Ammonia (NH_3) and determine the appropriate dose for Tilapia (*Oreochromis niloticus*) rearing. The research method was a Completely Randomized Design (CRD) one factor with 4 levels of treatment (P0: Control without the use of filters, P1: Use of zeolite 5.68 g/L, P2: Use of zeolite 11.37 g/L, P3: Use of zeolite 17.05 g/L). The appropriate treatment for Tilapia rearing is P3 (Zeolite 17.05 g/L) with TAN value is 0.2616 mg/L, Ammonia 0.0018 mg/L, TAN reduction is 59%, and Survival Rate of fish is 88.88%. The value of water quality during the study were temperature 27-29°C, pH 6.7-7.0, and Dissolved O2 6.2-6.9 mg/L.

Keywords: Ammonia; filter; culture media; *Oreochromis niloticus*; zeolite

PENDAHULUAN

Fish farming activities with high stocking density caused high mortality (Mahmoud *et al.*, 2021) and feeding, can increase waste production from fish metabolic residue and furthermore, Kokoua & Eleni (2018), stated that the remaining feed caused a decrease in water quality. Commonly the generated aquaculture wastes is ammonia. Ammonia production that exceeds the threshold can be dangerous for the survival and growth of farmed fish because it was toxic. According to Setyaningrum *et al.* (2019), stated that feces, feed residue and metabolite waste can be the cause of the decline in the quality of maintenance water which results in high levels of ammonia during maintenance. Fish excrete 80-90% of ammonia through the osmoregulation process, while from feces and urine about 10-20% of total nitrogen (Wijaya *et al.*, 2014). Intensive fish production can have a negative impact on survival, performance, fish health and change water quality (Dawood *et al.*, 2020).

Ammonia accumulation in culture media is one of the causes of water quality degradation which can result in the failure of fish culture production. This reduction in water quality needs to be found a solution in order to not causing the losses in cultivation activities. One way to reduce this problem is to keep fish in a recirculating system using filters. Ghasemi *et al.* (2016) suggested that zeolite is a micro-crystalline hydrated aluminosilicate, which has been found in various applications because of its unique physicochemical characteristics such as ion exchange and adsorption-desorption properties that can be used as filters. Gendel & Lahav (2013), states that some natural zeolites such as clinoptilolite and chabazite are among the most effective natural absorbents to remove ammonia. The application of sodium to form natural chabazite to capture ammonia from the tilapia aquaculture recirculation system has been successful.

Zeolit have the ability to reduce levels of ammonia from the water because the pore structure of zeolite contained sodium ions instead of ammonia adsorbed ions. The zeolite's irregular crystal structure on the surface and high surface area make it a very effective trap for fine particulates and ammonia ions. In addition, the microporous zeolite media contains a large surface area for entrapment of colloid-sized particles. This shows that zeolites can be used as water filters to reduce ammonia concentrations (Silaban *et al.*, 2012).

According to Nurhidayat (2009) pure zeolites have the ability to bind or have a large enough affinity for ammonia ions. Therefore, to remove ammonia, it was needed a zeolite that can exchange ions is needed, namely sodium ions (Na^+) from zeolite and clinoptilolite which can be replaced by ammonium ions ($NH4^+$) so that $NH4^+$ which was hanging around dissolves in water and is then bound by zeolite. The binding of the ammonium ion results in a reduction in the ammonia molecule. The reaction equation for the binding process is as follows:

$$Na^+Z^- + NH_4^+ \rightarrow NH_4^+Z^- + Na^+$$

$$2\,Na^+Z^- + Ca^{+2} \rightarrow Ca^{+2}Z^-_2 + 2\,Na+$$

The use of a zeolite filter with a dose of 11.37 g/L in a contaminated container can reduce ammonia levels by 2.156 mg/L (Firdaus, 2016).

The purpose of this study was to determine the effect of using zeolite filters on the value of ammonia levels in Tilapia (*O. niloticus*) rearing media and to find the right dose in the use of zeolite filters.

MATERIALS AND METHODS

Material

Tilapia (*O. niloticus*) juvenile, Zeolite, Pellets CP FF-999, NaOH, water samples, $MnSO_4$, chlorox solution, phenate solution, PK, Aquades, standard solution (0.1 ppm, 0.3 ppm, 0.5 ppm, 0.75 ppm, 1.0 ppm).

Tool

Aquarium, Spectrophotometer UV-Vis Labo, water pump Yamano SP-1200, measuring cup Pyrex Iwaki Glass, test tube Pyrex Iwaki Glass, Erlenmeyer Pyrex Iwaki Glass, Bottle samples Pyrex Iwaki Glass, Pasteur Pipette Pyrex Iwaki Glass, pH Meter Milwauke, Drying Oven Binder, Shimidzu analytical balance with an accuracy of 0.01.

Method

The research method was a Completely Randomized Design (CRD) with one factor, 4 levels of treatment and 3 replications. The treatment level refers to the research of Firdaus (2016), the best zeolite dose used was 11.37 g/L (7.58±3.79 g/L) with an ammonia reduction power of 2.156 mg/L (65%). Therefore, the treatments used in this study were: P0: Control without filters, P1: Use of zeolite 5.68 g/L, P2: Use of zeolite 11.37 g/L and P3: Use of zeolite 17.05 g/L.

Research procedure

The container were12 units of aquarium 30cm x 30cm x 20cm, equipped with a filter container in the form of a 1000 ml sample bottle and a water pump. Before filling the water, the fish rearing containers were sterilized with Callium Permanganate solution. Then the container were washed with running water until it's clean, then filled with 12 liters of water.

The zeolite granules which are used as treatment are first activated. Zeolite activation has to be done so that zeolite can work according to its function for the absorption of ammonia. Zeolite activation was carried out at the Laboratory of Aquaculture Environmental Quality, Faculty of Fisheries and Marine, Riau University. Zeolite activation was carried out according to Anwar's (1987) work step, the zeolite was weighed as much as 100 grams then put into a beaker containing 1000 ml of NaOH. The zeolite in the beaker is stirred for about 2 minutes and left for 4 hours. After that the zeolite is washed with distilled water until the smell of NaOH were gone. Furthermore, zeolite is dried for 2-3 hours at a temperature of 150°C.

The activated zeolite is then weighed according to the dose and then put into a filter in the form of a modified 1000 ml sample bottle. The pump is turned on so that the recirculation process can run. The filter installation is installed on top of the aquarium, then the filter is connected to the water pump using a hose. Fish maintenance water will be pumped and then enter the filter container. After the water passes through the filter container, it will be returned to the fish rearing media with an 18 watt pump.

The fish used in this study were the seeds of Tilapia (*O. niloticus*). Stocking density for tilapia was 1 fish/L with a length of 4-6 cm (Diansari *et al.*, 2013). Firstly, the test fish was adapted to the rearing media and feed for 2 days. The fish are then randomly placed into 12 rearing containers. Tilapia are fed in the form of CP FF-999 pellets with a feed dose was 4% of fish weight per day with a frequency three times a day in the morning, afternoon and evening (Putra *et al.*, 2011).

The parameters tested in this study were Total Ammonia Nitrogen (TAN), levels of non-ionized ammonia (NH_3), the reduction power of the TAN value and several supporting water quality parameters, such as dissolved oxygen (DO), temperature and pH. Measuring of test parameters is carried out once a week and carried out for 28 days. Measuring of test parameters was carried out at the Aquaculture Environment Quality Laboratory, Fisheries and Marine Faculty of Riau University.

Measurement of total ammonia nitrogen

According to Permatasari (2012) for the measurement of TAN (Total Ammonia Nitrogen) using the phenate method. A total of 10 ml of water sample was put into a measuring cup, then 1 drop of $MnSO_4$ was dropped. After that, 0.5 ml of chlorox was added to the sample and 0.6 ml of phenate solution, then the sample was left to rest for ±15 minutes. After the color has changed, the sample water was measured using a spectrophotometer with a wavelength of 630 nm. Meanwhile, a standard solution of NH_4Cl was made with a concentration of 0.1 ppm, 0.3 ppm, 0.5 ppm, 0.75 ppm, and 1.0 ppm to determine the calibration curve, each standard solution was put into a measuring cup, then drop 1 drop of $MnSO_4$.

After that, 0.5 ml of chlorox was added to the standard solution and 0.6 ml of phenate solution, then left to stand for ± 15 minutes and the absorbance of each standard solution was tested by means of a spectrophotometer. The feasibility of a calibration curve is tested by a linear linearity test. This test is obtained by determining the correlation coefficient (R) which is a measure of the perfection of the relationship between the concentration of the standard solution and the absorbance of the solution. The value of R^2 are both situated in the range of $0.9 \leq R^2 \leq 1$. Having obtained the value of R^2 then Plot the sample absorbance values into linear equations that have been obtained from the calibration curve can be seen that, equation stating the relationship between concentration and the absorbance is y=a+bx in this case y is the absorbance, x is the concentration. The value of a represents the slope of the curve while the value of b shows the intercept, which is the point of intersection between the curve with the y and x axes indicating the TAN concentration.

Ammonia reduction percentage

Ammonia reduction from the filter in the research container was observed at the end of the study. According to Suyata (2009), to find out the percentage (%) of ammonia reduction power, the formula is

$$\% \text{Reduction} = \frac{C0 - C1}{C0} \times 100\% \text{ .... (1)}$$

Information:
C 0 = initial TAN value
C 1 = final TAN value

Levels of unionized ammonia (NH_3)

Total Ammonia Nitrogen in water consists of two fractions of ammonia, namely ionized ammonia or ammonium which has positive ions (NH_4^+), and unionized ammonia which does not have positive ions (NH_3). The level of unionized ammonia in the waters will increase if there is an increase in temperature and pH. Ammonia levels (NH_3) were calculated using the formula proposed by Albert (1973) as follows:

$$NH_3\,(mg/L) = \frac{[TAN]}{(1+10\text{^}pKa\text{-}pH)} \text{ .... (2)}$$

Information:
TAN = Total Ammonia Nitrogen
pKa = Degree of Acid Solubility (Emerson *et al*., 1975)
$= \frac{(0{,}09018 + 2729{,}92)}{(T + 273)}$
T = water temperature (°C)
pH = Power Hydrogen

Measurement of water quality

Dissolved oxygen (DO)

Dissolved Oxygen (DO) were measured with DO meter, namely by inserting the DO probe into the test medium until the probe is submerged. Move the electrode in the media up or down then read part of the mg/L (SNI, 1994).

Temperature

Temperature measuring was carried out according to SNI (1994), namely the thermometer is immersed in water to the limit of the reading scale, allow 2-5 minutes until the temperature scale on the thermometer shows a stable number, the thermometer scale reading must be done without lifting the thermometer first.

pH

pH measuring was carried out using a pH meter with an accuracy level of 0.1. Measurements are made by dipping the pH meter into the container and reading it after the pH meter shows a constant number (SNI, 1994).

Measurement of fish survival rate

Fish survival rates were measured at the beginning and at the end of the study. The level of livelihood (SR) is calculated using the Effendi formula (2002) as follows:

$$SR = \frac{Nt}{N0} \times 100\% \text{ .... (3)}$$

Information:
SR = Survival Rate (%)
Nt = Number of test fish at the end of the study (ind)
No = Number of fish tested at the beginning of the study (ind)

RESULT AND DISCUSSION

Based on research that has been carried out for 28 days and observations made every 7 days, all data on the TAN value of Tilapia (*O. niloticus*) rearing media were obtained . The results of TAN measurements at the beginning and end of the study can be seen in Table 1.

Based on Table 1, it can be seen that the lowest TAN value at the beginning of the study was at P3 the zeolite dose of 17.05 g/L, which was 0.6520 mg/L and the highest TAN value in the control (P0) was 0.8997 mg/L. Based on the results of the ANOVA test, it showed $P<0.05$, using zeolite had a significant effect on the TAN value at the beginning of the study. The lowest TAN value at the end of the study was at P3 zeolite dose of 17.05 g / L of 0.2616 mg / L and the highest TAN value at P0 (control) was 0.7181 mg / L. Based on the results of the ANOVA test, it showed $P<0.05$, using zeolite had a significant effect on the TAN value at the end of the study.

Nitrogen in water exists in various forms of N valences 3 and 5. Ammonia in water can be in the form of ammonium ion (NH_4^+) and ammonia gas (NH_3). Both forms of ammonia are measured as Total Ammonia Nitrogen. Inglezakis & Zorpas (2012), zeolite can work as an ion exchange and as a filter through selective adsorption and molecular rejection. This zeolite can absorb ammonium ion NH_4^+ thereby reducing the amount of ammonia (NH_3) in the water.

The zeolite structure consists of channels and spaces, occupied by H_2O molecules and extra cationic skeletons such as K^+, Na^+, Ca^{2+},and Mg^{2+} which function to balance the negative charge of the zeolite. In this extra-structure cations can be exchanged for ions and thus are needed to maintain the charge balance of the entire skeleton (Colella & Mumpton, 2000; Inglezakis & Zorpas, 2012).

The addition of the zeolite caused the absorption of ammonia in the water to increase so that the ammonia content decreases. This is in accordance with the opinion of Hapsari *et al*. (2019), that zeolites have a high cation exchange capacity, so a higher number of zeolites can cause the filter to be more effective than treatments that do not use zeolites. The more zeolite does not decrease the filter effectiveness value because the zeolite is not easily saturated.

Table 1. Results of TAN measurement at the initial and final of the study.

Replication	Initial Total Ammonia Nitrogen (mg/L)			
	Treatment			
	P0	P1	P2	P3
1	0.9084	0.8133	0.7615	0.6664
2	0.9430	0.8047	0.7787	0.6404
3	0.8479	0.8565	0.8047	0.6491
Average	0.8997±0.0481[c]	0.8248±0.0277[b]	0.7816±0.0217[b]	0.6520±0.0132[a]
	Final Total Ammonia Nitrogen (mg/L)			
1	0.7382	0.5142	0.4281	0.2644
2	0.6951	0.5487	0.4195	0.2386
3	0.7209	0.5314	0.4195	0.2817
Average	0.7181±0.0216[d]	0.5314±0.0172[c]	0.4223±0.0049[b]	0.2616±0.0216[a]

Data shown with different letters are statistically different at P <0.05 level.

Table 2. The reduction value of TAN during the study.

Replication	Reduction of TAN (%)			
	Treatment			
	P0	P1	P2	P3
1	18.73	36.77	43.78	60.31
2	26.29	31.81	46.14	62.76
3	14.96	37.95	47.87	56.61
Average	19.99±5.76[a]	35.51±3.25[b]	45.93±2.05[c]	59.89±3.09[d]

Data shown with different letters are statistically different at P <0.05 level.

The value of TAN reduction during the study can be seen in Table 2. Based on Table 2, it can be seen that the highest TAN reduction value occurred at P3 which was 59.89% and the lowest reduction value occurred at P0 which was 19.99%. Based on the results of the ANOVA test, it showed P <0.05, zeolite had a significant effect on TAN reduction during the study. The TAN value of the fish culture medium tends to decrease along with the addition of zeolite to the water filter. This is due to the absorption of ammonia in the Tilapia (*O. niloticus*) rearing media so that the TAN value tends to decrease because the ammonia cation is more and more absorbed by the number of zeolite pore openings and exchanging sodium and potassium ions which function to neutralize metabolic waste.

Zeolite porosity had important role in differentiating between species. Zeolite porosity is determined by its crystalline structure (Colella & Mumpton, 2000). The pore size varies between 0.3 and 1 nm, resulting in a porosity of between 0.1 and 0.35 cm3/g, respectively (Colella & Mumpton, 2000; Inglezakis & Zorpas, 2012). Due to this micropore structure, the internal surface area tends to be very high, ranging from 300-700 m2/g (Colella & Mumpton, 2000).

For graphs of TAN fluctuations during the study can be seen in Figure 1. Based on Figure 1, it can be seen that the TAN value fluctuation during the study. In a container given a zeolite filter, the TAN value decreased every week. TAN values at P0 ranged from 0.7181-0.8997 mg/L, P1 0.5314-0.8248 mg/L, P2 0.4223-0.7816 mg/L, P3 0.2616-0.6520 mg/L. In the first week of the study, there was an accumulation of metabolic waste and feed residue which caused an increase in the TAN value of the fish rearing media. Furthermore, in the second week to the fourth week the TAN value can be reduced due to fish rearing using a recirculation system and the addition of a zeolite filter.

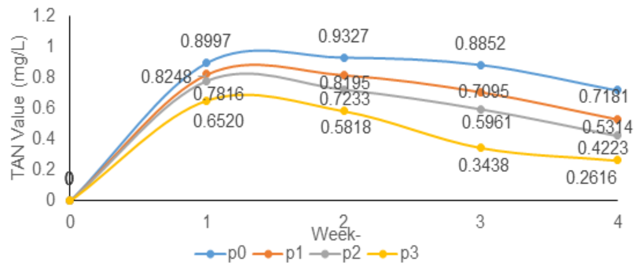

Figure 1. Fluctuation in total ammonia nitrogen during the study.

However, at P0 the TAN value continued to increase until the second week because at P0 it did not use a zeolite filter so that the recirculation system needed a longer time to reduce TAN. In addition, at P0 the accumulation of ammonia causes a sub-lethal effect which results in fish mortality. Ammonia produced from metabolic waste and fish urine is also reduced so that the TAN level in the maintenance medium (P0) becomes less. Whereas in the treatment using the zeolite filter, the performance of the zeolite can be seen so that the TAN content is continuously reduced. The use of zeolite at a dose of 17.05 g/L gave the best results in reducing the TAN value of Tilapia (*O. niloticus*) culture medium. The range of TAN values at the end of the study was still classified as safe for Tilapia. According to Prihartono

Table 3. Ammonia concentration at the initial and final of the study.

Replication	Treatment			
	P0	P1	P2	P3
Concentration of Initial Ammonia (mg/L)				
1	0.0082	0.0074	0.0048	0.0030
2	0.0080	0.0068	0.0045	0.0034
3	0.0061	0.0077	0.0063	0.0051
Average	0.0074±0.0011[b]	0.0073±0.0004[b]	0.0052±0.0009[ab]	0.0039±0.0011[a]
Concentration of Ammonia Final (mg/L)				
1	0.0050	0.0035	0.0027	0.0018
2	0.0047	0.0034	0.0024	0.0017
3	0.0039	0.0036	0.0030	0.0019
Average	0.0045±0.0005[d]	0.0035±0.0001[c]	0.0027±0.0003[b]	0.0018±0.0001[a]

Data shown with different letters are statistically different at $P < 0.05$ level.

(2006), the critical limit of fish to the content of dissolved ammonia in the maintenance medium is 0.6 mg/L.

Based on research that has been carried out for 28 days and observations made every 7 days, all data were obtained from ammonia levels in Tilapia (O. *niloticus*) rearing media for each treatment. The results of ammonia calculations at the beginning and end of the study can be seen in Table 3.

Based on Table 3, it can be seen that the lowest ammonia level at the beginning of the study was at P3 zeolite dose of 17.05 g/L of 0.0039 mg/L and the highest ammonia level was at P0 (control) which was 0.0074 mg/L. Based on the results of the ANOVA test, it showed P<0.05, zeolite had a significant effect on ammonia levels at the beginning of the study. The lowest ammonia level (NH_3) at the end of the study was at P3 zeolite dose of 17.05 g/L of 0.0018 mg/L and the highest ammonia level was at P0 (control) which was 0.0045 mg/L. Based on the results of the ANOVA test, it showed P<0.05, zeolite had a significant effect on ammonia levels at the end of the study. The graph of ammonia (NH_3) fluctuations during the study can be seen in Figure 2.

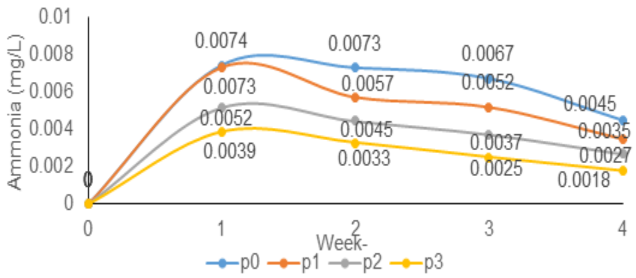

Figure 2. Ammonia (NH_3) fluctuation during the study.

Based on Figure 2, it can be seen that NH_3 fluctuations during the study. The NH^3 value in each treatment decreased every week. NH_3 levels at P0 ranged from 0.0074-0.0045 mg/L, P1 0.0073-0.0035 mg/L, P2 0.0052-0.0027 mg/L, P3 0.0039-0.0018 mg/L. Based on the requirements of BSNI 7550 (2009), the maximum limit of NH_3 levels for fish farming is <0.02 mg/L, so that NH3 level in each treatment meet the requirements for tilapia maintenance.

The decrease in NH_3 levels at the time of the study was in line with the decrease in the TAN value, besides that it was also influenced by the pH and temperature of the fish rearing media. In the first week of the study there was accumulation of TAN which caused NH_3 levels to increase. In the second week the TAN value could be lowered due to the use of a zeolite filter so that the NH_3 level was also reduced. According to Effendi (2003) The equilibrium between ammonia gas and ammonium ions in waters is shown by the following reaction:

$$NH_3 + H_2O \quad \leftrightarrow \quad NH_4^+ + OH.$$

The proportion of TAN increases in toxic form (NH_3) is influenced by temperature and pH. Each additional pH unit will increase the NH_3 concentration 10 times (Durborow *et al.*, 1997). Increasing the pH value to 1 point will increase the value of the NH_3 concentration in water up to 10 times from the original. At low pH, most of the ammonia will be ionized (NH_4^+), while the higher the pH causes NH_3 to increase, because the ammonium compounds formed are not ionized and will be toxic to fish (Widayat *et al.*, 2010).

Apart from pH, the factor that affects NH_3 is dissolved oxygen (DO). The toxicity of ammonia (NH_3) also increases with decreasing DO concentration and tolerance to ammonia decreases with decreasing DO. Toxic NH_3 levels will increase if there is a decrease in dissolved oxygen levels (Febriwahyudi & Hadi, 2012).

In addition to the measurement of TAN and ammonia (NH_3), measuring of the value of supporting water quality were also carried out. The measured water quality parameter values are temperature, pH, and dissolved oxygen (DO). Measurements were taken every seven days. The results of water quality measurements can be seen in Table 4.

The temperature value during the study ranged from 27-29°C. This value is classified as good for the survival of the fish that are kept because it is still in the range of quality standards, namely 25-32°C (BSNI 7550, 2009). This research was conducted indoors, so that the water temperature in the research container was quite stable.

The application of zeolite filters to the fish culture media

Table 4. Results of supporting water quality.

Parameters	Treatment				BSNI 7550 (2009)
	P0	P1	P2	P3	
Temperature (°C)	28-29	27-29	27-29	27-29	25-32
pH	6.8-7.0	6.9-7.0	6.7-7.0	6.7-7.0	6.5-8.5
O_2 (mg/L)	6.3-6.9	6.5-6.9	6.5-6.9	6.2-6.9	≥3

does not directly affect the temperature but affects the nitrification process that occurs in the zeolite media. Ammonia concentration also fluctuates depending on temperature. When high temperatures cause bacterial activity and the nitrification process to increase, so that the ammonia concentration is low. This is in line with Boyd's (1990) opinion that if the water temperature is low, the nitrification process will slow down, this is because the metabolic process of nitrifying bacteria slows down so that ammonia increases which results in toxic conditions for fish. The nitrification process takes place optimally in the temperature range 25-35 °C.

The pH value during the study ranged from 6.7-7.0. This value has met the requirements for maintaining the survival of Tilapia (*O. niloticus*) seeds, namely 6.5-8.5 (BSNI 7550, 2009). The pH value and temperature have a relationship with the unionized ammonia (NH_3). The unionized ammonia value (NH_3) is directly proportional to the pH value. This is supported by the statement of Kordi & Tancung (2007) which states that the percentage of unionized ammonia (NH_3) in waters will increase as the pH of the water increases. At high pH, the ammonia formed is unionized and is toxic to fish.

Dissolved O_2 values during the study period ranged from 6.2-6.9 mg/L. Based on water quality standards, the range of dissolved O_2 for Tilapia cultivation is ≥3 mg/L (BSNI 7550, 2009). This shows that the dissolved O_2 value obtained is still very supportive of the continuity of fish farming, because it is still above the water quality standard limit, namely ≥3 mg/L. Dissolved oxygen in waters is a limiting factor for aquatic organisms in carrying out activities. Therefore the availability of oxygen for aquatic biota determines the cycle of activity, as well as the growth rate depending on oxygen. The circulation system is one way to improve water quality as a medium for raising fish in aquaculture activities. Lesmana (2004) stated that water circulation can help the distribution of oxygen in all directions both in water and its diffusion or exchange with air and can reduce the accumulation or accumulation of toxic metabolic products so that toxic levels can be decreased.

The survival rate is the chance to live for an individual organism within a certain time, while mortality is the death that occurs in a population of organisms that causes a reduction in the number of individuals in that population. Based on the results of observations on the survival of Tilapia (*O. niloticus*) maintained in the recirculation system and the addition of zeolite filters with different doses, it can be seen that the survival rate of each treatment unit is presented in Table 5.

Based on Table 5, it can be seen that the survival rate of Tilapia at P0 that does not use a zeolite filter has a lower percentage compared to the treatment using a zeolite filter. Based on the results of the ANOVA test, it showed that P<0.05, using zeolite had a significant effect on the survival rate of fish during the study. The results of Student Newman Keuls's further test showed that P0 was significantly different from P1, P2, and P3 but there was no significant difference between P1 and P2. The low survival rate of Tilapia (*O. Niloticus*) in the P0 treatment was thought to be due to the ammonia content in the rearing container which was higher than in other treatments. The high survival rate of Tilapia (*O. Niloticus*) in the P3 treatment was due to the use of zeolite filters which caused ammonia content which tended to be lower than the P0 treatment. The accumulation of ammonia compounds from feed waste and metabolic products can be toxic which reduces the productivity and sustainability of cultivated fish (Marlina & Rakhmawati, 2016).

In the fisheries sector, ammonia the main pollutants. Ammonia were produced from the deamination process of protein in fish food culture and the excretion from fish gills. Apart from that, spoilage of food and fish feces are also caused ammonia formation in aquatic cultures. If ammonia accumulates in the fish's body, it can be toxic. If the ammonia concentration reaches >0.02 ppm can caused

Table 5. Survival rate of tilapia (*O. niloticus*).

Replication	Survival rate (%)			
	P0	P1	P2	P3
1	58.33	75.00	75.00	91.66
2	50.00	75.00	66.66	83.33
3	58.33	66.66	83.33	91.66
Average	55.55±4.80[a]	72.22±4.81[b]	74.99±8.35[b]	88.88±480[c]

Data shown with different letters are statistically different at P < 0.05 level.

mortality of fish. Although ammonia rarely accumulates to lethal levels (lethal), it can be harmful (sub-lethal) affectsto slower fish growth rates, reduced feed conversion and decreased disease resistance. In addition, Total Ammonia Nitrogen (TAN), which consists of Ammonium (NH_4^+) and the Ammonia (NH_3) gas in the culture of the waters can be converted to nitrite by certain bacteria. This nitrite compound can infiltrate the fish's bloodstream through the gills. This disease in fish is called brown-blood disease (Ghasemi *et al.*, 2016).

CONCLUSION

The using of zeolite filters with different doses had significant effects on the value of Total Ammonia Nitrogen (TAN) and non-ionized ammonia (NH_3) contentration in Tilapia (*O. niloticus*) rearing media. The best treatment was P3 with dose of 17.05 g/L, TAN value of 0.2616 mg/L, NH_3concentration of 0.0018 mg/L and TAN reduction of 59%. The highest level of survival rate was at P3, 88.88%. The water quality values were temperature 27-29°C, pH 6.7-70, dissolved 02 6.2-6.9 mg/L. The value of water quality were good to support the survival rate of Tilapia (*O. niloticus*).

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