



Water Quality in the Cultivation of Catfish (*Clarias gariepinus*) and Nile Tilapia (*Oreochromis niloticus*) in the Aquaponic Biofloc System

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Authors' contributions

This work was carried out in collaboration among all authors. Author IZ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors Iskandar and IDB managed the analyses of the study. Author BPM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: Water quality is one of them being an important role in terms of cultivation. Good water quality can support growth productivity in aquaculture. This is also of great concern when the rest of fish metabolism results that can contaminate fish contained in the maintenance media and if water is changed every day, water carrying toxins can pollute the area around the cultivation. One of the first steps to reduce the toxic content found in the maintenance media and the area around cultivation is to use aquaponic cultivation using biofloc. It is also expected to minimize the toxin content in maintenance media. This research aims to determine the comparison of the polyculture stocking density of sangkuriang catfish and nile tilapia which results in water quality that supports fish productivity.

Study Design: The research was conducted experimentally.

Place and Duration of Study: This research was carried out for 40 days between March 2019 - April 2019 in the Ciparanje Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran.

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Methodology: The method used in this research is experimental using a completely randomized design (CRD), consisting of 5 treatments with 3 replications. The treatments to be given are dense stocking variations with the following treatments: A(75 catfish:75 tilapia), B(100 catfish:50 tilapia), C(125 catfish:25 tilapia), D(150 catfish), E(150 tilapia).

Results: Water Quality Measured During The Study Namely, DO, Temperature, Ph, Nitrite, Nitrate And Ammonia Are Still In The Threshold For The Growth Of Test Animals During Maintenance.

Conclusion: Based on the results of the research that has been done, it can be concluded that the quality of water in maintenance media using aquaponics biofloc gives good water quality values on maintenance media and is still within the threshold for the growth of catfish and tilapia.

Keywords: Aquaponics; biofloc; catfish; stocking density; tilapia.

1. INTRODUCTION

Fish farming is a system which involves monoculture and polyculture systems. A monoculture cultivation system is a cultivation system that only maintains one type of fish or organism while. Polyculture cultivation system is a cultivation system that maintains fish or organisms of more than one species type. This system is very useful for the efficient use of natural feed in ponds [1]. Polyculture cultivation has the advantage that if a pathogen is attacked, there will be a second fish to cover the loss of cultivation with limited land and a water change system that *continues to* make the polyculture system a culture system that is much favored by farmers, one of which is catfish and tilapia. Intensive cultivation systems will affect three things, namely artificial feeding, controlling water quality and aquaculture of aquaculture, based on these three mutually sustainable matters, a polyculture cultivation system was created to increase aquaculture production. Basically catfish have a pattern of life at the bottom of a pond or at the edge of a pond, while tilapia has a life pattern in the middle layer to the bottom of a water pool [2,3], so that with different aquatic habitats it is possible to cultivate together or ordinarily called a communal system. According to [4], fish commodities that support aquaponics cultivation are catfish, because catfish produce more fish feces than other fish.

One of the obstacles in tilapia cultivation in addition to the availability of sufficient seeds is water quality. Important factors that need to be considered in supporting business success aquaculture is the provision of an environment that is suitable with the seeds, to obtain high survival [5,6]. Fish farming activities usually occur contamination caused by the presence of food waste and metabolic

results of the fish itself. Biofloc technology is one of the new alternatives in overcoming water quality problems in aquaculture which is adapted from conventional domestic waste processing techniques [7,8]. In addition to using biofloc techniques combined with aquaponic techniques can help improve water quality in aquaculture ponds. In general, aquaponics uses a meaningful recirculation system. reuse water that has been used in fish farming with biological and physical filters in the form of plants and media. The recirculation used contains maintenance compartments and water treatment compartments [9]. The use of recirculation systems is expected to increase the carrying capacity of cultivation media because the water used can be controlled properly, effective in water utilization and more environmentally friendly for life and fish growth [10]. This research aims to look at the value of water quality that can support growth in polyculture using aquaponic biofloc.

2. MATERIALS AND METHODS

2.1 Time and Place of Research

The study was conducted for 40 days from March 2019 - April 2019 Ciparanje Wet Laboratory of the Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran.

2.2 Materials and Tools

The tools used in this research were fiber, scoop, digital balance, ruler, millimeter block, jar, pottery, water pipe, aeration hose, aeration, DO meter, pH meter. While the material used is, catfish and tilapia seeds measuring 5 cm from the Babakanjawa Majalengka Fish Seed Center, PF 1000 commercial feed, probiotics EM4, molasses, flour, salt, Rockwool, kale seeds.

2.3 Research Methods

Complete randomized design (CRD) was used for the study, consisting of 5 treatments with 3 replications. Data was analyzed using survival (SR), daily growth (SGR), feed conversion ratio (FCR) analysis of variance (ANOVA). Test the real difference between treatments using Duncan multiple range test with an accuracy level of 95%.

2.4 Treatment Using a Recirculated Biofloc Polyculture System Includes

The treatment in this study is:

Treatment A: 75 catfish : 75 tilapia
Treatment B: 100 catfish : 50 tilapia
Treatment C: 125 catfish : 25 tilapia
Treatment D: 150 catfish
Treatment E: 150 tilapia

The research was carried out following several stages including preparation of a maintenance container, making biofloc, making aquaponic installations, sowing kale plants, acclimatizing test animals, conducting research. The research was carried out for 40 days by giving 5% of the feed twice a day and weight and water quality measurements every 10 days.

2.5 Procedure

2.5.1 Preparation of the experimental unit container

The study begins with preparation of a culture container which is carried out by cleaning the fiber tub using chlorine as a disinfectant, then rinsed and dried. Filling water into a fiber tub measuring 70 cm x 70 cm x 70 cm with 375 L of water. Installation of installation in the container includes the installation of a blower to supply oxygen demand, regulating the temperature of the water using a water heater installed in a fiber bath, installing paralons as an aquaponic installation. Installation of pumps from maintenance media to aquaponic media. The maintenance container is filled with water and oxygen, temperature, pH, ammonia, nitrite and nitrate are checked.

2.5.2 Biofloc manufacturing

The process of making biofloc before it is put on maintenance media is to prepare a bucket for making biofloc, then put water at drum plastic 5

liter with aeration. Biofloc material is put into a bucket that has been given water 5 liter, including molasses 1 liter, EM4 (Effective Microorganism 4) 445 milliliters, salt 800 gram and flour 250 gram. The ingredients are mixed in the bucket, then close the bucket tightly and leave it for 24 hours. After settling for 24 hours, the biofloc in the bucket is given high aeration and left for one week. After the biofloc process is silenced, the characteristics of biofloc formation are the scent of biofloc which becomes sour, the color of water becomes increasingly brownish, if water samples are taken and let stand there will be green-brown sediments floating in the water, then put on the water 15 ml of maintenance media. Biofloc that have been added to the maintenance media are given high aeration.

2.5.3 Aquaponic installation

Pipe was measured and cut at 2 inch long by 1 meter. Making holes in the pipe paralon. Paralon pipe installation using siltip. Installation of paralon pipes in the maintenance container, and connected to the pump on maintenance media. Test aquaponic circulation that connects the media.

2.5.4 Seedling plant water spinach

Soaking ground kale seeds overnight with clean water. Rockwool was put in tray in a humid state. Water spinach seeds were placed in a tray that has been given rock wool in a moist condition. Water spinach seeds that have germinated put into the potnet and then stored in the pipe paralon that has been arranged in a maintenance container.

2.5.5 Acclimatization of test animals

Prepare a tub then filled with water, then put on aeration and be given a heater. Acclimatization is done by inserting a plastic containing fish in the tub for 10 minutes. After 10 minutes the fish are removed from the plastic. Test animals are allowed to sit in the tub for one week, then put on maintenance media.

2.5.6 Research stage

The study was conducted for 40 days. Day 0 of the study carried out water quality testing (temperature, DO, pH, ammonia, nitrite and nitrate) before fish, plants, and probiotics were incorporated into the aquaponic installation. Subsequent water sampling to test for ammonia,

Table 1. Data on water quality

Treatment	Temperature °C	Dissolved oxygen (mg / L)	pH	Ammonia (mg / L)	Nitrite (mg / L)	Nitrate (mg / L)
A	24.3-28	5.2 - 7.6	7.1-8.5	0, 1 to 0.7	0.0 to 0.2	0.3-0.4
B	24.3 to 28	5.8 to 7.7	7.2 to 8.5	0.0 to 0.8	0,0- 0.5	0.3-0.4
C	24.3-28.6	5.3 -7.9	7.1-8.5	0.0-0.8	0.0-0.3	0.3- 0.4
D	24.3 - 28.5	5.6 -7.9	7.3-8.5	0.0-0.8	0.0-0.4	0.3-0.5
E	24.3 -28.3	5.2-7.8	7.1-8.5	0.0-0.5	0.0-0.3	0.4-0.5
SNI	23-30 °C *	> 5 *	6.5-8,5 *	1.0 *	<0.6 *	<10 *
	25-30 °C **	> 3 **				

Description: * (SNI 2009); ** (SNI 2000)

nitrite and nitrate is carried out every 10 days during the study. Water sampling for testing ammonia, nitrite and nitrate is done by entering 100 mL of water into a bottle. Water samples tested are water in the rearing tank. Water samples were taken to the MSP laboratory to measure nitrite, nitrate and ammonia levels while DO, temperature and pH measurements were carried out in situ by dipping the tip of the instrument on the surface of the water. Adding probiotics to the culture media as much as 15 ml and done once every 10 days. Probiotics are first activated using molasses in a ratio of bacteria to molasses 1:3 which aims to activate probiotic bacteria. Fish are fed twice a day using PF 1000 commercial feed. Feeding is carried out in the morning at 10.00 WIB and in the afternoon at 16.00 WIB. Feed is given as much as 5% of the biomass of test fish. Observation of fish growth is done by sampling which is done every 10 days. The number of fish taken was 25 catfish and 25 tilapia, and then the fish were weighed. Observation of plant growth is done by sampling which is done every 10 days on all aquaponic maintenance media. Plant height was measured using a ruler and counted the number of leaves in each aquaponic maintenance media.

3. RESULTS AND DISCUSSION

Water quality is one of the main environmental factors in the fish farming system. Water quality is a physical and chemical factor that can affect the maintenance media environment and indirectly affect the metabolic processes of test fish. Poor water quality can cause fish to become susceptible to disease [11,12].

3.1 Temperature

Based on the measurements of water temperature during the study, the values ranged from 24.3°C – 28.6°C. The optimum temperature

for tilapia 24°C – 30°C [13] and for catfish 25°C - 30°C [14]. The temperature during maintenance ranges from the threshold, which means that the temperature can support the growth process of the test fish on maintenance media. Based on the graph of temperature changes in the third week there was a decrease in all treatments, this is thought to be due to the influence of changing weather because of the transition season from dry season to the rainy season.

3.2 Dissolved Oxygen

Based on the graph of changes in dissolved oxygen above the highest dissolved oxygen value of 7.8 mg / L and the lowest value of 5.2 mg / L, this is related to high ammonia levels, if the dissolved oxygen content in maintenance media is low then ammonia levels on high maintenance media and impacting on fish growth [15,16].

3.3 pH

The value of the acidity degree obtained during the study ranged from 7.1 to 8.5. The highest value of acidity during maintenance is 8.5 and the lowest value is 7.1. Based on the graph of the acidity level above, in the 4th week, there was a decrease, this caused the nitrification process to run slowly because of the decreasing pH. The nitrification process runs slowly when the pH drops below 7 and when pH is less than 6 the nitrification process slowly stops. A decrease in pH can also occur, because of the degradation of water quality caused by residual feed, feces, algal respiration and reduced CO₂ in water [1,17].

3.4 Ammonia

Ammonia in the aquaculture environment also originates from the decomposition process of organic matter such as feed waste, dead algae, and aquatic plants [18,19]. The average

ammonia concentration in the study ranged from 0.0 mg / L - 0.8 mg / L. Ammonia concentration values in this study are still within tolerance. According to Molleda [1], Hussain et al. [5] freshwater fish have a tolerance to ammonia concentrations up to 1.0 mg / L. The increase is thought to be due to increased dissolved organic matter from the remaining feed and the results of fish metabolism and not fully oxidized by probiotic bacteria [20,21]. Some of the feed given to fish is used for its growth, but some of it will be excreted in the form of solid impurities and dissolved ammonia (NH₃) in water.

3.5 Nitrite

Based on the results of the research the fluctuating nitrite concentration shows a range between 0.0 mg / L - 0.5 mg / L. According to [22] concerning Management of Water Quality and Pollution Control, the nitrite threshold is <0.06 mg / L. Excess nitrite compounds in a waters will cause a decrease in the ability of fish blood to bind oxygen (O₂), because nitrite will react more strongly with hemoglobin which causes high mortality [23]. A nitrite is a transitional form between ammonia and nitrate (nitrification), and between nitrate and nitrogen gas (denitrification) [19].

3.6 Nitrate

Based on the results of the study the nitrate concentration fluctuated, showing a range between 0.3 mg / L - 0.5 mg / L. This condition is still within tolerance for fish growth. The results of observations of nitrate concentration still meet the proper range, because it is still below the maximum water quality standard, which is <10 mg / L [22]. Nitrate concentration tends to be stable at the 3rd, 4th and 5th weeks because kale plants can absorb nitrates well, resulting in high plant productivity. The increase in nitrate concentration was suspected because nitrifying bacteria went well-converting ammonia to nitrate. In addition to probiotics to polyculture maintenance media, the nitrification process can run optimally so that nitrate is high enough. According to Andriani et al. [24], Stouvenakers et al. [25], species and differences in the density ratio affect the dissolved oxygen (DO) content in the media. DO values in all treatments were around 4.3-7.6 mg / L. The presence of aquatic plants increased DO concentrations more significantly compared to media without aquatic plants.

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that the quality of water in maintenance media using aquaponics biofloc gives good water quality values on maintenance media and is still within the threshold for the growth of catfish and tilapia.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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