Evaluation of catfish performance in juvenile rearing using environmental probiotic

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Abstract. This research was conducted to determine the performance of catfish given environmental probiotics during breeding. Catfish used in the study had a length of 1 - 1.5 cm and a weight of 0.065 ± 0.1 grams with a stocking density of 1000 individuals per pond. The study carried out in a stagnant pond. The treatments given were: 1) using probiotic and 2) without probiotic as control. The study was conducted for 60 days. Parameters measured were growth, survival and water quality. Data analysis was carried out descriptively. The results showed that catfish given probiotics had a more uniform size with an average size of 9.54 cm and 5.89 grams. Whereas catfish without being given probiotic vary in size with an average length of about 6.73 cm and weight around 2.35 grams. The weight growth of fish given probiotic was 5.83 grams with the survival rate of 85%. While fish without probiotic have a weight growth of 2.29 grams with a survival rate of 60%. Levels of ammonia in water media with Rifa probiotic better than without Rifa probiotic. Based on these results, it can be concluded that the use of the environmental probiotic showed a better performance on catfish growth than the control (without probiotic).

1. Introduction
Depok City has an area of 200.94 Km and is directly adjacent to the capital city of Jakarta. Depok City has more residential land than the agricultural land. However, the agricultural in Depok City is still developing. Agriculture in Depok City was developed with the concept of urban agriculture, where farming in every land can be utilized. The fisheries sector, especially catfish culture, only cultivated in an area of 294.19 hectares or 2.94 Km. Compared to the area of Depok City which is 200.94 Km, the available land for catfish rearing is only 1.4% of the total area of Depok City. In 2014, catfish productivity reached 7247.03 tons, although the land for rearing was very limited, this City could still fulfill the demand for catfish in the market, and even supplies catfish demand in the city of Jakarta [1].

According to [2], most of the fish farmers in the Duren Mekar Village, Bojongsari District, Depok City, West Java, choose to cultivate catfish. Catfish has advantages compared to other fish, namely faster growth, economical prices and high nutritional content [3]. Catfish is a type of consumptionfish that has promising prospectsdue to high market demand. The development of catfish production over the past five years has shown significant results. This can be seen from the increase in national catfish production from 764,797 tons in 2016 to 1,771,867 tons in 2017 [4].

The juvenile rearing activity of catfish is a fish farming activity to produce juveniles that are ready to be stocked for enlargement with the relatively more uniform size of fish. The fish nursery is generally
carried out in a very limited aquatic environment with high stocking and feeding density (intensive). According to [5], the main problem in intensive fish rearing with high stocking densities and the high amount of feed is the accumulation of aquaculture waste in water media derived from the remaining feed and excretion of fish metabolism. This will have an impact on decreasing pond’s water quality because of the high toxicity of ammonia compounds.

An effort to maintain the quality of the aquatic environment effectively and efficiently is by applying the bioremediation method. Bioremediation is the use of microorganisms such as yeast, mold, and bacteria to reduce pollutants in aquatic and soil environments [6]. Enzymes produced by microorganisms modify toxic pollutants by changing the chemical structure of pollutants which leads to the biodegradation process. When toxic pollutants are degraded, the structure becomes less complex, and eventually becomes a harmless and non-toxic metabolite [7]. Microorganisms can convert ammonia to nitrite through intermediate forms and then used by bacteria to decompose and further convert nitrate. The results of the overhaul can be utilized by other living things [8].

One of the bioremediation techniques used to improve water quality in aquaculture business is the application of probiotics to fish ponds [6]. The use of probiotics as decomposition agents (bioremediation) has long been applied to shrimp cultures and can be applied through feed or directly to pond water. The use of probiotics in pond water was expected to improve the quality of the aquatic environment [9], so that the growth of cultivated fish will increase by good water quality. Based on this consideration, the research was conducted to find out the performance of catfish in the nursery pond with the application of environmental probiotics during nursery.

2. Materials and Methods

2.1. Time and place of research
This research was conducted in October to December 2017 at the cat fish farmer’s ponds in the Krukut Village, Limo District, Depok City, West Java Province, Indonesia.

2.2. Experimental design
Catfish juveniles (Clarias gariepinus) used have a length of 1 - 1.5 cm and weight of 0.065 ± 0.1 grams, with a stocking density of 1000 individuals per pond. The treatments were: 1) catfish rearing with the application of Rifa probiotic every 7 days, and 2) catfish rearing without the application of Rifa probiotic. The feed used in this study was a commercial pellet containing 22% protein, which was given 3 times a day by 5% of fish body weight. The study was conducted for 60 days. Rifa probiotic consists of a consortium of two types of bacteria, namely Pseudomonas aeruginosa (nitrifying bacteria) and Achromobacter xylosoxidans (denitrification bacteria) which were indigenous biological products of The Institute for Freshwater Aquaculture Research and Fisheries Extension, Bogor. The probiotics were given after 10 days of rearing and then given every 7 days with a dosage of 10 ml m⁻³. The parameters observed were absolute growth, daily growth rate (DGR), the survival rate (SR), feed conversion ratio (FCR), and water quality. The observation of growth, FCR and survival rate were carried out at the end of the study. Sampling was done every twenty days. The number of fish samples taken was 50 fish per pond for weight measurement. Fish weights were measured using a digital scale with a level of accuracy of 0.1 g. The calculations of absolute growth, DGR, FCR and survival rate were based on the following equation [10], [11], [12]:

\[
\text{Absolute Length (cm)} = \text{Final length (cm)} - \text{initial length (cm)}
\]

(1)

\[
\text{Absolute Weight (g)} = \text{Final weight (g)} - \text{initial weight (g)}
\]

(2)

\[
\text{Daily Growth Rate, DGR (\%)} = \frac{\ln(\text{final weight} - \text{initial weight})}{\text{Rearing duration}} \times 100\%
\]

(3)
Feed Conversion Ratio, FCR = \frac{\text{Total feed intake (g)}}{\text{Weight gain (g)}} \quad (4)

Survival Rate, SR (%) = \frac{\text{Number of fish at the beginning of the study (ind)}}{\text{Number of fish alive at the end of the study (ind)}} \quad (5)

Water quality that being observed were dissolved oxygen (DO) using DO meter, temperature using thermometer, pH using a digital pH meter and TAN uses a spectrophotometer that carried out every 10 days during rearing.

2.3. Data analysis
Data were tabulated and graphs generated using Excel 2013. Data analysis was carried out descriptively.

3. Results and Discussion
Catfish juveniles treated with Rifa probiotic have a more uniform size with an average length of 9.54 ± 0.01 cm and weight around 5.89 ± 0.02 grams. While catfish without probiotic varied and smaller in size with an average length of 6.73 ± 0.6 cm and weight of 2.35 ± 0.5 grams. The increase in length and weight of catfish with Rifa probiotic treatment and without Rifa probiotic treatment during the 60 days rearing period presented in figure 1. Based on these results it can be seen that catfish treated with Rifa probiotic had better growth than the control. This was supported by the DGR result of the two treatments. The DGR of Rifa probiotic treatment was 7.64 ± 0.1% per day while the DGR without Rifa probiotic (control) was 6.11 ± 0.3% per day (figure 2).

![Figure 1. Growth of length (cm) and weight (g) of catfish Clariasgariepinus for 60 days rearing treated with RIFA probiotic and without RIFA probiotic](image-url)
Figure 2. DGR (% weight/day) of catfish juveniles during the rearing period of 60 days treated with Rifa probiotic and without Rifa probiotic

FCR values of catfish with the application of Rifa probiotic (FCR = 1) showed lower results than catfish without application of Rifaprobiotic (FCR = 3.5). This indicates that the feed conversion ratio of catfish with the application of Rifa probiotic was better than the control (figure 3). Similarly, the survival rate of catfish juveniles that added Rifa probiotic has a higher survival rate with a value of 85% compared to controls which was only around 60%. Ammonia levels of water media for both treatments were 0.002 mg/L and 0.987 mg/L, respectively (figure 4).

Figure 3. FCR of catfish juveniles during 60 days rearing periods treated with Rifa probiotic and without Rifa probiotic
Based on the results of this study, it was seen that the use of Rifa probiotic in catfish ponds gave a better growth performance compared to catfish ponds without probiotic. This result is in line with the research conducted by [13]. He reported that the administration of probiotic was able to increase the relative growth rate of catfish juveniles from 2.04% to 3.12% and feed efficiency from 31.65% to 43.93%. The same thing was reported [14] that the growth of catfish given probiotic was significantly higher than catfish without probiotic. This is suspected because probiotic can improve the quality of ponds so that fish growth increases. Rife probiotic which consists of two types of bacterial isolates, namely Pseudomonas aeruginosa and Achromobacter xylosoxidans is a type of nitrifying and denitrification bacteria. Nitrifying bacteria are a group of bacteria capable of compiling nitrate compounds from ammonia compounds [15].

The nitrification process takes place in two major stages, namely the process of nitritation which is a process of oxidation of ammonia to nitrite and nitrate, and nitratation which is the oxidation of nitrite to nitrate. While denitrification bacteria are a group of bacteria capable of reducing nitrate (NO$_3^-$) compounds to free nitrogen compounds (N$_2$) [15]. The denitrification process is one of a series of nitrogen cycles that plays a role in returning nitrate compounds that accumulate in the waters to be used again in free form [16].

Rifa probiotic which is a consortium of nitrification and denitrification bacteria are thought to be able to reduce ammonia compounds by converting ammonia to nitrate compounds and then to nitrogen gas. Ammonia derived from catfish metabolites waste and feed that was not consumed, was used by Rifa probiotic to form nitrate. Nitrite then converted into a nitrate compound which was partially utilized by phytoplankton for growth and some of it was converted into nitrogen gas by Rifa probiotic. This has a positive impact to the water condition in catfish ponds, where toxic ammonia compounds reduced and the nitrates utilized by phytoplankton as their nutrient source.

4. Conclusion
Based on the results it can be concluded that catfish growth, which used probiotic showed a better performance than without probiotic. This can be seen from the absolute growth, DGR, SR, and FCR value of catfish with the application of Rifa probiotic that was higher than catfish without application of Rifa probiotic.
5. References

[1] Permana I S 2016 Analysis of risk of production of Sangkuriang catfish enlargement with biofloc systems in Farm 165 Depok City Essay (Department of Agribusiness, Faculty of Economics and Management, Bogor Agricultural Institute) p 57

[2] Rinaldi I 2018 Fish Cultivators in Depok Choose Catfish Kompas https://kompas.id/baca/metro/2018/06/29/pembudidaya-ikan-di-depok-pilih-lele/ Accessed on October 8 2018.

[3] Mahyuddin 2008 Complete Guide to Catfish Agribusiness (Jakarta: Self Help Spreader) p 171

[4] DGA Directorate General of Aquaculture-Ministry of Fisheries and Marine Affairs of Indonesia 2019 The aquaculture subsector throughout 2017 showed a positive performance. [Internet] [Download on 2019 October 18]. Available on: https://kkp.go.id/djpb/artikel/3113-subsektor-perikanan-budidaya-sepanjang-tahun-2017-menunjukkan-kinerja-positif

[5] Djokosetiyanto D, Sunarma A and Widanarni 2006 Indo J. Aquaculture 5 (1) 13-20

[6] Ranjan R, Siddh Nath and Bavitha M 2014 Inter J of multidiscp res & dev 1 (7) 335-40

[7] Abatenh E, Gizaw B, Tsegaye Zand Wassie M J. Envi. Chem.and Toxic. 1 (1) 02-09

[8] Stickney R R 1979 Principles of Warmwater Aquaculture (New York: John Wiley and Sons, Inc.) p 375

[9] Wang Y B, Tian Z Q, Yao J T and Li W F 2008 J. Aquaculture 277 203-07

[10] Zonneveld N, Huisman E A and Boon J H 1991 Principles of Fish Culture (Jakarta: PT Gramedia Pustaka Utama) p 193

[11] Effendie M I 2002 Fish Biology (Yogyakarta: Yayasan Pustaka Nusatama press) p 116

[12] Talpur A D and I khwanudin M H D 2012 Aquaculture 364-365 6-12

[13] Ahmadi H, Iskandar and Kurniawati N 2012 J of Fish and Marine 3 (4) 99-107

[14] Augusta T S 2017 J of Anim. Sci. in Tropics 6 (2) 69-72

[15] Madigan M T 2009 Biology of Microorganisms 12th Ed. (Boston: Pearson Education) pp 403-04

[16] Hastuti Y P 2011. J.Akua.Indo.10 (1) 89-98