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Pectoral Fin Morphometry of Nile Tilapia (*Oreochromis niloticus*) Cultivated in Different Aerator and Filter

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Abstract. The anomaly of the pectoral fin is caused by an inappropriate amount of oxygen and ammonia within the water, which is expected to be resolved by the combination usage of an aerator and filter. This study aimed to analyze the combination usage of an aerator and filter with different amounts toward the growth of Nile tilapia's pectoral fin. This study used a 2×2 factorial completely randomized design consisting of 4 treatments (ANF, AANF, AF, and AAF) with 6 replications. The measurement variable of the pectoral fin includes length, width, weight, and the ratio of the pectoral fin's length with the total size of the fish. The measurement was analyzed using two way-ANOVA and continued with the LSD test. The results of the combination usage of the aerator and filter revealed a significant effect ($P<0.05$) on the pectoral fin length, pectoral fin width, pectoral fin weight, and ratio of pectoral fin length to total body length. The research's conclusion was the combination of usage aerator and filter had a positive impact on the growth of Nile tilapia's pectoral fin. The study's novelty is the combination usage of an aerator and filter with a different number to promote the growth of the cell within the pectoral fin of Nile tilapia. This research would benefit people through the discovery of the combination usage of an aerator and filter to improve the growth of Nile tilapia's pectoral fin.

Key words: aerator, fin length, filter, nile tilapia, total body length.

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INTRODUCTION

Indonesia is one of a country that possessed a very rich oceanic potential. One of the most oceanic products demanded by society is a fisheries product. The fish commodity is popularly demanded by society, either as an ingredient for consumption or as an ornamental pet (Sari & Zakaria, 2017). The fish product holds very important importance for society as an economic commodity source that has sell value. The main fish commodity of a region could be a key to improving economic stability or becoming a source for regional income (Irnawati *et al*., 2011). This commodity can give an important contribution to development of the fisheries sector and the quality management of fish.

Nile tilapia is a freshwater fish commodity that has been lot raised by a fish farmer (Azhari & Tomasoa, 2018). Nile tilapia possess a beneficial value, which is having a vast tolerance to environmental change, capable to survive in low-quality water habitat, possessing fast growth and reproductive capability, and being easy to be cultivated (Rajagukguk *et al*., 2017).

One of the important factors in fish cultivation is survivability rate of fish. One of the aspect that influence survivability rate of fish is the movement capability of fish underwater (Mengistu *et al*., 2021). Swimming movement of fish underwater is done with help of an organ named fin (Heriyanto *et al*., 2020). The pectoral fin is one kind of fin which have function for controlling forward, sideway, and stopping movement underwater (Rahardjo, 2020). Fish's survivability is affected by movement capability underwater (Cano-Barbacil *et al*., 2020). This behavior of fish are used to avoid predator in order not to be eaten, to compete, and for forage water (Pasquet, 2019). Movement or behavior can be used as an indicator to evaluate a health status of fish in the cultivation area. A fish's healthy condition possesses an active movement behavior and is identified with normal anatomy of the pectoral fin, while fish with deteriorated health are identified with more passive movement behavior and an anomaly found in fin (Aliza *et al*., 2013).

The anomaly of the pectoral fin can affect the swimming movement of fish, like Nile tilapia. The anomaly of fin can appear in form of abnormal size fin, or unusual change, or even structural defect in a pectoral fin (Laily *et al.*, 2018). One of the important factors that caused anomalies in the pectoral fin in Nile tilapia is the environmental quality. Some variables related to aquatic environmental quality are including dissolved oxygen underwater and the amount of ammonia in water (Hapsari *et al.*, 2020). The low amount of dissolved oxygen could affect the reduction of feeding consumption and feed conversion which causes the production of metabolite energy for growth to become non optimal (Palstra *et al.*, 2020). The excessive amount of ammonia in water is the potential to hinder a growth of the fish. This kind of nitrogen waste could cause stress by interrupting oxygen binding with hemoglobin in fish erythrocytes (Nasmi *et al*., 2017). Aside causing a stress, ammonia also able to cause a structural damage to fish, especially to the gill and the fin part (Zeitoun *et al*., 2016).

Improvement of aquatic environmental quality, especially related to the amount of dissolved oxygen and ammonia was done by a few previous researcher, which is by siphonitation and aeration (Islami *et al*., 2017). These two methods were proven to improve the growth rate of the cultivated fish. Improvement of water quality was also done by the previous researcher by zeolite filter for the recirculation process in water. This method was proven to maintain the stability of dissolved oxygen's amount which supports the growth of fish (Diansari *et al.*, 2013). Another research result to improve both variables of aquatic were done by usage test of different kind of filter, which is coral filter, coal filter, and zeolite filter. The result showed that coral filter was effective to reduce the amount of ammonia and stabilize the amount of oxygen under water (Noorjana *et al.*, 2015).

According to many evidence of previous research shown that the usage of aerator and filter were able to increase the amount of dissolved oxygen and reduce the amount of ammonia in water. Application of both method were mostly used to measure the increase of biomass or growth rate of the fish. The research related to effect of aeration and filtration of fin anatomy of fish wasn't much published, especially the one related with pectoral fin. The aim of study conducted to analyze the effect of the usage of aerator, filter, and different combination between single aerator, double aerator, and filter to the growth of pectoral fin in nile tilapia.

METHODS

Research plan

This study was done by using a 2×2 factorial completely randomized design consisting of 4 treatments with 6 replications. The treatment factor was given to 24 Nile tilapia according to the designated treatment group in the raising container. The treatment group consists of a single aerator without a filter (ANF), a double aerator without a filter (AANF), a single aerator with a filter (AF), and a double aerator with a filter (AAF). The variable of the research consisted of the aerator and filter as the independent variable and pectoral fin length, pectoral fin width, pectoral fin weight, and the ratio between pectoral fin length with total length as the dependent variable.

Construction of raising medium

Raising medium where treatments were given was crafted with plastic container with capacity of 150 liter. Raising container was equipped with aerator and filter according to designed treatment that given. The treatment design in container was shown in Figure 1.

Raising Nile tilapia

Nile tilapia was first acclimated for 2 weeks. The fishes that already acclimated were transferred into raising container which already filled with 40L of water. Each container were given 6 Mile tilapia as replication. The fish were given feed 3 times a day with ad satiation method in the morning, afternoon, and evening. Measurement of environmental parameter was done during raising, including dissolved oxygen, amount of ammonia, water temperature, air temperature, salinity, and water pH. Water inside container will be drained for 70% of total water if the water become too murky. The raising treatment of Nile tilapia were done for duration of 60 days.

Isolation of pectoral fin

After the Nile tilapia raised for 60 days, the treatment was termination by draining all the water from raising container and leaving them flounder until it stopped according to method that used by Litaay et al., (2020). The fish that has stopped moving will be taken and the total length will be measured by digital caliper, while total weight will be measured with digital scale. The

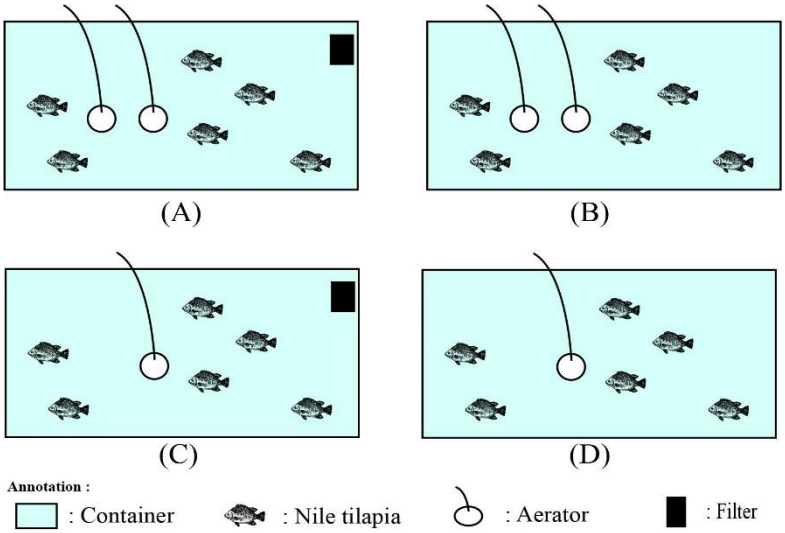

Figure 1. Design of cultivation container (A) double aerator with filter (B) double aerator without filter (C) single aerator with filter (D) single aerator without filter

measurement of research variables was started by isolation of the right side and left side of pectoral fin with dissecting set, then the measurement was done including pectoral fin length, pectoral fin width, and pectoral fin weight. The measurement of this research variables were customized according to research that were done by Thorsen & Westneat (2005) with illustration guide that shown in Figure 2.

Data analysis

Measurement data that gathered analyzed to determine the distribution pattern and its homogeneity. The results of the data analysis that show a normal and homogeneous distribution pattern then proceed with an advanced analysis with two-way ANOVA test ($\alpha = 0.05$). The differences between groups then determined with LSD test, and test of interaction between main factor was examined with LSD test.

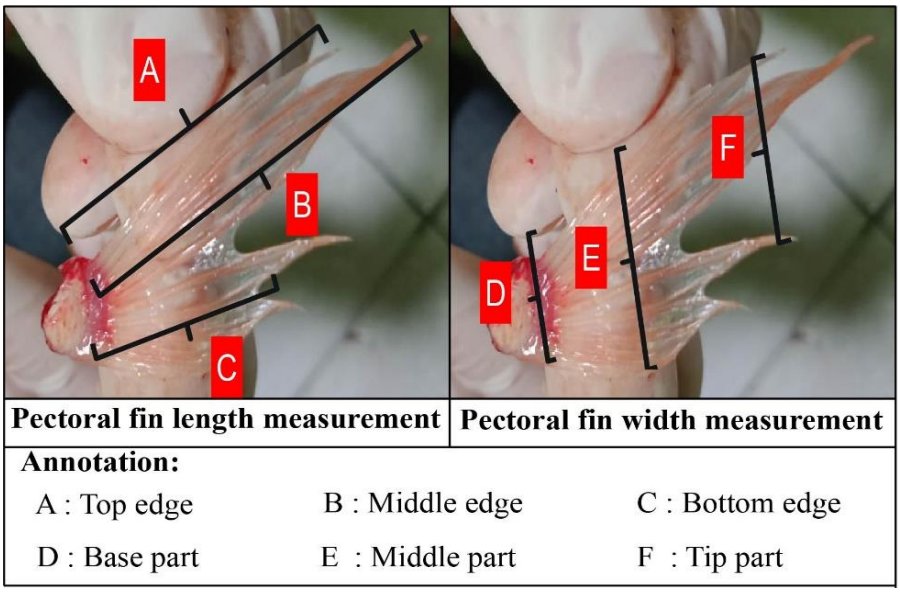

Figure 2. Measurement guide of pectoral fin length and pectoral fin width

RESULTS AND DISCUSSION

The data analysis result toward research variables of pectoral fin length, pectoral fin width, pectoral fin weight, and the ratio between pectoral fin length with total length shows that the usage of an aerator and filter in fish cultivation give a significant effect (P<0.05) to the growth of Nile tilapia's pectoral fin that cultivated for 60 days. The result of data analysis done to respective research variables were shown in Table 1.

According to analysis results for research variables with an aerator, the treatment showed that double aerator treatment granted an effect (P<0,05) toward every research variable compared with treatment with a single aerator. The usage of an aerator in raising containers in general was able to increase the concentration of dissolved oxygen in the water. Aerators trigger the shift of oxygen molecules from open air to the inside of water molecules (Pramyani & Marwati, 2020). Oxygen from the atmosphere will dissolve in water the moment after interaction between water from the raising container and the atmosphere. The value of dissolved oxygen will get higher along with the increase in contact duration between water and the atmosphere. The existence of the number of aerators in raising containers will affect the contact duration between water and the atmosphere. The more the number of aerators installed, the more contact duration between water and atmosphere in the cultivation container will be increased. The amount of dissolved oxygen in the water will give a positive impact related to the feeding consumption rate of fish. The concentration of oxygen in the water was capable to affect the appetite of the experimental fish (Stiller *et al.*, 2017). The high amount of dissolved oxygen will increase the feeding consumption rate of fish, which will directly affect the growth of the Nile tilapia, especially the structural growth of the pectoral fin. The feed consumed by fish will be a source of nutrition that supports the growth process of the body's organs.

The analysis result for research variables with filter treatment shown significant result (P<0,05) between the treatment group. The usage of filter treatment increases every observed parameter compared to the treatment without filter. The difference between treatment was related with filtration feature of filter which used during study. Filter used in raising container possess a valuable role for improving the quality of water, especially for the attrition of ammonia's concentration in water. The amount of ammonia was capable to be reduced by filter due continuous recirculation system in cultivation container. The water from raising container that repeatedly passed the absorbent component in filter will have the ammonia compound along with other contaminant particle absorbed by that component, which producing a cleaner water with low rate of ammonia when the water passing out from filter.

Table 1. The result of data analysis toward pectoral fin size for each treatment group after 60 Days of treatment

Treatment	Pectoral fin length (mm)	Pectoral fin width (mm)	Pectoral fin weight (g)	Pectoral fin length : total length ratio (mm)
Aerator (A)				
A	19.14^{a}±0.80	6.28^{a}±0.21	0.34^{a}±0.03	0.14^{a}±0.00
AA	25.24^{b}±0.80	7.14^{b}±0.21	0.53^{b}±0.03	0.17^{b}±0.00
Filter (F)				
NF	17.88^{a}±0.80	6.22^{a}±0.21	0.29^{a}±0.03	0.13^{a}±0.00
F	26.50^{b}±0.80	7.20^{b}±0.21	0.58^{b}±0.03	0.17^{b}±0.00
Aerator x Filter				
A x NF	12.90^{a}±1.14	5.41^{a}±0.30	0.12^{a}±0.04	0.11^{a}±0.01
AA x NF	22.87^{b}±1.14	7.02^{b}±0.30	0.46^{b}±0.04	0.16^{b}±0.01
A x F	25.39^{c}±1.14	7.16^{bc}±0.30	0.55^{bc}±0.04	0.17^{bc}±0.01
AA x F	27.62^{d}±1.14	7.25^{c}±0.30	0.60^{c}±0.04	0.18^{c}±0.01

Note :
A: single aerator, AA: double aerator, F : with filter, NF : without filter
$^{a-d}$ Mean values with different superscript within same column indicating significant difference between treatment group (p<0,05)
Data was shown as mean value ± standard deviation (SD)

The attrition of this kind of nitrogen waste will support attaining the water quality that beneficial toward the growth of Nile tilapia and prevent the structural damage of pectoral fin of fish happened. Ammonia was a toxic substance that possess a sublethal property (Wahyuningsih & Gitarama, 2020). Which means, a low amount of ammonia in water might not killed or gave a negative effect to fish for a short period of time, but for a long term might hindered the growth, caused a structural and functional damage of organ, and potentially kill or causing a damage for aquatic dweller. Ammonia contained in water was an excretion product of fish that expelled form anus in form of ammonia that not ionized. This compound would be toxic in water when reaching concentration amount of 0.025 mg/l. Ammonia with this sublethal property was capable to hinder the growth of Nile tilapia's pectoral fin by interrupted the respiration activity of fish. This condition will affect toward declining supply of oxygen through gill which will cause a reduction of appetite and rising the feed conversion value of the fish. A low intake of oxygen influence to the reduction of feeding consumption rate of the fish (Putra, 2015). This thing would be the cause of the nutrition shortage which required for the growth of Nile tilapia. The usage of filter for cultivation of Nile tilapia through study could be an alternative to reduce the concentration of ammonia in water. This study supported the result of research done by Hasibuan *et al.* (2021) which shown that the usage of filter in cultivation container was capable to significantly reduce the concentration of ammonia compared to raising container that wasn't using filter. The usage of filter was proven to be capable to reduce the amount of ammonia below the safe limit for fish's respiration activity, and capable to increase the amount of dissolved oxygen in raising medium.

The utilization of aerator and filter in raising container give a significant effect ($P<0.05$) toward the growth of Nile tilapia's pectoral fin (Figure 3). The data analysis of every observed variables of pectoral fin shown a significant difference of interaction ($P<0.05$) between the utilization of aerator and filter. According to the result of analysis for pectoral length variable was shown that the usage of double aerator with filter yield the highest value result of pectoral fin length compared to other treatment group. The result of analysis for pectoral fin width, pectoral fin weight, and ratio between pectoral fin length with total length was showing a higher value at treatment group of double aerator with filter. The measured variables of ratio of pectoral fin length with total length of this research could be compared with the result of research toward Phylogenetic differentiation of wild and cultured Nile tilapia that conducted by El-Zaeem *et al.* (2012) in various aquatic habitat, which shown that the Nile tilapia possess an average ratio number of pectoral fin length with total length with value size of 0.390±0.04 mm from Manzalah lake, 0.398±0.02 mm from Nile river, 0.357±0.03 mm from Edku lake, and 0.328±0.03 mm from cultured habitat.

Treatment interaction factor of double aerator

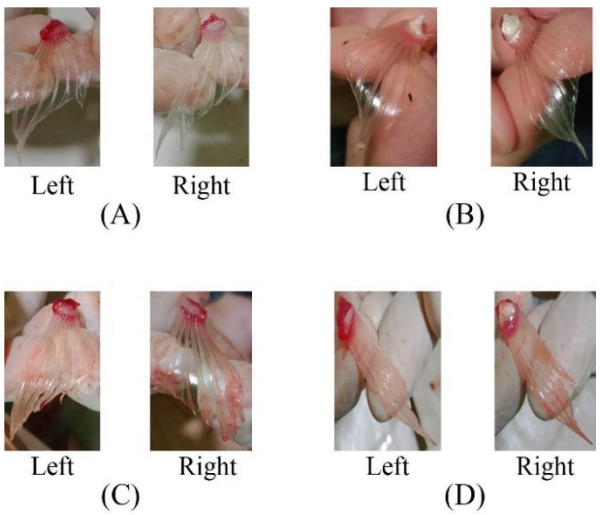

Figure 3. Pectoral fin comparation of each group treatment (A) single aerator without filter (B) double aerator without filter (C) single aerator with filter (D) double aerator with filter

with filter produce a higher average value result of research variables compared to other treatment interaction group. Both of those factor's treatment interaction render the dissolved oxygen rate to increase which giving an effect toward improvement of fish's respiration activity, reduction of ammonia's concentration in water, and enhance the absorption of oxygen that enter inside the body of Nile tilapia. The high amount of oxygen inside the body gives a positive effect toward increasing rate of feed consumption and metabolism rate inside the body of Nile tilapia. The increased oxygen supply inside the fish's body would reduce the feed conversion value and increase the rate of metabolism (Chabot *et al.*, 2016). The feed that consumed by Nile tilapia will provide nutrition availability that required for growth process like the growth of pectoral fin. Nutrition produced from feed digestion will be absorbed by intestinal epithelial cells (enterocyte) and transported to liver through vena porta hepatica. Nutrition from liver will be delivered to heart, then transported to the gill for diffusion between oxygen and carbon dioxide, then returned again to heart before distributed to all targeted cell inside the body through systemic circulation system. Cell would receive that nutrition and convert it into an energy for metabolism activity. Nutrition was an essential component to support the life sustainability of cell (Yuan *et al*., 2014). Nutrition received by cell would go through set of carbohydrate catabolism process before becoming an energy in form of ATP. Continuous metabolism that happened inside cell would help prolonging the lifespan of the cell and slowly will induce a process of hyperplasia and hypertrophy within cell or the increase of tissue's biomass.

Romdhoni (2015) stated that every tissue and organ inside an animal body will experience a certain pathology condition, one example was an increase in cell number (hyperplasia) and an increase in the size of the cell (hypertrophy). Hyperplasia in a cell occurred when the cell entered a mitotic phase which leads to an increase in cell biomass toward a tissue or organ. Hypertrophy in a cell happens as the result of an increase of intracellular matrix inside the cytoplasm which causes the cell's size to increase. Hyperplasia and hypertrophy that continuously happened will lead to a change in the size of a tissue that affects the increase of size and weight of an organ, especially a pectoral fin.

Despite the limitation in the study and analysis of the combination usage effect of aerator and filter towards the growth of pectoral fin within Nile tilapia, the morphometric studies carried out in this study are hoping to trigger an opportunity for further research in the future about the physiologic effect of combination usage of aerator and filter for improvement of the growth of pectoral fin within Nile tilapia toward the evaluation of swimming performance underwater for the sake to examine the health status and improve the survival rate of Nile tilapia. The novelty of this study is the combination usage of an aerator and filter with a different number to promote the growth of the cell within the pectoral fin of Nile tilapia. With this research, people would benefit from the discovery of the combination usage of an aerator and filter to improve the growth of nile tilapia's pectoral fin.

CONCLUSION

The utilization of an aerator combined with the usage of a filter give a positive impact on the growth of Nile tilapia's pectoral fin that will improve the survival rate and productivity of Nile tilapia in a long term.

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