



The Effect of using Fine Bubbles (FBS) on the Growth of Catfish Seeds (*Pangasianodon hypopthalmus*) with Different Stocking Density on Aquaponic System Using Fine Bubble

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Authors' contributions

This work was carried out in collaboration among all authors. Author RB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author I and Author R managed the analyses of the study. Author HH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study aims to determine the stocking density that can increase the survival rate of catfish seeds and to analyze the growth rate of catfish seeds in aquaponics systems using FBs. The catfish seeds used in this study were 4-5 cm in size with a weight of 0.5-1.0 g. The types of plants used were ground water spinach from the seedlings themselves and the FBs used had a pressure of 5.5 atm. The method used was an experimental method with a completely randomized design consisting of treatment A 375 fish, treatment B 450 fish, treatment C 525 fish, and treatment D 600 fish with a volume of water of each treatment is 150 L. Catfish seeds were maintained for 35 days. The results of statistical tests showed no significant difference and SR was also not significantly different. Statistically, the aquaponics system using FBs was able to support stocking densities of up to 600 individuals/150 L.

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1. INTRODUCTION

The production of catfish shows a significant increase. In 2015, catfish production was 339,069 tonnes and in 2016 increased to 437,111 tonnes (KKP 2016). Catfish production is still being increased. The national target for catfish production in 2019 was 1,149,400 tonnes (KKP 2016). This shows that catfish farming has a profitable opportunity.

The success rate of intensive cultivation is strongly influenced by the ability of cultivators to control water quality, one of which is the decrease in dissolved oxygen. Dissolved oxygen is a major limiting factor in intensive culture systems. Lack of oxygen can endanger aquatic animals because it can cause stress, become susceptible to disease, inhibit growth and even cause death, which can reduce productivity [1].

The application of the fine bubbles (FBs) technique in the fish cultivation system is used to increase the concentration of dissolved oxygen in the water so that it has positive effects such as faster fish growth, less susceptible to disease and water quality is maintained even in a closed pond system (water is circulated continuously) [2].

According to Pitrianingsih et al. [3], developing the aquaculture industry to increase fishery production by increasing stocking density and protein-rich artificial feed results in increased toxic waste in the waters. Waste in waters generally comes from leftover feed and feces. For fish, ammonia and nitrite are toxic, but they are useful for the growth of plants and vegetables [3,4]. The application of the aquaponics system in intensive cultivation ponds can be one way to overcome the problem of intensive cultivation.

Based on the research results of Asis et al. [5] regarding the growth of catfish (*Pangasianodon hypophthalmus* F.) in the maintenance of aquaponic systems with different densities (2 fish/L, 3 fish/L, 4 fish/L and 5 fish/L), the results showed that the 3 fish/L stocking density treatment resulted in the best growth of 2.80 gr, while the water quality during the study still met the quality standards of cultivated water and still supported fish life. In this sense, the purpose of this study was to determine the stocking density of catfish that could increase the survival rate

and growth rate of catfish seeds in an aquaponic system using Fine Bubbles (FBs).

2. MATERIALS AND METHODS

The method used in this study is an experimental method with a completely randomized design consisting of 4 treatments 3 times repetition, control treatment is in treatment B. The research treatments given are:

- Treatment A: FBs with stocking density of 375 fish/150 L.
- Treatment B: Without FBs with stocking density of 450 fish/150 L.
- Treatment C: FBs with stocking density of 525 individuals/150 L.
- Treatment D: FBs with stocking density of 600 fish/150 L.

2.1 Fish Acclimatization and Installation Inspection

Acclimatization is done by placing the seeds in the rearing tub for one week. This is done so that the fish are not stressed and reduce the mortality value.

At the beginning of the research, the assembled aquaponics installation was allowed to run for one week. This is done so that the water in the dissolved oxygen concentration and pH is stable in the media. At this stage, check for leaks at the installation.

2.2 Fish Care, Observation

Observations were carried out for 35 days starting from moving kale plants from the seedling tray to the aquaponics installation. The parameters observed in this study were fish survival, fish daily growth rate, feed conversion ratio, and water quality. The fish used come from Subang, West Java, Indonesia with a size range of 4-5 cm and a weight of 0.5-1g. The commercial feed with the brand PF-800 was given to fish twice a day as much as 5% of the fish weight. Fish were maintained in optimal water conditions. Fish growth was observed every 7 days for 35 days. The growth observed included length and weight. Samples were taken from each treatment as much as 10% of the fish population. Fish is measured by placing the fish on a ruler and measuring from head to tail, then the fish is weighed.



Picture 1. Aquaponic installation

Source: Personal documentation

2.3 Observed Parameters Include

2.3.1 Survival rate (SR)

Survival Rate (SR) is the ratio of the number of fish alive until the end of rearing. Observation of fish survival can be calculated using a formula, namely:

$$SR = \frac{N_t}{N_o} \times 100\%$$

Information:

SR: Survival rate (%).
 Nt: Number of fish at the end of the study.
 No: Number of fish at the start of the study.

2.3.2 Feed Conversion Rate (FCR)

Feed conversion can be calculated using the following formula:

$$FCR = \frac{F}{(W_t + d) - W_o}$$

Information:

FCR: Food conversion ratio (feed conversion ratio)
 F: The amount of feed consumed
 Wt: Fish weight at the end of the study
 Wo: Fish weight at the beginning of the study
 d: Weight of dead fish

2.3.3 Daily Growth Rate (DGR)

The daily weight growth rate is calculated using the following formula [6]:

$$DGR = \left(\sqrt[t]{\frac{W_t}{W_o}} - 1 \right) \times 100\%$$

Information:

DGR: Daily weight growth rate (% / day)
 Wt: Average fish weight day t (g)
 Wo: Fish average weight on day 0 (g)
 t: Maintenance time (days)

2.3.4 Water quality

Water quality parameters tested include temperature, dissolved oxygen, pH, and ammonia. Water sampling was carried out every seven days during the study. Measurements were carried out three times at different points. Observation of water quality was carried out with the aim of knowing whether during the research the water quality in the aquaponics system still met the standard of survival of the catfish seeds. Water samples were taken to the FPIK Unpad Aquatic Resources Management laboratory. DO, temperature and pH measurements are carried out in situ by immersing the tip of the tool on the surface of the water. Measurements were carried out three times at different points.

3. RESULTS AND DISCUSSION

The results of statistical analysis showed that each treatment was not significantly different in terms of survival, daily growth rate, and feed conversion ratio of Siamese catfish seeds, but the addition of FBs had an effect on survival, daily growth rate, and feed conversion ratio.

The survival rate of catfish seeds in each treatment showed a value of 98.00% - 99.05%. The survival value above 90% in cultivation is still very good so that this decline is still very small and has not limited production [7].

The treatment using FBs was able to increase the dissolved oxygen concentration, so that the fish did not have to compete with one another to breathe. FBs have a lower rise rate in the liquid phase, these bubbles can stay in water for a long time [8].

Treatment using FBs tends to produce growth rates that are statistically the same in value, namely treatments A, C, and D. This is consistent with the statement of Ebina et al. [9] stated that high dissolved oxygen can increase growth due to the influence of nano-sized aeration bubbles. The combination of increased metabolism and lower respiratory response to hyperoxia increases the proportion of energy that is metabolized and can be diverted for growth. According to Hermanto [10], states that the amount of oxygen consumed by fish after consuming feed is an indicator of the metabolic rate, this causes an increase in the growth of catfish seeds.

The daily growth rate in this study is still relatively good. This is consistent with the research of Asis et al. [5], the weight gain of catfish (*P. hypophthalmus*, F) with different stocking densities in the aquaponics system resulted in the highest weight gain value of catfish (450 fish/150 L) of 2.80 gr. According to Jobling [11], fish growth will decrease with increasing density. However, in this study the stocking density of up to 600 fish/150 L did not make a significant difference to the daily growth rate. Thus, the density of 600 fish/150 L has not become a limitation for the length and weight growth performance of fish. This is because water quality and feeding are still optimal for fish growth.

The treatment using FBs tended to produce RKP which was statistically the same in value, namely treatment A, C, and D. The RKP observations on

each treatment after 35 days of maintenance ranged from 1.00-1.23. Treatment D had the best RKP, namely (1.00), followed by treatment A (1.06), treatment C (1.08), and treatment B (1.11). Treatment B (control) produced the highest RKP value, presumably because there was no additional dissolved oxygen in the water for a high fish density so that low dissolved oxygen caused the test fish to experience a decrease in metabolism which would later affect the fish growth rate. According to Hermanto [10], increasing feed consumption requires more oxygen for digestion and metabolism.

According to Zonnerveld et al. [12]. Feed conversion is a measure that states the ratio of the amount of feed needed to produce 1 kg of fish meat. The smaller the RKP value, the more efficient the feed utilization, the feed quality can be determined through feed conversion because the RKP value provides an overview of the efficiency of feed use for growth (Steffens, 1989).

3.1 Water Quality

During the research, the water temperature of the maintenance medium was relatively stable with the use of the aquaponics biofiltration system. This is clarified by the statement of Samsundari [13], which states that the water temperature is relatively constant with the filtration process in biofiltering. This is due to the role of the recirculation system and the biofilter in maintaining the water temperature which was originally low after going through the recirculation system, namely the water is moved by a water pump. and entering the biofiltration process there is mechanical friction between water particles, planting media and plant roots so that the water temperature in the pond can increase and tends to be more constant.

Dissolved oxygen is a very important parameter of water quality because its existence is absolutely required by fish for the respiration process. Low dissolved oxygen content will cause decreased appetite which will affect the growth rate of fish. DO measurement results in each treatment ranged from 6.04 - 6.69, this is in accordance with the statement of Subachri et al [7] that dissolved oxygen is suitable for catfish culture more than 3 mg / L.

Power hydrogen (pH) which is often called the degree of acidity is very influential in the life of fish in the waters. The pH measurement results for each treatment ranged from 6.8 to 8.0 and

Table 1. Survival (SR), Daily Growth Rate (DGR), Feed Conversion Ratio (FCR)

Parameter	Treatments			
	A	B	C	D
	FBs, 375 fish/ 150 L	Without FBs, 450 fish/ 150 L	FBs, 525 fish/ 150 L	FBs, 600 fish/ 150 L
SR	98,67 ± 2,39 ^a	98,30 ± 2,16 ^a	99,05 ± 1,15 ^a	98,00 ± 2,80 ^a
DGR	4,13 ± 0,46 ^a	3,87 ± 0,32 ^a	3,96 ± 0,64 ^a	4,51 ± 0,34 ^a
FCR	1,13 ± 0,07 ^a	1,23 ± 0,07 ^a	1,17 ± 0,11 ^a	1,00 ± 0,05 ^a

Table 2. Concentration of different parametrs

Treatment	Parameter			
	Temperature (°C)	DO (mg/L)	pH	Ammonia (mg/L)
A	23,5 – 29	6,17 - 6,69	6,9 - 7,9	0,006 - 0,007
B	23 - 29,8	6,04 - 6,36	6,9 - 8,0	0,010 - 0,014
C	24,4 – 31	6,10 - 6,46	6,5 - 7,9	0,012 - 0,013
D	24 - 31,5	6,17 - 6,43	6,8 - 7,9	0,015 - 0,017
Quality standards	27 – 30	≥ 5	6,5 - 8,5	< 0,01

Source: SNI 01- 6483.4 (2000)

were still within the quality standard for cultivation, namely 6.5 - 8.5. According to Almaidah [14], pH conditions that can disrupt fish life are too low (very acidic) and too high (very alkaline).

According to Kordi [15], ammonia levels in waters are generally the result of fish metabolism in the form of solid (feces) and dissolved (ammonia) excreted through the anus, kidneys and gill tissue. The results of measuring ammonia for each treatment in this study were 0.006-0.017 mg / L. Ammonia value in this study tends to increase with increasing body size of fish.

Decreasing water quality can also be caused by the provision of an excessive amount of feed which causes the remaining feed and is not eaten by fish. the remaining feed will accumulate to be toxic and toxic to cultured fish due to the decomposition process of organic matter, which is carried out by anerobic bacteria which use dissolved oxygen in water to assist the decomposition process. Sumpono [16] states that the increase in ammonia concentration is not only caused by the higher stocking density but also by the maintenance time.

4. CONCLUSIONS

The application of Fine Bubbles to the cultivation of catfish seeds in aquaponics systems with different stocking densities

did not make a significant difference with good control of survival and growth rate.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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