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PROFIL DARAH DAN PERTUMBUHAN IKAN PATIN (*Pangasius* sp.) PADA PEMELIHARAAN MENGGUNAKAN SISTEM *MICROBUBBLE* DAN TANPA *MICROBUBBLE*

Blood Profile And Fish Growth Patin (Pangasius sp.) In Maintenance Using The Microbubble System And No Microbuble

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ABSTRAK

Penelitian ini bertujuan untuk menganalisa pengaruh *microbubble* terhadap profil darah dan pertumbuhan ikan patin (*Pangasius* sp.) pada pemeliharaan menggunakan sistem *microbubble* dan tanpa *microbubble*. Penelitian dilaksanankan selama 50 hari pada kolam bundar Program Studi Budidaya Perairan, Fakultas Pertanian, Universitas Mataram menggunakan rancangan acak lengkap (RAL) yang terdiri dari 2 perlakuan dan 20 ulangan yaitu P1: budidaya dengan teknologi *microbubble* dan P2: budidaya tanpa teknologi *microbubble*. Parameter uji meliputi hematokrit, hemoglobin, eritrosit, leukosit, diferensial leukosit, berat mutlak, panjang mutlak, berat spesifik, panjang spesifik, rasio konversi pakan (FCR), efisiensi pemberian pakan (EPP), kelangsungan hidup (SR) dan kualitas air. Data dianalisa menggunakan uji statistik non parametrik (t-test) Student t dengan menggunakan program SPSS. Sedangkan data profil darah dan parameter kualitas air dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa Penggunaan *microbubble* dapat meningkatkan pertumbuhan, SGR, FCR, dan EPP ikan patin (*Pangasius* sp.) yang lebih baik dengan profil darah yang masih optimal.

ABSTRACT

The study aims to analyze the influence of microbubbles on the blood profile and growth of patin fish (Pangasius sp.) on the maintenance using microbobble and without microbulble systems. The research was carried out for 50 days in the round pool of the Aquatic Crop Studies Program, Faculty of Agriculture, University of Mataram using a complete random design (RAL) consisting of 2 treatments and 20 repetitions namely P1: cultivation with microbubble technology and P2: cultivation without microbobble technology. Test parameters include hematocrites, haemoglobin, erythrocytes, leukocyte differentials, absolute weight, longitude, specific weight, length, feed conversion ratio (FCR), feeding efficiency (EPP), survival (SR) and water quality. The data were analyzed using the Student t non-parametric statistical test using the SPSS program. Research results show that the use of microbubbles can

enhance growth, SGR, FCR, and EPP of better patin fish (Pangasius sp.) with still optimal blood profiles.

Kata Kunci	*Microbubble, Ikan Patin, Parameter Pertumbuhan, Profil Darah*
Keywords	*Microbubble, Patin Fish, Growth Parameters, Blood Profile*
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INTRODUCTION

Catfish (*Pangasius* sp.) is a fishery biota that is in great demand in Indonesia, so it has become a mainstay commodity for freshwater cultivation that is in demand by consumers. Apart from that, catfish is also a source of food that has very high nutritional value (Adi *et al.*, 2021). Catfish is one of the biota that has been successfully cultivated with high stocking densities and minimal water use. One of the problems in cultivating catfish is that water quality decreases if fish density increases, which has an impact on fish growth (Septimesi *et al.,* 2016). One effort to improve water quality in fish farming is to use microbubble technology which functions to increase dissolved oxygen and reduce ammonia levels in cultivation ponds.

Microbubble is a technology that can produce small air bubbles so that it can increase dissolved oxygen and can reduce ammonia content by as much as 95%, so that the use of microbubble can degrade waste in water media and can improve water quality (Edi *et al.,* 2021). A microbubble generator is a tool that can produce microbubbles with a diameter of less than 100 µm. Microbubbles are also believed to be able to stimulate the work of aerobic bacteria so that they can degrade waste in the maintenance media water, this can be beneficial for the physiological conditions of the cultivated aquatic biota. Microbubble generator is a technology that functions as a producer of dissolved oxygen in water with a microbubble size that is smaller than ordinary aerators, This aerator is also able to increase the mass and length of cultivated fish and shorten the harvest period for aquaculture production, and is able to improve several water quality parameters, as well as microbubbles accelerating growth in fish cultivation (Heriyati *et al.,* 2020).

Several previous studies have shown that the use of microbubble devices can influence the survival, absolute length, absolute weight and feed conversion rate of tilapia. Apart from that, microbubble technology is very effective in increasing the amount of oxygen in the water (Scabra *et al.,* 2022). This is very beneficial for the physiological conditions of the biota being cultivated.

Blood profiles can be used to see physiological responses in fish. The stress response in fish can be seen from changes in levels of the hormone cortisol, blood glucose, hemoglobin and hematocrit. In stressful conditions there are changes in the number of erythrocytes, hematocrit values and hemoglobin levels, while the number of leukocytes tends to increase. Stress is a fish's defensive response to stressors. Factors that are sources of stress, whether in the form of environmental factors (temperature, salinity, pH, light) or biotic factors such as infection with

microorganisms, will have a negative impact on physiological changes in the fish's body. These changes include disruptions to growth and productivity. Blood characteristics can be used to determine physiological responses in fish (Firman et al., 2022).

Based on the description above, research was conducted on the blood profile and growth of catfish (*Pangasius* sp.) when reared using a microbubble system and without a microbubble.

METHODS

Place and Time

The research was carried out for 50 days, taking place in the circular pool of the production laboratory, while the blood profile was tested in the fish health laboratory of the Aquaculture Study Program, Faculty of Agriculture, Mataram University.

Research Design

This research is an experimental study using a completely randomized design (CRD) consisting of 2 treatments and 20 replications. The research design is as follows:

P1 : cultivation with microbubble technology
P2 : cultivation without microbubble technology

Procedure

Research preparation

a. **Preparation of Maintenance Tools and Media**

Initial preparations for the research began with preparing a maintenance container in the form of a round pond with a diameter of 2 m and a pond volume of 3140 liters which was used as a place for the test biota to live. Before using the pool, first wash it with soap, then rinse it using fresh water and dry it in the sun all day. Other equipment that must be available is supporting equipment such as installing a microbubble device as an oxygen supplier.

After the pool is dry, the next step is to fill the maintenance pool with water using the distribution pipe provided. The maintenance pond is filled with water up to a volume of 1000 liters. When the water has been filled, the microbubble device is turned on. The container that has been filled with water is then left for 24 hours before stocking the catfish in the rearing pond.

b. **Making Microbubble Tools**

Making the microbubble tool consists of a 10 cm ½ inch PVC pipe, an outer ½ inch fitting, nipple, aerator hose, ring, and a perforated bottle cap. The way to make it is to make a hole in the top fitting, the size of the hole follows the size of the nipple, then after making a hole, clean the edge of the hole using a knife and attach the nipple and aeration hose to it, then insert the holed bottle cap into the fitting, before that the fitting and faucet are given ring. After that, insert ½ of the PVC pipe into the fitting so that the faucet cannot move when the water flows. The microbubble tool is ready to use.

c. **Biota test preparation**

The biota used in the research was catfish (Pangasius sp.) with a size of 9-11 cm taken at the Lingsar Fish Seed Center (BBI), Lingsar District, West Lombok Regency. The catfish were then adapted for 10 days. After the adaptation process is complete, the catfish are stocked in round ponds with a stocking

density in the pond, namely 1 fish per 5 L of water, so that the number of fish used is 200 fish per pond.

d. **Distribution and Maintenance of Biota**

Stocking of fish is done in the morning and evening so that the fish do not experience stress. Before stocking, the catfish were acclimatized for 10-15 minutes so that the fish could adapt to the pond environment and the stocking density in this study was 1 fish/5 liters. The stocking density of catfish with the best growth is 2 fish/liter (Ratulangi *et al.,* 2021), the volume of water used in this study was 1000 liters.

Fish rearing is carried out for 50 days, with feeding twice a day, namely in the morning at 08.00 and in the afternoon at 16.00 WITA, in each pond using the adlibitum method, the type of feed used is commercial feed HI – PRO – VITE 781N-2 with The nutritional content is 31-33% protein, 4-6% fat, 3-5% fiber, and 9-10% water content. During maintenance, pipe cleaning and silencing is carried out every 3 days or conditionally. Apart from cleaning, water quality checks are also carried out in the form of DO, temperature, pH, nitrate and ammonia measurements. Apart from that, the weight and length of the fish were also measured at the beginning, middle and end of the study.

e. **Fish Blood Collection**

A total of 3 catfish samples were randomly selected in the rearing pond. The process of taking catfish blood is carried out using a 1 ml syringe to suck out the blood of the test fish. Before use, add 10% EDTA solution to a 1 ml syringe. The process of taking fish blood begins by inserting a 1 ml syringe in the linea lateralis at an angle of 450 then the tip of the syringe is pulled slowly until enough blood has been sucked. Catfish blood sampling activities during the research took place 3 times. The first blood sampling of catfish was carried out at the beginning of the rearing period, in the middle and at the end of rearing.

Research Parameters

Hematokrit

The hematocrit value is calculated by sucking fish blood samples with a microhematocrit tube up to ¾ of the tube. Then the end of the tube was closed using crytoseal to a depth of 1 mm, thus forming a crytoseal plug. Next, the microhematocrit tubes were centrifuged at a speed of 500 rpm for 5 minutes with tubes of the same volume facing each other so that the centrifuge rotation was balanced. The length of the entire volume of blood contained in the tube (b) and the percentage of the length of the part of the blood that settles (a) are used to calculate the hematocrit level reading = (a/b) x 100% (Chinabut *et al.,* 1991).

Hemoglobin (HB)

Hemoglobin levels were measured using the Sahli method. A total of 0.1 N-HCl was added to the dilution tube until it showed a scale of 2, the blood was sucked using an Hb pipette to a scale of 20, then stirred using a stir bar. The diluent tube is inserted into the comparator block to compare the color of the blood solution with the standard solution next to it. If it is not the same, add distilled water drop by drop into the diluent tube until the blood solution is the same as the blood solution. standard solution. The height of the blood solution on the scales is calculated as the Hb level (g/dL) (Alipin & Sari, 2020).

Eritrosit

Blood is sucked using an erythrocyte pipette to a limit of 0.5 then mixed with hayem solution until it reaches the limit of 11 printed on the pipette. The blood is homogenized, then the first two drops of blood solution in the pipette are discarded, then the blood is dropped into the hemocytometer and covered with a cover glass. Then the number of erythrocytes was counted using a microscope with 400x magnification. Calculation of the number of erythrocytes using the Blaxhall & Daisley (1973) method in Alipin & Sari (2020) as follows:

Number of erythrocytes = number of erythrocyte cells counted X 10^6 sel/mm^3

Leukosit

Calculation of the total number of leukocytes in a blood sample that has been mixed with anticoagulant is sucked using a leukocyte pipette to a scale of 0.5 and Turk's solution is added to a scale of 11. The pipette is shaken to form a number 8 for five minutes so that the blood and solution are evenly mixed, after the solution is homogeneous, two drops of blood are removed to remove the air in the tube, then the blood is dropped into the hemocytometer box and covered with a cover glass, make sure it is closed tightly without any air bubbles. then magnified 400 times under a microscope to view. Four large hemocytometer boxes were used to count the number of leukocytes using a microscope and the following formula (Rahmadona *et al.,* 2020):

Leukocyte count = number of leukocyte cells counted X 50 sel/mm^3

Leukocyte Differentiation

Blood smear preparations for observing differences in leukocytes are carried out by preparing two glass objects that are used to make blood smear preparations. On object glass A and object glass B, blood is dropped on object glass A, then blood is dropped on object glass B on object glass A at an angle of 45°. Glass object B is pulled to the right and then pushed to the left quickly and continuously. After obtaining a thin blood smear, it is then aired. After that, the smear preparation was placed in methanol for 5 minutes, after completion the preparation was placed in Giemsa dye for 20 minutes. Then dried after five minutes of washing under running water. If the preparation is dry, use a microscope to observe the preparation (Klontz, 2009). The leukocyte differential is calculated by finding a minimum number of 100 white blood cells to determine the number of leukocyte types. (Pal & Pal, 2006) in (Lestari *et al.,* 2017).

Absolute Weight

The increase in fish weight was measured using the formula Effendi (1979) in Permatasari (2016) as follows:

$$Wm = Wt - W0$$

Information:
Wm : Fish weight (g)
Wt : Fish weight at the end of the study (g)
Wo : Fish weight at the start of the study (g)

Absolute Length

Calculation of fish length using the formula used by Scabra *et al.,* (2024) :

$$Pm = Pt - P0$$

Information:
Pm : Absolute length of fish (cm)
Pt : Fish length at the end of the study (cm)
Po : Fish length at the start of the study (cm)

Specific Growth Rate

The specific growth rate (SGR) is calculated using the Steffen formula (1989) in Aulia *et al.,* (2020):

$$SGR = \frac{Inwt + Inwo}{t} \times 100\%$$

Information:
SGR : Specific growth rate (%)
T : Maintenance time (days)
Wt : Average weight of fish at the end of rearing (g/head)
Wo : Average weight of fish at the beginning of rearing (g/head)

***Feed Conversion Ratio* (FCR)**

According to Mokoginta *et al.,* (1995), the feed conversion ratio (FCR) can be calculated using the following formula:

$$FCR = \frac{F}{Wt - Wo} + D$$

Information:
FCR : Food Convercion Rasio
F : Total weight of feed given (g)
Wt : Final weight of fish (g)
Wo : Initial weight of fish (g)
D : Dead fish weight (g)

Feed Utilization Efficiency (EPP)

According to Tacon (1987) in Mustofa *et al.,* (2018), the feed utilization efficiency (EPP) value is calculated using the formula:

$$EPP = \frac{Wt - Wo}{F} \times 100\%$$

Information:
EPP : Feed utilization efficiency (%)
Wt : Total weight of fish at the end of the study (g)
Wo : Total weight of fish at the start of the study (g)
F : Amount of feed consumed during the study (g)

Survival Rate (*SR*)

According to Arisanti (2013), the survival percentage of test fish can be calculated using a formula:

$$SR = \frac{Nt - No}{Nt} \times 100\%$$

Information :
SR : Survival Rate (100%)
Nt : Number of fish at the end of rearing (tail)
No : Number of fish at the start of rearing (tail)

Water Quality Measurement

The water quality parameters measured were temperature, pH, DO, ammonia and nitrate. Water quality parameter measurements were carried out every 10 days during the research. The tools used for measurements are pH meters, DO meters and test kits.

Data Analysis

The growth data obtained was first tested using the normality test and homogeneity test. The data obtained is normal, so it can be continued using the non-parametric statistical test (t-test) Student t using the SPSS program. Meanwhile, blood profile data and water quality parameters were analyzed descriptively.

RESULT AND DISCUSSION

Result

Hematokrit

The results of Hematocrit calculations from this study are shown in figure 4.1. Hematocrit levels in catfish rearing using microbubbles (P1) and without microbubbles (P2), the highest levels were found in P1 at 15.24 ± 2.17 %, while the lowest hematocrit levels were in P2 at 12.49 ± 0.80%.

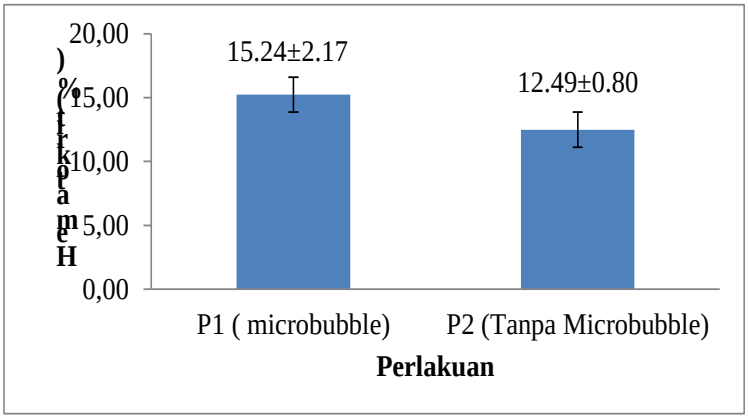

Figure 4.1 Hematocrit levels when rearing catfish (*Pangasius* sp.)

Hemoglobin

The results of hemoglobin calculations in this study are shown in Figure 4.2. Hemoglobin levels in rearing catfish (*Pangasius* sp.) using microbubbles (P1) and

without microbubbles (P2) were highest in P1 at 7.06 ± 0.18 %, while the lowest hemoglobin levels were in P2 at 6.51 ± 0 .21%.

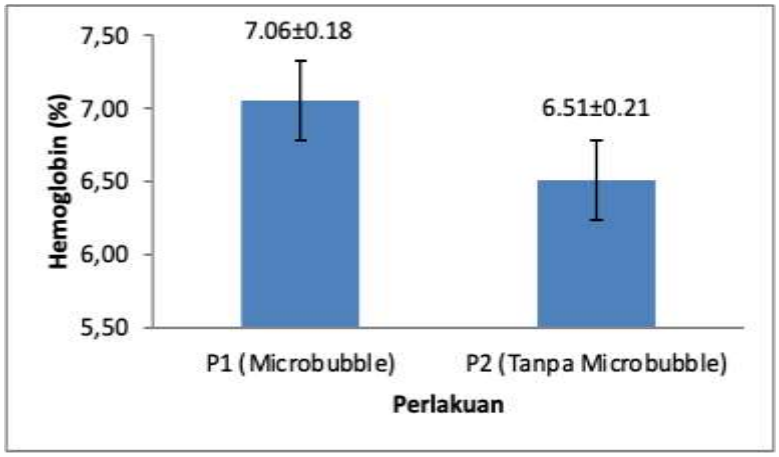

Figure 4.2 Hemoglobin levels in rearing catfish (*Pangasius* sp.).

Eritrosit

The results of Erythrocyte calculations in this study are shown in Figure 4.3. Obtaining erythrocyte levels when rearing catfish (Pangasius sp.) using microbubbles (P1) and without using microbubbles (P2) ranges from 1.51 ± 0.16x10^6 cells/mm^3 - 1.99 ± 0.31x10^6 cells/mm^3 obtaining high erythrocyte levels The highest was in P1 at 1.99 ± 0.31x10^6 cells/mm^3, while the lowest erythrocyte content found in P2 was 1.51 ± 0.16x10^6 cells/mm^3.

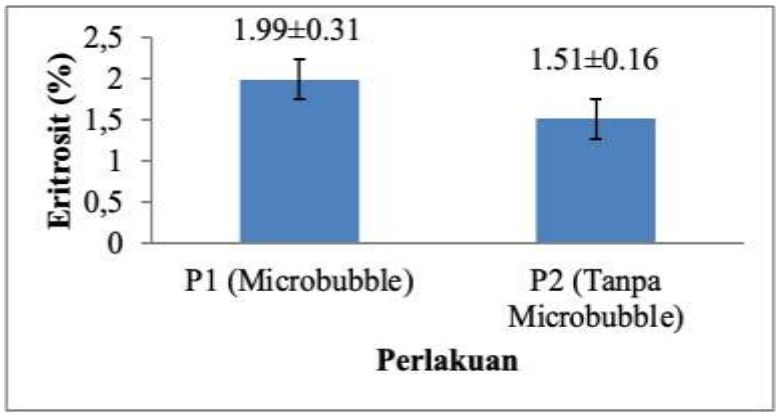

Figure 4.3 Erythrodite levels in rearing catfish (*Pangasius* sp.)

Leukosit

The results of leukocyte calculations in this study are displayed in Figure 4.4 Obtained leukocyte levels in rearing catfish (Pangasius sp.) using microbubbles (P1) and without microbubbles (P2) ranged from 2.50±0.06x10^4 cells/mm^3 – 2.70±0 .26x10^4 cells/mm^3 obtained the highest leukocyte levels found in P2 of 2.70 ± 0.26x10^4 cells/mm^3, while the lowest level in P1 was 2.50 ± 0.06x10^4 cells/mm^3.

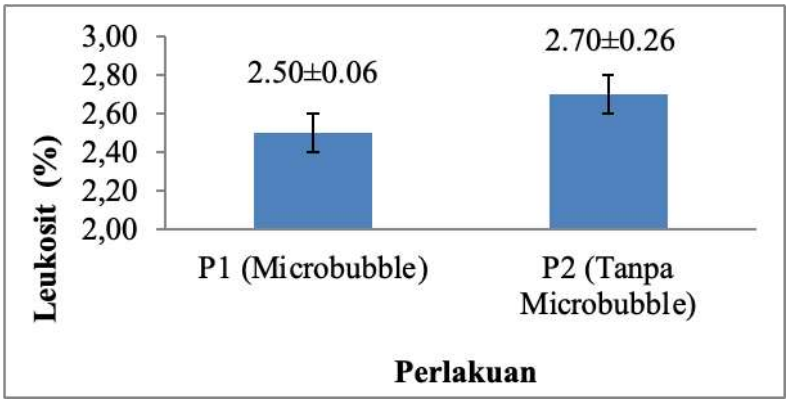

Figure 4.4 Leukocyte levels in rearing catfish (*Pangasius* sp.)

Leukocyte Differential

The results of Differential Leukocyte calculations in this study are 3 types, namely lymphocytes, monocytes and neutrophils, shown in 4.12. The differential values obtained for leukocytes were lymphocytes in P1 of 79.7 ± 0.03 % and P2 of 74.7 ± 0.01 %, monocyte values in P1 of 7.7 ± 0.01 % and P2 of 10.7 ± 0.02 %, while the value for neutrophils at P1 was 9 ± 0.01 % and at P2 was 11 ± 0.02%.

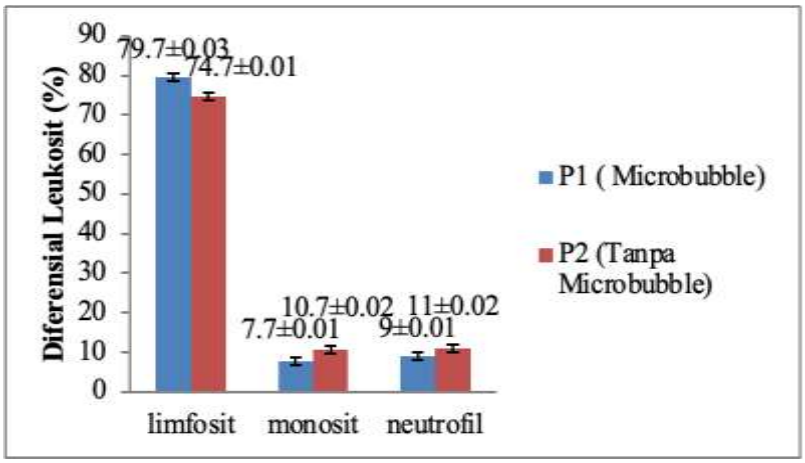

Figure 4.5 Differential percentage of leukocytes, namely lymphocytes, monocytes and neutrophils in catfish (*Pangasius* sp.)

Absolute Weight

The results of absolute weight calculations from this research are shown in Figure 4.6. The use of microbubbles showed that there was a significant difference ($t<0.05$) in the absolute weight of growing catfish (Pangasius sp.) using microbubbles (P1) and without microbubbles (P2). The highest absolute weight value is found in P1 using microbubble at 21.8 gr, while the lowest absolute weight value is at P2 without microbubble at 14.8gr.

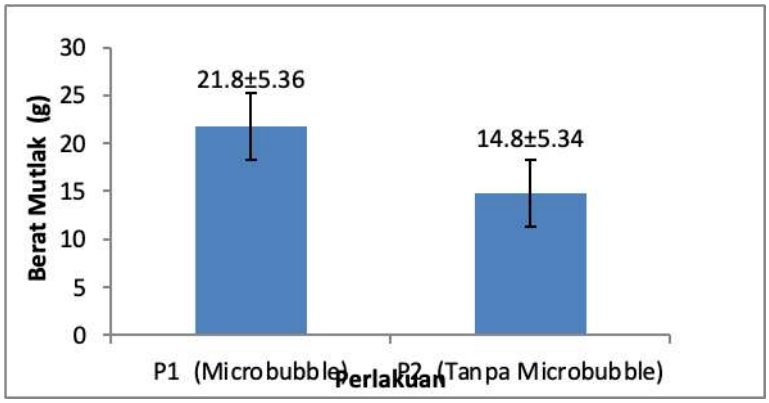

Figure 4.6 Absolute weight value in rearing catfish (*Pangasius* sp.)

Absolute Length

The results of absolute length calculations from this research are shown in Figure 4.7. The use of microbubbles showed that there was a significant difference (t<0.05) in the absolute length of growing catfish (*Pangasius* sp.) using microbubbles (P1) and without microbubbles (P2). The highest absolute length value is found in (P1) using microbubble at 6.48 cm, while the lowest absolute length value is at (P2) without microbubble at 5.36cm.

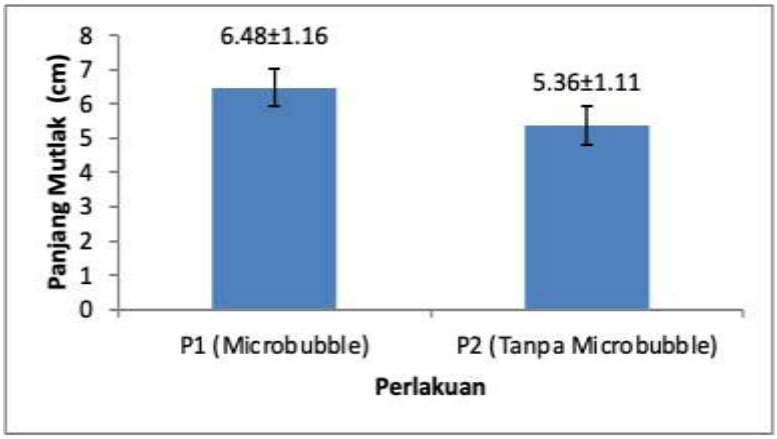

Figure 4.7 Absolute length value in rearing catfish (*Pangasius* sp.)

Specific Weight

The results of the Specific Weight calculation from this research are shown in figure 4.8. The use of microbubbles showed that there was a significant difference (t<0.05) in the specific weight of growing catfish (*Pangasius* sp.) using microbubbles (P1) and without microbubbles (P2). The highest specific weight value is found in (P1) using microbubble at 2.31 ± 0.48 %, while the lowest specific weight value is at (P2) without microbubble at 1.79 ± 0.49%.

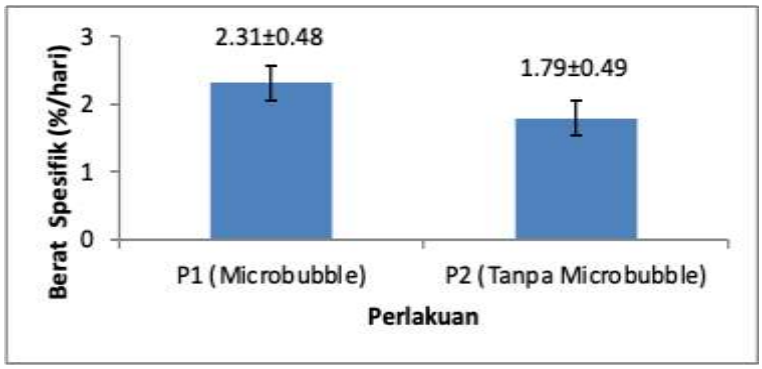

Figure 4.8 Specific weight values for rearing catfish (*Pangasius* sp.)

Specific Length

The results of the Specific Length calculation from this research are shown in Figure 4.9. The use of microbubbles showed that there was a significant difference ($t<0.05$) in the specific length of growing catfish (*Pangasius* sp.) using microbubbles (P1) and without microbubbles (P2). The highest specific length value was found in (P1) using microbubble at 0.99 ± 0.18 %, while the lowest specific length value was at (P2) without microbubble at 0.86 ± 0.16%.

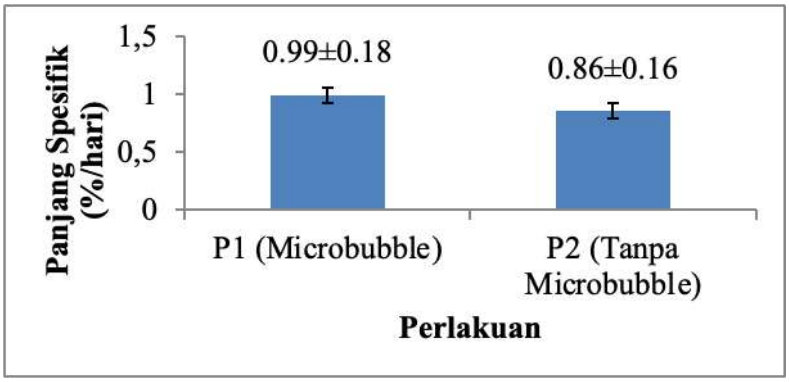

Figure 4.9 Specific length values in rearing catfish (*Pangasius* sp.)

FCR

The FCR calculation results from this research are shown in Figure 4.10. The use of microbubbles showed that there was a significant difference ($t<0.05$) in the FCR of rearing catfish (*Pangasius* sp.) using microbubbles (P1) and without microbubbles (P2). The highest FCR value was found in (P2) without microbubble at 2.35 ± 1.02 %, while the lowest FCR value was found at (P1) using microbubble at 1.60 ± 0.56%.

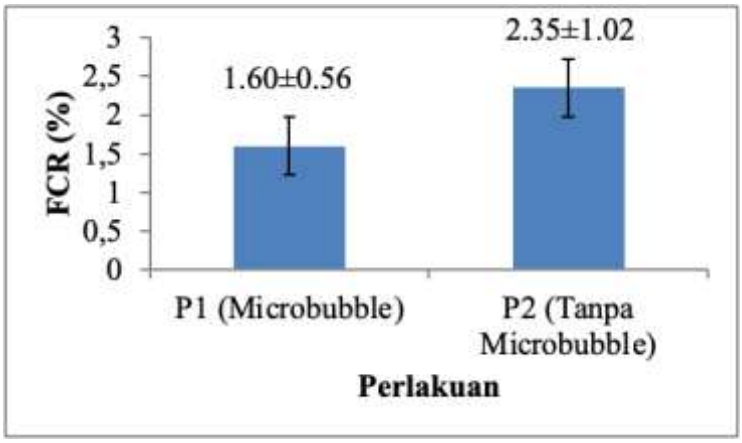

Figure 4.10 FCR value in rearing catfish (Pangasius sp.)

EPP

The results of EPP (*Feeding Efficiency*) calculations from this research are shown in Figure 4.11. The use of microbubbles showed that there was a significant difference (t<0.05) in EPP when rearing catfish (*Pangasius* sp.) using microbubbles (P1) and without microbubbles (P2). The highest EPP value was found in (P1) using microbubble at 68.36 ± 19.29 %, while the lowest EPP value was at (P2) without microbubble at 49.8 ± 19.58%.

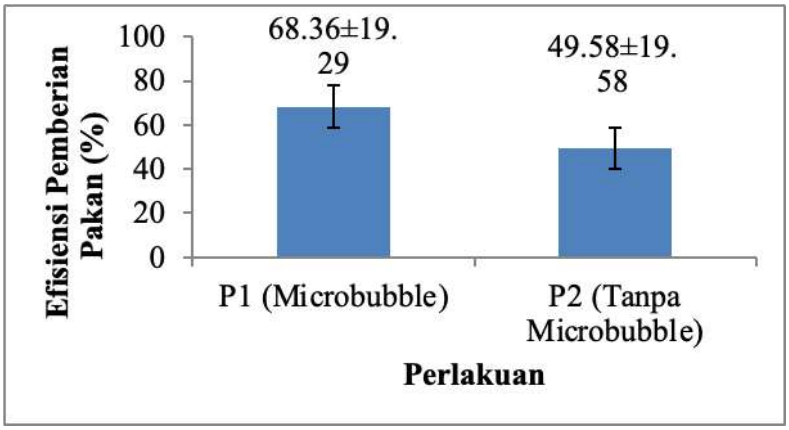

Figure 4.11 Feeding Efficiency Value (EPP) in maintenance catfish (*Pangasius* sp.)

SR

The results of the *Survival Rate* (SR) calculation from this research are shown in Figure 4.12. The use of microbubbles showed that there was no significant difference (t>0.05) in SR when rearing catfish (*Pangasius* sp.) using microbubbles (P1) and without microbubbles (P2). The highest SR value is found in (P1) using microbubble and (P2) without microbubble, both at 100%.

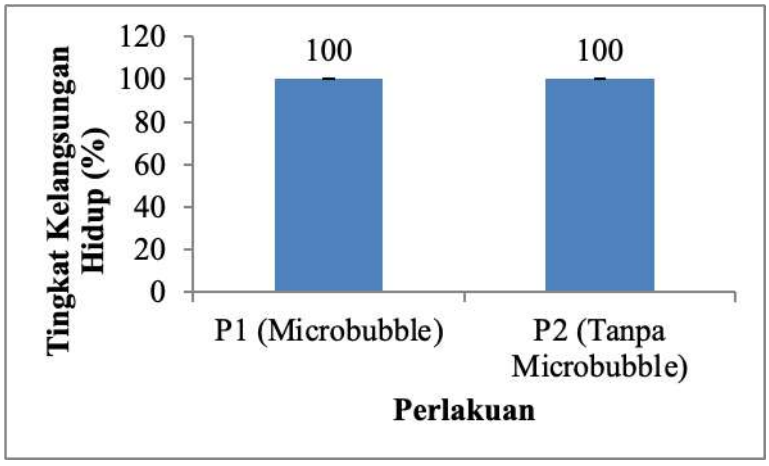

Figure 4.12 *Survival Rite* (SR) value in rearing catfish (*Pangasius* sp.)

Water Quality

The water quality parameters observed in this study included temperature, DO, pH, ammonia and nitrate. Water quality measurements are carried out once every 10 days during the 50 day maintenance period. Water quality measurements for 50 days showed normal results and there were no significant fluctuations. The obtained water quality values can be seen in the table 4.1

Table 4.1 Water Quality

Parameters	Obtained Range		References
	P1	P2	
Temperature (^{0}C)	27,3 – 28,2	27.5 -28.6	25 – 30 (Syagrizal *et al*., 2020).
DO (mg/l)	4,8 – 6,4	4,7 – 5,9	3 – 7 (Fujiana *et al* 2020).
pH	6,8 – 7,6	6,9 – 7,8	6,5 – 8,5 (Iskandar *et al*., 2022).
Ammonia (mg/l)	0,15	0,15 – 0,25	< 1 (Syagrizal *et al*., 2020).
Nitrate (mg/l)	2	2	< 10 (Fujiana *et al* 2020).

Discussion

Hematokrit

Hematocrit is a description of the percentage of red blood cells in the blood, which is the ratio between blood volume and blood plasma. Based on the research results, the highest hematocrit level was in (P1) at 15.24 ± 2.17 %, while the lowest hematocrit level was at (P2) at 12.49 ± 0.80 %. Based on optimal levels, the hematocrit in this study was low. According to Suriyadin *et al.,* (2023), the range of normal hematocrit levels in catfish is around 30% -44% and hematocrit levels that are lower or below 22% indicate that the fish will experience anemia, whereas if the hematocrit percentage is above normal, it indicates that the fish is experiencing anemia. stress. A hematocrit value below 30% indicates an erythrocyte deficiency and if the fish is

infected, the fish's appetite will decrease and the blood hematocrit value will decrease (Sajito *et al.,* 2017).

Hemoglobin

Blood hemoglobin (Hb) is closely related to erythrocytes, and functions as an oxygen binder and is used for catabolism processes to produce energy. Based on the research results, the highest Hb value was in P1 at 7.06 ± 0.18 g/dl, while the lowest value was at P2 at 6.51 ± 0.21 g/dl. The Hb values at P1 and P2 show optimal values. This is in accordance with the statement of Sajito *et al.,* (2017), normal catfish hemoglobin levels range from 5.05-8.33 g/dl. The high hemoglobin value is influenced by an increase in total erythrocytes, there is a correlation between the hemoglobin value and total erythrocytes, where hemoglobin is found in erythrocyte cells and the increase in fish erythrocyte values is caused by the age and size of the fish. The increase in age and size of fish is influenced by oxygen, where oxygen is needed by fish for respiration, blood circulation and metabolism. According to Syawal *et al.,* (2021), the increase in fish erythrocytes is caused by several factors, including increasing the age and size of the fish, increasing the age and size of the fish will affect oxygen requirements, where oxygen is needed by fish for respiration, blood circulation and metabolism. , so that larger fish have more erythrocytes than small fish.

Eritrosit

The erythrocyte value obtained was different in the two treatments, the erythrocyte value obtained during 50 days of maintenance ranged from 1.51 ± 0.16x106-1.99 ± 0.31x106 cells/mm3, where the erythrocyte value at P1 was 1.99 ± 0.31x106 cells /mm3, while P2 is 1.51 ± 0.16x106 cells/mm3, that this eryth value still in normal quantities. According to Handajani *et al.,* (2023), the number of normal catfish erythrocytes ranges from 1.5-2.83 × 106 cells/mm3. If the fish's average red blood cell count is below this range, it means the fish is anemic. If the number of red blood cells is above the normal limit, then the fish is under stress. Factors that influence total erythrocytes are species, size, physical activity, age, gender, parent differences, feed nutrition, and water quality such as lack of oxygen, and the number of erythrocytes is also influenced by physiological factors and changes in the cultivation environment (Suriyadin *et al.,* 2023).

Leukosit

Leukocytes are white blood cells and play a very important role in the immune system. The leukocyte value obtained during 50 days of maintenance ranged from 2.50 ± 0.06x104 cells/mm3 – 2.70 ± 0.26x104 cells/mm3, the leukocyte value at P1 was 2.50 ± 0.06x104 cells/mm3, while P2 was 2.70±0.26x104 cells/mm3. This leukocyte value is still within the normal range, this is in accordance with the statement by Sarjito et al., (2017), that the total leukocyte value in normal catfish is 2x104 – 1.5x105 cells/mm3.

Leukocytes are responsible for the immune response, if a foreign substance enters the body, the leukocytes will make antibodies. Antibodies will be used by the immune system to stimulate, identify and neutralize incoming foreign objects (antigens), such as bacteria. The greater the antigen stimulation, the more antibodies will be produced. Bacteria that enter the fish's body will be identified by leukocytes as antigens (Syawal et al., 2021).

Fish with a healthy physical condition have lower leukocyte cells than fish infected with bacteria or sick. The decrease in the number of leukocyte cells is due to activities to destroy bacterial or viral cells that infect the fish's body. Apart from that, fish that experience stress or illness caused by changes in environmental conditions or bacterial infections also show a response to an increase in the number of leukocyte cells (Suriyadin et al., 2023).

Differential Leukosit

Differential observations of leukocytes consist of lymphocytes, monocytes and neutrophils. The percentage of lymphocytes in the two treatments was different, where the highest percentage of lymphocytes was in (P1) using microbubble at 79.7 ± 0.03 %, while the lowest lymphocyte value was in (P2) without microbubble at 74.7 ± 0.01 %. The percentage of lymphocytes in the two treatments was still within the normal range, so the fish's immune system was still working well. According to Handajani et al., (2023), healthy catfish have lymphocyte values ranging from 71.12-82.88%.

Monocytes are a part of the catfish immune system. The percentage of monocytes in the two treatments was different, where the lowest percentage of monocytes was in (P1) using microbubble at 7.7 ± 0.01 %, while the highest percentage of monocytes was in (P2) without microbubble at 10.7 ± 0.02 %. The percentage of monocytes in the two treatments was still within the normal range, if the monocyte value exceeded the normal value, it was caused by the presence of foreign body or pathogen infection in the fish. According to Handajani et al., (2023), stated that a high percentage of monocytes is related to infection by foreign objects or pathogens in the body and non-specific immune responses, so that macrophage cells are activated to attack bacteria, the normal number of monocytes in catfish ranges from 5-13%.

Neutrophils play a role in destroying foreign objects that enter the fish's body. The percentage of neutrophils in the two treatments increased, where the highest percentage of neutrophils was in (P2) without microbubble at 11 ± 0.02 %, while the lowest neotrophil was in (P1) using microbubble at 9 ± 0.01 %. The percentage of neutrophils in the two treatments was not within the normal range, this was caused by the presence of pathogen infection or foreign objects in the fish, causing an increase in the number of neutrophils. According to Handajani et al., (2023), stated that the normal number of neutrophils ranges from 3.25-8.40%, the increase in the number of neutrophils is due to the immune mechanism in response to infection and causes an increase in the number of neutrophils, the process of phagocytosis is characterized by cell activity neutrophils in phagocytizing pathogens in the fish body.

Absolute Weight

Absolute weight is the growth rate of total fish biomass during rearing expressed in grams. The absolute weight value in the two treatments increased, the Absolute Weight value during the 50 day rearing period ranged from 14.8-21.8 grams, the treatment using microbubble showed the highest absolute weight value of 21.8 grams, while the absolute weight value in the treatment without microbubbles showed the lowest absolute weight value of 14.8 grams, based on the T-test that the use of microbubbles showed there was a significant difference in the absolute weight of growing catfish (Pangasius sp.), where microbubbles could increase the oxygen content inside waters that support fish growth, and low oxygen content will affect fish appetite and development. This is in accordance with the statement of Yanuhar et al

(2021), the working mechanism of microbubbles is by increasing dissolved oxygen levels and decreasing water oxygen levels which will cause a decrease in fish appetite, fish health and development.

Absolute Length

The absolute length growth rate is the increase in the total length of the fish during rearing expressed in cm. The absolute length value in the two treatments increased, the absolute weight value during the 50 day rearing period ranged from 5.36 ± 1.11-6.48 ± 1.16 cm. The treatment using microbubbles showed the highest absolute length value of 6.48 ± 1.16 cm, while the treatment without microbubbles showed the lowest absolute length value of 5.36 ± 1.11 cm, based on the T-test that the use of microbubbles showed that there was a difference which is significant in the absolute length of growing catfish (Pangasius sp.), where microbubbles can increase the oxygen content in the water so that the fish do not experience stress and the fish grow well. This is in accordance with the statement of Ratulangi et al., (2022), the use of microbubble devices can help increase fish growth and microbubble devices are able to stabilize and optimize dissolved oxygen in water. Scabra et al., (2022), When the fish are healthy or in other words do not experience stress, the energy in the feed will be used properly for growth.

Specific Weight

Specific weight growth rate is the amount of daily weight gain of fish during rearing expressed in percent (%). The specific length value of the two treatments increased, the specific weight value during 50 days of rearing was around 1.79 ± 0.49 – 2.31 ± 0.48 %. The treatment that used microbubbles showed the highest specific weight value of 2.31 ± 0.48%, while the treatment without microbubbles showed the lowest specific weight value of 1.79 ± 0.49%, based on the T-test that the use of microbubbles showed that there was a difference which is significant for the specific weight of rearing catfish (Pangasius sp.), where microbubbles can increase the oxygen content in the water so that the metabolism of the fish is very good in supporting its growth. This is in accordance with the statement of Yanuhar et al., (2021), a fast metabolic rate will influence fish growth, and this is related to the oxygen levels in the water.

Specific Length

Specific length growth rate is the daily length increase of fish during rearing expressed in percent (%). The specific length value of the two treatments increased, the specific length value during 50 days of maintenance was around 0.86 ± 0.16 - 0.99 ± 0.18%. The treatment using microbubbles showed the highest specific length value of 0.99 ± 0.18%, while the treatment without microbubbles showed the lowest specific length value of 0.86 ± 0.16%, based on the T-test that the use of microbubbles showed that there was a significant difference. significant effect on the specific length of catfish (Pangasius sp.) rearing, where microbubbles can increase the oxygen content in the water. The high oxygen content in the water will affect the fish's appetite so that the fish can grow well. On the other hand, low oxygen content in the water will affect the appetite and development of fish so that growth is poor. This is in accordance with the statement by Yanuhar et al., (2021), decreasing water oxygen levels will cause a decrease in fish appetite and fish development.

FCR

Food conversion ratio (FCR) or feed conversion ratio is the ability of fish to convert feed into meat. This parameter is an indicator in determining the effectiveness of a feed. The FCR value or feed conversion ratio for 50 days of maintenance is around 1.60 ± 0.56 - 2.35 ± 1.02 %. The treatment without using microbubbles showed the highest FCR value or feed conversion ratio of 2.35 ± 1.02%, while the treatment using microbubbles showed an FCR value of 1.60 ± 0.56%, based on the T-test that the use of microbubbles showed there was significant difference to the FCR or feed conversion ratio for growing catfish (Pangasius sp), where microbubbles can increase the oxygen content in the waters. The high oxygen content in the waters will increase fish appetite and feed conversion. On the other hand, the low oxygen content in the water results in a lack of fish appetite and metabolism, thereby inhibiting the fish growth process. This is in accordance with the statement of Yanuhar *et al.,* (2021), Microbubble is a technology that is able to distribute oxygen into the waters evenly through the micro-sized air bubbles it produces, a fast metabolic rate will influence fish growth, and this is related to the oxygen levels in the waters, decreasing oxygen levels in the waters will cause a decrease in appetite. fish eating, fish health and development and feed conversion. The smaller the feed conversion value, the better it is, indicating that the fish are utilizing the feed well and a low feed conversion value will help reduce feed production costs. This is in accordance with the statement by Ratulangi et al., (2022), the smaller the feed conversion value, the better the fish for cultivation, and a feed conversion value that is close to 1 indicates that the fish is utilizing the feed well.

EPP

Feeding Efficiency (EPP) shows values for 50 days of maintenance around 49.8 ± 19.58 - 68.36 ± 19.29 %. The treatment that used microbubbles showed the highest EPP value of 68.36 ± 19.29%, while the treatment without microbubbles showed the lowest EPP value of 49.8 ± 19.58%, based on the T-test that the use of microbubbles showed that there were significant differences. significant effect on EPP in rearing catfish (Pangasius sp), where microbubbles can increase the oxygen content in the water. The high oxygen content in the water will affect the fish's appetite so that the fish can make good use of the feed, and conversely the low oxygen content in the water will reduce the fish's appetite and thus inhibit growth. According to Yanuhar et al., (2021), a fast metabolic rate will affect fish growth, and this is related to the oxygen levels in the water, and decreasing water oxygen levels will cause a decrease in fish appetite, fish health and development.

SR

Survival rate is the percentage of fish that are alive at the end of rearing from the number of fish stocked at the beginning of rearing. The FCR value for 50 days of maintenance from the two treatments had the same SR, namely 100%. Microbubbles can increase the oxygen content in the water so that it can provide quite high fish survival. Apart from that, the high or low survival rate of catfish is also caused by the environment and water quality. This is in accordance with the statement by Ratulangi et al., (2022), water quality parameters can influence the survival rate of fish, using a microbubble device as an aeration system produces high survival, where the dissolved oxygen produced from this microbubble device is quite stable from start to finish. maintenance and produces evenly distributed oxygen (Scabra et al., 2022).

Water Quality

Water quality is a limiting factor in the growth of cultivated fish, including catfish. Catfish can live in poor water quality but will inhibit growth because their energy is used to survive in a poor water environment. Water quality measured during the research, such as temperature, pH and DO (dissolved oxygen), ammonia and nitrate, showed that it was still within optimal limits for catfish cultivation.

Temperature is one of the parameters of success in cultivation because it is a controlling factor that can influence the survival of fish growth. Based on the results of temperature measurements during the research, P1 obtained results ranging from 27.3 - 28.2 oC, while P2 ranged from 27.5 - 28.6 0C. This temperature range is the optimal range for catfish life. This is in accordance with the statement by Syagrizal et al., (2020), the optimal temperature range for catfish is between 25 – 30 0C.

Dissolved oxygen (DO) plays an important role in cultivation, the availability of dissolved oxygen in water determines the life of aquatic organisms including fish. Dissolved oxygen levels will affect development and growth, even in poor conditions, it can result in fish death. Fish need oxygen to burn fuel (food), activity, swimming and reproduction. Based on the results of dissolved oxygen measurements during the research, results obtained for P1 ranged from 4.8 – 6.4 mg/l, while P2 obtained results ranged from 4.7 – 5.9 mg/l. This range of dissolved oxygen (DO) values is the optimal range for catfish. According to Fujiana et al., (2020), the appropriate dissolved oxygen value required by catfish is around 3-7 mg/l.

The pH value shows the balance of acids and bases in water. Based on pH measurements during the research, P1 obtained results ranging from 6.8 – 7.6 mg/l, while P2 obtained results ranging from 6.9 – 7.8 mg/l. This range of pH values still supports the growth and survival of catfish. This is in accordance with the statement of Iskandar et al., (2022), the optimal pH range for catfish is between 6.5 – 8.5 mg/l. pH is also often used as an indication of the degree of acidity of waters, influenced by the concentration of C02 and acidic compounds, and pH is often used to determine whether the condition of cultivation media is good or bad.

Quite high levels of ammonia (NH3) come from uneaten feed residues and waste products of fish metabolism and ammonia is a toxic compound. Ammonia levels during the study where P1 was obtained was around 0.15 mg/l, while P2 was obtained around 0.15 – 0.25 mg/l. This ammonia level is still in the optimal range for the growth of catfish. According to Syagrizal et al., (2020), explained that the ideal ammonia concentration for fish is no more than 1 mg/L.

Nitrate is the end result of the nitrification process, namely the oxidation of ammonia to nitrite and the oxidation of nitrite to nitrate. Nitrate is very soluble in water and stable and nitrate is not toxic to organisms. The nitrate yield obtained from P1 was 2 mg/l, while P2 was also 2 mg/l. According to Fujiana et al., (2020), the safe nitrate value in fish farming is not to exceed 10 mg/l.

CONCLUSION AND SUGESSTIONS

Conclusion

The use of microbubbles can improve the growth, SGR, FCR, and EPP of catfish (*Pangasius* sp.) better with an optimal blood profile.

Sugesstion

It is recommended to use microbubbles to increase the production of catfish (Pangasius sp.).

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