# Growth and Survival Rate of Red Tilapia (*Oreochromis* Sp.) Cultivated in the Brackish Water Tank under Biofloc System

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***Abstract*—This study is aimed to evaluate the growth and survival rate of red tilapia (Oreochromis sp.) cultivated in a biofloc system brackish water tanks with the addition of different carbon sources. The experimental treatment was addition of different carbon sources to the media, namely molasses (B), tapioca flour (C), white sugar (D) and without carbon sources or controls (A). Test tilapia used were sized 3.71 ± 0.11 cm with a density of 300 fish / m$^3$ maintained for 40 days. Fish kept in tanks with a volume of 200 liters filled with sea water as much as 100 l with a salinity of 17 ppt, added with 10 ml / m$^3$ probiotics and carbon solution with a C / N ratio of 20: 1. The fish were fed with commercial feed (38% protein content), 3 times per day as much as 5% / body weight / day. The addition of probiotics and carbon is done every 8 days. The results of the analysis of variance (ANOVA) showed that the addition of carbon sources had a significant effect on growth, survival rate and feed efficiency. The results showed that the best growth, feed consumption and survival of red tilapia were obtained in treatment B (molasses).**

**Keywords—** ***Biofloc, Oreochromis sp, carbon source, growth***

## I. Introduction

Red tilapia (*Oreochromis* sp) is a potential fish species to develop in freshwater and sea water since the fish has wide range of tolerance to salinity [1] [2]. The consumption rate of red tilapia is increasingly and the fish become one of the export commodities [3]. Biofloc technology has been used in intensive cultivation of tilapia since the nature of tilapia that is able to live with high density, has a wide tolerance for environmental conditions and being an omnivorous fish with diverse feed types.

Increased production of tilapia to meet consumer needs is limited by several factors, including decreased water quality due to feed waste in the cultivation tank system. Inedible part of the feed, feces and fish metabolic waste products will accumulate in aquaculture containers, this waste will decompose resulting in water quality parameters decrease [4] [5]. Therefore the quality of water in fish farming needs to be managed properly for optimal living needs [6].

Biofloc technology is one alternative to overcome water quality problems in aquaculture [7] [8]. Biofloc technology is one of the most profitable alternative solutions to aquaculture wastes because in addition to reducing inorganic nitrogen waste, biofloc technology can also provide protein-supplemented feed for the fish [7] [8]. The application of biofloc technology can improve feed efficiency so that the feed used is more efficient compared to fish farming without biofloc technology. Biofloc technology can be practiced by adding organic carbon sources into the culture medium to stimulate the growth of heterotrophic bacteria and increase the of C / N ratio [9].

A researcher [10] Purnomo stated that there are several sources of carbohydrates that can be used as carbon (C) sources for biofloc formation such as tapioca flour, cassava flour, granulated sugar, molasses. The use of simple carbon sources in biofloc technology has the advantage of being easily absorbed and utilized by bacteria to accelerate its growth [11].

Several types of carbon sources can be used to accelerate the decrease in inorganic nitrogen concentration in water. For example molasses, containing about 37% carbon [12], tapioca flour with carbon content of 50.31% [13], and sugar is a carbohydrate having a C content of 42.39% [10]. From several studies conducted using several carbon sources in the form of molasses, sugar, acetate, glycerol, glucose, wheat flour, tapioca and starch, the results show that the use of different carbon sources affects the composition of floc, nitrogen assimilation levels and nutrient content in floc [7]. This study is aimed to evaluate the growth and survival of red tilapia by providing different types of carbon sources that are maintained in biofloc system brackish water tank.

## II. METHODOLOGY

This research was conducted from January to March. Using the experimental method with a complete random design. The experiment treatment is different carbon sources to the cultivating media, namely molasses (B), tapioca flour (C), white sugar (D) and without carbon sources or controls (A).

The containers used during the study were first cleaned using fresh water and dried. The container used is a tub with a volume of 200 liters and equipped with aeration. The tanks (12 tanks) then filled with 100 l of brackish water. Sea water (30 ppt salinity ) used in this study was collected from Sungai Apit District, Siak, Riau. The preliminary trial obtained that the best salinity was 17 ppt to grow red tilapia. Therefore in this study this salinity was setted to all experimental units.

Biofloc was cultured in tanks with a 200 liter volume of 12 tanks. Each tank was filled with 100 liters of sea water with 17 ppt salinity, biofloc culture was carried out by mixing probiotics (*Bacillus* sp.) of 10 ml / $m^3$ (Putra et al, 2017). Different carbon sources was poured togethe with probiotic solution into the media with a C/N ratio of 20: 1. The amount of carbon added is calculated based on the carbon content (C) in the ingredients and the nitrogen content in the feed given [16] [14].

$$\frac{C}{N} = \frac{\%\ C\ \text{molasse x molasse weight} + \%\ C\ \text{feed x feed weigh}}{\%\ N\ \text{feed X feed weight}}$$

To obtain a C/N ratio of 20: 1, a carbon source derived from molasses is 48 g with a C content of 37% [15], tapioca flour as much as 35 g with a C content of 50.3% [13], and white sugar 42 g with a C content of 42.3% [10]. Nitrogen (N) source is provided as much as 5 g from commercial feed with 38 % protein content. All of them were then mixed into all cultivation tanks that has been filled with water and left for 8 days and continuously aerated so that floc was formed. Floc formation is characterized by changes and foam formation. The fish are then released into the tanks with a density of 300 individuals per $m^3$ for 40 days. The animals were fed with commercial pellets (38% protein content, 5% fat, and crude fiber 6%, mineral mix 13% in ingredients). Ad feeding is carried out twice a day, and the growth of the fish were measured every 8 days.

The main parameters measured are absolute weight (g), specific growth rate (Metaxa et al., 2006), survival, feed efficiency, and feed conversion (Muchlisin et al., 2016). Water quality parameters consist of temperature, oxygen, and pH were all measured by Water Cheker (YSI-550 A, ASTM, Alla, France), and total ammonia nitrogen (TAN) with the Spectrophotometric method measured every 8 days.

All data were tabulated and analyzed using the SPSS 18.0 application which includes Analysis of Variance (ANOVA) with a 95% confidence interval. If the statistical test shows a real difference between treatments, the Newman-Keuls Study is continued, while the water quality data is analyzed descriptively. and presented in tabular form.

## III. RESULT AND DISCUSSION

### A. A. Growth of red tilapia.

The biofloc system is able to optimize the growth of fish that are kept at high stocking densities. High stocking density and accompanied by maximum carrying capacity will result in maximum fish weight growth. Feed availability is a factor that affects fish growth, where fish will grow well if these factors can be met. Conversely growth will be slow if one or both of them are lacking. Biofloc systems that also function as fish feed are always available in the rearing tanks, so as to maximize fish growth and reduce fish dependence on artificial feed. Red tilapia growth and survival rate data is presented in Table 1.

Table 1. Growth and survival rate of red tilapia (*Oreochromis* sp)

| Parameter | Experimental Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Absolute weight growth (g) | 2.72 ± 0.144[a] | 8.22 ± 0.329[d] | 5.18 ± 0.111[b] | 5.88 ± 0.575[c] |
| Daily growth rate (%) | 3.49 ± 0.111[a] | 7.86 ± 0.158[d] | 4.80 ± 0.053[b] | 5.20 ± 0.306[c] |
| SR (%) | 61.11 ± 5.09[a] | 92.22 ± 1.93[c] | 82.22 ±1.92[b] | 84.44 ± 5.09[b] |

The results showed that the culturing of red tilapia with different carbon additions had a significant effect on absolute weight, daily growth rate and survival (P <0.05). Treatments A, B, C and D are significantly caused a different growth rate of the animals. This is allegedly due to the consumption of feed in the same amount but with the presence of biofloc as additional feed was able to meet the needs of tilapia so that it caused a positive influence on growth.

The growth in absolute weight and the highest daily growth rate occurred in treatment B (molasses). This is because the addition of a carbon molasses source is more effectively utilized by heterotrophic bacteria changing inorganic N for bacterial development. The development of bacteria will form flocks which will ultimately be used by fish for growth in body weight. The growth of red tilapia seeds in each treatment looks different. Biofloc technology in aquaculture is to integrate biofloc formation techniques as a source of food for fish [16] [9]. Culturing of fish with the addition of carbon molasses and bacterial inoculants every 8 days can significantly increase growth.

Molasses is a simple sugar (Azhar, 2013) so it is easily absorbed by bacteria for its development. Adding a carbon source to the culture medium will spur the development of bacteria and provide additional feed for fish, where bacteria utilize nitrogenous wastes from the leftovers and excretion of cultured fish for their development, then floc will form as additional feed for domestic fish.

According to an expert [7] the addition of molasses as a carbon source in aquaculture can increase the C/N ratio of water which will further reduce inorganic nitrogen waters by increasing the growth of heterotrophic bacteria. The heterotrophic bacteria will form floc that can be used as high protein fish feed so as to increase growth. Microbial biomass that forms floc together with other microorganisms is useful as a food source for aquaculture fish [16]. A C: N ratio of> 10: 1 in fish culture systems is the optimum ratio in optimizing biofloc production and minimizing ammonia regeneration.

In this study the survival of red tilapia indicate that the biofloc system would be optimum if the water quality management was carried out properly. Aquaculture waste derived from leftover food or fish metabolism in biofloc techniques is utilized by biofloc microbes so that it can improve water quality and increase the amount of natural feed. According to [17], water quality is better because in the biofloc system the bacteria grow well and the density of the bacteria Bacillus sp. used does not experience a decrease, so it is more effective to decompose organic materials so that the water quality is maintained well for fish life. Provision of molasses will be used by bacteria for its development. The use of bacteria can improve water quality, because it can decompose organic matter, suppress the growth of pathogens and balance the microbial community so that it can provide a better environment for fish [18] [19].

*B.* B. Feed Comsumption

Feed is the main factor that supports the growth of red tilapia. Adequacy of feed in both quantities and nutrients is required by tilapia. Based on feed consumption and fish requirements, feed is divided into two parts, namely main feed and supplementary feed. In this study the fishes were fed wirh a fish pellet with 38% protein content. The average feed consumption for each treatment is presented in Table 2 below.

Table 2. Total feed consumption, feed efficiency and conversion ratio of each feed.

| Exp. Treatment | Efficiency (%) | Feed Conv. Ratio |
|---|---|---|
| A | $69.15 \pm 2.67^{a}$ | $1.45 \pm 0.05^{d}$ |
| B | $119.39 \pm 17.35^{c}$ | $0.85 \pm 0.13^{a}$ |
| C | $95.82 \pm 5.08^{b}$ | $1.05 \pm 0.05^{b}$ |
| D | $92.48 \pm 6.25^{b}$ | $1.08 \pm 0.07^{b}$ |

Statistical test results showed that the cultivation of red tilapia with different carbon sources had a significant effect on feed efficiency and feed conversion ($P < 0.05$). Treatment B was significantly different from treatments A, C and D. From the analysis of feed consumption it was found that the range of feed efficiency was 69.15% - 119.39% and the value of feed conversion ranged from 0.85 to 1.45. The treatment with the addition of a carbon source of molasses, tapioca and sugar was higher than without the addition of a carbon source (treatment A). two authors [20] stated that the culturing of fish with biofloc technology provides better efficiency or feed conversion compared to the culturing of fish without biofloc application. Others [16] stated that the growing of fish with biofloc technology the average consumption of artificial feed was lower than without biofloc but growth was higher. Adding a different carbon source to each media for growing red tilapia produces different amounts and nutrients of floc and ultimately results in different fish growth.

The conversion value of feed in treatment B is better than other treatments. This shows that the feed given can be used optimally and less than consumed by fish in other treatments, but still with higher growth results. Biofloc that grows in culturing media are used by fish as food. Biofloc in addition acts as an improvement in water quality also provides natural food so that the fish that are kept grow healthy and have high survival [21] [22].

The use of biofloc in aquaculture systems can provide benefits namely additional food sources for aquaculture [23] [24]. The formation of biofloc is produced from leftover food, metabolism and feces from aquaculture activities. Remaining feed and feces that are wasted in the water will produce inorganic nitrogen. Inorganic nitrogen can be converted into a single cell protein with the addition of carbon material in the waters and can be used as a source of fish or shrimp feed [16]. Utilization of biofloc technology has been widely studied and applied to shrimp, catfish and tilapia aquaculture. Growth and survival results as well as feed conversion ratio values are better than the culturing techniques commonly used [25] [17] [26] [27].

*C.* C. Water quality

Water quality measured in this study were temperature, dissolved oxygen (DO), acidity (pH), and ammonia (NH3). The data is presented in Table 2 below.

Table 3. Water Quality

| Parameter | Experimental Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Salinity (ppt) | 17-17.6 | 17-17.3 | 17-17.4 | 17-17.5 |
| Temp ($^{o}$C) | 26-30 | 26-30 | 26-30 | 26-30 |
| DO (mg/l) | 5.30 -6.20 | 5.20 -6.15 | 5.21-6.25 | 5.00-5.87 |
| $CO_2$ (mg/l) | 4.77 -7.90 | 6.30 -8.23 | 6.87-7.97 | 5.77-7.03 |
| pH | 7.5-7.8 | 7.5-7.8 | 7.5-7.8 | 7.5-7.8 |
| $NH_3$-N (mg/l) | 0.022-0.130 | 0.004-0.042 | 0.018-0.034 | 0.011-0.015 |
| $NO_2$-N (mg/l) | 0.070- 0.720 | 0.070-0.170 | 0.070-0.340 | 0.070 - 0.390 |
| $NO_3$+-N (mg/l) | 0.160-7.570 | 0.160-1.310 | 0.160-3.740 | 0.160 - 2.910 |

From this data it can be noted that the range of water quality in the research container meets the tolerance standards of red tilapia which was a good condition in rearing red tilapia.

## IV. CONCLUSION

The addition of different carbon sources in the cultivation media of red tilapia (Oreochromis sp) with biofloc technology significantly affected the growth of absolute weight, daily growth rate and survival rate. The best growth and consumption of feed is in the treatment with molasses.

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