Effects of Various Carbon Doses on Tilapia (*Orechromis* sp) Culture with Biofloc Technology

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Abstract. The purpose of this study was to evaluate the growth and survival of red tilapia (*Oreochromis* sp) which were cultured using biofloc technology with different amounts of molasses as a source of carbon. This study was carried out for 35 days in August-September 2017 at the Laboratory of Aquaculture Technology, Faculty of Fisheries and Marine Science, Universitas Riau, Pekanbaru, Indonesia. The experiment was done using a completely randomized design (CRD) with the following treatments: A: 50 ml/m³ molasses, B: 100 ml/m³ molasses, C: 150 ml/m³ molasses, and D: 200 ml/m³ molasses. The test fish used was red tilapia with a size of 3.57±0.06 cm and a weight of 1.14±0.09 g. Fish were kept in containers with a volume of 100 liters that are filled with brackish water with a salinity of 17 ppt. Feed was given at 3 times per day. Results showed significant effect of each treatment on the absolute weight and specific growth, but did not significantly affect the survival rate of red tilapia. Best growth and utilization of feed in red tilapia culture using biofloc technology was supplementing with add molasses at a dose of 200 ml / m³ (D).

Keywords: Molasses, biofloc, *Oreochromis* sp

1. Introduction

Biofloc technology has been applied intensively to fish culture. This technology is an alternative to overcome water quality problems in aquaculture [1, 2]. Biofloc technology can be done by adding organic carbon sources into the culture medium to stimulate the growth of heterotrophic bacteria and increase the C/N ratio [3].

[4] stated that there were some carbohydrate sources that could be used as a carbon source (C) for biofloc formation such as tapioca flour, cassava flour, granulated sugar, and molasses. The use of simple carbon sources in biofloc technology has an advantage of being easily absorbed and utilized by bacteria to accelerate its growth [5].

Molasses is a carbon source that can be used to accelerate the growth of bacteria and reduce the concentration of inorganic nitrogen in water. Molasses is a sugar factory waste that cannot be crystallized. Molasses contains about 37% carbon. Molasses are liquid and brown like soy sauce with a distinctive aroma [6]. From several studies conducted using several carbon sources in the form of molasses, sugar, acetate, glycerol, glucose, wheat flour, tapioca and...
starch, the results showed that the use of different carbon sources affected the composition of floc, nitrogen assimilation levels and nutrient content in floc [7].

Tilapia (*Oreochromis niloticus*) is a type of fish that is preferred because of its tasty and delicious meat, thus it has a potential to be developed since its cultivation is not difficult with a wide range ability (tolerance) to salinity [8,9], tilapia is an export commodity. Biofloc technology is the appropriate technology for intensive culture of tilapia because of the nature of the fish that can survive in high stocking densities, wide tolerance to extreme environmental conditions and an omnivorous fish with diverse types of feed.

Based on the description, research is needed to determine the effects of adding different amounts of molasses in the biofloc system on the growth and survival of red tilapia in brackishwater.

2. Materials and Methods

Time and Site of the Experiment

This research was done for 35 days on August-September 2018 in Aquaculture Technology Laboratory, Faculty of Fisheries and Marine Science, University of Riau.

Experimental Procedure

The experimental design was a completely randomized design using 4 treatment levels with 3 replications. The treatments applied in this study were A: 50 ml/m3 molasses, B: 100 ml/m3 molasses, C: 150 ml/m3 molasses, and D: 200 ml/m3 molasses.

The containers used during the study were cleaned using fresh water and dried. The container had a volume of 100 liters and equipped with aeration. Seawater used in this study was obtained from the Bengkalis Strait Waters of Bengkalis Regency with a salinity of 17 ppt [10]. Red tilapia used in experiments measuring 3.57 ± 0.06 cm and stocking density of 250 ind / m3 or 20 fish per container. Tilapia is obtained from the Fish Hatchery Center in Bengkalis district.

Biofloc was produced in the containers at a volume of 100 liters. Each container was filled with water at 80% capacity and biofloc culture was carried out by mixing probiotics (Bacillus sp) at a dose of 10 ml/m3 [11], and added with various doses of molasses: 50 ml/m3, 100 ml/m3, 150 ml/m3 and 200 ml/m3 into a mixing container (1 L). Biofloc was allowed to produce for 1 week and continuously aerated. The growth of the floc can be seen from the change of water into turbid brown and the formation of foam. After 1 week, red tilapia juveniles were stocked in the containers and cultured for 35 days. Commercial feed pellets (38% crude protein content) were given 3 times a day. Administration of probiotics and molasses was done every 7 days. Measurement of fish growth was done every 7 days during the culture period.

Data Collection

The main parameters measured were specific growth weight, absolute, absolute length, survival rate, feed efficiency, and feed conversion. While supporting parameters is water quality in the form of temperature, oxygen, pH, and Total Ammonia Nitrogen (TAN) as well as water spinach growth in the form of absolute weight and length.
1. Absolute Weight (BM) [12]

\[ BM = \bar{W}_t \times N_t \]

\( \bar{W}_t \) = average weight at the end of the research (g); \( N_t \) = Fish population at the end of cultivation (ind.)

2. Daily Growth Rate

Specific growth rate (%) was determined based on the difference of final average weight (Wt) and initial average weights (Wo), then compared to cultured time using the formula of [13].

\[ \alpha = \frac{\ln W_t - \ln W_0}{t} \times 100\% \]

\( \alpha \) = specific growth rate (%); \( W_t \) = total body weight at the initial experiment (g); \( W_0 \) = body weight during experiment (g); \( t \) = cultivation time (day)

3. Survival rate (SR)

Survival rate (SR) is the ratio of total fish alive at the end of cultivation with total fish at the beginning of cultivation. Survival rate was calculated using the formula of [11]:

\[ SR = \frac{N_t}{N_0} \times 100\% \]

\( N_t \) = Fish population at the end of cultivation (ind); \( N_0 \) = Fish population at the initial cultivation (ind.)

3. Data Analysis

The data obtained were tabulated and analyzed using SPSS 18.0. Analysis of Variance (ANOVA) at 95% confidence interval was used to determine significant differences in the fish growth rate and survival in relation to the different doses of molasses that were added to the rearing containers. If the statistical test results show significant differences among treatments, then Newman Keuls test was further used.

4. Results and Discussion

Biofloc system is able to optimize fish growth that are cultivated at high stocking density, high stocking density that is accompanied by maximum carrying capacity results growth of fish weight in biofloc system. Food availability is the crucial factor in fish growth, such that fish will grow well if these factors can be fulfilled and vice versa. Biofloc systems that also function as fish feed are always available in the cultivation containers therefore it could maximize fish growth and reduce fish dependence on artificial feed.

| No | Parameter                      | Treatment | A          | B          | C          | D          |
|----|--------------------------------|-----------|------------|------------|------------|------------|
| 1  | Absolute weight growth (g)     |           | 3.52±0.06a | 4.28±0.21b | 4.32±0.08b | 5.71±0.13c |
| 2  | Daily growth rate (%)          |           | 5.11±0.21a | 5.49±0.31a | 5.54±0.25a | 6.52±0.22b |
| 3  | SR (%)                         |           | 81.67±2.35a | 78.33±2.35a | 80.00±0.00a | 81.67±2.35a |
Results of the growth analysis showed that the highest absolute weight and daily growth rate occurred in treatment D. This showed that 200 ml/m³ molasses addition is more effectively utilized by heterotrophic bacteria to convert inorganic nitrogen for bacterial growth. The growth of bacteria will form floc that is used by red tilapia for its body weight growth. The growth of red tilapia in each treatment showed the difference. One that affects growth is feed. Biofloc technology in aquaculture is to integrate biofloc formation techniques as a source of food for fish [3].

Fish that are cultured with the addition of e of molasses as a carbon source at 200 g/m³ and bacterial inoculants every 5 days can significantly increase growth [11]. Adding a carbon source to the culture media will spur the development of bacteria and provide additional feed for fish, in which bacteria utilize nitrogenous wastes from the leftovers and excretion of cultivated fish for their development, subsequently the floc formed will be additional feed for fish.

According to [1], addition of molasses as a carbon source in aquaculture can increase the C/N ratio of waters which will further reduce inorganic nitrogen of waters by increasing the growth of heterotrophic bacteria, heterotrophic bacteria will form floc that can be used as high protein fish feed to increase growth. Microbial biomass that forms floc together with other microorganisms is useful as a food source for cultivated fish [14]. A C:N ratio of >10:1 in fish culture systems is the optimum ratio in optimizing biofloc production and minimizing ammonia regeneration.

The result of statistical tests showed that the red tilapia cultivation using carbon sources administration had a significant influence on the daily growth rate (P <0.05). This is assumed that the consumption of feed is still in the same amount and biofloc biomass as additional feed is able to meet the needs of cultivated tilapia and water quality is still in the optimal condition thus it does not affect growth despite the high fish density levels.

Survival of red tilapia in this study ranged from 80%-81.67%, and this shows that the level of fish survival is good because the biofloc system and water quality management are carried out appropriately. Aquaculture waste originating from leftover or fish metabolism is utilized by bacteria to improve water quality and increase the amount of natural feed. According to [15], water quality is better with the application of biofloc technology in which bacteria grow well and effectively to decompose organic materials so that water quality is maintained well for fish life. Molasses administration will be used by bacteria for their development. [16], the use of Bacillus sp. Bacteria can improve water quality because it can decompose organic materials, suppress pathogen growth and balance the microbial community therefore it can provide a better environment for fish. Water quality measured in this study is temperature, dissolved oxygen (DO), acidity (pH), and ammonia (NH₃) that can be seen in Table 2.
Table 2. Water quality

| Parameter | Unit | Treatment |
|-----------|------|-----------|
|           |      | A         | B         | C         | D         |
| Temperature | °C  | 26.30-30.0 | 26.00-29.3 | 26.0-29.3 | 26.0-29.3 |
| DO         | mg/L | 4.13-5.31  | 4.41-5.38  | 4.23-5.24 | 4.25-5.21 |
| pH         | -    | 7.00-7.60  | 7.00-7.60  | 7.00-7.60 | 7.00-7.60 |
| (NH₃)      | mg/L | 0.075-0.362 | 0.073-0.362 | 0.071-0.362 | 0.073-0.362 |
| Salinity   | ppt  | 16.3-18.3  | 16.30-18.3 | 16.3-18.3 | 16.3-18.3 |

The range of water quality in the treatment meets the tolerance standards of red tilapia which is a good condition in culture red tilapia.

5. Conclusion

The addition with different amounts of carbon sources in the biofloc system significantly affected the absolute weight and daily growth rate but not on the survival of red tilapia. The best treatment was found to be treatment D (200 ml/m³)

References

[1] Avnimcleeh, Y., 2007, Feeding with microbial flocs by tilapia in minimal discharge bio-flocs technology ponds. Aquaculture, 264,140-147.
[2] De Schryver, P. and Verstraete, W. 2009. Nitrogen removal from aquaculture pond water by heterotrophic nitrogen assimilation in lab-scale sequencing batch reaktors. Bioresource Technology, 100, 1162-1167.
[3] Crab, R., Avnimelech, Y., Defoirdt, T., Bossier, P., Verstraete, W., 2007. Nitrogen removal in aquaculture towards sustainable production. Aquaculture 270,1-14.
[4] Purnomo, P.D. 2012. Effect of Addition of Carbohydrates on Maintenance Media on Intensive Tilapia Production (Oreochromis niloticus). Jurnal of Aquaculture Management and Technology. 1(1):161-179.
[5] Chamberlain G, Yoram A, Robins PM, Mario V. 2001. Advantages of aeratedmicrobial reuse system with balanced C:N. Global Aquaculture Alliance: 54
[6] Suastuti M. 1998. Utilization of By-Products of the Agriculture Industry Molasses and Tofu Liquid Waste as a Source of Carbon and Nitrogen for Biosurfactant Production by Commercial and Local Bacillus sp. Thesis. Postgraduate Program in Agriculture Bogor.
[7] Avnimcleeh,Y., 2012. Biofloc Technology A Practical Guide Book, 2 edition. United States: The World Aquaculture Society
[8] Peterson M.S., Slack W.T., Woodley C.M., (2005) The occurrence of nonindigenous Nile Tilapia, Oreochromis niloticus (Linnaeus) in coastal Mississippi: ties to aquaculture and thermal effluent. Wetlands 25: 112-121
[9] Maryam S. 2010. Super Intensive Culture of Red Tilapia (*Oreochromis* sp.) With Biofloc Technology: Water Quality Profile, Survival and Growth. Faculty of Fisheries and Marine Sciences, Institute of Agriculture Bogor. 66 hal.

[10] Dahril, I., Tang U M., Putra. I. 2017. The Effect Of Different Salinity Against Growth And Survival rate of Red Tilapia (*Oreochromis* Sp.). Journal Berkala Perikanan Terubuk. Vol. 43 No.3.

[11] Putra, I., Rusliadi,. Muhammad, F., Usman M.T, and, Muchlisin Z.A. 2017. Growth Performance And Feed Utilization Of Afican Cattfish *Clarias gariepinus* Fed A Commercial Diet And Reared In The Biofloc System Enhanced With Probiotic. *F1000Research*. Vol 6:1545

[12] Zonneveld, N., Huisman, E. A., J. H. Boon. 1991. Principles of fish culture. Translation . PT Gramedia Pustaka Utama, Jakarta.

[13] Metaxa E, Deviller G, Pagand P, Alliaume C, Casellas C, Blanceton JP. 2006. High rate algae pond treatment for water reuse in a marine fish recirculation sistem; Water Purification and Fish Health. Aquaculture, 252:92-101.

[14] Hastuti, S dan Subandiyono. 2014. Performa Produksi Ikan Lele Dumbo (Clarias gariepinus, Burch) yang diPelihara dengan Teknologi Biofloc. Jurnal Saintek Perikanan. Vol. 10 No 1; 37-42.

[15] Suryaningrum, F.A., 2014. Application Maintenance Technology Seed Biofloc on Tilapia (*Oreochromis niloticus*). Fisheries and Marine Resources Management Journal Vol. 1 number1.

[16] Irianto, A. 2008. Biofloc Technology in Aquaculture: Proceedings of the 2008 Indonesian Aquaculture Seminar. Indonesian Aquaculture Community. Universitas Diponegoro Semarang, hlm. 152-159.