Original Research Article

Effect of Substitution Feed of Fish Meal and Meat Bone Meal (MBM) on Growth Performance and Survival Rate of Juvenile Tilapia (Oreochromis niloticus) Feeds

ABSTRACT

The research aims to create a feed formulation based on the use of meat bone meal (MBM) to improve the production performance of juvenile tilapia. The experiment method used was an experimental method using a Completely Randomized Design (CRD), consisting of 5 treatments and 3 replication, treatment A (control/commercial feed), B (fish meal 75%:25% MBM), C (fish meal 50%:50% MBM), D (fish meal 25%:75% MBM), and E (fish meal 0% : 100% MBM). The juvenile tilapia used were 5-8 cm and weighed 5,85 ± 0,029 g. The results showed that the effect of substitution of fish meal and MBM for each treatment was significantly different (P<0,05) on parameters of the performance production of juvenile tilapia. Treatment D gave the best result on production performance, namely SGR (1,45 ± 0,139%g/day) and SR (97 ± 0,82%).

Keywords: Feed, Meat Bone Meal, Tilapia, Production Performance

1. INTRODUCTION

Tilapia (*Oreochromis niloticus*) is one of the fish that popular with the public because of its thick flesh and delicious taste. Apart from that, tilapia is easy to cultivate, the price is relatively affordable and has a wide tolerance for the environment, making tilapia an economically important fish in the world [1]. Tilapia has a high protein content is 43,76% per 100 grams of fish weight [2]. Tilapia has great potential to be developed in Indonesia because its production continues to increase up to 4,02% from 2016-2020 [3].

Tilapia production is determined by several factors, one of which is feed. Feed must be in accordance with the nutritional needs of the fish being cultivated [4]. The problem that often arises in producing tilapia is the high price of feed caused by the use of imported ingredients [5]. So alternative materials are needed to reduce production costs, namely by substituting fish meal with meat and bone meal (MBM). MBM compared to fish meal has a relatively cheap price but the protein content is quite high, around 45-55% [4]. MBM can be obtained commercially and also made from waste. MBM contains essential amino acids such as lysine and methionine [6]. Apart from the protein

content, MBM also contains minerals, especially Ca and P [7].

MBM can be used as a raw material for fish feed which is expected to reduce the use of imported raw materials. The use of MBM in feed has been tested on livestock and fish such as red tilapia, silver catfish, pomfret, eel and freshwater lobster. The use of MBM in red tilapia feed can reach 35% [7]. A good ratio of animal and vegetable protein sources for tilapia is 40:60 [8]. So it is necessary to conduct research regarding the substitution of fish meal with meat and bone meal (MBM) using a ratio of animal protein sources and vegetable protein of 40:60 on the growth and survival of black tilapia fish.

2. MATERIAL AND METHODS

The research was carried out from 23 August to 23 November 2022, starting from making feed to carrying out research at the Aquaculture Laboratory Building 4, Faculty of Fisheries and Marine Sciences, Padjadjaran University. The equipment used in this research was an aquarium (25L), aeration equipment, heater, scoop net, pelletizer, blender, and digital scales. The materials used in this research were juvenile tilapia measuring 5-8 cm with an average weight of 5.85± 0.029 g, commercial feed with 33-35% protein, meat and bone meal, fish meal, fish oil, soybean meal, rice bran flour, tapioca flour, top mix, fish salt. The composition of feed raw materials in feed formulation refers to the source ratio omnivorous fish animal and vegetable protein, namely 40:60.

The research method used was an experimental method using a completely randomized design (CRD), consisting of 5 treatments and 3 replications, with a stocking density of 1 fish/2L [9]. The feeding rate of juvenile tilapia is two times a day, as much as 3% of the biomass. The ratio of substitution of fish meal with meat and bone meal in each treatment in feed formulation includes:

A: Commercial feed (control)
B: Feeding fish meal 75% substitute with 25% MBM
C: Feeding fish meal 50% substitute with 50% MBM
D: Feeding fish meal 25% substitute with 75% MBM
E: Feeding 100% MBM substitute

Table 1. Composition of experimental diets

Raw material	Treatment					
	A	B	C	D	E	
Fish meal	-	30	20	10	0	
Meat bone meal	-	10	20	30	40	
Rice bran flour	-	30	30	30	30	
Soybean meal	-	20	20	20	20	
Tapioca flour	-	6	6	6	6	
Fish oil	-	2	2	2	2	
Topmix	-	2	2	2	2	
Total	100	100	100	100	100	Standard
Total Protein (%)	33-35	35,45	35,37	35,27	35,20	30-40[10]
Total fiber (%)	Min 4	3,27	4,11	4,95	5,79	3-5 [11]
Total fat (%)	Max 5	10,48	9,96	9,75	9,53	6-10 [12]

2.1 Observation Parameters

2.1.1 Spesific Growth Rate (SGR)

Specific growth rate is the percentage of the difference between final weight and initial weight, divided by the length of maintenance time. The specific growth rate calculation formula is [13]:

$$SGR = \frac{(lnWt - lnW0)}{T} x\ 100$$

Information:
SGR = Specific Growth Rate
W0 = Initial Weight (g).
Wt = Final Weight (g)
T = Rearing Period (Days)

2.1.2 Survival Rate (SR)

Survival is the ratio of the number of fish that survive from the beginning to the end of the study. Survival can be calculated by the formula [14]:

$$Survival\ rate = \frac{Nt}{No} x\ 100\%$$

Information:
SR = Survival rates (%)
Nt = Final number of fish
No = Initial number of fish

3. RESULTS AND DISCUSSION

3.1 Specific Growth Rate

Based on the results of the research in Fig 1. Feeding with substitution of fish meal with MBM for 60 days of rearing shows that the feed given has a significant effect ($P < 0.05$) on the specific growth rate of juvenile tilapia, which ranges from 0.97-1. 45%g/day

Specific growth rate is the percentage increase in weight of juvenile tilapia each day. The results of the specific growth rate of juvenile tilapia show that fishmeal substitute feed with MBM has good specific growth rate values. The higher the SGR, the better the fish growth. Based on the graph of the specific growth rate of juvenile tilapia, it shows that feed with fish meal substitution and MBM had a better growth rate compared to control feed (commercial feed) and feed not substituted with fish meal (100% MBM). It is suspected that because the nutritional and energy needs of fish in treatment B, treatment C and treatment D are met, the fish can carry out metabolism so that growth occurs.

This growth occurred due to the utilization of feed consumed by the test fish. The nutrients in the feed are used by the fish to become nutrients in the body and convert these nutrients into energy. This energy is allocated as the main energy, namely to maintain the body and the remaining energy is used for growth. The digestibility value of commercial feed and MBM-based feed was not significantly different. The feed digestibility value shows that MBM-based feed is able to be digested by fish so that it can be further utilized for activity and growth [15].

The protein contained in MBM in the study was 59.17%. MBM also contains various amino acids, one of which is lysine and methionine [16]. Fish more efficiently use protein as energy. Protein digestibility values between commercial feed and MBM-based feed are not significantly different [11]. The digested protein is stored in the body and some is directly used as a source of energy and growth.

The lowest SGR value was in treatment E (100% MBM), namely 0.97%g/day, this was due to a decrease in the value of feed consumption. The decrease in feed consumption is thought to be due to the decrease in feed palatability which is caused by the decrease in feed attractants. The reduction in feed attractant was due to the fact that this treatment did not use fish meal. Fishmeal is considered an attractant in fish feed because the free amino acids contained in this ingredient effectively stimulate work olfactory and gustatory fish [17]. The calcium content in MBM is large, namely

10.3%, so excessive use of MBM will not be beneficial because excess calcium will reduce the fish's appetite [18].

3.2 Survival Rate

Survival rate or *survival rate* (SR) fish is the ratio of the number of live fish at the end of rearing to the number of fish at the beginning of rearing [11]. Fig 2 shows the percentage survival rate of juvenile tilapia during 60 days of rearing. Based on the research results in Fig 2 the percentage of fish survival between treatments is not significantly different or the use of MBM substituted with fish meal does not have a negative impact on the survival rate of juvenile tilapia.

Based on the graph, the survival rate for juvenile tilapia in treatments A, B, C, and D has the highest percentage value, while the lowest percentage survival value is in treatment E (MBM 100%). The death of juvenile tilapia during the rearing period was thought to be due to the aeration system being shut down due to a power outage resulting in low levels of dissolved oxygen (DO) in the water. Unbalanced dissolved oxygen will result in stress in fish because the brain does not receive sufficient oxygen supply, as well as death due to lack of oxygen (*anoxia*) which is caused by body tissues not being able to bind oxygen dissolved in the blood [19].

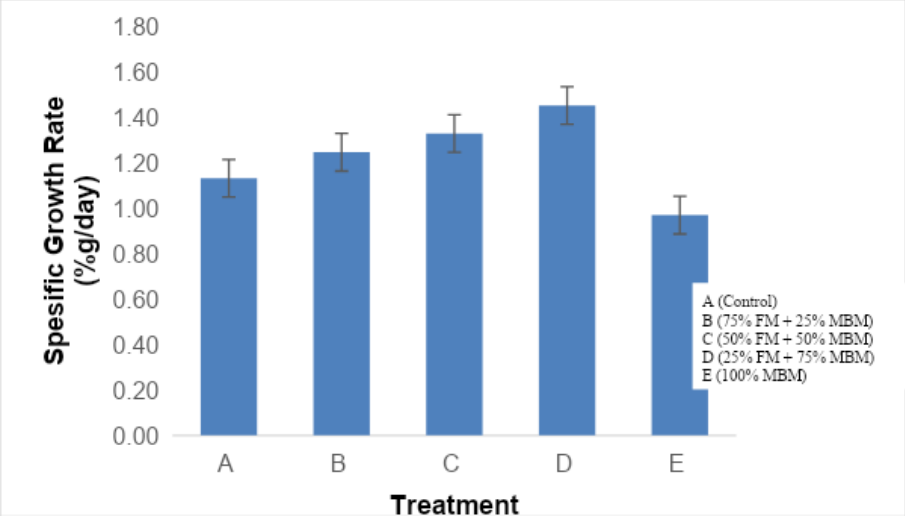

Fig. 1. Diagram of juvenile tilapia spesific growth rate

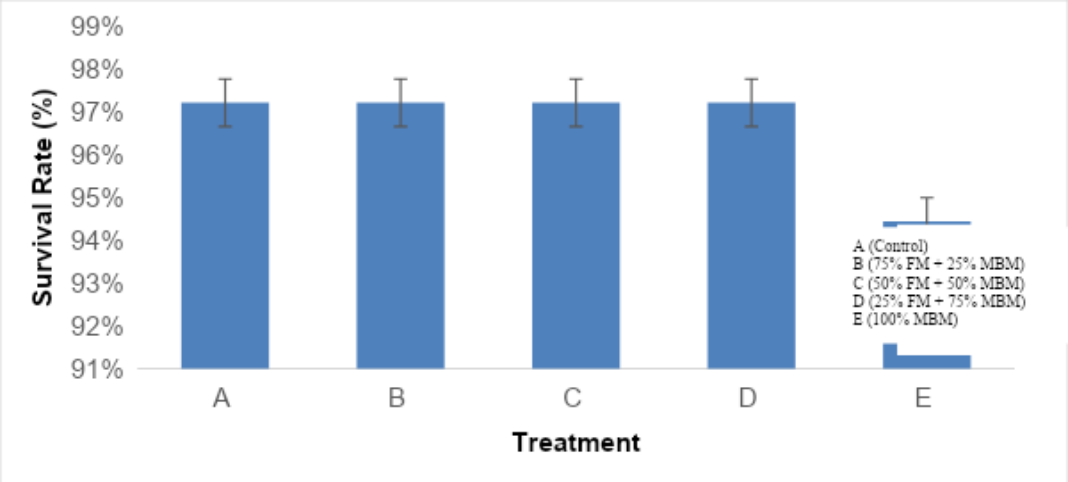

Fig. 2. Survival rate

The average good survival value is 63.5 - 86.0 [20]. Based on this statement, the survival value of tilapia during research in each treatment was still higher, namely 94-97%. The survival rate of tilapia fish which was not significantly different for each treatment and was in the high range could be caused by the positive reaction of the fish to the feed. This is indicated by eating the test feed. To maintain survival and growth, fish require nutritious food to fulfill fish nutrition [21].

4. Conclusion

The provision of meat bone meal (MBM) had a significantly different effect (P<0,05) on the performance of juvenile tilapia. Providing 75% MBM in the feed formulation provides the best production performance, namely SGR 1,45%g/day and survival rate 97%.

References

1. PDSPKP D. Tilapia Business and Investment Opportunities. Ministry of Maritime Affairs and Fisheries. 2019. Indonesia.
2. Leksono T, & Syahrul. Study of Quality and Consumer Acceptance of Fish Floss. Natur Indonesia. 2001;2(III);178-184. Indonesia
3. Ministry of Maritime Affairs and Fisheries. One Data from the Ministry of Maritime Affairs and Fisheries on National Production of Aquaculture. 2018. Indonesia
4. Suwarsito, Apreli NN, & Mulia DS. The Effect of Giving a Combination of Cassava Leaf Meal (Manihot utilissima) and Trash Fish Meal on The Growth and Survival of Tilapia (Oreochromis niloticus). Saintek. 2017;14(2);105-112. Indonesia.
5. Sari IP, Yulisman Y, & Muslim M. Growth Rate and Feed Efficiency of Tilapia (Oreochromis niloticus) Reared in Tarpaulin Ponds that are Periodically Fasted. Indonesian Swamp Aquaculture. 2017;5(1);45-55. Indonesia.
6. Purwaningsih S. Potential and Utilization of Fish Meal Basic Raw Materials. Fishery. 2006.
7. Hendriks WH *et al*. Nutritional Quality and Variation of Meat and Bone Meal. Asian-Australasian Journal of Animal Science. 2002; 15(10); 1507-1516.
8. Abdiguna A, Santoso L, Wardiyanto, & Suparmono. Use of Meat and Bone Meal as an Alternative Source of Animal Protein in Red Tilapia (Oreochromis niloticus). Aquaculture Engineering and Technology. 2013; 2(1); 191-196.
9. Manik RRDS, & Arleston J. Fish Nutrition and Feed. Widina Bhakti Persada Bandung. 2021.
10. El-Sayed AFM. Alternative Dietary Protein Sources for Farmed. Aquaculture. 1999; 179, 149-168 p.
11. Lovell RT. Nutrition and Feeding of Fish. Van Nostrand Reinhold. 1989. New York.
12. BBAT Sukabumi. Tilapia Fish Nutritional Content. 2005. Page 77.

13. Yuliati P, Kadarini T, Rusmaedi, & Subandiyah S. Effect of stocking density on the growth and survival of rows of gift tilapia (Oreochromis niloticus) in ponds. Indonesian Ichthyology. 2003; 3(2); 63-66.
14. Zonneveld N, Huisman EA, & Boon JH. Principles of Fish Farming. Gramedia Pustaka Utama. 1991;318. Indonesia
15. Effendi, H. Water Quality Studies: For Management of Water Resources and Environment. Canisius. 2003. Indonesia.
16. Mamora, M. Feed Efficiency and Growth Performance of Pomfret Fish (Colossoma macropomum) with Feeding Based on Meat Bone Meal and Commercial Feed. Fisheries journal. 2009. Indonesia
17. National Research Council. Nutrient Requirements of Poultry. Edition revision. 1994. Washington DC
18. Masyamsir. Practical Guide to Making Artificial Fish Food. Department of National Education Vocational School Management System and Standards Development Project. 2001. Jakarta
19. Dahril I, Tang UM, & Putra. The Effect of Different Salinities on the Growth and Survival of Red Tilapia (Orechromis sp.) Seeds. Worst Fish Periodicals. 2017; 45(3); 67-75.
20. Agribusiness Agency, Department of Agriculture. Agribusiness Investment in Leading Food Crops and Horticulture. Canisius. 1999. Yogyakarta.
21. Devani V, & Basriarti S. Optimizing the Nutrient Content of Artificial Fish Feed Using Multi Objective (Goal) Programming Model. Science, Technology and Industry. 2015; 12(2); 255-261.