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

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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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 replications: 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 in length and weighed 5,85 ± 0,029 g. The results showed that the effects of substitution of fish meal and MBM for each treatment were significantly different

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(P<0,05) on the parameters of the production performance 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 a popular kind of fish due to its thick flesh and delicacy. Moreover, tilapia is easy to cultivate, the price is relatively affordable and has a wide tolerance for the environment, making tilapia an economically important fish [1]. Tilapia has a high protein content, which is 43,76% per 100 grams of fish weight [2]. Tilapia has a 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 the feed.

The 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]. Therefore, alternative materials are needed to reduce production costs, namely by substituting fish meal with meat and bone meal (MBM). MBM has a relatively cheap price compared to fish meal even though 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 up to 35% [7]. A good ratio of animal and

2. MATERIALS 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 equipments used in this research were 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 raw materials in feed formulation refers to the omnivorous fish ratio of animal and vegetable protein, namely 40:60 vegetable protein sources for tilapia is 40:60 [8]. So, it is necessary to conduct research regarding the relationship between the substitution of fish meal with meat and bone meal (MBM) using a ratio of animal protein sources and vegetable protein of 40:60 and the growth and survival of black tilapia fish.

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

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]:

$$SGR = ((ln\mathrm{W}t - ln\mathrm{W}0) / T) \times 100$$

Information:

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

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]

2.1.2 Survival Rate (SR)

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

$$Survival\ rate = (Nt / No) \times 100\%$$

Information:

SR = Survival rate (%)
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 increase in weight of juvenile tilapia in percentage 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. The graph of the specific growth rate of juvenile tilapia shows that feed with fish meal substitution and MBM had a better growth rate compared to control feed (commercial feed) and feed that is not substituted with fish meal (100% MBM). It is suspected that this is because the nutritional and energy needs of fish in treatment B, treatment C and treatment D are met, so 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 which are converted 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 can 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 of 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 attractant. 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 of the 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 (SR) of 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 of the survival rate of juvenile tilapia during 60 days of rearing. Based on the research results in Fig. 2, the percentages of fish survival between treatments are not significantly different and the use of MBM substituted fish meal does not have negative impacts 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].

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 the test feed having been eaten. To maintain survival and growth, fish require nutritious food to fulfill fish nutrition [21].

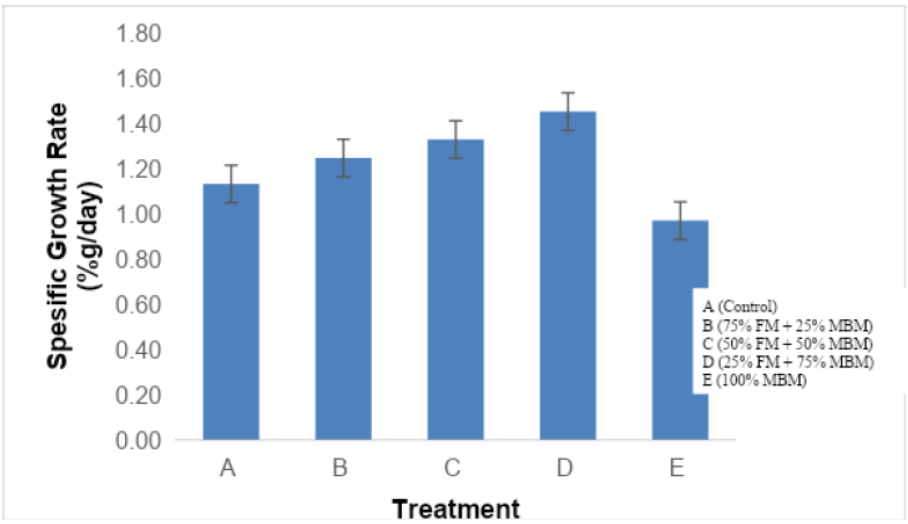

Fig. 1. Diagram of juvenile tilapia specific growth rate

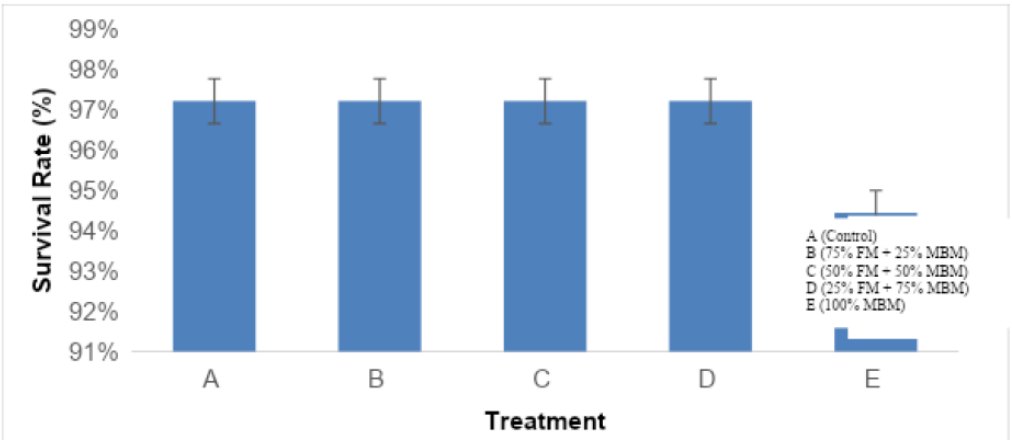

Fig. 2. Survival rate

4. CONCLUSION

The provision of meat bone meal (MBM) made a significant effect (P<0,05) on the production 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%.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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