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The Effect of Feeding Maggot Flour *Hermetia illucens* at Different Doses on Absolute Weight Growth of Dumbo Catfish *Clarias gariepinus* L Size 3 - 4 Cm

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Abstract

Based on statistical data from the Directorate General of Aquaculture, catfish production has shown an increase every year, with 990,000 tons in 2020, 1 million tons in 2021, 1.1 million tons in 2022, and 1.2 million tons in 2023. One of the alternative raw materials recommended by the Directorate General of Aquaculture to replace fish meal is maggot. This study aims to determine the effect of feeding maggot meal (Hermetia illucens) at different doses on the absolute weight growth of Dumbo catfish (Clarias gariepinus) measuring 3 – 4 cm. The benefits of this study are expected to serve as a source of knowledge and information, particularly for researchers and generally for the wider community, regarding the effects of feeding maggot meal (Hermetia illucens) at different doses on the absolute weight growth and absolute length growth of Dumbo catfish (Clarias gariepinus) measuring 3 – 4 cm. The research method was designed using a Completely Randomized Design (CRD) with four treatments, each consisting of six replications, resulting in 24 experimental units. The treatments were as follows P1: dose 100%, P2: dose 75%, P3: dose 50% and P4: dose 25%. The data from the research were analyzed using Analysis of Variance (ANOVA) and followed by the Least Significant Difference (LSD) test. The results showed that the best absolute weight growth of Dumbo catfish was observed in the P4 treatment dose 25%, with an average of 1.95 g. Water quality during the study was optimal, with temperatures ranging from 27.1°C to 29.4°C and pH levels ranging from 7.3 to 8.1.

Keywords: African Catfish, Maggot, Weight Growth.

INTRODUCTION

The demand for staple foods containing adequate nutrition, especially protein, continues to increase, driven by public awareness of the importance of healthy diets. Communities with higher awareness of protein needs are characterized by high levels of fish consumption. Fish plays an essential role in meeting nutritional needs; therefore, the fisheries sector must continue to be developed. To fulfill this demand, aquaculture is one of the government's efforts to explore aquatic biological resources and to increase the production of consumable fish, particularly freshwater fish. Freshwater aquaculture is divided into two types, namely food fish and non-food fish. One of the most widely cultivated freshwater food fish is catfish (Clarias sp.). Catfish farming continues to increase in line with the high market demand.

Catfish contributes approximately 10% of national aquaculture production, with an annual growth rate of 17–18% (Rahayu, 2013). Production and value projections based on data from the Ministry of Marine Affairs and Fisheries (2009) indicate that catfish demand in the Greater Jakarta area reaches 150 tons per day. According to statistical data from the Directorate General of Aquaculture (2023), catfish production has increased every year, reaching 990,000 tons in 2020, 1 million tons in 2021, 1.1 million tons in 2022, and 1.2 million tons in 2023.

Aquaculture is a highly promising sector for continuous development and has the potential to improve economic conditions (Oktavianna et al., 2019). One of the fish species widely cultivated in Indonesia is African catfish or dumbo catfish (Clarias gariepinus) (Primaningtyas et al., 2015). Dumbo catfish is a hybrid resulting from the crossbreeding of Clarias gariepinus from Africa and Clarias fuscus from Taiwan. The superior characteristics inherited from both parent species include rapid growth, higher egg production, high survival rates, and larger body size (Nurhidayat et al., 2017). Although dumbo catfish is not native to Indonesia, it is highly favored by the community due to its high nutritional value and relatively affordable price (Lestari & Dewantoro, 2018).

Dumbo catfish (Clarias gariepinus) is one of the important aquaculture commodities in Indonesia. Biologically, dumbo catfish has several advantages compared to other catfish species, such as the ability to spawn throughout the year, ease of cultivation, high egg fecundity, and rapid growth rates (Rohmana, 2009). The nutritional content of dumbo catfish meat is also relatively high, consisting of 18.2% protein, 12.7% fat, and 9.7% carbohydrates (Amri & Khairuman, 2008).

Artificial feed commonly used by catfish farmers is based on fish meal, which has a complex composition, sufficient nutritional content, good digestibility, and high palatability (Fauzi & Sari, 2018). Fish meal is a high-priced animal protein source, and its availability remains an issue because it largely depends on imports. Therefore, alternative ingredients are needed to reduce costs and ensure the supply of animal protein sources (Meitiyani et al., 2018). Alternative raw materials to replace fish meal recommended by the Directorate General of Aquaculture (2009) include maggot, Lumbricus worms, golden snails, single-cell protein, insect larvae, plant silage, fish waste silage, turi leaf meal, lamtoro leaf meal, and others. Laboratory tests conducted by the Fishery Product Technology Laboratory, FPIK–Undip (2011) showed that maggot proximate composition consists of 43.42% protein, 17.24% fat, 18.82% crude fiber, 8.70% ash, and 10.79% moisture content. According to Fahmi et al. (2007), maggot protein content ranges from 29.65% to 44.26%. Murtidjo (2001) stated that feed ingredients containing more than 19% crude protein are classified as protein sources. Black Soldier Fly (BSF) larvae or pre-pupae are the primary product used as alternative protein sources for animal feed; the second product is liquid resulting from larval activity, which functions as liquid fertilizer; and the third product is dry organic waste residue that can be used as compost (BB Veteriner, 2016).

Maggot was first introduced in 2005 by the IRD–France Bioconversion Team and the Freshwater Ornamental Fish Research Center (LRBIHAT), Depok. Maggot is an insect larva that lives in palm kernel cake (Fahmi et al., 2007). The use of insects such as Hermetia illucens maggot, in addition to functioning as organic waste decomposers, also has great potential as an alternative protein feed source due to its high protein content (Wardhana, 2016). Insect-based protein sources are more environmentally friendly and provide nutritional content suitable for livestock needs (Katayane et al., 2014). Another advantage is that insect protein does not compete with human food resources, making it highly suitable for animal feed such as poultry and fish (Veldkamp et al., 2012).

Based on the above background, the author is interested in conducting a study entitled “The Effect of Different Dosages of Maggot Meal (Hermetia illucens) Feed on the Absolute Weight Growth of Dumbo Catfish (Clarias gariepinus L) with a Size of 3–4 cm.”

RESEARCH METHODS

This study was conducted for 30 days, from December 16, 2024 to January 14, 2025, and took place at the researcher’s residence in East Jakarta, DKI Jakarta.

The equipment used in this study included plastic containers, a digital scale, labels, a mobile phone, stationery, a thermometer, and a pH meter. The materials used were dumbo catfish fingerlings measuring 3–4 cm, maggot meal, and Feng Li 0 meal.

The test fish used were dumbo catfish fingerlings measuring 3–4 cm, with an average weight of 0.5 g and an age of approximately two weeks. Before being placed into the containers, the fish were acclimatized for 15–20 minutes. A total of 240 fish were used in this study, with a stocking density of 2 fish/L. Prior to stocking, the weight of the dumbo catfish fingerlings was measured using a digital scale. Subsequently, 10 fish were placed into each container, and growth data were collected at the end of the experiment.

This study employed a Completely Randomized Design (CRD) with four (4) treatments, each consisting of six (6) replications, resulting in a total of 24 experimental units.

The experimental treatments were as follows:

P1 = 100% maggot meal
P2 = 75% maggot meal
P3 = 50% maggot meal
P4 = 25% maggot meal

The test feed in the form of maggot meal was obtained through online purchase. The BSF maggot meal was made from 100% Black Soldier Fly (BSF) maggots, hygienically processed and used as a substitute ingredient in fish feed formulation. The mixing of maggot meal and Feng Li 0 meal was carried out by first weighing the ingredients in a container and then mixing them until homogeneous. The composition of the test feed ingredients and their nutritional content as stated on the packaging are presented in Table 1 and Table 2.

Table 1. Composition of Test Feed Ingredients (%)

No.	**Ingredients**	**P1 (%)**	**P2 (%)**	**P3 (%)**	**P4 (%)**
1	Maggot Meal	100	75	50	25
2	Feng Li 0 Flour	0	25	50	75
Total		**100**	**100**	**100**	**100**

Table 2. Nutritional Content of Test Feed Ingredients on Packaging (%)

No.	**Ingredients**	**CP (%)**	**CL (%)**	**CF (%)**	**MC (%)**
1	Maggot Meal	28 – 42	15 – 25	4 – 7	0.6 – 1.6
2	Feng Li 0 Flour	40	5	2	13

Description: Crude Protein (CP), Crude Fat (LK), Crude Fiber (SK), and Ash Content (KA).

Absolute weight growth was calculated by weighing the harvested African catfish at the end of the culture period using a scale for each treatment. The absolute weight growth formula according to Marzuqi et al. (2012) is as follows:

$$W = Wt - W0$$

Where:
W = Absolute weight growth of reared fish (grams)
Wt = Average weight of fish at the end of the culture period (grams)
W0 = Average weight of fish at the beginning of the culture period (grams)

The water quality parameters measured were temperature and pH. Measurements were conducted in each container daily, in the morning and evening, throughout the study. Temperature measurements were performed using a water thermometer dipped into the experimental container for approximately 30 seconds. Water temperature measurements were taken at 7:00 AM and 5:00 PM WIB. The pH (acidity) was measured using a pH meter dipped in the water in the experimental container. The measurements were taken in the morning at 7:00 a.m. and in the afternoon at 5:00 p.m.

Based on the research data, with four treatments and six replications, there were a total of 24 experimental units. The data obtained from these 24 experimental units were entered in a data observation table according to each treatment. Analysis of Variance (ANOVA) was used to determine whether there were differences between the treatments.

The decision-making criteria for this test are as follows:

1. If the significance value (Sig.) is ≥ 0.05, there is no significant effect of the treatment.
2. If the significance value (Sig.) is < 0.05, there is a significant effect of the treatment.

If the analysis of variance indicates a significant or highly significant difference in the results of the treatments, the Least Significant Difference (LSD) test was performed to compare the values between the treatments. The application used to help analyze the data from this research is SPSS 26.0.

RESULTS AND DISCUSSION

Based on the results of a study on the effect of feeding maggot flour (Hermetia illucens) at different doses on the growth of 3-4 cm African catfish (Clarias gariepinus), different average growth data were obtained for each treatment. The weight of the African catfish was measured at the beginning and end of the culture period, resulting in the difference between the final and initial weights, which was used as the absolute weight growth data for the African catfish. The range of absolute weight growth values and the average growth of the African catfish are shown in Table 3.

Table 3. Average Growth Data for African Catfish (Clarias gariepinus)

Treatment	Range of Absolute Weight Growth (g)	Mean Absolute Weight Growth (g)	P
P1 (100%)	0.55 – 1.18	0.83 ± 0.23[a]	0.000
P2 (75%)	1.02 – 1.57	1.29 ± 0.22[b]	
P3 (50%)	1.18 – 1.78	1.61 ± 0.22[c]	
P4 (25%)	1.73 – 2.12	1.95 ± 0.17[d]	

Based on the results of research on the effect of feeding maggot (Hermetia illucens) flour at different doses on water temperature, data on the average temperature ranges for each treatment were obtained. The average temperature range data throughout the study can be seen in Table 4.

Table 4. Average Temperature Data

Treatment	Range of Average Temperature (°C)	Mean Temperature (°C)	P
P1 (100%)	27.1 – 29.1	28.18 ± 0.69[a]	0.989
P2 (75%)	27.5 – 29.4	28.27 ± 0.67[a]	
P3 (50%)	27.3 – 29.1	28.13 ± 0.69[a]	
P4 (25%)	27.5 – 29.4	28.24 ± 0.66[a]	

Based on the results of research on the effect of feeding maggot (Hermetia illucens) flour at different doses on water pH, data on the average pH ranges for each treatment were obtained. Data on the average water acidity (pH) during the study can be seen in Table 5.

Table 5. Average Acidity (pH) Data

Treatment	Range of Average pH	Mean pH ± SD	P
P1 (100%)	7.4 – 8.0	7.62 ± 0.26[a]	0.970
P2 (75%)	7.3 – 8.0	7.62 ± 0.28[a]	
P3 (50%)	7.3 – 8.1	7.67 ± 0.25[a]	
P4 (25%)	7.3 – 8.1	7.61 ± 0.29[a]	

Discussion

Based on Table 3, P1 had an average absolute weight gain of 0.83 g. P2 experienced an increase compared to treatment P1, with an average absolute weight gain of 1.29 g. P3 experienced an increase compared to treatments P1 and P2, with an average absolute weight gain of 1.61 g. Meanwhile, P4 experienced an increase compared to treatments P1, P2, and P3, with an average absolute weight gain of 1.95 g. Therefore, it can be concluded that treatment P4, with a dose of 25%, had the highest average absolute weight gain, and treatment P1, with a dose of 100%, had the lowest average absolute weight gain.

The analysis of variance revealed that the application of maggot meal at different doses significantly differed ($P<0.05$) on the absolute weight growth of African catfish. P1 was significantly different from P2, P3, and P4. P2 was significantly different from P1, P3, and P4. P3 was significantly different from P1, P2, and P4. Meanwhile, P4 was significantly different from P1, P2, and P3. Therefore, it can be concluded that the best treatment for absolute weight growth in African catfish is feeding maggot flour with P4 at a dose of 25%, followed by P3 at a dose of 50%, P2 at a dose of 75%, and P1 at a dose of 100%.

Growth can occur if the feed nutrients ingested and digested by the fish exceed the amount of nutrients needed to maintain their bodies (Mahyuddin, 2010). The lowest average absolute weight growth value was found in P1 at a dose of 100%, at 0.76 g. It is suspected that the nutritional content of the maggot flour used in terms of protein, fat, carbohydrates, vitamins, and minerals was insufficient to meet the African catfish's needs for optimal growth, resulting in stunted growth. Protein is very essential for the needs of the fish body which functions as the main source of energy, carnivorous fish such as catfish require high protein, which is more than 35% of the weight of the fish, the nutrients needed are protein, fat, carbohydrates, vitamins and minerals (Darseno, 2010). According to Mahyuddin (2010) the adequacy and balance of nutrients in the feed are not met so that it causes stunted weight growth in dumbo catfish seeds, because good feed is feed that is balanced or sufficient nutrition, both in terms of protein, fat, carbohydrates, vitamins and minerals. While the average value of the highest absolute weight growth in P4 is 0.99 g, this is in accordance with Abidin et al., (2015) that growth is obtained from the adequacy and balance of nutrients in the feed and the fish are able to utilize the feed given well. According to Amalia (2013) that good nutritional feed can meet the needs of fish in the metabolic process, it will provide better growth performance for the fish being raised. According to Bachtiar (2006), before growth can occur, the fish's energy needs for metabolism and activity must first be met. This excess energy will then be utilized for growth.

Table 4 shows that P1 shows an average water temperature range of 27.1–29.1°C with an average temperature of 28.18°C. P2 shows an average water temperature range of 27.5–29.4°C with an average temperature of 28.27°C. P3 shows an average water temperature range of 27.3–29.1°C with an average temperature of 28.13°C. P4 shows an average water temperature range of 27.5–29.4°C with an average temperature of 28.24°C.

The results of the one-way Analysis of Variance (ANOVA) statistical analysis above indicate that feeding maggot flour at different doses did not produce significant differences or had no significant effect on temperature, as evidenced by the results of P (Sig.) = 0.983 > α 0.05. Based on the results of the study from all treatments (P1, P2, P3, and P4), the temperature ranged from 27.1 to 29.4°C. Temperature values within this range can be categorized as optimal according to SNI (01-6484.4-2000) between 25 and 30°C. Based on Table 5, it can be explained that treatment P1 showed an average water pH range of 7.4 to 8 and an average pH of 7.62. Treatment P2 showed an average water pH range of 7.3 to 8 and an average pH of 7.62. Treatment P3 showed an average water pH range of 7.3–8.1, with an average pH of 7.67. Treatment P4 showed an average water pH range of 7.3–8.1, with an average pH of 7.61.

The results of the one-way analysis of variance (ANOVA) above indicate that feeding maggot flour at different doses did not significantly differ or had no significant effect on pH, as evidenced by the results of P(Sig.) = 0.970 > α 0.05. Based on the results of the study, all treatments (P1, P2, P3, and P4) showed that the pH range was between 7.3–8.1. This range can be categorized as good according to SNI (01-6484.4-2000) between 6.5–8.5.

CONCLUSIONS

Based on research results on the effect of feeding maggot flour (Hermetia illucens) at different doses on the absolute weight growth of 3-4 cm African catfish (Clarias gariepinus L.), the best treatment was treatment P4 with a 25% dose of 1.95 g, followed by treatment P3 with a 50% dose of 1.61 g, treatment P2 with a 75% dose of 1.29 g, and treatment P1 with a 100% dose of 0.83 g. The nutritional content of the maggot flour used was insufficient to meet the needs of African catfish for optimal growth, resulting in stunted growth. Water quality parameters during the study were considered optimal, with temperatures ranging from 27.1 to 29.4°C and acidity (pH) ranging from 7.3 to 8.1.

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