The Effect of a Combination of Maggot Flour (*Hermetia illucens* l.) and Coconut Drugs as an Alternative Feed on the Growth of Sangkuriang Catfish (*Clarias gariepinus* var)

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ABSTRACT

One important aspect in cultivation activities is feed because it can influence the growth and survival of fish during rearing. However, the cost of commercial feed is very expensive. Maggot can be used as a substitute for fish meal and coconut dregs as a mixture in fish feed. This research aims to determine the effect of the combination of maggot flour (*Hermetia illucens* L.) and coconut dregs on the growth of sangkuriang catfish (*Clarias gariepinus* var) and to determine the percentage of the combination of maggot flour (*Hermetia illucens* L.) and coconut dregs on the growth of sangkuriang catfish (*Clarias gariepinus* var). The method used was a completely randomized design (CRD) method with 5 treatments and 4 repetitions for 60 days. The results of this research showed that the alternative feed of 100% maggot flour (*Hermetia illucens* L.) had a good effect on the length growth and weight gain of sangkuriang catfish (*Clarias gariepinus* var) and the E maggot 100% treatment produced the best growth on length growth and increase. weight of sangkuriang catfish (*Clarias gariepinus* var).

Keywords: Maggot, coconut dregs, length, weight, sagkuriang catfish

INTRODUCTION

Sangkuriang catfish (*Clarias gariepinus* var) is a type of freshwater fish that is widely developed and consumed in Indonesia. Catfish contains a lot of protein, besides the processing method is easy and widely liked and the growth process of this fish is relatively fast (Audila et al., 2021). According to Idealistuti et al., (2021), the content found in catfish in general is 12-22% protein, 0.4-5.7% fat, and 74-85% water content.

According to Nursyahran & Basir (2017), one of the important aspects in cultivation activities is feed because it can influence the growth and survival of fish during rearing. The feed provided must meet the nutritional needs so that the fish can survive and grow. The amount of feed needed by fish every day is related to its weight and age.

In general, feed requirements in cultivation activities use commercial feed which can consume around 60-70% of the total production costs incurred. Therefore, alternative feed is needed as a substitute for animal protein sources that are cheaper and easier to obtain (Fahmi, 2015).

According to Fahmi (2015), black soldier fly maggots (larvae) can be used as an alternative raw material to replace fish meal. Maggots can live depending on the food media and environmental conditions in which they live. Maggots have a high protein content of 44.26%. The protein content in maggots is higher than the content in commercial feed which is around 20-25%, so the use of maggots can be applied as an alternative fish feed ingredient to reduce production costs (Berampu et al., 2021).

Apart from using maggots, according to research by Ramdhani et al, (2021), it is stated that using coconut dregs as fish food has a significant effect on the absolute weight of fish because of the additional nutritional content contained in coconut dregs flour. Coconut pulp is a vegetable source that can be used as a fish feed mixture (Wulandari et al., 2018). According to Amran et al, (2019) the nutritional content of coconut dregs is 17.09% protein, 9.44% fat, 23.77% carbohydrates and 30.4% crude fiber.

Based on the description above, it is necessary to carry out research which aims to see the effect of a combination of maggot flour (*Hermetia illucens* L.) and coconut dregs as an alternative feed on the growth of sangkuriang catfish (*Clarias gariepinus* var). This research is also expected to provide information to farmers regarding the combination of maggot flour and coconut dregs on the growth of sangkuriang catfish (*Clarias gariepinus* var) so that it is hoped that fish farmers can save on feed costs.

MATERIALS AND METHODS

A. Tools and materials

The tools used in this research were cloth meters, cameras, buckets, trays, styrofoam, LJK boards, do meters, pH meters, digital scales, thermometers, aerators, aerator hoses, feed making tools, blenders, ovens, filters, sockets, nets. cover, medium size basin (45L) with a diameter of 45 cm and a height of around 30 cm, 20 pieces, tray and stationery.

The materials used in this research were clean water, maggot (*Hermetia illucens* L.), sangkuriang catfish seeds (*Clarias gariepinus* var), aged around 30-40 days with a size of 8-10 cm, tapioca flour, fish meal, coconut dregs, plastic bags, label paper and commercial feed (prima feed brand pf-1000).

B. Ways of working

Research design used was a Completely Randomized Design (CRD) with 5 treatments and 4 repetitions for 60 days, namely as follows:

Treatment A = Control Feed (commercial feed) 100%

Treatment B = Alternative Feed (coconut dregs) 75% and maggot pellets 25%

Treatment C = Alternative Feed (coconut dregs) 50% and maggot pellets 50%

Treatment D = Alternative Feed (coconut dregs) 25% and maggot pellets 75%

Treatment E = 100% Maggot Pellets

Data collection is carried out every 15 days and samples are taken every 5 times with measurement intervals.

Research procedure used in this research include:

1. Preparation of containers
2. Preparation of test fish
3. Maintenance of test fish
4. Preparation for making maggot flour
5. Preparation for making coconut dregs flour
6. Preparation for making feed formulations
7. Feed application
8. Measurement of fish growth (length and weight)

Calculation of Research Parameters

Absolute length growth can be calculated using the following formula (Sabrina et al., 2018):

$L = Lt - L_o$

Information:

L = Absolute length growth (mm)

Lt = Average length at the end of the study (mm)

L_o = Average length at the start of the study (mm)

Absolute weight growth is the difference between the weight of the fish at the start of rearing and the weight of the fish at the end of rearing. Absolute weight growth can be calculated using the following formula (Prama et al., 2022):

$W = Wt - W_o$

Information:

W = Absolute weight (gr)

Wt = Average final rearing weight (gr)

W_o = Average initial maintenance weight (gr)

Survival rate is the ratio of fish that are still alive at the end of rearing to fish at the beginning of rearing. The SR formula is (Sabrina et al., 2018) as follows:

$$SR = \frac{N_1}{N_0} \times 100\ \%$$

Information:

SR = Survival (%)

N1 = Number of fish at the end of rearing (tails)

N0 = Number of fish at the start of rearing (tails)

Water quality measurements carried out in this research included measurements of pH, temperature and dissolved oxygen. Water quality measurements and water changes are carried out every 10 days or when the water in the tank becomes cloudy. Water changes are carried out in the morning when the water temperature is not too high.

The proximate test is a chemical analysis method used to identify nutritional content such as protein, carbohydrates, fat and water contained in a food substance from feed or food (Andyarini & Hidayati, 2017).

C. Data analysis

The data obtained will then be analyzed using Analysis of Variance (ANOVA) using SPSS version 27 software. If there is a real effect, then to examine the differences between treatments it will be further tested using the Duncan test.

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RESULTS AND DISCUSSION

A. Average Length of Sangkuriang Catfish

The average increase in length of Sangkuriang catfish in each treatment during the measurements ranged between 1,2075 cm to 4,715cm. Data and analysis of the average increase in length of Sangkuriang catfish can be seen in Figure 1.

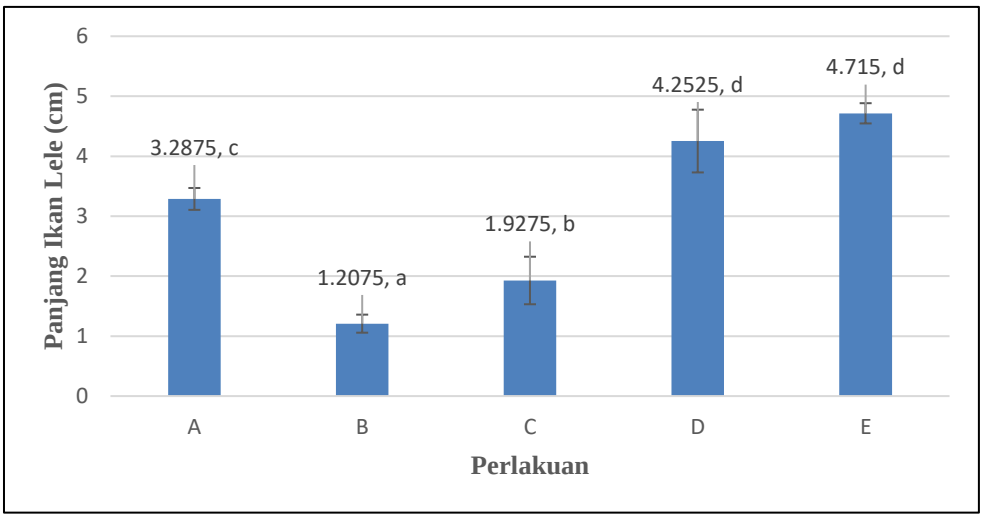

Figure 1. Average length of catfish for 60 days

Information:

A = Commercial Feed (100%)
B = Coconut Dregs 75% + Maggot 25%
C = Coconut Dregs 50% + Maggot 50%
D = Coconut Dregs 25% + Maggot 75%
E = Maggot 100%

Numerical notations followed by the same letter mean they are not significantly different, while different letter notations mean significantly different

Based on the results of research that has been carried out, there was an increase in the length of Sangkuriang catfish from the beginning of rearing to the end of rearing for each treatment. The average initial length of Sangkuriang catfish is 5.74 cm to 7.59 cm and the average final length of Sangkuriang catfish is 7.59 cm to 12.38 cm. Then the data was analyzed using analysis of variance (Anova) with the SPSS Version 27 application.

Based on the results of analysis of variance (Anova) on the increase in length, the calculated F value was obtained 51,308 and it is known that if the calculated F value is greater than the F table (0.05), it means that there are differences between the five treatments. To find out more specifically about which treatments have differences in average, further tests can be carried out, namely the Duncan test to determine differences in influence between treatments. In Duncan's test, it was found that there were several treatments, some of which were significantly different and some were not significantly different in terms of increasing the length of Sangkuriang catfish, which can be seen in Table 1.

Treatment E (100% maggot) produced the best growth in length because in this treatment the amount of feed given was responded well by the fish. Apart from that, there are no food residues in the rearing container. According to Simanjuntak et al., (2020), the amount of feed consumed by fish will have a direct effect on fish growth. The relative growth of fish is also influenced by the energy entering its body. Fish bodies can grow

optimally with the amount of nutrients received and absorbed by the body. Excess feed energy can be used for fish growth.

Table 1. Duncan Length Advanced Test Analysis of Sangkuriang Catfish

Treatment	N	Subset for alpha = 0.05			
		1	2	3	4
B	4	1.2075			
C	4		1.9275		
A	4			3.2875	
D	4				4.2525
E	4				4.7150
Sig.		1,000	1,000	1,000	1.38

In the Duncan further test, it was discovered that treatment a was significantly different from treatments b, c, d, and e. Treatment b is significantly different from treatments a, c, d, and e. Treatment c is significantly different from treatments a, b, d, and e. Treatment d is significantly different from treatments a, b, and c. Treatment e is significantly different from treatments a, b, and c. However, treatments d and e were not significantly different.

In practice B with a combination of 75% coconut dregs + 25% maggot food, the lowest length growth resulted because the catfish did not respond well to the feed given. According to Agustin et al., (2023), coconut dregs contain vegetable protein. Apart from that, it is caused by the high fat content in the feed which has the potential to inhibit the growth process of catfish. Fat that accumulates in the fish's body can cause the quality of fish meat to decrease and inhibit fish growth.

B. Average Weight of Sangkuriang Catfish

The average increase in weight of Sangkuriang catfish in each treatment during measurements ranged from 1.3075 gr to 8.6925 gr. Data and analysis of the average increase in weight of Sangkuriang catfish can be seen in Figure 4.2 as follows:

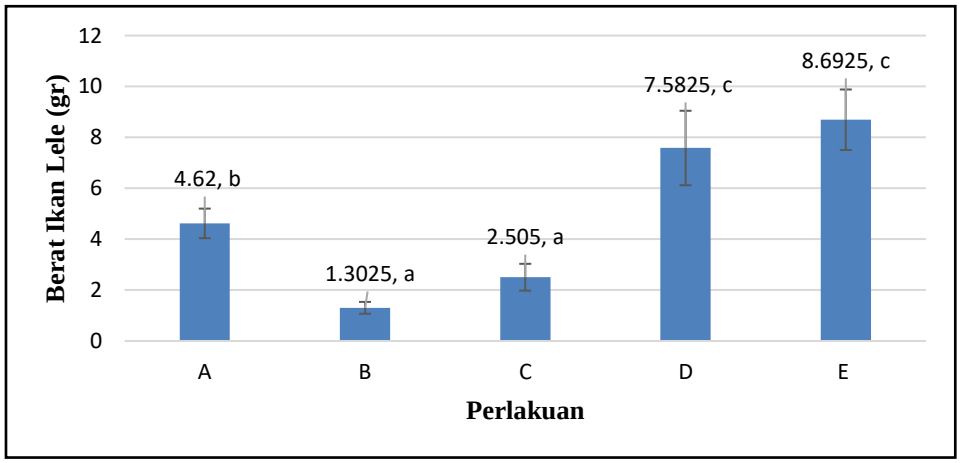

Figure 2. Average weight of catfish for 60 days

Information:

A = Commercial Feed (100%)
B = Coconut Dregs 75% + Maggot 25%
C = Coconut Dregs 50% + Maggot 50%
D = Coconut Dregs 25% + Maggot 75%
E = Maggot 100%

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Numerical notations followed by the same letter mean they are not significantly different, while different letter notations mean significantly different

Based on the results of research that has been carried out, there was an increase in the weight of Sangkuriang catfish from the beginning of rearing to the end of rearing for each treatment. The average value of the initial weight of Sangkuriang catfish was 1.29 grams to 3.6 grams and the average value of the final weight of the fish Sangkuriang catfish 4 grams to 12.87 grams. Then the data was analyzed using analysis of variance (Anova) with the SPSS version 27 application.

Based on the results of the analysis of variance (ANOVA) on the increase in weight, the calculated f value was obtained47.7261. If the calculated f value is greater than table f (0.05), it means that there are differences between the five treatments. To find out more specifically about which treatments have differences in average, further tests can be carried out, namely the duncan test to determine differences in influence between treatments. In the duncan test, it was discovered that there were several treatments, some of which were significantly different and some were not significantly different in terms of the weight gain of sangkuriang catfish, which can be seen in table 2.

Treatment E (Maggot 100%) produced the best weight growth, this was because the amount of feed given during the study responded well to the fish. According to Sulistiyoningsih et al., (2021), the most important thing in providing food for fish is that it has complete nutritional content such as protein, fat, carbohydrates, vitamins and minerals. Protein functions as the main energy source, especially carnivorous fish such as catfish which require high protein, namely more than 35% of the weight of the feed. If there is a lack of protein it will affect growth and loss of body weight.

Table 2. Duncan's Advanced Test Analysis of Sangkuriang Catfish Weight

Treatment	N	Subset for alpha = 0.05		
		1	2	3
B	4	1.3025		
C	4	2.5050		
A	4		4.6200	
D	4			7.5825
E	4			8.6925
Sig.		0.84	1,000	0.108

In Duncan's further tests it was discovered that Treatments B and C were not significantly different. Treatments D and E were not significantly different. Treatment A is significantly different from treatments C, D and E. Treatment B is significantly different from treatments A, D and E. Treatment C is significantly different from treatments A, D and E.

Treatment B (75% Coconut Dregs + 25% Maggot) resulted in the lowest weight growth due to the fact that the catfish did not respond well to the feed given and this was thought to be because the amount of protein consumed in treatment B was less. According to Taunu et al., (2019), stated that if the fish's protein requirements are not met, there can be a decrease in the body weight of the fish and it can even slow down the growth of the fish. Apart from that, the high fiber content also reduces the weight gain of catfish. According to Pratama et al., (2016), leftover feed and metabolic waste in waters can be toxic to fish. Increasing the toxic content in water can cause fish to experience stress and become susceptible to disease, which can disrupt the fish's growth process.

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C. Proximate Test

The results of the proximate analysis of feed (samples A, B, C, D and E) showed the following results in Table 3

Table 3. Proximate Test Analysis

No.	Sample	Water content (%)	Ash Content (%)	Protein (%)	Fat (%)	Carbohydrates (%)	Crude Fiber (%)
1	A	7.86	11.50	37.88	4.63	-	0.9
2	B	12.42	11.73	27.18	24.47	22.04	-
3	C	11.73	13,17	31.52	24.82	18.73	-
4	D	9.81	12.80	33.4	25.47	18.44	-
5	E	7.21	9.56	37.30	27.54	18.37	-

Based on the results of the table above, it is known that the highest feed moisture content is found in feed B with a percentage of 12.42% and the lowest in feed E with a percentage of 7.21%. The highest feed ash content was found in feed C with a percentage of 13.17% and the lowest in feed E with a percentage of 9.56%. The highest feed protein content was found in feed E with a percentage of 37.30% and the lowest in feed B with a percentage of 27.18%. The highest feed fat content was in feed E with a percentage of 27.54% and the lowest was in feed A with a percentage of 4.63%. The highest feed carbohydrate content was in feed B with a percentage of 22.04% and the lowest was in feed E with a percentage of 18.37%. The crude fiber content in feed A is 0.9%.

The optimum water content value for fish feed according to SNI 01-7242-2006 is a maximum of 12%. Low water content is very good for feed so that the feed does not spoil easily and inhibits the growth of microbes which can affect the texture and taste of the feed (Kumbang et al., 2023). The ash content value in accordance with SNI standards is less than 12%. Ash levels that are too high can affect fish digestibility and fish growth (Pratama et al., 2014). Protein has an important role in the growth process and is the main energy source for fish. If protein needs are not met, there will be a decrease or hampered growth or loss of body weight. Based on the literature (Iskandar & Fitriadi, 2017), the optimum protein content for fish is 25-50%.

According to Iskandar & Fitriadi, 2017, fat is an organic compound that cannot dissolve in water. Fat functions as an energy source for fish growth and survival. In general, good feed contains 4-18% fat. Carbohydrates function as a substitute for the lack of protein and fat content in fish feed. Properly processed carbohydrates can be beneficial for fish digestion. The optimum carbohydrate value is around 20-35% (Romadhon et al., 2013). Crude fiber is part of carbohydrates that cannot be digested and is not an important nutrient for fish. Coarse fiber can cause waters to become dirty. If the feed fiber content is high, it can result in decreased digestibility, decreased water quality, and increased metabolic waste (Iskandar et al., 2017).

D. Survival Rate

The survival rate of sangkuriang catfish reared for 60 days in each treatment A, B, C, D and E ranged between 95 – 100%. The highest average value was obtained from treatment D and treatment E, namely 100%. Then treatment B with an average value of 97.5% and the lowest average value was obtained from treatments A and C, namely 95%. Data and analysis of various survival rates of Sangkuriang catfish during the research can be seen in Figure 3.

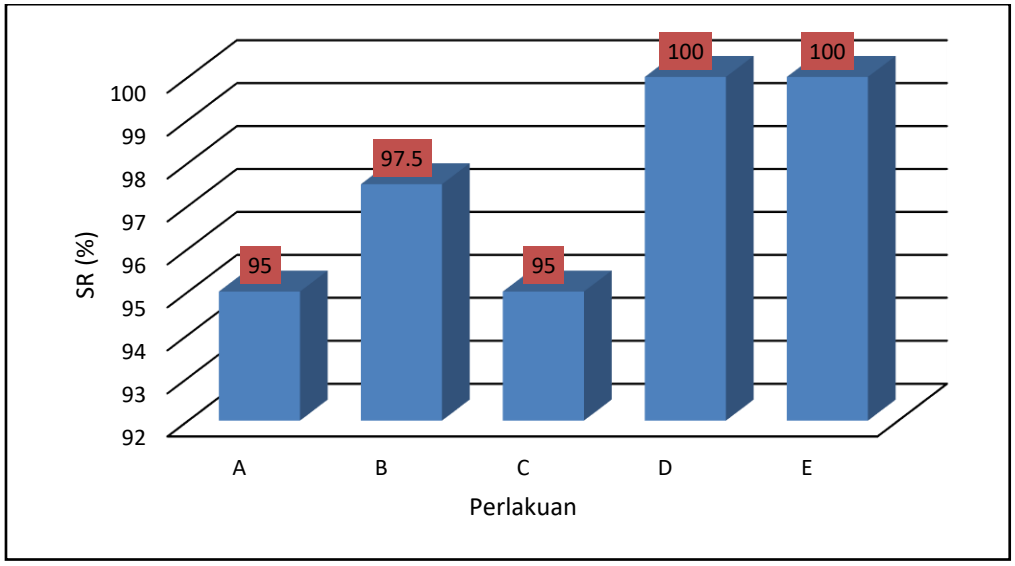

Figure 3. Survival Rate

Information:

A = Commercial Feed (100%)
B = Coconut Dregs 75% + Maggot 25%
C = Coconut Dregs 50% + Maggot 50%
D = Coconut Dregs 25% + Maggot 75%
E = Maggot 100%

Treatments A and C with a survival value of 95% were classified as good and treatment B with a survival value of 97.5%. This is in accordance with Pertiwi et al., (2021), who state that a survival rate (SR) ≥ 50% is classified as good, a survival rate of 30 – 50% is classified as moderate and if less than 30% is classified as not good. Apart from that, fish deaths result from the adaptation period to the new rearing environment and because the water media is often siphoned and added with water so that the fish experience stress which causes fish death.

The best survival rate was in treatments D and E with a value of 100%. This is thought to be due to providing feed that suits the fish's needs, thereby increasing the body's immunity which affects the growth and survival of catfish. This is in accordance with Pertiwi et al., (2021) who state that if feed availability is sufficient, the success rate of rearing can be close to 100% and no fish will die or disappear. So providing food that meets the nutritional needs of catfish is necessary to increase the growth and survival of the fish.

E. Water quality

The growth and survival rate of sangkuriang catfish (C. gariepinus var) is influenced by water quality. The parameters used to measure water quality are temperature, pH and DO. The results of water quality observations during the research showed a temperature of 28 - 30°C, pH 6.1 - 7.7, and DO 6.1 mg/L – 6.9 mg/L. Water quality data during the research can be seen in Table 4 as follows:

Table 4. Analysis of Average Water Quality During Research

Treatment	a		b		c		d		e	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Temperature	28	30	28	30	28	30	28	30	28	30
Ph	6.1	7.6	6	7.5	6.9	7.7	6.1	7.7	6.2	7.6
Do	6.1	6.9	6.1	6.9	6.2	6,8	6.2	6.9	6.1	6.9

Based on the results of research that has been carried out, it was found that the temperature range was 28 - 30°C, this temperature range is the optimal temperature range for the growth of sangkuriang catfish. According to Pratama et al., (2016), the optimal temperature range for cultivating Sangkuriang catfish is between 20-30°C. This is because high water temperatures can cause fish to experience stress and in the long term can cause fish death.

Based on the results of pH measurements, it was found that the average pH value range for each treatment was 6 – 7.7. The pH value in each treatment was optimal for the growth of sangkuriang catfish. According to Salamah & Zulpikar (2020), a good pH value for the growth and survival of sangkuriang catfish is in the range of 6.5 – 8.5. A pH value that is too high can be toxic to waters, causing fish death.

Based on the results of research on dissolved oxygen (DO) values, it was found that the average value range from different treatments was between 6.1 - 6.9 mg/L, which means that it is still the tolerance limit for Sangkuriang catfish. According to Susanti et al., (2021), the optimal level of dissolved oxygen for fish ranges from 3 to 5 ppm. Oxygen requirements for fish vary depending on the type, age and natural conditions of the fish. Small fish usually consume more oxygen than adult fish. In addition, a decrease in dissolved oxygen values can cause fish to experience stress, which can increase the chance of infection in fish.

CONCLUSION

The alternative feed of 100% maggot (*Hermetia illucens* L.) flour had a good effect on the length growth and weight gain of Sangkuriang catfish (*Clarias gariepinus* var) and in the 100% E maggot treatment it produced the best growth on the length growth and weight gain of Sangkuriang catfish

(*Clarias gariepinus* var).

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