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Effect of Catfish Culture Waste (*Clarias* sp.) on The Growth of Silk Worms (*Tubifex* sp.)

Pengaruh Limbah Budidaya Ikan Lele (*Clarias* sp.) Terhadap Pertumbuhan Cacing Sutra (*Tubifex* sp.)

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ABSTRACT

Silkworms, as natural food, have an essential role because they can stimulate fish growth. However, silkworms in nature are not always available all year round, so it is necessary to cultivate silkworms. Silkworms need a medium containing organic matter and inorganic matter for their growth. Catfish farming wastewater contains a lot of organic matter. This study aims to evaluate the effect of catfish farming waste (*Clarias* sp.) on the growth of silkworms (*Tubifex* sp.) in different initial biomasses. This research method uses the experimental method Complete Randomized Design with four treatments and three repeats. The treatment used is P1 = 15 grams of silkworms; P2 = 20 grams of silkworms; P3 = 25 grams of silkworms; and P4 = 30 grams of silkworms. For analyzing data use ANOVA with a 95% confidence level and the Lower Significance Difference test on SPSS. The results showed that the provision of catfish farming waste had a real influence on the growth of silkworms. Silkworms' absolute weight and biomass were highest in treatment four, which were 195.33 g and 0.112 g. Therefore, catfish farming waste has the potential to be used as raw material for silkworm feed.

ABSTRAK

Cacing sutra sebagai pakan alami memiliki peranan yang penting karena mampu memacu pertumbuhan ikan lebih cepat. Namun, cacing sutra di alam tidak selalu tersedia sepanjang tahun, sehingga perlu dilakukan budidaya cacing sutra. Untuk pertumbuhannya, cacing sutra membutuhkan media yang mengandung bahan organik dan bahan anorganik. Air limbah budidaya ikan lele mengandung banyak bahan organik. Penelitian ini bertujuan untuk mengevaluasi pengaruh limbah budidaya ikan lele (*Clarias* sp.) terhadap pertumbuhan cacing sutra (*Tubifex* sp.) pada biomassa awal yang berbeda. Penelitian ini menggunakan metode eksperimental Rancangan Acak Lengkap dengan 4 perlakuan dan 3 kali ulangan. Perlakuan yang digunakan yaitu P1 = 15 gram cacing sutra; P2 = 20 gram cacing sutra; P3 = 25 gram cacing sutra; dan P4 = 30 gram cacing sutra. Analisis data menggunakan ANOVA dengan tingkat kepercayaan 95% dan uji Beda Nyata Terkecil atau Lower Significance Diferent pada SPSS. Hasil penelitian menunjukkan Pemberian limbah budidaya ikan lele memberikan pengaruh nyata terhadap pertumbuhan cacing sutra. Bobot mutlak dan biomassa cacing sutra tertinggi terjadi pada perlakuan 4 yaitu 195,33 g dan 0,112 g. Oleh karena itu limbah budidaya ikan lele mempunyai potensi untuk dimanfaatkan sebagai bahan baku pakan cacing sutra.

Kata Kunci	*Cacing sutra, ikan lele, limbah*
Keywords	*Silkworms, catfish, wastewater*
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INTRODUCTION

The availability of natural food is a factor that plays an important role in cultivation activities, especially in the initial phase or seeding phase. One type of natural food that is suitable for fish and other freshwater animals is silk worms (Tubifex sp.), especially in the initial phase (larvae) because they fit the mouth opening. However, silk worms in nature are not always available throughout the year, so many silk worms are cultivated (Muria, 2012). Silk worms (Tubifex sp.), usually form red colonies and are used as fish food which contains high nutrients including up to 57% protein, 13.3% fat, 2.04% crude fiber, 3.6% ash content, and water 87.7% (Febrianti, et al, 2020).

Silk worms have better advantages as natural food compared to water fleas (Daphnia sp. or Moina sp.). In general, production of silk worms currently still depends on catches from nature, while the demand for silk worms is quite high for ornamental fish and food fish. The availability of silk worms in nature is not available throughout the year, especially during the rainy season, because silk worms in nature are carried by strong currents due to high rainfall, so cultivation needs to be carried out in order to meet the need for silk worms as natural food and their availability does not depend on the season. (Kusumorini, et al., 2017).

Silk worm cultivation relies heavily on maintenance media because it plays an important role in the success of silk worm cultivation. Silk worms require a medium that contains organic and inorganic materials. However, the problem faced by cultivators is meeting the need for organic materials which is difficult to fulfill optimally (Umidayati, et al, 2020). Catfish is a fish that produces a lot of organic material in its cultivation system.

Cultivation wastewater using the recirculation method contains a lot of organic material which will be used by decomposer organisms as nutrients for growth, because the worms act as a biofilter to reduce the NH_3 content. The mechanism is that when silk worms eat organic material in the form of fish feces, the possibility of the ammonification process (the conversion of organic material into NH_3) is reduced so that the concentration of NH_3 is reduced (Ardana, 2018). Therefore, this research was carried out so that we could determine and compare the effect of different densities in cultivating silk worms using waste from fish cultivation on the biomass growth of Tubifex sp. This study aims to evaluate the effect of catfish (*Clarias* sp.) cultivation waste on the growth of silk worms (*Tubifex* sp.) at different initial biomass.

METHODS

This research was conducted at the Aquaculture Laboratory, Faculty of Agriculture, Mataram University. The research implementation time lasted 2 months. The containers used in this research were 4 buckets with a size of 150 liters as a place for cultivating catfish, and 12 trays with a length of 35 cm and a width of 25 cm as a place for cultivating silk worms. The media used is rice field mud which is placed in each tray with a height of 2 cm which has been cleaned of rubbish and other dangerous materials. Then the water flows continuously using a recirculation system. The initial stocking density of silk worms was 15 grams in treatment 1, 20 grams in treatment 2, 25 grams in treatment 3, and 30 grams in treatment 4. In each treatment there were 3 repetitions. The water flow is continuously controlled so that it is continuously available during the silk worm cultivation period.

Catfish growth parameters

The growth parameters in this research are specific fish growth, fish length and fish survival. The specific growth of tilapia fish that is measured is weight, using a formula (Pratama 2017).

Absolute Weight Growth

$W = Wt - Wo$

Information:

W = Absolute Growth (gram)
Wt = Average weight of fish at the end of rearing (gram)
Wo = Average weight of fish at the start of rearing (gram)

Absolute Length Growth

$L = Lt - Lo$

Information:

L = Absolute Length Growth (cm)
Lt = Average length of fish at the end of rearing (cm)
Lo = Average length of fish at the beginning of rearing (cm)

Specific Weight and Length Growth Rates (SGR)

$SGR = [((\ln Wt - \ln Wo))/t] \times 100\%$

Information:

SGR = daily growth rate (%)
Wt = average weight of fish at the end of rearing (g)
Wo = average weight of fish at the beginning of rearing (g)
t = long maintenance time (hari)

Degree of Survival of Catfish

The degree of survival/Survival Rate is the percentage of the number of live fish and the number of fish at the end of the study (Pratama, 2017).

SR=Nt/Nox 100 %
Information :
SR : Survival Rate (%)
Nt : Number of fish at the end of the study (tail)
No : Number of fish at the start of the study (tail)

Feed Conversion
The formula used to calculate feed conversion is:
FCR=F/((Wt+D)-Wo)
Information :
FCR = Food Conversion Ratio
Wo = Initial weight of fish
Wt = Final weight of fish
D = Weight of dead fish
F = amount of feed consumed

Silk Worm Growth Parameters

Absolute weight growth is the rate of growth in the total weight of the worm. The formula for finding absolute weight growth according to Suharyadi (2012) is:

GR = Wt -Wo
Information :
GR = Growth Rate
Wt = Final average weight (g/container)
Wo = Initial average weight (g/container)

Absolute biomass of silk worms (Brown, 1997) :

B = GR/V
Information :
B = Absolute biomass (g)
GR = Total biomass (g)
V = Media thickness volume

Water Quality

The water quality parameters measured during the research were dissolved oxygen (DO), pH, temperature and ammonia. Water quality measurements are carried out every 21 days (in the morning at 08.00, in the afternoon at 12.00, and in the afternoon at 16.00) for 4 times.

Data Analysis

Observation data included growth, growth rate, biomass, and were analyzed using ANOVA with a 95% confidence level. If there is a difference, continue with the Smallest Significant Difference test or Lower Significance Difference. Analysis was carried out using the SPSS software program.

RESULT AND DISCUSSION

Absolute weight of catfish

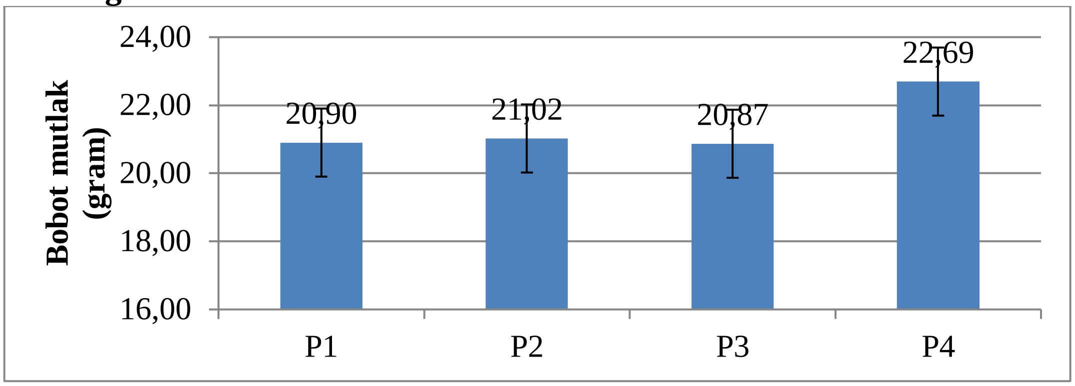

Figure 1. Absolute weight of catfish during research

The absolute weight growth rate value for catfish can be seen in Figure 1. It can be seen that treatment 4 (P4), has the highest value, namely 22.69 g. Followed by P2, which is 21.02 g, P1 which is 20.90 g, and P3 which is 20.87 g. According to Wiadnya at al,. (2000) the ability of fish to digest and utilize feed greatly influences the increase in body weight of the fish itself. Taharudin at al., (2016) stated that the highest absolute weight growth was 50 grams and the lowest absolute weight growth was 34 grams. The highest absolute weight growth is thought to be due to the non-uniform size of catfish, non-uniform use of feed, and the minimum number of fish deaths during rearing. The non-uniform size of catfish affects growth rates due to different metabolism, thus affecting feed utilization. Fish weight growth is also influenced by water quality, where low ammonia levels can affect fish weight growth. According to Safrina at al., (2015) optimal ammonia for fish growth ranges from 0.21-0.84 ppm

The lowest absolute weight growth result in the P3 treatment was 20.87 grams, this result is thought to be due to the non-uniform size of the catfish and the large number of fish deaths during rearing caused by stress which is influenced by water quality

Absolute length of catfish

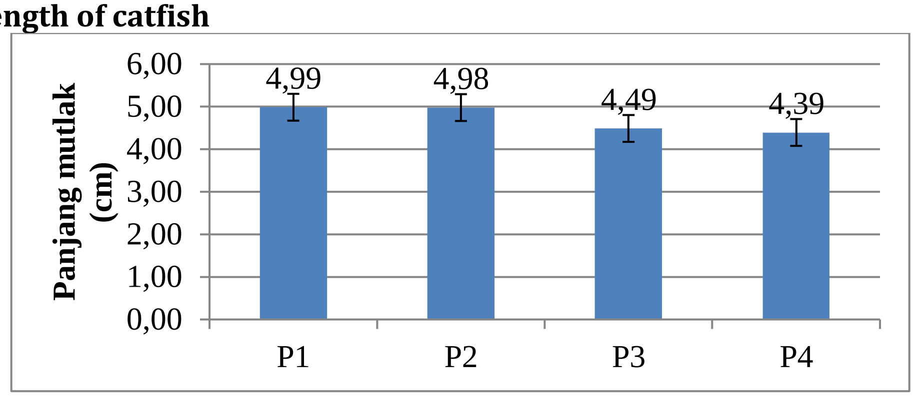

Figure 2. Absolute length of catfish during research

The absolute length growth rate value for catfish can be seen in Figure 2. It is known that treatment 1 (P1), has the highest value, namely 4.49 cm. then followed by P2 of 4.98 cm, P3 of 4.49 cm, and P4 of 4.39 cm. Efendie (1979) stated that growth is influenced by two factors, namely internal factors including heredity, sex, age, and external factors including the aquatic environment, food, disease and parasites. According to Taharudin at al., (2016) the highest absolute length growth was 13 cm and the lowest absolute length growth was 9 cm. The non-uniform size of catfish affects growth rates due to different metabolism, thus affecting feed utilization.

The lowest absolute length growth value was at P5, namely 4.39 grams, this is thought to be due to differences in size when stocked and fish death. Fish deaths are caused by high levels of fish stress due to poor water quality. Fish growth is influenced by several factors such as feed, cultivation container, temperature, salinity, season and physical activity (Djunaedi et al., 2016)

Specific weight of catfish

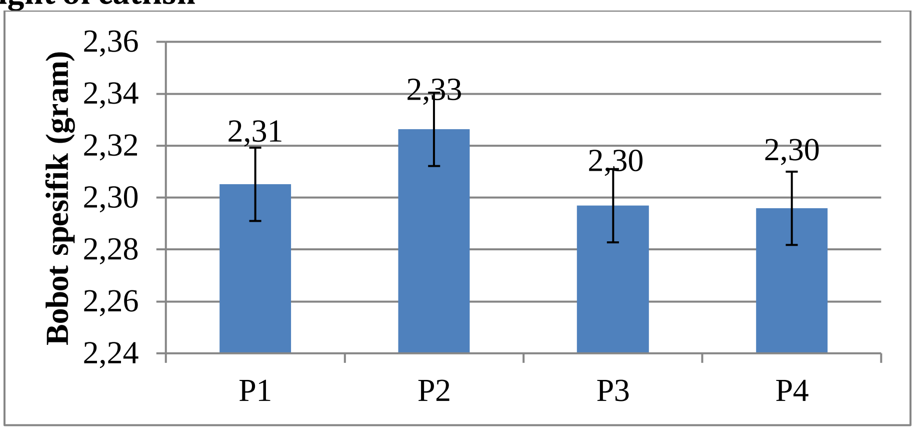

Figure 3. Specific weight of catfish during research

The value of the specific weight growth rate for catfish can be seen in Figure 3. It is known that treatment 2 (P2), has the highest value, namely 2.33 g. followed by P1, which is 2.31 g, P3, which is 2.30 g, and P4, which is 2.30 g. According to Sitio et al. (2017) the specific weight growth of catfish can grow to a maximum of 1.65%/day. Setiawati at al,. (2013) added that fish will grow if the food nutrients digested and absorbed by the fish's body are greater than the amount needed to maintain its body. The difference in specific weight growth is thought to be due to the non-uniform size of the fish resulting in differences in feed utilization. According to Windarti (2020), if the r value is close to 1 it means there is a strong relationship between the length and weight of the fish, and if the r value is not close to 1 it means the relationship between the length and weight of the fish is weak. A strong correlation indicates a relationship between fish length and weight, this is influenced by adequate feed. Fish growth is influenced by several factors such as feed, cultivation container, temperature, salinity, season and physical activity (Djunaedi et al., 2016).

Specific length of catfish

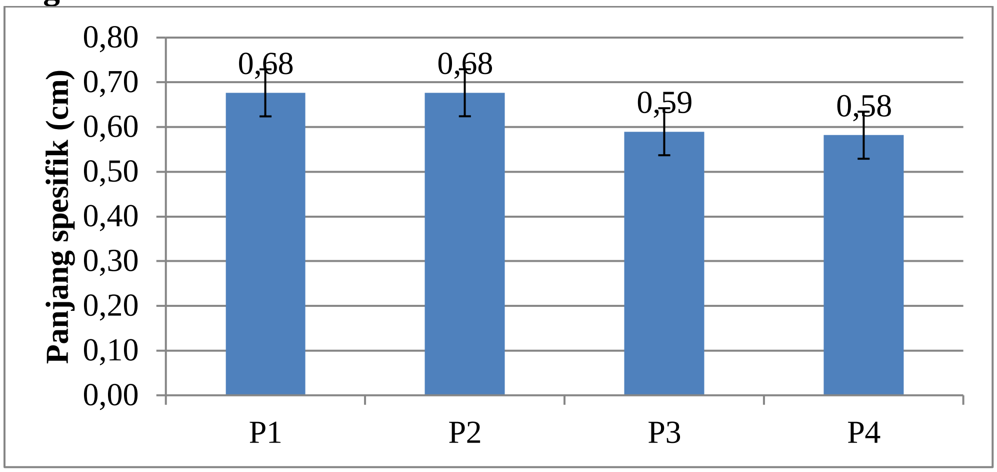

Figure 4. Specific length of catfish during research

The specific length growth rate value for catfish can be seen in Figure 4. Based on Figure 4, it is known that treatment 1 (P1), has the highest value, namely 0.68 cm. followed by P2, which is 0.68 cm, P3, which is 0.59 cm, and P4, which is 0.58 cm. According to Sitio et al. (2017) the specific length growth of catfish can grow a maximum of 5.05%/day. According to Affandi at al., (1992) growth will occur if there is excess energy from the feed consumed after the minimum energy requirements (for basic living) have been met. The highest specific length growth is thought to be due to the non-uniform size of catfish, and the use of feed, different sizes of catfish can influence the growth in length of catfish where length and weight are interconnected. According to Windarti (2020), if the r value is close to 1 it means there is a strong relationship between the length and weight of the fish, and if the r value is not close to 1 it means the relationship between the length and weight of the fish is weak. A strong correlation means that the weight of the fish will increase as the body length of the fish increases. The strong correlation is also thought to be due to the availability of sufficient food and environmental conditions that support fish growth.

The lowest specific length growth is thought to be due to the non-uniform size of catfish and feed utilization. The specific length growth of catfish is also influenced by water quality, where poor water quality levels can affect fish length growth. Effendie (1997), there are several factors that influence growth, including internal factors and external factors which include the amount and size of food available, the amount of food using available food sources, temperature, dissolved oxygen (Scabra, Marzuki, et al., 2022; Scabra & Budiardi, 2020), water quality factors (Scabra & Setyowati, 2019), age and size of the fish and mature gonads. Fish growth is influenced by several factors such as feed, cultivation container, temperature, salinity, season and physical activity (Djunaedi *et al.,* 2016).

Survival rate (SR) of catfish

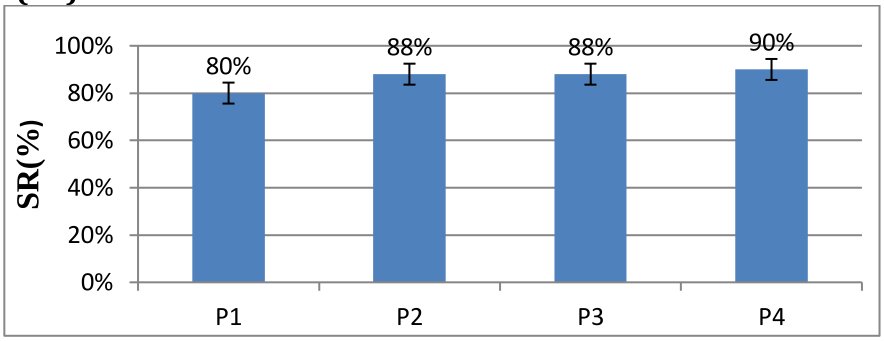

Figure 5. Survival rate of catfish cultivation media

The results of the analysis of the observed survival rates show results that are not much different, which can be seen in Figure 5. The measurement results show that P2 and P3 have the same results, namely with a value of 0.88, then P1 with a value of 0.8, and finally P4 with a value of 0.88. value 0.9. According to Gustav (1998), a good average fish survival rate ranges from 73.5 – 86.0%. According to Effendie (1997), the survival rate is influenced by biotic factors, namely competition, parasites, age, predators, density and human handling, while abiotic factors are the physical and chemical properties of waters. Based on the results of the data above, it shows that the highest survival rate value is found in P4, namely 90%. The high survival rate is thought to be because the catfish seeds look healthy and the water quality is quite good. According to Maniani at. al., (2016) states factors that can influence survival, such as stocking density, feed, environment (water quality), seed quality, life characteristics, and disease.

Feed conversion ratio (FCR) of catfish

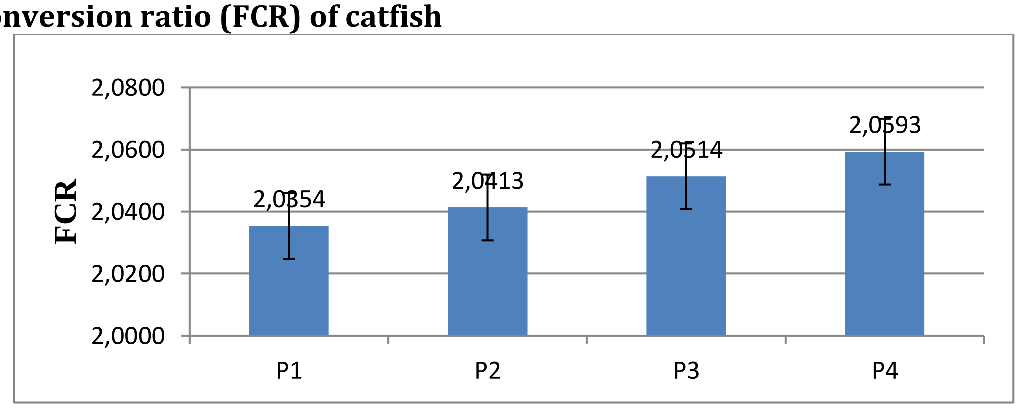

Figure 6. Feed conversion to catfish cultivation media

The picture above shows that the FCR value during the research ranged from 2.0354 – 2.0593. The calculation results show that P1 has a value of 2.0354, then P2 has a value of 2.0413, after that P3 has a value of 2.0514, and finally P4 has a value of 2.0593. From the results obtained, it was found that the highest FCR result was obtained by P4 with a value of 2.0593 and the lowest FCR was obtained by P1 with a value of 2.0354. According to Effendi 2014 in Mardhiana at al 2017, Feed Convertoin Ratio is a measure that states the ratio of the amount of feed needed to produce 1 kg of farmed fish. If FCR = 1, it means that producing 1 kg of fish meat requires 1 kg of feed. According to Mardhiana at al 2017, feed conversion for catfish seeds ranges from 1.7 to 2.8. The FCR value is influenced by several factors, including feed, seeds and the environment. The quality of fish seeds also affects the FCR value because good fish seeds will grow faster and use less feed during rearing. The fish rearing environment is the main factor that needs to be maintained during rearing because the environment will have an impact on fish seeds during rearing, a good environment will make fish grow faster because there are no inhibiting factors that arise.

The FCR level of feed in African catfish is determined by growth and the amount of feed given. The efficiency of feed use shows the value of feed that can be converted into increased body weight of fish. In accordance with (Scabra, Hermawan, et al., 2022) the smaller the feed conversion ratio (FCR) value, the better the fish utilize the feed provided so that the greater the weight of meat produced. A low FCR indicates efficient use of feed, so that only a small amount of protein is broken down to meet energy needs and the rest is used for growth. FCR calculations are very important in the fish farming process because they can determine whether the feed provided has been used as efficiently as possible.

Absolute weight of silk worms

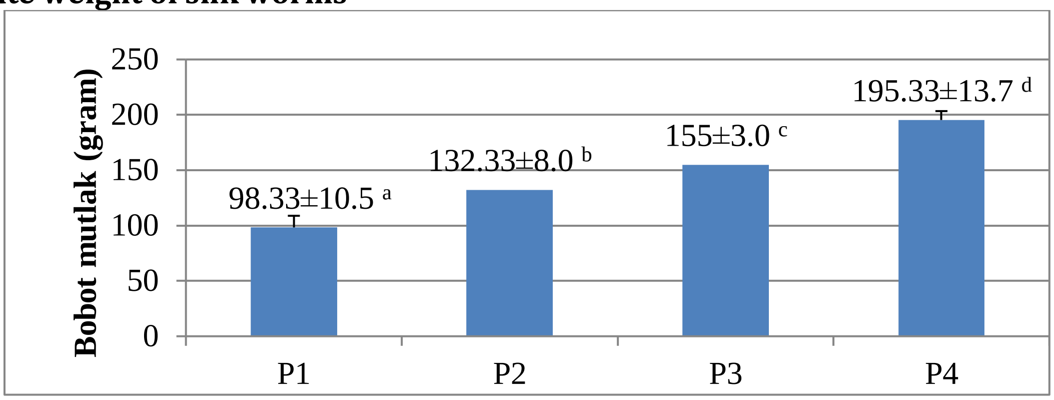

Figure 7. Absolute weight of silk worms during research

The absolute weight growth rate value of silk worms can be seen in Figure 7. Based on Figure 7, it is known that treatment 4 (P4), has the highest value, namely 195.33 g. followed by P3, which is 155 g, P2, which is 132.33 g, and P1, which is 98.33 g.

The results of the analysis of variance showed that the different weights of the worms in each treatment had a significant effect ($p < 0.05$) on the absolute weight growth rate of the silk worms, so Duncan's further test was carried out to determine the best treatment. Further test results show that P1 is significantly different from P2, P3, and P4. The absolute weight growth of silk worms is known by calculating the difference between the body weight of the silk worm at the end and the body weight of the silk worm at the start of rearing. Based on Figure 6, the results show that in treatment 4, the absolute weight of silk worms was obtained with a value of 195.33 g, which is the highest value with the highest density. It is suspected that this is due to the different density of worms, apart from that, the movement space or rearing media can also influence the rate of growth of silk worms. Suparmin (2019) stated that apart from density factors, environmental factors or space for movement also greatly influence the growth rate of silk worms. The catfish waste used meets the requirements to support the growth of silk worms (Tubifex sp.). Febrianti (2004) stated that

silk worms (Tubifex sp.) get food in the form of bacteria and organic particles resulting from the decomposition of organic material by bacteria.
The lowest absolute weight growth of silk worms was in treatment 1, namely with a value of 98.33 g. It is thought that this was due to the low density of silk worms so the absolute weight growth was also low compared to treatment 4 with high density which also influenced the high absolute weight. Suparmin (2019) stated that apart from density factors, environmental factors or space for movement also greatly influence the growth rate of silk worms..

Absolute biomass of silk worms

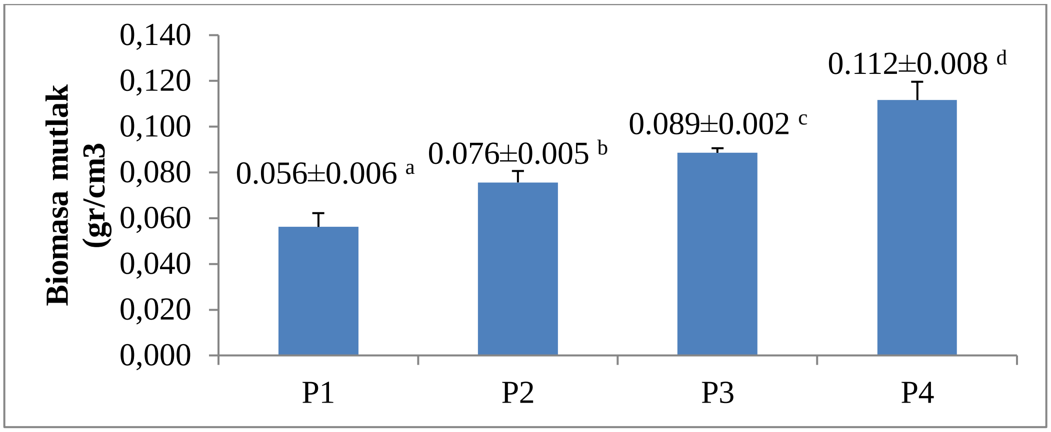

Figure 8. Absolute biomass of silk worms during the study

The absolute biomass value of silk worms can be seen in Figure 8. Based on Figure 8, it is known that treatment 4 (P4), has the highest value, namely 0.112 gr/cm3. followed by P3, which is 0.089 gr/cm3, P2 which is 0.076 gr/cm3, and P1 which is 0.056 gr/cm3.

The results of the analysis of variance showed that different worm weights in each treatment had a significant effect ($p < 0.05$) on the absolute biomass of silk worms, so Duncan's further test was carried out to determine the best treatment. Further test results show that P1 is significantly different from P2, P3, and P4. Silk worm biomass is determined by calculating the absolute weight of the silk worm divided by the media volume. Based on Figure 7, the results show that in treatment 4, the biomass of silk worms was obtained with a value of 0.112 g, which is the highest value with the highest density. It is thought that this is due to the different density of worms, and also silk worms are more comfortable looking for food in groups, silk worms are more like to live in colonies. The catfish waste used meets the requirements to support the growth of silk worms (Tubifex sp.). Febrianti (2004) stated that silk worms (Tubifex sp.) get food in the form of bacteria and organic particles resulting from the decomposition of organic material by bacteria. The increase in biomass during silk worm rearing proves that silk worms can utilize fish water waste as food for their survival and reproduction. This is because fish water waste particles are small in size and still contain nutrients for silk worms. Because of the nature of silk worms, they search for food and live in water areas that have high nutritional content. According to (Khairuman, 2008) to support the life of silk worms, the bottom of the waters is muddy, contains lots of organic material, the water is calm but still flowing and the waters are cool.

The lowest silk worm biomass was in treatment 1, namely with a value of 0.056 g, it is thought that this was due to the low density of silk worms so the absolute weight growth was also low compared to treatment 4 with high density which also influenced the high absolute weight. On days 1-15, the increase in silk worm biomass was low compared to the biomass on the following days, namely days 30, 45 and 60. The low increase in biomass at the start of maintenance was because the silk worms had to adapt to a new environment that was different from their initial environment. In the statement (Pardiansyah et al., 2014), it was stated that the biomass of silk worms decreased on day 10 and increased on day 15 until the end of the study. The availability of sufficient food can reduce the level of competition between adult worms and young worms to obtain food, thereby influencing the growth of silk worms (Afifi et al., 2011).

Water Quality

Table 1. Results of measuring water quality parameters

Parameter	Treatment	Range value	Optimal value	Feasibility library
Temperature (^oC)	P1	27,75 – 28,52	25 - 28	Astutik (2016)
	P2	27,82 – 28,65		
	P3	27,85 – 28,85		
	P4	27,80 – 28,65		
DO	P1	5,90 – 6,67	2,5 - 7	Effendi, 2017
	P2	5,62 – 6,72		
	P3	5,12 – 6,30		
	P4	4,75 – 5,72		
pH	P1	7,75 – 8,15	5,5 - 8	Effendi, 2017
	P2	7,65 – 8,15		
	P3	7,52 – 8,20		
	P4	7,52 – 8,12		
Ammonia	P1	0,06 – 0,49	0,21 – 0,84	Safrina, 2015
	P2	0,06 – 0,93		
	P3	0,06 – 0,55		
	P4	0,06 – 0,76		

The results of calculating the water quality of the experimental media show that it is still within the normal range that can be tolerated by silk worms for their growth. The water temperature of the experimental media ranged between 27 - 28 0C, this value is still within normal limits as stated by Sumaryam (2000) that the appropriate water temperature for culturing silk worms is in the range of 24 - 32 0C. The overall results of the 60-day research on water quality parameters in terms of temperature obtained the highest value reaching 28,850C on the 21st day, it is thought that this was because in the afternoon the weather was still clear and there was sunlight coming in. This value is a value that is still considered optimal to support the growth of silk worms (Tubifex sp.). The use of plastic material as a container is thought to be the cause of the high temperature range, apart from that the small size of the container also helps the temperature increase quickly. This assumption is reinforced by Bintaryanto & Taufikurohman (2013) who state that plastic tubs cannot spread heat from environment to environment, but the heat obtained remains trapped in the cultivation container so that the worms cannot reproduce optimally.

The dissolved oxygen content in the experimental water media during the research ranged from 4 - 6 ppm. This value range is still within normal limits, in accordance with Sulmartiwi (2006) that the DO suitability for silk worms to live and reproduce is in the range of 2.4 – 7 ppm. The dissolved oxygen content in the water during the research was quite good, ranging from 5.1 – 6.6 ppm, this was because the water in the research container was always flowing. The source of oxygen contained in the container not only comes from the diffusion process caused by the flow but also occurs due to the metabolic process caused by decomposing microorganisms originating from catfish feces and leftover feed.

During the research, the degree of acidity of the experimental media water was between 7 - 8. This range value is still within normal limits which is good for cultivating silk worms, as stated by Suharyadi (2012) that the optimal pH range for cultivating silk worms is 5.5 - 8. 0. Overall the pH value during the research was considered good for the growth of silk worms. pH conditions during the study were within tolerable limits in the range of 7.5-8.2. The highest pH value reaches 8.2, this is thought to be because the carbon dioxide (CO2) content is very small. According to Syafradiman and Masril (2013) silk worms can reproduce at a pH between 6-8. Meanwhile, the optimal pH for the life of silk worms in nature is between 5.5-8.0. At neutral pH, bacteria can break down organic matter normally into simpler ones that can be utilized by silk worms as food.

From the results of ammonia exchange for 60 days, the average results were obtained as in table 1. The highest ammonia was found in treatment 2 with a result of 0.93, while the lowest ammonia was found in treatment 4 with a result of 0.06. According to Safrina at al., (2015) the ammonia content ranges from 0.21-0.84 ppm, this value is still suitable for the growth of silk worms. The level of ammonia (NH3) in the water in the container during the research in each treatment significantly influenced the development and growth of silk worms. From the results of ammonia measurements in each treatment using catfish waste, the highest ammonia level was in treatment 2, namely with a value of 0.84 mg. /L, this is thought to be due to a lack of water in the cultivation tank, however the ammonia range in all treatments is still within the normal range. Efendie (2013) stated that silk worms can grow optimally in conditions of <3.6 mg/L ammonia and can reproduce in media that contain <1 mg/L ammonia..

CONCLUSSION

The provision of catfish cultivation waste had a real influence on the growth of silk worms, the highest absolute weight of silk worms occurred in treatment 4, namely 195.33 g, and the highest silk worm biomass occurred in treatment 4, namely 0.112 g. Therefore, catfish cultivation waste has the potential to be used as raw material for silk worm feed.

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