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The Effect of Silkworm (*Tubifex* sp.) Growth on Rice Field Mud, Chicken Manure, and Tofu Pulp Media with Different Compositions

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ABSTRACT

The rapidly increasing demand for silkworms as natural feed has caused prices to rise, making silkworms a potentially valuable natural feed for farmed fish. To date, the supply of silkworms as natural feed still relies on nature, meaning that silkworms are not available throughout the year, but only during the rainy season. One way to support the availability of silkworms is through cultivation. The purpose of this study was to examine the effect of chicken manure, rice field mud, and tofu pulp on the growth of silkworms. The method used was a quantitative experiment with a completely randomized design (CRD) consisting of four treatments: P1 (100% mud), P2 (50% mud + 50% chicken manure), P3 (50% mud + 50% tofu pulp), and P4 (50% mud + 25% chicken manure + 25% tofu pulp). The results of the study showed that treatment P4 provided the highest absolute biomass growth with an average of 3.03 g. This indicates that the combination of chicken manure and tofu pulp provides an optimal synergistic effect for worm growth. From these results, it can be concluded that the combination of rice field mud, chicken manure, and tofu pulp (P4) is the most effective medium for silkworm growth.

INTRODUCTION

Aquaculture activities today are not only about studying and developing fish farming techniques, but also about finding natural feed alternatives that can reduce production costs (Khotimah, 2023). Setiadi (2023) states that the media used for aquaculture must be free from bacterial contamination and other heavy metals because aquaculture media plays an important role in the success of silkworm aquaculture.

Mi'raizki *et al*. (2015) found that enriching silkworm culture media can increase the quantity and quality of silkworm production. According to Cahyono *et al*. (2015), organic materials used as media and food sources for silkworms can be fermented. Through the fermentation process, the nutritional content of organic materials will increase, so that they can be used as media and food sources for silkworms.

Silkworms have been widely cultivated on various media, including chicken manure, tofu pulp (Sari *et al*., 2021), quail manure, powdered milk, tapioca flour (Rusydi *et al*., 2021), pig

manure, chicken manure, cow manure, and fine mud (Wenda et al., 2018). These media contain organic matter that can be used as a food supply to support silkworm growth (Fatah *et al*., 2021). Tofu residue is a byproduct of tofu production and is widely available at a relatively low price but still contains a fairly high amount of protein. The crude protein contained in tofu pulp is around 23.39%, crude fiber 19.44%, crude fat 9.96%, ash 4.58%, and BETN 30.48% (Agustina *et al*., 2020). One way to support the availability of silkworms is through cultivation.

Based on this, research was conducted on silkworm cultivation using a medium consisting of rice field mud, chicken manure, and tofu pulp. This formulation of plant and animal-based materials is expected to be a solution in increasing the productivity and quality of silkworms. The purpose of this study was to examine the effect of rice field mud, chicken manure, and tofu pulp on silkworm growth.

METHODS

Research Location and Time

This research will be conducted at Family Pisces Farm, located at Jl. Pasir Jambak No.20, Pasie Nan Tigo, Kec. Koto Tangah, Padang City, West Sumatra 25586. The research will be conducted from August 5 to August 21, 2025.

Tabel 1. Research Materials and Tools

No	Materials	Tools
1	Silkworms	Plastic Container (38 cm x 18 cm)
2	Chicken Manure	Scales
3	Compost Mix (Chicken Manure & Tofu Pulp)	Thermometer
4	Tofu Pulp	pH Meter
5	Catfish Pond Water	Stirring Tool
6	EM4	

Research Design

The study used a completely randomized design (CRD) with 4 treatments and 3 replicates, resulting in a total of 12 experimental units, referring to (Hafsah et al., 2023).

Table 2. Composition of Silkworm Media

Treatment	Media Composition (Chicken Manure: Tofu Pulp)
P1	Mud 100%
P2	Mud 50% : Tofu Pulp 50%
P3	Mud 50% : Chicken Manure 50%
P4	Mud 50% : Chicken Manure 25% : Tofu Pulp 25%

Research Steps

The feed consists of chicken manure and fermented tofu pulp using EM4 solution. The EM4 activation process is carried out by mixing molasses and water in a 1:2 ratio, namely 0.5 liters of molasses and 1 liter of water for every 100 mL of EM4. The entire mixture is then boiled, poured into jars, and left to cool for one day. Once cooled, 100 mL of EM4 is added to the mixture, which is then sealed and fermented for five days while being shaken at least once a day (Fajri *et al*., 2014).

Silkworms are spread by weighing 10 g per container and spreading them evenly, then maintaining them for 15 days, changing the water every two days if it becomes cloudy. After 15 days of maintenance, the worms are harvested and cleaned, then weighed to determine their final weight.

Observed Parameters

The parameters observed in this study included:

1. Absolute growth of silkworm biomass.

The calculation of absolute growth based on silkworm weight according to Umidayati *et al*. (2021) is:

$$G = Wt – Wo$$

Where:

G : Absolute growth of silkworms (g)
Wt : Weight of silkworms at harvest (g)
Wo : Weight of silkworms at release (g)

2. Productivity of Silkworms (*Tubifex* sp.)

Worm productivity is measured based on the total biomass produced per unit of time. Productivity can be measured using the formula by Umidayati *et al*. (2021):

$$P = Bt/T$$

Where:

P : Silk worm productivity (g/day)
Bt : Total biomass of harvested silkworms (g)
T : Rearing time (days)

3. Relative Growth of Silkworms

Relative growth uses the formula according to Patongloan *et al*. (2023):

$$GR = (Wt - W0) / W0 \times 100$$

Where:

GR : Relative growth (%)
WT : Average weight at the end of the experiment
W0 : Average weight at the start of the experiment

4. Water Quality

pH, measures the acidity or alkalinity of the medium to determine whether pH affects silkworm growth. Temperature, measures the temperature in the medium to determine the effect of temperature on silkworm activity.

Data Analysis

After the data was obtained, analysis was performed using analysis of variance (ANOVA) to determine whether there were significant differences in silkworm growth between different treatments. If the ANOVA results showed significant differences, Duncan's Multiple Range Test (DMRT) was then performed to determine which treatment produced the best results.

RESULTS

Absolute Growth

The results of observations on the absolute growth of silkworm biomass can be seen in Figure 1.

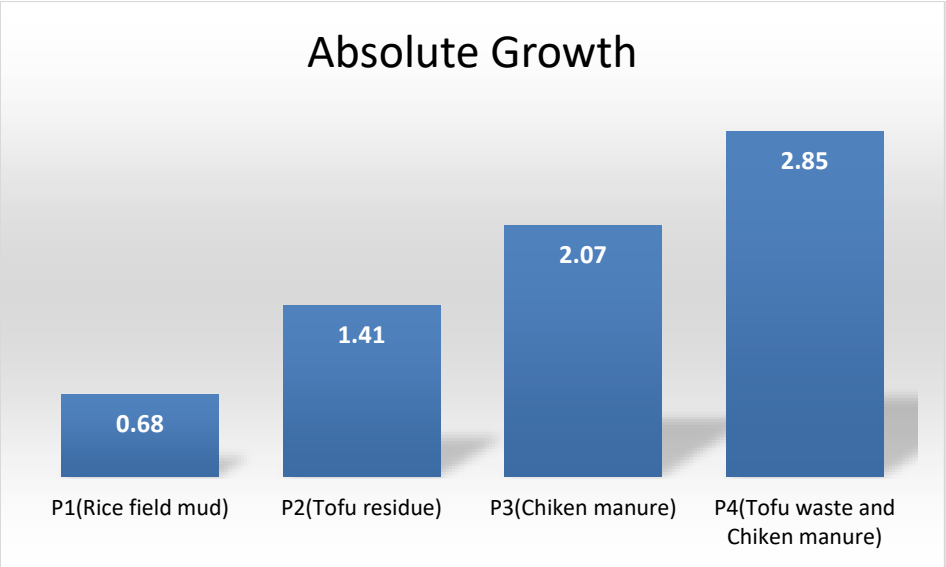

Figure 1. Absolute Biomass Growth

Based on the findings presented, the absolute growth of silkworm biomass showed different variations in each treatment. The highest growth was achieved in P4 with an average of 2.85 g, followed by P3 with 2.07 g, P2 with 1.41 g, and P1 with 0.68 g. In P3, biomass growth was quite high, ranging from 2.07 g. This indicates that chicken manure is quite effective in supporting silkworm growth thanks to its abundant and easily decomposable nutrient content. On the other hand, P2 produced moderate biomass growth with a range of 1.41 g. Although tofu pulp contains high protein, its use as a single medium is less than optimal due to the limited macro nutrients essential for silkworm growth. The lowest growth was found in P1 with a range of only 0.68 g.

From the results of the one-way ANOVA analysis, it was revealed that the maintenance medium treatment had a significant effect on the total biomass growth of silkworms. The F-value reached 102.50 with a p-value of 0.000001 (p). The DMRT test results showed that there was a significant difference in the absolute growth of silkworms between P4 and P3, P2, and P1, where P4 produced significant absolute growth. In their study, Patongloan *et al*. (2023) also argued that treatment with 10 grams of mud, 5 grams of chicken manure, and 5 grams of tofu pulp fermented with EM-4 resulted in an average absolute biomass growth of 11.83 grams.

Based on the ANOVA results for the absolute biomass growth of silkworms (*Tubifex* sp.), the "Porb F" value (0.0008) < 0.01, it can be concluded that the differences in silkworm media treatments were significantly influenced by the treatments tested. Sucipto *et al*. (2023), the research shows that the absolute weight growth of silkworms has different percentage values for each treatment, with treatment D having the highest value of around 16.77% (50% pond mud + 30% chicken manure + 20% palm oil waste).

Productivity of Silkworms (*Tubifex* sp.)

Productivity is measured based on total biomass produced per unit of time. Data on silkworm productivity can be seen in Table 3 below:

Table 3. Productivity of Silkworms

No.	Treatment	Productivity (g/day)			Average
		Sample Replicate 1	Sample Replicate 2	Sample Replicate 3	
1	P1 (Rice Field Mud)	0.70	0.72	0.71	0.71
2	P2 (Tofu Residue)	0.75	0.77	0.76	0.76
3	P3 (Chicken Manure)	0.80	0.81	0.81	0.80
4	P4 (Tofu Waste and Chicken Manure)	0.84	0.87	0.86	0.86

Source: Data Processed (2025)

Silkworm productivity shows variation depending on the type of treatment applied Table 1 shows that the daily yield of silkworms varies based on the treatment. Treatment P4, which uses tofu pulp and chicken manure, produces the highest average yield of 0.86 g/day. This shows that the combination of these two organic materials is able to provide more comprehensive nutrition for silkworms.

Tofu pulp serves as a source of vegetable protein, while chicken manure contains many nutrients such as nitrogen and phosphorus. This allows nutrients to be quickly available and directly utilized by silkworms. Therefore, even when not mixed with other materials, chicken manure remains a good medium for silkworm cultivation.

Meanwhile, in treatment P2, the average productivity achieved was 0.76 g/day. These results indicate that tofu residue can support silkworm growth, but not to the maximum extent compared to chicken manure. This may be because although tofu residue is rich in protein, its content of other macro nutrients is still limited and insufficient to significantly increase productivity. Finally, treatment P1 produced the lowest average of 0.71 g/day. This low value indicates that rice field mud is not ideal for use as a single medium in silkworm cultivation. Its nutritional content is inadequate to support biomass growth or daily productivity.

Overall, the findings of this study indicate that P4 is the best choice for increasing silkworm productivity. This combination yields higher results than the use of a single medium, making it an efficient and environmentally friendly solution for silkworm cultivation by utilizing inexpensive and readily available organic waste. The results of the ANOVA analysis also show that there are significant differences in silkworm productivity between different treatments (F-count = 96.32; p-value = 0.000001). Where P4 shows a significant difference in productivity compared to P3, P2, and P1.

These results are also in line with the research by Setiadi *et al*. (2023), which states that observations of silkworm growth during a 30-day maintenance period show that the treatment of 80% tofu pulp, 10% rice bran, and 10% fish meal has the highest biomass, productivity, and population. Based on the ANOVA test results in SPSS Version 26, the sig values for biomass, productivity, and population were found to be significant (P <0.05).

Relative Growth of Silkworms (*Tubifex* sp.)

The data on the relative growth of silkworms can be seen in Figure 2.

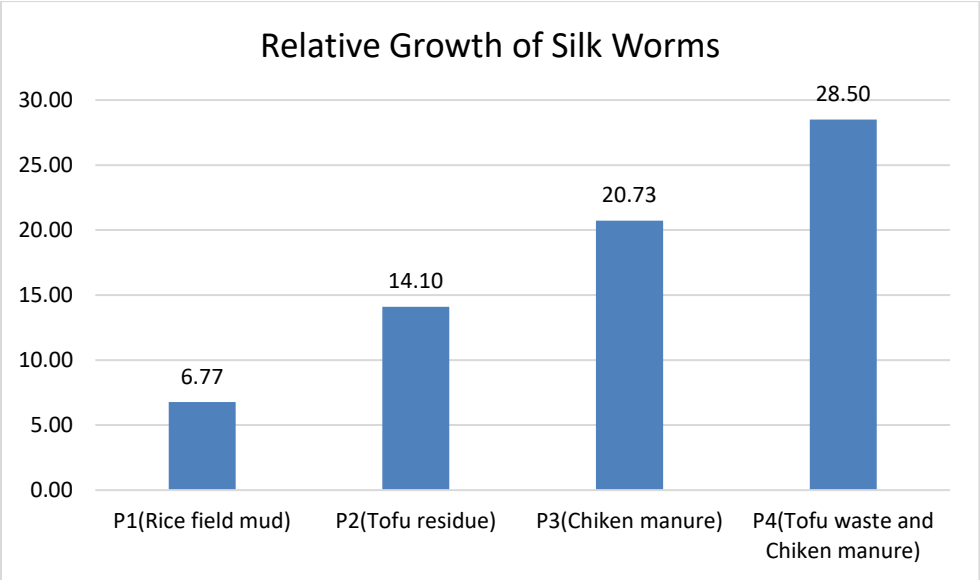

Figure 2. Relative Growth of Silkworms (*Tubifex* sp.)

The relative growth graph of silkworms shows clear differences between treatments. The highest growth was obtained in P4 with a value of 28.50%. This means that the combination of the two media was able to provide more complete nutrition, thereby supporting optimal silkworm growth. Treatment P3 ranked second with a growth rate of 20.73%. P2 produced a relative growth of 14.10%. Tofu pulp has beneficial protein content, but other nutrients are less abundant, so its growth is not as good as P3 or P4.

The lowest growth was found in P1 with a value of 6.77%. This shows that rice field mud is less suitable for use as a single medium because its nutrient content is limited. Overall, the best medium is P4, followed by P3, P2, and finally P1. These results prove that a combination of organic materials can improve silkworm growth better than a single medium.

The results of relative growth observations over 15 days showed an increase in each treatment. The lowest relative growth was found in rice field mud (6.77%), increasing in tofu pulp (14.10%), higher in chicken manure (20.73%), and highest in the combination of tofu pulp + chicken manure (28.50%).

The ANOVA test showed that the difference in relative growth in silkworms was significant (F-count = 102.50; p-value < 0.05). The DMRT test results showed that all treatments were significantly different from each other, with the combination of tofu pulp and chicken manure as the best medium.

Thus, chicken manure, whether used alone or in combination with tofu pulp, can be recommended as the best medium for silkworm cultivation, as it has been proven to produce the highest relative growth compared to other treatments.

Water Quality Parameters

Water quality is one of the determining factors in silkworm cultivation, as it greatly affects their metabolic activity, growth, and survival. In this study, the water quality parameters observed were temperature and pH. The water quality parameters can be seen in Table 4.

Table 4. Water Quality Parameters

No	Parameter	Unit	Water Quality							
			Pre-Research				Post-Research			
			P1	P2	P3	P4	P1	P2	P3	P4
1.	Temperature	^{o}C	26.6	26.6	26.6	26.6	26.8	27.4	26.1	27.8
2.	pH	-	6.5	6.5	6.5	6.5	6.8	7	7	7.2

Temperature measurements at the beginning of the study showed similar results for all treatments, namely 26.6°C. After 15 days of observation, the water temperature showed little change. The temperature in the rice field mud treatment rose to 26.8°C, while the treatment with tofu pulp increased to 27.4°C; for the combination treatment of tofu pulp and chicken manure, the temperature rose to 27.8°C, while the chicken manure treatment actually decreased slightly to 26.1°C.

This temperature range (26.1–27.8°C) is still within the acceptable limits for silkworm cultivation. The difference in temperature between treatments was most likely influenced by the decomposition process of organic matter. In treatments using tofu pulp and chicken manure, the activity of microorganisms in fermenting organic matter tended to be more active, thereby generating heat and slightly increasing the temperature. Conversely, media that only used chicken manure reached stability more quickly, so the temperature was relatively lower.

At the beginning of the study, the pH value of the water was uniform across all treatments at 6.68. After 15 days, the pH in treatment P1 increased to 6.85, P2 to 7.05, P3 to 7.15, and P4 to 7.07. The increase in pH that occurred at the end of the study was most likely caused by the decomposition of organic matter, especially chicken manure, which produces alkaline compounds such as ammonia. However, the measured pH value is still safe for silkworms.

In other words, water quality factors are not a major obstacle in this study. Differences in the productivity and growth of silkworms are more controlled by variations in the type of feed media (rice field mud, tofu pulp, chicken manure, and combinations of these media).

DISCUSSION

Absolute Growth

These results are in line with the findings of Agustina *et al*. (2020), who stated that the growth of silkworm biomass in tofu pulp media was higher than in vegetable waste media and the control variable (without tofu pulp and vegetable waste). Masaniku *et al*. (2023) also found that the application of chicken manure fertilizer can affect the growth of silkworms. This shows that the combination of the two media can provide more comprehensive and balanced nutrients, thereby promoting maximum silkworm biomass growth.

This combination produces a better synergistic effect than the use of a single medium. Hafsah (2023), all materials used as substrates have the same concentration ratio so that they can meet the nutritional requirements for silkworm growth. Hidayat & Iskandar (2020), the application of fertilizers at different doses will directly affect the organic matter in the medium. Thus, the more organic matter in the medium, the greater the number of organic particles and bacteria, which affects the amount of food in the medium and influences the absolute length of silkworms.

Productivity of Silkworms (*Tubifex* sp.)

Molese & Suherman (2022), the tofu pulp provided contains protein that has undergone a processing and fermentation process, making it easier for silkworms to absorb and thereby increasing silkworm biomass production. The combination of these two materials creates a more balanced environment, supporting silkworm growth and optimal productivity. Furthermore, the P3 treatment produced an average of 0.85 g/day. Chicken manure has proven to be quite efficient because it has a high organic content and is easily decomposed (Masaniku *et al*., 2023). Umidayati & Sinung (2020), while productivity in conventional systems only reaches 0.5 liters per square meter per month, productivity in apartment systems reaches a minimum of 1.2 liters per square meter per month.

Relative Growth of Silkworms (*Tubifex* sp.)

The difference in the average relative growth of silkworms in each treatment is thought to be influenced by the space or living environment, in addition to the amount of food available during the silkworm culture process, which can also affect the silkworm population. Patongloan *et al*. (2023) in their study also argued that the ANOVA results for the relative growth of silkworms referred to the "Porb F" value (0.0008) < 0.01, so it can be concluded that the differences in silkworm media treatments were significantly influenced by the differences in the treatments tested.

Water Quality Parameters

Aryzegovina *et al*. (2023), the optimal temperature is between 25–30°C, while the temperature in the research medium ranged from 27–28°C, meaning that the temperature in the research medium was still suitable for the life of Tubifex sp. worms. Hasibuan (2021) states that the ideal temperature for silkworm growth is between 25–28°C, as this range allows for optimal metabolism and reproduction. Research conducted by Setiadi (2020) also shows that maintaining silk worms at a temperature between 26–28°C produces better results than temperatures below 24°C. Putri *et al*. (2019) shows that maintaining silkworms in a medium with a pH close to neutral provides a better growth rate compared to a medium with a high acidity level (pH > 8).

Based on the research results and comparison with previous studies, it can be concluded that the water quality parameters in this study support optimal conditions for silkworm growth and productivity, and are also in line with the recommendations provided by Simanulung (2021), which sets the optimal pH at 6.5–7.5.

CONCLUSION

Chicken manure, rice paddy mud, and tofu pulp have a significant effect on silkworm growth. Each type of medium provides a different level of biomass growth, so the choice of medium is crucial to the success of cultivation. Among the media tested, the combination of chicken manure and tofu pulp proved to be the most effective in supporting the biomass growth of silkworms. This combination is able to provide more balanced nutrients, resulting in more optimal growth compared to other media.

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