Fermentation of Cassava Skin Waste and Beef Cattle Manure as Growing Media on The Condition of Maggot (*Hermetia illucens*) Media

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ABSTRACT

This study aims to determine and examine the use of beef cattle manure and fermented cassava skin waste as a growing medium on the condition of the Black Soldier Fly (BSF) maggot media. The research method used a Completely Randomized Design (CRD) consisting of 5 treatments and replications. Treatment (P0 = 100% Beef cattle manure; P1 = 80% Beef cattle manure + 20% Fermented Cassava Peel; P2 = 60% Beef cattle manure + 40% Fermented Cassava Peel; P3 = 40% Beef cattle manure + 60% Fermented Cassava Peel; P4 = 20% Beef cattle manure + 80% Fermented Cassava Peel. The variables observed were pH, morning temperature, afternoon temperature, and evening temperature. The data obtained were analysed using ANOVA. Significantly different results were further tested using Duncan. Fermentation of cassava and beef cattle skin waste as a maggot growth medium had a significant effect (P <0.05) on pH and afternoon temperature but had no significant effect on morning and afternoon temperature. This study concluded that treatment P4 had the highest average at noon and afternoon temperatures of 31.92^{0}C; 29.83^{0}C, treatment P0 was highest at pH of 8.57. The highest P2 treatment fibre at a morning temperature of 26.34^{0}C. The pH and temperature of the media in this study can still be tolerated by maggots for their growth and development.

Keywords: *Fermented Cassava Peel, beef Cattle Manure, Temperature, pH.*

INTRODUCTION

Feed is one of the most important factors in livestock farming. Sources of protein in poultry feed come from fish meal, meat meal, soybean meal, blood meal, peanut meal, and others (1). These protein sources are not yet available on the market at affordable prices for small and medium-scale poultry farming businesses. However, the demand for raw feed materials such as fish and soybean meals is increasing, making raw protein materials more expensive (2). Importing raw materials from high-quality protein sources also causes expensive feed prices. Efforts that can be made to reduce high production costs are by using alternative feed ingredients. One alternative feed that can be used is maggots or Black Solider Fly (BSF) larvae.

Maggot, also known as *Hermatia illucens*, is a type of fly from the *Stratiomydae family* commonly found in grass and leaves (3). This type of fly is black and looks like a wasp. Maggot can be used as animal feed as a source of protein because it has 40-50% protein (4). Maggot production is relatively fast; in one laying, it can produce 500-900 eggs (5). The price of maggots on the market is relatively low, at IDR 8,000 per kg (6). Maggot cultivation can be affected by the growing medium used to support maggot production. Maggots are able to grow and develop on media that contain nutrients that are suitable for their life needs (7). One of the wastes from agro-industrial activities is cassava peels, while livestock waste is beef cattle manure.

Cassava peel waste is usually used as animal feed because it contains higher

crude fibre and protein than tubers, making it a potential medium for growing maggots. The nutrient content of cassava peel includes 74.53% water content, 11.35% crude fibre, 9.46% ash, 2.27% crude fat, 79.60% BETN, and 6.78% crude protein (8). Cassava peel is used as feed in small amounts because it contains cyanide acid (HCN), which is harmful to livestock if consumed (9) Cyanide acid in cassava peel ranges from 150-360 mg/kg fresh weight (10). The high levels of cyanide in cassava peel need to be reduced by fermentation. According to (11), five-day fermentation can reduce HCN content by 0.015%. In addition to cassava peel waste, cattle manure, which is usually used as manure, can also be used as a growing medium for maggots. Cow manure contains nutrients, including 18.8% BETN and 8.3% protein (12). Cow manure also contains 10.42% C-organic nutrients, 0.88% nitrogen (N-total), 0.34% phosphorus (P-total), and 0.56% potassium (K2O) (13). These nutrients are very supportive of maggot cultivation.

The growth of BSF maggots is supported by the conditions of the media used. The pH and temperature of the media have an impact on BSF maggot activity. Maggots can grow at media temperatures around 27-30°C, and maggots cannot survive at temperatures of more than 36°C with media moisture of more than 60% (14). (15) state that the pH of the medium for maggot growth ranges from 6-8, but BSF maggots are adaptable to environmental conditions with a pH of 0.7-13.7 (16).

Based on the description above, research is needed to determine the best maggot growth media, including pH and temperature conditions, with the fermentation of cassava peel waste and cattle manure as a growing medium.

MATERIAL AND METHODS

This research was conducted from May 2024 to June 2024. Maggot maintenance media was prepared at the Maggot House, Sempu Hamlet, Ngadirojo Village, Secang District, Magelang Regency, Central Java Province.

The tools used in this study include gallon containers, tubs or buckets, fermentation barrels, air hoses, small mineral water bottles, digital scales, choppers, Digital HTC-2, stirring sticks, sieves, HT digital pH meters 02, maggot wire stands, gloves, documentation tools, and stationery. The materials used in the study were maggot eggs, cattle manure, cassava skin, EM4, molasses, glue, water, duct tape, sacks, tissue, and plastic.

The experimental design used in the study was a Completely Randomized Design (CRD) with five treatments and five replications. The treatments to be used in this study were: P0: 100% Beef cattle manure; P1 = 80% Beef cattle manure + 20% Fermented Cassava Peel; P2 = 60% Beef cattle manure + 40% Fermented Cassava Peel; P3 = 40% Beef cattle manure + 60% Fermented Cassava Peel; P4 = 20% Beef cattle manure + 80% Fermented Cassava Peel

RESULT

pH

pH is an external factor supporting maggot growth in the growing medium. Based on the ANOVA test, fermentation of cassava peel waste and beef cattle manure as a maggot growing medium had a significant effect ($P < 0.05$) on the pH of the growing medium.

The results of Duncan's further tests, fermentation of cassava skin, and beef cattle manure on pH can be shown in Figure 1.

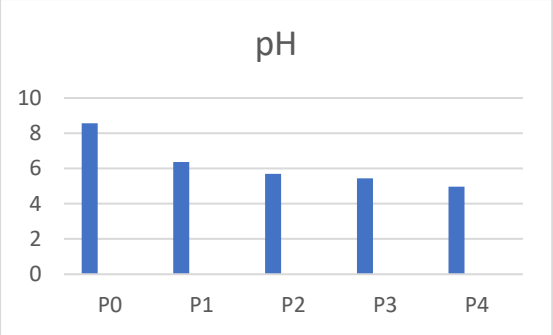

Figure 1. Effect of treatment on media pH

MORNING TEMPERATURE

Morning temperature is one of the external factors that affect maggot growth. Figure 2 shows the results of the ANOVA test of cassava skin fermentation and beef cattle manure on morning temperature.

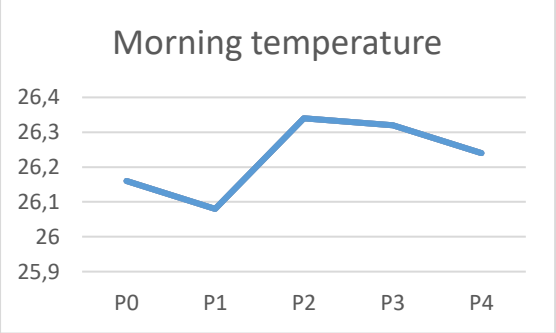

Figure 2. Effect of cassava skin fermentation and beef cattle manure on morning temperature

AFTERNOON TEMPERATURE

Based on the ANOVA test, the fermentation of cassava peel waste and beef cattle manure as a maggot growth medium had a significant effect (P <0.05) on the temperature of the medium during the day. Based on Duncan's further test, the fermentation of cassava skin and beef cattle manure at daytime temperatures can be shown in Figure 3.

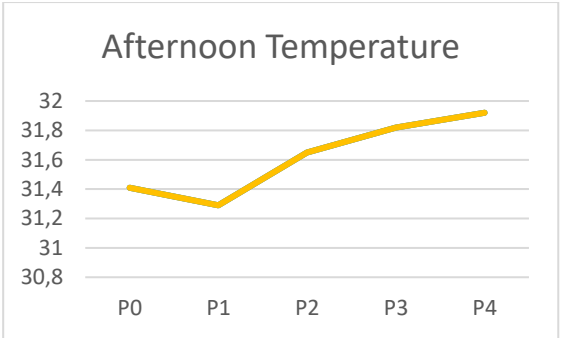

Figure 3. Effect of cassava skin fermentation and beef cattle manure on daytime temperatures

EVENING TEMPERATURE

Figure 4 shows the results of the ANOVA test of cassava skin fermentation and beef cattle manure at afternoon temperatures.

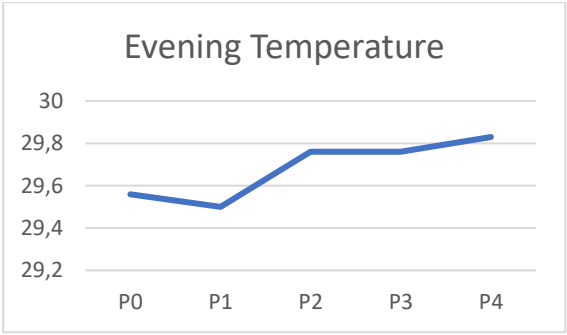

Figure 4. Effect of cassava skin fermentation and beef cattle manure on evening temperatures

Based on ANOVA, it shows that the fermentation of cassava peel waste and beef cattle manure as a medium for growing maggots has no significant effect (P>0.05) on the temperature of the media in the afternoon.

DISCUSSION

pH

Fermentation of cassava peel waste and beef cattle manure as a maggot growing medium had a significant effect (P <0.05) on the pH of the growing medium. This is thought to be because adding fermented cassava peel waste to the growing medium causes the medium to become relatively acidic. This follows (17), who state that the growth medium has an acidic pH because the medium is fermented first.

The beef cattle manure media that is not supplemented with fermented cassava skin waste has a higher pH than the beef cattle manure media that is supplemented with fermented cassava skin waste. This is due to the activity of microorganisms involved in the fermentation process, which produces organic acids that can lower the pH.

This shows that adding cassava skin fermentation to the growing medium affects high and low-pH production. The addition of cassava skin fermentation causes the media conditions to become acidic, so the pH drops. In addition, microbial activity also causes acid in the media. Based on (18), microbial activity causes the temperature to rise and produces organic acids.

Based on Figure 1. The lowest pH was found in P4 at 4.97, and the highest in P0 at 8.57. The pH of P0 is quite high because no microbial activity causes the medium to be acidic, but P1-P4 has been added with fermentation at different levels for each treatment. P4 has a low pH because more fermentation is added so that bacterial activity is; according to (19), the higher the fermentation levels in a medium, the lower the pH of the medium will be.

The pH value of the media in this study was 4.97-8.57, which is still considered good as a maggot-growing medium. According to (16), maggots have a pH tolerance of 0.7-13.7. In addition, the pH used can support maggot growth because maggots resist extreme media conditions.

MORNING TEMPERATURE

The fermentation of cassava peel and beef cattle manure as a growing medium for maggots did not significantly affect morning temperatures (P>0.05). This is because in the morning, the maggots are not very active in eating, and the light intensity is still low. (16) that insect activity starts at 08.00 and is very active from 09.00 am to 2.00 pm with a morning light intensity of 110 µmol m^2s^1. In addition, the temperature in the morning is still cold, so the maggots are not very active in eating and wait for the temperature to warm up. According to (20), maggots prefer warm environmental temperatures, but if the ambient temperature is cold, then the maggots are not active.

Based on Figure 2. The highest temperature in the morning was found in the P2 treatment at 26.34 ^{0}C and the lowest in P1 at 26.08 ^{0}C. This is because the P2 maggot treatment ate more actively than the P1 treatment. The morning temperature in this study ranged from 26.08 -26.34 ^{0}C, which was less than ideal for maggot growth, so maggots tended to be inactive. The ideal temperature for maggot growth is 27-36^{0}C (14;21). Although the media temperature in the morning is still not optimal, maggots can still grow because maggots can survive in extreme environments.

AFTERNOON TEMPERATURE

Fermentation of cassava peel waste and beef cattle manure as a maggot growth medium had a significant effect (P <0.05)

on the temperature of the medium during the day. This is thought to be because the maggots are very active in eating during the day, and the temperature of the medium increases. This follows (22), who state that the increase in temperature in the medium is due to the heat generated from the fibre hydrolysis process in the growth medium carried out by maggots and microbes to produce energy. In addition, the transfer of heat from the cage into the container also causes the temperature to increase.

Based on Figure 3. It was found that Treatment P4 had the highest daytime temperature value of 31.92^{0}C, and the lowest temperature in Treatment P1 was 31.29^{0}C. This shows that the addition of cassava skin fermentation has an impact on increasing the temperature of the media because the media will become acidic, which causes the pH of the media to drop. The high media temperature is due to microbial activity that produces heat energy into the container due to fermentation. This follows (18) that microbial activity causes an increase in temperature and produces organic acids.

The media temperature during the day ranges from 31.29 - 31.92^{0}C, which is still good for maggot growth and development. This follows (14) and (21), who state that the best media temperature conditions are 27-36 ^{0}C. The temperature during the day is suitable for maggots, allowing them to develop and grow well.

EVENING TEMPERATURE

Fermentation of cassava peel waste and beef cattle manure as a medium for growing maggots has no significant effect (P>0.05) on the temperature of the media in the afternoon. It is suspected that the activity of maggots in eating begins to gradually decrease according to (23) that BSF Maggots will be active since 08.30 WIB and their peak activity is at 11.00 WIB and according to (16) that in the afternoon maggot activity gradually decreases. In addition, the temperature of the cage environment, which is still hot because the light intensity is still high, causes heat transfer from around the cage into the fermentation container so that the temperature in the afternoon in the growing media container is still hot.

Based on Figure 4. It was found that the P4 treatment had the highest temperature in the afternoon of 29.83^{0}C. This is thought to be because P4 added higher fermentation so that more microbial activity emits heat in the container. This follows (20), who state that microbial activity during fermentation emits heat to the surrounding maggot environment. The afternoon temperature value in this study ranged from 29.50 - 29.83 ^{0}C, which is the ideal temperature to support the growth and development of maggots. This follows (14), who state that maggots can be at a media temperature of around 27-30^{0}C and cannot survive at temperatures above 36 ^{0}C.

CONCLUSION

Based on the results of this study, it can be concluded that the fermentation of cassava peel waste and beef cattle manure as a growing medium has a significant effect on increasing pH and daytime temperature but not significantly on morning and afternoon temperatures. Treatment P4 had the highest average noon and afternoon temperatures of 31.92^{0}C and 29.83 ^{0}C. Treatment P0 was highest at a pH of 8.57, while the highest morning temperature was in P2 at 26.34^{0}C. The pH and temperature of the media in this study were still tolerable for maggots' growth and development.

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