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The Effectiveness of Maggot (*Hermetia Illucens*) Growth in Various Growing Media

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Abstract. Utilization of maggot as a substitute for protein source feed ingredients can be a solution to overcome the high cost of feed. However, the inappropriate growth media caused the growth of maggots to be inhibited. Palm kernel cake, vegetable and fruit waste have high nutritional content which has the potential as a medium for growing maggots. The purpose of this study was to determine the best growth of maggot on various growing media. The treatments given in this study were $P0_A$ = 100% palm kernel cake; $P0_B$ = 100% vegetable and fruit waste; P1 = palm kernel cake 75% + vegetable and fruit waste 25%; P2 = palm kernel cake 50% + vegetable and fruit waste 50%; P3 = palm kernel cake 25% + vegetable and fruit waste 75%. The results showed that the use of growing media from mixing 25% palm kernel cake + 75% vegetable and fruit waste (P3) gave better results as a growth medium for the effectiveness of the growth of maggot. This is due to the nutritional needs of maggots for its growth have been met from the nutritional content and organic matter available in optimum quantities in the growing media. It was concluded that the growing media from palm kernel cake with vegetable and fruit waste had effectiveness in increasing the growth of maggot.

Keywords: fruit waste, growing medium, maggot, palm kernel cake, vegetable waste

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1. Introduction

Utilization of Black Soldier Fly larvae (Hermetia Illucens) has been widely used in fish and poultry farms as an alternative feed ingredient or as a substitute for conventional protein sources. According to Vanessa et al. [1] Maggot flour (Black Soldier Fly) has the potential as a substitute for fish meal up to 100% for broiler feed mixtures without negative effects, although the best results are obtained from fish meal replacement up to 25% or 11.25% on feeding. However, maggot cultivation activities are still very limited because the success rate of maggot cultivation is still low, this is related to the nutrient content of the growing media used and environmental conditions/temperatures that are not suitable, where quality planting media will produce high maggot production because it can provide sufficient nutrition for the growth and development of

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maggots. According to Dina, Edriani, and Putri [2] The success in maggot production is determined by the nutrient content of the media and environmental conditions, where maggot likes humid environmental conditions. Saurin et al. [3] added that a quality growing media will result in higher maggot production because it can provide sufficient nutrition for the growth and development of maggot.

Palm kernel cake, vegetable and fruit waste have the potential to be used as growth and bioconversion media for mass production of maggot larvae in maggot *(Hermetia Illucens)* cultivation. This is because palm kernel cake, vegetable and fruit waste still contain nutrients in the form of protein, fat, water, carbohydrates. According to Anis, Tampubolon and Achmadi, [4], the crude protein content in vegetable waste is 12.64% - 23.50% and crude fiber content is 20.76% - 29.18%. In addition, palm kernel cake is a by-product with the highest nutritional value with crude protein content varying from 15% to 17%, the other largest component is cellulose which is resistant to biological degradation and acid hydrolysis [5]. Based on research Lisa [6], The use of growing media for maggot with treatment A = vegetable waste (500 g), B = fruit waste (500 g), C = a combination of vegetable waste (250 g and fruit 250 g) that was reared for 20 days, shows the results of the highest population density, weight and length of maggot produced in the combination treatment of vegetable and fruit waste, namely the average population density of 0.20 tail/cm3, weight 383 g and maggot length 2.186 cm. Furthermore, research by [7] showed that the combination of 75% palm oil cake media and 25% fermented rice bran resulted in the highest maggot production with an average maggot weight of 0.159 g and an average maggot length of 1.72. The purpose of this study was to determine the growth of maggot (*Hermetia Illucens*) is best on a variety of growing media.

2. Materials and Methods

The materials and tools used in this study were eggs from the *Black Soldier Fly* as much as 1.5 g, palm kernel cake 7.5 kg, a mixture of vegetable and fruit waste 7.5 kg, probiotics (EM4) and aquadest, basins, wire network/ ram, digital scales, manual scales. This study used a completely randomized design consisting of 5 treatments and 3 replications. The treatments given in the study with a maintenance period of 21 days were: $P0_A$ = 100% palm kernel cake; $P0_B$ = 100% vegetable and fruit waste; P1 = Palm kernel cake 75% + vegetable and fruit waste 25%; P2 = Palm kernel cake 50% + vegetable and fruit waste 50%; P3 = Palm kernel cake 25% + vegetable and fruit waste 75%. Palm kernel cake is fermented for 7 days with a ratio of Palm kernel cake : Water : EM4 = 1 kg : 2 liters : ± 100cc. *Black Soldier Fly* eggs were stocked as much as 0.1 g/kg of growing media in each treatment which had been placed in a basin with a diameter of ± 60 cm and a height of ± 45 cm, then maggot was reared for 21 days as the time for maggot growth. Harvesting of maggot was carried out on day 21 by separating the maggot from the media using tweezers and washing it with clean water. Furthermore, observations and measurements of

research parameters were carried out including maggot population density, production weight and maggot length. Statistical analysis was performed using ANOVA [8], where significantly different results were followed by *Duncan's Multiple Range Test* (DMRT).

3. Results and Discussion

3.1. The Population Density of Maggot

The population density of maggot (tail/cm3) obtained from the division between the number of maggots and the volume of media in each treatment medium is presented in Figure 1. Based on the results of statistical analysis, the population density of maggot *(Hermetia illucens)* showed that the combination of palm kernel cake (BIS) with vegetable and fruit waste as maggot growing media had a significant effect on the population density of maggot *(Hermetia illucens)* harvested after a 21-day rearing period. According Lisa [6], maggot maintenance on the 20th day is the peak of the increase in the maggot population and on the 20th day of maintenance, maggot harvesting should be carried out. Further analysis *(Duncan Multiple Range Test)* showed that mixing palm kernel cake with vegetable and fruit waste as maggot growing media in P3 treatment significantly increased the maggot population density compared to the control treatment.

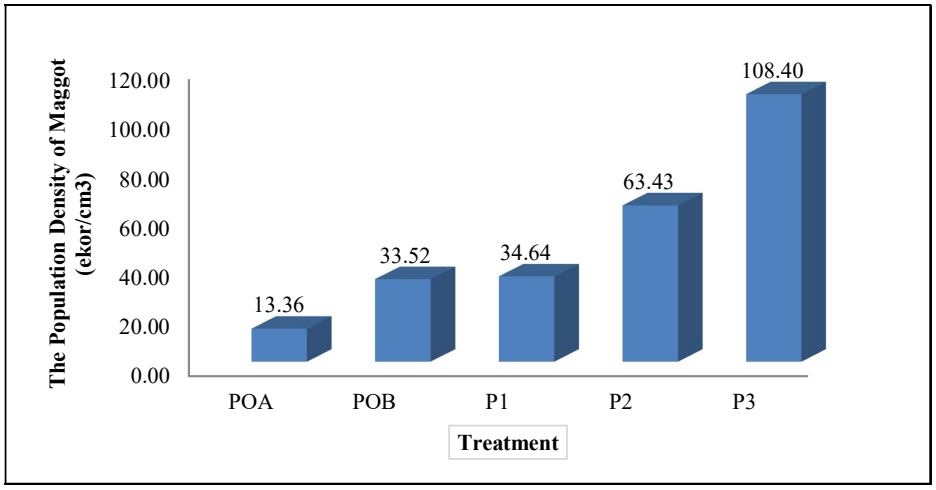

Figure 1. The Use of Various Growing Media on the Population Density of Maggot

The highest maggot population density produced was P3 treatment (palm kernel cake 25% + vegetable and fruit waste 75%) which was 108.40 tail/cm^3. This indicates that the growing media in treatment (P3) has optimum nutritional content so that it can stimulate increased growth and development of maggots. According to Ahmad, Sipayung and Putra [9] Optimum nutrient content in maggot growing media is very influential to produce maggot production with high value and maggot weight with good quality. On the other hand, the high content of organic matter in the growing media from mixing 25% BIS with 75% vegetable and fruit waste (P3 treatment) can increase the growth of the number of bacteria in the media, where the bacteria will produce organic particles produced. of the bacterial decomposition process. This organic will be a source

of maggot food in the growing media. According to Lisa [6] Vegetable waste contains beneficial microbes and high organic acids in the form of lactic acid derived from the metabolism of lactic acid bacteria. [4] added that the crude protein content in vegetable waste was 12,64% - 23,50% and crude fiber content was 20,76% - 29,18%. In addition, palm kernel cake is a by-product with the highest nutritional value with crude protein content varying from 15% to 17%, the other largest component is cellulose which is resistant to biological degradation and acid hydrolysis [5]. Based on research Lisa [6], the best maggot population density with an average of 0,20 tail/cm3 was produced by growing media that came from a mixture of 250 g of vegetable waste and 250 g of fruit waste. On the other hand, POA treatment (BIS 100%) had the lowest population density because palm kernel cake experienced dryness or decreased humidity due to the dewatering nature of the maggot. According to Dina, Edriani, and Putri, [2] Success in maggot production is determined by the nutrient content of the media and environmental conditions, where maggot likes humid environmental conditions.

3.2. The Weight of Maggot Production

The weight of maggot production obtained from weighing the harvested maggot on each treatment medium can be seen in Figure 2. The production weight of maggot (*Hermetia illucens*) in the P3 treatment growing media (palm kernel cake 25%+ vegetable and fruit waste 75%) showed the highest maggot production weight value of 144,67 g, which was then followed by P2 treatment (palm kernel cake 50% + vegetable and fruit waste 50%) and P1 (Palm kernel cake 75% + vegetable and fruit waste 25%). This shows that the combination of palm kernel cake (BIS) with vegetable and fruit waste as a medium for maggot growth has a significant effect on the production weight of maggot (*Hermetia illucens*).

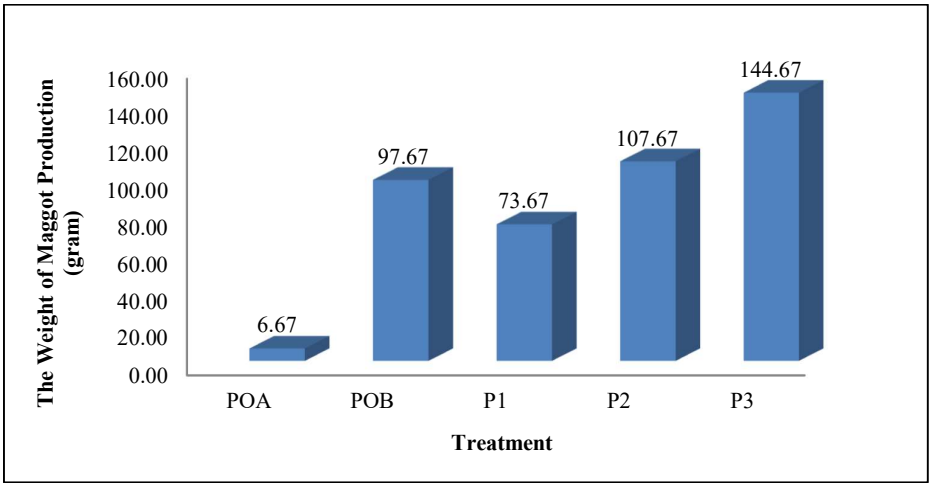

Figure 2. The Use of Various Growing Media on the Weight of Maggot Production

The highest maggot production weight in the P3 treatment was caused by the nutrient content and organic material in the growing media that were available in optimum quantities for the growth needs of maggots, where the maggots would remodel organic material and reduce nutrients into

protein to increase the growth/weight of the maggot body. According to [10] Maggot has the ability to convert organic material into body weight. Saurin et al. [3] added that a quality growing medium will produce more maggot because it can provide sufficient nutrients for the growth and development of maggots, the results of which can be measured by the weight of maggot production. Maggot production weight can reach 400 grams with egg mass ranging from 15.8-19.8 mg and individual egg weight between 0.026-0.030 mg [11].

Furthermore, environmental conditions both temperature and humidity can also affect the increase in maggot production weight, where the average temperature range during maggot maintenance in this study is 22.9 ^{o}C, while humidity during maintenance is around 54%, where this temperature and humidity are environmental conditions. optimum and suitable for the development and growth of BSF larvae (maggot). According to Leslie, Vanlaerhoven, and Tomberlin [12], the optimum newly hatched larvae live at a temperature of 28-35 ^{o}C with a humidity of around 60-70%. Katayane et al. [13] added that maggot likes a moist environment and a growing medium that has a distinctive aroma with a high content of nutrients, organic matter and crude protein.

On the other hand, the very low weight of maggot production on PO_A control media (BIS 100%) was 6,67 g. Although it is known that palm kernel cake contains nutrients, especially high crude protein content, the presence of *dewtering* properties (absorb water) possessed by maggots as one of the characteristics of maggots so that the PO_A control media experienced a decrease in humidity which resulted in the PO_A control media becoming dry and affecting the PO_A control media. growth rate of maggot (*Hermetia illucens)*. According to Melta, Hem, Subamia [14] Maggot has *dewtering* properties (absorbs water), treats organic waste, makes waste aeration, and is resistant to changes in pH and temperature. The results of research by [15] show that maggot growing media from mixing 50% palm kernel cake with 50% rice bran can produce the highest average maggot weight, which is 2622,67 g.

3.3. The Length of Maggot

The length of maggot is one of the parameters of growth other than the weight of maggot, where the measurement of the length of the maggot is a sign of the growth of maggot. The length of the maggot harvested in each treatment medium can be seen in Figure 3. Based on the results of statistical analysis, mixing palm kernel cake (BIS) with vegetable and fruit waste as maggot growing media gave a significant effect on increasing the length of maggot *(Hermetia illucens)*. The *Duncan Multiple Range Test* further test showed that mixing palm kernel cake with vegetable and fruit waste as a medium for growing maggots in P3 treatment significantly increased maggot length compared to PO_A treatment controls. This is indicated that the maggot growing media that comes from mixing palm kernel cake with vegetable and fruit waste produces a growing medium with a moisture/water content level that is suitable for the needs of maggot life, so that the maggot can grow and develop properly, especially in the development of the maggot body length.

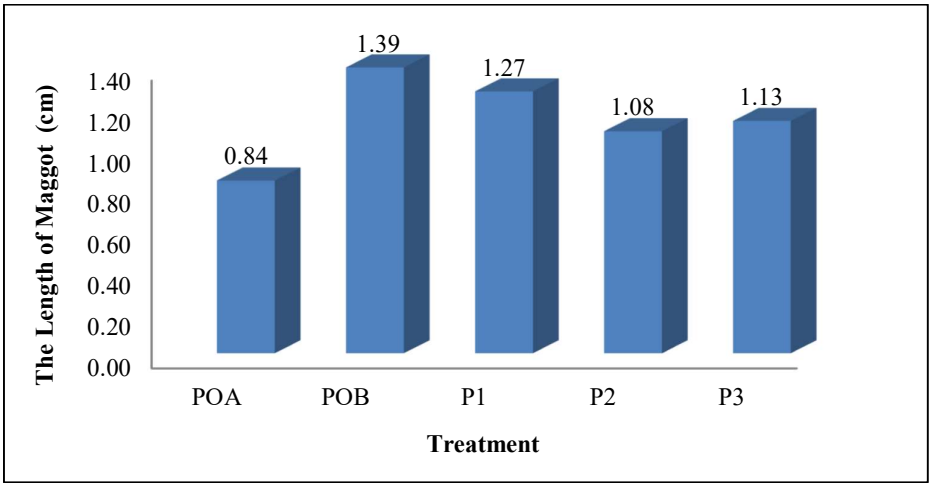

Figure 3. The Use of Various Growing Media on the Length of Maggot

On the other hand, the growth and development of maggots will be slow in growing media that have high water content such as growing media with 100% vegetable and fruit waste (PO_B). Results of the research Lisa [6] The lowest maggot length with an average of 1.68 cm is found in growing media with 500 gr vegetable waste material which has a high-water content so that it inhibits the proliferation of maggots.

However, seeing from the value of maggot length produced in this study, growing media with 100% vegetable and fruit waste material (PO_B control) produced the highest maggot length *(Hermetia illucens)* compared to treatments P1, P2 and P3 whose growth medium was a mixture of palm kernel cake with vegetable and fruit waste. This has something to do with the level of the maggot population in one growing space (maggot population density), where the PO_B treatment control has a lower population density value than the P1, P2 and P3 treatments, which is 33,52 tails/cm^3, so that the maggot has a larger space wider area to grow and develop, including in the process of increasing the length of the maggot's body. According to [13] the factors that influence the production of maggot are the density of maggot in the rearing room, the conditions of the maintenance environment and the nutrient content in the maggot growing media. Based on the research of [16] mixing palm kernel cake (BIS) with tofu dregs did not significantly affect the maggot length, but the highest average maggot length was produced in media using 100% BIS, which was 17,26 mm.

4. Conclusion and Recommendation

Maggot growing media derived from mixing core cake with vegetable waste gave a significantly different effect on increasing maggot growth both population density, maggot production weight, maggot length. Mixing palm kernel cake (BIS) 25% with vegetable and fruit waste 75% (P3) is recommended as a maggot growing medium that can produce the best effectiveness on maggot growth.

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