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ANALYSIS OF POC CONTENT OF HERMETIA ILLUCENS LARVAE FEEDED WITH PALM OIL MEAL

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ABSTRACT

Palm kernel meal (PKE) is a byproduct of Palm Kernel Oil (PKO) production that contains high levels of fiber and protein, making it potentially useful as feed for Black Soldier Fly (Hermetia illucens) larvae. BSF larvae are then processed into liquid organic fertilizer (POC) due to their high protein content. This study used a quantitative method with a descriptive comparative test approach to analyze the effect of two types of feed, namely fermented palm kernel meal (P1) and food waste (P2), on larval weight and the nutrient content of C-organic, N, P, K, and pH of POC after anaerobic decomposition for 40 days. The results showed that fermented palm kernel meal produced a higher larval weight, namely 9.90 kg, compared to food waste of 5.45 kg. However, POC from larvae with food waste feed had a higher nutrient content than POC from fermented palm kernel meal feed.

Keywords: *Hermetia illucens, palm kernel cake, liquid organic fertilizer, BSF larvae, food waste.*

INTRODUCTION

Indonesia, as the world's largest palm oil producer, has significant potential for utilizing palm kernel meal waste. Palm kernel meal, a byproduct of the palm kernel oil (PKO) extraction process, still contains high levels of protein, fat, and crude fiber, making it a potential feed source for Black Soldier Fly (BSF) (Hermetia illucens) larvae (Bokau et al., 2018). The protein content of palm kernel meal ranges from 14–17%, with a fat content of 9.5–10.5% and a crude fiber content of 12–18% (Widiyastuti et al., 2021). Through a fermentation process using probiotics, the nutritional quality of the feed medium can be improved, supporting the growth and protein content of the resulting BSF larvae. Bokau et al. (2018) reported that the use of fermented palm kernel meal can produce BSF larvae with a protein content of 48.67–50.58%. In addition to plantation waste, the increasing amount of organic waste, such as household food scraps, is also a growing environmental problem every day. Poorly managed organic waste can cause soil and water pollution (Yuliana et al., 2024). Black Soldier Fly (Hermetia illucens L.) larvae have the ability to effectively decompose organic waste, making them useful as bioconversion agents for organic waste into economically valuable products, such as animal feed and organic fertilizer. One such product is liquid organic fertilizer (POC), a fertilizer derived from the decomposition of organic matter with the help of microorganisms that contain nutrients beneficial to plants. The high protein content of BSF larvae can be broken down during the fermentation process into compounds that are more

easily absorbed by plants
(Madusari et al., 2021).

Many studies have been conducted on the nutrient content of liquid organic fertilizer from BSF larvae, but studies on the use of palm kernel meal as feed on the quality of the resulting POC are still limited. Therefore, this study was conducted to analyze the effect of providing fermented palm kernel meal and food waste on BSF larval weight and the nutrient content of organic carbon, nitrogen, phosphorus, potassium, and pH in the resulting liquid organic fertilizer. This study is expected to provide scientific information on the use of palm kernel meal waste as a medium for BSF larval cultivation and as a raw material for liquid organic fertilizer that is economically valuable and environmentally friendly.

RESEARCH METHODS

Time and Place of Research

This research was conducted from February to April 2026. The cultivation of Black Soldier Fly (Hermetia illucens) larvae was carried out at Ratna BSF, Jalan Bunga Teratai No. 9, Medan Selayang. Analysis of the nutrient content of liquid organic fertilizer was conducted at the Laboratory of the Faculty of Agriculture, University of North Sumatra.

Tools and materials

The tools used in this study included knives, aeration hoses, fermentation containers, blenders, funnels, glue, jerry cans, digital scales, and pH meters. The materials used consisted of black soldier fly (Hermetia illucens) eggs, pineapple, papaya leaves, EM-4 Agriculture, EM-4 Animal Husbandry, molasses, water, fermented palm kernel meal, and food waste (domestic waste).

Research Procedures

The research procedure consists of three main stages, namely fermentation of palm kernel meal, cultivation of Black Soldier Fly larvae (Hermetia illucens), and production of liquid organic fertilizer (POC).

1. Cultivation of Hermetia illucens Larvae

a. Preparation of Feed Media

Twenty kilograms of palm kernel meal was fermented using EM-4 for Livestock, representing 10% of the total ingredients. The fermentation process was carried out for 7 days to help break down complex compounds into simpler ones, making them easier for larvae to digest (Liew et al., 2022).

b. Hatching Media

Black Soldier Fly eggs were obtained from Ratna BSF, Jalan Bunga Teratai No. 9, Medan Selayang. Ten grams of eggs were placed on 0.5 kg of palm kernel meal. The eggs were incubated for 3–4 days until hatching, maintaining humidity at 60–80%.

c. Enlargement Media

Seven-day-old larvae were transferred to their respective rearing bioponds according to the treatment. Feeding was carried out up to a total of 20 kg for each treatment. Feed was provided in stages: 2 kg for the first feeding, 3 kg for the second feeding, 4 kg for the third feeding, and 5 kg for the fourth feeding until the larvae reached harvest stage.

Figure 1. Hermetia illucens larvae

2. Making Liquid Organic Fertilizer

Pre-pupal larvae were harvested and ground using a blender. A total of 5 kg of larvae were mixed with 0.5 kg of pure pineapple and 0.5 kg of pure papaya leaves. Next, 0.5 liters of EM-4 Agriculture bioactivator and 0.5 liters of molasses were added to the mixture. All ingredients were placed in a closed container fitted with an aeration hose and connected to a bottle filled with water to create anaerobic conditions. The decomposition process lasted for 40 days. After fermentation was complete, the liquid was filtered using a filter cloth to obtain pure liquid organic fertilizer.

Figure 2. POC from Hermetia illucens larvae fed with palm kernel meal

RESULTS AND DISCUSSION

The Effect of Feed on the Weight of Black Soldier Fly Larvae (Hermetia illucens)

Based on the results of a 12-day study using different feed treatments, namely fermented palm kernel meal and food waste, differences in the weight of Black Soldier Fly (Hermetia illucens) larvae were obtained. The use of fermented palm kernel meal as a feed medium resulted in higher BSF larval production, reaching 9.90 kg, compared to the food waste medium which only produced 5.45 kg. The high larval production in the fermented palm kernel meal medium is thought to be due to its higher and more stable protein content. In addition, the fermentation process helps break down complex compounds into simpler ones, making them easier for larvae to digest (Majid et al., 2023). Protein plays an important role in metabolism and cell division, thereby increasing larval weight gain during the growth phase.

The water content of the feed medium also affects BSF larval production. The higher the water content, the lower the larval growth and weight (Dewi et al., 2024).

Furthermore, low nutritional quality of the feed can inhibit larval development (Yuliana et al., 2024). This is in line with Purnamasari et al. (2021), who stated that a feed medium with a balanced protein, carbohydrate, and water content can support optimal larval growth. Providing high-quality feed can increase maggot production because the nutritional needs of each larval growth phase are properly met. Therefore, the use of fermented palm kernel meal has the potential to be an alternative primary feed in BSF cultivation to increase production and economic value.

Table 1. Weight of BSF larvae

Types of Feed	Larva Weight (kg)
Fermented palm oil meal	9.90
Food waste	5.45

Analysis of Organic C, N, P, K, and pH Nutrient Content in Liquid Organic Fertilizer
The results of the analysis of the nutrient content of liquid organic fertilizer (POC) conducted at the Laboratory of the Faculty of Agriculture, University of North Sumatra include parameters of C-organic, nitrogen (N), phosphorus (P), potassium (K), and pH. The results of the analysis showed that the POC from larvae fed with fermented palm kernel meal (POC A) had a C-organic content of 1.40%, N-total 0.19%, P 0.10%, K 1.04%, and pH 4.20. Meanwhile, the POC from larvae fed with food scraps (POC B) had a C-organic content of 2.32%, N-total 0.37%, P 0.22%, K 1.01%, and pH 5.61.

Table 2. Results of POC Nutrient Content Analysis

Parameter	POC A	POC B	Unit
C-organic	1.40	2.32	%
N-total	0.19	0.37	%
P	0.10	0.22	%
K	1.04	1.01	%
pH	4.20	5.61	-

Organic carbon plays a role in maintaining soil fertility, physical quality, and productivity and is an indicator of soil quality (Setiani et al., 2023). The organic carbon content of both types of POC is relatively low because most of the carbon is utilized by microorganisms as an energy source during the fermentation process and released as CO_2 gas. Nitrogen, phosphorus, and potassium are primary macronutrients that play a vital role in plant growth. The nitrogen content of POC B is higher than that of POC A because food waste contains a mixture of animal protein, carbohydrates, and vegetables, which are more easily broken down into simple nitrogen compounds by the enzymatic activity of Hermetia illucens larvae. However, the nitrogen content of both POCs is still below the SNI 19-7030-2004 standard of 0.40%. The low nitrogen content is thought to be influenced by the length of the decomposition process and the possibility of nitrogen evaporation during fermentation (Setiani et al., 2023).

The phosphorus content of POC B is 0.22% higher than that of POC A, which is 0.10%. Based on SNI 19-7030-2004, this phosphorus content meets the minimum standards, potentially supporting respiration, root development, flowering, and fruit formation in plants. Differences in phosphorus content are influenced by the composition of the organic matter and the rate of decomposition during fermentation (Sulfianti et al., 2021).

The potassium content in both types of organic fertilizer (POC) is relatively high, exceeding the minimum Indonesian National Standard (SNI) of 0.20%. Potassium plays a role in water absorption, the formation of sturdy stems, and increasing plant resistance to pests and diseases (Naim et al., 2024). Furthermore, the pH values of both POCs remained within a safe range for plant application, indicating optimal decomposition and the product's suitability for use as a liquid organic fertilizer (Afa et al., 2024). The quality of the resulting biofertilizer (POC) is determined not only by its macronutrient content, such as organic carbon, nitrogen, phosphorus, and potassium, but also by the amino acid content formed during fermentation. According to Madusari et al. (2021), the use of EM4, pineapple, and papaya leaves in the BSF larvae fermentation process can produce various essential and non-essential amino acids that are beneficial in improving plant growth, chlorophyll content, resistance to environmental stress, and soil microbial activity.

CONCLUSION

Based on the results of research on the analysis of the liquid organic fertilizer (POC) content of Hermetia illucens larvae with different feed treatments, it can be concluded that:

1. The use of fermented palm kernel meal as a feed medium was able to produce a higher weight of Black Soldier Fly (BSF) larvae, namely 9.90 kg, compared to food waste feed which produced a larval weight of 5.45 kg during 12 days of maintenance.
2. Liquid organic fertilizer (POC) from larvae fed with food waste has a higher nutrient content, namely 2.32% organic C, 0.37% nitrogen, and 0.22% phosphorus, compared to POC from fermented palm kernel meal feed which has 1.40% organic C, 0.19% nitrogen, and 0.10% phosphorus.
3. The potassium content in both types of POC has exceeded the SNI 19-7030-2004 standard and the pH value is in the safe range for plants, however the total nitrogen content in both POCs still does not meet the minimum SNI standard of 0.40%.

Further research suggests combining fermented palm kernel meal and food waste as BSF larval feed to increase larval weight and POC quality. Furthermore, evaluation of fermentation duration is needed to increase nitrogen content according to SNI standards, as well as testing POC application on plants to determine its effectiveness on plant growth and resilience.

REFERENCES

Bokau, RJM, & Basuki, TP (2018). Palm kernel cake as a bioconversion medium for mass production of maggot larvae and response testing on tilapia (Oreochromis niloticus). Proceedings of the National Seminar on Agricultural Technology Development, 122–128.

Dewi, KW, & Muchlis., Purnawan. (2024). Analysis of the effect of various types of feed on the quality of maggots in organic waste processing. Proceedings of the National Seminar on Science & Technology Applications (SNAST).

Liew CS, Wong CY, Abdelfattah EA, Raksasat R, Rawindran H, Lim JW, Kiatkittipong W, Kiatkittipong K, Mohamad M, Yek PNY, Setiabudi HD, Cheng CK, Lam SS. 2022. Fungus-fermented palm kernel shells as feed for black soldier fly larvae in producing protein and biodiesel. Journal of Fungi. 8 (4):332.

Madusari, S., Rahhutami, R., & Septiani, RA (2021). Evaluation and application of liquid organic fertilizer for Black Soldier Fly larvae in early oil palm (Elaeis guineensis Jacq.) seedling nurseries. Citra Widya Edukasi Oil Palm Polytechnic, 1(13), 87–92.

Majid, Z., et al. (2023). Identification of amino acid and fat profiles of Black Soldier Fly larvae using oil cake and food waste feed. Journal of Agricultural Industrial Technology, 33(1), 41–49.https://doi.org/10.24961/j.tek.ind.pert.2023.33.1.41

Naim, F., Mohamad, E., & Kilo, LJ (2024). Analysis of NPK element content in Sacha inchi (Plukenetia volubilis)-based organic fertilizer. Journal of Chemical Education and Chemical Sciences, 7(3), 224–227.

Purnamasari, KD, et al. (2021). Potential of organic waste as a growing medium for Black Soldier Fly (Hermetia illucens) maggots. Indonesian Journal of Animal Science and Technology, 7(2), 95–106.

Setiani, V., Kristina, MD, Armesta, L., Amien, CA, & Defrianto, M. (2023). Analysis of CNPK content from the utilization of food waste into liquid organic fertilizer (POC). Journal of Environmental Pollution Control (JPPL), 5(1).

Sulfianti, Risman, & Saputri, I. (2021). NPK analysis of liquid organic fertilizer from various types of rice washing water with different fermentation methods. Jurnal Agrotech, 11(1), 36–42.

Widiyastuti, DA, & Salsabilla, N. (2021). Potential of palm kernel cake as a planting medium mixture for tomato plants (Lycopersicum esculentum Mill). Journal of Agro-Industrial Technology, 1(8), 1–10.

Yuliana, RB, Hartini, H., & Putra, MA (2024). The effect of providing different types of feed on the growth of Black Soldier Fly (BSF) maggot larvae. Journal of Environmental Technology, 2(2), 1–10.