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ORIGINAL ARTICLE

NPK CONCENTRATION IN LIQUID MAGGOT FERTILIZER MADE FROM DIFFERENT ORGANIC RESOURCES ANALYZED

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Abstract The overuse of chemical fertilizers can have detrimental effects on soil quality. It is important for farmers to find sustainable alternatives. One possible solution being explored is the use of liquid maggot derived from organic sources. This study aimed to determine the most suitable composition that fulfills plant needs and follows established guidelines. The research approach employed a qualitative descriptive method to assess the impacts of three treatments using different types of organic matter: fruit waste, restaurant waste, and palm oil cake. Phosphorus and potassium concentrations were determined through MP-AES analysis while nitrogen content was measured using the Kjeldahl method. The findings revealed that only the treatments involving fruit waste and restaurant waste met the recommended potassium levels. However, these treatments fell short of meeting requirements for other essential nutrients. As a result, additional research is needed to assess nutrient concentrations in different organic substances.

Keywords: fruits waste · liquid organic fertilizer · maggots · palm oil cake · restaurant waste ·

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Introduction

Environmental issues are garnering increasing attention from various stakeholders today, including academics, politicians, and society at large. This heightened focus can be attributed to the deteriorating environmental conditions witnessed over the past few decades. One of the prominent concerns pertains to the effective management of garbage and waste generated by human activities, encompassing industries, agriculture, and households.

Waste, which is the residue of industrial and household production processes, is commonly referred to as solid waste. Chemically speaking, waste comprises both organic and inorganic compounds. The need for waste management arises from the potential negative impact of waste on the environment and human health. The level of risk associated with waste poisoning is determined by the type and nature of the waste in question. Several factors influence the level of hazard posed by waste, including its volume, frequency of disposal, and the amount of pollutants it contains. Fruit waste, in particular, is a type of waste that is often underutilized. It is

typically discarded openly without proper management, leading to unpleasant odors and environmental disturbances. The nutritional content of fruit waste is relatively low, with raw protein ranging from 1-15% and raw fiber ranging from 5-38% (Jalaluddin et al., 2017).

Extensive research has been conducted to explore the efficacy of liquid organic fertilizers (LOFs) derived from fruit waste, restaurant waste, and palm coconut packages. For instance, Haryanta et al. (2022) conducted a study that demonstrated the potential of liquid organic fertilizer (LOF) made from urban organic waste for cultivating red onions. The research involved field experiments and utilized various types of organic waste as raw materials for fertilizer production.

In addition to their application in traditional farming, LOFs have also shown promise as a substitute for AB MIX in hydroponic systems. Astuti et al. (2021) found that LOFs derived from vegetable and fruit waste provided superior nutrition compared to AB MIX in hydroponic cultivation. A study conducted at the National High School Pondok Aren further supported the effectiveness of LOFs as a nutrient source for hydroponic plant growth.

Furthermore, Taufik et al. (2017) investigated the impact of local microorganism starters derived from snails and chicken intestines on the quality of palm coconut empty compost. The research employed experimental methods and considered the composting process of palm coconut waste. The results indicated that the application of starters from snails and chicken intestines enhanced the quality of the empty palm coconut compost. These studies collectively contribute to our understanding of the potential of utilizing organic waste to produce liquid organic fertilizers and compost (Rezafie and Asngad, 2019). By repurposing waste materials, these findings offer sustainable solutions for improving agricultural practices and reducing environmental impact.

Materials and Methods

The study was conducted in October 2022 in Bandar Lampung. Testing of fertilizer content analysis is carried out at the UPT Laboratory Integrated Center for Innovation and Technology (UPT LTSIT), University of Lampung. This study is a qualitative study with three repetitions, namely:

P1: Feeding maggot from fruit waste
P2: Feeding maggot from restaurant waste
P3: Feeding maggot from palm coconut

Instruments and Materials

The instruments used in the study are bucket, bottles, scales, a set of 250 ml distillation tools, one set of kjeldahl distillery units, a buret of 50 ml, erlenmeyer flask 250 ml, volumetric flask 1000 ml, 500 ml, 250 ml, and 100 ml, beaker glass 500 ml and 250 ml glass, 15 ml volumetric pipette, destruction flask. whatman no. 41 and MP-AES.

The materials used in the study were liquid maggot, H_2SO_4 concentrated, selenium catalyst mixture, NaOH 50%, HCl 0.1 N, H_3BO_4 4%, red-methyl blue methyl indicator, aquades for 10 ml sample, HNO_3 (1:1) 0.2 ml, and HCl (1: 1) 0.1 ml.

Production of used maggot LOF

The maggots are provided with feed based on the designated treatment groups (P1, P2, and P3). Once the organic matter has been decomposed by the maggots, the resulting mixture is filtered, and the liquid portion is collected to be used as cassava liquid fertilizer.

Observational variables

Physical Properties of used maggot LOF

The physical properties of the LOFs are observed, including its color, aroma, and the presence of any sedimentation. Sedimentation is also observed by determining the presence or absence of precipitate after allowing the LOF to stand at room temperature for 24 hours. These observations help assess the quality and characteristics of the Maggot Liquid Organic Fertilizer, providing valuable information about its physical attributes and stability.

Analysis of Nitrogen Content (N)

The determination of nitrogen content follows the guidelines outlined in the reference standard SNI 01-2354.4-2006. Initially, 5 ml of the sample is weighed into a digestion flask, along with boiling stones and two catalyst tablets. Subsequently, 5 ml of concentrated H_2SO_4 is added, and the mixture is allowed to sit in an acid room for 10 minutes. The solution is then heated for over two hours or until it becomes clear. After cooling to room temperature, an erlenmeyer flask containing 25 ml of 4% H_3BO_3 solution and an indicator is prepared to collect the distillate. The damaged flask is securely attached to the steam distillation apparatus assembly, and 50 to 70 ml of sodium hydroxide-thiosulphate solution is added. The distillate is collected in the erlenmeyer flask until the volume reaches at least 150 ml, indicated by a yellow color. Finally, the distillate is titrated with 0.1 N HCl, resulting in a color change from green to neutral gray.

Analysis of Phosphorus and Potassium Content

To analyze the phosphorus and potassium content, a 10 mm sample is prepared in a digestion flask. Then, 0.2 mm HNO_3 (1:1) and 0.1 ml HCl (1:1) are added to the flask. The digested samples are placed in a heavy iron digester at 95°C for 30 minutes. The sample solution is filtered using Whatman filter paper no. 41. After the sample has cooled down, the dilution process is carried out. The measurement of the sample is performed using MP-AES (Microwave Plasma Atomic Emission Spectroscopy).

Results and Discussion

The findings of observations of the physical characteristics of used maggot LOF, followed by the results of tests for nitrogen (N), phosphorous (P), and potassium (K), may be used to analyse the quality of the nutritional content of used maggot LOF with a range of organic matter. The study of all test parameters produced the following findings:

Physical properties of the used maggot LOF

The physical properties of the liquid maggot used in the study were observed and recorded. Treatments 1 and 2 (P1 and P2), which were derived from different waste mixtures, exhibited a dark brown color, as indicated in Table 1. P1 consisted of a variety of fruits, including bananas, pears, apples, oranges, strawberries, and grapes, which were obtained from damaged fruits discarded by fruit traders in the market. On the other hand, P2 comprised restaurant waste, such as rice, side dishes, and kitchen waste. However, P3 consisted solely of one organic material, palm oil cake.

Table 1. Physical Properties of the used maggot LOF

Treatment	Color	Scent	Sediment
P1	Dark brown	Acid	Present
P2	Dark brown	Acid	Present
P3	Light brown	Acid	Present

As a result, the color of LOF P3 was found to be brighter or lighter compared to P1 and P2. All treatments exhibited some level of precipitate, although P3 had a lower amount of precipitate compared to the other treatments. According to Nizori et al. (2021) successful fermentation processes are characterized by a color change to a more brownish or blackish hue. These observations provide insights into the physical properties of the liquid maggot used in the study, highlighting the variations in color and precipitate formation among different waste mixtures. The changes in color align with the expected characteristics of a successful fermentation process.

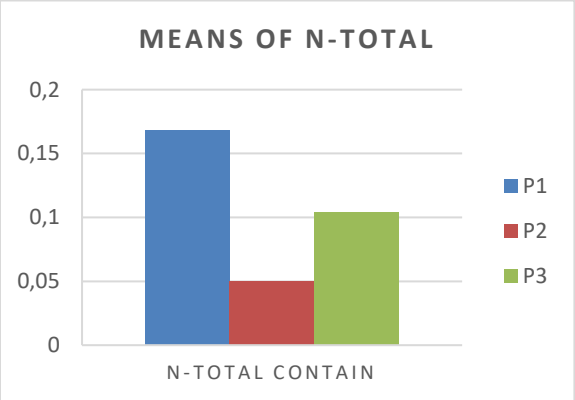
Total Nitrogen (N) Content

Nitrogen is a crucial macronutrient required by plants for the growth and development of their vegetative parts, including roots, stems, and leaves. However, an excessive amount of nitrogen can inhibit flowering in plants. Plants uptake nitrogen in the form of nitrate (NO_3^-) and ammonium (NH_4^+). During the decomposition process, ammonia compounds can be formed,

which may be associated with low total nitrogen levels. Ammonia, characterized by its pungent odor, can evaporate into the air during aerobic fermentation processes. According to Ndegwa and Thomson (2000), microorganisms are unable to assimilate excess nitrogen that is not utilized and it will be lost through volatilization as ammonia or denitrification.

Organic matter serves as the primary component of organic fertilizers, which also contain nutrients such as nitrogen (N), phosphorus (P), and potassium (K). However, the composition of nutrients in organic fertilizers is not fixed and varies depending on the materials used and the composting or manufacturing methods employed (Anggraini et al., 2019). Consequently, due to the utilization of different types of organic waste for each variable, there is a possibility of incomplete decomposition processes, leading to variations in nitrogen content among the samples obtained from organic waste. The variability in nitrogen content among different organic waste sources emphasizes the need for careful management and monitoring of the composting or manufacturing processes to ensure optimal nutrient availability for plants.

Figure 1. Average of N-total content of each treatment



In Figure 1 the highest amount of nitrogen is found in P1 with organic matter derived from fruit waste with a value of 0.168% and the lowest amount of nitrogen is occupied by P2. For all treatments (Table 2), none of the treatments met SNI 19-7030-2004 or the standards from the Minister of Agriculture 261/KPTS/SR.310/M/4/2019 concerning the minimum technical requirements for organic fertilizers, biological fertilizers and soil conditioners. These factors highlight the importance of understanding the nitrogen content in organic fertilizers, as it plays a crucial role in plant growth and development. The variability in nitrogen content among different organic waste sources emphasizes the need for careful management and monitoring of the composting or manufacturing processes to ensure optimal nutrient availability for plants.

Table 2. Average content of N-total VS Fertilizer Standard

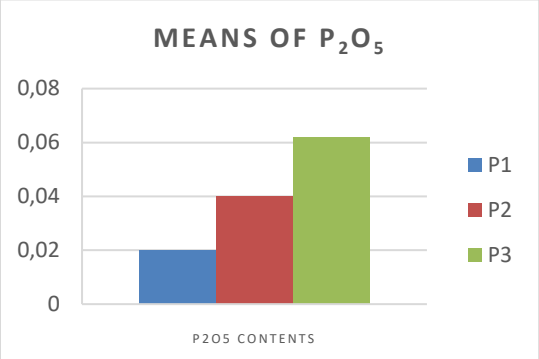
Treatment	N-total (%)	SNI 19-7030-2004	Minister of Agriculture 2019
P1	0.168	0.40	2-6
P2	0.050	0.40	2-6
P3	0.104	0.40	2-6

Content of Phosphorus (P_2O_5)

The compound known as phosphorus (P), which is an organic substance, is crucial for photosynthesis, soil fertility, and the chemical physiology of plants. Phosphorus is also necessary for plant growth points, tissue development, and cell division (Widarti et al., 2015). P shortage symptoms in plants include slowed growth, early yellowing of old leaves, and severely decreased root development.

According to Nur et al. (2016), the amount of phosphorus in waste varies depending on the kind and may slow down decomposition. Subsequently Sulfianti's (2013) research discovered that the acidity of the solution, which increases with fermentation duration up to a certain point, impacts the phosporus level.

Figure 2. Average of P_2O_5 content of each treatment



According to the findings of the examination of the phosphorus content (Figure 2), LOFs from palm oil cake (P3), which had the greatest P level of 0.062%, and LOFs from fruit waste, which had the lowest P content. This is due to the fact that palm oil cake has a 5.5% N-total, a 1.1% P_2O_5 content, and a 1% K_2O content (Widiyastuti and Salsabila, 2021). Additionally, none of the P contents satisfied the established requirements (Table 3), exactly as the findings of the N content, which neither met SNI's nor the Minister of Agriculture's standards.

Tabel 3. Average Contents of P_2O_5 VS Fertilizer Standard

Treatment	P_2O_5 (%)	SNI 19-7030-2004	Minister of Agriculture 2019
P1	0.020	0.10	2-6
P2	0.040	0.10	2-6
P3	0.062	0.10	2-6

Content of Potassium (K_2O)

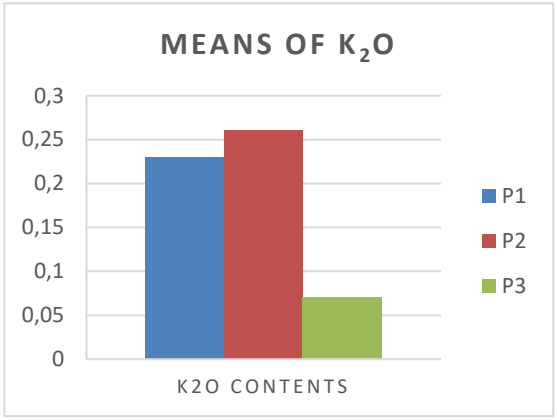
Plants take up potassium in the form of K^+ ions. Protein and cellulose, which fortify plant stems, are produced by potassium during photosynthesis (Ekawandani and Kusuma, 2018). The leaf edges will turn dark if the plant lacks potassium. A source of potassium binding in the compost heap is the incorporation of organic waste by microorganisms (Trivana and Pradhana, 2017).

According to the research, P2 had the greatest potassium level (0.26%), while P3 had the lowest (0.07%) (Figure 3). As a result, P3 has a low potassium concentration that falls short of the required level; but, if the fermentation process runs smoothly, the potassium content will rise.

As stated by Supriyanti (2017), potassium acts as a catalyst to hasten fermentation in microorganisms. More material may be broken down as a result of the quick fermentation process than there is potassium in the liquid fertilizer.

While the K_2O analysis findings for P1 and P2 did not match the 2019 Minister of Agriculture guidelines, they did fulfil the standard requirements for SNI 19-7030-2004 (Table 4). The two treatments that fulfil this requirement are comparable in that they both use different sources of organic matter, as opposed to P3, which uses just one kind of material only organic.

Figure 3. Average of K_2O content of each treatment



In relation to the 2019 Minister of Agriculture Regulation about acceptable standards for liquid organic fertilizer, the minimum amount of nutrients that can be accumulated from N + P_2O_5 + K_2O is 2-6%.

Table 4. Average Contents K_2O VS Standard

Treatment	K_2O (%)	SNI 19-7030-2004	Ministry of Agriculture 2019
P1	0.23	0.20	2-6
P2	0.26	0.20	2-6
P3	0.07	0.20	2-6

Nevertheless, LOFs created from diverse organic materials in this study could not be classified as LOF with Permentan standard due to the amounts of N, P, and K obtained were below the

requirements for quality. These three LOFs still contain nutrients that plants may consume, and they can be used as substitute organic fertilizers with some restrictions—personally, not for sale. Further studies are required on the many types of organic materials combined with garbage around us in order to generate liquid organic fertilizer (LOF) from used maggot that can be marketed.

Conclusion

Because the potassium content value satisfies the specifications set by SNI and Permentan 2019, used maggot LOFs made from fruit and restaurant waste may be combined with other materials to create used maggot LOF. Additionally, due to its high phosphorus content, organic palm oil cake may be utilised as a source of phosphorus for plants.

Compliance with ethical standards

Conflict of Interest

The authors declare that they have no conflicts of interest.

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