Analysis of Nutrient Content in Liquid Organic Fertilizer from Fruit Waste

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Abstract

Liquid organic fertilizer derived from fruit waste is a solution resulting from the decomposition of organic materials sourced from agricultural by-products, such as fruits and vegetables that contain multiple nutrient elements. This study aims to quantitatively analyse the nutrient content of the liquid organic fertilizer made from agricultural organic waste, including the peels of various fruits such as banana, rambutan, pineapple, papaya, watermelon, mangosteen, kwini, and orange, which were fermented for 14 days with the addition of EM4. The parameters tested include the levels of Nitrogen (N), Phosphorus (P), and Potassium (K), organic carbon content, and pH levels. The nutrient analysis was conducted using the Kjeldahl method for Nitrogen (N) content, spectrophotometry for Phosphorus (P) analysis, atomic absorption spectroscopy (AAS) for Potassium (K), spectrophotometry for organic carbon analysis, and pH measurement via electrometry. The findings indicate that the liquid organic fertilizer with the code BZ 19724 contains macro nutrients of 0.01% total N, 0.01% P2O5, and 0.20% K2O. Furthermore, the recorded pH value was 4.19, with organic carbon content reaching 0.88%. Conversely, the liquid organic fertilizer with the code BZ 60624 displayed different results. The macro nutrient content in this sample recorded 0.04% total N, 0.03% P2O5, and 0.39% K2O. The pH value obtained was 4.72, and the organic carbon content was 0.90%. Liquid organic fertilizer derived from fruit waste demonstrates potential as a substitute for inorganic fertilizers, and further research could be conducted to explore its viability as a liquid organic fertilizer.

Keywords: Sustainable Agriculture, Liquid Organic Fertilizer, Fruit Waste, Nutrient Elements

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Introduction

In the era of globalisation, the deteriorating environmental conditions can lead to various new problems. One significant issue that has arisen is related to waste. The increasing population corresponds with a rise in the composition and volume of waste (Fernandez et al., 2024). Food waste remains a concerning problem worldwide due to its negative impacts. The production of food waste has escalated alongside changes in human lifestyles, resulting in resource depletion, increased environmental pollution, and higher greenhouse gas emissions (Zuhra & Angkasari, 2023).

Indonesia has become the country in Southeast Asia that generates the most food waste. According to the United Nations Environment Programme (UNEP) through the Food Waste Index Report 2024, Indonesia produces food waste amounting to 14.73 million tonnes per year. Data from the National Waste Processing Information System (SIPSN) indicates that out of a total of 34.21 million tonnes of waste generated in 2024, 39.25% is food waste.

The continuously increasing waste problem poses a unique challenge in managing and reducing the available waste. In efforts to mitigate the rising food waste, organic waste such as fruit can be utilised to create environmentally friendly liquid organic fertilizer as nutrition for plants. Liquid organic fertilizer derived from fruit waste has become an important focus in sustainable agricultural practices. Fruit waste, such as residues from fruit processing industries and unused harvests, is often discarded, despite the potential for it to serve as a source of nutrients for plants.

Liquid organic fertilizer derived from fruit waste contains various essential nutrients, such as nitrogen (N), phosphorus (P), and potassium (K), which are crucial for plant growth. Research by Lubis et al. (2024) indicates that the nutritional value of the Bioz liquid organic fertilizer, produced from fermented ecoenzymes, is still lower compared to that of commercial hydroponic nutrients for nitrogen (N), phosphorus (P), and potassium (K). However, the analysis of phosphorus (P) and potassium (K) content has met the quality standards set by SNI 19-7030-2004 for Bioz liquid organic fertilizer. Regarding the nitrogen content in Bioz, all samples exceeded the nutritional levels of commercial AB mix fertilizers. Notably, the Bioz2 variant, which is made from organic materials such as water spinach, pineapple peels, papaya, and banana stems, closely aligns with the quality standards outlined by SNI for phosphorus and potassium, with values of 0.10 and 0.83, respectively, thus meeting the minimum requirements of P 0.10 and K 0.2. Consequently, the utilisation of fruit waste as liquid organic fertilizer not only reduces environmental pollution but also enhances agricultural productivity.

The use of liquid organic fertilizer also supports the principles of sustainable agriculture by reducing reliance on synthetic chemical fertilizers. This aligns with the Food and Agriculture Organization (FAO) report, which states that the use of organic fertilizer can improve soil quality and reduce negative environmental impacts (FAO, 2020). Therefore, it is essential to analyse the nutrient content in liquid organic fertilizer derived from fruit waste to provide appropriate recommendations for farmers.

This study aims to determine the nutrient content in liquid organic fertilizer and to inform on the potential of liquid organic fertilizer as a more environmentally friendly alternative to inorganic fertilizers.

Research Method

This research was conducted at the Pembangunan Panca Budi University in Medan and the Laboratory of the Agricultural Assembly and Modernisation Agency (BRMP) in Medan for the purpose of testing nutrient elements. The parameters examined included the levels of Nitrogen (N), Phosphorus (P), and Potassium (K), organic carbon content, and the pH level of liquid organic fertilizer. The analysis of soil elements was performed using the Kjeldahl method for determining Nitrogen (N) content, while Phosphorus (P) analysis was carried out using spectrophotometry. The analysis of Potassium (K) was conducted through Atomic Absorption Spectrophotometry (AAS), the assessment of organic carbon was performed using

spectrophotometric equipment, and the pH of the liquid organic fertilizer derived from fruit waste was measured using electrometric methods.

The liquid organic fertilizer from fruit waste was produced using materials sourced from various types of organic waste, namely the peels of banana, rambutan, pineapple, papaya, watermelon (code: BZ 19724), as well as mangosteen, kuini, orange, and papaya peels (code: BZ 60624). The preparation of the liquid organic fertilizer involved the use of 1 kg of molasses, 3 kg of organic waste materials, and 10 litres of non-PAM/well water.

Results

The results of the nutrient content analysis from liquid organic fertilizers derived from fruit peel waste, such as bananas, rambutan, pineapples, papayas, and watermelons (code BZ 19724), are presented in Table 1. This table indicates that the test material contains macronutrients with details of 0.01% total nitrogen (N), 0.01% phosphorus pentoxide (P_2O_5), and 0.20% potassium oxide (K_2O). Additionally, the pH value is recorded at 4.19, with organic carbon (C) reaching 0.88%.

The results of the nutrient content analysis from liquid organic fertilizers derived from mangosteen, kwini, oranges, and papayas (code BZ 60624), are presented in Table 1. This table indicates that the test material contains macronutrients with details of 0.04% total nitrogen (N), 0.03% phosphorus pentoxide (P_2O_5), and 0.39% potassium oxide (K_2O). Additionally, the pH value is recorded at 4.19, with organic carbon (C) reaching 0.90%.

Table 1. Analysis of Nutrient Elements in Liquid Organic Fertilizer from Fruit Waste

No	Type of Analysis	Code Test		Method	Standards SNI	Permentan RI No. 261 of 2019
		BZ 19724	BZ 60624			
1	C-Organik (%)	0,88	0,90	Spectrophotometry	9,8	10
2	N-Total (%)	0,01	0,04	Kjeldahl	0,4	2-6
3	P2O5 (%)	0,01	0,03	Spectrophotometry	0,1	2-6
4	K2O (%)	0,20	0,39	AAS	0,2	2-6
5	pH	4,19	4,72	Electrometry	4-9	4-9

Source: Agricultural Assembly and Modernisation Agency (BRMP), Regulation Of The Minister Of The Republic Of Indonesia No. 261 Of 2019

The results of the analysis conducted on the nutrient content of two types of liquid organic fertilizer samples derived from fruit peel waste reveal several important findings. The first sample analysed is a liquid organic fertilizer made from the waste of kepok banana, rambutan, pineapple, papaya, and watermelon peels, identified by the code BZ 19724. The second sample is a liquid fertilizer sourced from the waste of mangosteen, kwini, orange, and papaya peels, identified by the code BZ 60624.

The analysis revealed that the total nitrogen (N-total), phosphate (P2O5), and potassium (K2O) levels in both liquid organic fertilizer samples are still below the minimum technical standards set for liquid organic fertilizers. These standards are in accordance with the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 261 of 2019, which governs various aspects related to organic fertilizers. This regulation states that the percentage of total macronutrients contained in liquid organic fertilizer, which is the sum of N, P2O5, and K2O, must reach a minimum of 2%. However, when examined against the quality standards SNI-19-7030-2004, where P2O5 must be a minimum of 0.2%, it is noted that the test results of the liquid organic fertilizer from fruit waste have met the potassium (P2O5) standard (Lubis et al., 2024).

When comparing the two samples of liquid organic fertilizer, the analysis indicates that the liquid organic fertilizer with the code BZ 60624, made from mangosteen, kwini, orange, and papaya peel waste, demonstrates better performance compared to the liquid organic

fertilizer with the code BZ 19724. This suggests that the raw material composition of the second liquid organic fertilizer contributes more significantly to the macro nutrient content necessary for supporting plant growth. This finding aligns with research conducted by Setiawan and colleagues (2021), which found that orange waste has a higher potential for providing nitrogen compared to other fruit wastes.

Consequently, the results of this analysis provide a clear indication that while both types of liquid organic fertilizer originate from fruit peel waste, the quality and nutrient content produced can vary depending on the type of fruit used as raw material. This discovery is crucial for the development of more effective liquid organic fertilizers that meet plant needs and comply with government standards.

Based on the testing conducted in accordance with the quality standards stipulated in the Regulation of the Minister of Agriculture of the Republic of Indonesia Number 261 of 2019, the expected pH value should fall within the range of 4 to 9. Therefore, the test results indicating a pH value greater than 4 have met the criteria established in these quality standards. Tanti et al. (2019) assert that the pH value tends to increase during the decomposition process, which is attributed to the activity of acid-producing bacteria. In line with this, it can be assumed that extending the fermentation period or duration will lead to an increase in pH until a constant point is reached.

Therefore, it is important to understand that the management of fermentation time can have a significant impact on the quality of the final product. The increase in pH values that occurs during this fermentation process indicates the presence of chemical changes that may have implications for the properties of the resulting product. Consequently, controlling parameters such as pH during the fermentation process becomes crucial to ensure that the final product meets the desired quality standards. Furthermore, a deep understanding of the dynamics of pH changes during fermentation can assist in designing a more efficient and effective process, thereby ensuring that the results not only meet standards but also possess superior quality.

Conclusion

The liquid organic fertilizer produced from fruit waste, such as banana peels, rambutan skins, pineapple skins, papaya skins, and watermelon rinds, coded BZ 19724, demonstrates a relatively specific macro-nutrient content. In this case, the fertilizer has a total nitrogen (N-total) content of 0.01%, phosphorus pentoxide (P2O5) of 0.01%, and potassium oxide (K2O) of 0.20%. On the other hand, the liquid organic fertilizer derived from mangosteen skins, kwini skins, orange peels, and papaya skins, with the code BZ 60624, shows a slightly higher composition, containing N-total of 0.04%, P2O5 of 0.03%, and K2O of 0.39%. When comparing the organic carbon values of the two samples, it is evident that sample BZ 19724 has an organic carbon value of 0.88%, while sample BZ 60624 exhibits a slightly higher organic carbon value of 0.90%. Nevertheless, the results of the macro-nutrient content analysis for both types of liquid organic fertilizers are still classified as very low when compared to the standards established in the Minister of the Republic of Indonesia Regulation No. 261 of 2019. However, it is important to note that the pH of the liquid organic fertilizer made from fruit waste also yields beneficial results, with the pH for sample BZ 19724 recorded at 4.19, whereas sample BZ 60624 has a pH of 4.72. In addition to the pH meeting quality standards, P2O5 has also met the quality standard SNI-19-7030-2004, where the minimum P2O5 is set at 0.2. Thus, while both types of liquid organic fertilizers have low macro-nutrient content, they still provide important information regarding pH and potassium, which can influence soil fertility and plant growth.

References

[1] FAO. (2020). The State of Food and Agriculture 2020. Rome: Food and Agriculture Organization.
[2] Fernandez, Y. B., Ardiatma, D., & Ilyas, N. (2024). Carbon Footprint Analysis of Food Waste from Restaurants In Bogor City. Jurnal Info Sains: Informatika dan Sains, 14(02), 187-202.
[3] Kementerian Pertanian Republik Indonesia. (2019). Persyaratan Teknis Minimal Pupuk Organik, Pupuk Hayati, dan Pembenah Tanah. No. 261 2019, 1-18.
[4] KLHK. (2024). Sistem Informasi Pengolahan Sampah Nasional (SIPSN). https://sipsn.kemenlh.go.id/sipsn/public/data/komposisi. Diakses pada 28 Desember 2025 pukul 20:00 WIB.
[5] Lubis, N., M. Wasito, R. Damayanti, dan D. Hayati. (2024). Pupuk Organik Cair Berbahan Dasar Ekoenzim dari Hasil dan Limbah Pertanian sebagai Nutrisi pada Sistem Hidroponik. Biofarm: Jurnal Ilmiah Pertanian, 20 (1).
[6] Lubis, N., M. Wasito, R. Damayanti, dan D. Hayati. (2024). Analisis Kadar Unsur Hara dari Pupuk Organik Cair Bioenzim Berbahan Dasar Limbah Pertanian. Agropross: National Conference Proceedings of Agriculture, 661-667.
[7] Tanti, N., Nurjannah, dan R. Kalla. 2019. Pembuatan Pupuk Organik Cair dengan Cara Aerob. Jurnal ILTEK 14 (2), 2053-2058.
[8] United Nations Environment Programme (UNEP). (2024). Food Waste Index Report 2024. Think Eat Save: Tracking Progress to Halve Global Food Waste. Nairobi.
[9] Zuhra, A., & Angkasari, W. (2023). Pengaturan Hukum Internasional Terhadap Limbah Makanan dan Dinamikanya di Indonesia. Uti Possidetis: Journal of International Law, 4(3), 340-374.