Liquid Organic Fertilizer Made from Fruit and Vegetable Peel Waste as an Environmentally Friendly Alternative

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| ABSTRACT

Liquid organic fertilizer (POC) made from household organic waste is an innovation that has the potential to reduce organic waste accumulation and support the availability of alternative fertilizers that are cost-effective and environmentally friendly. This study aims to describe the process of making POC from fruit peels and vegetable waste using a simple fermentation method, and to evaluate the potential of POC results as a source of plant nutrients. The manufacturing process is carried out by mixing 10 kg of organic waste (5 kg of fruit peels and 5 kg of vegetables), 10 liters of water, 1 kg of bran, 100 ml of molasses, and 100 ml of microorganism activator (EM4). Fermentation takes place for 7–21 days in a closed container with stirring every three days. The results show that this formulation is easy to apply on a household scale, produces nutritious liquid fertilizer, and can be applied directly or through a dilution of 1:5 to 1:10. Thus, POC from organic waste has the potential to be a solution for integrated waste management with sustainable agriculture .

| KEYWORDS :
organic waste; fermentation; liquid organic fertilizer; fruit peel; vegetables

I. INTRODUCTION

Household organic waste management remains a significant environmental challenge. Fruit and vegetable peels constitute the largest component of domestic waste and generally end up in landfills without recycling. This situation has the potential to generate greenhouse gas emissions, disrupt sanitation, and pollute the environment due to uncontrolled decomposition. This challenge opens up opportunities for innovation based on utilizing waste to create valuable products, one of which is through the production of liquid organic fertilizer (POC). POC is a form of organic fertilizer that can be obtained through the fermentation process of organic materials using active microorganisms.

Organic fertilizer (POC) offers the advantage of rapid nutrient availability, can be applied through leaves or soil, and can be produced using simple, low-cost methods. This makes it an effective strategy for sustainable agriculture, particularly for household-scale farming, urban farming, and small-scale farming groups. The novelty of this research lies in the raw material composition, which combines fruit and vegetable peel waste in a balanced ratio (1:1), the addition of bran as a source of microbial nutrition, and the use of molasses and EM4 as fermentation activators. This formulation is designed to be easily applied by the community without requiring technical equipment or high costs. Furthermore, the fermentation method is carried out for a flexible duration of 7–21 days with regular stirring to maintain microbial activity.

The contribution of this research lies in providing an applicable model for processing household organic waste into

liquid fertilizer suitable for use as a source of plant nutrients. This research focuses not only on product yield but also on the urgency of a circular approach that integrates waste management and food production. Thus, this research has potential impacts on sustainable agricultural practices, environmental education, and reducing dependence on synthetic chemical fertilizers. The objectives of this study are to document the process of making liquid fertilizer (POC) from fruit and vegetable peel waste and to assess its feasibility as an environmentally friendly solution that can support plant growth and reduce the burden of organic waste in the environment.

II. METHODOLOGY

This study used a descriptive experimental design with a focus on the production of liquid organic fertilizer using household organic waste. The materials used consisted of 5 kg of fruit peel waste, 5 kg of vegetable waste, 10 liters of clean water, 1 kg of bran, 100 ml of molasses, and 100 ml of EM4 microbial starter. All ingredients were chopped to a size of approximately 1 cm before being mixed in a 60-liter fermentation vessel. The vessel was tightly closed and stored under anaerobic conditions.

The fermentation process lasts 7–21 days, with stirring every three days. This stage aims to release excess gas and ensure even microbial activity. After fermentation is complete, the POC is filtered and stored in an airtight container. The POC is tested through physical observation and dosage adjustments, either directly or by diluting it with water at a ratio of 1:5 to 1:10.

III. RESULTS AND DISCUSSION

The fermentation process of liquid organic fertilizer (POC) lasts 7–21 days and exhibits visual, chemical, and organoleptic changes reflecting the activity of microorganisms during the decomposition of organic matter. These changes are observed through color, aroma, pH, and solution consistency. The results are presented in Table 1.

I. RESULTS OF OBSERVATIONS OF THE FERMENTATION PROCESS AND FINAL CHARACTERISTICS OF POC

Observed Parameters	Time			Final Remarks
	Day 7	Day 14	Day 21	
Color	Light brown	Light brown	Light brown	Light brown
Aroma	Sharp acid	Fermentative acids	Mild acid, not stinging	The distinctive aroma of fermentation
pH	5.5 - 5.8	5.0 - 5.3	4.5 - 5.0	Ideal conditions for acid fermentation
Consistency	Dilute liquid with a little sediment	More homogeneous	Homogeneous and stable	Ready to use
Microbial activity	High	Stable	Starting to slow down	Indicates product stability
Solution clarity	Cloudy	Thick turbidity	Stable turbidity	Reasonable for organic POC
Fermentation gas	Lots	Decrease	Minimum	Fermentation is complete

Product Characteristics

After fermentation reaches a stable phase (day 21), the POC exhibits visual characteristics as mature liquid organic fertilizer, namely dark brown color, homogeneous liquid texture, mild acidic pH, and a mild fermentative aroma. Sedimentation still occurs in small amounts, and this is normal because some of the material is still in the form of

organic solids that are not completely decomposed. The fermentative aroma indicates the success of microbial activity (EM4, yeast, *Saccharomyces* , lactic acid bacteria) in decomposing organic materials. The addition of bran and molasses has been shown to help accelerate microbial activity at the beginning of fermentation because it provides an easily digestible source of carbon and energy.

Applications and Usage

The resulting POC can be applied directly or through dilution. A dilution concentration of 1:5 to 1:10 is recommended for use on horticultural crops, seedlings, and plants sensitive to high concentrations of organic nutrients. Meanwhile, direct application can be used on compost media or woody plants with high nutrient tolerance. The solution remains stable when stored in a closed container and protected from direct light. Optimal shelf life is estimated at 3–6 months if not exposed to air and contamination.

Discussion

The results of this study indicate that the combination of fruit and vegetable peel waste with microbial nutrient sources such as bran, molasses, and EM4 activator produces a liquid organic fertilizer (POC) that physically exhibits good fermentation characteristics. The increasingly dark color changes indicate the decomposition of lignocellulose and complex organic compounds into simpler components. The decrease in pungent aroma at the end of fermentation indicates that the decomposition of proteins and volatile compounds has stabilized. The final pH range is between 4.5–5.0, which is the ideal range for liquid organic fertilizer, as the mildly acidic medium can help dissolve nutrients and suppress certain pathogens in the soil.

These findings align with previous research showing that the organic waste fermentation process produces a fertilizer with nutrients that can be absorbed by plants, increases soil microbiological activity, and significantly supports plant growth. These results indicate that the method can be replicated at the household, school, and farmer group levels as part of implementing the circular economy and environmentally friendly agriculture concepts.

IV. CONCLUSION

This study shows that fruit and vegetable peel waste can be used as raw material for making liquid organic fertilizer through a simple fermentation process using additional bran, molasses, and microbial activator (EM4). The results of fermentation for 7–21 days showed changes and stabilization of physical characteristics such as color, aroma, consistency, and fermentation conditions, which were marked by a decrease in gas and a pungent aroma. The final product of the LOC showed quality characteristics suitable for use, namely dark brown color, homogeneous liquid texture, normal fermentative aroma, and mild acidic conditions that are in accordance with the characteristics of liquid organic fertilizer.

This research contributes to providing an applicable method for processing household organic waste that not only reduces waste volume but also generates added value in the form of organic fertilizer beneficial for plant growth. The use of the produced POC demonstrates its potential as an economical and environmentally friendly fertilizer alternative, applicable at the household level, in urban farming communities, and in farmer groups.

Although this study yielded positive results, several limitations were identified, such as the lack of quantitative laboratory testing of nutrient content and the lack of measurable application tests on various crop types. Therefore, further research is needed to analyze nutrient composition in the laboratory, test agronomic effectiveness on various commodities, and develop formulation and storage standards so that POC can be applied more widely as part of a sustainable agricultural system.

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