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Production of Liquid Compost with EM_4 Bio Activator Volume Variation from Vegetable and Fruit Waste

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Abstract Compost is a combination of substances used to enrich and nourish the soil. Compost availability is highly beneficial to agriculture. Using EM_4 Bio Activator, vegetable and fruit waste may be converted into compost instead of being thrown. The objective of this study is to determine the best amount of EM_4 Bio Activator for creating liquid compost. This research uses vegetable and fruit waste, such as pineapple, spinach, banana, long beans, banana stem, papaya, and coconut water, along with a small amount of sugar, as the fermentation's primary ingredient. Variations in the treatment volume of EM_4 Bio Activator were 5 mL, 10 mL, and 15 mL. The fermentation process lasts one week. The results conclude that the addition of 10 mL of EM_4 Bio Activator is optimal for fermenting Vegetable and Fruit Waste (with the amount specified in the study technique) into Liquid Compost or perhaps EM_4 Bio Activator. The approximate ratio for one week of fermentation is 10 mL EM_4 Bio Activator per 1.7 kg of mixed ingredients.

Keywords: Local microorganism, EM_4 Bio Activator, Vegetable waste, Fruit waste

INTRODUCTION

The humus in Indonesia's soil makes the country an excellent producer of food products. Many individuals have relocated to metropolitan regions throughout time. This has the ability to render the soil normally utilized for agriculture unfit for agriculture. The physical, chemical, and biological properties of the soil define its infertility. Physically, the soil seems dry and desolate; it lacks a moist feel suitable for plant growth. Chemically, the soil has a low pH and is devoid of macro and micronutrients. Biologically, the soil lacks organisms capable of fertilizing the soil. This causes dry, barren, and even high-toxicity soil to be a problem that is not difficult to find in Indonesia.

The poor physical, chemical, and biological quality of the soil has an effect on the unusability of land for agriculture. Without agricultural activity, food production might become unstable. Compost fertilizer is required to resolve this issue. Compost may be used to increase soil humus levels.

Composts consist of substances derived from nature and containing nutrients in their natural proportions. Organic fertilizer is one of the most significant components in efforts to boost soil fertility in a manner that is safe for human health, so that the agricultural products produced are fit for human consumption (Musnamar, 2003).

Fertilizer is a substance that is put to planting soil or plants in order to fulfill the nutritional requirements of plants so that they may grow properly. Materials used as fertilizer may be either organic or inorganic (mineral). Supplements are distinct from fertilizers.

Fertilizers supply the basic ingredients necessary for plant growth and development, while plant hormones and other additives aid to regulate metabolic processes. However, a variety of supplements may be added to fertilizers, particularly synthetic fertilizers.

It is vital to consider the demands of these plants when applying fertilizer so that plants do not get an excess of nutrients. A nutrient's deficiency or excess may be damaging to plants. One may apply fertilizer via the soil or by spraying it on the foliage.

Compost is one sort of organic fertilizer. EM_4 is a sort of solution containing bacteria, including decomposer bacteria that work as the soil's natural decomposer of organic matter. Therefore, it is often utilized in the production of organic fertilizers.

Depending on the producer/factory that creates the goods and labels their product, EM_4 might exist in numerous forms. EM_4 solution may rapidly ferment and degrade soil organic matter in order to deliver essential nutrients to plants and expand the variety of beneficial soil bacteria.

EM_4 Agricultural products are bacteria that ferment organic soil materials, which fertilizes plants and nourishes the soil. Natural selection of fermented and synthetic soil microbes encapsulated in a liquid media.

The EM_4 Packaged Farms are at rest (dormant) (Ramaditya et al, 2017; Siswati et al., 2009). In the disintegration or decomposition of organic matter, bacteria serve as inoculants or starters (activators) that speed up the decomposition process (Anggraini et al., 2019; Meriatna et al., 2018; Susi et al., 2018; Manullang et al., 2017; Nur et al, 2016). EM_4 Agriculture will be active and ferment organic matter (plant residues, green manure, manure, etc.) present in the soil when inoculated by spraying it into organic matter and soil or on plant stems.

Organic substances, such as sugar, alcohol, amino acids, proteins, carbohydrates, vitamins, and other organic compounds, are readily absorbed by plant roots as a consequence of the fermentation of organic materials. Incorporating organic materials into the soil without EM4 inoculation will result in the decomposition of organic matter, which may result in the production of heat and harmful fumes that can inhibit plant development.

In addition, this effort may be utilized to address the growing issue of organic waste. The majority of human activities generate waste, and excessive waste generation may create environmental issues (Conilie et al, 2021). Creating fertilizer out of organic waste is one technical solution to the issue of organic waste (Aklis & Masyrukan, 2016). If waste is not treated and all of it is disposed of in a landfill, it will accumulate and lead to an increase in environmental deterioration since it emits methane gas that contributes to global warming (Indriyanti et al, 2015). Therefore, continued environmental degradation will harm human life (Febriani et al, 2020).

Therefore, the contribution of EM_4 Bio Activator to the production of compost is essential and advantageous for agricultural technology. Errors in the amount of EM_4 Bio Activator given to composting materials might result in the failure of composting. The precise volume comparison between the fermenting material and the fermenter is crucial. Excessive carbohydrates might lead to the death of fermentor bacteria as a consequence of excessive alcohol's ability to harm microorganisms (Hidayah, 2019). The objective of this study is to determine the best amount of EM_4 Bio Activator for creating liquid compost.

METHOD

Tools and Materials

Table 1 outlines the tools and materials utilized for this investigation.

Table 1. List of tools and materials.

No.	Tools	Amount	Materials	Amount
1	Bucket	3 Pcs	Coconut water	1 Liter
2	Scales	1 Pcs	Ripe Pineapple	0.5 kg
3	Knife	1 Pcs	Sugar	1 kg
4	Plastic wrap	1 Pcs	Fresh water spinach	0.25 kg
5			Ripe banana	0.5 kg

6	Fresh long beans	0.25 kg
7	Inner banana stem	1.5 kg
8	Ripe papaya	0.5 kg

Research Procedure

The research phase consists of a literature review, research planning, research execution, data collecting, data analysis, evaluation, and report (Hudha et al., 2022). The steps of research execution will be elaborated upon by providing the relevant documentation in table 2.

Table 2. Research flowchart.

No.	Stages	Documentation Image
1.	Prepare tools and materials	
2.	Chop all the vegetables and fruit ingredients: (i) ripe Pineapple, (ii) fresh water spinach, (iii) ripe banana, (iv) fresh long beans, (v) inner banana stem, and (vi) ripe papaya. The largest chopped pieces are at least 4 cm.	

3. Put all the chopped pieces into the three buckets evenly.

4. Put 0.5 liters of coconut water and 0.3 sugar into each bucket.

5. Add 5 ml of EM_4 solution into the first bucket, then 10 ml of EM_4 solution into the second bucket, and 15 ml of EM_4 solution into the third bucket.

6. Each bucket is then stirred so that the contents are evenly mixed

7. Cover each bucket with plastic and tie tightly

8. After a week, the bucket is opened to reveal liquid compost.

FINDINGS AND DISCUSSION

Table 3. Compost condition results after one week.

No	Aspect	Product		
		5 mL EM_4	**10 mL EM_4**	**15 mL EM_4**
1.	Result Image			
2.	Em-4 compost water	+ (a lot)	+++ (the most of the three)	++ (a lot)
3.	Surface condition	Fully covered in fungi	Partially covered in fungi	Slightly covered in fungi
4.	Temperature condition	Cold	Cold	Cold
5.	Smell	Unappealing (smell of alcohol)	Unappealing (smell of alcohol)	Unappealing (smell of alcohol)
6.	Microorganisms visible	Fungi	Fungi	Fungi
7.	Unwanted visible organisms	Maggots, Cocoons of maggots	Maggots, Cocoons of maggots	Maggots, Cocoons of maggots
8.	pH	4.0	4.0	4.0
9.	Dregs	++	++	+++

Figure 1. The results of the liquid compost condition in the mixture given 5 mL EM_4 after one week of fermentation.

Figure 2. The results of the liquid compost condition in the mixture given 10 mL EM_4 after one week of fermentation.

Figure 3. The results of the liquid compost condition in the mixture given 15 mL EM_4 after one week of fermentation.

The EM_4 solution is the one purchased in the market at a price of Rp.20,000. Therefore, this is a generic solution that farmers can purchase cheaply, and not a specialized one. The addition of the EM_4 solution to the ingredients that want to be used as fertilizer is useful for accelerating the conversion of these organic materials to make liquid compost faster and more perfect.

The first treatment was to add 5 mL of EM_4 to the prepared mixture of organic materials. The second treatment was to add 10 mL of EM_4 to the prepared mixture of organic materials. The third treatment was to add 15 mL of EM_4 to the prepared mixture of organic materials.

The produced compost solution appears to be suitable for use as liquid compost that can promote plant growth. However, is the final product an actual EM_4 product? Due to the limitations of this study, the conclusion cannot be validated.

The EM_4 solution must contain photosynthetic bacteria, lactic acid bacteria, yeasts, actinomycetes, and yeast fungi at minimum. These microorganisms must be present in the solution that is produced. The only fungus that can be identified in the product solution is the one that appears on the surface.

In this solution, photosynthetic bacteria, lactic acid bacteria, and actinomydetes could not be identified. However, the EM_4 solution has additional physical features that might be used as a measure of its manufacturing performance, including:

- The container inflates and becomes steamed due to the formation of gases.
- There is a fragrant (aromatic) smell of acidity.
- The color of the solution is cloudy.
- When shaken/stirred/poured, the solution emits tiny gas bubbles.
- The flavor of the remedy is quite sour.
- There is a white film on both the solution's surface and the fermentation vessel's walls.

In addition to the features that indicate the successful fabrication of the EM_4 solution, the unsuccessful EM_4 solution exhibits the following characteristics:

- The solution's color does not change (remains clear).
- No smell.
- If the smell becomes rotten, it indicates that many microorganisms have died due to the long duration of fermentation (> 6 days) or because it has been contaminated with anti-fermenting agents such as oil, anti-bacterial chemicals, or mildew.

Table 4. The results of the liquid compost condition in the mixture given 5 mL EM_4 after one week of fermentation.

Results	Successful indication
There is no gas and the container is not bubbling, yet there are water droplets on the bucket's walls	The container inflates and becomes steamed due to the formation of gases
There is a fragrant (aromatic) smell of acidity	There is a fragrant (aromatic) smell of acidity
The color of the solution is cloudy	The color of the solution is cloudy
When shaken/stirred/poured, the solution emits tiny gas bubbles	When shaken/stirred/poured, the solution emits tiny gas bubbles
The flavor of the remedy is quite sour	The flavor of the remedy is quite sour
There is a white film on both the solution's surface and the fermentation vessel's walls	There is a white film on both the solution's surface and the fermentation vessel's walls

Table 5. The results of the liquid compost condition in the mixture given 10 mL EM_4 after one week of fermentation.

Results	Successful indication
The container inflates and becomes steamed due to the formation of gases	The container inflates and becomes steamed due to the formation of gases
There is a fragrant (aromatic) smell of acidity	There is a fragrant (aromatic) smell of acidity
The color of the solution is cloudy	The color of the solution is cloudy
When shaken/stirred/poured, the solution emits tiny gas bubbles	When shaken/stirred/poured, the solution emits tiny gas bubbles
The flavor of the remedy is quite sour	The flavor of the remedy is quite sour
There is a white film on both the solution's surface and the fermentation vessel's walls	There is a white film on both the solution's surface and the fermentation vessel's walls

Table 6. The results of the liquid compost condition in the mixture given 15 mL EM_4 after one week of fermentation.

Results	Successful indication
There is gas and the container is not bubbling, yet there are water droplets on the bucket's walls	The container inflates and becomes steamed due to the formation of gases
There is a fragrant (aromatic) smell of acidity	There is a fragrant (aromatic) smell of acidity
The color of the solution is cloudy	The color of the solution is cloudy
When shaken/stirred/poured, the solution emits tiny gas bubbles	When shaken/stirred/poured, the solution emits tiny gas bubbles
The flavor of the remedy is quite sour	The flavor of the remedy is quite sour
There is a white film on both the solution's surface and the fermentation vessel's walls	There is a white film on both the solution's surface and the fermentation vessel's walls

Based on these data, it can be stated that the third treatment EM_4 solution (15mL) was successful, but not better than the second treatment (10mL), but better than the first treatment (5mL). The third result shows that the addition of an additional EM_4 solution to the materials to be used as EM_4 has a significant effect and even produces good EM_4.

This shows that 10 mL of EM_4 solution is the ideal volume for producing liquid compost with the amount of material identified by this research method. If an excessive amount of EM_4 solution is introduced (for instance, 15 mL), microbes are likely to struggle for food and grow uncontrollably. If too little EM_4 solution is introduced (for example, 5 mL), the number of microorganisms will be low, and they will need more than one week to proliferate.

The third treatment (15 mL) was better to the first treatment (5 mL) most likely because the fermentation duration was just one week, thus the total microorganisms in 15 mL multiplied more quickly than those in 5 mL.

This study produces liquid compost (or a solution with potential EM_4) that may be used directly in agriculture and plantations, or rejuvenated by combining with other raw materials, while the dregs can be utilized directly as compost.

Carbohydrates are an essential source of energy for anaerobic microorganisms (Indriani et al., 2013). In regards to supplies of nutrients or energy for microbial development, according to Budiyani et al. (2016), temperature, pH, and oxygen also impact microbial growth throughout the fermentation process. In addition to the nutrients supplied, further study should be conducted to identify the influence of temperature, pH, and oxygen on fermentation outcomes.

The appearance of maggots was also a concern in this investigation, most likely because the bucket wasn't sealed firmly or because the material used was previously polluted. However, the appearance of these maggots did not significantly disrupt the transformation of these materials into an EM_4 solution.

Instead of daily vegetable and fruit waste being discarded (for example, household waste), it may be utilized as compost (Handayani et al. 2019; Puspikawati & Puspikawati, 2019; Rulyana et al., 2017). The presence of waste as a substance that is wasted or discarded from sources deriving from human and natural activity with no economic value has become a critical environmental issue (Sunarsih, 2018).

The greater the number of household activities, the more vegetable and fruit waste will be generated, causing unpleasant aromas, contaminating the environment, and becoming a source of illness that has a negative effect on the public's health (Ekawandani & Kusuma, 2018). Fermenting vegetable and fruit waste into liquid organic fertilizer is an alternative to waste processing efficient organic fertilizer (Putra & Ratnawati, 2019; Kusumaningtyas et al., 2015). Vegetable and fruit waste may serve as a source of biomass and a substrate for the development of decomposing microbes, as well as a bioactivator (Hudha et al., 2022).

CONCLUSION

From the aforementioned findings, it can be concluded that the addition of 10 mL of EM_4 Bio Activator is optimal for fermenting Vegetable and Fruit Waste (with the

amount specified in the study technique) into Liquid Compost or perhaps EM_4 Bio Activator. The approximate ratio for one week of fermentation is 10 mL EM_4 Bio Activator per 1.7 kg of mixed ingredients.

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