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Processing Leaf Waste Into Compost Using Rice Water And Em4 Fermentation Activators

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Abstract

The purpose of this study was to see the difference in the results of processing leaf waste into compost using different activators between rice water fermentation and EM4. Leaf waste is a concern and problem at Mambaul Ulum Bata-bata Boarding School. The amount of waste that is not processed affects the condition of environmental sustainability. Given the lack of processing of leaf waste that exists to date, it is very important to improve leaf waste management techniques so that the composting process can turn it into a valuable product. This research uses qualitative methods and primary data collection by observation and secondary data by literature study. This research is also experimental to determine the physical changes of compost with the addition of rice water fermentation activator and EM4 liquid. In the results of samples using rice water fermentation activator, the results were obtained with temperatures ranging from 29 - 31 degrees Celsius, dry humidity conditions and pH ranging from 5.7 - 6 which means that some compost is still acidic because it has a pH less than 6. The physical properties of the soil have the characteristics of smelling soil, black in colour, and fungus has spread. As for the results of the second sample using EM4 activator with temperature results ranging from 30 - 32 degrees Celsius, dry humidity conditions and pH ranging from 6.9 - 7.3 which means the compost has a normal pH. The physical properties of the soil have the characteristics of smelling dry leaves, brownish in colour, and white spots appear and begin to spread.

Keywords: Leaf waste, Compost, rice water fermentation, EM4

Abstrak

Tujuan penelitian ini adalah untuk melihat perbedaan hasil pengolahan sampah daun menjadi kompos menggunakan aktivator berbeda antara fermentasi air beras dan EM4. Sampah daun menjadi perhatian dan permasalahan di Pesantren Mambaul Ulum Bata-bata. Banyaknya sampah yang tidak diolah mempengaruhi terhadap kondisi kelestarian lingkungan. Mengingat kurangnya pengolahan sampah daun yang ada sampai saat ini, maka sangat penting untuk meningkatkan teknik pengelolaan sampah daun sehingga proses pengomposan dapat mengubahnya menjadi produk yang bernilai. Penelitian ini menggunakan metode kualitatif dan pengumpulan data primer dengan observasi serta data sekunder dengan studi literatur. Penelitian ini juga bersifat eksperimental untuk mengetahui perubahan fisik kompos dengan penambahan aktivator fermentasi air beras dan cairan EM4. Pada hasil sampel yang menggunakan aktiavtor fermentasi air beras didapatkan hasil dengan suhu berkisar 29 - 31 derajat celcius, kondisi kelembaban yang kering serta pH berkisar antara 5.7 - 6 yang berarti sebagian kompos masih bersifat asam karena memiliki pH kurang dibawah 6. Sifat fisik tanah memiiki karakteristik berbau tanah, berwarna hitam, dan jamur sudah menyebar. Sedangkan untuk hasil dari sampel kedua yang menggunakan aktivator EM4 dengan hasil suhu berkisar 30 - 32 derajat celcius, kondisi kelembaban yang kering serta pH berkisar antara 6.9 - 7.3 yang berarti kompos memiliki pH yang normal. Sifat fisik tanah memiiki karakteristik berbau daun kering, berwarna kecoklatan, serta muncul bercak putih dan mulai menyebar.

Kata Kunci: *Sampah daun, Kompos, fermentasi air beras, EM4*
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Introduction

One of the environmental issues that needs to be addressed seriously is leaf waste which is a concern and problem at Mambaul Ulum Bata-bata Islamic Boarding School. The amount of waste that is not processed affects the condition of environmental sustainability, so waste can be considered a negative problem. According to data from the Ministry of Environment and Forestry, 57% of waste in Indonesia is organic waste (food waste, wood branches, leaves), 16% plastic, 10% paper, and 17% others (metal, textiles, leather, rubber, glass). Waste or what is often known as garbage is the result of human activities and natural processes in the form of blockages (Jupri et al., 2023). Waste is divided into organic and inorganic waste. Another waste that can be processed into high-value products is the processing of dry leaf waste that can be obtained from plants that have been dried (Rahmadina & Tambunan, 2017). Leaf waste can be found everywhere and one of them is in the environment of Mambaul Ulum Bata-bata Pamekasan Islamic Boarding School which is also surrounded by trees and every day the trees shed their leaves, resulting in quite a lot of leaf waste.

One method that has been used in the past is to collect leaf waste, pile it up, and burn it; this burning process has a negative impact as it pollutes the air. Burning waste in open spaces also causes air pollution, which in turn destabilizes the ecosystem (Habib et al., 2022). Given the lack of leaf waste treatment to date, it is imperative to improve leaf waste management techniques so that the composting process can turn it into a valuable product. A lot of leaf waste is currently not utilized as organic fertilizer, this is due to the lengthy process of composting leaf waste using natural decomposers. Most students already know and follow the rules about disposing of waste in the bins that have been provided, but only a small proportion of students are aware of waste management outside the school environment. Given the educational paradigm that prioritizes role models from parents, teachers, or other individuals, education about composting is very important in schools.

Waste is always produced by human activities, both daily activities and other activities. The composting method is one option to overcome the problem of leaf waste at the Mambaul Ulum Bata-bata Islamic Boarding School and turn it into something more

valuable. Processing dry leaf waste into organic fertilizer is one solution to soil pollution, because compost is the decomposition of organic materials or a process of breaking down complex compounds into simple compounds with the help of microorganisms (Handayani et al., 2023). Organic materials that have rotted as a result of interactions between microorganisms are called compost. The food supply for these microbes is organic materials.

The purpose of composting is to accelerate natural processes by organizing and managing them. Processing waste made from dry leaves into organic fertilizer is one of the solutions to soil pollution, this is because compost with the help of microorganisms through the process of breaking down complex compounds into simple compounds. Compost is a rich source of nutrients such as macro- and micro-nutrients needed by plants such as nitrogen (N), phosphorus (P) and potassium (K). However, the amount is relatively small and varies depending on the raw materials as well as the manufacturing process, additives, maturity level and storage method. Making Compost Fertilizer from dry leaves is in line with the theme of the Pancasila student profile loading project (P5), namely composting. The main purpose of making compost from dry leaves is to reduce the use of organic fertilizers, as well as the use of resources in the surrounding environment, to optimize the use of dry leaf waste so that it has high utility value and is useful as compost fertilizer. The use of compost fertilizer is very good for soil and plant fertility so that it can reduce household and industrial waste in the community and the surrounding environment, especially in Dena Village, Madapangga Bima Sub-district (Dinata, 2023).

Rice water fermentation is an increasingly popular technique in the world of organic farming, as it can be used as an effective compost activator. The quality of nutrients N, P, K from liquid fertilizer made from rice washing water waste with the addition of eggshell powder is included in the very high criteria, where the number of leaves and height of green mustard plants that have been treated with various concentrations of liquid fertilizer (Jannah & Rahayu, 2018). This fermentation process not only utilizes rice washing water that is usually wasted, but also brings benefits to the environment and agriculture as a whole. The rice water fermentation process is carried out by storing the rice washing water in a closed container and leaving it for several days. During this period, natural bacteria and microorganisms will multiply in the rice water, creating a solution rich in nutrients and beneficial microbes.

EM4 is a mixed culture of microorganisms consisting of Lactobacillus bacteria, Actinomycetes, Streptomyces, yeast fungi and photosynthetic bacteria that play a role in the decomposition of organic matter. The ability of bacteria to degrade waste components that can prevent odors is a decomposition process by EM4. One of the benefits of using EM4 is that it accelerates the decomposition/degradation of organic matter, accelerates the fermentation of organic waste without causing adverse effects during the decay process of organic matter. EM4 has the characteristics of a brownish yellow liquid solution, smells good with a sweet and sour taste at an acidity level of less than 3.5. If the pH exceeds 4, the liquid can no longer be used (Kadek et al., 2021).

Based on this description, the researcher wants to provide education to residents at Mambaul Ulum Bata-bata Islamic Boarding School, especially students regarding the utilization of organic waste. The waste management is through making organic compost using rice fermentation and EM 4 activator to reduce the volume of existing waste. Dry leaves are collected and chopped into smaller sizes to speed up the decomposition process. The composting process was carried out in the open with regular stirring to ensure good air circulation. Temperature, humidity, and pH were measured periodically to monitor the progress of the composting process.

Method

The research is experimental to determine the physical changes in compost with the addition of rice water fermentation activator and EM4 liquid. The research location was conducted at the Mambaul Ulum Bata-bata Pamekasan Islamic Boarding School and the research time was conducted from February 12 to April 15, 2024. The samples used consisted of 8 samples divided into 4 samples for compost using rice water fermentation activator and 4 samples for compost using EM4 activator. Parameters to determine the maturity of compost are physical such as temperature, humidity, color, texture, pH and physical conditions.

This research also uses qualitative methods with primary data collection through observation and secondary data with literature studies from various sources of books, articles, and websites. Data processing and analysis were carried out descriptively by comparing the performance of several activators (rice water fermentation and EM4) in the composting process through the observation of physical changes in leaf waste in each treatment, the data obtained was then described descriptively through tabulation which could be seen from the physical properties of the composting results. The following are the

tools and materials used and how they work. Tools; 1. Composs Bag, 2. Plastic bucket, 3. Knife/Scissors, 4. Latex gloves, 5. Sieve, 6. Plastic compost bin. Materials; 1. Organic waste, 2. Rice water fermentation, 3. EM 4. The workflow is; 1. Prepare waste shredding tools (scissors, knife), 2. Put the chopped organic waste into the composs bag, 3. Pour enough fermented rice water on 3 samples, 4. Also pour enough EM 4 on 4 samples, 5. Stir until smooth, 6. When it is flat, close the composs bag in the room, 7. Check periodically, 8. After the compost is blackish in color and does not cause a pungent odor, it means that the compost is finished, 9. Composting time is approximately 6-8 weeks.

Result and Discussion

Based on the results of the composting process carried out for 6-8 weeks and observations made on the results of 8 compost samples using rice water fermentation activator, the following data were obtained:

Table 1. Results of compost samples using rice water activator

Sample	Temperature	Humidity	pH	Observation Compost
1	31	Dry	5.7	Smells of soil, colored black, and mold has spread
2	29	Dry	6	
3	30	Dry	5.8	
4	30	Dry	5.7	

Based on table 1, the results of compost samples using rice water fermentation activator with temperatures ranging from 29 - 31 degrees Celsius, with dry humidity conditions and pH ranging from 5.7 - 6, which means that some compost is still acidic because it has a pH less than 6. The physical properties of the soil have the characteristics of smelling soil, black in color, and mold has spread. The following table 2 also presents the results of composting using EM4.

Table 2. Results of compost samples using EM4

Sample	Temperature	Humidity	pH	Physical Observation of Compost
1	32	Dry	7.3	Smells of dry soil, dark brown to black, and white patches appear white and begin to spread
2	30	Dry	6.9	
3	31	Dry	7.1	
4	31	Dry	7.1	

Based on the table above, it is known that compost using EM4 activator with temperatures ranging from 30 - 32 degrees Celsius has dry humidity conditions and pH ranging from 6.9 - 7.3 which means that the compost has a normal pH. Physical properties of the soil have the characteristics of smelling dry leaves, brownish in color, and white spots appear and begin to spread.

The difference in the results of compost quality experiments using rice water fermentation activator and EM4 shows that quality compost is compost that has been completely decomposed and does not cause adverse effects on plant growth. The advantage of using EM4 is that it accelerates the process of forming organic fertilizer and improves soil structure for the better and supplies the nutrients needed by plants (Meriatna et al., 2019). The quality of compost is usually identified with the content of nutrients in it, the nutrients in compost are fairly complete (macro and micro nutrients), there will be an increase in the quality of compost when the dwell phase is carried out. Where the dormant phase is to let the finished compost in a pile without treatment for approximately 6 weeks to 1 month, to maximize the materials or activators used and the decomposition reaction occurs and the compost becomes stable. After the dormant process, the compost undergoes a change in color to a dark color, is crumbly and smells like soil or leaves.

There are several parameters in determining the maturity of compost, Gaur (1981) states that these parameters are physical conditions such as temperature, humidity, color, texture, pH, odorless and free of pathogens, parasites and grasses. Maturity is the level of perfection of the composting process. In mature compost, raw organic matter has decomposed to form stable products. To determine the level of compost maturity can be done by laboratory tests or simple observations in the field. Observations are made through measuring temperature, pH, humidity and seeing the physical characteristics produced from observing compost.

Temperature

Temperature is a determinant in composting activity. Table 1 shows the results of compost samples using rice water fermentation activator with temperatures ranging from 30 - 31 degrees Celsius while Table 2 describes compost using EM4 activator with temperatures ranging from 30 - 32 degrees Celsius. When the composting process begins, some of the energy produced will increase the temperature. An increase in temperature is an indicator of the decomposition process as a result of the relationship between water content and the work of microorganisms. When organic matter is broken down by

microorganisms, a certain amount of energy in the form of heat is released. Temperature and pile height affect the metabolism of microorganisms in the pile causing energy in the form of heat. The heat generated will partly be stored in the pile and partly released in the evaporation process. The heat trapped in the pile will increase the pile temperature.

Moisture

Humidity is the level of air wetness (the amount of water contained in the air) expressed as a relative percentage to its saturation point, so it is necessary to observe the moisture level in the compost. At the beginning of the composting process is the mixing of compost materials into homogeneous, and this must have a humidity of 50-60 percent. How to measure it can be by mixing activators in the form of rice water or EM4 until the condition of the waste becomes moist. The resulting humidity of the two samples between compost using rice water fermentation activator and EM4 produces the same good condition which is dry. When the composting process begins, some of the energy produced will increase the temperature. An increase in temperature is an indicator of the decomposition process as a result of the relationship between moisture content and the work of microorganisms.

pH

The effect of pH conditions on organic compost is very important to consider because pH affects various biochemical and microbiological processes that occur during the decomposition of organic matter. Microorganisms such as bacteria and fungi play a major role in the decomposition of organic matter. Most decomposing microorganisms work most effectively at neutral to slightly alkaline pH (around pH 6-7.5). pH that is too acidic or too alkaline can inhibit the activity of these microorganisms, thus slowing down the composting process. In addition, pH also affects the formation and destruction of organic matter: The process of forming stable humus from organic matter is more effective at neutral pH. In table 1, the results of compost samples using rice water fermentation activator pH values range from 5.8 - 6, which means that some compost is still acidic because it has a pH less than 6. As for the results of the second sample that we can see in table 2, it describes compost using EM4 activator with a pH ranging from 6.9 - 7.3, which means that the compost has a normal pH. In inappropriate pH conditions, the humus formation process can be inhibited, and the resulting organic matter is less stable and has reduced quality as fertilizer. To ensure

the pH of the compost is within the optimal range, it is important to monitor and balance the ingredients added to the compost pile.

Physical Condition

Good organic compost has several physical properties that can be easily recognized. According to Harada et al (1993), the quality of compost is determined by the level of maturity of the compost, in addition to the nutrient content and heavy metal content. The color of good compost generally has a dark brown to black color. In Table 1, the results of compost samples using rice water fermentation activator with soil physical properties have the characteristics of smelling soil, black color, and fungus has spread. As for the results of the second sample that we can see in table 2, it describes compost using EM4 activator with the physical properties of the soil having the characteristics of smelling dry leaves, brownish in color, and white spots appearing and starting to spread This color indicates that organic matter has decomposed well. The ideal compost texture is crumbly and loose. This means that the compost is not too dense or watery, but can be easily held and separated by hand and the smell of mature compost will have a smell like fresh forest soil. This odor indicates that the decomposition process has been completed and there are no organic materials that have not decomposed.

From the observations in table 1 and table 2, it is found that the use of EM4 as a composting activator is more efficient than rice water fermentation activator. EM4 has the advantage of being able to accelerate the composting process, the addition of EM4 is also proven to eliminate odors that arise during the composting process if it takes place properly, EM4 contains several microorganisms that are beneficial in the composting process which can increase fermentation and decomposition of organic waste, suppress the activity of pests and pathogenic microorganisms EM4 solution is a bioactivator used to make compost in solid form. Organic materials that are commonly composted using EM4 bioactivator include straw, manure, animal manure, grass, chaff, or sawdust. EM4 bioactivator can also be used to make solid compost from tofu industry waste (tofu pulp). EM-4 bioactivator is not recommended for decomposing relatively hard organic materials such as oil palm empty fruit bunches (TKKS) because it will take a long time (Khasanah & Murdowo, 2021).

The results also show that leaf waste can be turned into quality compost within 6-8 weeks. The resulting compost has good nutrient content, such as nitrogen, phosphorus, and potassium which are essential for plant growth. The application of this compost in agricultural soils shows an increase in soil fertility, water retention, and a reduction in the

need for chemical fertilizers. In addition, compost can also reduce landfill waste, reduce greenhouse gas emissions, and reduce environmental pollution as well as reduce waste management costs and provide cheaper organic fertilizers for farmers. Utilizing leaf waste by making it into compost is an effective and sustainable solution to the problem of organic waste. In addition to providing environmental benefits, leaf compost also provides added economic value to the community. The processing of organic waste into compost in Kersik Village, Marangkayu Sub-district, provides significant benefits because it reduces air pollution and minimizes the need for landfill, the use of compost from organic waste also has a positive impact on soil quality and agricultural productivity (Sari et al., 2024).

Conclusion

The use of EM4 as a composting activator is more efficient than rice water fermentation activator. This occurs due to the pH condition in samples using rice water activator has a value of less than 6 which can be interpreted that the sample is acidic which can be caused by the poor quality of existing rice water fermentation, because during the mixing process the rice water needed is not much so that the mixing process is not immediately thorough from the beginning and finally must be added during the next day.

Suggestion

For further researchers, to conduct further research on the composting process with other methods so that this research is more complete. This journal recommends further development of efficient composting methods and their application at various scales, both household and industrial. As for schools, to continue to educate school residents, especially students, about the use of organic waste through the manufacture of organic compost to reduce the volume of existing waste.

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