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Comparison Of Eco-Enzyme Effectiveness of Lime Peel Waste (Citrus Aurantifolia L.) And Pineapple Peel (Ananas Comosus L.) As A Floor Cleaning Liquid

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Abstract. Organic waste produced by household activities is quite large. One way to process organic waste by making eco-enzyme products. Eco-enzyme is a complex solution resulting from the fermentation of fresh waste (fruit and vegetable peels), brown sugar as molasses, and water. By making eco-enzymes we have processed most of the waste and reduced chemical waste products. The research was conducted from February 10 to March 20, 2024. This study uses a quantitative method using a pseudo-experimental design. The samples used were lime peel and pineapple peel. With 16 repetitions of the treatment. The data was analyzed using the t-test for independent samples. The results showed a decrease to an average value of pH 2.65, an average TDS value of 1248,125 mg/L, and an average value of 978.81 ml volume. Results of organoleptic tests on Eco-enzyme Lime Peel (Citrus Aurantifolia L.) for the aroma smelled of sour lime fruit and the color obtained was cloudy brown). Meanwhile, the results of Eco-enzyme Pineapple Peel (Ananas Comosus L.) decreased to an average value of pH 2.57, an average value of TDS of 1212.5 mg/L, an average value of 970 ml and the results of organoleptic tests on the smell of pineapple fruit and the color obtained was cloudy brown. There is a difference in Eco-enzyme from lime peel and pineapple peel which can be seen from the pH and TDS tests. For floor cleaners, both get clean, non-slippery, and non-sticky floor results. So Eco-enzyme from this ingredient can be used in everyday life.

Keywords: Eco-enzyme, Lime Peel (Citrus Aurantifolia L), Pineapple Peel (Ananas Comosus L), Floor Cleaning Fluid

INTRODUCTION

Indonesia's large population with a high growth rate results in an increase in the amount of waste. Based on data from the National Waste Management Information System (SIPSN) of the Ministry of Environment and Forestry (KLHK), the volume of waste heaps in Indonesia in 2022 reached 19.45 million tons.Waste management is a systematic, comprehensive, and sustainable activity that includes waste reduction and handling. Waste management Indonesian low of 2008 no 18 in clause 19 point a includes activities: restriction of waste generation, waste recycling, or waste reuse. [1]

The volume of organic waste produced by household activities is quite large, reaching 60-70% of the total waste produced, including food waste, fruit peels, vegetable waste, and animal waste. All of these ingredients can be processed into eco-enzymes. [2]

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Managing some of the organic waste into eco-enzymes not only reduces waste piles but can also be a source of family income either directly or indirectly. The increase in income is directly obtained from sale of eco-enzymes produced, while indirectly it can be used as an eco-enzyme in vegetable plants cultivated in the yard. [3]

Eco-enzyme is a complex solution resulting from the fermentation of fresh kitchen waste (fruit and vegetable peels), brown sugar as molasses, and water. Eco-enzyme It can function as an antifungal, antibacterial, and insecticide. This liquid has been widely used as a detergent mixture, vegetable and fruit cleaner, descaler, insect repellent, and plant grower. What's inside Eco-enzyme is Acetic Acid (H3COOH) which can kill germs, viruses, and bacteria. The content of the enzyme itself is lipase, trypsin, and amylase, and can kill/prevent pathogenic bacteria. In addition, it also produces NO3 (Nitrate) and CO3 (Carbon trioxide) which are needed by the soil as nutrients. In addition, eco-enzymes can be developed into floor-cleaning liquids through the process of organoleptic, pH, and TDS testing so that they are safe for use by people in their daily lives. From an economic point of view, the manufacture of eco-enzymes can reduce the cost of purchasing floor-cleaning fluids or insecticides.[4]

It's just that not all of this organic waste can be used as raw materials for eco-enzymes. Organic waste that can be used as eco-enzyme materials is fruit waste, fruit peels, and vegetable waste. Managing some of the organic waste into eco-enzymes not only reduces waste piles but can also be a source of family income either directly or indirectly. The increase in family income is directly obtained from the sale of the eco-enzyme produced, while indirectly it can be used as an eco-enzyme in vegetable crops cultivated in the yard.[5]

The principle of the eco-enzyme manufacturing process is actually similar to the composting process, but with the addition of water as a growth medium so that the final product obtained in the form of liquid is preferred because it is easier to use. The special feature of this eco-enzyme is that it does not require a large area for the fermentation process like in making compost, even this product does not require a composter tub with certain specifications. Used bottles of mineral water and other products that are no longer used can be reused as fermentation tanks. [6]

Based on these problems and potentials, I am interested in conducting research on making eco-enzymes by utilizing household organic waste in the form of lime peel and pineapple peel as a floor-cleaning liquid.

METHODS

This study uses a quantitative method with a pseudo-experimental design. The samples were lime peel and pineapple peel. With 16 repetitions of the treatment. The samples used in this study were lime peel and pineapple peel. For lime peel, it is obtained from household waste, while pineapple peel is obtained from fruit merchant waste. The subject of this study is to determine the content of lime peel and pineapple peel to pH, TDS, volume, color, and aroma of eco-enzyme with a ratio of 1 : 3 : 10. Composition 1 for sugar as much as 100 g, 3 for lime peel waste as much as 300 g, and 10 for water as much as 1000 ml.

Aroma, color, and volume testing using organoleptic tests, for pH and TDS (Total Dissolved Solids) using pH meters and TDS meters. The data was analyzed using the t-test for independent samples (independent) which is a statistical test used to find out the mean difference between two unpaired samples. Manufacturing procedure: cut the lime peel waste and pineapple peel into small pieces, then, separate each type of fruit peel into a different container with the weight of the peel in each container weighing 300 g using a scale, measure the weight of sugar with a scale weighing 100 g, measure water using a measuring cup of 1000 ml, then, add 5 g of yeast, Put all the ingredients in a plastic bottle container, close all the containers tightly, label the date of manufacture and the date of completion, and let it sit for 1 month

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RESULTS AND DISCUSSION

A good Eco-enzyme standard is to have a pH below 4, dark brown in color, and a fresh and sour aroma typical of fermented fruit. [5] The results of the study are as follows:

Based on the results of pH, TDS, Volume measurements and organoleptic tests (aroma and color) carried out after the fermentation process of eco-enzyme from lime peel and pineapple peel waste, namely on the 30th day, it can be seen that on the first day to the tenth day, gas production has been high due to the addition of yeast. This can be observed from inside the plastic bottle, which is indicated by the formation of fermented gas bubbles. This shows that microbial activity in digesting organic matter is still very high. The fermentation process of organic matter by microorganisms produces enzyme activity by releasing CO2 gas and alcohol. This process causes a change in the properties of organic materials. [7]

On the eleventh to twentieth day, alcohol is formed so that the smell of alcohol comes out of the eco-enzyme solution. Furthermore, on the twenty-first to thirtieth day, it emits a sour odor from the eco-enzyme liquid which is the smell of acetic acid. Many mineral compounds and vitamins, will continue to break down and naturally form enzymes. The results showed that the fermentation time took 30 days with the addition of yeast. Eco-enzyme fermentation products are subjected to high microbial activity, so they can be used to inhibit microbial growth.

1. Eco-enzyme Acidity (pH) Test of Lime Peel (Citrus Aurantifolia L.) and Pineapple Peel (Ananas Comosus L.)

The results of the Eco-enzyme Acidity Level (pH) Test of Lime Peel and Pineapple Peel can be seen in the following table:

Table 1. Results of Eco-enzyme Acidity (pH) Test from Lime Peel and Pineapple Peel

NO	Repetition	Lime Peel			Pineapple Peel		
		Acidity (pH)	TDS	Volume	Acidity (pH)	TDS	Volume
1	1	2,62	1210	998	2,57	1140	993
2	2	2,65	1240	983	2,56	1180	973
3	3	2,63	1220	978	2,55	1230	953
4	4	2,57	1250	995	2,53	1170	980
5	5	2,56	1250	980	2,68	1220	944
6	6	2,63	1190	996	2,56	1220	990
7	7	2,68	1210	985	2,56	1190	971
8	8	2,68	1310	999	2,54	1250	967
9	9	2,69	1220	948	2,61	1240	947
10	10	2,68	1220	985	2,56	1240	977
11	11	2,68	1280	994	2,53	1150	984
12	12	2,65	1370	950	2,53	1190	967
13	13	2,71	1230	941	2,54	1190	954
14	14	2,69	1230	971	2,56	1240	985
15	15	2,68	1320	991	2,56	1240	979
16	16	2,69	1220	967	2,73	1310	956
Average		2,65	1248.125	978,81	2,57	1212.5	970

Source: primary data 2024.

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Based on Table 1, The pH value of the eco-enzyme products that have been obtained has decreased after the fermentation process. A significant decrease in pH was seen after 30 days of incubation. However, there was no significant difference in pH values for each type of material and its repeatability. This condition indicates at the time of measurement on the 30th day the alcohol formed has turned into acetic acid. This causes the pH of the tested product to drop to reach an average pH value of 2.65 in lime peel and an average pH value of 2.57 in pineapple peel

in another study the fermentation process was carried out for 90 days. The decrease in pH was seen significantly after incubation for 30 days. However, the products incubated until the 60th and 90th days did not experience a significant decrease in pH.8 So it can be concluded that the pH value of the tested eco-enzyme products both experienced a decrease after the fermentation process.

The TDS (Total Dissolved Solids) value, namely for lime peel type, it decreased to reach an average TDS value of 1248.125 mg/L and for pineapple peel type, it decreased to reach an average TDS value of 1212.5 mg/L. When viewed from each repetition that has been carried out, there is no significant difference in the decrease that occurs from the two materials. With the low TDS value produced, eco-enzyme products become more visually attractive because they are clearer than before fermentation.

Another study, the raw materials that experienced a decrease in TDS value were those that only used pineapple peel waste. While those containing orange peel waste experienced an increase in TDS value. [8] So there is a difference between this study and previous studies regarding the decrease and increase in TDS value from orange peel waste materials.

The eco-enzyme products have decreased in volume after fermentation for 30 days. The decrease or increase in volume is based on the waste used to obtain eco-enzyme products. Of the 16 repetitions, all repetitions from the two materials experienced a decrease in volume. On the 30th day of incubation, the most volume decrease in lime peel reached an average volume value of 978.81 ml, and pineapple peel reached an average volume value of 970 ml.

2. Organoleptic Test of Eco-Enzyme Aroma from Lime Peel (Citrus Aurantifolia L.) and Pineapple Peel (Ananas Comosus L.)

The results of the Organoleptic Test of Eco-enzyme Aroma from Lime Peel and Pineapple Peel can be seen in the following table:

Table 2. The Organoleptic Test Results of Eco-enzyme Products aroma from Lime Peel and Pineapple *Peel*

No.	Repetition	Lime Peel	Pineapple Peel
1	1 – 8	Lime Fruit Sour	Pineapple Fruit Sour
2	9 - 16	Lime Fruit Sour	Pineapple Fruit Sour

Source: primary data 2024

The table data shows that the results of the organoleptic test on the aroma parameter can be seen that on day 0 or before fermentation, the mixture of molasses-flavored materials is fermented. However, after fermentation for 30 days, the sour-smelling solution of the raw materials was used. In fermentation, eco-enzyme products from lime peel have an acidic aroma of lime fruit and from pineapple peel have an acidic aroma of pineapple fruit, both of which produce a distinctive sour aroma from fermentation.

The fermentation process was carried out for 90 days. The results of the organoleptic test on the aroma parameters can be seen that on day 0 or before fermentation, the mixture of ingredients had a molasses aroma. However, after being fermented for 30 days, the solution had a sour aroma

from the raw materials used. On the 60th day of fermentation, and also on the 90th day of fermentation, it also had a sour aroma typical of fermentation. So that the aroma produced has a more dominant pineapple acid aroma and a more dominant orange acid aroma. [9] So it can be concluded that the aroma produced from the eco-enzyme product has the same aroma according to the fruit skin material used.

3. Color Organoleptic Test of Eco-enzyme Products of Lime Peel (Citrus Aurantifolia L.) and Pineapple Peel (Ananas Comosus L.)

The results of the Color Organoleptic Test of Eco-enzyme Products of Lime Peel and Pineapple Peel can be seen in the following table:

Table 3. The Results of Organoleptic Test of Color Eco-enzyme Products of Lime Peel and Pineapple Peel

No.	Repetition	Lime Peel	Pineapple Peel
1	1 – 8	Turbid Chocolate	Turbid Chocolate
2	9 - 16	Turbid Chocolate	Turbid Chocolate

Source : primary data 2024

The results of the organoleptic test in the table, it can be seen that before fermentation, the mixture of ingredients is clear brown. The clear brown color is caused by the dominance of molasses which is deep black. All the ingredients that have been mixed into a clear brown color. After fermentation for 30 days, eco-enzyme products from lime peel and pineapple peel both have a cloudy brown color.

Septiani said, all eco-ezyme variants that have been harvested have a brown liquid color. The resulting brown color is not the same, but there is a difference in color from each product variant, such as watermelon skin which has a slightly greenish brown color. [10] So there is a difference in the color produced, which also depends on the fruit skin used.

4. Differential Effect Test of Eco-Enzyme from the Content of Lime Peel and pineapple peel based on pH

Table 4. Result of t Test Differential Effect Test of Eco-Enzyme from the Content of Lime Peel and pineapple peel based on pH

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Result pH Test Product Eco-enzyme	Variations That Same Assumed	0,051	0,823	4.656	30	0,000	0,08250	0,01772	0,04632	0,11868
	Variations that Same no Assumed			4.656	28.354	0,000	0,08250	0,01772	0,04623	0,11877

Source : primary data 2024

Based on the t-test table above, it can be seen the difference in the effectiveness of eco-enzyme from lime peel and pineapple peel based on pH, where the sig. value (P-Value) is 0.000. It was

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concluded that there were differences in the effectiveness of eco-enzymes from lime peel and pineapple peel as floor cleaning fluids based on Ph.

5. Difference in the effectiveness of eco-enzymes from the content of lime peel type and pineapple peel based on TDS

Table 5. Result of t Test Difference in the effectiveness of eco-enzymes from the content of lime peel type and pineapple peel based on TDS

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Result TDS Test Product Eco-enzyme	Variations that Same Assumed	0,032	0,860	2.200	30	0,036	35.625	16.195	2.551	68.699
	Variations that Same no Assumed			2.200	29.618	0,036	35.625	16.195	2.533	68.717

Source: primary data 2024

Based on the t-test table above, it can be seen the difference in the effectiveness of eco-enzyme from lime peel and pineapple peel based on TDS, where the sig. (P-Value) is 0.036.

Ho is rejected, it is concluded that there were differences in the effectiveness of eco-enzymes from lime peel and pineapple peel as floor cleaning fluids based on TDS.

6. Difference in the effectiveness of eco-enzymes from the content of lime peel and pineapple peel based on Volume

Table 6. Result of t Test Difference in the effectiveness of eco-enzymes from the content of lime peel and pineapple peel based on Volume

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Result Volume Test Product Eco-enzyme	Variations that Same Assumed	0,350	0,558	1.458	30	0,155	8.813	6.046	-3.535	21.160
	Variations that Same no Assumed			1.458	28.958	0,156	8.813	6.046	-3.553	21.178

Source: primary data 2024

The t-test table above, it can be seen that there are differences in the effectiveness of eco-enzyme from lime peel and pineapple peel based on volume, sig. value is 0.155 and 0.156. It was concluded that there is no difference in the effectiveness of eco-enzyme from lime peel and pineapple peel as a floor cleaning fluid based on volume.

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Eco-enzyme from lime peel (Citrus Aurantifolia L.) and pineapple peel (Ananas Comosus L.) as a floor cleaning liquid is very effective to use in daily life. When used as a floor cleaner with a dose of eco-enzyme + water = 1-2 bottle caps with a size of 6-12 mL + 1 bucket of water with a size of 5 L in accordance with the eco-enzyme making learning module that has been compiled by Eco-enzyme Nusantara. The results that can be observed after the application of floor cleaning liquid are that the floor looks clean, not slippery, and also not sticky. However, the resulting aroma is less flavorful. With the other dose, namely 4 bottle caps or 24 mL eco-enzyme + 1 bucket of water with a size of 5 L. The results obtained are the same as the results of the first measurement test. The last dose is as many as 6 bottle caps or 36 ml eco-enzyme + 1 bucket of water with a size of 5 L. The results obtained are also the same as the previous one. However, when eco-enzymes are dissolved in water, the resulting aroma is more emit than the previous dose.

CONCLUSIONS

1. The effectiveness of eco-enzyme from lime peel was obtained with an average pH value of 2.65, an average TDS value of 1248,125 mg/L, an average value of 978.81 ml volume, and an organoleptic test on the sour smell of lime fruit with a cloudy brown color.
2. The effectiveness of eco-enzyme from pineapple peel was obtained with an average pH value of 2.57, an average TDS value of 1212.5 mg/L, an average value of 970 ml volume, and an organoleptic test on the sour smell of pineapple fruit with a cloudy brown color.
3. There is only a slight difference in the pH and TDS values of Eco-enzyme from lime peel and pineapple peel.
4. Eco-enzyme application from lime peel and pineapple peel as a floor cleaner both obtain clean, non-slippery, and non-sticky floor results. So Eco-enzyme from this ingredient can be used in everyday life.

REFERENCES

1. Bachelor, G., Pada, F., Pharmacy, J., Medicine, F., Science, D., Uin, K., & Makassar, A. (n.d.). *Zam-Zam water microbiology test in thesis packaging submitted to meet one of the requirements for obtaining.*
2. Eco-Enzyme Manufacturing Learning Module Revision 2. (2021, May 2). (n.d.).
3. Larasati, D., Puji Astuti, A., & Triwahyuni Maharani, E. (n.d.). Organoleptic test of eco-enzyme products from fruit peel waste (Case study in Semarang City). *National Seminar of Edusainstek FMIPA UNIMUS 2020.*
4. Master of Science Education J Service, on the Utilization of Household Organic Waste as Raw Material for Lolita Eco-Enzyme, Endang Susilowati, P., Ma, M., et al. (2021). Economic empowerment of crab fishermen through the development of Bubu Fi fishing gear technology in Pemongkong Village, East Lombok Regency. *Journal of Master of Science Education Service, 4*(4). https://doi.org/10.29303/jpmpi.v3i2.1147
5. Novianti, A., & Muliarta, N. (2021). Eco-enzyme based on household organic waste as a multipurpose liquid. *AJ, 1*(1), 12–17. https://doi.org/10.22225/aj.1.1.3655.12-17
6. Nusantara Eco-Enzyme Community. (2021). *Eco-enzyme manufacturing module.*
7. Rukmini, P., & Herawati, D. A. (2023). Journal of chemistry and eco-enzyme engineering from organic waste (fruit and rhizome waste) fermentation. *Journal of Chemistry and Eco-Enzyme Engineering, 4*(1).
8. Septiani, U., Oktavia, R., Dahlan, A., et al. (n.d.). Eco-enzyme: Processing household waste into multipurpose products at the Khazanah Welfare Foundation. *National Seminar on Community Service, LPPM UMJ.* http://jurnal.umj.ac.id/index.php/semnask
9. Sulfiati. (2022). *Effect of eco-enzyme component variations on the antibacterial activity of Staphylococcus aureus and Escherichia coli.*
10. Suprayogi, D. R. (2022). *Analysis of eco enzyme products from pineapple fruit peel (Ananas comosus L.) and Berastagi orange (Citrus × sinensis L.).*