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COMPARISON OF ECOENZYME QUALITY BASED ON ORGANOLEPTIC TEST RESULTS ON VARIOUS ORGANIC FRUIT AND VEGETABLE MATERIALS

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Abstract

Eco-enzyme is a multifunctional liquid produced from the fermentation of organic waste. This study aims to compare the quality of the eco-enzyme in various organic materials (fruits and vegetables). This study includes qualitative and quantitative observations. Qualitative observations include organoleptic tests, including aroma, color, and texture. Quantitative observations include measurements of pH, TSS, and TDS levels. The research data shows that the eco-enzyme with pineapple material obtained the highest volume of 36.95%. Meanwhile, cabbage leaves and onion skins showed the best quality in terms of clarity, with the lowest TSS value of 10-13 mg/L. The combination of fruit skins produced an eco-enzyme with the highest mineral content, namely a TDS concentration of 2,755 mg/L, but with a lower fermentation rate at pH 5. The results obtained indicate that each material has its own advantages in certain test parameters
Keywords: Eco-enzyme, organoleptic tests

INTRODUCTION

Eco-enzymes are complex organic solutions produced through the fermentation of organic materials such as fruit and vegetable waste, sugar (usually brown sugar, palm sugar, or molasses), and water. The ongoing fermentation process of these organic materials produces various enzymes, organic acids, and bioactive compounds that can provide antimicrobial, cleaning, and nutritional properties for plants (Hasanah, 2021; Novianti & Muliarta, 2021; Hanifah *et al*., 2022).

The quality of the resulting eco-enzyme is highly dependent on the type of organic material used as the fermentation substrate. Different types of organic materials can produce different eco-enzyme characteristics (Wikaningrum *et al*., 2022). Eco-enzyme quality evaluation is generally conducted through various physicochemical parameters. Eco-enzyme characteristics can be determined through several parameters, including pH, total suspended solids (TSS), and total dissolved solids (TDS) (Suliestyah *et al*., 2022; Das *et al*., 2024). Although eco-enzymes have been widely produced and used in various countries, there is still limited scientific information comparing the quality of eco-enzymes made from various types of organic materials. Comprehensive research comparing the organoleptic characteristics, pH, TDS, and TSS of eco-enzymes made from various organic wastes from vegetables and fruits is still limited. Information on this is needed to optimize raw material selection in production to produce high-quality eco-enzymes

This research is expected to make a significant contribution to the eco-enzyme development process, particularly in optimizing the selection of organic waste raw materials. The test results can also serve as a reference for the community, small and medium enterprises, and industry in producing eco-enzymes with consistent and optimal quality.

METHODS

The materials used in the manufacture and testing of eco-enzymes are a combination of fruit peels, including orange peel, papaya, and pineapple, as well as cabbage leaves and onion skin. The procedure for making ecoenzymes using various

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types of organic materials can be carried out by following the eco-enzyme manufacturing procedures (Rochyani *et al.,* 2020; Dewi *et al.,* 2021; Larasati *et al*., 2022; Nurlaela *et al.,* 2022; Maryanti & Wulandari, 2023).

The research data were analyzed qualitatively and quantitatively. Qualitative observations included organoleptic tests, including aroma and color after 90 days of fermentation. Quantitative observations included pH, TSS, and TDS levels using a water quality control device equipped with pH, TSS, and TDS meters

RESULTS AND DISCUSSION

The results of organoleptic observations of the aroma, color, and texture of various types of eco-enzymes made using mixed ingredients after a 90-day fermentation process are shown in Table 1

Table 1. Organoleptic Test Results of Eco-Enzyme Products

	Organileptic Test		
Types of ecoenzymes	Flavor	Color	texture
Fruit leather combination	fruity	cloudy	runny texture
Orange peel	fruity	cloudy	runny texture
Papaya	Smell of alcohol	rather clear	runny texture
Pineapple	Smell of alcohol	rather clear	runny texture
Cabbage	Smell of alcohol	a little cloudy	runny texture
Onion	Smell of alcohol	a little cloudy	runny texture

The organoleptic test results showed that the combination of fruit peel and orange peel retained a distinctive fruity aroma, indicating that the fermentation process was still in its early stages or the pH was relatively stable. In contrast, other organic materials (papaya, pineapple, cabbage leaves, and onion peel) produced an alcoholic aroma, indicating that the alcoholic fermentation process was well underway. In terms of color, most products showed varying degrees of clarity, with papaya, pineapple, and onion peel producing relatively clearer colors than the others. All eco-enzyme products had a consistent and runny texture, indicating the characteristics of normal fermentation fluids.

The results of organoleptic tests showed significant variations in characteristics between the types of eco-enzymes produced. In terms of aroma, there are two categories of eco-enzyme groups formed, namely eco-enzymes made from orange peel and a combination of fruit peels that produce eco-enzyme products with a distinctive fruity aroma, and eco-enzymes from papaya peel, pineapple, cabbage leaves, and onions that produce eco-enzyme products with an alcoholic aroma. The appearance of an alcoholic aroma in eco-enzymes indicates an optimal alcohol fermentation process, where the natural sugar content derived from organic materials can be converted into ethanol by indigenous microorganisms found in the organic materials used (Samriti & Arya, 2019). Good eco-enzymes have a fresh, sour aroma typical of fruits or have an aroma like tape or resemble the smell of alcohol, where the appearance of this aroma is caused by organic acids and volatile compounds produced during the fermentation process. The aroma indicates that the microorganisms contained in the eco-enzyme can work optimally without any interference or contamination by pathogenic bacteria or fungi, which also indicates that the eco-enzyme can be used safely in the agricultural sector (Utpalasari *et al.,* 2020).

The color characteristics of the eco-enzyme show a color difference from clear to cloudy, where the eco-enzyme with orange peel and a combination of fruit peels shows

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a cloudy color, cabbage leaves show a slightly cloudy color, and papaya, pineapple, and onion peels produce a slightly clear color. Good eco-enzymes generally have a clear color. However, the resulting color condition can also be influenced by the raw materials used, where the appearance of color indicates that the fermentation process can proceed optimally and does not experience significant contamination (Utpalasari *et al.*, 2020). S. Good quality eco-enzyme has a thin but slightly thick liquid texture without any lumps or thick sediment at the bottom of the container. The results obtained indicate that the texture of the resulting eco-enzyme is of good quality. The texture of the eco-enzyme obtained indicates that the fermentation process has produced compounds evenly without experiencing solid sediment at the bottom of the container.

The results of observations of the volume of various types of eco-enzymes made using different materials are shown in Table 2

Table 2. Volume of Eco-Enzymes Produced from Various Organic Materials

Types of Eco-enzymes	Fluid Volume	Pulp weight	Product volume	Product Color
Fruit leather combination	495	116	29,9	orange
Orange peel	450	190,4	19,11	yellow
Papaya	500	162,7	23,5	yellow
Pineapple	564	96,2	36,95	yellow
Cabbage	594	165,5	26,41	light brown
Onion	560	123,7	31,16	orange

Based on Table 2, cabbage leaves produced the highest liquid volume (594 mL), followed by pineapple (564 mL), indicating a good extraction efficiency. In contrast, the highest product volume percentage was achieved by pineapple (36.95%), highlighting its optimal ability to produce eco-enzyme liquid. Additionally, orange peel had the highest pulp weight (190.4 grams), which correlated with the lowest liquid volume (450 mL), suggesting a denser fiber structure and greater difficulty in extraction. Finally, the variation in product color from yellow to orange and light brown reflects differences in the natural pigment content of each organic material. The results of pH, TSS, and TDS measurements of various eco-enzymes made using various materials after a 90-day fermentation process are shown in Table 3.

Table 3. Results of pH, Total Dissolved Solids (TDS), and Total Suspended Solids (TSS) measurements on Eco-Enzyme products

Types of Eco-enzymes	pH	TDS (mg/L)	TSS (mg/L)
Fruit leather combination	5	2755	53
Orange peel	3	964	346
Papaya	3	933	58
Pineapple	3	924	130
Cabbage	4	2475	10
Onion	4	2649	13

The pH parameters showed significant variations, with the combination of fruit peels having the highest pH (5), which is still within the weak acid range. In contrast, orange, papaya, and pineapple peels showed a more acidic pH, namely 3, which

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indicates a more intensive fermentation process. The highest Total Dissolved Solid (TDS) value was found in the combination of fruit peels (2,755 mg/L) and onion peels (2,649 mg/L), which indicates a high content of minerals and dissolved compounds. The highest Total Suspended Solid (TSS) value was found in orange peels (346 mg/L), indicating the presence of more suspended particles, possibly originating from organic material residues that have not been completely decomposed. pH measurements showed that the lowest pH value of 3 was obtained in eco-enzymes made from orange, papaya, and pineapple peels, while the highest pH value of 5 was obtained by eco-enzymes made using a combination of various fruit peels. The low pH value, ranging from pH 3-4 in most samples, indicates optimal acidic conditions for eco-enzymes, in accordance with established quality standards, where eco-enzymes can be said to be of good quality if they have a pH of 3-4 (Yu *et al*, 2024). This acidic condition plays an important role in the antimicrobial activity and stability of eco-enzyme products during storage. The appearance of acidic pH in eco-enzyme products can be caused by the process of carbohydrate metabolism into volatile organic acids, resulting in an acidic pH and a distinctive aroma (Chakraborty *et al,* 2023).

The process of carbohydrate metabolism into volatile organic acids is an indicator of successful fermentation and impacts changes in product aroma. Total Dissolved Solids (TDS) showed significant variation, with the highest value of 2,755 mg/L in the eco-enzyme with fruit peel combination and the lowest value of 924 mg/L in the eco-enzyme with pineapple. The high TDS value in the eco-enzyme made from a combination of various fruit peels and onion peels (2,649 mg/L) indicates the presence of high mineral and soluble compounds in the eco-enzyme product, which is positively correlated with the potential biological activity of the eco-enzyme (Galintin *et al.,* 2021). In contrast, eco-enzymes made from fresh fruit such as pineapple, papaya, and orange peel were only able to produce eco-enzymes with relatively low TDS values (924-964 mg/L), which may be due to the high air content and softer cellular structure of the materials, making it more difficult for minerals and compounds to dissolve. Correlation analysis showed that eco-enzymes with lower pH tended to have lower TDS, as seen in orange, papaya, and pineapple peels. This suggests that intensive fermentation processes with low pH can convert more soluble compounds into other fermentation products. Total Suspended Solids (TSS) showed different results from TDS, where the highest value was found in eco-enzymes using orange peel as raw material (346 mg/L) and the lowest value in eco-enzymes using cabbage leaves (10 mg/L).

The high TSS in orange peel can be associated with the high fiber and pectin content in orange peel, where materials with relatively high fiber content tend to produce more suspended particles during the fermentation process (Pathak et al, 2018). The low TSS value of eco-enzymes made from cabbage leaves and shallot skins indicates a more complete fermentation process, resulting in a clearer liquid (Suliestyah *et al*., 2022). The highest eco-enzyme product volume was produced by eco-enzymes made from cabbage leaves (594 ml) with a product volume percentage of 26.41%, while the lowest volume was obtained by eco-enzymes made from orange peel (450 ml) with a percentage of 19.11%. Pineapple showed the best production efficiency with a product volume percentage of 36.95% even though its absolute volume was 564 ml. The high production efficiency of eco-enzymes made from pineapple can be influenced by several factors. The effectiveness of eco-enzyme production can be influenced by sugar content, endogenous enzymes, and the physical structure of the raw materials used (Wang *et al.,* 2022).

In this case, pineapple contains the enzyme bromelain, which can accelerate the hydrolysis and fermentation processes. The color variations in eco-enzyme products

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reflect the bioactive compounds present in each raw material used. The yellow eco-enzyme produced by orange peel, papaya, and pineapple indicates high flavonoid and carotenoid content. The orange color of the combination of fruit peel and onion skin indicates high levels of anthocyanin and beta-carotene, while the light brown color of cabbage leaves indicates oxidation of phenolic compounds during fermentation (Bangar *et al.,* 2022).

CONCLUSION

Based on the results of producing and testing various eco-enzyme products using different organic ingredients, it can be concluded that the pineapple-based eco-enzyme demonstrated the best performance in terms of production efficiency, producing the highest volume of 36.95%. Meanwhile, cabbage leaves and onion skins demonstrated the best quality in terms of clarity, with the lowest TSS values of 10-13 mg/L. The combination of fruit skins provided the eco-enzyme with the highest mineral content, with a TDS concentration of 2,755 mg/L, but with a lower fermentation rate, with a pH of 5. The results obtained indicate that each ingredient has its own advantages in certain testing parameters, which are not the same between eco-enzyme products.

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