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ANALYSIS OF ECO-ENZYMES FROM ORGANIC WASTE BASED ON FRUITS AND VEGETABLES

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ABSTRACT

One method of processing organic waste is using eco-enzymes, which are made by fermenting vegetable and fruit waste com-bined with water and sugar. This research aims to examine the properties of organoleptic enzymes, their raw materials, and their application to human requirements. This study used an ex-perimental method by repeating twice for each raw material, including vegetables, a mixture of fruit peels (mango, pineapple, and durian), pineapple peel, banana peel, and orange peel. Then the eco-enzyme data is analyzed for characteristics based on parameters such as color, aroma, taste, and pH. According to the findings, the eco enzyme has a distinct brown color that ranges from light brown to dark brown, the aroma and taste produced range from very sour and smelly to a slightly sour and characteristic smell, and the pH levels range from 2.98 to 3.50. The characteristics that have been analyzed organoleptically in this study indicate that the eco enzymes produced are very good, namely brown color, sour aroma, slightly doormat taste, and a pH value of <4. Eco enzymes are used in various fields, such as household needs as cleaning fluids, the environment as a wastewater purifier, health, which is used to improve well wa-ter quality, and agriculture as a fertilizer and plant disinfectant.

INTRODUCTION

Waste is categorized as waste material from industrial and household production due to human needs (Prasetio et al., 2021). Waste production from time to time has increased in large quantities along with the increase in the number of humans and their

needs (Pranata et al., 2021). Waste production in Indonesia in 2022 in a day reaches 54,455 tons, and the count in one year reaches 19.88 million tons (Ningsih et al., 2023). Based on research by Arifki and Melisa (2018), big cities in Indonesia have problems overcoming waste problems, most of which are classified as organic waste. This indicates that the waste problem in Indonesia is currently very serious if left unmanaged (Hikmatriana et al., 2022). Waste management is a waste reduction activity carried out systematically, comprehensively, and continuously to get maximum results with fast and efficient costs (Septiani et al., 2021). Waste management is everyone's responsibility (Febriani et al., 2022). Several waste management methods have been widely applied in the community, such as inorganic waste sorting for further recycling and reuse (Tamyiz et al., 2018; Jayantri and Mohammad, 2021). while in organic waste, various products are made, such as compost, animal feed sources from maggots, and eco enzymes (Satori et al., 2018; Pranata et al., 2021; Dewi and Novi, 2022). Eco enzyme is a waste processing method that is currently being developed that, in the process, converts organic waste into liquids with many benefits (Muktiarni et al., 2023). During the process, fruit and vegetable waste is combined with sugar and water and then left to ferment for three months. This method has been documented in studies by Rasit et al. (2019) and Galintin et al. (2021). Furthermore, research conducted by Rizkina et al. (2023) has demonstrated that eco-enzymes provide numerous benefits when applied in various fields. In applying the benefits of eco-enzymes, it is necessary to understand the characteristics of the solution by characterizing it based on predetermined parameters such as pH, aroma, taste, and color (Gumilar et al., 2023).

Some research on organoleptic enzymes is done using one to three raw materials separately, and still, few use more raw materials. Varshini and Gayathri's (2023) research compared two eco enzymes with raw materials from *Cucurbima maxima* vegetable waste and *Citrus medica* fruit skin waste. Meanwhile, Patel et al.'s (2021) research uses raw materials from vegetable waste types Tagetes L. and *Azadirachta indica* Juss leaves and from *Citrus* fruit skin waste. Then, in their research, Rusdianasari et al. (2021) used raw materials from fruit waste types *Citrus, Carica papaya* L., and *Ananas comosus*. Based on research by Supebrianto and Yoga (2023), organoleptic analysis was carried out to determine the quality of the eco enzyme produced. Organoleptic eco-enzymes derived from various raw materials are suspected in each eco-enzyme product to have different

characteristics. Putra and Nyoman (2022) conducted a study that examined the characteristics of eco-enzymes derived from various raw materials. The study found that the pH, aroma, and color of eco-enzymes differed based on the raw materials used. ANOVA test analysis shows variations in measurements of each of these parameters for enzymes. By knowing the characteristics of various types of raw materials, the product quality of eco-enzymes can be known. From the above problems, it is necessary to research the organoleptic analysis of eco enzymes from several kinds of raw materials, which include vegetables, a mixture of fruit peels (mango, pineapple, and durian), pineapple peels, banana peels, and orange peels, to produce good-quality eco enzyme products to manage organic waste and provide information on the use of eco enzymes for human needs.

MATERIALS AND METHODS

The research was conducted at the Ecology and Environment Laboratory, which is part of the Faculty of Forestry and Environment, University of Kuningan. The tools used in this study were knives, buckets, shredders, and pH meters. The ingredients used include vegetables as much as 1 kg, a mixture of fruit peels (mango, pineapple, and durian) as much as 1 kg, pineapple peel as much as 1 kg, banana peel as much as 1 kg, water as much as 3 liters, and palm sugar as much as 0.3 kg. The manufacture of eco enzymes is carried out on each raw material so that 5 product samples are produced with a volume of 5 liters per sample.

The organoleptic analysis involves the visual identification of various parameters such as color, aroma, and taste (Septiani and Susanti, 2023). Then the pH analysis was carried out at the School of Life Science and Technology, Bandung Institute of Technology (ITB). Organoleptic data were then analyzed using a one-way ANOVA test and a Duncan test with an intensity level of 95% to see the effect of raw materials on the quality of eco-enzyme products produced (Sugiarti et al., 2020).

RESULTS AND DISCUSSION

Organoleptic characteristics of eco enzymes, which include parameters such as color, aroma, taste, and pH, have differences in each raw material. Based on research by Rijal et al. (2021), determining this parameter is done by visualization, smell, and taste through the human senses. Eco enzymes usually produce almost the same color based on the raw materials used, which are brown; this color is also influenced by the sugar used and the time of the fermentation process (Rusdianasari et al., 2021; Ningsih et al., 2023). This is in line with research conducted where eco-enzymes produced have a brownish color in all raw materials. The color of eco-enzymes is presented in Table 1.

Table 1. Color of Eco Enzymes from Various Raw Materials

No	Eco Enzyme	Color
1	Vegetable	Brown
2	Fruit	Brown
3	Pineapple peel	Brown
4	Banana peel	Brown
5	Orange peel	Brown

After analyzing Table 1, it is apparent that the enzymes produced from all raw materials have a brown color. This shows the fermentation process carried out from start to finish, producing good enzymes. This brown color is due to the use of the same sugar in all raw materials. According to Munir et al.'s (2021) research, the addition of certain types of sugar can impact the color of enzymes produced. If the enzymes appear anything other than brown, it indicates a decrease in quality (Putra et al., 2022). However, if the enzymes appear darker, they can still be refined by adding more sugar and fermenting again to improve their quality (Natasya et al., 2023). Eco-enzymes obtained from all raw materials show different shades of brown. Vegetable raw materials have a rather dark brown color; fruit mixtures have a rather dark brown color; pineapple peel has a dark brown color; banana peel has a light brown color; and orange peel has a rather dark brown color. This happens because the raw materials used vary and have different characteristics with their respective characteristics. The shades of brown eco-enzymes in various raw materials are presented in Figure 1.

Figure 1. The Shades of Brown Color of Eco Enzymes (A)Vegetable, (B) MixFruit, (C) Pineapple peel, (D) Banana peel, (E) Orange peel

Aroma is one of the parameters studied in this study. Eco enzymes have an aroma that is produced from the fermentation process (Ningsih et al., 2023). Eco enzymes produced from vegetable raw materials, fruit mixtures, pineapple peels, banana peels, and orange peels have a strong sweet-sour aroma (Seprianto et al., 2022). Eco aroma enzymes from various raw materials are presented in Table 2.

Table 2. The Aroma and Taste of Eco Enzymes from Various Raw Materials

No	Eco Enzyme	Aroma and Taste
1	Vegetable	Sour and Odorless
2	Fruit	Very Sour and Distinctive Smelling
3	Pineapple peel	Sour and Distinctive Smell
4	Banana peel	Somewhat Sour and Distinctive Smell
5	Orange peel	Very Sour and Odorless

Based on table 2, there are variations in aroma in eco enzymes from slightly acidic to very acidic; this result is the same as the research of Larasati et al. (2020) and Natasya et al. (2023), which found that eco enzymes generally produce sour aromas. Based on Maryanti and Fitri's research (2023), eco enzymes produce a sour aroma derived from acetic acid, which is the result of bacterial metabolism in the fermentation process. The eco-enzyme fermentation process uses an anaerobic method, which is a bacterial process of obtaining energy in a closed room without oxygen. An enzyme made from vegetable raw materials shows a sour aroma with a slight doormat taste afterward and has no odor. This result is different from Yuliana et al.'s (2023) research that vegetable waste has a sour aroma and a characteristic smell of fermentation.

The sour aroma is produced from the levels of lactic acid produced during the fermentation process; lactic acid is influenced by the total lactic acid bacteria (BAL), which are naturally found in vegetable waste (Edam, 2018). A small level of lactic acid

can affect the odor substance called volatile so that a little evaporates and causes enzymes to show a sour and odorless aroma. Then an enzyme made from mixed fruit shows a very sour aroma with a slight doormat taste afterwards and a distinctive smell. The raw materials used include mango peel, pineapple skin, and durian skin. Based on research by Putra and I Nyoman (2022), eco enzymes with mixed fruit raw materials show a sour aroma and distinctive smell of fruit skin. Similar to eco enzymes, the mixture of eco enzyme fruit from pineapple skin shows a sour aroma with a slight doormat taste afterward and a distinctive smell.

Based on research by Yuliana et al. (2023) and Natasya (2023), pineapple skin enzymes show a strong, distinctive smell from pineapple. Unlike others, the banana peel enzyme shows a slightly sour aroma with a slight doormat taste afterward and a distinctive smell. While the orange peel enzyme eco shows a very sour aroma with a slight doormat taste afterward and a distinctive smell, the sour aroma comes from acetic acid from banana and orange peels with different levels, namely the acetic acid content of orange peels is higher than banana peels, so there are differences in aroma, and the condition of banana peels that are rotten when fermentation is carried out will have an impact on eco enzymes not having a distinctive odor (Supebrianto and Yoga, 2023).

The variation of the aroma of eco acid enzymes in various raw materials, including slightly sour, sour, and very sour, shows that the content of organic acids contained in them, such as acetic and lactic acids, has a high value, so this causes the pH value to decrease. Based on a study conducted by Ningsih et al. in 2023, it was found that the higher the content of eco-organic acids, the more eating enzymes will decrease the pH value. The study revealed that the pH value of eco-enzymes ranged from 2.98 to 3.50, which is less than 4. Similarly, Permatananda and Gede's research in 2023 showed that an ideal pH value for a good eco enzyme is 3.3 or less than 4. You can find the pH values for eco-enzymes in Table 3 of the study

Table 3. The pH of Eco Enzymes from Various Raw Materials

No	Eco Enzyme	pH
1	Vegetable	3,28 – 3,30
2	Fruit	3,20 – 3,24
3	Pineapple peel	3,48 – 3,50
4	Banana peel	3,45 – 3,52
5	Orange peel	2,98 – 3,01

Organoleptic tests conducted using one-way ANOVA showed different significant values for each variable tested. The color variable shows a significance value of 0.359 > 0.05, indicating that this variable has no real effect on the quality of eco-enzyme products. In contrast, the aroma and taste variables have a significance value of 0.001 < 0.005, which states that this variable has a real effect on the quality of the product produced. The test results on aroma and taste variables continued with the Duncan test, which showed that enzymes made from pineapple peel and banana peel had a real effect on vegetables, peels, and products made from fruit. The results of this study are the same as Sarlinda and Yustin's (2023) research, which found that color has no real effect on the quality of eco enzymes.

This is shown by the fact that eco enzymes that have a light brown color are more effective in killing germs on the floor of the house compared to eco enzymes with dark brown colors. Meanwhile, it is different from Maryanti and Fitri's (2023) research, which shows that eco enzymes from shallot raw materials have good quality because they have a deep brown color. The aroma and taste of eco-enzymes in this study have a real effect on the quality of the products produced. This result is the same as the research of Desmawati et al. (2023), who found that aroma and taste have a real effect on accelerating the manufacture of eco-enzymes. Then, in Syaiful's research (2023), it was explained that making a cleaning solution with an enzyme solution produces an orange aroma and taste that is liked by many people.

The abundance of raw materials used in making eco enzymes can be the basis for using eco enzymes that are right on target. A lot of literature has explained the use of eco enzymes with different raw materials for various fields such as household needs, environment, health, agriculture, and others. Eco enzymes made from vegetable waste and fruit mixtures are used in agriculture as organic fertilizers and disinfectants for plants (Gunawan et al., 2022; Fadlilla et al., 2023; Sinaga et al., 2023). Pineapple peel eco enzyme is used in the environmental field as a wastewater purifier (Gaspersz and Herlina, 2022); banana peel eco enzyme in the health sector is used to improve well water quality (Lespita and Abdul, 2023); and orange peel eco enzyme in household needs is used as a floor cleaning liquid, insect repellent, and antibacterial liquid in cleaning bathtubs (Sidauruk et al., 2022).

CONCLUSION

The color, aroma, taste, and pH of eco-enzymes produced from raw materials show differences from each other. All raw materials for eco-enzymes have a color range from light brown to dark brown. then The aroma and taste produced range from very sour and smelly to a slightly sour and characteristic smell. In addition, the calculated pH level ranges from 2.98 to 3.52. Based on findings from ANOVA's one-way testing analysis, aroma and taste variables affect the quality of the products produced. In contrast, color variables have no real impact on the quality of eco-enzyme products

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