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Study On The Production of Ecoenzimes from Market Waste Raw Materials

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ABSTRACT
Market waste is a component of organic waste that has not been widely used. One of the efforts to utilize market waste is to use market waste as a raw material for making ecoenzymes. This study aims to describe the characteristics of the color, pH, aroma, and total dissolved solids (TDS) of ecoenzymes produced from market waste including mustard greens, kale, banana peels, pineapple peels, and various combinations of these market wastes. Ecoenzyme fermentation was carried out for 90 days. The results of the observations showed that there were differences in color, pH, aroma, and TDS in the resulting ecoenzymes. The color of the ecoenzyme produced is generally brown with different color degradation. The aroma of the ecoenzymes produced also varies, but ecoenzymes containing banana peels, as well as a combination of fruit and vegetable peels, apart from the treatment of banana peels + kale, produce an unpleasant odor. The pH of the ecoenzyme produced was entirely acidic with a pH range of 2.9-5.6. The lowest ecoenzyme pH was made from kale + mustard greens, while the highest pH was made from banana skin treatment. Ecoenzyme TDS values also varied, with the lowest value being 955 in the banana peel treatment, and the highest value in the mustard greens treatment with a value of 2920. The results showed that market waste has the potential to be used as a raw material for making ecoenzymes.

Keywords: *ecoenzym, substrate, market waste*

INTRODUCTION
Along with the increasing population, it is also accompanied by an increasing amount of waste generated from community activities. According to data from the National Waste Management Information System (SIPSN) in 2021, most of the waste in Indonesia is in the form of organic waste which includes food scraps (40.3%) and plant residues in the form of wood, twigs and trees (12.9%). Other waste components in the form of plastic, rubber, cloth, glass and metal have a percentage of no more than 17.3%. Most of the waste is generated from households (40.8%), traditional markets (17.3%), and trade centers (18.2%), while other places, such as offices and public facilities, do not exceed 8.3% (SIPSN , 2021). Based on these data it can be seen that the market, although there are not as many as households, but the waste generated from activities in it ranks third after the place of commerce (SIPSN, 2021).

Organic waste generated from activities in the market, for example, is leftover fruits and vegetables. Market waste is usually only disposed of in landfills, so it only moves waste-related problems. Various efforts have been made to reduce market waste piles. Several ways are offered by turning it into compost or animal feed (Indriyanti et al., 2015; Bahrun and Herliana, 2019). This method is a good method, but it is not attractive to some people because the use of compost and animal feed is limited to certain groups of people. For this reason, currently market waste is being intensively used as compost and animal feed, which is used in the fermentation process which produces ecoenzymes.

Ecoenzyme is a complex organic solution produced from the fermentation of kitchen waste (Vama and Cherekar, 2020). The raw materials used in making ecoenzymes include fruit peels (Vama and Cherekar, 2020; Rahayu et al., 2021; Mavani et al., 2020) and agricultural waste (Rahayu et al., 2021). Vama and Charekar's research (2020) shows that ecoenzyme solutions have a variety of benefits, for example in stimulating plant germination so that they can be used as fertilizers, can be used as disinfectants because they show antimicrobial activity so they can be used as cleaning solutions in daily activities. The benefits of ecoenzymes are more widespread and can be felt by various groups.

Making ecoenzymes from different materials produces different characteristics (Nurlatifah et al., 2022). Most studies comparing the characteristics of ecoenzymes produced from different materials have only compared fruit peel raw materials, while comparisons with vegetables or a combination of fruit and vegetable peels have not been widely carried out. Even though vegetables are also components that are also found in market waste and have the potential to be utilized. Therefore research on the characteristics of ecoenzymes produced from various market wastes needs to be carried out. This study aims to compare the physical and chemical characteristics of ecoenzymes made from market waste.

METHOD

This research is an exploratory study with one type of treatment, namely the variation of ecoenzyme substrates. Four types of ecoenzyme substrates were used, namely kale, mustard greens, banana peels, and pineapple peels. The total treatment used in this study was 10 treatments (Table 1). Making ecoenzymes refers to the Vama and Cherekar method (2020). Market waste is washed clean, then cut into small pieces. Market waste is then drained until half dry. The market waste is then put into a plastic bottle that has been washed clean, then brown sugar and water are added, then closed. The ratio between market waste, brown sugar and water is 3:1:10. All the ingredients that have been put into the bottle are then homogenized. During the fermentation process, every day for the first two weeks, the bottle cap is opened for a few seconds to remove the gas produced, then the bottle cap may be opened only occasionally. The fermentation process is carried out for ninety days. Parameters observed in this study included color, appearance, aroma, pH, and total dissolved solids. The results of the observations obtained were then analyzed descriptively.

Table 1. Treatment of various substrates from market waste used in the manufacture of ecoenzymes

Treatment code	Substrate used
A	Spinach
B	Say
C	Spinach + mustard
D	Pineapple skin
E	Banana peel
F	Banana peel + pineapple peel
G	Pineapple skin + mustard
H	Banana peel + mustard
I	Pineapple skin + kale
J	Banana peel + kale

RESULT AND DISCUSSION

Result

In this study, four types of market waste were used as raw materials in the manufacture of ecoenzymes, namely kale, mustard greens, pineapple peels, and banana peels. Based on the four market wastes used, there are a total of 10 treatment variations, in the form of different raw materials for making ecoenzymes. The characteristics of the ecoenzymes obtained due to the use of different substrates are shown in Table 2.

Table 2. Characteristics of ecoenzymes made from market waste

Treatment code	Substrate used	Before			After 90 days				
		Color	Solution conditions	Aroma	Color	Solution conditions	Aroma	pH	Total dissolved solids
A	Spinach	Chocolate	Mixed	A mixture of the aroma of brown sugar and kale	Light yellowish brown	Mixed	Fermented aroma	3.4	2750
B	Say	Light chocolate	Mixed	Dominant aroma of brown sugar	Orange light brown	Separated, there is a precipitate	Fermented aroma	3.4	2920
C	Spinach + mustard	Chocolate	Mixed	Dominant aroma of brown sugar	Cloudy greenish brown	Mixed, there are white spots in the solution	Fermented aroma mixed with a slightly rotten smell	2.9	1710
D	Pineapple skin	Chocolate	Mixed	Dominant pineapple scent	Dark chocolate	Separated, there is a precipitate	Fragrant aroma of fermented pineapple	3.2	2120
AND	Banana peel	Clear chocolate	Mixed	Dominant banana aroma	Greenish light brown	Separated, there is a precipitate	Dominant stench	5.6	955
F	Banana peel + pineapple peel	Cloudy chocolate	Mixed	Dominant pineapple scent	Orange light brown	Mixed	Fermented aroma	3.8	2910
G	Pineapple skin + mustard	Clear chocolate	Mixed	Dominant aroma of mustard	Orange light brown	Separated, there is a precipitate	Fermented aroma mixed with a slightly rotten smell	3.6	2150
H	Banana peel + mustard	Clear chocolate	Mixed	Dominant aroma of mustard	Light brown	Mixed, there are white spots in the solution	Dominant stench	5.5	1500
I	Pineapple skin + kale	Chocolate	Mixed	Dominant sweet aroma of pineapple	Dark chocolate	There are deposits	Fermented aroma mixed with a slightly rotten smell	3.1	2740
J	Banana peel + kale	Chocolate	Mixed	Dominant sweet aroma of bananas	Dark chocolate	There are deposits	Fermented aroma	3.2	2870

Discussion

Various studies on ecoenzymes have been carried out (Mavani et al., 2020; Vama and Cherekar, 2020; Galintin et al., 2021; Rahayu et al., 2021). These various studies use different raw materials. The use of different raw materials also causes differences in the characteristics of the resulting ecoenzymes.

In this study, the color of the ecoenzyme at the beginning of the fermentation was brown, but along with the fermentation process, the color changed with each treatment. The color of the ecoenzymes on the 90th day of fermentation is generally brown but with different brightness and additional other colors (Figure 1). Nurlatifah et al. (2022) stated that the color of the eco enzyme will vary depending on the material used.

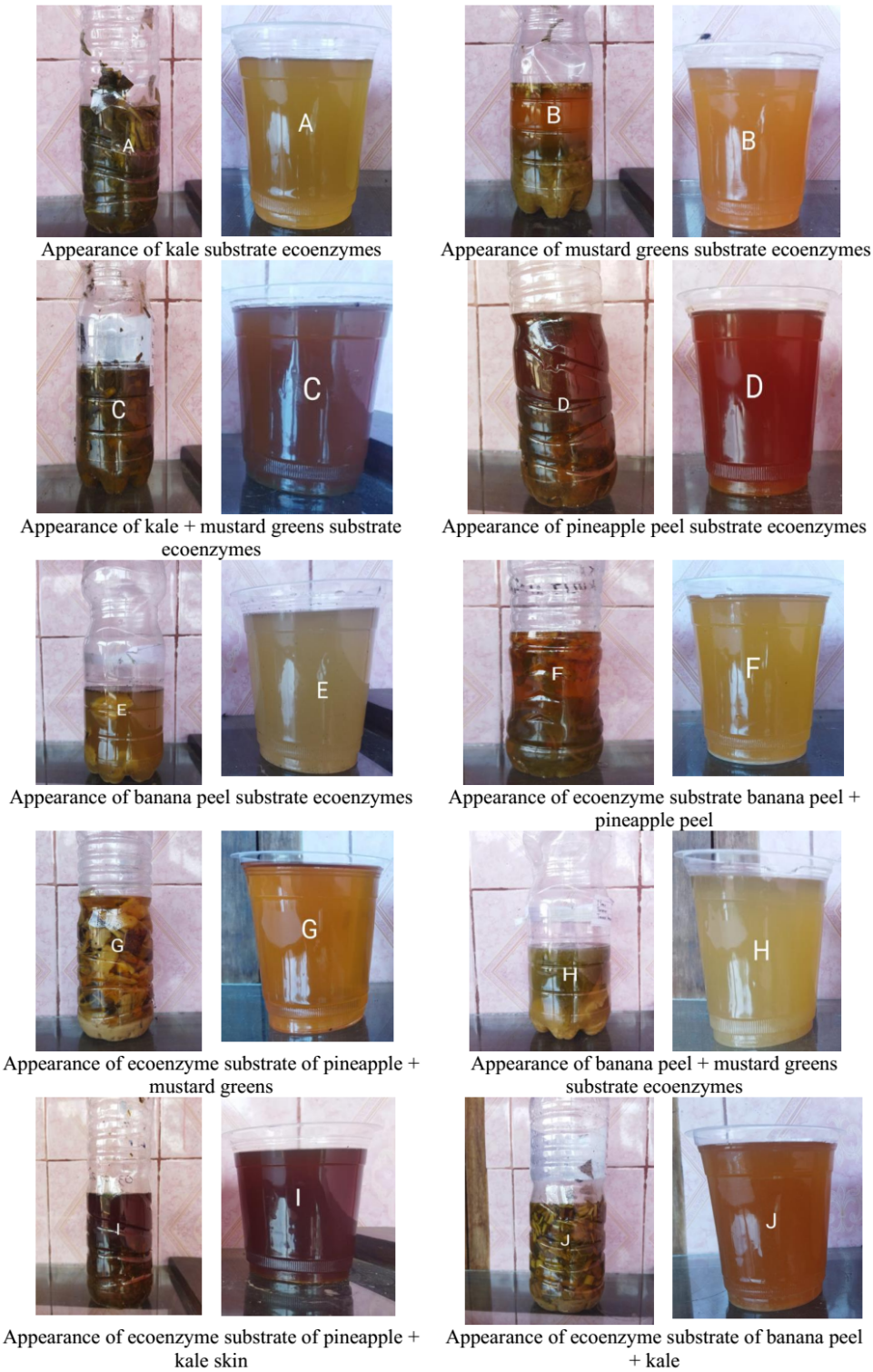

Figure 1. Color appearance of ecoenzymes

In this study also observed the condition of the solution. The entire solution is initially mixed, but along with the fermentation process, there is a change in the condition of the solution. The condition of the solution after fermentation is mixed, some are separated, and some precipitate appears.

Another parameter observed in this study is aroma. There was a change in aroma from the beginning of fermentation until the 90th day of fermentation. Pineapple raw materials produce a pleasant aroma. Pineapple fruit is widely used in the manufacture of ecoenzymes, for example in the research of Mavani et al. (2020), Ginting et al. (2022), and Nurlatifah et al. (2022). In contrast to pineapple peels, raw materials

that contain banana peels (except the treatment of banana peels + kale), as well as treatments that use a mixture of fruit and vegetable peels tend to give off an unpleasant odor.

Besides color, solution condition, and aroma, the pH of the solution is also another parameter that is observed. The measurement results showed that the pH of all treatments was acidic. Another study conducted by Rasit et al. (2019), Galintin et al. (2021), Bahari and Wikaningrum (2022), and Nurlatifah et al. (2022) with a pH between 2.79-3.88. This acidic pH indicates the presence of acid produced from the fermentation process (Galintin et al., 2021). Organic acids that have been detected in ecoenzymes, for example, are citric acid (Rasit et al., 2019), lactic acid, and acetic acid (Nurlatifah et al., 2022). In this study, total dissolved solids (TDS) were also observed as a parameter. The TDS of various treatments varied. High TDS values can be caused by the presence of organic matter in the fermentation process (Rasit et al., 2019).

CONCLUSIONS

Based on the results of the research conducted, it can be concluded that the type of ecoenzyme substrate affects changes in ecoenzyme characteristics. The resulting ecoenzyme color is generally brown with different color degradation. The aroma of the ecoenzymes produced also varies, but ecoenzymes containing banana peels, as well as a combination of fruit and vegetable peels, apart from the treatment of banana peels + kale, produce an unpleasant odor. The pH of the ecoenzyme produced was entirely acidic with a pH range of 2.9-5.6. The lowest ecoenzyme pH was made from kale + mustard greens, while the highest pH was from banana peel treatment. Ecoenzyme TDS values also varied, with the lowest value being 955 in the banana peel treatment, and the highest value in the mustard greens treatment with a value of 2920.

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