Production and Characterization of Eco-Enzyme from Fruit Peel Waste

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Abstract. The amount of household waste such as fruit peel waste which is organic waste will have an impact on the environment. The organic waste can be processed into eco-enzyme. Eco-enzyme is obtained from the fermentation process. The fruit peel used are watermelon, pineapple, banana, and orange. The fermentation process used fruit peel waste, water, and sugar in a ratio of 3 : 10 : 1. After 90 days of the fermentation process, filtering is carried out to obtain the filtrate which is an eco-enzyme. The obtained of eco-enzyme has brown and a sour aroma. Eco-enzyme positive has contains acetic acid and lactic acid, also flavonoids, alkaloids, and saponins. This eco-enzyme can be used to cleaned the floors, as a fertilizer, and others. It has changed what was a waste at the first, into something that has many benefits, by processed the waste in the right way.

Keywords: Fruit Peel Waste; Fermentation; Eco-Enzyme

1 Introduction

For now and in the future, the production of household waste will continue to increase. The human activity that continuously every day is eating. The fruits and vegetables that are commonly consumed by people have the potential to produce a waste because they only eat the flesh of the fruits, while the fruit peel is not used and becomes garbage. Likewise with vegetables, it will be a waste if there are parts of the vegetables that are not used and not fresh. A waste that comes from fruits or vegetables is organic –[1]. Piles of garbage will have an impact on the environment. Garbage that is not managed properly can cause air pollution, water pollution, and soil pollution [2]. The organic waste can also be a trigger of harmful microorganisms‘ growth. Flood disasters can also be caused by piles of garbage. This organic waste can be processed into many benefits, namely eco-enzyme. Through the fermentation process, eco-enzyme can be made with waste materials of fruit peel, water, and sugar in a ratio of 3 : 10 : 1 [3]. This eco-enzyme can be used as a disinfectant and hand sanitizer in the condition of the COVID-19 pandemic [4]. Hand sanitizer is a familiar object for us during a pandemic like this. Wherever we go, always carry hand sanitizer. Using hand sanitizer is a form of anticipation and keeping our body clean so that it doesn’t infect and transmit the virus. In agriculture, eco-enzymes can also be used as fertilizers and biopesticides [5]. In addition, eco enzyme can also remove algae and others [6]. The natural fermentation process in the process of making eco-enzyme allows everyone to do it even at home. In this study, the fruit

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peels waste used was watermelon, pineapple, banana, and orange peel waste. Each of eco-enzyme solution obtained was characterized by the content of acetic acid and lactic acid, as well as flavonoids, alkaloids, and saponins. Then, eco-enzymes are applied to clean the bathroom floor.

2 Materials and Methods

Each of fruit peel waste, both watermelon, pineapple, banana, and orange are processed into eco-enzyme. There will be four kinds of eco-enzymes produced. Each of fruit peel is added with brown sugar and water. Prepare four plastic containers as a place for the fermentation process of each fruit peel waste. In each container, put 600 gr of fruit peel waste, 200 gr of brown sugar, and 2.000 mL of water. Keep in a closed container for 3 months. The total mass of the waste of fruit peel and brown sugar and the volume of water followed the ratio of 3 : 10 : 1 for the waste of fruit peel, water, and brown sugar. Occasionally, open the container and stirred to remove the gas ~~that~~ produced from the fermentation process [7]. Keep the container cool and dry. After 3 months, filter it to obtain the filtrate. The filtrate is an eco-enzyme. An initial check is carried out for the color and scent produced. Eco-enzyme can be said good if it has brown color and has a fresh sour smell. Store each filtrate in a separate bottle and label it.

a) *Characterization of Eco-Enzyme*
   Eco-enzymes obtained from each fruit peel waste were characterized to determine the pH value, presence or absence of acetic acid and lactic acid. The identification of the presence of flavonoids, alkaloids, and saponins was also carried out [8].
b) *pH Test*
   pH testing is done using a pH meter. A pH meter is a device that can measure hydrogen ions in a solution. Solutions with a low pH value are called "acidic" while a high pH value is called "alkaline". The pH scale ranges from 0 to 14 from strong acid to strong base with a middle pH value of 7 being called neutral.
c) *Acetic Acid Test*
   The eco-enzyme was added with 1 N $AgNO_3$ and observed what changes occurred. Positive contain acetic acid if after added it will produce a precipitate [9].
d) *Lactic Acid Test*
   $FeCl_3$ was added to the eco-enzyme. If it produces a red-brown color, the eco-enzyme is positive contain lactic acid.
e) *Flavonoid Test*
   Eco-enzyme was added with 0.1 Mg powder, 1 mL concentrated HCl and 1 mL alcohol. Once mixed then shaken vigorously. If a red, yellow, or orange solution is formed, it indicates a positive eco-enzyme contain flavonoids [10].
f) *Alkaloid Test*
   Bauchardat test is used to detect the presence of alkaloids. In the eco-enzyme taken as much as 2 mL then added 1.27 grams of Iodine and 2 grams of Potassium Iodide in 100 mL of aquadest. If the results show a brown precipitate, the eco-enzyme is positive for alkaloids [11].
g) *Saponin Test*
   Eco-enzyme is added with aquadest hot and then shaken. If it produces foam, then the eco-enzyme is positive contain for saponins [12].

3 Result and Discussion

The fruit peel waste from watermelon, pineapple, banana, and orange was choose because the fruits are commonly consumed and it's not difficult to find it. People only ate the flesh from it. The more often we consumed these fruits, the more fruit peel waste will be produced. Even though, the fruit peel waste can be processed into eco-enzyme by adde brown sugar and water.

3.1 *Produced of Eco-enzyme*

To obtained the eco-enzyme, the first step is the fermentation process. In the fermentation process, sugar is needed which served as a provider of carbon (C) [5]. The sugar that used is not white sugar that has gone through the bleached process, but brown sugar. The price of brown sugar is also relatively cheaper than white sugar, made it more economical [7]. In the process of produced this eco-enzyme, doesn't required a large area and a large container. It is enough to used a plastic container with a size adjusted to the ingredients entered. Avoid used the glass containers during the fermentation process, because it will produced gas which made the container broke easily [13]. In this study, we used plastic container. The fermentation process is carried out for three months. In the first weeks, once a day, the lid of the plastic container is opened to release the gas produced from the fermentation process. In the following months, the container cover opened once a week. More gas will came out in the first weeks. After 3 months, a filtering process was carried out to obtain the filtrate which is an eco-enzyme. In Figure 1, showed the time before and after filtering.

(a) (b)

Fig. 1. Before filtering (a); and After filtering (b)

At the time before filtering observed, there is a white fungus. After the filtration process, the obtained filtrate or eco-enzyme has bright brown color. The resulting brown color varied due to the different materials used. These observations indicated that the eco-enzyme production is successful [3]. Then, the filtered eco-enzyme was put into a bottle with a label. The results of observations in the form of color and odor produced from each fruit peel waste can be seen in Table 1.

Table 1. Color and Odor Observation Results from Eco-enzyme

Eco-enzyme	**Colour**	**Odor**
Banana Peel	Clear brown	Fresh sour
Watermelon Peel	Brown	Sour with a slight bad smell
Orange Peel	Brown	Fresh sour from orange
Pineapple Peel	Brown	Fresh sour from pineapple

The resulting sour smell is sour in accordance with the original fruit scent. This also showed that the eco-enzyme obtained was successful. Indeed, with a long fermentation time of 3 months, it also affected the color, scent, and pH produced [1].

3.2 *Characterization of Eco-Enzyme* From Fruit Peel Waste

The obtained of eco-enzyme then carried out several measurements and tests. Used a pH meter, each of eco-enzyme measured and the pH values obtained can be seen in Table 2.

Table 2. Eco-enzyme pH measurement results used a pH meter

Eco-enzyme	pH
Banana Peel	3,88
Watermelon Peel	3,30
Orange Peel	3,21
Pineapple Peel	3,23

Based on the data in Table 2, the eco-enzyme pH value of all ingredients is less than 4. The pH value indicated that the eco-enzyme production was successful [14]. The process of measured pH using a pH meter can be seen in Figure 2.

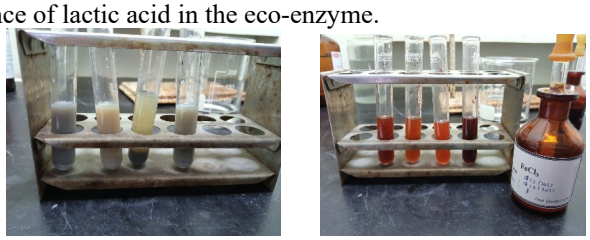
Fig. 2. Eco-enzyme pH measurement

A pH value below 4 indicated that the eco-enzyme is acidic. Each of eco-enzyme tested to determined whether it contains organic acids such as acetic acid and lactic acid. The results of tested for acetic acid and lactic acid can be seen in Table 3.

Table 3. Acetic acid and lactic acid test results

Eco-enzyme	Acetic Acid	Lactic Acid
Banana Peel	Positive (+)	Positive (+)
Watermelon Peel	Positive (+)	Positive (+)
Orange Peel	Positive (+)	Positive (+)
Pineapple Peel	Positive (+)	Positive (+)

In Figure 3, it can be seen that each of eco-enzyme produces a precipitate when added with $AgNO_3$, which indicated the presence of acetic acid in the eco-enzyme. From the rest of the fruit can caused bacterial metabolism naturally so that the acetic acid is produced [9]. On the addition of $FeCL_3$, a color changed to brownish red was observed. The resulting color indicated the presence of lactic acid in the eco-enzyme.



(a) (b)

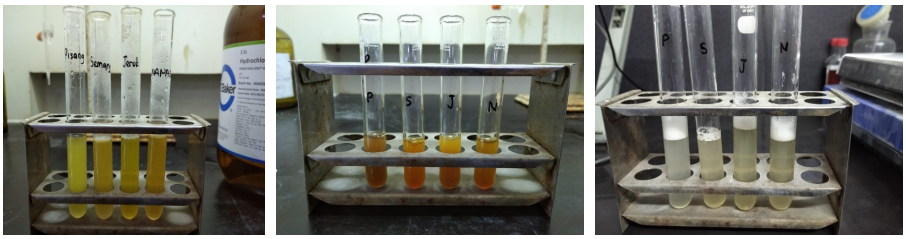
Fig. 3. Acetic acid test (a); and Lactic acid testing (b)

Back to the indication of the success or failure of the eco-enzyme produced is the presence or absence of organic acids in it. The production of eco-enzyme said to be successful if it contains several organic acids such as acetic acid, lactic acid, citric acid, and others [15]. The next tested for the eco-enzyme that obtained is to identify the presence of flavonoids, alkaloids, and saponins. The test results of each eco-enzyme can be seen in Table 4.

Table 4. Test results for flavonoids, alkaloids, and saponins

Eco-enzyme	Flavonoid	Alkaloid	Saponin
Banana Peel	Positive (+)	Positive (+)	Positive (+)
Watermelon Peel	Positive (+)	Positive (+)	Positive (+)
Orange Peel	Positive (+)	Positive (+)	Positive (+)
Pineapple Peel	Positive (+)	Positive (+)	Positive (+)

The eco-enzyme from all materials positive contained flavonoids, alkaloids, and saponins. From the observations shown in Figure. 4, all of eco-enzymes produced a yellow color when Mg and HCl powder were added which indicated the presence of flavonoids. The yellow color is produced due to the reduction with Mg and HCl [16]. The presence of flavonoids in the fruit functions as an antioxidant [17]. Flavonoids are not only contained in the fruit, but the fruit peel also contained flavonoids [10]. A brown precipitate appeared when iodine and potassium iodide are added which indicates the presence of alkaloids. The precipitate generated because the test used KI produced complex compounds between metal ions and reagents [16]. In agriculture, this alkaloid was a chemical that is used as a parameter in assessed the quality of botanical ingredients [18]. Another function of these alkaloids is to inhibited the grew of bacteria or can be called antibacterial [11]. Foam appeared after added aquadest and shook which indicated the presence of saponins. Foam is produced due to the presence of glycosides which has the ability to produce foam in water [19]. Saponins have two different sides, one side is soluble in water which is called hydrophilic and the other side is insoluble in water which is called hydrophobic. When the eco-enzyme is added with aquadest and shook, the hydrophilic side will bound to water and the hydrophobic side will produce foam because it bound to air. It‘s applied in the environment, from the nature of these saponins is able to remediated hydrophobic pollutants or even heavy metals in soil and water [20].

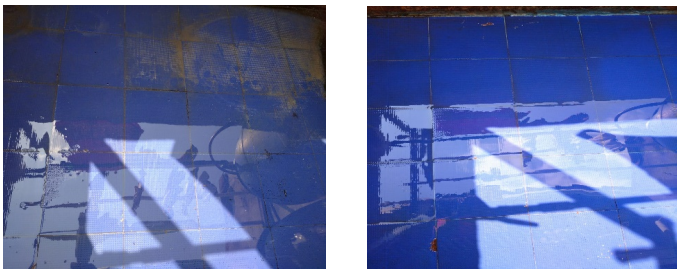


(a) (b) (c)

Fig. 4. Flavonoid testing (a); Testing for alkaloids (b); and Testing of saponins (c)

3.3 *Application of Eco-enzyme*

The obtained of eco-enzyme applied to cleaned the bathroom floor. In Figure. 5, it is showed before and after cleaned with eco-enzyme. It looked that initially dirty became clean after used eco-enzyme to cleaned it.



(a) (b)

Fig. 5. Before cleaning (a); and After cleaning using eco-enzyme (b)

This eco-enzyme has benefits in cleaned floors and various equipment. Therefore, eco-enzyme can also be called a cleaning agent because of its ability to killed bacteria [11]. During this pandemic, eco-enzymes can be used as disinfectants and hand sanitizers. In agriculture, eco-enzyme can also be used as a natural organic fertilizer [14]. This eco-enzyme is very useful for various aspects, such as for agriculture and environmental hygiene. The various benefits of eco-enzymes are related to the characteristics or the compounds contained in them. The presence of acetic acid was able to destroy organisms, so functionally it can be as a pesticide. Sugar added during the fermentation process is utilized by microbes. The metabolism of these microbes produces ozone which can killed bacteria. The presence of flavonoids, alkaloids, and saponins made the eco-enzyme able to acted as an antibacterial.

4 Conclusion

The fruit peel waste, which if it‘s not process will turn into waste, can be processed into eco-enzyme. Eco-enzyme is a multifunctional and environmentally friendly solution. Everyone can make eco-enzyme because the manufacturing process is easy. The presence of organic acids such as acetic acid and lactic acid as well as metabolic compounds such as flavonoids, alkaloids, and saponins makes eco-enzymes capable of acting as antibacterials.

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