

# The Utilizing Fruit and Vegetable Peels as a Way to Maintain a Healthy Environment

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**Abstract.** Fruit and vegetable peels are a common type of organic waste generated in households. Due to their high water content, they decompose naturally. However, if left unattended, these peels undergo anaerobic bacterial decomposition, leading to unpleasant odors and detrimental environmental impacts. Fruit and vegetable peels have the potential to be transformed into valuable resources. One such method is by converting them into eco-enzyme. Eco-enzyme is a complex organic solution produced through the fermentation of fresh fruit and vegetable peels, brown sugar, and water. The resulting liquid is typically dark brown with a characteristically fresh, sour aroma. In RT 24, Simpang Rimbo, Jambi City, many housewives were unaware of the benefits of processing fruit and vegetable peels and lacked understanding of the distinction between organic and inorganic waste. This community service project aimed to reduce organic waste and its associated air pollution by promoting the production of eco-enzyme from fruit and vegetable peels. The project involved several stages: preparation, pretest, socialization, training, and posttest. The results indicated a high level of enthusiasm among participants and a significant improvement in their knowledge of organic waste management after the training.

**Keywords:** Eco-enzyme, Fruit peels, Organic, Vegetable, Waste

## 1 Introduction

*Rukun Tetangga* (RT) 24, located in Simpang Rimbo. Simpang Rimbo has a total area of 22 hectares. RT 24 has a population of 450 people and a highly active women's empowerment and family welfare organization (PKK). The PKK is a driving force for community development, especially for women. Among their ten core programs, environmental sustainability and health planning are key priorities [1].

As the frontline in building a quality human resource, women play a crucial role in maintaining a healthy environment and ensuring healthy planning for their children and families. A healthy environment must be free from waste. Waste is the leftover product or item that is no longer used [2] but can still be recycled into valuable items [3]. Waste is categorized into organic and inorganic types. Organic waste is waste derived from living organisms that decompose easily, both naturally and through processing, and can be reused. Organic waste is environmentally friendly and can be processed into something useful when managed properly, while inorganic waste is waste that is no longer used and difficult to decompose [4], [5], [6].

Our surroundings are often littered with waste, such as food scraps, fruit and vegetable peels and seeds, fruit waste, fish bones, and fallen leaves. These belong to the category of organic waste and can be recycled. One way to utilize and process organic waste is by converting it into eco-enzyme. Eco-enzyme is a complex organic solution produced through the fermentation of organic waste, sugar, and water. Eco-enzyme is dark brown in color and has a strong sour/fresh aroma [7].

Eco-enzyme has various uses, including as a versatile cleaner, plant fertilizer, plant pest repellent, and environmental protector, as it can neutralize various pollutants. Eco-enzyme is derived from various organic raw materials, such as fruits and vegetables [8].

The PKK Arwana in RT 24 is a dynamic and optimistic team of women who are committed to empowering families and promoting their well-being. However, they were previously unaware of the proper handling and processing of fruit and vegetable peels from household waste, believing that they had no economic value and were merely discarded or burned. Additionally, the byproducts of eco-enzyme can be further developed into new products with economic value [9].

Based on the above, there is a need for awareness-raising, guidance, training, demonstrations, and support to address the issue of household waste management and its conversion into eco-enzyme and its derivative products

with economic value. The goal of this initiative in RT 24 is to create a healthy environment, manage waste effectively to prevent it from reaching landfills, sort and process waste into useful products for the environment and with economic value, aligning with the ten core programs of the PKK."

## 2 Methodology

The community service activities were carried out using the Participatory Learning and Action (PLA) method, involving active participation from the partners and local residents. The PLA method was chosen to ensure that participants not only received information but also engaged directly in the training process, making the results more effective and sustainable.

The stages of the community service activities include:

a. Preparation Stage

This stage involved preparing materials, modules, and equipment to be used during the training, as well as coordinating with the residents of RT 24, especially the PKK Arwana mothers, to prepare the venue and training materials. A technology package, consisting of modules and equipment to support the activities, was distributed to the participants.

b. Pretest

Before the training began, a pretest was conducted to measure the participants' initial understanding of organic waste management. The pretest was used to assess the participants' knowledge of eco-enzyme making and household waste management before receiving the training.

c. Socialization

Socialization was conducted to provide an initial understanding of the differences between organic and inorganic waste, as well as the importance of organic waste management in maintaining the environment. This stage aimed to introduce the concept of eco-enzyme and its benefits for the environment and daily life.

d. Training and Extension

Training was conducted through extension and demonstration related to the handling of household waste through the fermentation process. The extension provided the theoretical basis, while the practical demonstration showed the steps in processing fruit and vegetable peels into eco-enzyme. Participants were actively involved in the practice of making eco-enzyme, from selecting materials to the fermentation process.

e. Posttest:

After the training was completed, a posttest was conducted to evaluate the increase in participants' knowledge of organic waste management and eco-enzyme making. The posttest aimed to measure the effectiveness of the training in improving participants' understanding.

### 2.1 Participant Contributions and Participation

The partners involved, namely the residents of RT 24, especially the PKK Arwana mothers, provided active participation in these activities by:

a. Gathering the residents of RT 24, especially the PKK mothers, to attend the training.

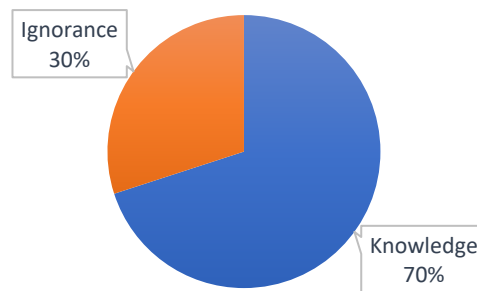
b. Providing a location for the extension and demonstration activities.

c. Providing raw materials such as fruit and vegetable peels, as well as supporting equipment used during the training.

## 3 Result

### 3.1 Pretest

A pretest was conducted to assess participants' initial understanding of organic waste and its management, particularly regarding eco-enzyme production. This baseline measurement was essential to tailor the training accordingly. The results indicated that the majority of participants lacked sufficient knowledge and skills in utilizing fruit and vegetable peels.



**Figure 1.** Result pretest

### 3.2 Socialization

The subsequent socialization stage involved educating the community members on the distinction between organic and inorganic waste, and the significance of organic waste management in safeguarding environmental health. During this phase, participants were introduced to the concept of eco-enzyme, an organic solution produced through the fermentation of fruit and vegetable peels. The socialization aimed to instill the understanding that household waste, especially organic matter, could be transformed into a valuable resource rather than being dismissed as mere environmentally harmful trash.

### 3.3 Practical

Following the socialization, a training session was conducted, combining theoretical knowledge with practical demonstrations. Participants were encouraged to actively participate in the eco-enzyme making process, not just by listening to lectures. They learned to select suitable raw materials, such as fresh, non-rotten fruit and vegetable peels, and understood the fermentation process involving brown sugar and water. The demonstration provided a deep understanding of the fermentation stages and the resulting eco-enzyme, which typically has a sour aroma and a brownish color. It's important to note that the quality of the eco-enzyme is significantly influenced by the raw materials used, as different fruits and vegetables produce varying aromas and colors. This eco-enzyme making technique is relatively simple and can be carried out using easily accessible household materials.



**Figure 2.** Practical Workshop on Producing Eco-Enzyme from Fruit and Vegetable Waste

#### 3.3.1 Eco-Enzyme Making Process

##### a. Preparation of Materials

To make eco-enzyme, the primary ingredients needed are fresh fruit and vegetable peels, brown sugar, and water. The fruit and vegetable peels should be fresh, not rotten, and odor-free. Commonly used peels include orange, pineapple, apple, and leafy green vegetables. Brown sugar serves as a carbon source that supports the fermentation process.

- b. Material Ratio  
The formula used in making eco-enzyme follows a 1:3:10 ratio, which is one part brown sugar, three parts fruit and vegetable peels, and ten parts water. For example, if you use 100 grams of brown sugar, you will need 300 grams of fruit and vegetable peels and 1 liter of water.
- c. Making Process
  1. Mix the brown sugar with water until the sugar dissolves completely.
  2. Add the finely chopped fruit and vegetable peels to the sugar-water mixture.
  3. Store the mixture in a closed but not airtight container (such as a bucket or large plastic bottle) to allow the fermentation gases to escape.
  4. Store the container in a cool, shaded place, away from direct sunlight.
- d. Fermentation  
The fermentation process takes about 3 months. During this time, the mixture undergoes natural fermentation involving the activity of microorganisms. Every few days, the container lid should be opened slightly to release the accumulated gas. A distinctive sour, fresh aroma will develop over time, and a dark brown liquid will form.
- e. Harvesting  
After 3 months, the eco-enzyme is ready to be harvested. Strain the mixture to separate the eco-enzyme liquid from the remaining fruit and vegetable peels. The resulting liquid is the eco-enzyme solution, while the solid residue can be used as compost or fertilizer.

### 3.4 Post-test

After the training, a post-test was conducted to evaluate the participants' increased knowledge about eco-enzyme making. The post-test results showed a significant improvement; 100% of participants successfully understood the concepts and steps of eco-enzyme making, compared to only 30% before the training. This improvement indicates that the training activities were effective in increasing the community's understanding of organic waste management, and demonstrates the positive impact of the participatory approach used in the program. It also shows the potential to promote environmental awareness and sustainable practices in the community.

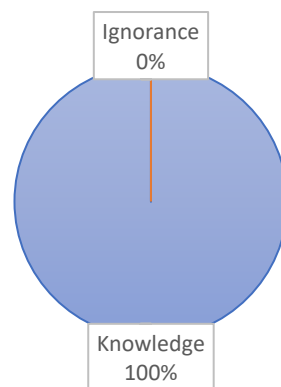


Figure 3. Posttest result

## 4 Discussion

The community service activities in RT 24, Simpang Rimbo Subdistrict, Jambi City, have had a significant impact, not only in increasing participants' knowledge of organic waste management but also in creating real social change. The use of the Participatory Learning and Action (PLA) method was the key to the success of this program. The PLA method focuses on the direct involvement of participants in the learning process and real-world actions, which aligns with the concept of participatory education [10]. PLA allows participants to learn through practical experiences and reflection on their own actions, making them not only recipients of information but also agents of change [11].

In this series of activities, mentoring was carried out through several well-structured stages, starting from preparation to post-testing. In the preparation stage, training modules and necessary equipment were carefully prepared to support the learning process. The fruit and vegetable peel raw materials provided by the residents were used as practical examples during the training, making the training material more relevant and directly applicable in making eco-enzyme. Based on data, around 70% of household waste is organic waste that can be

used as raw material for making eco-enzyme [12]. At this stage, mentoring was also conducted in separating organic and inorganic waste. This knowledge is in line with research showing that the use of organic materials in agriculture can reduce dependence on synthetic chemicals and support environmental sustainability [13]. In addition, participants learned that the fermentation process is greatly influenced by the raw materials used. The aroma and color of the eco-enzyme can vary depending on the type of fruit and vegetable peel fermented. For example, orange peels usually produce a fresher and more pleasant aroma, while green vegetable peels tend to produce a stronger aroma [14]. This variation demonstrates the rich potential of organic materials available around us, which can be used to produce products that benefit the environment and human health. With this understanding, it is hoped that participants can become more aware of organic waste management and apply their new knowledge in their daily lives, and contribute to efforts to maintain a cleaner and healthier environment.

Before the socialization and training began, a pretest was conducted to measure the participants' initial understanding. The pretest results showed that most participants (70%) did not know about eco-enzyme and how to make it. This information became an important basis for directing the training material to focus more on the introduction and benefits of eco-enzyme. Previous training on making eco-enzyme has been conducted, showing an increase in the knowledge and ability of the community to manage organic waste into something useful [15], [16]. The post-test results after the socialization and training on making eco-enzyme using fruit and vegetable peel waste showed a significant increase in participants' knowledge. All training participants (100%) knew and were able to practice making eco-enzyme from fruit and vegetable peels. This is reinforced by previous research which shows that socialization and training can increase participants' knowledge of eco-enzyme [17], [18].

During the eco-enzyme making training, participants were very enthusiastic and interested. The many benefits and uses of eco-enzyme motivated participants to be able to make eco-enzyme. Research by Barman and his team in 2022 shows that eco-enzyme has great potential in various fields, including industrial waste treatment, cleaning, and even as a hand antiseptic. Research by Barman shows that eco-enzyme has great potential in various fields, including industrial waste treatment, cleaning, and even as a hand antiseptic [19]. Research reveals that eco-enzyme has benefits such as antibacterial and antifungal activity, can remove residual deposits in water pipes to prevent pipe clogging, can absorb pollutants from cigarette smoke, vehicle exhaust, and the like [20]. The enthusiasm and active participation of the participants made the training run smoothly and the objectives could be achieved. This is supported by the use of the Participatory Learning and Action (PLA) method. PLA is effective because it involves participants as individuals and as a team when trying to solve real problems [21].

## 5 Conclusions

The community service program in RT 24, Simpang Rimbo, effectively increased residents' understanding of eco-enzyme production through the PLA method. Active participation and practical training led to a 100% success rate in understanding the process. The program is expected to promote sustainable waste management and environmental protection.

## 6 Acknowledgments

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