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ECO ENZYME TRAINING FOR ORGANIC WASTE MANAGEMENT

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ABSTRACT The problem of organic waste, primarily produced by homes and also created by educational entities like schools, can lead to environmental consequences if not handled correctly. Organic waste has considerable potential to be converted into eco enzyme, which offers numerous advantages. Acknowledging this potential, the community service initiative sought to strengthen the community at Educational Institution of Nonthaburi, Thailand, by providing training in eco enzyme production. The approach used in this task comprised lectures and hands-on practical training. The program outcomes showed a 60% rise in knowledge about eco enzyme production following the training that used discarded fruit and vegetable scraps. This initiative aims to act as a community empowerment framework for autonomous organic waste handling, especially in educational settings.

KEYWORDS: *Eco Enzyme; Organic Waste; Molasses; Educational Institution.*

1. INTRODUCTION

Solid waste is typically divided into organic and inorganic categories (Faizah et al., 2022). Inefficient waste management represents a major environmental concern, possibly resulting in disease outbreaks and visual deterioration (Putri et al., 2022). In Indonesia, the overall waste produced was anticipated to hit 26.2 million tons in 2023, underscoring the critical need to tackle this problem. Consequently, efficient strategies are necessary to decrease waste volume, particularly from home or household sources. Data shows that around 33.78% of waste in Indonesia, including cities like Palembang, is still poorly managed (Aisah & Sumantri, 2024).

Organic waste, made up of biodegradable biological materials, makes up about 68% of household waste composition. Even though it breaks down naturally, mishandling can cause environmental contamination (Handajani et al., 2024). At present, the management of organic waste is inadequate, frequently disposed of in water bodies, empty lots, or incinerated. Indeed, organic

waste holds considerable potential for transformation into useful products like eco-enzyme (Agustina et al., 2024; Syahrorini et al., 2022). Eco-enzyme, as stated by Pranata et al. (2021), is a fermented substance obtained from organic waste like vegetable trimmings and fruit skins combined with molasses and water, leading to a brownish liquid that has a sweet-sour scent. Studies show that fruit peels—high in vitamin C and acidic substances—are excellent options for producing eco-enzymes (Benny et al., 2023; Verma et al., 2019). Eco-enzyme has antibacterial, antifungal, and insect-repellent characteristics (Vidalia et al., 2023), and it has been shown to effectively decrease pollution and foul smells in water (Rasit et al., 2019; Varshini & Gayathri, 2023). These advantages render eco-enzyme an appropriate option for household or small-scale uses, like those executed in this activity.

The community engagement project took place at a village school in Nonthaburi, Thailand, an establishment that is constantly evolving and encounters difficulties in handling its local organic waste. Nonthaburi, located immediately north of Bangkok, ranks among Thailand's most populated provinces. Although the region is recognized for its urban expansion, numerous villages in the province continue to depend on conventional waste disposal methods, having restricted access to contemporary waste management facilities. This renders community-based waste management initiatives especially important for promoting environmental sustainability.

Training on eco-enzyme production was implemented as a hands-on method to assist the school in managing its waste problems independently. Eco-enzyme possesses significant capability as a sustainable cleaning solution because of its enzymatic components—like α-amylase, maltase, and proteolytic enzymes—that can decompose starch-derived substances (Nangoi et al., 2022). Its uses are varied, including glass and floor cleaning agents, soaps, fertilizers for plants, and natural insect deterrents (Maryanti & Wulandari, 2023). Observations at the Nonthaburi school indicated significant organic waste coming from the kitchen, gardening efforts, and small livestock. In accordance with the school's vision to foster environmental consciousness and self-sufficiency, the training on transforming organic waste into eco-enzyme seeks to enable school members to handle their waste autonomously, thereby enhancing sustainable development within the school community.

2. METHOD

This community service activity was carried out using socialization and training methods. The implementation took place in September 2024 at a school located in a village in Nonthaburi, Thailand, and was attended by approximately 50 participants, including teachers, students, and members of the surrounding community. The activity consisted of three main stages, as follows:

2.1. Activity Preparation

The activity began with establishing a shared understanding of the program, including the schedule, participants involved, and the facilities and equipment required. The team then prepared the tools and materials needed for the eco-enzyme training, such as plastic containers, product bottles, fruit peels, vegetable scraps, and other materials for the fermentation process.

2.2. Eco-Enzyme Production Training

At this stage, the service team simulated the eco-enzyme production process before applying it at the partner location. The preparation process used leftover fruit peels (orange, dragon fruit, and mango) and vegetables. The eco-enzyme was harvested after three months through fermentation. The production procedure was carried out as follows:

a. Mixing the eco-enzyme ingredients using a ratio of 1 : 3 : 10 = sugar/molasses : organic waste: water.
b. Storing the mixture in a plastic container, sealing it tightly, and allowing it to ferment for three months.
c. Placing the product in a cool area away from direct sunlight.
d. Releasing accumulated gas after two weeks by opening the container briefly.
e. The eco-enzyme is ready for use after three months.

2.3. Evaluation and Monitoring

The evaluation activity was conducted to assess the achievement of the community service objectives. Monitoring was carried out to obtain information regarding whether the eco-enzyme products produced were successful, including identifying any challenges encountered during the process.

3. RESULT AND DISCUSSION

The community service activity at the School in the Nonthaburi Village, Thailand, was attended by students, teaching staff, and local residents living around the Nonthaburi Village area, with a total of approximately 50 participants. The event began with welcoming remarks from the Principal of the School in Nonthaburi Village, Thailand, who expressed strong support for the implementation of this activity. The principal emphasized that the program aligns with the school's ongoing initiatives, as the school manages a small plot of land for livestock and agriculture, making proper waste management essential so that waste produced from these activities can be processed and utilized effectively.

The next remarks were delivered by the head of the community service program, **Ir. Susi Susanti, S.T., M.T.,** followed by the service team members: **Dr. Selpiana, S.T., M.T.; Dr. Nina Haryani, S.T., M.T.; and Muhammad Rendana, Ph.D.** who conveyed the objectives and importance of carrying out this activity. The implementation of the community service program on processing organic waste into eco-enzyme at the School in Nonthaburi Village, Thailand, was carried out through several stages described below.

3.1. Eco-Enzyme Socialization

The socialization regarding the types of waste was delivered by the head of the program, **Ir. Susi Susanti, S.T., M.T.,** during the first session. The material presented included an explanation of the definition of waste and the various types of waste found in the environment, particularly household waste. The waste commonly generated from school activities must first be identified so that it can later be processed using the appropriate treatment techniques. The session also included explanations on why waste must be processed and its impact on the environment.

Participants showed great enthusiasm during the socialization session. Several participants actively asked questions and shared their previous personal experiences related to managing waste from daily school activities. In this program, organic waste such as vegetable scraps, fruit peels, and leftover food was used to produce eco-enzyme. Previous literature has shown successful eco-enzyme production using citrus peels (Benny et al., 2023), banana peels (Ismail et al., 2024), and pineapple peels (Ningrum et al., 2024). The delivery of this material was conducted through a direct lecture method (Figure 1).

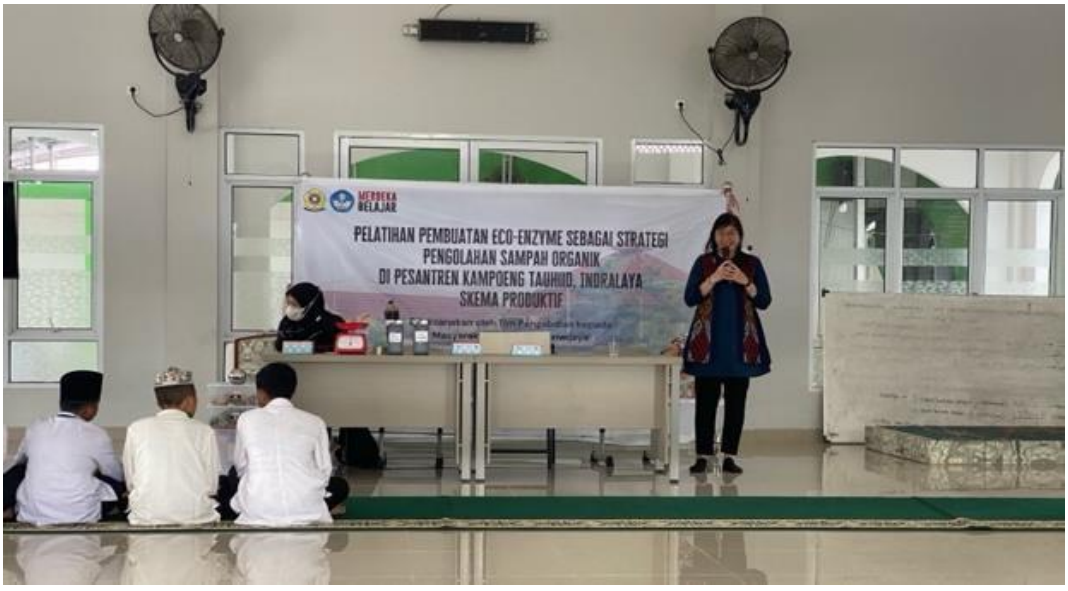

Figure 1. Eco-enzyme material briefing session

The introduction to eco-enzyme was conducted during the second session. The material was delivered by **Muhammad Rendana, Ph.D.**, focusing on the definition of eco-enzyme, its benefits, and its environmental impact. According to Das et al. (2024), eco-enzyme is an organic liquid produced through the fermentation of waste materials such as fruit peels, vegetables, water, and brown sugar. Eco-enzyme can also be used in daily human activities, such as disinfectant cleaning liquid, soap, and plant fertilizer (Hanifah et al., 2022). An interactive discussion emerged during the sharing session regarding the types of materials that can be used to produce eco-enzyme and its applications in daily life. This indicates that most participants were enthusiastic and interested in this waste-processing technique. Mavani et al. (2020) found in their study that eco-enzyme extracted from fruit peels can act as an antimicrobial agent. Das et al. (2024) also reported that eco-enzyme can be utilized in the treatment of textile wastewater.

3.2. Eco-Enzyme Production Training

The eco-enzyme production training was conducted during the third session. The demonstration was led by **Dr. Selpiana, S.T., M.T.,** assisted by students. The activity began with an explanation of the materials and tools needed for eco-enzyme production, including organic waste (fruit peels and vegetables), molasses solution, well water, plastic containers, a weighing scale, a knife, and scissors. During the production process, it was explained that the ratio (proportion) of organic waste, molasses, and water is 1:3:10. This same ratio was also used in the studies by Wibowo et al. (2024) and Rani et al. (2020) to successfully produce eco-enzyme. Mixing fruit and vegetable waste has shown promising results in eco-enzyme production (Galintin et al., 2021).

The mixture was then placed into a plastic container, stirred, and sealed tightly to create anaerobic conditions for 90 days (Figure 2). In the second month, the solution was mixed every two weeks and once more in the middle of the third month, consistent with previous findings by Vama & Cherekar (2020). The harvested eco-enzyme is later diluted with water according to specific ratios depending on its intended use, such as for disinfectants, dishwashing soap, floor cleaners, and other household applications. Additionally, eco-enzyme can also serve as fertilizer, a natural pesticide, and detergent (Halim et al., 2024; Hmad & Gargouri, 2024; Narang et al., 2024).

Figure 2. Eco-enzyme production training session

The final stage of this community service activity was monitoring and evaluation. Evaluation was conducted to identify issues and challenges encountered during the eco-enzyme production training. In this activity, the team distributed pre-test and post-test questionnaires to compare participants' understanding before and after the training.

The results showed an increase of approximately 60% in the number of participants who understood eco-enzyme production by the end of the program. Initially, only 30% of participants were familiar with eco-enzyme before the training, and this figure increased to 90% after the training was delivered.

After the activity concluded, the community service team conducted monitoring to observe the continuation and implementation of the eco-enzyme production process. The results indicated that participants had successfully applied eco-enzyme to various derivative products such as floor cleaners, disinfectants, dishwashing liquid, and many others.

4. CONCLUSION

The community service program on eco-enzyme production training has provided positive impacts for the school in Nonthaburi Village, Thailand, as well as for the surrounding community, particularly in terms of household organic waste management. The activities received strong positive responses from participants, as reflected by the increased level of understanding regarding the processes introduced during the program.

The eco-enzyme products have been successfully utilized for various household applications, including floor cleaners, disinfectants, dishwashing liquid, and others. It is also expected that the training and socialization on eco-enzyme production can serve as a potential source of income through the commercialization of eco-enzyme products for household use, natural pesticides, and disinfectant cleaners.

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CONFLICT OF INTERESTS

All authors declare that they have no financial or non-financial conflicts of interest related to this article. Activity implementation: SS, MR, Slp, NH; Manuscript preparation: SS; Impact analysis of the community service program: MR, Slp; Presentation of community service outcomes: SS; Manuscript revision: MR.

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