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COMMUNITY-BASED ECO-ENZYMES PRODUCTION: A STEP TOWARD A CLEAN AND SUSTAINABLE ENVIRONMENT

PEMBUATAN ECO-ENZIM BERBASIS KOMUNITAS: LANGKAH MENUJU LINGKUNGAN BERSIH DAN BERKELANJUTAN

Scope:
Health

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A B S T R A C T

Background: *This community service activity focuses on the issue of processing household organic waste into valuable products, namely eco-enzyme. Waste can have an impact on human health, including a medium for transmission of diseases such as diarrhea and leptospirosis, decreased air quality.* **Objective:** *This activity aims to reduce the volume of household organic waste to reduce environmental pollution and improve the quality of life of the community and create valuable products.* **Method:** *The method used in this activity is Participatory Action Research (PAR) where the activity is divided into 2 sessions, namely counseling and demonstration activities. The activities were carried out on March 16 - July 20, 2024 and the targets of the activities were residents of Pojok Village, Kediri City as many as 45 people. Activities were carried out in partnership with Bank Sampah Sri Wilis.* **Results:** *In this activity, it was found that there was an increase in participant's knowledge about household organic waste processing, especially in making eco-enzymes. This is known from the results of pretest and post-test scores which have increased significantly.* **Conclusion:** *Training activities on making eco-enzymes can be an alternative in processing organic waste into useful product innovations, reducing environmental pollution, and improving the quality of human life.*

A B S T R A K

Latar belakang: *Kegiatan pengabdian masyarakat ini berfokus pada isu pengolahan sampah organik rumah tangga menjadi produk bernilai guna, yaitu eco-enzyme. Sampah dapat berdampak pada kesehatan manusia, diantaranya media penularan penyakit seperti diare dan leptospirosis, penurunan kualitas udara.* **Tujuan:** *Kegiatan pengabdian kepada masyarakat ini bertujuan untuk mengurangi volume sampah organik rumah tangga untuk menurunkan pencemaran lingkungan dan meningkatkan kualitas hidup masyarakat serta menciptakan produk bernilai guna.* **Metode:** *Metode yang digunakan dalam kegiatan ini adalah Participatory Action Research (PAR) dimana kegiatan dibagi menjadi 2 sesi, yaitu kegiatan penyuluhan dan unjuk kerja. Kegiatan dilaksanakan pada 16 Maret – 20 Juli 2024 dengan sasaran kegiatan adalah warga Desa Pojok, Kota Kediri sebanyak 45 orang. Kegiatan dilaksanakan dengan bermitra dengan Bank Sampah Sri Wilis.* **Hasil:** *Pada kegiatan CSA ini diperoleh hasil bahwa terdapat peningkatan pengetahuan peserta tentang pengolahan limbah organik rumah tangga, khususnya dalam pembuatan eco-enzym. Hal ini diketahui dari hasil nilai pretes dan postes yang mengalami peningkatan yang signifikan.* **Kesimpulan:** *Kegiatan pelatihan pembuatan eco-enzyme dapat menjadi alternatif dalam mengolah limbah organik menjadi inovasi produk yang bermanfaat, mengurangi pencemaran lingkungan, dan meningkatkan kualitas hidup manusia.*

BACKGROUND

Population growth and the increase in community activities lead to an increase in the volume of waste generated. Poorly managed waste causes environmental pollution, health issues, and a decline in the quality of life for the community (Abidin et al., 2022; Hasibuan, 2016; Marmi et al., 2022; Prodyanatasari et al., 2024). Waste problems have become a critical issue in various regions, including Pojok Village, Kediri City. In this village, a large amount of household waste, both organic and inorganic, ends up in landfills without proper treatment. This condition has the potential to cause environmental pollution and health problems for nearby residents, such as water ecosystem damage, decreased air quality, and soil degradation (Basuki et al., 2023; Hasibuan, 2016; Istanti et al., 2023; Low et al., 2021; Pahrijal, 2023; Syarlisjiswan, 2024; Wahyudi, 2019; Widiani and Novitasari, 2023; Yusdian, 2023).

To address the waste problem, collaboration, cooperation, and the involvement of all parties, including the community, environmental-focused communities, and educational institutions, are needed. To raise awareness of the dangers of waste to human quality of life, the Bhakti Wiyata Institute of Health Sciences collaborated with the Bank Sampah Sri Wilis to hold a Community Service Activity (CSA) in Pojok Village, Kediri City. The *Bank Sampah Sri Wilis* is a waste-conscious community organization based in Pojok Village. It has programs to educate the public on the importance of waste management and provides incentives for those who recycle waste (Halim et al., 2024; Nurussalamah et al., 2024). Additionally, the Bank Sampah Sri Wilis serves as a forum for developing community creativity in transforming waste into valuable products, fostering a circular economy at the village level (Hidayat et al., 2023; Saputro et al., 2015). One of the activities conducted at the Bank Sampah Sri Wilis is converting inorganic waste into economically valuable products, such as souvenirs, recycled baskets, and more. However, the *Bank Sampah Sri Wilis* has not yet engaged in recycling organic waste into usable products. To address this, the community service team invited the *Bank Sampah Sri Wilis* to collaborate on a Community Service Activity in processing organic waste into eco-enzymes (Istanti et al., 2023; Widiani and Novitasari, 2023; Yusdian, 2023).

The production of eco-enzymes is an innovative and sustainable solution to minimize and reduce waste volume at the local level. Eco-enzymes is a fermentation solution produced from organic residues, such as vegetables and fruits, which can be used as a natural cleaner, organic fertilizer, and botanical pesticide (Galintin et al., 2021; Prasetyo, 2021; Syarlisjiswan, 2024). Galintin et al (2021) conducted community service activities by teaching residents how to make eco-enzymes from vegetable and fruit waste. This activity encouraged residents to process household organic waste into eco-enzyme, which can then be used as organic fertilizer (Galintin et al., 2021). Annisa et al (2024) in their community service activities empowered residents to produce eco-enzymes from agricultural waste, which was then used as an organic pesticide to reduce the use of chemical pesticides on agricultural land (Annisa et al., 2024). Handono et al (2023) also carried out a community service activity to produce eco-enzymes to reduce organic waste in urban areas, resulting in a 30% reduction in household waste volume (Handono et al., 2023). In line with Handono's research, Beni's research states that eco-enzymes can be used as organic fertilizer rich in nutrients, both macronutrients and micronutrients for plants, thus replacing and reducing the use of chemical fertilizers that can potentially damage the soil in the long term (Beni, 2023). Similarly, Yulistiar's research and Widyasari's research revealed that eco-enzymes are effective in reducing harmful chemicals, such as nitrates, phosphates, and other organic substances commonly found in organic waste (Widyasari and Wiratama, 2021; Yulistiar and Manggalou, 2023).

The community service activity in Pojok Village aims to increase public awareness of the importance of organic waste management and to provide education on how to make eco-enzyme. Workshops and training sessions will be held involving the community in the production process, enabling people not only to gain knowledge but also practical skills they can apply in their own homes (Cahyantini and Setyawati, 2023). Thus, eco-enzymes production in Pojok Village can be an initial step toward a cleaner and healthier environment, encouraging the community to be more concerned with organic waste management. The community-based eco-enzymes production involves collaboration with the Bank Sampah Sri Wilis, aiming to enhance the active role of the waste bank in producing valuable, economical, and innovative products from waste, as well as to support the sustainability of integrated waste management activities.

METHOD

This community service activity was carried out using the Participatory Action Research

(PAR) method with the target of 45 housewives in Pojok Village, Kediri City. The implementation of activities began on March 16 - July 20, 2024. The implementation of activities collaborates and partners with Bank Sampah Sri Wilis. *Bank Sampah Sri Wilis* is a community formed with the vision of creating a clean and healthy environment through effective and sustainable waste management (*Bank Sampah Sri Wilis*, 2024). Through collaborative activities in making eco-enzymes by utilizing household organic waste aims to minimize the quantity of household organic waste produced. This activity was carried out through 4 stages, as shown in Figure 1.

Figure 1. Stages of Community-Based Eco-enzymes Making Activity

The education session was conducted using lecture, question and answer, and discussion methods. The training session was carried out with a demonstration of eco-enzymes making. In this activity, a pre-test was also conducted before the education activity was carried out. The pretest was given to determine the participant's initial knowledge about household organic waste treatment and eco-enzymes production. The pretest used a questionnaire sheet consisting of 20 questions related to organic waste management and eco-enzyme production. The third stage was the demonstration of making eco-enzymes by utilizing vegetable, fruit, and foliage waste. After the demonstration stage was completed, participants were given a post-test to measure their final knowledge after the education and demonstration of making eco-enzymes. After giving the post-test, the service activity was completed. The next stage is checking and monitoring the eco-enzymes fermentation process once a week. Checking and monitoring uses an Observation Sheet and is carried out by *Bank Sampah Sri Wilis,* CSA team, and participants in turn and on schedule. The checking and monitoring process was carried out for three months to get eco-enzymes with good quality. Indicators observed during the eco-enzyme fermentation process include: (1) the color of the eco-enzyme solution produced during the fermentation process is brownish to dark brown; (2) the distinctive aroma of eco-enzyme such as fresh sour smell; (3) producing carbon dioxide (CO_2) gas during fermentation which indicates that the fermentation process is going well, and (4) good clarity of the eco-enzyme solution.

RESULT AND DISCUSSION

In this community service, the process of making eco-enzymes is carried out with structured and tested stages, starting from collecting organic waste from households in Pojok Village, Kediri City. The main materials used include vegetable, fruit, and leaf waste. The following are some of the results of the community service activities carried out:

1.   Characteristics of activity participants

This community service activity was carried out using the Participatory Action Research (PAR) method with the target of the activity being residents of Pojok Village who were dominated by housewives in Pojok Village, Kediri City totaling 45 people. The implementation of activities began on March 16 - July 20, 2024.

Based on Table 1, it shows that the majority of respondents were aged 45-54 years as many as 25 (56%) respondents, female gender 45 (100%) respondents, the last high school education was 23 (51%) respondents, and the most common occupation was as a housewife 30 (67%) respondents.

2.   Pre-test dan Post-test Analysis

Community service activities on making community-based eco-enzymes, steps towards a clean and sustainable environment with the target of activities are housewives in Pojok Village, Kediri City totaling 45 people. The implementation of activities began on March 16 - July 20, 2024.
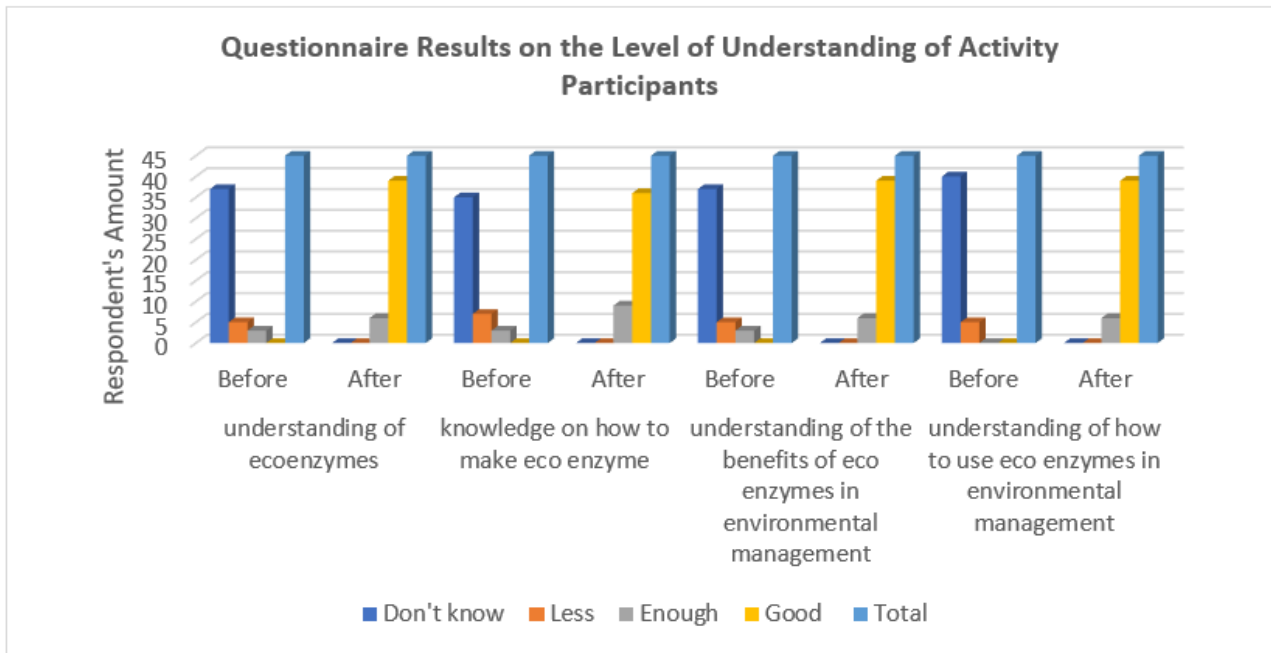
From the activities that have been carried out, the results show that the percentage of the number of respondents based on eco-enzymes has increased.

From Table 2, it can be seen that before the implementation of community service activities 37 respondent's (82%) of respondents did not know about eco-enzymes, while 11% stated that they knew a little and only 7% stated that they knew enough. The knowledge possessed by respondents on average comes from friends and from social media. After conducting community service activities about eco-enzymes, many respondents became more knowledgeable. After conducting community service activities on eco-enzymes, 86.57% of respondents understood well and 13.33% were sufficient.

The following are the characteristics of the respondents in the community service activities carried out:

Table 1. Characteristics of Respondents

No	Characteristics	Categori	n	%
1	Age	35-44	18	40,00
		45-54	20	44,44
		55-65	7	15,55
		Total	45	100,00
2	Education	Elementary School	3	6,67
		Junior High SChool	10	22,22
		High School Equivalent	23	51,11
		Higher Education	9	20,00
		Total	45	100,00
3	Gender	Male	2	4,44
		Female	43	95,55
		Total	45	100,00
4	Occupation	Retirement	1	2,22
		Private Employee	5	11,11
		Entrepreneur	9	20,00
		Housewife	30	66,67
		Total	45	100,00

(Source: Primary data, 2024)

The following are the results of the pre-test and post-test of the respondents in the community service activities carried out:

Table 2. Questionnaire Results on the Level of Understanding of Activity Participants

Knowledge Categories	Understanding of Eco-Enzymes		Knowledge on How to make Eco-Enzymes		Understanding of The Benefits of Eco-Enzymes in Environmental Management		Understanding of How to use Eco-Enzymes in Environmental Management	
	Before	After	Before	After	Before	After	Before	After
Don't know	37	0	35	0	37	0	40	0
Less	5	0	7	0	5	0	5	0
Enough	3	6	3	9	3	6	0	6
Good	0	39	0	36	0	39	0	39
Total	45	45	45	45	45	45	45	45

Figure 2. Questionnaire Results on The Level of Understanding of Activity Participants

Table 2 also shows that 77.78% of respondents did not know how to make eco-enzymes before the training, but after the training, 80% of respondents had a good understanding of the process. Figure 3 shows the implementation of training and field practice in making eco-enzymes.

Figure 3. Eco-enzymes Manufacturing Process

Based on Table 2, it is also obtained information that before community service activities were carried out, 37 (82%) respondents did not know the benefits of eco-enzymes and after community service activities respondents who had good knowledge increased to 39 (87%) respondents. The following is documentation of community service activities carried out:

Figure 4. Eco-enzymes Manufacturing Process Based Community

Based on Table 2, it can be seen that before the community service activity, 40 (89%) respondents did not know the benefits of eco-enzymes and after the community service activity respondents who had good knowledge increased to 39 (87%) respondents. There is a significant difference in the results of education and training on the manufacture of eco-enzyme on respondents before and after the activity (p=0.000 using wilcoxon sign ranked test). These results indicate that the training or intervention provided has successfully increased the knowledge of participants, as seen from the increase in

results between the pre-test and post-test. The processing of household organic waste into eco-enzymes provides numerous benefits, including:

1. Reduction in Waste Volume: A study by Wahyudi & Setiawan (2020) implementing an eco-enzymes utilization program within communities found that the volume of organic waste at landfills decreased by 60%, reducing the need for landfill space and lowering greenhouse gas emissions from organic waste decomposition. Similarly, Wahyudi, J. reported that each kilogram of organic waste converted to eco-enzymes reduced CO_2 and methane emissions by 0.84 kg, helping to reduce greenhouse gas effects in the atmosphere (Wahyudi, 2019). This decrease in greenhouse gases positively impacts air quality, reduces global warming, and mitigates extreme climate change. Controlled climate change will help protect ecosystems and biodiversity, which in turn supports food and water security for human survival.

2. Reduction of Environmental Pollution: Ecoenzymes produced from organic waste fermentation contain microbes that aid in organic waste decomposition, which aligns with the findings of (Wahyudi, 2019). They found that eco-enzymes help break down organic waste, thereby reducing the volume of waste entering landfills (Wahyudi, 2019). Ecoenzymes accelerate the decomposition of organic waste and produce eco-friendly compounds. Research by Galintin's revealed that eco-enzymes from household organic waste processing are rich in probiotics, which benefit digestive and overall health (Galintin et al., 2021).

3. Increased Environmental Awareness: Training on eco-enzymes production raises public awareness about the importance of organic waste management. Understanding the eco-enzyme production process helps participants recognize the positive impacts of waste reduction and pollution control.

4. Reduction of Soil and Water Pollution: The use of eco-enzymes organic fertilizer, which is environmentally friendly, reduces soil and water pollution around households.

5. Improved Soil Quality: Eco-enzymes from household organic waste processing can be used as a natural fertilizer to enhance soil fertility. This training provides knowledge on how to use eco-enzymes for more eco-friendly and productive agriculture.

6. Economic Empowerment: Training on eco-enzymes production can also create new business opportunities. With the knowledge of eco-enzymes production and usage, communities can develop natural cleaning products or organic fertilizers that are marketable.

7. Value-Added Products: Eco-enzyme products can be used as safe, effective, and eco-friendly cleaning products, reducing the need for synthetic chemicals. Utilizing eco-enzymes as cleaning agents aligns research, which shows the potential of eco-enzymes to be developed into a variety of eco-friendly cleaning products such as detergents, air fresheners, and skincare items (Pratama et al., 2022; Surtikanti et al., 2024).

8. Food Safety and Health: The use of eco-enzymes in agriculture results in produce that is safer from harmful chemicals. This training is essential for improving public health and food safety.

The community service activities carried out and in collaboration with Bank Sampah Sri Wilis, which is an activist community in the field of waste management, aim to help invite the community in the environmental care movement by creating a sense of togetherness and solidarity. This joint activity in making eco-enzymes is also an environmental campaign effort to strengthen social ties between community members and the community. This is done to create an environment that supports each other in an effort to maintain sustainability. Waste banks are one of the frontlines in encouraging active community participation in waste management in the surrounding environment. The contribution of Bank Sampah Sri Wilis in this community service activity can increase community activeness, increase a sense of community and community concern for the environment. In this training activity for making eco-enzymes, there were several obstacles, including: (1) Not all training participants have a good initial understanding of the benefits of eco-enzymes, which makes them less enthusiastic during the first training sessions, (2) It takes time to shift participants' mindset toward recognizing the importance of processing organic waste into eco-enzymes. Participants only fully understand the importance of organic waste processing after they have truly seen the benefits of eco-enzymes, (3) The fermentation process of organic waste into eco-enzymes takes a considerable amount of time, at least three months, (4) Technical challenges in the processing stages, such as weather, environmental temperature, humidity, and aeration, affect the eco-enzyme fermentation process, (5) Accuracy

in the composition of ingredients for eco-enzyme production is crucial, including the water-to-organic-waste-to-brown-sugar ratio (10:3:1) to ensure the process runs accurately and optimally, and (6) Commitment, consistency, and continuity in program implementation are essential.

Efforts that can be made to address the challenges and obstacles encountered during ecoenzymes training include: (1) Creating a user-friendly ecoenzymes production guidebook for the community, (2) Producing ecoenzymes using readily available equipment, such as used bottles, (3) Providing regular support after the training by creating a WhatsApp group to guide participants online in case they encounter difficulties or obstacles in applying ecoenzymes, (4) Establishing a community to disseminate information on ecoenzymes production and its uses, and (5) Conducting extensive outreach to raise awareness about the benefits and goals of the training by providing and demonstrating real examples of ecoenzymes products that can be used by the community, such as organic fertilizers and floor-cleaning soaps.

After the training on processing organic waste into ecoenzyme is completed, organic waste management will continue where the community can process waste independently. The ecoenzyme products that have been made will be utilized for community needs. As a follow-up to this activity, further training will be conducted on the utilization of ecoenzymes into valuable products, such as: dish soap, laundry soap, floor cleaning soap, organic fertilizer, environmentally friendly organic pesticides, and so on.

CONCLUSION AND SUGGESTION

The eco-enzymes production training has an important role in organic waste management and environmental awareness. Through this training, participants can learn effective ways to process household waste into useful products, such as natural fertilizers and environmentally friendly cleaners. The benefits of this training include a reduction in the volume of waste disposed of, improved soil quality, and community economic empowerment through potential new businesses. In addition, the training also encourages cooperation and solidarity among community members, creating a cleaner and healthier environment. Overall, the eco-enzymes manufacturing training not only supports environmental sustainability but also empowers the community to actively contribute in maintaining the ecosystem.

Community-based eco-enzymes can increase public awareness in waste management efforts for the creation of a clean and pollution-free environment. In addition, the involvement of practitioners and collaboration with experts in their fields needs to be done. As an outcome of the activity, it is important to make a good ecoenzymes making guide and promotional activities through social media to disseminate information on the importance of household organic waste processing, such as making eco-enzymes.

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