Jurnal Pengabdian KOLABORATIF
Vol. 2 No. 2 (2024) pp.17-26
E-ISSN: 2985-9026
https://journals.usm.ac.id/index.php/kolaboratif

Making A Multi Purpose Liquid (Eco-Enzyme) as An Alternative for Processing Household Organic Waste and Reviewing Its Benefits

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Article History:
Recieved:
July 14, 2024
Revised:
July 23, 2024
Accepted:
July 30, 2024
Published:
July 31, 2024

ABSTRAK

Kegiatan ini dilakukan sebagai upaya meningkatkan kesadaran dan pengetahuan masyarakat dalam mengelola sampah organik rumah tangga menjadi *eco-enzyme*. *Eco-enzyme* merupakan cairan alami yang dihasilkan dari proses fermentasi sampah dapur organik seperti kulit buah dan sayur, gula pasir (gula putih, gula merah atau gula tebu), dan air. Kegiatan pelatihan dilaksanakan di rumah Kepala Dusun Gentan, Desa Doplang, Kecamatan Bawen, Kabupaten Semarang pada hari Rabu tanggal 25 Oktober 2023, dengan peserta pelatihan adalah perempuan anggota Dasawisma (Dawis). Kegiatan dilaksanakan dengan metode sosialisasi dan demonstrasi untuk memudahkan peserta memahami materi dan tata cara pembuatan *eco-enzyme*. Berdasarkan hasil evaluasi kegiatan, peserta sangat antusias mempelajari ilmu baru yang belum diketahui sebelumnya. Peserta belajar tentang teknologi pembuatan *eco-enzyme* dari limbah rumah tangga. Selain mampu menciptakan lingkungan yang bersih, hasil *eco-enzyme* juga memberikan berbagai manfaat bagi kehidupan.

Keywords: *organic kitchen waste; eco-enzyme; household waste*

ABSTRACT

This activity was conducted to increase public awareness and knowledge in managing household organic waste into eco-enzymes. Eco-enzyme is a natural liquid from the fermentation process of organic kitchen waste such as fruit and vegetable peels, granulated sugar (white sugar, brown sugar, or cane sugar), and water. The training activity was held at the home of the head of Gentan Hamlet, Doplang Village, Bawen Subdistrict, Semarang Regency on Wednesday, October 25, 2023, with the training participants being women members of Dasawisma (Dawis). The activity was carried out using socialization and demonstration methods to facilitate participants' understanding of the material and the process of making eco-enzymes. Based on the evaluation results, the participants were very enthusiastic about learning new knowledge they did not know before. Participants learned about the technology of making eco-enzymes from household waste.

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DOI: 10.26623/jpk.v2i2.9832

In addition to creating a clean environment, the resulting eco-enzyme also provides various benefits for life.

INTRODUCTION

The largest amount of waste generally comes from household waste. According to the 2022 National Waste Management Information System (SIPSN) report, household waste constitutes 38.3% of the total waste. This waste is divided into organic and inorganic categories. Inorganic waste consists of synthetic materials that are difficult or impossible for microbes to degrade. Conversely, organic waste contains carbon, hydrogen, and oxygen, making it easily broken down by microorganisms (Adzillah, 2023).

Inorganic and organic waste can still be utilized if managed properly. One approach is to separate disposal locations for these two types of waste. However, observations indicate that people are still unable to sort them effectively. This aligns with Khoiriyah's (2021) opinion, which states that besides suboptimal waste management, public awareness of environmental cleanliness is also a significant factor. Addressing this issue can be achieved through community empowerment strategies, such as educational initiatives on waste management.

Inorganic waste management is carried out through recycling processes, such as repurposing used drink bottles into flower pots. Meanwhile, organic waste is used to create compost. Composting is one of various methods for processing organic waste, aiming to reduce waste and transform it into useful products (Aristoteles, et al., 2021). In addition to compost, household organic waste can also be converted into eco-enzymes.

The KKN activity in Doplang Hamlet, Gentan Village, Bawen District, Semarang Regency, was conducted to increase public awareness and knowledge in managing household organic waste into eco-enzymes.

LITERATURE REVIEW

Eco-enzyme is the result of the fermentation of organic kitchen waste such as fruit and vegetable peels, sugar (brown sugar, cane sugar), and water (Murdiana, Yuhara, Rahmavika, & Danila, 2022). According to Junaidi (2021), eco-enzyme can be made by utilizing leftover kitchen waste fruit and vegetables that are no longer used as food products, mixed with water and palm sugar. The eco-enzyme made from orange peels and rhizomes, with a specific mixture composition, is then fermented and observed for changes in color, pH, and odor (Rukmini & Herawati, 2023). This mixture is fermented anaerobically for three months. Unlike compost, eco-enzyme does not require a large area of land or a composter tank with specific specifications for the fermentation process.

Research has demonstrated the versatility of eco-enzymes in various applications. For instance, Alkadri & Asmara (2020) used eco-enzymes to make hand sanitizer and disinfectant. Rangkuti, Ardilla, & Ketaren (2022) combined eco-enzyme with photosynthetic bacteria (PSB) to create an organic plant booster fertilizer. Additionally,

eco-enzymes can be processed into liquid soap and have been successfully used as an alternative to synthetic pesticides when made from vegetable waste (Hermawan, et al., 2023).

Eco-enzyme also benefits the environment. The fermentation process produces and releases ozone (O_3 gas), which can reduce greenhouse gasses in the atmosphere (Widayat, Pahlawan, & Rajab, 2022). The use of eco-enzymes accelerates the decomposition of organic material, enhancing soil fertility (Brown & Jones, 2022). This helps maintain the balance of agricultural ecosystems and increases soil resistance to erosion and degradation (Ministry of Agriculture and Rural Development, 2020). The numerous benefits and minimal impact of eco-enzyme make it an efficient alternative for reducing organic waste.

METHODS

This program was implemented on Wednesday, October 25, 2023, with the training participants being women members of Dasawisma (Dawis) Gentan Hamlet, Doplang Village. This program includes a training and mentoring component for making eco-enzymes. The method used generally involves a preparation stage, which includes coordinating with the head of Gentan Hamlet, Doplang Village, to facilitate access for the technical team and arrange the location for the activities, as well as organizing the tools and materials needed. During the preparation stage, the KKN team also prepared eco-enzyme socialization materials, which included introducing eco-enzymes, instructions on making eco-enzymes, guidelines for harvesting eco-enzymes, and information on the use and benefits of eco-enzymes, all presented using PPT. After that, the socialization stage for Dawis mothers was conducted by members of the KKN group in the form of lectures with the aid of PowerPoint slides.

Before the outreach activities were carried out, the KKN team tested the training participants' understanding of household waste processing and their knowledge of eco-enzymes. The training stage followed, during which the practice of making eco-enzymes was demonstrated to the Dawis women. At the end of the activity, an evaluation was conducted through a question-and-answer session with the Dawis women regarding eco-enzymes, covering both the socialization material presented and the benefits and processing stages. This evaluation stage helped to conclude and assess the success of the activity plan. After completing the activity, each participant was provided with an eco-enzyme module to practice at home. In summary, the flowchart of activities can be seen in Figure 1 below.

Figure 1. Flowchart of Implementation of Socialization and Training on Making Eco-enzymes

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In general, the production flow for making eco-enzymes from vegetable and fruit waste, namely, preparation of raw materials, the first process begins with collecting raw materials consisting of molasses sugar, vegetable and fruit waste, water, measuring cups, digital scales, bottles 1.5-liter plastic, bucket or container. In the process of making eco-enzyme (Figure 2), the prepared ingredients are then measured according to the rules for making eco-enzyme with a ratio of sugar, organic waste (vegetables and fruit), and water respectively of 1:3:10. Organic waste is washed thoroughly and cut into small pieces before being mixed with other ingredients.

Figure 2. Process of Making Eco-enzyme

The process of making the eco-enzyme fermentation mixture begins by adding 10 parts of water to a container until it is filled to 60% of its volume. Next, mix 1 part of sugar into the container of water, followed by adding 3 parts of organic waste cut into small pieces. The fermentation mixture is then sealed tightly and left for 90 days in a shady place with good circulation and cleanliness. After the manufacturing process, label the bottles with the date of manufacture. In the first week, the lid of the fermentation container is opened to release the gas in the container and stir the ingredients. This process is repeated when the fermentation reaches 30 days. After 90 days, the eco-enzyme can be harvested by separating the organic waste dregs from the solution. The resulting eco-enzyme liquid is put into harvest bottles, and the eco-enzyme is ready to be used.

RESULT AND DISCUSSION

This training activity on making eco-enzymes aims to provide education about the use of organic waste. The target participants for this training activity are housewives in Gentan hamlet, Doplang village, Bawen district, Semarang Regency. Out of the 12 participants who took part in the training, all of them said that household organic waste was just thrown away without knowing that the waste could be processed and reused. Figure 3 illustrates documentation of the process of making eco-enzymes.

Training on how to make eco-enzymes is certainly a solution for housewives in managing organic waste. Eco-enzyme is a multi-purpose natural liquid derived from fruit/vegetable waste, sugar, and water (Viza, 2022). Eco-enzyme liquid is produced using a ratio of 1:3:10, consisting of 1 kg of sugar, 3 kg of vegetable and fruit waste, and 1 liter of water. According to Junaidi (2021), the process of making eco-enzymes is

similar to composting, but water is added as a growth medium. The resulting liquid product is preferred for its ease of use and numerous benefits.

Figure 3. Documentation of the Process Making Eco-enzyme

The use of the three main ingredients for making eco-enzymes has its uses. One of the main ingredients used is sugar. The sugar used in making this eco-enzyme is molasses. This added sugar functions as a source of sugar for bacteria to carry out fermentation (Rochyani, Utpalasari, & Dahliana, 2020). Apart from that, in Yuliono (2022), palm sugar is used as a source of high-carbon organic material with a sucrose content (84%). Another reference states that the use of sugar in making eco-enzymes is not only specific to one type of sugar but can use other types of sugar, such as brown sugar or palm sugar (Budiyanto, et al., 2022).

The fruit or vegetable waste used contains organic acids. These organic acid compounds are later converted into an enzyme solution (Rasit & Mohammad, 2018). Another reason for using fruit or vegetable waste is that these organic materials still contain many types of enzymes that remain active during the eco-enzyme production process. For instance, citrus fruits contain a significant amount of lipase enzyme, found not only in the flesh but also in the fruit peel, with levels as high as 57.55 u/g (Gumilar, Kadarohman, & Nahadi, 2023).

However, not all organic waste can be used. Several criteria for organic waste that can be used as material for making eco-enzymes include: it still looks fresh, is not rotten, is not hard, and does not contain maggots. Using aromatic organic waste such as orange peel and mint leaves can add a distinctive smell to the eco-enzyme liquid that will be produced (Budiyanto, et al., 2022). Meanwhile, water is a medium between dissolved and suspended solid phases (Ademollo, et al., 2012).

The eco-enzyme fermentation process, until the liquid is ready for harvest, takes up to 3 months. During this period, organic materials are degraded by bacteria (Nazim & Meera, 2023), producing ozone gas (O_3) (Rubin, 2001). Additionally, other fermentation products include nitrate (NO_3) and carbon trioxide (CO_3). In the first month of fermentation, alcohol is formed, followed by vinegar or acetic acid (CH_3COOH) in the second month, imparting a sour smell. Minerals and vitamins continue to decompose, resulting in the natural production of enzymes by the third month (Yuliono, et al., 2022).

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The production of eco-enzymes requires containers, which can range from large tanks to reused plastic jars or bottles, thereby promoting the utilization of inorganic waste.

The use of materials made of glass is strictly avoided because the fermentation microbial activity can cause the container to break (Prabulingga, Astuti, & Maharani, 2020). A good final result of eco-enzyme, as stated by Pribadi & Hidayah (2023), has a pH below 4, apart from that, the eco-enzyme liquid is brown and has a fresh sour aroma (Alkadri & Asmara, 2020). According to Chahaya S, Lubis, Tumanggor, & Khairani (2022), several factors need to be considered to achieve good fermentation results:

a) The waste used should consist of various types to promote a diverse bacterial population
b) Place the fermentation solution in a location with good airflow that is not exposed to direct sunlight.
c) Do not open and close the container frequently; ensure the container is tightly sealed during the fermentation process and always kept clean.

Potential use of eco-enzyme:

a) Degrading detergent waste in water

   Detergent is a cleaning agent made from a mixture of chemicals. Detergents are used to wash clothes, as well as household and industrial equipment. The three main compositions of detergents are surfactants (surface active substances), whitening agents, and fragrance agents. Surfactants that accumulate in water bodies will result in the shallowing of the waters and obstruction of oxygen transfer. Eco-enzymes can kill germs, bacteria, and viruses because they contain acetic acid and alcohol. Eco-enzyme contains lipase, amylase, and trypsin enzymes. The lipase enzyme has biocatalyst properties that can help the surfactant degradation process in detergents. Based on the results of previous research, it is known that enzyme lipase can accelerate the rate of degradation reactions (Pratamadina & Wikaningrum, 2022).

b) Natural fertilizer

   Eco-enzymes are made from various organic household wastes that can be used as a source of carbohydrate sugar and support the growth of microorganisms when they decompose in the soil. The protein elements from the leftover vegetables will be broken down into nitrogen, which is useful for fertilizing the soil. A study explained that the enzyme content in organic waste in eco-enzymes was able to improve the characteristics of soil contaminated with metals (Muliarta & Darmawan, 2021). Furthermore, Satrio, Hasibuan, & Azzida (2023) explained that the acetic acid (CH_3COOH) content in eco-enzymes can kill germs, viruses, and bacteria. Apart from that, the enzyme content lipase, cellulase, invertase, laccase, xylanase, pectinase, tannase, trypsin, and amylase produced through fermentation can help fertilize land. Apart from that, NO_3^- (nitrate ion) and CO_2 (carbon dioxide) are also produced which are needed by the soil as nutrients.

c) Disinfectant

Disinfectants are chemical preparations that can destroy or reduce the growth of microorganisms on the surface of objects. According to research by Rusdianasari, et al. (2021), eco-enzymes contain compounds that are effective in reducing bacterial growth, specifically phenolic compounds, which are bactericidal. These phenolic compounds interact with the cell walls of microorganisms, causing protein denaturation. This denaturation leads to structural changes in the proteins, increasing cell permeability and ultimately inhibiting cell growth.

d) Will be blocked and damaged

The use of eco-enzymes, whether as a natural fertilizer or disinfectant, requires a specific dosage mixed with other ingredients. Yuliani, Kristiowati, & Hermyantono (2022) explain the appropriate dosage for using eco-enzymes.

CONCLUSION

Based on the results of the training outreach activities on making eco-enzymes in Gentan Hamlet, the response from Dawis women, as training participants, was very positive. This is evidenced by their attentiveness during the sessions and their high enthusiasm in asking and answering questions. Participants gained new knowledge from this activity, and the mothers expressed their appreciation and intention to practice making eco-enzymes at home. They also raise awareness on effectively handling organic household waste to produce eco-enzymes. It is hoped that the people of Gentan Hamlet will continue to make and use eco-enzymes sustainably. This practice can help create a cleaner environment by reducing rubbish piles, and the eco-enzyme can be used as a detergent waste degrader in water, a natural liquid fertilizer, a disinfectant, and much more.

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