



TRAINING ON CONVERTING ORGANIC HOUSEHOLD WASTE INTO LOCAL MICROORGANISMS (MOL) FOR FAMILY WELFARE EMPOWERMENT MOVEMENT MEMBERS

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Abstrak

Kegiatan pengabdian kepada masyarakat ini bertujuan untuk meningkatkan pemahaman serta keterampilan praktis ibu-ibu PKK dalam mengolah sampah dapur menjadi Mikroorganisme Lokal (MOL) sebagai solusi alternatif pupuk cair yang ramah lingkungan. Program ini dilaksanakan di wilayah Perumahan Sutorejo Indah, Kelurahan Dukuh Sutorejo, Surabaya, dengan melibatkan 21 peserta. Metode pelaksanaan program meliputi sosialisasi teoretis, pembagian brosur panduan, serta demonstrasi praktis pembuatan MOL menggunakan reaktor galon plastik portabel. Evaluasi keberhasilan program diukur melalui desain eksperimen semu (quasi-experimental) menggunakan instrumen kuesioner tervalidasi sebanyak 20 butir soal pilihan ganda (pre-test dan post-test), yang mencakup pemahaman konsep limbah organik dan prosedur pembuatan MOL. Data dianalisis secara statistik melalui uji paired sample t-test dengan bantuan perangkat lunak Minitab. Hasil analisis menunjukkan peningkatan pemahaman yang signifikan pada para peserta, yang ditandai oleh nilai rata-rata yang meningkat dari 77,38 pada pre-test menjadi 84,52 pada post-test (kenaikan sebesar 7,14 poin) dengan p-value sebesar 0,002 ($p < 0,05$). Selain itu, proses fermentasi MOL selama 20 hari terbukti berhasil, ditandai dengan perubahan fisik yang jelas pada warna cairan yang menjadi cokelat keruh gelap serta timbulnya aroma khas fermentasi yang asam dan segar. Kegiatan ini berkontribusi dalam membekali warga dengan keterampilan pengelolaan sampah organik secara mandiri dan berkelanjutan.

Kata kunci: Sampah Organik; Mikroorganisme Lokal (MOL); Pupuk Organik; Pelatihan

Abstract

This community service activity aims to increase the understanding and practical skills of Family Welfare Empowerment Movement women in processing kitchen waste into Local Microorganisms (MOL) as an alternative solution to environmentally friendly liquid fertilizer. This program was carried out in the Sutorejo Indah Housing area, Sutorejo Hamlet Village, Surabaya, involving 21 participants. The method of implementing the program includes theoretical socialization, distribution of guide brochures, and practical demonstrations of making MOL using portable plastic gallon reactors. The evaluation of the success of the program was measured through a quasi-experimental design using a validated questionnaire instrument of 20 multiple-choice questions (pre-test and post-test), which included an understanding of the concept of organic waste and the procedure for making MOL. The data was statistically analyzed through a paired sample t-test with the help of Minitab software. The results of the analysis showed a significant increase in understanding in the participants, which was marked by an average score that increased

from 77.38 in the pre-test to 84.52 in the post-test (an increase of 7.14 points) with a p-value of 0.002 ($p < 0.05$). In addition, the 20-day fermentation process of MOL proved to be successful, characterized by a clear physical change in the color of the liquid that became a dark cloudy brown and the emergence of a distinctive aroma of fermentation that was sour and fresh. This activity contributes to equipping residents with organic waste management skills independently and sustainably.

Keywords: Organic Waste; Microorganism local (MOL); Organic fertilizer; Training

INTRODUCTION

Environmental carrying capacity plays a vital role in sustaining human life and well-being. However, waste management in urban areas still faces a classic issue where municipal solid waste is typically transferred directly from Temporary Storage Sites to Final Disposal Sites without proper sorting or volume reduction at the initial stage. Based on recent national data from the Ministry of Environment and Forestry (KLHK/SIPSN 2025), household waste remains the largest contributor to the national waste composition, accounting for over 57% of total municipal solid waste and dominated by organic kitchen scraps. When properly processed, domestic organic waste has great potential to be transformed into useful, value-added products (Ariandani et al., 2022). Conversely, if waste is not managed effectively, it can cause severe environmental problems that affect the health of living beings due to soil, air, and groundwater pollution (abdirhasid)(Elmi et al., 2021)

In urban areas, the lack of environmental education contributes to low public awareness regarding waste separation at the source. At the same time, urban agricultural initiatives and residential yard cultivation require a continuous supply of soil nutrients, which usually relies on organic and chemical fertilizers (Fajri et al., 2020). Transforming wet kitchen waste into a liquid form rich in decomposer microbes, commonly known as Local Microorganisms (MOL), serves as a strategic solution (Ningsih & Siswati, 2021). The production of MOL is highly advantageous due to its technical simplicity, environmental biosecurity, and low production costs (Wulantika et al., 2020). The maturation process of this liquid nutrient can be achieved through controlled closed anaerobic fermentation (Kusnayadi et al., 2021). This independent fertilizer production from kitchen waste presents an intelligent approach for residents to reduce domestic gardening expenses while managing organic fractions independently (Dianagari & Anggraini, 2019).

The neighborhood at RT 012 RW 008, Sutorejo Indah Housing, Dukuh Sutorejo Village, Surabaya, is a residential area with active use of household yards for ornamental and productive plants. However, baseline observations revealed no integrated waste-separation mechanism in this neighborhood. Kitchen waste was completely mixed with inorganic waste in domestic bins, accelerating foul odors and attracting disease vectors (Ashlihah et al., 2020). While several previous community service programs have attempted to address organic waste processing (Ariandani



et al., 2022; Ashlihah et al., 2020), they generally consisted of conventional counseling sessions without direct motoric training, systematic quantitative evaluation, or bioprocess tracking.

In response to these limitations, this community engagement initiative introduces a structured training method that combines hands-on practice with household reactor prototypes and rigorous pre and post-test assessments. Therefore, this study not only provides environmental education but also offers a measurable framework for knowledge acquisition and product monitoring. The primary objective of this activity was to enhance the conceptual understanding and practical skills of the local Family Welfare Empowerment members in transforming kitchen organic waste into high-quality liquid MOL.

METHOD

Research Design and Participation

This community engagement program applied a quasi-experimental research design with a one-group pre-test and post-test approach. The target population was the members of the Family Welfare Empowerment women's association in Sutorejo Indah Housing, Surabaya. A purposive sampling technique was implemented to recruit participants who met the specific inclusion criteria. The inclusion criteria required that participants be active Family Welfare Empowerment members of RT 012 RW 008, attend the entire series of training and demonstration activities, and complete both the pre-test and post-test evaluation forms. Based on these criteria, a total of 21 participants were selected. The activity was executed in March 2026.

Materials and Tools Setup

The tools and materials used in the hands-on practical demonstration were standard and carefully quantified to match the educational brochures distributed to the participants. The formula for the MOL production consisted of 0.6 kg of blended household fruit waste and kitchen scraps, 3 liters of clean water, and 60 ml of liquid brown sugar (or molasses), which served as an immediate source of carbon and energy for the microflora. The reactor utilized was a portable 5-liter plastic gallon equipped with an airtight seal to maintain anaerobic conditions.

Implementation Procedure

The community service program was structured into three consecutive operational phases: First, preparation phase: This stage involved preliminary interviews with the head of RT 012 RW 008 to map out logistics, analyze baseline domestic waste generation, and validate the relevance of the materials. At this stage, the evaluation instrument was finalized. The instrument consisted of a 20-item multiple-choice questionnaire covering basic definitions of organic waste, segregation benefits, types of MOL raw materials, and chronological steps of

fermentation. The content validity of the questionnaire was reviewed and confirmed by environmental engineering and microbiology experts.

Second, implementation and monitoring phase: The activity opened with brief speeches by the local authorities, followed by the distribution of the pre-test questionnaire to capture baseline knowledge. Next, an interactive presentation was delivered alongside the distribution of structured, visual educational brochures. This was immediately followed by a direct hands-on demonstration of MOL production, where participants actively blended fruit waste, calibrated liquid ratios, and sealed the plastic reactor. The closed reactors were then placed in a designated monitoring area for a 20-day fermentation period. The bioprocess monitoring protocol involved briefly opening the cap daily to release accumulated fermentation gases (CO₂) and recording visual changes in color and odor.

Third, evaluation phase: Upon completion of the interactive training session, the participants were given the post-test questionnaire containing identical items to the pre-test to measure short-term knowledge retention (Wahyuddin et al., 2024).

Data Processing and Statistical Analysis

To determine whether the training program led to a statistically significant improvement in participants' comprehension, the pre-test and post-test scores were analyzed using a parametric paired-samples t-test in Minitab. The statistical significance level was set at α value was set at 0.05 (5%). The statistical hypotheses tested were formulated as follows:

$H_0: \mu d = 0$, H_0 = there is no increase in pre-test and post-test results regarding the understanding of making MOL from food waste.

$H_1: \mu d \neq 0$, H_1 = there is an increase in pre-test and post-test results regarding the understanding of making MOL from food waste.

H_0 is rejected if P-value < 0.05

RESULTS AND DISCUSSION

RESULT

The community service initiative successfully engaged 21 members of the local Family Welfare Empowerment (PKK) organization, all of whom actively participated in the interactive training program from the beginning to the end of the activity. The training commenced with an opening session that introduced the objectives, expected outcomes, and implementation stages of the program, while also encouraging participants to actively contribute throughout the learning process. As shown in Figure 1, the demonstration area was carefully prepared by arranging all required training equipment, ingredients, and raw materials in an organized manner to facilitate practical instruction. This initial setup enabled participants to clearly observe each tool and material before the hands-on session, thereby improving their understanding of the production process and ensuring the training proceeded efficiently. Overall, the opening and introductory session




established a conducive learning environment that promoted participant engagement, enhanced readiness for practical activities, and supported the successful implementation of the community service program.



Figure 1. Opening session of the training program





To support the learning process, informative visual media were utilized. Figure 2 shows the educational brochure distributed to each participant, which details the step-by-step procedures, raw material formulations, and troubleshooting indicators for producing local microorganisms at home.



PEMBUATAN MIKROORGANISME LOKAL (MOL)

Definisi
Cairan yang terbuat dari bahan alami atau limbah organik yang kaya mikroorganisme sebagai aktivator atau tambahan nutrisi

Macam-macam bahan dasar Mol

Sumber mikroorganisme: Bahan organik: kulit buah, nasi basi, rebung, sampah daun dll.	Sumber karbohidrat/ makanan mikroorganisme: Gula merah, gula pasir, air tebu dll.	Media fermentasi: Air bersih
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Pembuatan Mol

Alat dan Bahan <ul style="list-style-type: none"> • Drum/tong plastik • Kulit pisang dihaluskan sebanyak 0.6 kg yang telah dihaluskan • Gula merah 2 ons dilarutkan dengan 60 ml air bersih • Air bersih 3 liter 	Rasio Campuran <ul style="list-style-type: none"> • Kulit buah pisang: 60-70% dari total bahan. • Gula: 5-10% dari total berat bahan. • Air: Cukup untuk merendam bahan (sekitar 30-40%).
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Prosedur Pembuatan

1. Tuangkan air 3 liter ke galon 5 liter
2. Masukkan kulit buah yang sudah halus sebanyak 600 ml/600 gr kedalam galon
3. Tambahkan gula merah cair 60 ml
4. Tutup dan biarkan selama 10-15 hari.
5. Buka tutup botol setiap hari untuk mengeluarkan gas yang dihasilkan dari fermentasi

Figure 2. Brochure for local microorganism (MOL) production

During the practical application phase, participants were actively involved in every stage of the eco-enzyme production process through guided hands-on activities under the supervision of the training facilitators. As illustrated in Figure 3, members of the local Family Welfare Empowerment (PKK) organization directly participated in grinding the fruit waste into smaller pieces to accelerate the fermentation process, accurately measuring the required liquid components according to the prescribed formulation, and carefully transferring the prepared mixture into portable fermentation reactors. Throughout the demonstration, facilitators provided step-by-step explanations of the purpose and function of each processing stage while emphasizing proper handling techniques and hygiene practices to ensure product quality. This interactive learning approach enabled participants to strengthen their practical skills, clarify the theoretical concepts presented during the introductory session, and gain confidence in independently producing eco-enzymes at the household level. The high level of participant engagement observed during the practical session demonstrated the effectiveness of experiential learning in enhancing both technical competence and community readiness to adopt sustainable organic waste management practices.



Figure 3. Demonstration or Practical Application of MOL Production

Following the completion of the fermentation period, the Microorganism Local (MOL) solution exhibited characteristics that indicated successful microbial activity and proper decomposition of the organic materials. The fermented product developed a brownish liquid with a distinctive fermented aroma, while no signs of contamination, such as mold growth or foul odor, were observed. These physical characteristics suggest that the fermentation process proceeded under favorable conditions and that beneficial microorganisms were able to proliferate effectively throughout the incubation period. The resulting MOL solution is suitable for use as a biofertilizer and organic decomposer, providing a sustainable alternative for improving soil fertility and supporting environmentally friendly agricultural practices. The final appearance of the fermented MOL product is presented in Figure 4.



Figure 4. Results of the MOL fermentation

The final stage of the educational session focused on evaluating participants' knowledge and understanding after completing both the theoretical and practical components of the training program. As presented in Figure 5, each participant independently completed an evaluative questionnaire under the supervision of the community service team to ensure that responses accurately reflected their individual comprehension. The questionnaire was designed to assess participants' understanding of the objectives of the program, the procedures for producing Microorganism Local (MOL), the benefits of utilizing organic waste, and the potential application of the fermented product in daily agricultural practices. The evaluation process also provided an opportunity to identify areas where additional explanation or follow-up assistance might be required to strengthen participants' knowledge and practical skills. Overall, the evaluation results served as an important indicator of the effectiveness of the training activities and demonstrated the extent to which the educational objectives of the community service program had been achieved.



Figure 5. Discussion and Implementation of Pre-test and Post-test After Socialization and Demonstration

To confirm the statistical significance of the score changes, a paired-samples t-test was conducted. The expanded statistical output is presented in Table 1. The biological result of the community service activity was recorded after the full 20-day

fermentation cycle. Figure 6 displays the physical outcome of the mature liquid MOL product.

Table 1. Result: paired samples t-test

Sample	N	Mean	StDev	SE Mean	P-VALUE
Pre-Test	21	77.38	12.71	2.77	0.002
Post-Test	21	84.52	11.38	2.46	

The empirical results presented in Table 1 demonstrate a clear improvement in participants' conceptual understanding. The average knowledge score increased from 77.38 points on the pre-test to 84.52 points on the post-test, representing an absolute improvement of 7.14 points (a 9.22% increase). The statistical analysis generated a p-value of 0.002. Because the p-value of 0.002 is substantially lower than the pre-established significance threshold ($\alpha = 0.05$), the null hypothesis (H_0) is firmly rejected, and the alternative hypothesis (H_1) is formally accepted. This confirms that the training intervention led to a highly statistically significant improvement in residents' knowledge of organic waste recycling and liquid fertilizer compounding. The individual quantitative data collected from the 20-item multiple-choice tests are summarized and compared in the bar chart in Figure 6.

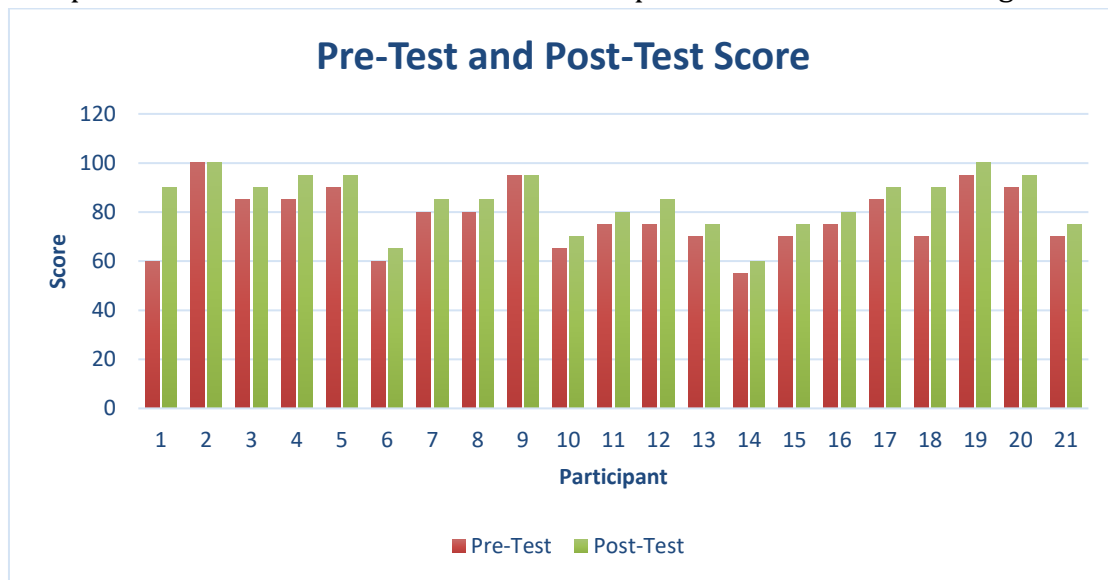


Figure 6. Pre-test and post-test scores of the educational outreach participants

Discussion

This pronounced knowledge enhancement is attributed to the combination of theoretical instruction via visual brochures and immediate motoric practice through hands-on fabrication. The distribution of structured brochures (Figure 2) served as an effective cognitive anchor, allowing the participants to easily absorb technical guidelines and follow the presenter during the training session. This finding aligns with the experimental work of Safitri et al. (2024), which demonstrates that integrating direct practical applications with structured reading

materials can enhance short-term knowledge retention rates in community adult education by 9% to 12%. Additionally, the systematic dissemination of waste management information is critical to expanding long-term environmental behavior in residential zones (Ariandani et al., 2022).

From biochemical and microbiological standpoints, the 20-day closed anaerobic fermentation process was successful. As documented in Figure 6, the final liquid product exhibited a deep, dark brown turbid color and emitted a strong, pleasant sour odor reminiscent of alcohol or fresh tape fermentation. These physical indicators confirm the proper growth and metabolic dominance of beneficial native microorganisms, particularly Lactic Acid Bacteria (LAB) and indigenous yeasts, as suggested by past biochemical evaluations (Manullang & Daryono, 2018; Riska et al., 2024). During the 20 days of anaerobic containment, these microorganisms metabolized the simple sugars provided by the liquid brown sugar substrate into organic acids, ethanol, and carbon dioxide (Yu et al., 2021). The organic acids lowered the solution's pH, creating an acidic environment that effectively sanitized the liquid by inhibiting putrefactive and pathogenic bacteria (Zhang et al., 2024). The turbidity of the liquid signifies a high concentration of active microbial cells suspended in the organic matrix, indicating that the mature MOL is ready to be utilized as an efficient biological activator for soil fertilization and domestic composting (Rohmadi et al., 2022).

The 20-day closed anaerobic fermentation process successfully transformed kitchen fruit waste into a mature, high-quality liquid MOL. This result offers a strategic alternative to the aerobic composting methods previously conducted in the same neighborhood by Rosalina et al. (2025), which predominantly generated solid compost and required more physical space. The use of 5-liter portable liquid reactors in this study offers greater spatial efficiency for urban households.

Qualitative feedback gathered through post-activity discussions revealed highly enthusiastic responses from the PKK members. The participants noted that the use of a simple 5-liter plastic gallon reactor made the technology highly accessible and easy to replicate within their limited kitchen or backyard spaces. Several participants expressed concerns regarding potential foul odors generated during anaerobic fermentation. However, this challenge was resolved through targeted mentoring during the demonstration, in which the team explained the importance of maintaining an airtight seal and performing brief daily pressure releases to vent accumulated carbon dioxide without allowing oxygen to enter. This interactive troubleshooting session successfully boosted participants' confidence to adopt organic waste recycling practices independently at home.

CONCLUSIONS AND SUGGESTIONS

This community service initiative successfully demonstrated that the structured training program effectively improved the knowledge and practical skills

of PKK members in converting household organic waste into Local Microorganisms (MOL). The quantitative evaluation showed a statistically significant increase in average comprehension scores from 77.38 to 84.52 ($p=0.02$), demonstrating the efficacy of combining visual media with hands-on technical practices. Furthermore, the biological implementation was highly successful: the 20-day controlled anaerobic fermentation transformed kitchen fruit waste into a mature, high-quality liquid MOL characterized by an optimal dark, turbid color and a healthy, sour, fermented odor, signaling bioprocess mastery among the target community group.

The evaluation involved a relatively small sample from a single neighborhood unit, limiting the generalizability of the findings, and lacked a non-equivalent control group, preventing full isolation of external confounding factors. In addition, the assessment focused on short-term knowledge retention and immediate product characteristics without examining long-term technology adoption or the impact of MOL on soil and plant productivity. To support program sustainability, it is recommended that the PKK Cadres of RT 012, in collaboration with neighborhood authorities, establish a communal waste-processing corner with larger reactor units, while the academic service team provides bi-monthly monitoring and advanced mentoring to standardize MOL quality, support production scaling, and develop a localized distribution network for residential greening and small-scale commercialization.

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