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Pembuatan biopack dari limbah kertas dan daun bagi ibu-ibu pemberdayaan kesejahteraan keluarga dan guru pendidikan anak usia dini

Making biopackaging from paper and leaf waste for women in the family welfare empowerment program and early childhood education teachers

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ABSTRACT

Various creative approaches can be developed to reduce the generation of both organic and inorganic waste. On the other hand, office and school paper waste, as well as plant matter such as dry leaves, are still not being utilized optimally. Biopack is an innovative cardboard container made from a mixture of paper pulp and dry leaves. This product can be used as eco-friendly packaging because it easily degrades when disposed of in soil or water after use. School paper waste and dry leaves available in the Wanaasri Palembang area hold significant potential as raw materials for Biopack. Utilizing this potential is expected to increase public awareness, particularly among the PKK Rumah Cinta Dahlia Wanaasri and the teachers at PAUD Permata Bunda, as key drivers in promoting the innovation of waste management into economically valuable products that can support the establishment of community-based businesses or entrepreneurship. This community service activity was carried out through outreach and a biopack-making demonstration using lectures and hands-on simulations. The evaluation was conducted through a questionnaire to analyze the level of effectiveness and the potential for sustainability of the activity. Survey results from activity participants revealed that 93% were not yet able to recycle used paper and leaves, 63% still disposed of used paper and leaves in trash bins, and 93–100% of participants rated the activity as beneficial, noting that it broadened their knowledge and understanding of making biopack from used paper and leaves, and that they liked the biopack products and were able to use them at home. Furthermore, it is hoped that the Wanaasri community will be able to produce its own biopack, that it will be adopted by teachers at the Permata Bunda Early Childhood Education Center as a teaching aid in the learning process, and that it will eventually be commercialized.

Kata Kunci
Biopack; kertas bekas; limbah daun kering; pemberdayaan masyarakat; sampah anorganik.

Berbagai pendekatan kreatif dapat dikembangkan untuk menekan timbulan sampah baik organik maupun anorganik. Disisi lain limbah kertas perkantoran/sekolah, dan tanaman berupa daun kering, masih belum dimanfaatkan secara optimal. *Biopack* merupakan inovasi wadah berbahan karton yang dibuat dari campuran bubur kertas dan daun kering. Produk ini dapat dimanfaatkan sebagai kemasan ramah lingkungan, kerena mudah terdegradasi ketika dibuang ke tanah atau air setelah digunakan. Sampah kertas sekolah dan daun kering yang tersedia di wilayah Wanaasri Palembang memiliki potensi besar sebagai bahan baku *biopack*. Pemanfaatan potensi tersebut diharapkan mampu meningkatkan kepedulian masyarakat khususnya PKK Rumah Cinta Dahlia Wanaasri dan Guru PAUD Permata Bunda sebagai penggerak dalam mendorong inovasi pengelolaan sampah menjadi produk bernilai ekonomi yang dapat menunjang terbentuknya usaha mandiri atau kewirausahaan masyarakat. Kegiatan pengabdian ini dilaksanakan melalui sosialisasi dan simulasi pembuatan *biopack* dengan metode ceramah dan simulasi. Evaluasi dilakukan melalui pengisian kuesioner untuk menganalisis tingkat kebermanfaatan dan potensi keberlanjutan kegiatan. Dari hasil survei peserta kegiatan diperoleh bahwa 93% belum bisa melakukan daur ulang sampah kertas bekas dan daun, 63% masih membuang sampah kertas bekas dan daun ke tempat sampah, 93-100% peserta menilai kegiatan ini memberikan manfaat, menambah wawasan, pemahaman tentang pembuatan biopack sampah kertas berkas dan daun, dan menyukai produk *biopack*, serta mampu mempraktekannya dirumah. Lebih lanjut diharapkan Masyarakat wanaasri mampu memproduksi biopack sendiri, dan diterapkan bagi guru PAUD Permata Bunda sebagai media ajar pada proses kegiatan belajar mengajar, dan lebih lanjut dapat dikomersialisasi.

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INTRODUCTION

Paper is one of the most common types of waste generated by human activities; it is commonly found in households, offices, and schools (Saputra & Fauzi, 2022; Ganing et al., 2025). By recycling used paper, we can maintain the balance of nature and prevent global warming (Mufridayati et al., 2015; Tobroni & Gayatri, 2018). Paper recycling offers numerous benefits, including reducing environmental waste, conserving energy, mitigating the impacts of global warming, and generating income (Arfah, 2017; Aziz & Nitri, 2018). Just as with paper waste, biomass waste, such as dry leaves, poses another problem within the category of organic waste, which has long been discarded or burned without further management (Wang & Tester, 2023).

Based on an analysis of the situation on the ground, the Wanaasri District, Sungaiselayur Village, Kalidoni Subdistrict, Palembang City, has one early childhood education (PAUD) school (Permata Bunda), one sports field (volleyball), and one mosque (Nurul Jannah), all of which have gardens or yards with a variety of plants and trees. Residents' homes also generally have yards with gardens featuring plants or trees. Given this situation, the area generates paper waste from the early childhood education center and offices/residences, as well as dry leaves from trees in home gardens, parks, and the mosque—all of which could be used as biopack material (Badan Pusat Statistik, 2023).

According to 2025 data from the national waste management performance information system of the Ministry of Environment, the total amount of waste in Indonesia reached 144,839 metric tons per day, with 25% of the waste (35,747 metric tons per day) managed, while the remaining 75% of waste (109,092 tpd) remains unmanaged (Kementerian Lingkungan Hidup Republik Indonesia, 2025). The largest component of waste generated in South Sumatra is food waste, which ranks first at 40.91%. The rest consists of plastic waste (18.9%), wood, twigs, or leaves (13%), and paper (10.63%) (Frezy et al., 2025). In Palembang City, South Sumatra, verified data from 2025 shows that out of 1,261 tons per day (tpd) of waste, only 0.21% is managed, while the remaining 99.79% remains unmanaged (Badan Pengendalian Lingkungan Hidup, 2025). This waste primarily originates from households (47.05%), followed by traditional markets (22.13%), residential areas (9.53%), commercial centers (8.22%), offices (6.09%), and the remainder from public facilities (5.36%). The percentage of waste in Palembang City by type is dominated by organic waste at 67.5% and paper at 10.5% (Dinas Lingkungan Hidup Kota Palembang, 2023).

Office or school waste, such as used paper, and biomass waste, such as dry leaves, can have a negative impact on the environment if not properly managed (Kamsiati et al., 2024). This waste typically ends up at temporary waste collection sites (TPS) and is burned directly. This causes air pollution in the form of odors and produces harmful gases (carbon monoxide and carbon dioxide) after the burning process (Ridhuan et al., 2024; Irfan et al., 2020).

The problem of inorganic waste, such as used paper, and organic waste, such as dry leaves, certainly requires extra attention to be resolved. One approach to managing this waste is to transform it into creative, innovative, practical, and affordable products that are marketable and useful. By processing waste into useful products, we can reduce negative environmental impacts and greenhouse gas emissions, thereby contributing to climate change mitigation (Hidayat et al., 2023; Rosyidah & Sa'diyah, 2022).

The production of biopack has become an alternative solution for reusing environmental waste and creating eco-friendly products, such as storage containers, thereby fostering a sustainable ecological cycle. Biopack can be produced and practically; it is cost-effective and has market appeal. Biopack is expected to become one of the most innovative, eco-friendly packaging products, creating items that are truly environmentally friendly. Biopack, or bio-packaging, refers to biodegradable packaging materials, often made from renewable resources and biopolymers, designed to reduce environmental impact by being more sustainable than traditional non-recyclable packaging options (Siciliano et al., 2024). Biopack serves as an alternative to reduce paper waste and dry leaves.

Several other studies on the use of waste paper to create innovative products have been conducted, including transforming it into multipurpose handicrafts (Latif et al., 2022), scrapbooks (Kurniawan & Wakhid, 2008), and sheets for eco-friendly packaging (Ganing et al., 2025). Bie et al. (2025) conducted a systematic and bibliometric review on the recycling of agricultural waste into biodegradable packaging. Through bibliometric analysis and a technological review, the study indicates that agricultural waste such as straw, fruit peels, and grass/leaves is utilized because its natural polymer content (cellulose, protein, amylose/amylopectin) can be converted into packaging with various important properties, such as mechanical strength, barrier capability, biodegradability, safety, as well as active functions like antibacterial properties and food freshness indicators.

The Family Welfare Empowerment (PKK) Action Team (TP) at Rumah Cinta Dahia on Wanaasri Street, Sungaiselayur Village, Kalidoni Subdistrict, Palembang City, serves as the hub for PKK TP activities focused on strengthening family

resilience, education, and the programs of Working Group 1 (Understanding and Practicing Pancasila & Mutual Cooperation) and Working Group 4 (Health, Environmental Sustainability, & Healthy Planning). This house serves as a venue for visits and guidance, including environmental activities such as Clean Friday. Additionally, on Wanaasri Street, there is the Permata Bunda Early Childhood Education (PAUD) school, where one of the teachers' key activities involves creating products or crafts as learning tools for the PAUD children.

Based on the situation analysis and related research mentioned above, this community service project focuses on educating participants—specifically the women of the PKK Rumah Cinta Dahlia Wanaasri and the teachers at Permata Bunda Early Childhood Education Center—on how to transform waste into creative, innovative, and affordable products using practical and simple technologies, to maintain environmental cleanliness, reduce inorganic waste (used paper) and organic waste (dry leaves), and provide participants with solutions for managing waste that is typically discarded and not utilized. Additionally, this community service activity aims to have a positive impact on the environment; in addition to reducing waste, it transforms it into products with practical value and marketability. The primary benefit of this activity is to foster product innovation—specifically, the most eco-friendly recycled products—embodying the concept of "Reverse Ecology: from systems to environments and back." This naturally transforms waste into other forms in an eco-friendly manner, thereby benefiting the environment.

METHODS

This activity will be held from September to December 2025 at the Permata Bunda Early Childhood Education Center/Rumah Cinta Dahlia (PKK Secretariat), Jalan Wanaasri, Palembang. The overall implementation method was divided into several stages, as shown in Figure 1. The first stage was a situation analysis involving a field survey to identify existing problems at the activity site and possible solutions. Next, the process of obtaining permits involved discussions with the target audience—namely, the chairperson of the Rumah Cinta Dahlia Wanaasri PKK—on the results of the situational analysis and the proposed solutions to the existing problems. The schedule for the activity, including the date, time, and location of implementation, was established. An initial briefing was held with community representatives (PKK members) regarding the activities to be carried out.

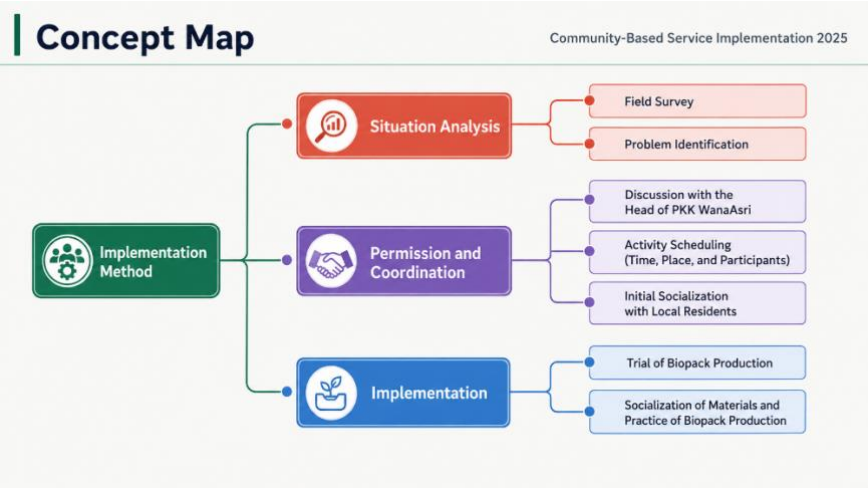

Figure 1. Stages of the Biopack Production Community Service Project

The implementation process began with students conducting a trial run of biopack production. Next, an awareness campaign and hands-on training on biopack production were conducted for the women of the PKK at Rumah Cinta Dahlia Wanaasri and the teachers at Permata Bunda Early Childhood Education Center, according to the scheduled timeline. Finally, an evaluation was conducted using a questionnaire to assess the level of understanding and the sustainability of the community service program. The steps in the biopack production process are shown in Figure 2.

The steps for making biopack, as shown in Figure 2, include:

1. Procurement of raw materials: Used paper is collected from early childhood education (PAUD) schools and residents, and dry leaves are gathered, cleaned, dried, and shredded into smaller pieces.
2. 100 grams of shredded used paper is mixed with 250 mL of water and then blended until it becomes paper pulp.
3. The shredded dry leaves are ground using a blender or chopper (they can also be crushed manually).
4. Additional raw materials: prepare tapioca starch, water, and a biopack molding tool.
5. Tapioca starch glue is prepared to bind the paper pulp and dried leaves by mixing it with warm water.

6. Production of 1 (one) biopack sample: mix 200 g of paper pulp with 100 g of dried leaves, adding tapioca starch glue as an adhesive (50 g of tapioca starch dissolved in 250 mL of warm water).
7. The mixture in the pot is heated over low heat on the stove while stirring until thoroughly combined.
8. Biopack molding: The biopack mixture is then molded using a molding tool and then dried.
9. Biopack testing: the finished biopacks are ready for use as storage containers and for other applications.
10. The same procedure applies to biopack types made solely from paper pulp and dried leaves, using 300 g of each as raw materials.

This procedure is a modification of the research conducted by Noor et al. (2020) and Kurniawan & Wakhid (2008).

Figure 2. The Steps in Biopack Production

Target Audience

This program will provide outreach and technical guidance on using waste paper and dry leaves as materials for biopackaging, in line with the Tri Dharma of Higher Education at Sriwijaya University, specifically through community service activities. The target audience for this community service program consists of women from the PKK Rumah Cinta Dahlia group and early childhood education (PAUD) teachers residing in the vicinity of the Wanaasri area, Kalidoni Village, Sungaiselayur Subdistrict, totaling approximately 40 individuals. The activity also involves 9 students researching biopack production, along with other students participating in the event. This activity also serves as an application or alignment with several courses offered in the Department of Chemical Engineering, Faculty of Engineering, University of Sriwijaya, such as ethics and effective communication, technopreneurship, and waste treatment technology.

Design and Evaluation

The design and evaluation of the activities consist of:

1. Focus Group Discussions (FGDs) with beneficiary participants. The FGD begins with a presentation of the proposing team's objectives, followed by an educational session and presentation on waste processing technology and an introduction to biopack products.
2. Conducting training/simulations on the biopack production process for the community by providing information on production procedures, supplying necessary equipment on-site, and offering hands-on practice and guidance.
3. Distributing brochures/booklets with instructions on the production process, along with a goodie bag containing materials and equipment, with the hope that participants can quickly learn and practice the process at school or at home.
4. Administering pre- and post-activity questionnaires to assess the level of understanding of the information provided, as well as a questionnaire regarding the perceived benefits of the activity's outcomes.

RESULTS AND DISCUSSION

Pre-implementation: Situation analysis and initial outreach

At this stage, the community service team conducted a situational analysis and initial outreach by surveying the site and discussing with some community members and the local neighborhood association chairperson in the Wanaasri area of Kalidoni. The situation analysis was conducted to identify existing waste management issues and assess the potential

of waste as a primary raw material for biopack production, while the initial outreach aimed to provide solutions to these issues.

Figure 3. Dry Leaf Waste Around Wanaasri Park

Figure 4. Permata Bunda Wanaasri Early Childhood Education School

The results of the observations (Figures 3 and 4) indicate potential for using dry leaves and waste paper from the offices and Permata Bunda early childhood education center as raw materials for biopack production. Based on random interviews with 2–3 respondents and periodic direct observations, on average, dry leaf waste and used paper are usually thrown into the trash or burned directly. Sari (2019) noted that the amount of waste generated in the Kalidoni subdistrict reaches 1,305 tons per day, or 38,065 tons per month.

The team conducted interviews with the Head of RT 06 RW 02 in Sungaiselayur Village, Kalidoni Subdistrict; the Chairperson of the Rumah Cinta Dahlia PKK; and a resident who also works as a teacher at the Permata Bunda Early Childhood Education Center. Based on the initial analysis and interviews, it was concluded that organic waste (dry leaves) and inorganic waste are among the problems faced in the area and require solutions for their processing and management.

Figure 5. Initial Briefing for PKK Mothers to Set the Activity Schedule

An initial outreach session was conducted for the women of the Rumah Cinta Dahlia PKK and representatives of the Kalidoni early childhood education (PAUD) teachers, explaining the purpose and objectives of the community service

activity to be carried out (Figure 5). Following a discussion on processing waste (paper and dry leaves) into biopack as a solution for waste management, an agreement was reached to conduct an outreach session and a demonstration on the materials and the process of making biopack. The use of used paper and dry leaves was deemed necessary to reduce existing waste as part of waste management around residents' homes.

Experiment: Making Biopacks

The production of these biopacks was carried out in groups by a team of students from the Department of Chemical Engineering, Faculty of Engineering, Universitas Sriwijaya (UNSRI), who served as the implementing team for approximately three weeks. The complete production process for the biopacks is shown in Figures 6–8, and the resulting biopacks are shown in Figure 9.

Figure 6. Preparation of Raw Materials for Biopack in the Form of used Paper Waste and Dry Leaves

Figure 7. Raw Material Mixing Process

Figure 8. The Biopack Production Process

Figure 9. A View of the Finished Biopack

The process of making biopack begins with preparing used paper and dried leaf waste. The dried leaves are cut into small pieces and then blended (the same procedure applies to the used paper, with the addition of water—100g of paper to 250mL of water—until a paper pulp forms). Prepare 200g of pulp, 100g of dried leaves, and 50g of tapioca flour dissolved in 250mL of water. All these ingredients are mixed in a pot over heat, stirring until homogeneous. Then, the mixture is molded onto the back of a stainless steel bowl (22 cm diameter, 6 cm height) lined with plastic and dried for 2 days. Finally, remove it from the mold, and it is ready for use. (The same procedure applies for variations using only used paper without dried leaves, and dried leaves without used paper).

Activity: Outreach and Training (Biopack Production Simulation)

This outreach event was attended by 40 women from the Rumah Cinta Dahlia PKK, 5 teachers from the Permata Bunda Early Childhood Education Center, 8 faculty members, and 9 students, and took place at the Rumah Cinta Dahlia and Permata Bunda Early Childhood Education Center offices on Jalan Wana Asri, Kalidoni, Palembang. The series of activities began with participant registration and a prayer, followed by the main event: an outreach and training session led by a team of faculty and student volunteers. This involved presenting materials and conducting training or simulations on the process of making biopacks from used paper waste and dry leaves. The outreach and training activities are shown in Figure 10.

(a) (b) (c) (d) (e)

Figure 10. A series of outreach events on the production of biopacks made from used paper waste and dry leaves; (a) registration of participants, (b) presentation of materials and a demonstration of biopack production, (c) a question-and-answer session and discussion, (d) the presentation of awards, souvenirs, and door prizes, and (e) a group photo session with the community service team

In addition to the presentation of materials and practical exercises or simulations on biopack production, there were also discussions and Q&A sessions led by both the presenters and the participants. This was done to assess participants' understanding of the material presented and to deepen it. As a token of appreciation for residents, the team gave rewards or souvenirs to those who asked questions and answered them correctly. At the end of the event, the team presented a commemorative plaque and a blender/chopper for making biopack to the chairperson of the Rumah Cinta Dahlia PKK. It took a group photo with the event participants and students.

Evaluation: Survey on the use of paper waste and leaves, the level of understanding, and the perceived benefits of the activity among the community

The evaluation was conducted to determine the extent to which the community manages paper waste and dry leaves, their understanding of the material presented, the benefits of the activity, and the community's ability to apply its outcomes. This evaluation was conducted by having participants, as respondents representing the Wanaasri community, complete a written questionnaire. Of the 45 participants, 30 completed the questionnaire; 30 stated that the activity was beneficial; 22 noted that the activity expanded their knowledge of paper and leaf waste biopacks; and 23 indicated that the presentation of the material and the demonstration of biopack production were easy to understand. The results of the questionnaire indicate that this community service activity can be continued in future initiatives that offer tangible benefits to the community.

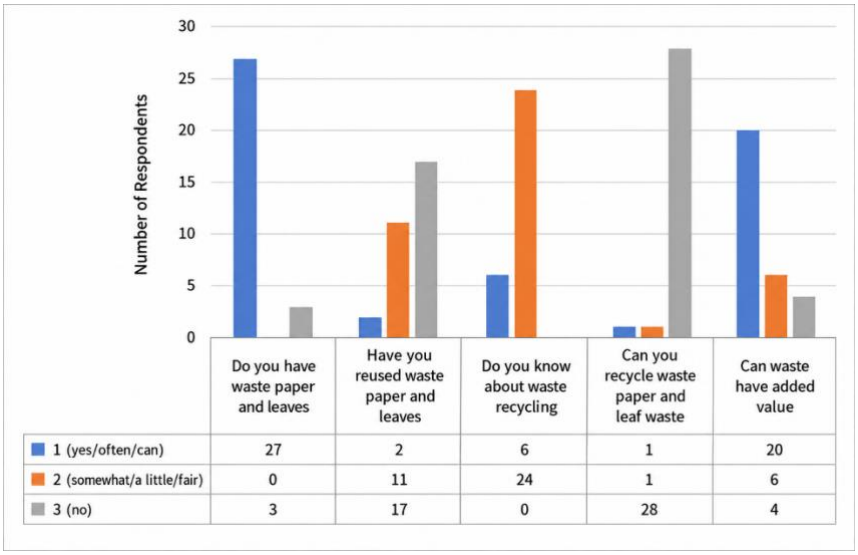

Figure 11. Survey Results on the use of Paper, Document, and Leaf Waste by the Community

The results of a survey conducted via a questionnaire completed by community service participants showed that 90% of participants had waste paper and leaves, 57% of participants had not yet made any efforts to reuse waste paper and leaves, 93% were not yet able to recycle waste paper and leaves, and more than 50% believed that this waste could have added value if managed properly (Figure 11).

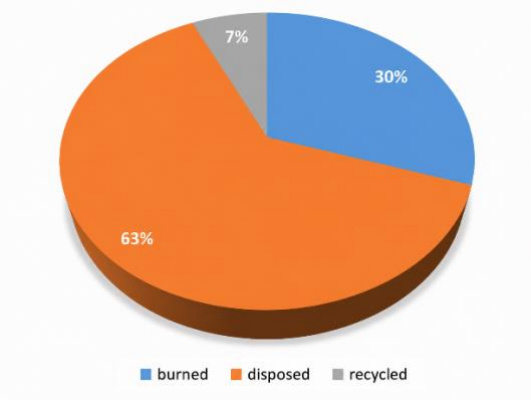

Figure 12. Survey Results on the use of Paper, Document, and Leaf Waste by the Community (Follow-up)

Furthermore, a survey on the utilization of paper and leaf waste revealed that most residents do not reuse used paper or leaves (Figure 12). According to the survey results, 63% of Wanaasri residents dispose of used paper and leaves in trash bins, 30% burn them, and only 7% recycle leaf waste specifically to make plant fertilizer.

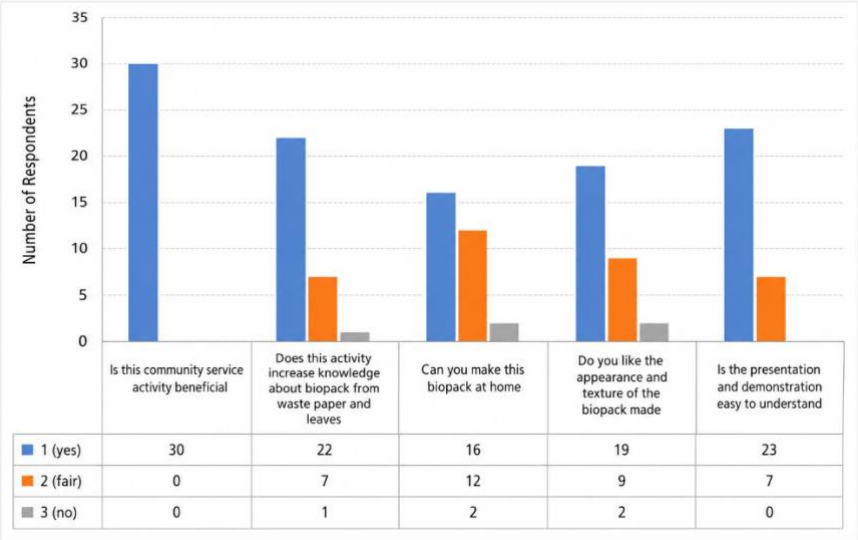

Figure 13. Survey Results on the Level of Understanding of the Production of Biopack for Paper, Document, and Leaf Waste

To assess the public's level of understanding of the production of paper, document, and leaf waste biopacks, a survey was conducted by distributing questionnaires to participants, which were then analyzed in tables and graphs (Figure 13). The survey results showed that 100% of participants rated the activity as beneficial, 97% gained new insights into the production of biopack from paper waste and leaves, 93% liked the biopack products they made, 93% were able to make biopack at home, and 100% of participants understood the material presented.

Of the three types of biopack produced in Figure 14 (paper waste, dry leaves, and a mixture of dry leaves and used paper), 47% of respondents preferred the biopack made from a mixture of used paper and leaves, as it was deemed to have a better appearance, texture, and strength compared to the other types (Figure 15).

(a) Biopack Made from Recycled Paper

(b) Biopack Made from Dried Leaves

(c) Biopack: A Blend of Recycled Paper and Dried Leaves

Figure 14. Biopack Products

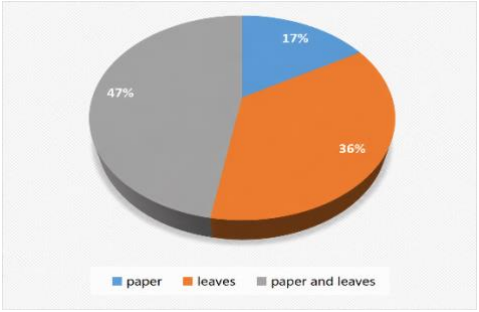

Figure 15. Results of the evaluation survey of the three types of biopackaging produced (paper waste; dry leaves; and a mixture of dry leaves and used paper)

Biopack made from a mixture of recycled paper and dried leaves is preferred over other types because it has a better physical appearance, with a higher material density, a stronger, denser structure, a smooth surface, a more pleasant aroma, and is lightweight. Meanwhile, biopack made from recycled paper has the fewest fans or is least preferred because it has a physical appearance with insufficient material density (there are still cracks) in some areas, is somewhat brittle,

has a rough surface, an unpleasant characteristic odor, and is the heaviest. Biopack made from dried leaves has the physical characteristics of a dense material with a rough surface, the lightest density, and a distinct smell of dried leaves.

CONCLUSION

The outreach and training session on making biopacks from used paper pulp and dry leaf waste for the PKK mothers of Rumah Cinta DAHLIA and the early childhood education teachers of Wanaasri, Kalidoni District, Palembang, went smoothly. Participants were very enthusiastic about the activity, as evidenced by their keen attention to the material and the questions they asked regarding the topics presented. A survey conducted after the event revealed that residents understood the information provided and felt the benefits of the activity.

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