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Transforming Waste Cooking Oil into Aromatherapy Candles to Enhance Environmental Conservation and Support Entrepreneurship Programs in Sirahan Village

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Abstract. *Waste cooking oil (WCO) is often found in people's homes as waste from frying food which can pollute the environment if not managed properly. On the other hand, students at the Ibnu Hajar Community Learning Center (PKBM) and members of the PKK group in Sirahan Village, Magelang Regency, need to develop their entrepreneurial skills to support local economic growth. This community service project aimed to train these groups in utilizing WCO as a raw material for producing aromatherapy candles. The methods employed in this activity include education and hands-on training. The results demonstrated that the community service program improved participants' knowledge and understanding regarding the risks of repeated use of WCO on health and its impact on the environment. Moreover, participants acquired new skills to support the local economy through eco-friendly entrepreneurship. Thus, proper processing of WCO can transform the use of WCO into a valuable household commodity and industrial product.*

Katakunci:
Kewirausahaan; limbah; lilin aroma terapi; minyak jelantah; pelestarian lingkungan.

Abstrak. Minyak jelantah (WCO) sering ditemukan di rumah-rumah masyarakat sebagai limbah penggorengan makanan yang dapat mencemari lingkungan jika tidak dikelola secara tepat. Di sisi lain, siswa di Pusat Kegiatan Belajar Masyarakat (PKBM) Ibnu Hajar dan kelompok PKK di Desa Sirahan, Kabupaten Magelang, memiliki kebutuhan untuk mengembangkan keterampilan kewirausahaan guna mendukung peningkatan perekonomian lokal. Kegiatan pengabdian ini bertujuan untuk memberikan pelatihan kepada kedua kelompok mitra mengenai pemanfaatan WCO sebagai bahan dasar pembuatan lilin aromaterapi. Metode yang digunakan dalam kegiatan ini meliputi edukasi serta pelatihan. Hasil pengabdian menunjukkan bahwa program pengabdian berhasil meningkatkan pengetahuan dan pemahaman peserta pelatihan mengenai risiko penggunaan WCO secara berulang terhadap kesehatan dan dampaknya terhadap lingkungan. Selain itu, speserta memperoleh keterampilan baru untuk mendukung perekonomian lokal melalui wirausaha berbasis lingkungan. Dengan demikian, pengolahan WCO yang tepat dapat mengubah penggunaan WCO menjadi komoditas rumah tangga dan produk industri yang bernilai.

1. Introduction

Cooking activities are inherently linked to the use of cooking oil, which is both a fundamental human necessity and an essential material in food preparation. Cooking oil is derived from purified plant or animal fats and remains liquid at room temperature. Commonly used types of cooking oil include vegetable oil, corn oil, and ghee. However, when cooking oil is repeatedly used for frying, it undergoes three major degradation reactions including hydrolysis, oxidation, and polymerization. These reactions could alter the physical and chemical properties of the fat (Gertz, 2000; Sanli et al., 2011).

Through the degradation reactions that occur during the frying process, a number of physical and chemical changes occur in cooking oil including increased viscosity, density, FFA content, total polar matter (TPM), polymerized triglycerides, and decreased number of double bonds, and so on (Sanli et al., 2011). If the frying process is continued, these materials will undergo further degradation and eventually the oil becomes unsuitable for use and must be discarded because it can be harmful to health when it enters the human body (Baghani et al., 2022).

The results of scientific studies show that repeatedly heated cooking oil and its smoke increase the incidence of genotoxic, mutagenic, tumorogenic and various other cancers. The mechanism of toxicity involved in the use of repeatedly heated cooking oil and its cooking smoke is through increased abnormal cells, including fractures, fragmentation, exchanges, and double chromosome damage and micronuclei. Furthermore, consumption of these materials in large quantities has been associated with a number of malignancies, including lung, colorectal, breast, and prostate cancers (Ganesan et al., 2019).

Apart from posing a threat to human health, the disposal of WCO in landfills or drains can pose serious environmental challenges (Hosseinzadeh-Bandbafha, et al. 2022). Direct disposal of WCO waste through the kitchen sink can cause WCO to freeze in the pipes, causing backfilling and blockage of the drainage system (Hashim et al., 2024). Besides, improper disposal of WCO can lead to environmental pollution, particularly causing adverse impacts on water ecosystems and landfills. WCO that enters the water ecosystems creates an oil layer on the surface of the water, causing aquatic organisms to die due to a lack of oxygen (Hamdi et al., 2022). Therefore, proper handling is essential to ensure that WCO can be recycling in a way that is beneficial and avoids negative impacts on human health and the environment. Repurposing used WCO into useful products is an effective alternative to reduce environmental pollution.

One of the villages in Salam sub-district, Magelang Regency, namely Sirahan Village has a total population of 3822 people. Currently, based on village data, the highest level of population welfare is in the category towards prosperity (39.40%), while the rest are in the vulnerable to poverty category (34.66%), somewhat poor (16.95%), poor (7.48%), and very poor (1.49%). Meanwhile, the largest proportion of people based on their recent education, respectively, are high school level (23.836%), elementary school (21.22%), have not graduated from elementary school (18.73%), and have not/have not attended school (16.745%). Due to these conditions, an institution of Ibnu Hajar Learning Activity Center (PKBM) was established in Sirahan Village to support the education of the Sirahan Village community through the equivalency education program and entrepreneurship programs to teach life skills so that students and the Sirahan Village community have economic independence.

Based on the interview with the management of PKBM Ibnu Hajar, the community faces significant challenges, including low levels of education and skills, which hinder their ability to improve their family's economic situation. However, although PKBM Ibnu Hajar has made efforts to provide learning opportunities through equivalency education, student interest remains low, with only around 20 out of 239 registered students regularly attending classes. Attendance is highest on Saturdays when entrepreneurial activities are offered. Additionally, the PKBM management faces challenges such as limited entrepreneurship programs due to a lack of tutor expertise and insufficient funding to conduct activities that promote entrepreneurial skills.

Based on these conditions, the transformation of WCO into aromatherapy candles represents a sustainable solution by promoting environmental conservation and entrepreneurship. This program involved two key community groups which includes students at the Ibnu Hajar Community Learning Activity Center (PKBM) and members of the PKK in Sirahan Village, Magelang Regency.

The economic potential of waste processing activities for the economic empowerment of housewives has been previously reported (Yanti et al., 2022). Similarly, Rahayu et al. (2021) and Nugraheni (2022) have highlighted the environmental benefits of candle-making training, particularly in its ability to transform hazardous waste by promoting the recycling of WCO into eco-friendly products. These findings emphasize the significant potential and benefits of the aromatherapy candle-making training program using WCO

Based on the explanation above, the purpose of this community service activity is to provide training to both partner groups on the use of WCO as a basic material for making aromatherapy candles. The processing of aromatherapy candles made from WCO is processed by filtering, melting, printing, and attractive packaging. Although made from WCO, the resulting product is the same as aromatherapy candles in general (Bachtiar et al., 2022). Unlike candles in general which function as a substitute for lamps and are physically unattractive, innovations in the form of aromatherapy candles have dual functions, namely as lighting tools, therapy media, and room fresheners (Shofi, 2019).

2 Method

The method for this community service project involves socialization and training on making aromatherapy candles from WCO. The activity took place at the PKBM Ibnu Hajar in Sirahan Village, Salam, Magelang Regency, Central Java. The participants included 80 individuals, consisting of students from the Ibnu Hajar Community Service Center and members of the PKK group from Sirahan Village.

The technical procedures for the community service activities are including: (1) analysis of situation to identify problems and alternative solutions; (2) socialization and introduction of the program; (3) determining the time and location of the activities in coordination with the partners; (4) preparing the necessary materials, tools, and supplies for the training on making aromatherapy candles from used WCO; and (5) conducting training to increase awareness of health and environmental issues regarding the dangers of repeated use of WCO, as well as training to improve participants' skills in making aromatherapy candle products from WCO. The flow of community service activities can be illustrated in Figure 1.

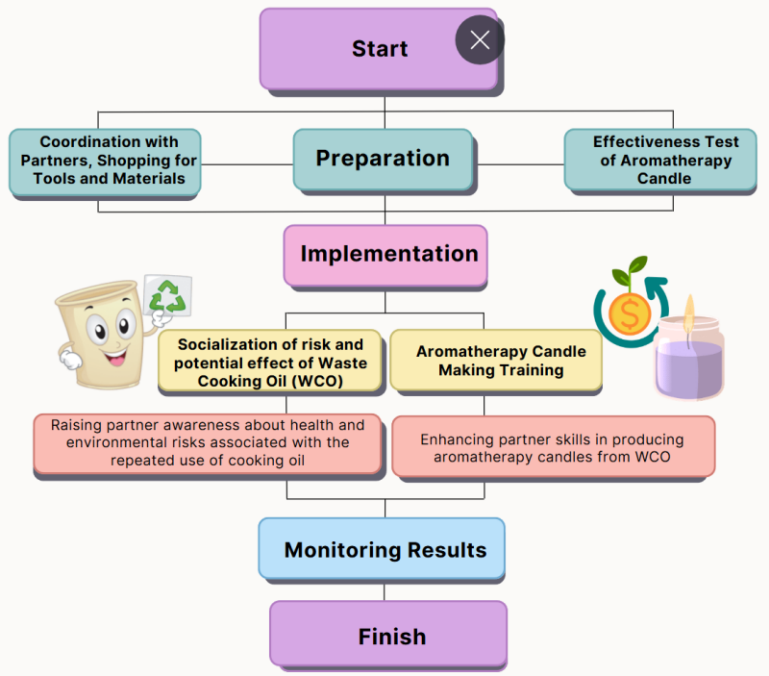

Figure 1. Flow of Community Service Activities

The tools used in making aromatherapy candles are glasses as candle molds, scales, knives, measuring cups, skewers, gas cylinders, stoves, spoons, pans, and basins. The materials used are WCO collected by students of PKBM Ibnu Hajar and PKK community in Sirahan Village, Magelang Regency, crayon waste as candle dye, essential oil as an aroma producer, paraffin wax, and candle wicks.

The process of making aromatherapy candles begins with filtering and bleaching the WCO using bleaching earth or charcoal for 24 hours. The clarified oil is then heated indirectly on the stove. Next, paraffin wax is added to a pan containing the used cooking oil in a 1:1 ratio and stirred until homogeneous. The mixture of used cooking oil and paraffin is then poured into a basin, where it is combined with dyes and essential oils. Once all the ingredients are thoroughly mixed, a candle wick is attached to a skewer for support and placed in a candle mold to ensure it stands upright. The mixed ingredients are then carefully poured into the candle mold. After all the mixture has been added, the candle is allowed to harden. Finally, the finished candle is attractively packaged and marketed to achieve economic value

3 Results

a. Preparation

The preparation stage follows the results of the situation analysis conducted by the community service team in collaboration with its partners. During this stage, coordination with partners is undertaken to finalize the technical implementation of activities. This includes determining administrative requirements, ensuring the completeness of tools and materials, and addressing other technical aspects related to the training activities. Additionally, an effectiveness test is performed on the aromatherapy candles to verify that they function properly as intended aromatherapy products (see Figure 1).

b. Implementation

The activities conducted in Sirahan Village focused on the socialization and training of making aromatherapy candles from WCO. The session began with a presentation by the resource person on the negative health impacts of repeatedly using cooking oil and the environmental risks associated with disposing of used cooking oil waste. The discussion then moved to the potential of utilizing WCO into aromatherapy candle products to support sustainable entrepreneurship. This is because the availability of WCO will always be available along with the use of cooking oil in cooking activities. Participants were also introduced to the tools, materials, and procedures for making aromatherapy candles, providing them with a foundational understanding for hands-on practice in the subsequent session.

In the initial stage of the training activity, the facilitator together with the participants discussed environmental issues in their environment, such as the impact of used cooking oil pollution on the environment and human health, and confirmed the involvement of students and the community in managing used cooking oil. In the subsequent stage, participants, along with the community service team, practiced making aromatherapy candles (see Figure 1). The participants displayed high enthusiasm and engagement throughout the activity, as evidenced by their active involvement in both the candle-making process and the discussion sessions. As a token of appreciation for their active participation, the aromatherapy candles created during the workshop were sent home with the participants.

Figure 1. Training Activities for Converting Used Cooking Oil into Aromatherapy Candles: (a) Effectiveness test of aromatherapy candle production; (b) Training session with PKBM Ibnu Hajar students; (c) Training session with the PKK Group of Sirahan Village; (d) Group photo with participants.

c. Monitoring Results

The evaluation of the activity indicated that the community service program was aligned with the activity plan and had a positive impact on the community (see Table 1). An increase in participants' understanding of the effects and potential uses of WCO was confirmed through a question-and-answer session. Additionally, WCO, which was previously discarded after cooking, is now being recycled into material for making aromatherapy candles, thereby enhancing entrepreneurial skills.

Table 1. Criteria and Indicators of Program Success

No.	Criteria	Descriptions
1.	Participant knowledge and understanding	Participants were able to answer questions regarding the risks of repeated use of WCO on health and its impact on the environment, and were able to explain the tools, materials, and

No.	Criteria	Descriptions
		procedures for making aromatherapy candles from WCO correctly.
2.	Participation	Participants were actively engaged in the activity, as evidenced by their involvement in asking and answering questions, as well as in practicing the process of making aromatherapy candles
3.	Impact of the community program	Participants gained new skills that could enhance the local economy through environmentally based entrepreneurship

4 Discussion

This activity involves educational sessions, hands-on training, and practical experience to support entrepreneurship programs focused on producing aromatherapy candles. The goal is to enable participants to actively engage in problem-solving by leveraging local resources, ultimately leading to economic benefits if managed effectively.

The initial activities, which involved education and socialization, successfully increased public knowledge and awareness about the risks and dangers of improper WCO management. This aligns with previous community service activities reported by Prastyo et al. (2023) & Hawik et al. (2024) which demonstrated that education and training strategies such as converting used cooking oil into aromatherapy candles can raise awareness and encourage both students and the community to actively contribute to reducing the potential for land and water pollution.

One of the primary raw materials used in making aromatherapy candles is WCO, which is readily available due to its continuous use in cooking activity. Utilizing WCO not only supports environmental sustainability but also aligns with recent study highlighting that improperly disposed cooking oil often ends up in water channels, leading to significant environmental issues such as clogged drains, soil contamination, air pollution, and water pollution (Foo et al., 2021; Awogbemi et al., 2021; Baghani et al., 2022). For example, the environmental impacts arising from improper disposal of used cooking oil on the soil can damage the ecology of its inhabitants.

To date, the use of WCO has been utilized in a number of biotechnological conversions and applications, for example as a raw material for biofuel, bisabolene, biolubricants, liquid detergents,

dishwashing soaps, plasticizers, polyurethane foam, surfactants, asphalt rejuvenators, and aromatherapy candles (Figure 2). This means WCO produced by the community cannot be ignored and set aside considering its many potential applications to support the circular economy. Moreover, WCO is also a cost-effective and easily available material. Therefore, the community should no longer be indifferent to the life cycle of this resource.

The process of making candles from WCO involves several stages: filtering and bleaching, melting, molding, and packaging. The filtering and bleaching stage aims to remove impurities, such as color, free fatty acids, peroxides, odors, and non-fat substances, from the oil (Yuarini et al., 2021). Although the results of filtering and bleaching process make WCO clearer, but the participants were also warned not to reuse the oil for cooking.

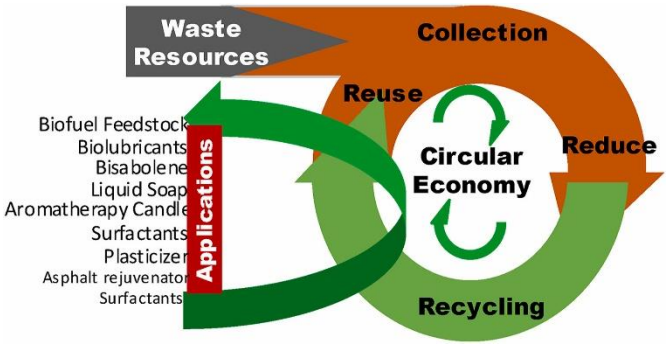

Figure 2. The role of WCO as a waste resource in a circular economy (Awogbemi et al., 2021)

During the melting stage, preheated used cooking oil is mixed with paraffin in a 1:1 ratio and stirred until homogeneous. The resulting mixture is then combined with dyes derived from crayon waste and essential oils. In the cooling stage, a candle wick is inserted into the mixture, which is then allowed to cool for a week to achieve a solid wax texture.

Based on the results of the training activities, it is evident that participants gained a clearer understanding of the impact and potential of using used cooking oil. Additionally, they practiced making aromatherapy candles with significant market value. The participants' high level of enthusiasm was evident during the Q&A session, where they actively engaged by asking and answering questions posed by the instructor. This interaction helped evaluate their understanding of the

material and demonstrations. Therefore, it is hoped that these skills will serve as an alternative source of income for the community in the future.

5 Conclusion

The results of this community service demonstrate that the program has had a positive impact on the partner groups, specifically the students of PKBM Ibnu Hajar and the PKK groups in Sirahan Village. Participants were able to learn how to make aromatherapy candles from WCO, which offers environmental benefits and has the potential to boost the local economy through environmentally-based entrepreneurship. According to the criteria and indicators of program success, the effective implementation of this community service initiative serves as an inspiration for enhancing entrepreneurial skills among students and communities in other regions, potentially contributing to the advancement of a circular economy.

6 Acknowledgment

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