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Practical Socialization of Green Chemistry Through the Production of Environmentally Friendly Herbal Hand Sanitizer from Aloe Vera Extract to Improve Health

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Abstract

The excessive use of synthetic chemical-based cleaning products has the potential to cause negative impacts on human health and the environment. Therefore, educational efforts are needed to encourage the application of green chemistry principles through the use of sustainable natural materials. This community service activity aimed to socialize the application of green chemistry through the production of environmentally friendly herbal hand sanitizers based on Aloe vera fermentation to PKK cadres in Karangsong Village. The method used was a descriptive-participatory approach through literature studies, material delivery, demonstrations, and direct practice of herbal hand sanitizer production. Data was obtained through observation, discussion, and participant feedback during the activity, then analyzed qualitatively and descriptively. The results of the activity showed an increase in participants' understanding and skills regarding the concept of green chemistry, the benefits of aloe vera, and the fermentation process in making herbal hand sanitizer. Participants were able to independently practice product manufacturing and showed interest in applying it in their daily lives and developing local economic potential. This activity proves that practical socialization based on green chemistry is effective in increasing awareness, skills, and community empowerment, and has the potential to support health and environmental sustainability..

Keywords: Green Chemistry, Hand Sanitizer, Aloe Vera, Fermentation, Community Service, Community Empowerment

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Introduction

Technological advances and industrialization have greatly contributed to improving the quality of human life, but on the other hand, they have also caused various environmental and health problems (Gusman et al., 2024). The excessive use of synthetic chemicals in hygiene and health products, such as alcohol-based hand sanitizers and other synthetic chemical compounds, has the potential to cause skin irritation, long-term health problems, and environmental pollution due to the chemical waste produced (Minarni et al., 2022). This situation has prompted the need for safer, more sustainable, and environmentally friendly alternatives.

In response to these issues, the concept of green chemistry has developed as a scientific approach that emphasizes the design of chemical products and processes that minimize the use of hazardous

materials, reduce waste, and utilize renewable natural resources (Magfirah et al., 2025). The application of green chemistry principles in everyday life has become an urgent need as public awareness of health and environmental issues increases (Gusman, et al., 2025).

Previous studies have shown that applying green chemistry principles in cleaning products can reduce negative environmental impacts while improving user safety (Mustafa, 2025). Several community service studies have also reported that the use of local natural ingredients in the manufacture of health products can increase community independence and awareness of sustainable lifestyles (Gusman, et al., 2025). Previous community service research has reported that involving PKK cadres in training on the use of local materials and household waste not only improves practical skills, but also encourages environmentally friendly behavioral changes and opens up creative economic opportunities based on natural and sustainable products (Gusman, et al., 2025).

Hand sanitizer is one of the hygiene products whose use has increased significantly, especially since the COVID-19 pandemic (Gusman et al., 2022). Previous research has generally focused on the effectiveness of alcohol-based hand sanitizer as an antiseptic agent, but there has been relatively limited research on the development of herbal hand sanitizer based on natural ingredients using a green chemistry approach, particularly through fermentation (Zuhlianty et al., 2025). A practice-based socialization approach has proven effective in improving public science literacy and skills in producing natural-based products, as demonstrated in various community assistance and training programs based on local resources (Gusman, et al., 2025).

Aloe vera is an easily found plant that has been extensively studied for its antibacterial, antiseptic, and anti-inflammatory properties, which originate from active compounds such as saponins, anthraquinones, and polysaccharides (Wijaya & Masfufatun, 2022). Previous studies have shown that aloe vera has the potential to be used as a base ingredient for herbal hand sanitizers, but its implementation in the form of community service-based outreach and training activities is still limited, especially in local communities (Verawati et al., 2025).

Karangsong Village has community groups that are active in health activities through Posyandu and PKK (Family Welfare Development). PKK cadres play a strategic role in maintaining family health and spreading healthy living practices in their neighborhoods. Therefore, socialization and training activities on making herbal hand sanitizers based on Aloe vera fermentation are relevant as a form of practical application of green chemistry principles that also empower the community.

Based on the above description, this article aims to disseminate and implement green chemistry principles through the production of environmentally friendly herbal hand sanitizer based on Aloe vera fermentation for PKK cadres in Karangsong Village, as an effort to increase awareness, skills, and community health in a sustainable manner.

Method

This outreach program uses a participatory approach that actively involves PKK cadres in the training process for making herbal hand sanitizer. The method includes an introduction to the concept of green chemistry and the benefits of aloe vera as a natural ingredient with antibacterial, antiseptic, and anti-inflammatory properties. The training focuses on the practice of fermenting aloe vera to increase the bioavailability of active components and the production of environmentally friendly herbal hand sanitizer.

A literature review was conducted to examine the concept of green chemistry, the use of natural ingredients in cleaning products, and previous studies related to the manufacture of herbal hand sanitizers based on medicinal plants (Iriyani et al., 2023). The literature reviewed included scientific articles, reference books, and community service reports discussing the principles of green chemistry, the antibacterial activity of Aloe vera, and the use of fermentation methods to increase the effectiveness of bioactive compounds (Wahid & Dadiono, 2022). The results of the review show that previous studies generally focused on testing antibacterial effectiveness or product formulation, while aspects of community socialization and empowerment using a green chemistry approach were still limited. Therefore, this activity places socialization and training as the main focus, while integrating the findings

of previous studies into field practice.

1) Socialization and training activities were carried out in several stages, namely:
   Provision of initial material, including an introduction to the concept of green chemistry, the impact of using synthetic chemicals, and the potential of Aloe vera as a natural ingredient with antibacterial, antiseptic, and anti-inflammatory properties;
2) Demonstration and practice of Aloe vera fermentation, which aims to increase the bioavailability of active components and reduce the use of additional chemicals;
3) Practice of making herbal hand sanitizers, with an emphasis on safety, effectiveness, and environmental friendliness;
4) Discussion and reflection, which discusses the application of products in everyday life as well as opportunities for the development and marketing of herbal products based on local resources.

The following is the process flow for making fermented aloe vera hand sanitizer as an effort to implement PHBS in the Karangsong community, as shown in Figure 1.

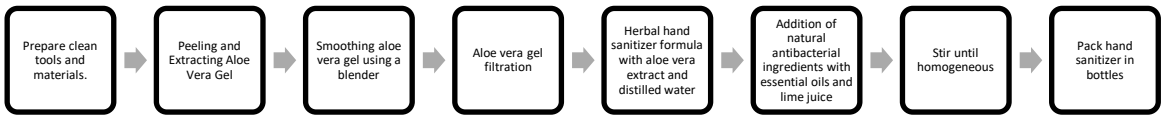

Figure 1. Process flow for making hand sanitizer using aloe vera fermentation

The data analysis technique used was qualitative-descriptive, assessing participants' increased understanding and skills before and after the outreach activities. Data was obtained through direct observation during training, group discussions, and participant feedback regarding their understanding of green chemistry concepts and their ability to practice making herbal hand sanitizers. The results of the analysis were compared with previous research findings that emphasized product effectiveness, so that this activity provided an additional contribution in the form of strengthening the aspects of education, empowerment, and sustainability of green chemistry implementation at the community level.

Results and discussions

A practical green chemistry outreach activity involving the production of environmentally friendly herbal hand sanitizer based on Aloe vera fermentation was carried out in Karangsong Village, with PKK cadres as the main participants. The activity was carried out successfully and showed a high level of participation. All participants were actively involved in the material presentation session, discussion, and herbal hand sanitizer production practice.

Observations during the activity showed an increase in participants' understanding of the concept of green chemistry, particularly regarding the use of natural ingredients, reduction of synthetic chemicals, and the importance of environmental sustainability. Participants were able to explain the basic principles of green chemistry and relate them to the practice of making environmentally friendly herbal hand sanitizer.

Figure 2. Socialization to PKK cadres

In addition, the results of the practice showed that most participants were able to follow the Aloe vera fermentation procedure and herbal hand sanitizer formulation correctly. The herbal hand sanitizer products produced had physical characteristics suitable for everyday use, such as a homogeneous gel texture and natural aroma, and were considered safe and comfortable to use by the participants.

Some participants also reported that they had started using the herbal hand sanitizer produced during the training in their daily activities and had introduced it to their family members and neighbors. This shows the potential for the implementation and sustainability of these activities at the community level.

The improvement in the understanding and skills of PKK cadres in this activity shows that the participatory socialization approach is effective in internalizing the concept of green chemistry in the community. This finding is in line with previous research and community service activities which state that practice-based training methods are more effective in improving science literacy and community skills than lecture-based approaches alone.

The use of aloe vera as a base ingredient for herbal hand sanitizers supports previous research findings that this plant has antibacterial, antiseptic, and anti-inflammatory properties. However, unlike some previous studies that emphasized laboratory testing and the antibacterial effectiveness of the product, this activity emphasized education, community empowerment, and the direct application of green chemistry principles. Thus, this activity made an additional contribution by integrating scientific concepts into the daily practices of the community.

Conclusion

Based on the results of the community service activities that have been carried out, it can be concluded that the practical dissemination of green chemistry through the production of environmentally friendly herbal hand sanitizers based on Aloe vera fermentation has successfully achieved the research objectives. This activity has increased the understanding and skills of the PKK women in Karangsong Village regarding the concept of green chemistry, the use of natural materials, and the process of producing safe and sustainable hygiene products.

The results of the dissemination show that participants not only understand the principles of green chemistry conceptually, but are also able to apply them practically through the fermentation process of Aloe vera and the manufacture of herbal hand sanitizers. These findings confirm the hypothesis that the application of a participatory approach in the dissemination of green chemistry can increase community awareness, skills, and readiness in using and producing environmentally friendly hygiene products.

In addition to improving health and environmental awareness, this activity also opens up opportunities for local economic empowerment through the utilization of local natural resources. Thus, practical green chemistry socialization based on Aloe vera fermentation has the potential to become a model of

sustainable community service that can be replicated in other communities.

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