



Training on Herbal Massage Oil Preparation Using Family Medicinal Plants (TOGA) for Elementary School Students

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ARTICLE INFO	ABSTRACT
Keywords: Downstream Utilization; Education; Elementary School Students; Herbal Massage Oil; TOGA	This community service program aimed to provide elementary school students with knowledge and practical exposure to the simple downstream utilization of family medicinal plants (TOGA) through training in herbal massage oil preparation at SD Inpres Pattung, Gowa Regency, Indonesia. The program used demonstrations and guided group practice covering material sorting and washing, size reduction, extraction in carrier oil, filtration, packaging, and simple labeling. Student understanding was evaluated using an eight-item quiz completed by seven respondents. The mean proportion of correct answers for five multiple-choice items was 88.6%, with perfect scores for understanding product benefits and the warming effect of ginger (100% each), and high scores for understanding the principle of spice extraction into oil and identifying an appropriate carrier oil (85.7% each). The lowest performance was observed in recalling the complete main ingredients (28.6%). Because the knowledge evaluation involved only seven student respondents, the findings should be interpreted descriptively. All respondents stated that they intended to give the product to family members, suggesting that the activity was perceived as relevant to household use. The activity produced an educational prototype and a simple practice procedure that may support similar school-based educational activities.
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INTRODUCTION

Family medicinal plants (Tanaman Obat Keluarga; TOGA) have long been part of community-based health practices in Indonesia. However, the use of TOGA in school environments is often limited to introducing plant names and their perceived benefits and is less frequently continued into the processing of plant materials into products that can actually be used. School gardens and garden-based activities can provide opportunities for hands-on education, real-world learning, environmental connection, and curriculum integration (Chan et al., 2022; Falzon & Conrad, 2024; Mann et al., 2022; Walshe et al., 2024). Processing activities can provide elementary school students with more concrete learning experiences while connecting the stages of “growing” and “using” medicinal plants (Ari Nugrahani et al., 2024).

Traditional herbal massage oil is a simple herbal preparation that is familiar in the community. Vegetable oils can function as alternative solvents for the extraction of phytochemicals from plant materials and can be used to produce herbal-infused oils (Yara-Varón et al., 2017). Ginger (*Zingiber officinale*) contains gingerols and shogaols, which are among its major bioactive constituents and have been extensively studied in relation to extraction and processing (Garza-Cadena et al., 2023; Kamaruddin et al., 2023; Maghraby et al., 2023). Ginger processing conditions can influence the relative recovery and transformation of gingerols and shogaols (Dalsasso et al., 2022). Chili (*Capsicum* sp.) contains capsaicin, a compound capable of activating heat-sensitive transient receptor potential channels and contributing to the perception of warmth (Rosales et al., 2023).

Lemongrass (*Cymbopogon citratus*) contains volatile compounds, particularly citral-related constituents, that contribute to its characteristic aroma (Aćimović et al., 2024; Luang-In et al., 2024).

In this activity, commercially available vegetable oil was used as the carrier oil because it was economical and readily available in the community. From an educational perspective, product-making activities in elementary schools are consistent with experiential learning, which positions students as active participants. Systematic evidence from elementary science education indicates that experiential learning is associated with students' curiosity, motivation, understanding, competence, and learning achievement (Susiloningsih et al., 2023). Experience-based approaches can support the development of knowledge and skills through direct involvement in activities (Chan et al., 2022; Varman et al., 2021). School gardening interventions may also provide experiential learning opportunities through direct interaction with plants, practical activities, and integration with classroom learning (Holloway et al., 2023; Muzaffar et al., 2023).

Previous activities at SD Inpres Pattung introduced students to family medicinal plants (TOGA) and revitalized the existing TOGA garden. However, these activities had not yet been extended to hands-on processing of selected TOGA plants into a simple household-use product. Therefore, this community service activity was designed to provide elementary school students with knowledge and practical exposure to the preparation of herbal massage oil using selected rhizomes and spices from TOGA. The activity aimed to describe the implementation of the training and assess students' post-training knowledge of the materials, preparation principles, and intended use of the resulting product.

METHOD

Place and Time

The activity was conducted at SD Inpres Pattung, Barombong District, Gowa Regency, South Sulawesi, Indonesia, on 23 May 2026 as part of the 2026 PNPB Community Service Program of the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Negeri Makassar.

Participants

The participants in the program series were Scout members of SD Inpres Pattung, accompanied by teachers and school staff, with a total of 34 participants across the program activities. For the knowledge evaluation of the herbal massage oil training, seven students from grades 2–4 were purposively selected based on their enthusiasm and willingness to participate in the hands-on herbal massage oil preparation. The remaining students continued to participate in another concurrent educational activity on herbal soap preparation because of the limited activity time. Therefore, the knowledge evaluation was conducted with seven student respondents as a limited post-training assessment and was not intended to represent all program participants. The activity was conducted with permission from the school principal and under the supervision of teachers and facilitators. Students were accompanied throughout the hands-on activity to support safe and appropriate participation. No separate written parental/guardian consent or child assent was obtained for this community-service evaluation. The activity was conducted under the school's institutional permission, as documented through the partnership with SD Inpres Pattung, with teacher supervision throughout the activity.

Instruments, Materials, and Equipment

The materials included ginger (*Zingiber officinale*), chili (*Capsicum* sp.), lemongrass (*Cymbopogon* sp.), several other spices, and commercially available vegetable oil as the carrier oil. Some plant materials were obtained from the school TOGA garden established or revitalized in the preceding activity. The equipment included knives, cutting boards, basins or containers, strainers, a heating vessel, product containers, and labels.

Activity Procedure

The training followed a demonstration–guided practice model. The procedure consisted of the following stages:

Short instructional session. The team explained the basic principle of herbal massage oil: extractable components from spices are transferred into a carrier oil. The material was presented using simple language and concrete analogies appropriate for elementary school students.

Material preparation and formulation. The formulation consisted of 500 g of ginger (*Zingiber officinale*), 500 g of red chili (*Capsicum annum*), 100 g of kencur (*Kaempferia galanga*), 200 g of lemongrass (*Cymbopogon citratus*), 100 g of turmeric (*Curcuma longa*), 100 g of shallot (*Allium cepa* var. *aggregatum*), 50 g of garlic (*Allium sativum*), 20 g of kaffir lime peel and 10 g of kaffir lime leaves (*Citrus hystrix*), 200 g of galangal (*Alpinia galanga*), and 100 g of pepper (*Piper nigrum*). Commercially available vegetable oil was used as the carrier/extraction medium, with 200 mL used for the chili oil, 200 mL for the ginger oil, and 1,000 mL for the spice oil (Sulfikar et al., 2026a)

Sorting, washing, and size reduction. These preparation steps were performed by the community service team one day before the activity. Ginger was cleaned, peeled, and crushed or thinly sliced; chili was cut; and the additional spices were cleaned and cut into small pieces according to the formulation. Clean and dry utensils and containers were prepared before processing.

Extraction into carrier oil. The extraction was conducted in three stages. First, 500 g of red chili was cooked in 200 mL of vegetable oil over medium-to-low heat until the chili became dry and darker, followed by filtration to obtain chili oil. Second, 500 g of ginger was cooked in 200 mL of vegetable oil over low heat until dry, followed by filtration to obtain ginger oil. Third, the remaining spice materials were soaked in 1,000 mL of vegetable oil for approximately 1–2 h and then heated over very low heat until boiling and the spices became slightly brown. The heat was then turned off, the mixture was cooled and covered, and it was allowed to stand for 24 h before filtration to obtain the spice oil. The heating temperature was not directly measured using a thermometer; therefore, the heating conditions are reported descriptively rather than as a specific temperature range.

Filtration, mixing, and packaging. The three oil components—chili oil, ginger oil, and spice oil—were mixed until homogeneous and transferred into clean, dry 100-mL bottles. The containers were tightly closed and labeled with the product name, ingredients, preparation date, and external-use instructions. The SOP specified a 100-mL packaging size; the final recovery yield was not quantitatively determined.

Hygiene and safety procedures. Clean and dry utensils and containers were used during preparation and packaging. Care was taken during cutting and heating, and direct contact with hot oil was avoided. Appropriate protective equipment, such as gloves, was used when necessary, and the work area was maintained in a safe and ventilated condition.

Topical safety precautions. The product was intended for external use only. Participants were instructed to apply the oil only to the required body area and to avoid contact with the eyes, mouth, and other sensitive areas. Because the formulation contains red chili, participants were advised to avoid application to damaged or irritated skin and to discontinue use if skin irritation or an allergic reaction occurred. The hands-on activities were conducted under the supervision of the community service team and teachers.

Evaluation Instrument

Student understanding was evaluated using an eight-item knowledge quiz consisting of one open-ended item on ingredient composition, five multiple-choice items on the material and process, one open-ended item on product storage, and one reflective open-ended item. The quiz items were developed based on the materials and procedures presented during the training and were reviewed by the community service team for alignment with the learning content and age appropriateness. No formal psychometric validation was conducted because the quiz was used as a simple post-activity educational assessment. The quiz was completed by seven respondents.

Multiple-choice responses were analyzed descriptively as the percentage of correct answers for each item, using the following categories: high understanding ($\geq 75\%$), moderate understanding (50–74%), and low understanding ($< 50\%$). Open-ended responses were assessed using predefined criteria based on the expected information from the training materials. For the ingredient-composition item, a response was categorized as complete when the respondent correctly recalled the main ingredients specified in the training; responses containing only part of the ingredients were

categorized as incomplete. The storage and reflective responses were summarized qualitatively based on the consistency and relevance of the responses to the training material.

For the carrier-oil item, vegetable-based oils considered suitable for the preparation, including VCO and ordinary vegetable cooking oil, were accepted as correct responses, whereas non-oil materials such as kerosene were considered incorrect. Because the evaluation did not include a pre-test, comparison group, or direct performance rubric, the results were interpreted as a descriptive assessment of post-training knowledge rather than evidence of knowledge improvement or skill enhancement.

RESULTS AND DISCUSSION

Training Implementation

The training was implemented using a demonstration-guided practice approach. Students were organized into small groups and were assigned to relatively safe stages, particularly filtration and packaging, while cutting and heating were handled by the community service team. This division of roles applied basic safety considerations for elementary school participants and accommodated the preparation stages that required longer processing time.



Figure 1. Delivery of instructional material on the roles of ginger, chili, and lemongrass in herbal massage oil preparation.

The activity connected TOGA learning with direct experience in making a simple product. Students were not only introduced to plant materials but also observed changes in the materials during processing and learned that the spices were placed in oil to transfer extractable components into the oil phase. This simple explanation reflects the broader principle of plant extraction, in which processing conditions and solvent characteristics influence the recovery and composition of extractable compounds. Studies on ginger have shown that extraction and thermal processing can alter the relative recovery of gingerols and shogaols (Dalsasso et al., 2022; Huang et al., 2026; Maghraby et al., 2023).



Figure 2. Final stages of the activity, including packaging of the herbal massage oil, and evaluation of students' understanding through the knowledge quiz

Student Knowledge Outcomes

The mean proportion of correct responses across the five multiple-choice items was 88.6%, which falls within the high-understanding category. Four of the five multiple-choice items were answered correctly by more than 70% of respondents. Two items reached 100%: understanding the benefits of the product and understanding the warming effect of ginger. Understanding the purpose of soaking spices in oil and identifying an appropriate carrier oil both showed a high result of 85.7%. The item concerning another spice associated with a warming effect showed a lower but still moderate result of 71.4%.

These results provide a descriptive indication of students' post-training knowledge. Given the small number of respondents ($n = 7$), the findings should be interpreted cautiously and should not be generalized to the broader student population.

The relatively high proportion of correct responses may reflect students' immediate exposure to the training materials and practical activity; however, the present evaluation does not allow conclusions about longer-term knowledge retention or improvement.

This finding is consistent with evidence that experiential learning in elementary science education is associated with students' understanding, motivation, competence, and learning achievement (Susiloningsih et al., 2023). School garden-based programs have likewise been reported to support knowledge development when gardening activities are integrated with educational activities (Chan et al., 2022; Holloway et al., 2023).

Table 1. Results of the student knowledge quiz on herbal massage oil preparation ($n = 7$)

No.	Evaluation Indicator	Result
1	Naming three main ingredients	2 of 7 students (28.6%) answered completely
2	Identifying the carrier oil	6 of 7 students (85.7%) provided an acceptable answer; 4 selected VCO and 2 selected ordinary vegetable cooking oil. One student selected kerosene.
3	Explaining the benefits of herbal massage oil	All students (100%) answered correctly
4	Explaining the purpose of spice soaking	6 of 7 students (85.7%) understood the extraction principle
5	Identifying the warming effect of ginger	All students (100%) answered correctly
6	Identifying a spice associated with a warming effect	5 of 7 students (71.4%) answered correctly
7	Explaining storage of the herbal massage oil	Most students did not explain all storage principles completely
8	Explaining the planned use of the product	All students stated that they would give the product to family members

An important finding was the low ability to recall the ingredient composition. Only 2 of 7 students (28.6%) could state the three main ingredients completely. Although six students could mention ginger and six could mention lemongrass, chili was more frequently omitted. Three students instead mentioned turmeric. One possible explanation is that the recall pattern may have been influenced by exposure to different plant materials across the sessions, as turmeric was one of the plants emphasized in the preceding TOGA education session conducted on the same day (Sulfikar et al., 2026b). However, this possible memory interference was not directly assessed in the present evaluation.

The difference between the open-ended composition item and the multiple-choice items may reflect differences in both the content assessed and the response format. The open-ended item required students to provide ingredient information without answer prompts, whereas the multiple-choice items provided response options. Therefore, the observed difference should not be

interpreted solely as evidence of a difference between recall and recognition. A practical implication is the use of an illustrated recipe card that students can take home as a memory aid without substantially increasing the duration of the training. Take-home materials and family involvement have also been identified as useful components in school garden-based interventions (Chan et al., 2022).

The carrier-oil item showed a correct-response rate of 85.7% (6 of 7 students). Four students selected virgin coconut oil (VCO), while two selected ordinary vegetable cooking oil; both responses were considered acceptable because they represent vegetable-based oils that can function as carrier oils in a simple herbal oil preparation. One student selected kerosene, which was considered incorrect and highlights the importance of clearly distinguishing edible or suitable vegetable oils from non-oil materials during practical instruction. The use of commercially available vegetable oil in the activity was intentionally aligned with the objective of introducing an economical and readily accessible material for household-level practice.

The item concerning another spice associated with a warming effect was answered correctly by 5 of 7 students (71.4%). The storage item showed that some students could not yet explain all storage principles completely. Although this item was not designed as a primary quantitative indicator, the responses suggest that some messages concerning protection of the product from conditions that may accelerate deterioration had been conveyed.

Product Use and Program Implications

All respondents (7/7) stated that they intended to give the product to family members, particularly in relation to perceived household use for muscle aches and fatigue. Pedagogically, this response indicates that the product was perceived as relevant to household life rather than merely as a school task. It provides an early indication that the learning experience can be connected with family-level utilization of TOGA.

The program has three main implications. First, the training connected the revitalization of the school TOGA garden with utilization of plant materials in a simple product. Second, the quiz response patterns provide a basis for improving instructional design, particularly through an illustrated recipe card to strengthen recall of the ingredient composition. Third, the resulting product should be regarded as an educational or demonstrative prototype; further development toward commercialization requires additional guidance regarding applicable product requirements and regulations.

CONCLUSION

The training on herbal massage oil preparation using rhizomes and spices from TOGA at SD Inpres Pattung was successfully implemented and produced an educationally labeled prototype together with a simple practical procedure suitable for school-based educational activities. The quiz results from seven respondents showed a mean correct-response rate of 88.6% across five multiple-choice items, with 100% performance for understanding product benefits and the warming effect of ginger and 85.7% for understanding the principle of spice extraction into oil and identifying an appropriate carrier oil. The lowest performance was observed in recalling the ingredient composition completely (28.6%). These results provide a descriptive overview of students' post-training knowledge and suggest that illustrated recipe cards may be useful as supporting materials in future activities. All respondents reported that they intended to give the product to family members, suggesting its relevance to household use. The findings should be considered in the context of the limited evaluation, which involved seven student respondents and focused on post-training knowledge without a pre-test or direct assessment of practical skills.

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AI DISCLOSURE STATEMENT

The authors used an AI-assisted writing tool during manuscript preparation for language organization and formatting support. The authors reviewed and edited the manuscript and take full responsibility for the accuracy and integrity of the final content.

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