

DOI: <http://doi.org/10.21698/simi.2025.ab55>

OPTIMIZATION OF VOLATILE LAVENDER OIL EXTRACTION FOR COSMETIC APPLICATIONS

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Keywords: *extraction, lavender oil, Lavandula angustifolia, ultrasound-assisted steam distillation*

Introduction

Lavandula, the scientific name for lavender, is a popular aromatic plant in the *Lamiaceae* family that is valued for its unique scent and numerous uses in the essential oil, cosmetic, and pharmaceutical sectors. *Lavandula angustifolia* is one of the most widely grown and economically valuable species in the genus *Lavandula*. *Lavandula angustifolia* has gained prominence in the Republic of Moldova, a country rich in aromatic and medicinal plants, due to its high yield of volatile oil with valuable bioactive properties and its ability to adapt to local agroclimatic conditions. Lavender production and processing boost the economy of the country and encourage the adoption of sustainable farming methods.

In the cosmetics sector, lavender oil is widely utilized in skin and hair care products such as lotions, creams, shampoos, and serums. Its soothing, moisturizing, and antibacterial qualities, along with its attractive scent, enhance the cosmetics' usability and sensory appeal. The quality and effectiveness of the extraction are significantly influenced by the processing method and parameters used. This study focused on identifying key elements that affect oil yield and quality to optimize the extraction process of lavender volatile oil and generate high-quality lavender oil.

Materials and methods

In this study, the steam distillation (*with steam distillation unit*) method combined with ultrasonic pre-treatment (*with ultrasonic bath with heating, Sonorex*) of the plant material was used for the extraction of lavender oil. To optimize the extraction process of lavender oil, the following parameters were varied: type of solvent, solvent maceration temperature and duration, ratio of solvent to plant material, ultrasonic pre-treatment time, extraction duration, and number of extractions. The quality assessment of the extracted oil was carried out based on organoleptic and physicochemical parameters.

Results and conclusions

To optimize the process of extracting lavender oil in the initial stage, the following solvents were used: distilled water, ethyl alcohol (70%), and methyl alcohol (80%). As a result of using methyl and ethyl alcohol as solvents, it was observed that lavender oil does not separate. This behavior can be explained by the fact that alcohols lower the boiling point of water; thus, the oil extraction temperature is not reached. To use alcohols as solvents, it is necessary to use vacuum distillation. This process is not cost-effective, as it considerably increases energy consumption and, as a result, the cost of the extraction process. Subsequently, the optimal solvent

maceration temperature and time were determined. To achieve this goal, 6 samples of plant material (30 g) were macerated with distilled water for 30 to 360 min at temperatures of 20–50°C. Then, 200 mL of distilled water was added and it was subjected to steam distillation for one hour. The resulting oil was separated and then dried on anhydrous CaCl₂. The obtained results were used to calculate the oil extraction yield (η) (Table 1).

Table 1. Yield of lavender oil extraction based on different parameters

1.	Maceration temperatures, °C	20.00	25.00	30.00	35.00	40.00	50.00
	η (m/m), %	1.25	1.71	1.72	1.73	1.73	1.74
2.	Maceration time, min	0.00	30.00	60.00	120.00	240.00	360.00
	η (m/m), %	1.07	1.72	1.73	1.73	1.73	1.74
3.	Steam distillation, min	30.00	40.00	50.00	60.00	80.00	120.00
	η (m/m), %	0.80	0.96	1.10	1.60	1.63	1.70
4.	Ultrasound treatment, min	10.00	20.00	30.00	40.00	50.00	60.00
	η (m/m), %	1.77	1.93	2.53	2.27	2.10	1.93

The results presented in Table 1 indicate that maceration plays a significant role in the extraction and the optimal maceration temperature is 30°C. At a temperature of 20°C, the η of lavender oil is 1.3–1.4 times lower, and at temperatures above 30°C, the yield changes insignificantly. Also, the results indicate that, without maceration, the η of lavender oil extraction is 1.5–2 times lower compared to the samples subjected to maceration. Therefore, it can be concluded that it is strictly necessary to subject the plant material, for 30 min, to maceration with distilled water. It was established that as the distillation time increases, the yield of lavender oil extraction also rises, reaching its optimum at 60 minutes. After 60 min, it continues to increase negligibly and is not cost-effective from an energetic perspective. As the ultrasonic pretreatment time increases, reaching a maximum of 30 min, the η of lavender oil initially rises and then falls. The evidence indicates that long ultrasonic pretreatment leads to the decomposition of compounds in the plant material, which leads to a decrease in the η . It can be concluded that ultrasonic pretreatment plays a positive role in the extraction of lavender oil, and the optimal pretreatment time is 30 min.

As a result, the optimal parameters for the lavender oil extraction were determined, such as solvent—distilled water, maceration for 30 min at a temperature of 30°C, followed by ultrasound pretreatment (30 kHz) for 30 min, and steam distillation for one hour. The extraction yield of lavender oil, extracted through the optimized process, is 2.53%. The obtained results indicate that the quality of extracted lavender oil from *Lavandula angustifolia*, based on organoleptic and physicochemical parameters, satisfies all technical requirements of ISO 3515:2013, and it can be used as a raw material or as a product in the cosmetic and pharmaceutical industries.

Acknowledgment

The results have been obtained in the framework of the project 010603, *Advanced research in computational and ecological chemistry, identification of technological procedures for treatment, formation of water quality and quantity*, Institute of Chemistry of the Moldova State University.