

Letter to Editor



A Brief Review of Recent Approaches to the Influence of Chemical Properties of Natural Essential Oils on Their Stability and Biological Effects

Dara Dastan^{1*}

¹. Department of Pharmacognosy, School of Pharmacy, Medicinal Plants and Natural Products Research Center, Institute of Cancer, Hamadan University of Medical Sciences, Hamadan, Iran.

*Corresponding author: Dara Dastan, Department of Pharmacognosy, School of Pharmacy, Medicinal Plants and Natural Products Research Center, Institute of Cancer, Hamadan University of Medical Sciences, Hamadan, Iran.

Email: d.dastan@umsha.ac.ir

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Dear Editor,

Natural essential oils are among the most important natural products widely used in daily life. Their application in pharmaceutical, cosmetic, health, and food industries is significant. Natural essential oils have been reported to exhibit various biological effects, such as antimicrobial, antioxidant, and anti-acetylcholinesterase effects.

Given the properties of essential oil compounds and their non-polarity, their solubility and formulation in products with a non-polar base is easy and common. Many pharmaceutical, cosmetic, health, and food products are polar, and the solubility of essential oils at the appropriate dose is practically impossible. In some cases, such as topical cosmetic products, administering essential oils in a non-polar formulation, such as oil, is unpleasant and unacceptable to consumers.

In addition, in many biological tests investigating the effectiveness of natural essential oils, such as antimicrobial, antioxidant, and anti-acetylcholinesterase effects, the culture medium and

test solution are polar, and the essential oil's solubility at an effective dose is practically impossible. Also, in most cases, after adding the essential oil to culture media, test solutions, and pharmaceutical, cosmetic, health, and food products, it becomes insoluble over time. In other words, by increasing the time and decreasing the temperature, the essential oil becomes insoluble in polar solvents. This causes errors in the study of the biological effects of essential oils and reduces the quality of pharmaceutical, cosmetic, health, and food products. Therefore, studies to address this problem and increase the solubility of essential oils in polar solutions and products are of great importance at both the scientific and industrial levels. Given the widespread use of natural essential oils in everyday products, the importance of this issue is doubled, which will ultimately lead to the production of high-quality products at lower cost. Various studies have been conducted for this purpose, and various products have been developed from natural essential oils to address this issue. However, given the



differences in the chemical profiles of natural essential oils, the research opportunity remains and has yet to achieve the desired results. Various solutions, such as nanoemulsions, nanoencapsulation, microencapsulation, nanoliposomes, and polymeric and biopolymeric formulations, are used to increase the solubility of compounds (1). However, for natural essential oils, using these methods is more complicated and not easily achievable. In addition to the diversity of chemical profiles of natural essential oils, their volatility is one of the factors that limit the optimization of effective parameters in formulations and increase water solubility.

One of these is the diversity of the chemical profiles of natural essential oils, which varies the types and percentages of compounds from one plant essential oil to another, altering formulation conditions. This difference is related to the structural diversity and, in practice, to the different polarities, boiling points, and functional groups of the essential oil compounds. Natural essential oils include monoterpenes, sesquiterpenes, phenols, and aliphatic hydrocarbons. Monoterpenes and sesquiterpenes are also divided into two groups: hydrocarbon and oxygenated. For example, plant essential oils, such as *Thymus vulgaris* L. and *Origanum vulgare*, contain large amounts of thymol and carvacrol (2, 3). The main content of *Pistacia atlantica* subsp. *Kurdica* and *Ferulago bernardii* essential oils is α -pinene (4, 5). Given the non-polarity of α -pinene and the polarities of thymol and carvacrol, the essential oil formulations of these plants and the practical approaches to increase the solubility of the essential oil in aqueous solution will differ.

Another important point is the solubility of natural essential oils at the desired dosage in aqueous solutions and formulations. In pharmaceutical and cosmetic products, dissolving the appropriate dosage of essential oils in the formulation is essential.

Another issue that researchers should consider is that after preparing a suitable aqueous formulation of a natural essential oil and optimizing parameters that enhance solubility, the formulation's stability under different conditions and over various time periods

must be evaluated. Also, given the volatility of the essential oil compounds, the formulation should be stable with respect to its active ingredients. However, the formulation should be able to release the essential oil appropriately during use.

Considering the use of natural essential oils in scientific research and in various pharmaceutical, cosmetic, health, and food products, as well as their limitations due to physical and chemical properties, it is suggested that researchers address this issue further in future studies. Additionally, to increase the likelihood that study results are applicable, researchers should consider the parameters of non-polarity, volatility, and the diversity of natural essential oil compounds.

Conflict of Interest

The authors declared no conflicts of interest.

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