Essential oils with biological activity

Research article

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Abstract

Essential oils from the leaves and the flowers of lavender and from lemon peel were extracted using steam distillation. These oils were separated using thin layer chromatography and characterized using FTIR spectroscopy.

Keywords: essential oils, steam distillation, thin layer chromatography, FTIR spectroscopy.

1. INTRODUCTION

Essential oils, also called volatile oils or ester oils, have been used since ancient times both as natural remedies and for skin care and beauty. Essential oils (such as lavender oil, sea buckthorn oil, rose oil, jasmine oil, etc.) are hydrophobic liquids containing a number of volatile flavor compounds of plant origin [1].

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The main components of many essential oils are monoterpenes [2]. Essential oils are widely widespread in the vegetable kingdom. Volatile oils can be accumulated and synthesized in all organs of the plant: flowers, leaves, roots, fruits, bark or wood of stems [3].

Most plants contain less than 1% volatile oil. Usually, the name "aromatic plants" is given to those plants that have a much larger amount of essential oil, having a perceptible smell that is not lost due to their exploitation [3].

Extraction of essential oils can be done by distillation, pressing, filtration or maceration. The distillation process involves the use of a steam distillation device at a certain pressure. By pressing which can be manual or mechanical, lemon or orange oils can be obtained. Filtration is a rapid method that involves the passing of a steam jet over the plant suspended on a grid. Maceration is a process by which plants are mixed with various vegetable oils and after several days the plant decomposition takes place. [4]

Entrainment extraction is an old, economical method, being used both in industry and in the laboratory, due to the simplicity of the installation and the advantageous efficiency.

Lavender (*Lavandula angustifolia*) is an exotic species that is native to India, the Canary Islands, Southern Europe. Lavender oil can be used in the perfume and soap industry but also as a pesticide (against moths). Lavender oil, due to its active compounds (linalool, borneol, α -terpineol, terpinen-4-ol and 1,8-cineole) has a calming action on the central nervous system, has antiseptic, healing, diuretic action. It can also be used as a stimulant, antispasmodic, as well as to combat diseases of the respiratory tract [5].

Citral is a monoterpenic component, which is found mostly (65-85%) in lemongrass oil. Lemongrass tea is popular in Brazil as a spasmolytic, analgesic, anti-inflammatory, antipyretic, diuretic and tranquilizer. The antiviral activity of lemon oil against *Herpes simplex* virus has also been proven [6].

Limonene (1-methyl-4-methylethyl cyclohexene) is a monocyclic monoterpene in the form of two isomers: (+) - limonene, the main component of essential oils present in citrus peels and another isomer (-)

- limonene with smell of turpentine which is found as the main component in pine and oak [8].

Limonene has been shown to prevent several types of cancer, including breast, liver, lung, pancreas, etc. Nowadays, limonene is used as a cytostatic agent that blocks cell division [7].

2. MATERIALS AND METHODS

2.1. *Materials*

Chloroform, methanol, toluene, ethyl acetate, vanillin, 2,4-dinitrophenylhydrazine, hydrochloric acid, sulfuric acid, were purchased from Fluka or Aldrich. All the chemicals were analytical grade and used directly without any further purification. All sample solutions were prepared with deionized water.

2.2. *Apparatus*

Thin-layer chromatography was realized with silica gel 60G F₂₅₄ glass plates. FT-IR spectra of these compounds were recorded on a Bruker ATR ZnSe spectrophotometer, within the range of 4000-550 cm⁻¹, at room temperature with a spectral resolution of 2 cm⁻¹.

2.3. *Methods*

2.3.1. *Oil extraction*

Lemon peels and lavender plants, respectively, were shredded and then mortared using a mortar with pestle. The vegetal tissues were placed in a round-bottomed flask, covered with distilled water and then subjected to steam distillation. The volatile oil together with a small amount of water is collected in a flask. Using 1 mL of chloroform, the volatile oil is extracted and isolated using a separatory funnel.

2.3.2. *Chromatographic separation*

The sample (5-10 µl), in the form of a 0.01-1% solution, was deposited in the form of a small circular spot on a line ('starting line')

located near the lower edge of the adsorbent layer. The plate was then placed vertically in a chromatographic development tank containing a mobile phase layer whose height must not reach the starting line. Elution was done with chloroform-methanol 9:1. The eluent was raised by capillarity up to one cm from the top edge of the plate, then the chromatographic plate was removed from the tank, a horizontal scratch was made to limit the moist area and the plate was dried. The visualization was done with a 1 % solution of vanillin in sulfuric acid for linalool and with a solution of 2,4-dinitrophenylhydrazine for citral.

3. RESULTS AND DISCUSSION

3.1. Lemon oil extraction

In order to extract volatile oil from lemons, the peels of the fruits of *Citrus medica* were used. They contain 0.5 % volatile oil, composed of 80-90 % limonene along with citral (5 %), n-decyl aldehyde, linalool, n-nonyl alcohol, terpineol, caprylic acid and methyl anthranilate (Scheme 1).

Scheme 1. Structure of lemon oil components

Lemon oil is a colourless liquid, with an intense lemon smell and taste, with acidic reaction.

The components present in the volatile oil were separated using thin layer chromatography. The presence of citral (1) was highlighted by reaction with 2,4-dinitrophenylhydrazine (2), when a yellow spot with $R_f=0.73$ corresponding to citral 2,4-dinitrophenylhydrazone (3) has been obtained (Figure 1).

Figure 1. Synthesis of citral 2,4-dinitrophenylhydrazone (3)

The presence of citral is highlighted by FTIR spectroscopy. An absorption band characteristic for the carbonyl group is observed at 1640 cm^{-1} . The wide and intense band at 3285 cm^{-1} is due to water molecules.

Figure 2. FTIR Spectrum of lemon oil

3.2. Lavender oil extraction

Lavender volatile oil is found in dried plants in a proportion of in 0.5 % and is composed of linalool and linalyl acetate (Scheme 2), along with terpinen-4-ol and camphor, limonene and geraniol.

Scheme 2. Structure of lavender oil components

Lavender oil looks like a colourless liquid, with an intense lavender smell and taste.

The components present in the volatile oil are separated by thin layer chromatography using a 9:1 chloroform-methanol eluent. Visualization of the main component, linalool ($R_f=0.64$), is done by spraying a solution of 1 % vanillin in sulfuric acid. Vanillin is a reagent used to identify alcohols and forms a blue color with linalool.

The presence of linalyl acetate is evidenced by FTIR spectrometry. At 1636 cm^{-1} , an absorption band characteristic of the carbonyl group of linalyl acetate is observed. The wide and intense band at 3288 cm^{-1} is due to water molecules.

Figure 3. FTIR Spectrum of lavender oil

4. CONCLUSIONS

Lavender and lemon essential oils were separated by steam distillation. The components were separated by thin layer chromatography. FTIR spectroscopy was used to identify citral in lemon oil and linalyl acetate in lavender oil.

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