EXTRACTION OF ESSENTIAL OIL FROM ALBANIAN *SALVIA OFFICINALIS* L. BY HYDRODISTILLATION METHOD AND ITS CHARACTERIZATION BY FTIR SPECTROSCOPY

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Abstract

Albania is a significant producer of aromatic and medicinal plants. In particular, it is an important producer and exporter of *Salvia officinalis* L. A large number of aromatic and medicinal plants are steam distilled every year in order to get their essential oils. Albania is the main exporter of *Salvia officinalis* L. to USA. It is reported, that in 2009 the USA imported 2295 metric tons of *Salvia officinalis* L. 55% of which was exported by Albania (Schmiderer *et al*. 2013). Therefore, it is of high interest to study the chemical constituents present in the essential oils extracted from *Salvia* species. Extraction of essential oil from *Salvia officinalis* L. is carried out using a hydro-distillation method. The essential oil yield after three hours of distillation was 0.84%. After the extraction, the obtained oil is characterized by means of FT-IR spectroscopy. IR analysis indicated presence of monoterpenes such as thujones, camphor, 1,8 cineole and pinene.

Përmbledhje

Shqipëria është shumë e pasur me bimë mjekësore dhe aromatike. Vendi ynë prodhon dhe eksporton sasi të konsiderueshme të *Salvia officinalis* L. ose në gjuhën popullore Sherebela. Çdo vit, sasi të konsiderueshme bimësh aromatike dhe medicinale, kalohen në proçesin e hidrodistilimit për t'ju marrë vajin esencial. Shqipëria është ndër vendet kryesore eksportuese të sherebelës. Sipas disa raporteve të vitit 2009, në SH.B.A janë importuar 2295 ton bimë, nga të cilat 55% kanë qënë me origjinë Shqipëtare. Në këtë punim, ekstraktimi i Sherebelës u krye me anë të distilimit Clevenger. Rendimenti i vajit esencial të përftuar ishte 0.84%. Në vazhdim, vaji esencial u analizua me spektroskopinë FT-IR. Nga rezultatet e përftuara u pa së përbërësit kryesor të saj janë monoterpene të tilla si: tujon, kamfor, 1,8 cineol, pinen.

Fjalëkyçe: *Salvia officinalis* L., vaji esencial, hidrodistilim, spektroskopia FT-IR.

Keywords: Salvia officinalis L., essential oil, hydrodistillation, FT-IR spectroscopy.

Introduction

Essential oils are the most important group of chemical molecules of plants that make smells what they are. The origin of the name "essential oil" comes from the simple fact that fragrances are the essence of many plants. They

contain hundreds of different carbon- and hydrogen- based compounds called terpenes or hydrocarbons. Each volatile oil is made up of a unique blend of up to one hundred different terpenes, which like an artist's palette, gives the plant the ability to build unique essential oils, each with their biological activity and mood- and emotional-affecting properties. Albania is distinguished for its natural bio-resources such as a large number of herbs, medicinal, cosmetic and aromatic plants (Metaj 2007; Vaso 1998). Our country is a large producer of *Salvia* species such as *Salvia officinalis* L. and *Salvia fruticosa* Mill.

These species are rich in essential oil and they are known as the most important aromatic and medicinal herbs (Schmiderer *et al*. 2013). Traditionally, the extraction of essential oils from herbs has been carried out by steam distillation and organic solvent extraction using a Soxhlet technique (Reverchon, Senatore 1994). Following our previous studies on the essential oils extraction from Albanian herbs (Taraj *et al*. 2013, Andoni *et al*. 2014), we advanced this work by utilizing steam-distillation method (Clevenger apparatus) to obtain essential oil from *Salvia officinalis* L. We utilized FTIR spectroscopy for the characterization of *Salvia officinalis* L. FTIR analysis indicated presence of thujones, camphor, 1,8 cineole and pinene in the essential oil of *Salvia officinalis* L. This outcome is in good agreement with the reported data by (Schulz *et al*. 2005).

Materials and methods

The origin of the *Salvia officinalis* L. used in this work is from local Albanian herb. The herb (50 g) is dried at 40°C until constant weight and subjected to a grinding process before came into contact with the steam. The steam distillation extraction was carried out in a Clevenger apparatus using a ratio of 5:1 water/dried herbs. A picture of steam distillation apparatus, Clevenger type is shown in Fig. 1.

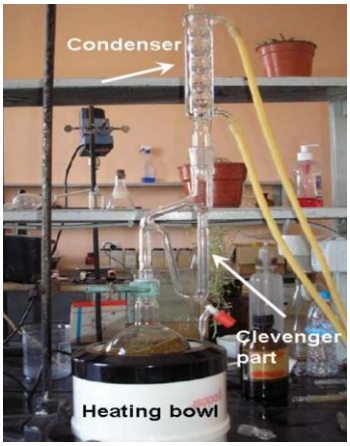

Figure 1: Photo of Clevenger apparatus used for the extraction with steam distillation indicating by arrows the main parts.

A Clevenger apparatus and a condenser were attached to the round flask placed on an electric mantle (heating bowl). The water-plant mixture was then subjected to distillation for an optimum number of hours which was determined to be 3 hours. In the first 30 minutes once the oil had started collecting in the collecting column of the Clevenger apparatus, about 1 ml of hexane was put through the condenser to prevent any polyphenol or other component of the essential oil from getting in contact with the water.

The essential oil (dissolved in hexane) was then separated in a separating funnel and further analyzed by FT-IR spectroscopy. FTIR spectra were obtained by Nicolet 6700 spectrometer, manufactured by Thermo Electron. The measurements were carried out in the transmission system in the mid-IR range (4000 – 400 cm^{-1}). The spectra were analyzed using OMNIC program.

Results and discussion

The main components have been identified from the FT-IR spectrum of the essential oil shown in the Fig. 2. The band positioned at ~ 1734 cm^{-1} is attributed to camphor and thujone (stretching vibration of C=O) (Smith. 1999). In this respect it is reported that IR spectrum of essential oil of S*alvia Officinalis* L. was characterized by a peak positioned at ~ 1734 cm^{-1}. Authors attributed this peak to camphor (Schulz *et al*. 2005).

However, our former work of oil extraction from *Salvia officinalis* L. using a Soxhlet method indicated the presence of thujone as well (FT-IR analysis and TLC analysis) (Ciko *et al.* 2016; Dama *et al.* 2015). Therefore, we have assigned the band at ~1734 cm^{-1} to both camphor and thujone. Additionally, the diagnostic IR band of pinene (-C=C-, alkene) appears at ~1640 cm^{-1} (Smith. 1999).

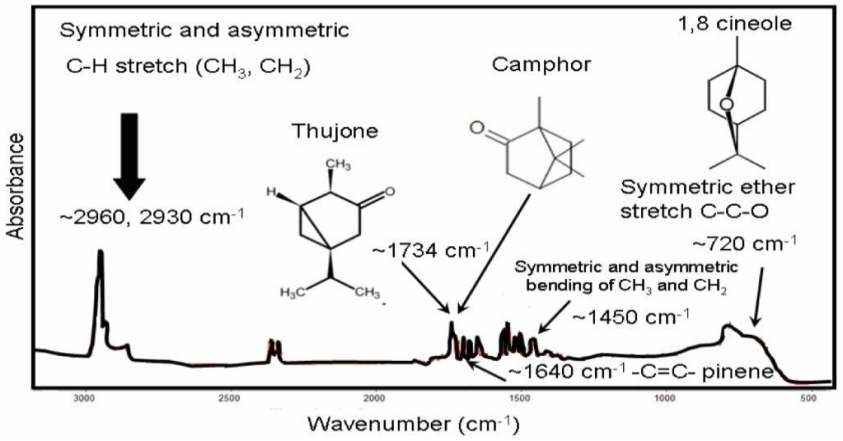

Figure 2. FTIR spectrum of oil extract of *Salvia officinalis* L. obtained by water distillation extraction. In the insert are presented chemical structures of the main components identified in the IR spectrum.

To this end, ethers give rise to a band in the region ~720 cm^{-1} attributed to C-C-O symmetric ether stretch (Smith. 1999). In the FT-IR spectrum of Fig. 2 a band appears in the region ~720 cm^{-1}. We have attributed it to 1,8 cineole. This is in good agreement with our previous studies of oil extract from *Salvia officinalis* L. by different extraction methods. IR and TLC analysis indicated presence of 1,8 cineole too (Ciko *et al.* 2016; Dama *et al.* 2015).

In addition, the bands in the regions ~ 2960-2930 cm^{-1} and ~1450 cm^{-1} are assigned to symmetric and asymmetric C-H stretches (CH_3, CH_2) and symmetric and asymmetric bending of CH_3, CH_2, respectively (Smith. 1999). Eventually, as expected from our former work, the yield of the essential oil was 0.84% which is lower compared to the yield of the extract obtained with the Soxhlet method (8.63 %) (Ciko *et al* 2016).

Conclusions

The extraction of essential oil from *Salvia officinalis* L. leaves was performed using the steam distillation method. The acquired oil was characterized by FT-IR spectroscopy. IR analysis indicated presence of monoterpenes such as thujones, camphor, 1,8 cineole and pinene and this is in good agreement with reported data (Schulz *et al*. 2005). Therefore, has been concluded that *Salvia* species contain mainly camphor and 1,8 cineole.

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