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Extraction of Essential Oil from Albanian Chamomile (*Matricaria recutita* L.) by a Hydro Distillation Method and its Characterization by FTIR Spectroscopy

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ABSTRACT: Chamomile (Matricaria recutita L.) is one of the most commonly used medicinal herbs. It is well known for its therapeutic applications. Due to its geographical position and Mediterranean climate, Albania is a considerable producer of medicinal and aromatic plants. Extraction of essential oil from M. recutica L. is carried out using a hydro distillation method by means of a Clevenger apparatus. The obtained oil had blue light color. FTIR analysis indicated presence of matricine (as chamazulene), dicycloether and α-bisabolol as organic components present in the essential oil of M. recutica L.

KEYWORDS: Extraction, essential oil, chamomile, hydro distillation, IR spectroscopy

I. INTRODUCTION

Chamomile is native to Western Europe, Western Asia and India and abundant throughout North America [12, 6]. Chamomile (*Matricaria recutita* L.) is one of the most commonly used medicinal herbs and it is well known for its therapeutic applications. It is included in a wide range of cosmetic products for various purposes. Albania is acknowledged for its natural bio-resources such as a large number of medicinal and aromatic plants [9, 3]. Chamomile (*Matricaria recutita* L.) is also a well-known aromatic and medicinal herb in Albania [7]. It belongs to the *Asteraceae* family and it is generally known as German chamomile, Roman chamomile and English chamomile [12]. Usually, the extraction of essential oils from herbs can be performed by hydro distillation technique using e Clevenger apparatus. Following our previous work on extraction of essential oils from Albanian aromatic and medicinal herbs [7, 8], we carried out extraction of essential oil from *Matricaria recutita* L. by utilizing a Clevenger apparatus. The main constituents of *Matricaria recutita* L. are the terpenoids α-bisabolol and its oxides (75 %) [4, 6], dicycloethers (13 %) [12, 4] matricine [12, 6] and apigenin-7-glucoside. FTIR analysis of the obtained oil indicated presence of matricine, α-bisabolol, dicycloether and apigenin-7-glucoside as organic components present in the essential oil of *M. recutica* L.

II. MATERIALS AND METHODS

The origin of the flower heads of *M. recutica* L. used in this work is from local Albanian herbs. The herb was dried at 40°C; subjected afterwards to grinding process and then used such as for the extraction. Figure 1 exhibits a photo of Albanian chamomile. Albanian chamomile has a green color characterized by fluffy stems and white flowers with a yellow disc in center. The stem of the Albanian chamomile is in the upright position.

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Fig. 1 Photo of Albanian chamomile (*M. recutica* L.)

10 g of dried flowers of the plant were poured into a 500 ml flask. Afterwards, into the flask, was added 300 ml water. Figure 2 shows a photo of the set up used for the hydro distillation. The Clevenger apparatus and a condenser were attached to the round flask. The flask was put on an electric mantle (heating bowl). The water-flower mixture was then subjected to the distillation process which lasted 3 hours continuously. 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. This way any polyphenol or any other compound of the essential oil that is soluble in water will not get in contact.

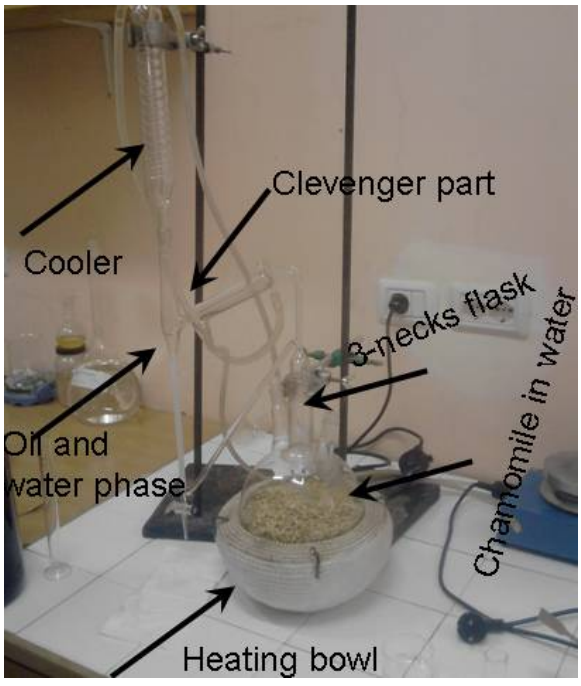

Fig. 2. Photo of Clevenger apparatus used for the extraction with steam distillation indicating by arrows the main parts.

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, which allows spectral measurements in NIR (12000 - 4000 cm^{-1}) and MIR (4000 - 400 cm^{-1}) region. This system works in two geometries, the geometry of the transmission and reflectance (Attenuated Total Reflection - ATR). In this study, the transmission geometry is used in the range mid Infra-Red (4000 – 400 cm^{-1}). The spectra were analyzed using OMNIC software.

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III. EXPERIMENTAL RESULTS

The yield of the essential oil obtained with Clevenger apparatus was 0.11 % for 10 g herb. The essential oil was light blue in color. It is reported that due to thermal degradation matricine converts to chamazulene giving the essential oil a blue color [12]. Figure 3 displays chemical structures of matricine and chamazulene.

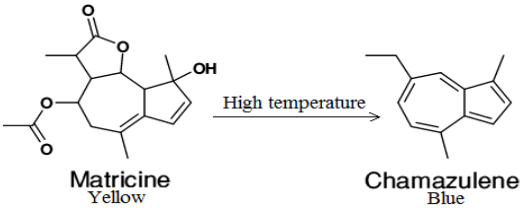

Fig. 3. Chemical structures of matricine and chamazulene.

Figure 4 displays FTIR spectrum of the extract obtained with Clevenger method using hexane as solvent. The band at ~1716 cm^{-1} present in IR spectrum belongs to C=O stretching vibration and it is attributed to the presence of matricine. Mwazighe [5] reported a peak appearing between 1770 cm^{-1} and 1720 cm^{-1} in the IR spectra whose intensity ranged from medium to strong and it was characteristic of the chamomile extract. The C=O stretching vibration appears as an intense band between 1800 and 1600 cm^{-1} [10]. Additionally, the band at ~1016 cm^{-1} belongs to the O-C-C stretch of the ester (matricine). Matricine converts to chamazulene during the hydro distillation. Therefore, one should expect disappearance of the band at ~ 1716 cm^{-1}. During the degradation within water distillation process the lactone ring of matricine converts to chamazulene carbonic acid. Afterwards, undergoing decarboxylation, chamazulene carbonic acid converts to chamazulene. It is possible that in the FTIR spectrum of Figure 4 matricine is partially degraded or it exists as chamazulene carbonic acid.

In addition, apigenin-7-glucoside features also a C=O functional group in its chemical structure, therefore we attribute the intense band ~1716 cm^{-1} to apigenin-7-glucoside as well, in addition to matricine. The bands at ~1225 cm^{-1} and at ~1176 cm^{-1} are assigned to dicycloether since ethers give rise two or more bands at 1210-1070 cm^{-1} (asymmetric C-O-C stretch, saturated branched). Whereas, the alkyl/aryl (mixed) ethers appear with bands in the regions 1300-1200 cm^{-1} and 1050-1010 cm^{-1} (asymmetric C-O-C stretch). The band ~1090 cm^{-1} is attributed to the α-bisabolol, since tertiary alcohols have a diagnostic C-O stretch at 1210-1100 cm^{-1}. In addition, the O-H bend of an alcohol (α-bisabolol) appears at ~700 cm^{-1} [10].

Lastly, in the FTIR spectrum of *M. recutica* L. oil appeared two sharp peaks positioned at ~1454 cm^{-1} and 1375 cm^{-1}. It is known that isopropyl and *gem*-dimethyl groups give rise to a split umbrella mode with two peaks in the IR spectrum positioned at ~1385 to 1365 cm^{-1} [10]. The splitting is caused by vibrational interaction between the umbrella modes of the two methyl groups. The split of the umbrella modes is of about equal intensity. Additionally, the band at ~ 1375 cm^{-1} can also indicate the presence of a CH_3, a CH_2 or both groups; whereas CH_3 symmetric bend (umbrella mode) shows up at 1375±10 cm^{-1} [10]. The chemical structure of α-bisabolol consists of an isopropyl group. We attribute the bands at ~1454 cm^{-1} and 1375 cm^{-1} to the isopropyl group of α-bisabolol.

The bands positioned at ~3000-2800 cm^{-1} correspond to the asymmetric and symmetric C-H stretches (CH_3 and CH_2) [10]. The band in the region 3500-3200 cm^{-1} belongs to the O-H vibrations [10]. The overall IR analyses of peaks assignments is tabulated in Table 1.

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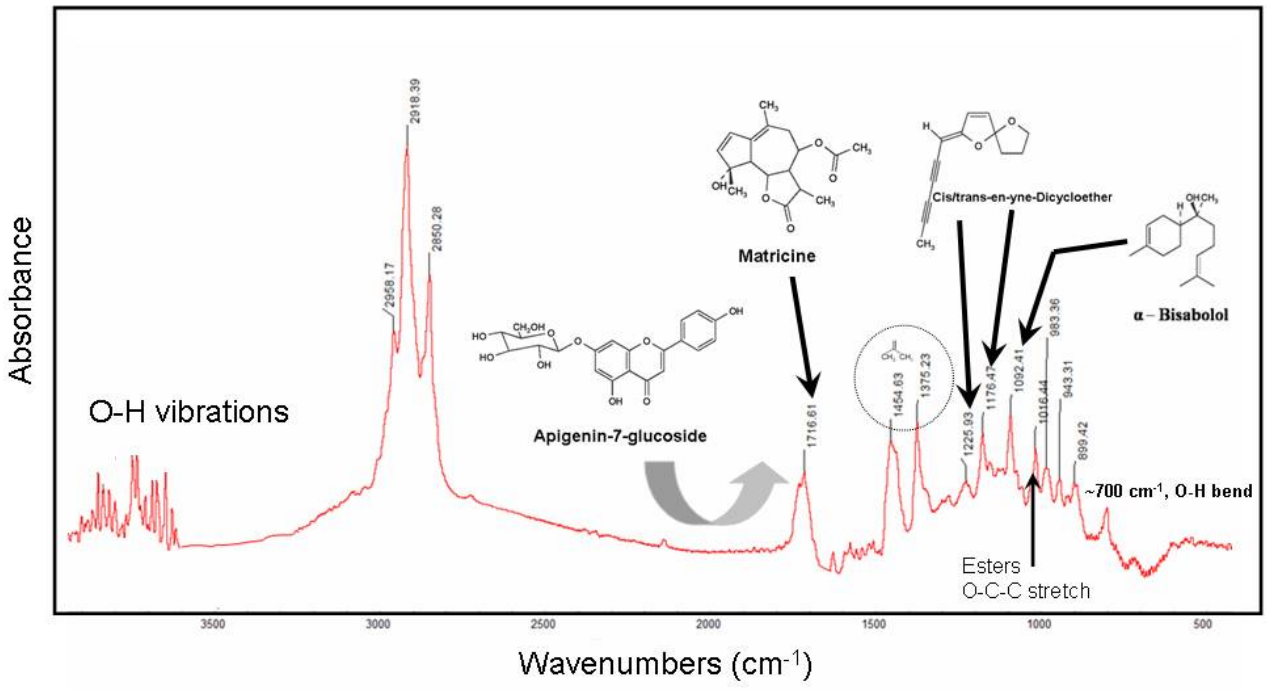

Fig. 4. FTIR spectrum of *M. recutita* L. obtained by water distillation method utilizing a Clevenger apparatus. In the insert are indicated the peak assignments of the main components along with their chemical structures as identified in the IR spectrum

Table 1. Overall IR analysis for the extraction of essential oil of M. recutica

Components	Functional group	Wavenumber (cm^{-1})
Matricine	C=O, O-C-C	~1716, ~1016
Apigenin-7-glucoside	C=O (ketone group)	~1716
α-Bisabolol	C-O, isopropyl group	~1092, ~1454 and ~1375
Dicycloether	C-O-C	~1176 and ~1225

IV. CONCLUSION

Extraction of essential oil from Albanian *M. recutica* L. was carried out by hydro distillation method utilizing a Clevenger apparatus. The yield of the oil extract obtained was 0.11 % for 10 g herb. IR analysis indicated presence of matricine (C=O group identified with a band positioned at ~1716 cm^{-1}), possible presence of apigenin-7-glucoside (ketone functional group identified with a band positioned at ~1716 cm^{-1}), α-bisabolol (C-O vibration identified with a band at ~1092 cm^{-1} and isopropyl group identified with two bands at ~1454 cm^{-1} and ~1375 cm^{-1}) and dicycloether identified by the C-O-C functional group with two bands at ~1176 cm^{-1} and at~1225 cm^{-1}.

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