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RAPID COMMUNICATION

GC–MS analysis of essential oil from the leaves of Algerian *Bupleurum plantagineum* Desf.

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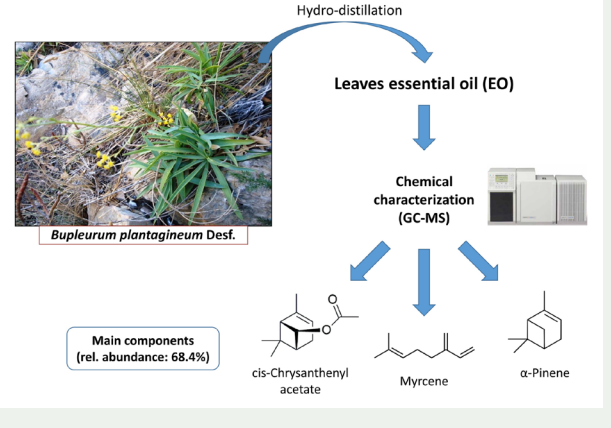
ABSTRACT

Bupleurum plantagineum Desf. (Apiaceae) is a plant endemic to North Africa, including Algeria. It is used as natural medicine, due to its anti-inflammatory, antioxidant and hepatoprotective properties. In this work, we studied the chemical composition of the essential oil (EO) obtained by hydro-distillation from *B. plantagineum* leaves collected from the national park of Gouraya (Bejaïa), Algeria. Thirty components were identified in the EO by Gas chromatography–Mass Spectrometry(GC–MS) (relative abundance: 96.7%). Monoterpene hydrocarbons (56.8%) were the predominant, followed by oxygenated monoterpenes (36.7%). The main components were *cis*-chrysanthenyl acetate (33.5%), α-pinene (18.4%), myrcene (16.5%) and (*E*)-anethole (4.9%). This volatile profile differs from those reported for other *Bupleurum* spp. and for *B. plantagineum* from Algeria, suggesting the identification of a new chemotype. Overall, our results represent a contribution to the characterisation of natural products from Algeria and the preservation of its natural biodiversity. The same results will also represent a starting point for further studies on *B. plantagineum*.



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1. Introduction

Apiaceae is one of the most widely studied families of flowering plants (Judd et al. 2007). Members of this family are herbs, less often shrubs or trees, with global distribution, especially in temperate regions (Heywood 1971). Many medicinally important apiaceous plants have been used for centuries in folk medicine for the treatment of various ailments (Smaili et al. 2011). *Bupleurum* is the largest genus of the Apiaceae family and is represented by almost 190 species widely distributed in the Northern Hemisphere (Ashour and Wink 2011). In several regions of Europe, Asia, and North Africa, plants of the *Bupleurum* genus are used as natural remedies due to their anti-inflammatory, antioxidant and hepatoprotective properties (Yen et al. 1991; Testai et al. 2005; Barrero et al. 2006; Liu et al. 2006). The roots are commonly used for these purposes (Ashour and Wink 2011). Fourteen species of *Bupleurum* have been registered in Algeria, of which *B. plantagineum* Desf., *B. atlanticum* Murb., *B. montanum* Coss., *B. balansae* Boiss. et Reut. and *B. oligactis* Boiss are endemic (Chermat and Gharzouli 2015).

The phytochemistry of *Bupleurum* spp. has been previously investigated. Several saikosaponin triterpenes have been reported (Utrilla et al. 1991; Zhao et al. 1996; Barrero et al. 2000), as well as polyphenols and essential oils (EOs; Baeva and Karryev 1984; Ocete et al. 1989; Pistelli et al. 1996; Barrero et al. 1998; Laouer et al. 2009; Maxia et al. 2011; Bencheraiet et al. 2012; Benahmed et al. 2014). The EO is usually characterised by the predominance of mono- and sesquiterpenes (Laouer et al. 2009). Limonene, α-pinene, β-pinene, sabinene and myrcene have been identified as the main monoterpenes, while β-caryophyllene, germacrene D and spathulenol have been reported as the most representative sesquiterpenes (Casiglia et al. 2016).

In this work, we aimed at characterising the EO from the leaves of *B. plantagineum* from Algeria, which has been scarcely investigated up to now. Our results are intended at contributing to the characterisation of natural products from Algeria and the preservation of its natural biodiversity.

2. Results and discussion

The yield of the EO obtained from the leaves of *B. plantagineum* was 0.4%. It is worth to highlight that this is a preliminary study made of only one hydro-distillation experiment. Further experiments will be required to assess the yield reproducibility. The composition of EO is reported in Table S1 of the Supplementary Material, were the relative abundance of identified constituents is shown. The composition of EO (%) needs to be further evaluated for value range confirmation especially for the main characterising compounds. An exemplificative chromatogram is reported in Figure S1.

Thirty components were identified in the EO (relative abundance: 96.7%). Among these, the most representative were monoterpenes (oxygenated: 44.6%; hydrocarbons: 40.4%). Sesquiterpenes were found in lower percentages (hydrocarbons: 7.6%; oxygenated: 2%), while phenylpropanoids and aldehydes accounted for only 2.1% (Table S1). The main identified components were *cis*-chrysanthenyl acetate (33.5%), α-pinene (18.4%), myrcene (16.5%), (*E*)-anethole (4.9%) and limonene (3.3%).

The composition of EOs from *Bupleurum* spp. has been widely described in literature, and is exhaustively summarised in a work published by Casiglia et al. (2016).

Along with monoterpenes and sesquiterpenes, aldehydes and alkanes such as heptanal and undecane have been reported among the most abundant components. However, quantitative differences depending on the plant species and climatic, pedoclimatic, and environmental conditions of the collection site are usually observed (Casiglia et al. 2016). In Table S2 of the Supplementary Material, we summarised the data published after 2016. Overall, they reflect those already reported by Casiglia et al. Monoterpenes and sesquiterpenes are abundant components of many species, especially those from Europe (*Bupleurum fruticosum* and *Bupleurum paniculatum*) and Russia (*Bupleurum scorzonerifolium*). Nevertheless, species from China (*Bupleurum marginatum*, *Bupleurum bicaule*, Bupleurum *chinense*) present a completely different profile, which is dominated mainly by aldehydes and fatty acids (Table S2). Regarding specific compounds, α-pinene, β-pinene, and limonene represent the main monoterpenes in the species from Europe (Italy and Portugal), while *Bupleurum scorzonerifolium* from Russia shows a higher abundance of myrcene and β-ocimene (*cis* and *trans* isomers). The EOs from this species are also characterised by high concentrations of germacrene D, which represents the main sesquiterpene. On the other hand, a great heterogeneity characterises aldehydes and fatty acids, and different compounds have been reported in the EOs from *Bupleurum* species from China (Table S2).

The comparison of our results with those published previously highlights some differences. The first one regards some characteristic components of many *Bupleurum* EOs such as sabinene and heptanal, which are scarcely abundant in *Bupleurum plantagineum*. As stated above, this can be related to climatic, pedoclimatic, and environmental conditions of the collection site (Casiglia et al. 2016). The second one regards *cis*-chrysanthenyl acetate. Being this component usually found in low amounts in *Bupleurum* spp., its abundancy in *B. plantagineum* from Algeria suggests it as a volatile marker of this species. This observation is supported by literature. Laouer et al. (2009) focused on the EO from leaves collected from the Megress Mountain, in the North of Algeria. Sixty-eight components identified, among them were α-pinene (31.9%), *cis*-chrysanthenyl acetate (28.2%), myrcene (24.8%) and limonene (5.1%; Laouer et al. 2009). More recently, Mékaoui et al. (2020) focused on the EO from the leaves of *B. plantagineum* collected in the Bejaïa Province. In this case, *cis*-chrysanthenyl acetate was the main component among those identified (20.94%), followed by α-*trans*-bergamotene (19.89%), dehydro-aromadendrene (6.56%) and α-pinene (4.72%). Compared to these results, the EO analysed in our study was characterised by a lower number of components and different amounts of some of the most abundant (e.g. α-pinene, myrcene, limonene).

The third difference relies on (*E*)-anethole. To the best of our knowledge, this monoterpenoid has been reported only in the EO from *B. marginatum*, although in low amounts (0.2%; Ashour et al. 2009). Except for this study, (*E*)-anethole has never been reported in the EOs of other *Bupleurum* spp., nor from Algeria (Laouer et al. 2009; Mékaoui et al. 2020) nor from other regions (Casiglia et al. 2016). Considering the high amounts (>4%) revealed in our study, this component may be considered as a marker of a new *B. plantagineum* chemotype growing in the Bejaïa Province of Algeria.

3. Experimental

Refer to the Supplementary Material.

4. Conclusions

Overall, the chemical profile of the EO from the leaves of *B. plantagineum* from Northern Algeria contributes to distinguish this species from others of the same genus growing in Europe, China and other regions of the North Africa. Some components characteristic of *Bupleurum* spp. are less representative of this EO, which conversely presents higher amounts of *cis*-chrysanthenyl acetate. This component can represent a marker of Algerian *B. plantagineum*, as already suggested by previously published works on this species. Nevertheless, we also determined some differences with these latter, especially regarding (*E*)-anethole, which was determined as a main component in our study. For this reason, it can be considered as a marker of a new *B. plantagineum* chemotype growing in the Bejaïa Province of Algeria, although further investigations are required.

To conclude, the results presented in this study represent a contribution to the characterisation of an understudied medicinal herb of Algeria, and they may be useful for the preservation of biodiversity of the Algerian flora.

Disclosure statement

No potential conflict of interest was reported by the authors.

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