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SHORT COMMUNICATION

Essential oil composition of *Inula britannica* L. from Bulgaria

Milka Todorova^a, Antoaneta Trendafilova^a, Viktoria Ivanova^a, Kalina Danova^a and Dimitar Dimitrov^b

^aInstitute of Organic Chemistry with Centre of Phytochemistry, Bulgarian Academy of Sciences, Sofia, Bulgaria;

^bNational Museum of Natural History, Bulgarian Academy of Sciences, Sofia, Bulgaria

ABSTRACT

The separately distilled flowers (F) and leaves' (L) essential oils of *Inula britannica* L. were investigated using capillary gas chromatography–flame ionization detector (GC–FID) and gas chromatography–mass spectrometry (GC–MS). A total of 83 constituents, representing 96.91% (F) and 96.73% (L) of the total oils, were registered. The oils were rich in terpenoids (57.85% and 77.28%), of which sesquiterpenoids dominated. The main constituents of the essential oils were viridiflorol (7.17%–8.20%) and himachalol (3.45%–8.71%) followed by 6,10,14-trimethyl-2-pentadecanone (5.43%–2.95%), 13-tetradecanolide (3.93%–4.87%) and 3-methyl-4-propyl-2,5-furandione (4.06%–0.29%).

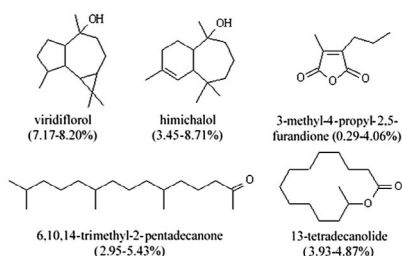
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1. Introduction

Inula britannica L. is mainly distributed in Asia (China, Korea and Japan) and in most of the European countries. In Chinese folk medicine, it is used to treat bronchitis, digestive disorders and inflammation (Zhang et al. 2015). *I. britannica* had a wide variety of applications due to its anticancer, antioxidant, antiinflammatory, neuroprotective and hepatoprotective activities (Khan et al. 2010; Seca et al. 2014, 2015; Wang et al. 2014). Phytochemical study of this species is focused on sesquiterpene lactones, flavonoids and phenolic acids, to which are attributed its healing properties. Several reviews summarised the results on scientific investigations of bioactive secondary metabolites as well as biological activities of extracts, and individual

CONTACT Milka Todorova ✉ todorova@orgchm.bas.bg

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compounds isolated from different *Inula* species (Khan et al. 2010; Seca et al. 2014, 2015; Wang et al. 2014). Extracts and fractions from certain *Inula* species like *I. crithmoides* L. and *I. helenium* L. exhibited different biological activities (Bucchini et al. 2015; Lee & Kang 2016). The promising results could be used for the further bioguided extensive phytochemical research. The literature survey revealed that the information about essential oil composition of *I. britannica* is scarce. To the best of our knowledge, only two articles on volatile components are published (Zha et al. 2005; Erenko et al. 2012). One more article dealt with SF-CO₂ extraction of essential oil without data on its chemical composition (Zhao et al. 2013). Therefore, in continuation of our research on secondary metabolites in *I. britannica*, the essential oil composition of the taxon of Bulgarian origin is presented in this paper.

2. Results and discussion

The obtained essential oils from flowers (**F**) and leaves (**L**) separately were subjected to GC analysis. Eighty-three components in concentration above 0.15% representing 96.91% and 96.73% of the total oils in **F** and **L**, respectively, are listed in Table S1. Nine of them were not identified, but their type was determined on the basis of their mass-spectral fragmentation, while one (MW 188) was unknown. The other substances were identified on the basis of mass spectra and RI. Various structural types of components were detected – terpene and aliphatic hydrocarbons, alcohols, ketones, lactones, aromatic and furan derivatives. As can be seen, the two oils **F** and **L** differed from each other qualitatively in the presence/absence of 15 components. Most of them were in concentrations less than 1%, but one unidentified sesquiterpene alcohol reached 3.00% in **F**. It should be noted that no one component in the studied oils exceeded 10%. The main constituents in both oils were viridiflorol (8.20% in **L**) and himachalol (8.71% in **L**) followed by 6,10,14-trimethyl-2-pentadecanone (5.43% in **F**), 13-tetradecanolide (4.87% in **L**) and 3-Me-4-propyl-2,5-furandione (4.06% in **F**). The principal group representing 60.64% (**F**) and 71.82% (**L**) consisted of oxygen containing compounds, regardless their chemical class, while hydrocarbons were 34.92% and 25.39% in flower and leaf oils, respectively. Saturated aliphatic hydrocarbons C₂₃–C₂₉ were almost six times higher in flowers. Among them C₂₅H₅₂ dominated similarly to the earlier reported data for *I. britannica* (Erenko et al. 2012). Normal and ramified alkanes have been detected in *I. viscosa* (Haoui et al. 2011; Madani et al. 2014; Mahmoudi et al. 2016) as well as in *I. verbascifolia* (Fontana et al. 2014). Further, the total amount of terpenoids [57.85% (**F**) and 77.28% (**L**)] prevailed over the other types of components [39.06% (**F**) and 19.45% (**L**)]. Similar to *I. verbascifolia* (Fontana et al. 2014), the amount of sesquiterpenoids 45.02% (**F**) and 64.83% (**L**) dominated over monoterpenoids, which were 10.47% and 10.33%, respectively. On the other hand, sesquiterpenoids in **L** were with 20% more in comparison with **F**, while the concentration of monoterpenoids was the same.

Further, different types of lactones reaching levels 5.69% (**F**) and 6.86% (**L**) were identified. Thus, the macrolide 13-tetradecanolide was registered in significant amount 3.93% (**F**) and 4.87% (**L**), while 16-hexadecanolide was found in the leaves only. Any macrolide has not been described before for *Inula* essential oils. 13-Tetradecanolide is identified in some *Achillea* species (Hayran & Demirci 2015). Macrocyclic lactones (C₁₄–C₁₇) are found in *Angelica archangelica* reaching maximum 25% in one of the studied samples (Nivinskiene et al. 2003). γ -Palmito lactone, dihydroactinidiolide, ivalin and 3-Me-4-propyl-2,5-furandione were compounds containing furanone functional group.

It is worth to note that the previously reported main components thymol, carvacrol, borneol and cis-chrysantenol in Ukrainian *I. britannica* (Erenko et al. 2012) were not detected now. Surprisingly, in the same oil, alantolactone and isoalantolactone, characteristic for *I. helenium*, have been identified, but no one of them was found neither in the oil nor in the extract (unpublished data) obtained from the Bulgarian *I. britannica*. 2,3,4,5-Tetrahydro-1-benzoxepin-3-ol, which was a major substance in the oil from this species of Chinese origin (Zha et al. 2005), also lacks in the studied now sample. Thus, the above discussed deviations in essential oil composition are an indication for intraspecific variability of *I. britannica*. This statement is in accordance with differences in the lactone profiles published up to now for *I. britannica* of different origins.

Disclosure statement

No potential conflict of interest was reported by the authors.

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