



UNIVERSITY OF NIŠ
The scientific journal FACTA UNIVERSITATIS
Series: **Physics, Chemistry and Technology** Vol. 2, No 1, 1999 pp. 27 - 30
Editor of series: Momčilo Pejović, e-mail: pejovic@elfak.ni.ac.yu
Address: Univerzitetski trg 2, 18000 Niš, YU
Tel: +381 18 547-095, Fax: +381 18 547-950

ALKANES FROM *ACHILLEA ASPLENIFOLIA VENT.*

UDC 547.21+547.473

Nebojša Simić¹, Radosav Palić¹, Slobodan Milosavljević²,
Vlatka Vajs², Dejan Djoković², Novica Randjelović³

¹ Department of Chemistry, Faculty of Mathematics and Natural Sciences,
University of Niš, PO Box 91, 18000 Niš, Yugoslavia, E-mail:
sima@filfak.filfak.ni.ac.yu

² Faculty of Chemistry, University of Belgrade, Studentski trg 16,
11001 Belgrade, Yugoslavia

³ Faculty of Technology, University of Niš, 16000 Leskovac, Yugoslavia

Abstract. *The hydrocarbon fraction of Achillea asplenifolia Vent. has been analyzed by capillary gas chromatography (GC) and GC- mass spectrometry (GC-MS). It was found to consist of the usual odd-carbon number dominant distribution of n-alkane homologues (C₂₁-C₃₃). The main compound was nonacosane (C₂₉, 25.5%) and the carbon preference index (CPI) was low (6.87).*

Key words: *Achillea asplenifolia, n-alkanes, n-nonacosane*

INTRODUCTION

Achillea asplenifolia Vent. ($2n = 18$, Section *Millefolium*, group *A. millefolium*) is a species with restricted spreading from Czech and Slovak Republic southwards to Central Yugoslavia and South Romania. Stem is 40-100 cm high, with pink to purplish-red, rarely white flowers. It usually grows on wet lowland meadows [1].

A. asplenifolia was subject of a few chemical studies concerning essential oil [2] and its antibacterial activity [3]. Proazulenes were also investigated by Kastner et al. [4].

Protecting coats, so called »waxes«, on the leaves of ground plants have an almost universal occurrence. Their main functions are to protect plants from physical damage and, especially, from the loss of water. The main components of the waxes are *n*-alkanes with odd and even numbers of C-atoms (C₂₁-C₃₇, C₂₀-C₃₀), branched alkanes (C₂₇-C₃₃), higher alcohols and acids (usually in the form of esters), aldehydes (as polymers) and ketones. Odd-carbon alkanes are usually prevailing in the alkane fraction [5].

There are opinions that carbon preference index (CPI) and average chain length (ACL) could be used as a chemotaxonomic marker at a genus level [6, 7, 8].

Alkanes, as possible chemotaxonomic markers, were investigated in this study. The aim of the paper is to provide the first information about alkane composition of this plant species.

EXPERIMENTAL

Plant material. Plant material was collected in the blooming stage of vegetation (August 21, 1998), on the locality Selevenj meadow near Horgoš, Yugoslavia. A voucher specimen is deposited in the private herbarium of Dr Novica Randjelović (*Herbarium Moesiacum Doljevac*), who also identified the plant. After separation from underground parts, aerial parts of the plant were air-dried for ten days at room temperature.

Extraction and isolation. The dried plant material was extracted using the procedure reported earlier [6]. The extraction of 100 g of the plant material gave 1.97 g of residue. Fractionation on CC [6] and precipitation of the alkane fraction gave 78 mg of alkanes.

Identification procedure. The alkane fraction was analyzed on an analytical gas chromatography (GC) and a gas chromatography-mass spectrometry (GC-MS). The constituents were identified by coinjection of authentic hydrocarbon standards and by comparison of their retention indices along with mass spectra to those from the MS library [9]. The percentage of the components (Table I) was computed from GC (FID) peak areas without using correction factors.

GC. The analysis was carried out on a gas chromatograph Varian model 3400, fitted with a FID and a 60 m x 0.25 mm fused silica capillary column, with a 0.3 μm film thickness of DB-5. Carrier gas was He (2 mLmin⁻¹). The operating conditions were: temperature program 50°C - 285°C at 15°Cmin⁻¹ and an injector and detector temperature of 300°C.

GC-MS. GC-MS analyses were performed on a Finigan Mat, model 8230, equipped with a fused silica 30 m x 0.25 mm, PTE-5 capillary column, with a film thickness 0.25 μm ; carrier gas was H₂ (2.5 mLmin⁻¹) with the same temperature program as for the analytical GC. Ionization potential was 70eV with an ion source temperature of 180°C.

RESULTS AND DISCUSSION

The content and composition of alkanes of *A. asplenifolia* are shown in Table 1. As it can be seen, odd-carbon number alkanes are dominant, maximizing at C₂₉, what was also remarked for *A. lingulata*, *A. nobilis*, *A. crithmifolia* [6] and *A. serbica* [10]. However, a high content of nonacosane was also found in *Satureja* genus [7, 8], what diminishes its importance as a possible chemotaxonomic marker for the genus *Achillea*.

Average chain length (ACL) value was lower than those in the other *Achillea* species [6, 10]. CPI had the lowest value of those reported earlier for the above-mentioned *Achillea* species [6, 10]. *A. lingulata*, *A. nobilis*, *A. crithmifolia*, *A. serbica* and *A. asplenifolia* belong to different sections of the genus *Achillea* [1]. Therefore, the differences between them in CPI and ACL are rather expected. However, although insufficient for a general conclusion, the obtained results suggest that it is very likely that

CPI similarities in the genus *Achillea* L. do not appear at the genus level.

Table 1. Composition of the n-alkane fraction of *Achillea asplenifolia*

<i>Alkanes</i>	<i>Carbon No.</i>	<i>%</i>
Heneicosane	21	1.3
Docosane	22	0.5
Tricosane	23	2.4
Tetracosane	24	1.3
Pentacosane	25	7.1
Hexacosane	26	1.5
Heptacosane	27	12.1
Octacosane	28	2.4
Nonacosane	29	25.5
triacontane	30	2.5
Hentriacontane	31	13.1
Dotriacontane	32	0.9
Tritriacontane	33	1.0
Total:		71.6
CPI	6.87	
ACL	20.18	

Acknowledgements. The authors thank the Ministry of Science & Technology of Republic of Serbia for financial support of this study.

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ALKANI IZ *ACHILLEA ASPLENIFOLIA* VENT.

**Nebojša Simić, Radosav Palić, Slobodan Milosavljević,
Vlatka Vajs, Dejan Djoković, Novica Randjelović**

*U ovom radu ispitivana je ugljovodonična frakcija ekstrakta *Achillea asplenifolia* Vent. gasnom hromatografijom (GC) i GC- masenom spektrometrijom (GC-MS). Rezultati su pokazali uobičajenu dominantnu raspodelu n-alkana sa neparnim brojem C-atoma (C₂₁-C₃₃). Nonakozan (C₂₉) je najzastupljenije jedinjenje (25,5%). Preferencijalni ugljenični indeks (odnos alkana sa neparnim i parnim brojem C-atoma, CPI) ima malu vrednost (6,87).*

Ključne reči: *Achillea asplenifolia*, n-alkani, n-nonakozan