

NOTE

**The fatty acids and alkanes of *Satureja adamovicii* Šilić and
Satureja fukarekii Šilić**

DUŠANKA KITIĆ,¹ RADOSAV PALIĆ,² NOVICA RISTIĆ³ and GORDANA STOJANOVIĆ^{2*}

¹Faculty of Occupational Safety, Černojevića 10a, YU-18000 Niš,

²Department of Chemistry, Faculty of Science, Ćirila i Metodija 2, YU-18000 Niš and

³Department of Chemistry, Faculty of Science, Vidovdanska b.b. YU-38000 Priština, Yugoslavia

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The content and composition of fatty acids and alkanes of *Satureja adamovicii* Šilić and *Satureja fukarekii* Šilić were analyzed by GC. It was found that unsaturated acids prevailed and that the major components were palmitic, oleic, linoleic and linolenic acids. The hydrocarbon fractions of pentane extracts were shown to consist of the alkane homologues (C₁₇ to C₃₄) with nonacosane and hentriacontane being prevailing compounds.

Key words: *Satureja adamovicii* Šilić, *Satureja fukarekii* Šilić, fatty acids, hydrocarbons.

Satureja adamovicii Šilić and *Satureja fukarekii* Šilić are endemic species of the Balkan peninsula.¹

Satureja adamovicii Šilić grows on the stony approaches to uncovered cliffs of small uneven spots of Macedonia. *Satureja fukarekii* Šilić, also known as *Satureja tenuis* Formanec and *Satureja montana* L. var. *kitaiballi* (Weirzb.) Brig. subvar. *tenuis* (Formanec),² usually grows on karst rocks and serpentine sides of some river gorges of Macedonia.

Chemical studies of these species concerned the qualitative and quantitative determination of the essential oil content.³ We could find only one paper dealing with hydrocarbon fractions of pentane extracts of some species of *Satureja* genus^{4,5} and one about the content and composition of the fatty acids of the total nutrient lipids of 11 species of *Satureja*.⁶ The aim of this study was to enrich the data of the above mentioned species to include those of the compositions of the acids and hydrocarbons, because of their insufficiency in the literature.

EXPERIMENTAL

Plant material. The plant material was collected in the blooming phase of vegetation. *S. adamovicii* Šilić specimens were collected from the valley of the Rajec river and *S. fukarekii* Šilić near

* Address for correspondence

Katlanovska banja in Macedonia. The specimens were deposited in the herbarium of Dr. Novica Randelović, at the Faculty of Technology in Leskovac. The leaves, flowers and the green parts of the stems were air-dried for ten days at room temperature. The fatty acids and hydrocarbons were determined by previously reported procedures.^{7,8} The chloroform extraction of *S. adamovicii* Šilić gave 7.80% and of *S. fukarekii* Šilić 7.20% of residue. The pentane extraction of *S. adamovicii* Šilić gave 2.03% and of *S. fukarekii* Šilić 1.54% of residue.

The methyl esters of the fatty acids of *S. adamovicii* Šilić and *S. fukarekii* Šilić were analyzed with a Hewlett Packard series 2 Gas Chromatograph on a Carbowax 20 M capillary column 25 m × 0.32 mm with an FID. N₂ was the carrier gas (pressure 330 kPa). The column temperature was programmed, 40–50 °C (at 2 °C/min), 55–140 °C (at 10 °C/min), 140–200 °C (at 5 °C/min) and then held 12 min at 200 °C. The injector temperature was 200 °C and the detector temperature 300 °C. Identification of compounds was carried out by the co-injection of authentic compounds. The obtained results are shown in Table I.

The hydrocarbons fractions of *S. adamovicii* Šilić and *S. fukarekii* Šilić were analyzed on 4 m × 3 mm fused silica DB-1 column, FID, carrier gas He (2 cm³/min). The column temperature was programmed 50–250 °C at 15 °C/min. The injector and detector temperature were both 300 °C. Identification of compounds was carried out by the co-injection of authentic compounds.

RESULTS AND DISCUSSION

The chloroform extraction of aerial dry plant material gave a 7.80% residue for *S. adamovicii* Šilić and 7.20% for *S. fukarekii* Šilić.

The saponification of the chloroform extract with a 12% NaOH ethanolic solution afforded the free fatty acids, which were esterified by methanol and the obtained methyl esters GC analyzed.

Identification by the GC of the fatty acids gave the results shown in Table I. It is obvious that unsaturated fatty acids prevail in both examined species.

TABLE I. Methyl esters of the fatty acids of *S. adamovicii* Šilić and *S. fukarekii* Šilić

Components	<i>S. adamovicii</i> Yield, %	<i>S. fukarekii</i> Yield, %
Methyl laurate	0.17	0.15
Methyl myristate	1.99	1.43
Methyl palmitate	24.13	24.45
Methyl stearate	5.68	4.34
Methyl oleate	15.67	11.56
Methyl linoleate	8.39	14.53
Methyl linolenate	20.62	29.27
Methyl licanate	2.28	2.27

The U/S index (unsaturated/saturated acids) is 1.5 and the ratio linolenate/linoleate is 2.45 for *S. adamovicii* Šilić and 2.0 for *S. fukarekii*, while for the nutlet lipids of 11 species of *Satureja* genus the U/S index ranges from 10.0 to 22.8 and the average linolenate/linoleate value is 4.4 (ranging from 4.9 to 3.2).⁶

From our results, it may be supposed that the fatty acid composition, U/S and the linolenate/linoleate index of the ground part of plant may serve as taxonomic markers, as well as for the nutlet lipids.

The pentane extracts of the dry aerial parts of *S. adamovicii* Šilić and *S. fukarekii* Šilić were found to contain 2.03% and 1.54% of residue, respectively (calculated per weight of dried plant material). The yield of the hydrocarbon fractions, calculated per weight of dry residue of pentane extracts, were 3.03% and 2.60%, respectively, for *S. adamovicii* Šilić and *S. fukarekii* Šilić.

The separated hydrocarbon fractions of the pentane extracts of *S. adamovicii* Šilić and *S. fukarekii* Šilić showed IR bands, ν_{\max} cm⁻¹, at 1450 (–CH₃), 2853–2962 and 720–750 (–CH₂–) pointed to the presence of a large number of methylene groups. The ¹H-NMR data confirmed the presence of methyl (δ 0.9 ppm) and methylene (δ 1.25 ppm) protons. The melting interval was 63–66 °C. The results of GC analyses are summarized in Table II.

TABLE II. Percent composition of *n*-alkanes

Components	<i>S. adamovicii</i> Šilić	<i>S. fukarekii</i> Šilić
Heptadecane	0.58	0.92
Octadecane	1.59	0.88
Nonadecane	0.89	1.68
Icosane	0.56	1.02
Henicosane	0.56	1.34
Docosane	0.23	0.91
Tricosane	0.43	1.35
Tetracosane	0.20	1.12
Pentacosane	0.81	1.59
Hexacosane	0.49	1.41
Heptacosane	2.63	3.27
Octacosane	1.60	3.74
Nonacosane	32.55	25.59
triacontane	2.87	2.82
Hentriacontane	26.43	14.65
Dotriacontane	2.93	2.39
Tritriacontane	10.30	5.73

The *n*-alkane distributions of *S. adamovicii* Šilić and *S. fukarekii* Šilić are odd carbon dominant, maximizing at C-29 (32.55% and 25.59%, respectively) with a Carbon Preference Index (CPI) of 7.2 and 3.7 and an Average Chain Length (ACL) of 25.44 and 19.78, respectively.

A survey of the literature reveals that there are some differences between our results and those published earlier.⁵

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ИЗВОД

МАСНЕ КИСЕЛИНЕ И АЛКАНИ ИЗ *Satureja adamovicii* ШИЛИЋ И *Satureja fukarekii* ШИЛИЋ

ДУШАНКА КИТИЋ,¹ РАДОСАВ ПАЛИЋ,² НОВИЦА РИСТИЋ³ И ГОРДАНА СТОЈАНОВИЋ

¹Факултет заштитиће на раду, Чарнојевића 10а, 18000 Ниш

²Одсек за хемију, Филозофски факултет, Ђурића и Методија 2, 18000 Ниш и

³Одсек за хемију, Природно-математички факултет, Видовданска б.б., 38000 Приштина

Испитиване су масне киселине и алкани врста *Satureja adamovicii* Шилић и *Satureja fukarekii* Шилић методом GC. Утврђено је да код обе врсте преовлађују незасићене масне киселине. Најзаступљеније масне киселине су: палмитинска, олеинска, линолна и линоленска. Такође је утврђено да су заступљени алкани од C₁₇ до C₃₄ са наонакозном и хенетриаконтаном као најзаступљенијим компонентама.

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