

SHORT COMMUNICATION

Gas chromatography-mass spectrometry study of the root and herb of *Smallanthus sonchifolius*

Studium obsahových látek kořenu a nati *Smallanthus sonchifolius* pomocí plynové chromatografie – hmotnostní spektrometrie

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Summary

Smallanthus sonchifolius (yacon) is a new prospective plant cultivated in Europe as a natural sugarcane substitute. It is used for diabetes and for the prevention of obesity. The study of carboxylic acids in the roots and herb of *S. sonchifolius* was carried out for the first time by gas chromatography-mass spectrometry (GC-MS). As a result of the study, 12 components were found in the roots of *S. sonchifolius*, 9 of which were carboxylic acids. The *S. sonchifolius* herb contained 41 components, 18 of which were carboxylic acids. The dominant compounds in the roots were: undecanoic acid, methyl ester – 546.04 mg/kg; 1-benzazirene-1-carboxylic acid, 2,2,5a-trimethyl-1a-[3-oxo-1-butenyl] perhydro-, methyl ester – 360.63 mg/kg; 9-octadecenoic acid (Z)-, methyl ester – 119.21 mg/kg. In the herb of the yacon dominant is cyclohexanol, 1-ethynyl – 28.67 mg/kg.

Key words: *Smallanthus sonchifolius* (yacon) • carboxylic acids • GC-MS

Souhrn

Smallanthus sonchifolius (jakon) je nová perspektivní rostlina, která se v Evropě pěstuje jako přírodní náhražka cukrové třtiny. Používá se při diabetu a pro prevenci obezity. Studie karboxylových kyselin v kořenu a nati *S. sonchifolius* byla metodou plynové chromatografie – hmotnostní spektrometrie (GC-MS) provedena poprvé.

Výsledkem studie bylo zjištění 12 složek v kořenu *S. sonchifolius*, z nichž devět byly karboxylové kyseliny. Nať *S. sonchifolius* obsahovala 41 složek, z nichž 18 byly karboxylové kyseliny. Dominantní sloučeniny v kořenu byly methylester kyseliny undecylové – 546,04 mg/kg; L-benzaziren-1-karboxylová kyselina, 2,2,5a-trimethyl-1a-[3-oxo-1-butenyl] perhydro-methylester – 360,63 mg/kg; methylester kyseliny olejové – 119,21 mg/kg. V nati jakonu byl dominantní cyklohexanol, 1-ethynyl – 28,67 mg/kg.

Klíčová slova: *Smallanthus sonchifolius* (jakon) • karboxylové kyseliny • GC-MS

Introduction

Carboxylic acids have various pharmacological effects and play a significant role in the human body. Especially polyunsaturated acids with several double bonds are important. Into this group, octadecadienoic, octadecatrienoic and arachidonic can be included. They are often called essential fatty acids. They have the greatest biological activity, they participate in the transfer and exchange of cholesterol, the synthesis of prostaglandins and other vital substances, maintain the structure of cell membranes, are necessary for the work of the visual apparatus and nervous system, and increase immunity. The absence of these acids in food inhibits growth, inhibits reproductive function, leads to the development of atherosclerosis¹⁾. Octadecadienoic and octadecatrienoic acids cannot be synthesized by the human body itself and should be received with food. Expanding the resource base of natural sources of biologically active substances, improving the quality of life and enriching the diet is relevant in the modern world. One of the most promising plants is *Smallanthus sonchifolius*, which has been introduced into the culture in many countries of the world²⁻⁴⁾.

S. sonchifolius (yacon) is a herbaceous, perennial plant of the genus *Smallanthus* (*Polymnia*) of the *Asteraceae*

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Table 2. Component composition of the *S. sonchifolius* herb

№	TR, min	Empirical formula	Compound	Content	
				mg/kg	%
1	3.92	C ₈ H ₁₂ O ₅	2-pentenedioic acid, 3-methoxy-, dimethyl ester	4.99	2.40
2	5.19	C ₉ H ₁₄ O ₇	citric acid, trimethyl ester	4.99	2.40
3	10.45	C ₁₅ H ₃₀ O ₂	methyl tetradecanoate	4.91	2.36
4	13.14	C ₁₀ H ₁₈	bicyclo[3.1.1]heptane, 2,6,6-trimethyl-, (1.alpha, 2.beta, 5.alpha)-	4.98	2.39
5	13.35	C ₁₁ H ₁₈ O	5,6,7,7-tetramethyl-octa-3,5-dien-2-one	5.02	2.41
6	13.73	C ₈ H ₁₂ O	cyclohexanol, 1-ethynyl-	28.67	13.77
7	13.86	C ₂₂ H ₂₂ FN ₃ O	1-(4-fluorophenyl)-2-[(4-hydroxy-6-methylpyrimidin-2-yl)thio]ethan-1-one	4.97	2.39
8	14.16	C ₂₀ H ₄₀ O	3,7,11,15-tetramethyl-2-hexadecen-1-ol	4.95	2.38
9	14.70	C ₁₀ H ₁₈	m-menth-1(7)-ene	4.96	2.38
10	15.09	C ₁₀ H ₁₆ O	2-cyclopenten-1-one, 2-pentyl-	4.99	2.40
11	15.20	C ₁₇ H ₃₄ O ₂	hexadecanoic acid, methyl ester	4.95	2.38
12	15.63	C ₁₈ H ₂₈ O ₃	benzenepropanoic acid, 3,5-bis(1,1-dimethylethyl)-4-hydroxy-, methyl ester	5.00	2.40
13	15.80	C ₁₂ H ₂₇ O ₄ P	phosphoric acid, monododecyl ester	4.77	2.29
14	16.34	C ₅ H ₉ NO	2-pyrrolidinone, 1-methyl-	5.33	2.56
15	17.24	C ₁₁ H ₁₈ O	2-n-heptylfuran	4.78	2.30
16	17.52	C ₁₈ H ₃₆ O ₂	hexadecanoic acid, 14-methyl-, methyl ester	4.96	2.38
17	17.75	C ₁₀ H ₁₆ O	2,4-dodecadienal	4.92	2.36
18	18.45	C ₁₈ H ₃₂ O ₂	valeric acid, tridec-2-ynyl ester	4.95	2.38
19	19.07	C ₁₈ H ₃₂ O	9,12,15-octadecatrien-1-ol	4.96	2.38
20	19.33	C ₁₉ H ₃₆ O ₂	10-octadecenoic acid, methyl ester	4.94	2.37
21	19.79	C ₁₉ H ₃₄ O ₂	octadecanoic acid, methyl ester	4.95	2.38
22	20.97	C ₂₁ H ₄₆ OSi	6,10,14-trimethyl-pentadecan-2-ol, o-trimethylsilyl	4.93	2.37
23	23.13	C ₁₀ H ₁₄ O	1(2h)-pentalenone, hexahydro-5-methyl-4-methylene	5.22	2.51
24	23.20	C ₁₉ H ₃₂ O ₂	9,12,15-octadecatrienoic acid, methyl ester	5.13	2.46
25	24.08	C ₂₁ H ₄₂ O ₂	eicosanoic acid, methyl ester	4.91	2.36
26	26.12	C ₂₂ H ₄₄ O ₂	heneicosanoic acid, methyl ester	4.85	2.33
27	28.07	C ₂₃ H ₄₆ O ₂	docosanoic acid, methyl ester	4.98	2.39
28	29.34	C ₂₀ H ₄₂	eicosane	4.45	2.14
29	29.80	C ₂₄ H ₄₈ O ₂	tricosanoic acid, methyl ester	5.05	2.43
30	30.15	CH ₃ C ₆ H ₄ SO ₂ NHNH ₂	diisopropylketone p-tosylhydrazone	5.10	2.45
31	30.87	C ₂₅ H ₅₀ O ₂	tetracosanoic acid, methyl ester	4.94	2.37
32	31.42	C ₁₄ H ₄₄ O ₆ Si ₇	heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-tetradecamethyl-	4.97	2.39
33	31.92	C ₁₀ H ₃₀ O ₃ Si ₄	tetrasiloxane, decamethyl-	4.90	2.35
34	32.32	C ₁₂ H ₂₂ Si ₂	1,3-bis(trimethylsilyl)benzene	4.96	2.38
35	32.43	C ₂₇ H ₅₄ O ₂	hexacosanoic acid, methyl ester	5.09	2.44
36	33.45	C ₁₃ H ₂₂ OSi ₂	2,4,6-cycloheptatrien-1-one, 3,5-bis-trimethylsilyl-	4.98	2.39
37	33.81	C ₁₀ H ₃₀ O ₃ Si ₄	tetrasiloxane, decamethyl-	4.96	2.38
38	33.86	C ₆ H ₂₀ O ₄ Si ₄	cyclotrisiloxane, hexamethyl-	4.93	2.37
39	34.00	C ₁₇ H ₁₄ O ₄	2-(acetoxymethyl)-3-(methoxycarbonyl) biphenylene	1.80	0.86
40	34.15	C ₂₂ H ₄₄ O ₂	heneicosanoic acid, methyl ester	3.99	1.91
41	36.39	C ₁₁ H ₂₂ O ₂	decanoic acid, methyl ester	4.92	2.36

INNOWAX (30 m × 250 μm × 0.50 μm) was used for separation. The mobile phase: helium, gas flow rate: 1.2 ml/min. Temperature of the sample injections heater: 250 °C. Temperature of furnace is programmable from 50 to 320 °C with the rate of 4 degree/min. For component identification the data from the mass-spectra libraries NIST05 and WILEY 2007 with the total number of spectra of more than 470000 were used combined with identification programs AMDIS and NIST.

For quantitative calculations, the internal standard method was used. Calculation of components content C (mg/kg) was carried out using the formula:

$$C = P_1 \cdot 0.25 \times 1000 / P_2 \cdot m,$$

where: P_1 – peak area of the tested substance, P_2 – peak area of the standard, 0.25 – mass of the internal standard (μg) injected into the sample; m – sample mass (g).

The relative content of carboxylic acids was determined once in % of their sums.

The results of the research are presented in Figs. 1, 2 and Tables 1, 2.

Results and discussion

The study of carboxylic acids in the roots and herbs of *S. sonchifolius* was carried out for the first time by gas chromatography-mass spectrometry. As a result of the study, 12 components were found in the roots of *S. sonchifolius*, 9 of which were carboxylic acids. The *S. sonchifolius* herb contains 41 components, 18 of which are carboxylic acids. The dominant compounds in the roots are: undecanoic acid, methyl ester – 546.04 mg/kg; 1-benzazirene-1-carboxylic acid, 2,2,5a-trimethyl-1a-[3-oxo-1-butenyl]perhydro-, methyl ester – 360.63 mg/kg; 9-octadecenoic acid, methyl ester – 119.21 mg/kg. In the herb of the yacon dominant is the: cyclohexanol, 1-ethynyl – 28.67 mg/kg. The roots and herbs of *S. sonchifolius* are a promising raw material for further phytochemical and pharmacological research.

Conflicts of interest: none.

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