SHORT COMMUNICATION

Research in the chemical composition of the bark of *Sorbus aucuparia*

Výzkum chemického složení kůry *Sorbus aucuparia*

Elena Krivoruchko • Alexander Markin • Victoria Samoilova • Tetiana Ilina • Oleh Koshovyi

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Summary

The quantitative contents of 40 carboxylic acids, with the prevalence of hexadecanedioic, lignocerinic, behenic, azelaic, palmitic and benzoic acids, and 39 components of essential oil were determined in the extracts of the bark of *Sorbus aucuparia* by the GC-MS method. The quantitative contents of 6 phenolic compounds, *i.e.*, chlorogenic, caffeic, and gallic acids, catechin, quercetin, and apigenin-7-glucoside were determined by the HPLC method in the ethanolic extract of the bark of *Sorbus aucuparia*.
Key words: *Sorbus aucuparia* • bark • carboxylic acids • phenolic compounds • essential oil, GC-MS, HPLC

Souhrn

V extraktu kůry *Sorbus aucuparia* byl stanoven metodou GC-MS kvantitativní obsah 40 karboxylových kyselin s prevalencí hexadekandiové, lignocerové, behenové, azelaové, palmitové a benzoové kyseliny, a 39 složek silice. V etanolickém extraktu kůry *Sorbus aucuparia* byl metodou HPLC kvantitativně stanoven obsah šesti fenolických sloučenin, tj. kyseliny chlorogenové, kávové a galové, katechinu, kvercetinu a apigenin-7-glukosidu.
Klíčová slova: *Sorbus aucuparia* • kůra • karboxylové kyseliny • fenolické sloučeniny • silice • GC-MS • HPLC

Introduction

Sorbus aucuparia (European mountain ash, Rowan tree) from the family *Rosaceae* is widely spread throughout Europe as an ornamental and medicinal plant. Fruits and leaves of *S. aucuparia* contain vitamins, carbohydrates, organic acids, phenolic compounds and terpenoids, which are known to have an antioxidant, antiscorbutic, diuretic, choleretic, antidiabetic, laxative, or hemostatic effect[1–6]. Yet, the bark of *S. aucuparia* has not been given enough attention by researchers. From scattered research it is known that extracts from the bark of *Sorbus decora* and *Sorbus americana* have an antidiabetic effect, whereas extracts from the bark of *Sorbus commixta* have a hepatoprotective effect[7–9]. The objective of this work was to study carboxylic acids, essential oil and phenolic compounds of the bark of *Sorbus aucuparia*.

Ass. Prof. Elena V. Krivoruchko, D.Sc. (✉) • V. A. Samoilova • T. V. Ilina • O. M. Koshovyi
National University of Pharmacy
4-Valentynivska str., 61168 Kharkiv, Ukraine
e-mail: evphyto@gmail.com

A. Markin
Pharmacognosy Department, National University of Pharmacy, Kharkiv, Ukraine

Experimental part

The bark of the branches of *S. aucuparia* was harvested for analysis in April 2017 in the Botanic Garden of the National University of Pharmacy.

The identification and determination of carboxylic acids in the bark of *S. aucuparia* was carried out by the HPLC method on an Agilent Technologies 6890 chromatograph with a mass spectrometric detector, 5973N. The sample for the analysis was prepared according to the previously described procedure[6]. We used the NIST05 and WILEY 2007 mass spectra libraries with a total number of spectra exceeding 470000, in combination with the AMDIS and NIST programs for identification of the components.

Essential oil from the bark of *S. aucuparia* was obtained by the hydrodistillation method. The determination of essential oil components was carried out on an Agilent Technologies 6890 chromatograph with a 5973N mass spectrometric detector. The procedure of obtaining essential oil and the chromatographic conditions were described earlier[10].

The research of phenolic compounds in a 70 % ethanolic extract of the bark of *S. aucuparia* was carried out by the HPLC method. The Shimadzu LC-20 Prominence module system, equipped with a LC-20AD quaternary pump, a CTO-20A column oven, a SIL-20A autosampler, a SPD-M20A diode array detector and a LC-20 chemstation, was used for data analysis. The chromatographic conditions were described previously[11]. The iden-

tification of phenolic compounds in the ethanolic extract of the bark of *S. aucuparia* was carried out against the retention time of standards and spectral characteristics.
The results of the research are presented in Tables 1, 2, and 3.

Results and discussion

We determined the contents of 40 carboxylic acids in the bark of *S. aucuparia* by the GC-MS method as 10 aromatic, 12 dibasic, 1 tribasic, and 17 fatty acids; predominantly hexadecanedioic (903.0 mg/kg), lignoceric (850.5 mg/kg), behenic (732.3 mg/kg), azelaic (697.3 mg/kg), palmitic (444.6 mg/kg) and benzoic acid (317.0 mg/kg). Identified in the essential oil of the bark of *S. aucuparia* also were 39 components, namely 1 triterpene, 8 aldehydes, 3 alcohols, 3 ketones, 12 fatty acids and 12 alkanes. The oil contains a significant amount of the precursor of numerous triterpenes, *i.e.*, squalene (1283.52 mg/kg). Most identified aldehydes, alcohols and ketones are fragrant substances imparting odour to the raw materials. Identified by the HPLC method also were 6 phenolic compounds in the ethanolic extract of the bark of *S. aucuparia*. Also determined were 3 phenolic acids, *i.e.*, chlorogenic, caffeic and gallic, and 3 flavonoids, *i.e.*, catechin, quercetin and apigenin-7-glucoside, with chloro-

Table 1. Carboxylic acids of bark of Sorbus aucuparia

Acid	T_R^* min	Content mg/kg	Acid	T_R min	Content mg/kg
Caproic	4.438	49.5	8-Hydroxynonanoic	27.626	198.1
Oxalic	9.367	185.0	Margaric	28.017	21.2
Malonic	12.513	188.8	Undecanedioic	28.401	23.7
Fumaric	13.941	17.7	Citric	28.942	96.6
Levulinic	14.766	48.0	Stearic	29.483	43.0
Succinic	14.989	27.4	Oleic	29.768	152.2
Benzoic	15.29	317.0	Linoleic	30.476	173.3
Glutaric	17.22	39.1	Linolenic	31.43	87.6
Phenylacetic	18.073	9.8	Vanillic	32.049	42.9
Salicylic	18.33	7.7	Arachidic	32.54	214.9
Lauric	19.233	68.4	p-Coumaric	34.436	53.6
Pimelic	20.995	75.6	Behenic	35.49	732.3
Malic	22.027	32.9	Hexadecanedioic	36.047	903.0
Myristic	22.724	36.1	Tricosanoic	36.778	52.9
Suberic	22.83	181.5	p-Hydroxybenzoic	36.901	34.7
Pentadecanoic	24.04	42.3	Syringic	37.352	21.0
Azelaic	24.776	697.3	Gentisic	37.96	18.2
Hydroxybenzylacetic	25.596	232.3	Lignoceric	38.189	850.5
Palmitic	26.232	444.6	Octadecanedioic	38.819	249.4
Palmitoleic	27.331	14.79	Ferulic	39.667	117.24

T_R^* – retention time of acid methyl ester

Table 2. Main components of essential oil of bark of Sorbus aucuparia

Compound	T_R min	Content mg/kg	Compound	T_R min	Content mg/kg
2-Ethylhexanol	7.747	7.6	Geranylacetone	20.554	15.9
Hexanal	8.148	3.9	Dodecan-1-ol	21.865	25.9
Nonanal	9.475	15.5	Dodecan-2-one	22.019	26.8
Dec-2-en-1-ol	11.595	1.8	Dodecanal	22.412	7.3
Camphora	10.438	1.4	Tridecanal	25.358	32.0
Decanal	12.775	13.4	Tetradecanal	27.732	29.7
Undecanal	15.674	9.8	Squalene	41.056	1283.5
Undec-2-enal	17.871	22.6			

Table 3. Phenolic compounds of ethanolic extract of bark of Sorbus aucuparia

Compound	T_R min	Content mg/g	λ nm
Gallic acid	6.8	0.019	260
Catechin	19.4	0.191	213, 267, 337
Chlorogenic acid	20.4	0.056	217, 233, 324
Caffeic acid	22.7	0.035	295, 321
Apigenin-7-glucoside	36.4	0.007	265, 337
Quercetin	48.0	0.003	287, 330

genic acid (0.056 mg/g) prevailing among the acids in the raw material and catechin (0.191 mg/g) prevailing among the flavonoids. Previously, chlorogenic and caffeic acids, catechin and quercetin were found in the leaves and fruit of *S. aucuparia*, and gallic acid in the fruit of *S. aucuparia* [2–5]. Apigenin-7-glucoside was not identified in *S. aucuparia*, but it was identified, among the species of the genus *Sorbus,* in the leaves of *S. torminalis*[12]. The results of the present research testify for the importance of further phytochemical and pharmacological studies in the bark of *S. aucuparia*.

Conflicts of interest: none.

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