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CHEMICAL COMPOSITION OF THE AERIAL PART OF RUMEX K-1

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The content and composition of lipids, proteins, flavonoids, and carbohydrates from the aerial part of Rumex K-1 were studied.

Key words: Rumex K-1, lipids, amino acids, carbohydrates, flavonoids.

Rumex K-1 is a highly proteinaceous culture. The protein content in the dry mass of the aerial part reaches 40% depending on the habitat. This is 2.5-3 times that in grains [1].

The patriarchal line of the food culture is *Rumex confertus* Willd. (Polygonaceae); maternal, *Spinacia angliyskiy* (Chenopodiaceae). Data on the lipids of *R. acemosa* and *R. paulsenianus* Rech. have been published [2, 3]. The leaves of *R. confertus* can be used to treat avitaminosis and neoplastic diseases [4]. *S. angliyskiy* is rich in vitamins, proteins, and sugars and is used in folk medicine for anemia, rickets, and avitaminosis [4-6].

We studied the chemical composition of the principal classes of natural compounds in the aerial part of Rumex K-1 collected in Tashkent district at the end of flowering. Freshly prepared raw material was dried in the shade to a constant moisture content of 7%.

Lipids were extracted from the ground raw material by $CHCl_3$—CH_3OH. The fraction containing lipids consisted of 4.4% after purification from nonlipid components [7, 8].

The total lipids were separated by TLC (system 1). The following classes of compounds were identified: hydrocarbons, carotenes, xanthophylls, esters, triacylglycerins, tocopherols, fatty acids, sterols, chlorophylls, and pheophytins. The unsaponified part contained 30.8% of the total lipids.

Proteins were extracted from pulp of Rumex K-1 culture after extraction of lipids by phosphate buffer containing NaCl (1 M) at pH 9.3. The protein yield was 24.8%.

The amino-acid composition of the proteins was determined in an amino-acid analyzer after acid hydrolysis. A total of 17 amino acids was found in the hydrolysate.

Amino acid	Wt. %	Amino acid	Wt. %
Asp	2.73	Val	4.48
Thr	1.77	Met	3.6
Ser	1.73	Leu	36.5
Glu	4.09	Lys	5.86
Pro	0.45	Arg	0.33
Gly	1.93	His	3.83
Tyr	4.43	Phe	5.58
Ala	5.62	Ile	8.73
Cys	0.43		

It can be seen that the protein is rich in essential amino acids such as leucine, isoleucine, lysine, valine, and phenylalanine [9].

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Flavonoids were determined by extracting a sample of Rumex K-1 with aqueous ethanol (70%), condensing the solution, and extracting with $CHCl_3$. Spectrophotometry [10] of the $CHCl_3$ extract detected 0.17% flavonoids of the starting raw material mass.

Paper chromatography (PC, systems 2 and 3) of the remaining alcoholic solution identified glucose, fructose, and saccharose. Their content was 18% of the raw material according to photocolorimetric quantitative analysis using phenol—H_2SO_4 [11].

Extraction of the remains of the raw material by water afater extraction of flavonoids isolated the water-soluble polysaccharides. The extract was condensed, purified of proteins according to the literature [12], and precipitated by alcohol to yield water-soluble pectinic substances (WSPS) in 3.1% yield based on raw material.

The isolated WSPS are a cream-colored powder that is very soluble in water and gives no color with iodine, indicative of the absence of starch. PC of the WSPS hydrolysate detected fructose and traces of glucose, i.e., the polysaccharide is a glucofructan.

The IR spectrum of the WSPS contains absorption bands at 815, 880, and 945 cm^{-1}, typical of inulin glucofructans [13].

The pectinic substances (PS) were obtained next by extraction of the raw material with oxalic acid—ammonium oxalate (0.5% solution).

The PS yield was 1.1%. They are a light-brown powder that forms a gel in water with a relative viscosity of 11.2.

The amount of ascorbic acid determined by the K-iodate method [14] was 755 mg/kg of raw material.

The total carotene content in Rumex K-1 culture was found by spectrophotometry [15] as 58.1 mg/kg of raw material.

The concentrations of microelements were determined by atomic absorption. The following values were found: Cu, 0.08 mg/kg; Zn, 0.073 mg/kg; Ca, 0.9 mg/kg; K, 1.1 mg/kg; Na, 0.98 mg/kg [16].

Thus, the chemical composition of the aerial part of Rumex K-1 includes lipids, flavonoids, carbohydrates, microelements, and vitamins. Rumex K-1 is also a rich source of protein.

EXPERIMENTAL

IR spectra were recorded on a Perkin—Elmer System 2000 Fourier spectrometer as KBr pellets at 400-4000 cm^{-1}. The amounts of microelements were determined by atomic absorption on a Perkin—Elmer 403 spectrophotometer using the analytical line 283.3 nm.

Lipids were extracted from ground raw material by $CHCl_3$—CH_3OH (2:1, v/v) twice with shaking at room temperature for 8 h each time. The extracts were combined and condensed in a rotary evaporator to give the total lipids and nonlipid components such as carbohydrates, amino acids, and other hydrophilic compounds. They were removed from the lipid solution by washing three times with aqueous $CaCl_2$ (0.04%) [7]. The amount of purified lipid extract was 4.4% of the starting mass. Lipids were separated and identified as before [3].

Pulp after lipid extraction was extracted by phosphate buffer containing NaCl (1 M) at pH 9.3 (1:10 ratio). The supernatant liquid was treated with $(NH_4)_2SO_4$ [44 g $(NH_4)_2SO_4$ per 100 mL of solution]. The precipitated protein was centrifuged, dialyzed against running water to remove completely salts, and lyophilized. The yield of proteinaceous compounds was 24.8% of the raw mass.

The amino-acid composition of the protein was determined on an LKB-410 amino-acid analyzer after acid hydrolysis for 24 h in HCl (5.7 N) at 110°C. The hydrolysate was filtered, evaporated in a rotary evaporator at 40°C, and left over solid KOH for 20 h. The hydrolysate was dissolved in acetate buffer at pH 5.4 and placed on the column of the amino-acid analyzer.

A sample of the aerial part of Rumex K-1 was extracted by alcohol (70%) three times with boiling for 1 h (1:8). The alcohol extracts were combined and condensed in a rotary evaporator. Flavonoids were extracted from the thick extract by $CHCl_3$. The $CHCl_3$ extract was evaporated to dryness and dissolved in ethanol (50%) with subsequent reaction with $AlCl_3$ in alcohol to form a complex absorbing at 415 nm $E_{1cm}^{1\%}$. The flavonoid content was 0.17% of the raw material.

PC (system 2, butanol:pyridine:water, 6:4:3; system 3, water-saturated phenol) on Filtrak FN-13 paper of the alcohol solution after removal of flavonoids identified fructose, glucose, and saccharose by comparison with standards using anilinium acid phthalate and 5% urea solution.

The raw material remaining after flavonoid extraction was extracted twice by water at room temperature for 2 h. The extracts were combined. Protein was removed as before [12]. The aqueous solution was evaporated in vacuum in a rotary

evaporator at 40°C and precipitated by alcohol (1:2). The precipitate was filtered off, washed with alcohol, and dried at 100±5°C.

The WSPS yield was 3.1% of the raw mass. WSPS (0.1 g) were hydrolyzed by H_2SO_4 (1 N) at 100°C for 6 h. The hydrolysates were neutralized by $BaCO_3$, deionized by KU-4 (H^+) cation exchanger, condensed, and studied by PC (system 1).

The raw material remaining after WSPS isolation was treated twice with a mixture of equal volumes of oxalic acid and ammonium oxalate solutions (0.5%, 1:10) at 70°C for 2 h. The extracts were dialyzed against distilled water, evaporated, and precipitated by alcohol (1:2). The precipitate was separated, washed with alcohol, and dried at 100±5°C. The PS yield was 1.1% of the raw mass.

Ascorbic acid was determined by the K—iodate method [14] and amounted to 755 mg/kg of raw material. The total carotene content was determined by a spectrometric method [15].

REFERENCES

1. A. A. Pokrovskii, ed., *Chemical Composition of Food Products* [in Russian], Pishchevaya Prom-st′, Moscow (1976).
2. L. N. Pilipenko and A. A. Kolesnik, *Khim. Prir. Soedin.*, 199 (1993).
3. S. D. Gusakova, T. V. Khomova, and A. I. Glushenkova, *Khim. Prir. Soedin.*, 604 (1990).
4. N. N. Brezgin, *Medicinal Plants of the Upper Volga* [in Russian], Verkhne-Volzhskoe Izd., Yaroslavl (1973).
5. Kh. Kh. Kholmatov and A. I. Kosimov, *Medicinal Plants* [in Russian], Izd. Ibn Sino, Tashkent (1994).
6. L. G. Kretsu, L. Domashchenko, and M. D. Sokolov, *World of Food Plants* [in Russian], Timpyl, Kishinev (1989).
7. J. N. Hawthorne and G. Hiibsher, *Biochem. J.*, **71**, 195 (1959).
8. *Handbook of Study Methods, Industrial Chemical Control and Accounting of Production in the Oil-Fat Industry* [in Russian], VNIIZh, Leningrad (1967), Vol. 1, Book 2.
9. B. Jirgensons, *Natural Organic Macromolecules*, Pergamon Press, Oxford and New York (1962).
10. L. Ya. Bershtein and A. L. Kaminskii, *Spectrophotometric Analysis in Organic Chemistry* [in Russian], Khimiya, Leningrad (1986).
11. M. Dubois, K. A. Gulles, J. Hamilton, F. A. Rebers, and F. Smith, *Arab. Chem.*, **28**, 350 (1956).
12. M. G. Sevag, *Biochem. J.*, **273**, 419 (1934).
13. L. M. J. Verstraeten, *Anal. Chem.*, **36**, 1040 (1964).
14. *State Pharmacopoeia* [in Russian], Xth Ed., Meditsina, Moscow (1968), p. 43.
15. R. S. Limar′ and O. V. Sakharova, *Methods of Quantitative Study of Photosynthesis* [in Russian], VNII Plant Growing, Leningrad (1973).
16. W. J. Price, *Analytical Atomic Absorption Spectrometry*, Heyden, New York (1972).