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CHEMICAL COMPOSITION OF THE HYBRID RUMEX K-1

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The chemical composition of the leaves and roots of the hybrid fodder dock Rumex K-1 (fam. Polygonaceae) introduced into cultivation in the environs of Almaty has been studied for the first time. It has been shown that the leaves and roots of the plant contain a considerable amount of such biologically active substances as lipids, vitamins, phenolic compounds, polysaccharides, and anthraquinones. The fatty acid compositions of the leaf and root lipids are given.

The hybrid fodder dock Rumex K-1 is the earliest highly productive perennial crop bred by the new crop division of the Central Botanical Garden of the Ukrainian Academy of Sciences in 1974-1979 [1] and widely used as a fodder additive. Rumex K-1 is a hybrid of two species of the Polygonaceae family — patience dock (*Rumex patienta* L.) as the maternal form with *Rumex tianschanicus* A. Los as the paternal form.

The main methods of growing Rumex K-1 under the irrigation conditions of the southeastern region of the republic have been developed in the Kazakh V. R. Vil'yams Scientific Research Institute of Agriculture. We have studied the chemical compositions of the level and roots of Rumex K-1 gathered in the incipient flowering phase (Table 1).

Table 1 shows the diversity of the class of chemical compounds in the leaves and roots of Rumex K-1. With the exception of the chlorophylls and carotenoids, the qualitative compositions of the compounds identified were the same. The amount of biologically active substances in the leaves was considerably greater than in the roots.

The carotenoids of the leaves were represented mainly by carotenes, 80% of them being the biologically active β-carotene (provitamin A). Oxygenated carotenes — xanthophylls — predominated in the roots. The chlorophyll of the leaves consisted of a combination of the blue-green *a* and the yellow-green *b* chlorophylls, present in approximately equal amounts.

TABLE 1. Chemical Compositions of the Leaves and Roots of the Hybrid Dock Rumex K-1

Components	Leaves	Roots
Carotenoids, mg-%	26.6	14.4
carotenes	20.9	1.2
β- isomer	16.7	–
α- isomer	4.2	–
xanthophylls	5.7	13.2
Chlorophylls, mg-%	56.9	–
a	26.7	–
b	30.2	–
Anthracene derivatives, mg-%	350.0	110.0
hypericin	10.0	2.0
Sum of the phenolic compounds, %	10.2	3.4
anthocyans	0.02	0.01
flavonoids	5.1	0.7
phenolic carboxylic acids	2.6	1.0
tanning substances	2.5	1.7
Organic acids (calculated as malic), %	3.0	1.6
Ascorbic acid, mg-%	37.0	27.0
Polysaccharides, %	16.5	9.0
Lipids, %	1.0	0.4

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TABLE 2. Fatty Acid Compositions of the Lipids of the Leaves and Roots of the Hybrid Dock Rumex K-1

Acid	Amount, % of the total acids	
	leaves	roots
10:1	0.2	1.2
11:0	0.1	0.9
12:0	1.6	0.7
13:0	2.2	0.1
14:0	1.4	0.4
15:0	2.3	0.1
16:0	17.1	16.8
16:1	4.2	2.6
17:0	0.6	1.6
17:1	0.3	0.6
18:0	1.1	2.0
18:1	3.4	13.3
18:2	11.1	46.7
18:3	54.4	13.0
Total sat.	26.6	23.8
unsat.	73.4	76.2
inc. conj. dienes	1.3	–

Anthracene derivatives are characteristic for the *Rumex* genus [2]. In the hybrid dock Rumex K-1 we showed the presence of hypericin — a photosensitizing substance characteristic for many representatives of the *Hypericum* genus [3].

Phenolic compounds were represented by such classes of chemical compounds as anthocyans, flavonoids, tanning substances, and phenolic carboxylic acids. Flavonoids predominated in the leaves, and tanning substances in the roots. The amounts of anthocyans in the epigeal and hypogeal organs of the plant were insignificant. Attention is attracted by the high levels of polysaccharides in the leaves and roots — 16.5 and 9.0%, respectively. The hybrid Rumex K-1 may definitely become a source of polysaccharides for the pharmaceutical industry.

We also studied the fatty acid compositions of the neutral lipids isolated from the air-dry tissues of the plant by steeping with hexane at room temperature. The fatty acids of the lipids were analyzed in the form of the methyl esters by GLC and UV spectroscopy [4, 5] (Table 2).

The qualitative compositions of the fatty acids of the lipids of the leaves and the roots were the same, with the exception of the presence of conjugated dienic acids in the leaf lipids. Substantial differences were observed in the levels of individual acids. The lipids were found to contain acids both with even and with odd numbers of carbon atoms. Of the latter, the 13:0 and 15:0 acids predominated in the leaves, and the 17:0 and 17:1 acids in the roots. The amounts of palmitic acid in the leaf and roots lipids were practically the same, while the amount of palmitoleic acid in the leaves was 1.6 times greater than in the roots.

We must mention the specificity of the accumulation of acids with 18 carbon atoms, the amount of oleic and linoleic acids in the root lipids being 4 times that in the leaf lipids. Linolenic acid was the main acid in the leaf lipids, where its amount was 4 times greater than in the root lipids. The high degree of unsaturation of the lipids characterizes the great adaptability of the hybrid dock Rumex K-1 to the environmental conditions.

In the UV spectrum of a hexane solution of the methyl esters of the leaf lipid fatty acids there was a maximum at 232 nm showing the presence of isomers of dienic acids with two conjugated bonds, their amount being 1.3% [5]. No acids with conjugated bonds were detected in the root lipids.

Thus, the chemical composition of the hybrid dock Rumex K-1 shows the presence of a high level of biological active substances: carotenoids (provitamin A), ascorbic acid (vitamin C), linoleic and linolenic acids (vitamin F), and flavonoids (vitamin P), and also chlorophylls, polysaccharides, and organic acids. Rumex K-1 may be of interest not only as a fodder plant but also as a valuable medicinal raw material.

EXPERIMENTAL

The chemical composition of the air-dry comminuted raw material was determined by generally adopted methods: carotenoids and chlorophylls as in [6, 7], hypericin as in [8], phenolic compounds as in [9], polysaccharides and ascorbic acid as in [10], and lipids as in [4, 5].

GLC conditions: Chrom-5 instrument, flame-ionization detector, steel column, 0.3 × 370 cm, filled with Chromaton N-AW (0.20-0.25 mm) upon which 15% of polyethyleneglycol succinate had been deposited. Column temperature 180°C, rate of flow of carrier gas, argon, 45 ml/min, of hydrogen 45 ml/min, and of air 500 ml/min. The quantitative level of fatty acids was calculated from the product of the height of the peak and the retention time measured in minutes [4].

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