FLAVONOIDS OF *Astragalus torrentum*

N. N. Guzhva, S. F. Dzhumyrko, and A. L. Kazakov

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Continuing a study of plants of the genus *Astragalus* [1], we have investigated the epigeal part of *A. torrentum* Bunge collected in the Krasnosel'sk region of Armenia on the shores of Lake Sevan. On two-dimensional paper chromatography of an ethanolic extract in the solvent systems butan-1-ol–CH_3COOH–H_2O (4:1:5) and 15% acetic acid, in the epigeal part of the plant we detected more than 10 substances of flavonoid nature, eight of which were isolated in the individual states.

The air-dry raw material was exhaustively extracted with 70% ethanol. The extract was concentrated, the ethanol was distilled off, and the residue was freed from the lipophilic substances with chloroform. The total flavonoids were extracted with ethyl acetate and precipitated with chloroform and were then separated on a column of polyamide sorbent. Eight flavonoid compounds were obtained in the individual state. Their structures were shown with the aid of chemical and physicochemical methods on the bais of the results of acid hydrolysis, and also by comparison with authentic samples.

Substance 1 – $C_{15}H_{10}O_6$, mp 275-277°C, λ_{max} 267, 370 nm (ethanol); this was characterized as 3,4',5,7-tetrahydroxyflavone (kaempferol) [2].

Substance 2 – $C_{21}H_{20}O_{11}$, mp 179-181°C, $[\alpha]_D^{20}$ –56° (c 0.1; dimethylformamide), $\lambda_{max}^{C_2H_5OH}$ 357, 255 nm. Acid hydrolysis yielded an aglycone, identified as kaempferol, and D-glucose, identified by paper chromatography. The results of a study of the UV spectra of the aglycone and the glycoside showed that the glycoside had free hydroxy groups in the 4', 5, and 7 positions and the sugar component occupied position 3. The facts given permitted this substance to be regarded as kaempferol 3-O-β-glucopyranoside (astragalin) [3].

Substance 3 – $C_{28}H_{32}O_{17}\cdot 2H_2O$, mp 198-201 (ethanol; $[\alpha]_D^{20}$ –56.6° (c 0.13; dimethylformamide), λ_{max} 355, 255 nm. The acid hydrolysis of the compound yielded the aglycone $C_{16}H_{12}O_7$, mp 302-305°C, identified as isorhamnetin, and D-glucose. The substance was astragaloside (isorhamnetin 3-O-gentiobioside) [4].

Substance 4 – $C_{21}H_{20}O_{11}\cdot 2H_2O$, mp 228-231°C, $[\alpha]_D^{20}$ –15.1° (c 0.14; methanol), λ_{max} 257, 359 nm (ethanol). Acid hydrolysis yielded the aglycone kaempferol and D-galactose. A mixture of the glycoside and trifolin gave no depression of the melting point. The substance was identified as 4',5,7-trihydroxyflavone 3-O-β-D-galactopyranoside (trifolin) [2].

Substance 5 – $C_{15}H_{10}O_7$, mp 310-312°C (from ethanol), λ_{max} 256, 370 nm (ethanol), was identified as 3,3',4',5,7-pentahydroxyflavone (quercetin) [2].

Substance 6 – $C_{33}H_{40}O_{19}$, mp 188-190°C (ethanol), $[\alpha]_D^{20}$ –120.4° (pyridine–ethanol), λ_{max} 350, 265 nm, consisted of robinin (kaempferol 7-O-β-rhamnopyranoside 3-O-β-robinobioside) [5].

Substance 7 – $C_{28}H_{32}O_{11}\cdot 2H_2O$, mp 180-182°C, $[\alpha]_D^{20}$ –32.2° (c 0.31; dimethylformamide), λ_{max} 354, 266 nm. Hydrolysis with sulfuric acid gave an aglycone with the composition $C_{16}H_{12}O_7$, mp 303-305°C, λ_{max} 370, 255 nm, identified as isorhamnetin, and a mixture of D-glucose and L-rhamnose, which were identified by paper chromatography. A mixture of the glycoside isolated and narcissin gave no depression of the melting point and, consequently, the substance was isorhamnetin 3-β-D-rhamnopyranosyl-(6 → 1)-α-L-glucopyranoside, or narcissin [6].

Substance 8 – $C_{27}H_{30}O_{16}\cdot 2H_2O$, mp 188-191°C (from ethanol). On acid hydrolysis with 5% H_2SO_4, an aglycone with mp 307-310°C was detected together with the carbohydrate components D-glucose and L-rhamnose. The substance was quercetin 3-rutinoside (rutin) [7].

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This is the first time that any of the substance mentioned have been isolated from *Astragalus torrentum*.

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FLAVONOIDS OF *Astragalus floccosifolius*

R. K. Yasinov, N. V. Syrovezhko, G. P. Yakovlev, and S. N. Ovcharenko

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The epigeal part of the herbaceous perennial plant *Astragalus floccosifolius* Sumn. gathered in the flowering phase in May, 1982, in Tadzhikistan has been investigated for the presence of flavonoids. To isolate the total flavonoids, 0.10 kg of the dried and comminuted herb was exhaustively extracted successively with 96% and 70% ethanols. The combined extracts were evaporated in vacuum to an aqueous residue, which was treated with chloroform to eliminate ballast substances. The flavonoids were extracted from the purified aqueous extract with ethyl acetate. The aqueous residue and the ethyl acetate extract were chromatographed on columns of polyamide, and the flavonoids were eluted with water and with mixtures of water and ethanol.

The ethyl acetate extract yielded substances (I-VIII), and the aqueous residue substances (IX-XI).

Substance (I) (eluted by 30% ethanol) was identified as rutin (quercetin 3-O-rutinoside), mp 190-192°C (aqueous ethanol), $[\alpha]_D^{20}$ −43.2° (c 0.5; methanol), λ_{max} 360, 260 nm [1].

Substance II (eluted by 40% ethanol) was isorhamnetin 3-O-β-D-glucoside, $C_{22}H_{12}O_2$, mp 243-246°C (ethanol), $[\alpha]_D^{20}$ −60° (c 0.5; ethanol), λ_{max} 358, 257 nm [2].

Substance (III) (eluted by 40-50% ethanol) was isorhamnetin 3-O-β-D-galactoside (cacticin), mp 271-273°C (aqueous ethanol), $[\alpha]_D^{20}$ −44.2° (c 0.45; methanol, λ_{max} 358, 255 nm [3].

Substance (IV) (eluted by 40% ethanol) was quercetin 3-O-α-L-rhamnoside (quercitrin), mp 177-180°C (aqueous ethanol), $[\alpha]_D^{20}$ −164° (c 0.1; ethanol), λ_{max} 360, 260 nm.

Substance (V) (eluted by 60% ethanol) was quercetin, mp 312-314°C (ethanol), λ_{max} 372, 256 nm [5].

Substance (VI) (eluted by 70% ethanol) was kaempferol, mp 276-277°C (ethanol), λ_{max} 370, 265 nm [5].

Substance (VII) (eluted by 70% ethanol) was isorhamnetin, mp 302-304°C (decomp.) (methanol), λ_{max} 375, 255 nm [6].

Substance (VIII) (eluted by 70% ethanol) was apigenin, mp 347-348°C (ethanol), λ_{max} 335, 269 nm [1].

Substance (IX) (eluted by 30% ethanol) was rhamnetin 3-O-β-D-galactoside, mp 225-226°C (methanol), $[\alpha]_D^{20}$ −43.4° (c 0.5; dimethylformamide), λ_{max} 362, 260 nm [7].

Leningrad Institute of Pharmaceutical Chemistry. V. L. Komarov Botanical Institute, Academy of Sciences of the USSR, Leningrad.

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