# FLAVONOID COMPOSITION OF THE HERB *Polygonum aviculare*

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*Polygonum aviculare* L. is an annual herbaceous plant of the family Polygonaceae and is widely distributed in Europe, the Caucases, Siberia, and Central Asia [1]. It contains tanning agents [2], hydroxycinnamic and phenolcarboxylic acids, flavonoids [3], essential oils, carotene (4.7–4.9 mg%), vitamin C (57–450 mg%), vitamin $K_1$ [4], sugars (2.65%) [5], silicic acid including its soluble form, saponins, coumarins [6], slime, and anthraquinone glycosides [7].

*P. aviculare* herb has long been used in folk medicine for diseases of the liver, kidneys, and bladder; as a uterine hemostatic; and for tuberculosis, stomach ulcers, dysentery, malaria, and various tumors [8, 9]; and in modern medicine as an astringent, tonic, and diuretic agent [10].

We studied the chemical composition of *P. aviculare* herb collected during flowering in Tashkent. Dried and ground aerial part (1.5 kg) was extracted (4×) with alcohol (70%, 10 L). The alcohol extracts were condensed in a rotary evaporator at 40°C. The concentrated alcohol extract was diluted with water (1:1) and treated successively with hydrocarbons, $CHCl_3$, EtOAc, and *n*-BuOH. The EtOAc fraction was chromatographed over a column (110 × 3.5 cm) of silica gel (1:20) with elution successively by $CHCl_3$ and $CHCl_3$:MeOH (97:3, 95:5, 90:10, 85:15, 80:20). Fractions of 200 mL were collected. Elution by 97:3, 85:15, and 80:20 systems isolated compounds **1**–**3**.

The isolated compounds were identified using UV, IR, PMR, $^{13}C$ NMR, HMBC, NMQC, COSY, and NOESY spectral data and direct comparison with authentic samples.

**Liquiritin (liquiritigenin-4′-*O*-*β*-D-glucopyranoside) (1)** [11]. Crystalline compound, $C_{21}H_{22}O_9$, mp 212–214°C. UV spectrum (EtOH, $\lambda_{max}$, nm): 270, 364. IR spectrum (KBr, ν, $cm^{-1}$): 3332 (OH), 2922, 2854 (CH, $CH_2$ stretching), 1650 (C=O), 1608, 1579, 1512 (aromatic rings).

PMR spectrum (600 MHz, DMSO-$d_6$, δ, ppm, J/Hz): 2.69 (1H, dd, J = 16.8, 2.4, H-3*β*), 3.16 (1H, dd, J = 16.8, 12.6, H-3*α*), 5.54 (1H, dd, J = 12.6, 2.4, H-2), 6.37 (1H, t, J = 1.8, H-8), 6.53 (1H, dd, J = 9.0, 1.8, H-6), 7.09 (2H, dd, J = 8.4, 1.2, H-3′,5′), 7.47 (2H, dd, J = 8.4, 1.2, H-2′,6′), 7.67 (1H, d, J = 9.0, H-5), 4.91 (1H, d, J = 7.8, H-1″), 3.24-3.31 (H-2″,3″,5″), 3.20 (1H, t, J = 9.6, H-4″), 3.71 (1H, br.d, J = 11.4, H-6″*α*), 3.48 (1H, t, H-6″*β*).

$^{13}C$ NMR spectrum (150 MHz, DMSO-d6, δ, ppm): 78.63 (C-2), 43.18 (C-3), 189.94 (C-4), 128.42 (C-5), 110.58 (C-6), 164.67 (C-7), 102.59 (C-8), 163.06 (C-9), 113.55 (C-10), 132.35 (C-1′), 128.02 (C-2′), 116.16 (C-3′), 157.48 (C-4′), 116.16 (C-5′), 128.02 (C-6′), 100.28 (C-1″), 73.21 (C-2″), 76.62 (C-3″), 69.69 (C-4″), 77.05 (C-5″), 60.68 (C-6″).

**Avicularin (quercetin-3-*α*-L-arabinofuranoside) (2)** [12], $C_{20}H_{18}O_{11}$, yellow crystalline powder, mp 201–203°C. UV spectrum (MeOH, $\lambda_{max}$, nm): 259, 305, 359.

PMR spectrum (400 MHz, DMSO-$d_6$, δ, ppm, J/Hz): 6.27 (1H, d, J = 2.1, H-6), 6.51 (1H, d, J = 2.1, H-8), 6.88 (1H, d, J = 8.6, H-5′), 7.52 (1H, d, J = 2.5, H-2′), 7.60 (1H, dd, J = 2.5, 8.6, H-6′), 12.7 (s, 5-OH), 5.52 (1H, d, J = 5.5, H-1″), 3.20–4.25 (H-Glc).

$^{13}C$ NMR spectrum (400 MHz, DMSO-$d_6$, δ, ppm): 156.2 (C-2), 132.26 (C-3), 178.94 (C-4), 158.95 (C-5), 99.51 (C-6), 164.36 (C-7), 94.20 (C-8), 157.12 (C-9), 104.30 (C-10), 121.11 (C-1′), 114.94 (C-2′), 144.69 (C-3′), 149.12 (C-4′), 114.95 (C-5′), 120.98 (C-6′), 107.2 (C-1″), 82.10 (C-2″), 76.26 (C-3″), 85.30 (C-4″), 60.60 (C-5″).

**Cinaroside (luteolin-7-*O*-*β*-D-glucopyranoside) (3)** [13], yellow powder, $C_{21}H_{20}O_{11}$, mp 240–242°C. UV spectrum (MeOH, $\lambda_{max}$, nm): 251, 350, 368. IR spectrum (KBr, ν, $cm^{-1}$): 3313 (OH), 2926, 2854, 1656 (C=O), 1601, 1563, 1528.

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PMR spectrum (600 MHz, DMSO-$d_6$, δ, ppm, J/Hz): 6.45 (1H, br.s, H-6), 6.76 (1H, s, H-3), 6.80 (1H, br.s, H-8), 6.91 (1H, d, J = 8.4, H-5′), 7.43 (1H, d, J = 1.8, H-2′), 7.46 (1H, dd, J = 8.4, 1.8, H-6′), 5.09 (1H, d, J = 7.8, H-1″), 3.26–3.31 (H-2″,3″,5″), 3.18 (1H, t, H-4″), 3.71 (1H, br.d, J = 10.8, H-6$\alpha$″), 3.47 (1H, t, H-6$\beta$″).

$^{13}$C NMR spectrum (150 MHz, DMSO-$d_6$, δ, ppm): 162.95 (C-2), 103.26 (C-3), 181.92 (C-4), 156.95 (C-5), 99.53 (C-6), 164.46 (C-7), 94.79 (C-8), 161.14 (C-9), 105.32 (C-10), 121.41 (C-1′), 113.54 (C-2′), 145.68 (C-3′), 149.82 (C-4′), 115.95 (C-5′), 119.18 (C-6′), 99.84 (C-1″), 73.07 (C-2″), 76.25 (C-3″), 69.48 (C-4″), 77.13 (C-5″), 60.69 (C-6″).

Liquiritin and cinaroside were isolated for the first time from *P. aviculare*.

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