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POLYPHENOLS FROM *Geranium saxatile*

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Plants of the genus *Geranium* L. (Geraniaceae) are widely distributed around the world [1]. About 300 species of plants of this genus have been described, of which 13 are indigenous to Uzbekistan [2, 3].

All geranium species, like other plants, contain tanning agents (hydrolyzed and condensed) [1], which exhibit a broad spectrum of pharmacological activity, in addition to simple phenols and their derivatives, flavonoids, catechins, and proanthocyanidines [4–8]. Several effective drugs were created based on the isolated polyphenols [9–12].

The subject of our investigation was the aerial part of *G. saxatile* Kar. et Kir.

The occurrence of saponins in the subterranean part of this plant [13], of steroidal saponins in the aerial part [14], and of coumarins in stems and flowers [15] were reported. The chemical composition of *G. saxatile* growing in Uzbekistan has not been investigated. Therefore, we considered it expedient to continue the chemical investigation of polyphenols from this species.

We found phenolic compounds in the aerial (3.94%) and subterranean (7.13%) parts of the plant during a determination of the content of tanning agents in it using the Leventhal method [16].

The air-dried ground aerial part (1.5 kg) of *G. saxatile* collected during flowering in Western Tien-Shan (Chatkal Range, upper region of Kyzyl village, alpine belt) was extracted (5×) with alcohol (80%, 25.5 L). The alcohol extracts were condensed in a rotary evaporator at 50–55°C. The concentrated EtOH extract was diluted with H_2O (1:1) and worked up successively with hexane, $CHCl_3$, EtOAc, and *n*-BuOH.

The total EtOAc fraction was placed on a chromatography column (165 × 4.5 cm) of KSK silica gel (eluent $CHCl_3$:MeOH, MeOH:H_2O in various ratios) and then rechromatographed over Sephadex LH-20 (eluent MeOH:H_2O gradient). The chromatographic separation isolated **1**–**3**, which were identified using spectral properties (UV, IR, PMR spectra) and by comparison of physicochemical properties with literature data.

Compound 1, white crystals, very soluble in alcohol and hot water, mp 238–240°C. UV spectrum (C_2H_5OH, λ_{max}, nm): 211, 274. R_f 0.65 (BAW 4:1:2), 0.34 (2% CH_3COOH). Gave a blue color with iron chloride solution (1%). Compound **1** was gallic acid [4, 5].

Compound 2, slightly soluble in boiling water and alcohol, insoluble in ether, mp 356–358°C (dec.). UV spectrum (C_2H_5OH, λ_{max}, nm): 365, 254. IR spectrum (ν_{max}, cm^{-1}): 3265, 3250 (OH), 1720 (carbonyl), 1616 (double bond). R_f 0.43 (BAW 40:12.5:29), 0.05 (15% CH_3COOH). Compound **2** was identified as ellagic acid [4–6].

Compound 3, yellow powder, mp 219–221°C, very soluble in MeOH. UV spectrum (C_2H_5OH, λ_{max}, nm): 259.34, 364.68. IR spectrum (ν_{max}, cm^{-1}): 3114, 2980, 2900, 1715, 1656, 1606, 1550, 1505. PMR spectrum (400 MHz, CD_3OD, δ, ppm, J/Hz): 3.26 (1H, td, J = 6.2, 0.9, H-5″), 3.49 (1H, dd, J = 11.2, 6.2, H-6″), 3.49 (1H, dd, J = 9.6, 3.4, H-3″), 3.58 (1H, dd, J = 11.2, 6.2, H-6″), 3.76 (1H, dd, J = 9.6, 7.8, H-2″), 3.79 (1H, dd, J = 3.4, 0.9, H-4″), 5.10 (1H, d, J = 7.8, H-1″), 6.15 (1H, d, J = 2.1, H-6), 6.34 (1H, d, J = 2.1, H-8), 6.80 (1H, d, J = 8.5, H-5′), 7.52 (1H, dd, J = 8.5, 2.1, H-6′), 7.78 (1H, d, J = 2.1, H-2′). Compound **3** was identified as 5,7,3′,4′-tetrahydroxyflavon-3-*O*-glucoside (quercetin-3-*O*-glucoside) [7, 8].

Compounds **1–3** were isolated from *G. saxatile* for the first time.

The obtained EtOAc fraction exhibited antihypoxic properties for acute normobaric and hemic hypoxia.

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