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STEROID COMPOUNDS FROM STEMS OF *Yucca gloriosa*

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We studied previously the chemical composition of *Yucca gloriosa* L. (Spanish bayonet) introduced into Georgia on an industrial scale. Several dozen steroid glycosides, derivatives of various aglycons, were isolated from leaves, flowers, and rhizomes. The steroidal sapogenin tigogenin from the leaves was recommended as raw material for synthesizing steroidal hormonal drugs [1, 2]. Dried leaves on the lower tier of the living plant that consisted mainly of spirostanol glycosides were a source of the proposed fungicidal drug Gloriofucin [3]. Total steroidal saponins of flowers were called Alexin and were an effective stimulator of the growth and development of agricultural crops [4]. Glycosides from the plant rhizomes exhibited the same activity [5].

In continuation of studies of *Y. gloriosa*, herein we communicate results from a study of steroids from the stems, which make up about 35% of the total plant mass.

Stems of *Y. gloriosa* that were collected at the Tbilisi Medicinal Plant Experimental Plot of Kutateladze Pharmaceutical Chemistry Institute were peeled, ground, and dried. Raw material (300 g) was extracted with refluxing MeOH (70%). The MeOH was distilled off. The precipitate that formed in the aqueous liquid upon cooling was filtered off and recrystallized from MeOH to afford a white crystalline powder (0.1 g) that gave a reaction for steroidal glycosides of the spirostanol series [6]. The compound melted at 302–306°C, $[\alpha]_D^{20}$ –27.0° (*c* 1.0, $CHCl_3$). It gave a single spot on TLC at the level of an authentic sample of yuccaloeside A. A mixed sample with it did not cause melting-point depression. Acid hydrolysis formed the aglycon with mp 185–188°C. Its physicochemical properties were identical to those of smilagenin. The monosaccharide part of the hydrolysate contained D-glucose and D-galactose.

The glycoside was characterized as 25*R*,5β-spirostan-3β-ol 3-*O*-β-D-glucopyranosyl-(1→2)-β-D-galactopyranoside and was yuccaloeside A, which was first isolated by us from leaves of *Y. aloifolia* [7].

The aqueous liquid remaining after the separation of yuccaloeside A was purified of lipophilic substances by a small amount of $CHCl_3$ and extracted exhaustively with water-saturated *n*-BuOH. The solvent was distilled off to afford total steroidal saponins as an amorphous yellow powder (24 g, 8% of starting raw material) that contained at least 15 glycosides of the spiro- and furostanol series according to TLC.

At this stage, we limited ourselves to studying only the composition of the stem sapogenins.

The BuOH extract (6 g) was hydrolyzed with HCl (8%) in the presence of benzene [8] to obtain total sapogenins consisting of four components. The total sapogenins (1.4 g) were chromatographed over a column of Al_2O_3 (1:20 ratio). From the first petroleum-ether effluents isolated sapogenin **1**; from subsequent petroleum-ether–benzene (7:3 and 2:8), sapogenins **2** and **3**; and from the final benzene:$CHCl_3$ (3:2), sapogenin **4**.

The sapogenins were recrystallized from MeOH to afford white crystals of **1** (0.14 g), **2** (0.07), **3** (0.07), and **4** (0.06).

Sapogenin 1, mp 186–188°C, $[\alpha]_D^{20}$ –65° (*c* 1.0, $CHCl_3$). IR spectrum (ν, cm^{-1}): 3386 (OH), 1272, 1218, 987, 918, 900, 848; intensity 900>918 (25*R*-configuration). A mixed sample with authentic smilagenin did not show mp depression. The sapogenin acetate was prepared {mp 148–150°C, $[\alpha]_D^{20}$ –61° (*c* 1.0, $CHCl_3$)}. Sapogenin **1** was identified as smilagenin, 5β,25*R*-spirostan-3β-ol [9–11].

Sapogenin 2, mp 201–203°C, $[\alpha]_D^{20}$ –68° (*c* 1.0, $CHCl_3$). IR spectrum (ν, cm^{-1}): 3378, 1079, 1041, 979, 956, 922, 902, 864; 902>922 (25*R*-configuration). Sapogenin acetate: mp 206–208°C, $[\alpha]_D^{20}$–75° (*c* 1.0, $CHCl_3$). The TLC mobility and physicochemical properties of sapogenin **2** corresponded with tigogenin, 5α,25*R*-spirostan-3β-ol [9–11].

Sapogenin 3, mp 265–268°C, $[\alpha]_D^{20}$ +8° (*c* 1.0, $CHCl_3$). IR spectrum (ν, cm^{-1}): 3394, 1712, 1241, 968, 918, 902, 860; 902>918 (25*R*-configuration). Sapogenin acetate: mp 244–245°C, $[\alpha]_D^{20}$ –2° (*c* 1.0, $CHCl_3$). The TLC mobility and physicochemical properties corresponded with gekogenin, 5α,12-keto,25*R*-spirostan-3β-ol [9–11].

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Sapogenin 4, mp 245–247°C. IR spectrum (ν, cm^{-1}): 3391, 1056, 979, 925, 902, 871; 902<925 (25*S*-configuration). Acetylation formed a diacetate with mp 216–218°C. A mixed sample with authentic neogitogenin gave one spot on TLC. The results confirmed that the sapogenin was neogitogenin, 5α,25*S*-spirostan-2α,3β-diol [9–11].

Thus, stems of *Y. gloriosa* were rich in steroidal glycosides, the main component of which was yuccaloeside A, and sapogenins, smilagenin. The total amount of the last in raw material was 1%. Neogitogenin was isolated from this plant for the first time.

REFERENCES

1. E. P. Kemertelidze and T. A. Pkheidze, *Khim.-farm. Zh.*, **6**(12), 44 (1972).
2. N. I. Men′shova, N. P. Sorokina, G. S. Grinenko, N. N. Suvorov, Yu. R. Gurevich, E. P. Kemertelidze, and T. A. Pkheidze, *Khim.-farm. Zh.*, **8**(7), 15 (1974).
3. E. P. Kemertelidze, M. M. Benidze, and A. V. Skhirtladze, *Khim.-farm. Zh.*, **43**(1), 27 (2009).
4. E. Kemertelidze and M. Benidze, *Bull. Georgian Acad. Sci.*, **164**, 91 (2001).
5. N. M. Dzhaparidze, L. V. Berishvili, M. A. Machavariani, L. R. Takidze, and M. S. Dzhashi, *Khim. Zh. Gruz.*, **10**, 222 (2010).
6. I. S. Matthews, *Biochim. Biophys. Acta*, **69**, 163 (1963).
7. M. M. Benidze, O. D. Dzhikiya, M. M. Vugal′ter, T. A. Pkheidze, and E. P. Kemertelidze, *Khim. Prir. Soedin.*, 744 (1984).
8. O. S. Madaeva, N. A. Serova, L. S. Chetverikova, Yu. I. Sheinker, and V. I. Kichenko, *Tr. Vses. Nauchno-Issled. Inst. Lek. Aromat. Rast.*, **11**, 229 (1959).
9. A. V. Kamernitskii, N. K. Abubakirov, M. B. Gorovits, Yu. E. Vollerner, N. E. Voishvillo, I. G. Reshetova, and V. A. Paseshnichenko, *Chemistry of Spirostanols* [in Russian], Nauka, Moscow, 1986.
10. C. R. Eddy, M. E. Wall, and M. K. Scott, *Anal. Chem.*, **25**, 266 (1953).
11. N. Jones, E. Katzenellebogen, and K. Dobriner, *J. Am. Chem. Soc.*, **75**, 158 (1953).