Chemistry of Natural Compounds, Vol. 41, No. 3, 2005

STEROIDAL SAPOGENINS FROM RHIZOMES OF *Yucca gloriosa*

A. V. Skhirtladze, M. M. Benidze, and Ts. P. Sulakvelidze UDC 547.918

Tigogenin from leaves of *Yucca gloriosa* L. has been proposed by the I. G. Kutateladze Institute of Pharmaceutical Chemistry as an economical intermediate for the synthesis of steroidal hormone preparations [1, 2]. This is due to the fact that mainly saponins of only sapogenin—tigogenin, aglycon of the 5α-series, accumulate in the plant leaves. The composition of the flowers is about the same [3].

Yucca gloriosa is an evergreen, perennial, woody shrub that develops a tough rhizome and numerous fine roots. The rhizome of a single 10-year plant weighs up to 2 kg (air-dried mass). Steroidal saponins are not biosynthesized in the plant roots although about 5% of the total saponins are isolated from the rhizome. In contrast with those from leaves, they are primarily furostanol glycosides.

The composition of the aglycons was established by direct hydrolysis of air-dried ground rhizomes by the literature method [4] to afford total sapogenins (1.2%) consisting of six compounds that we designated as sapogenins **1**-**6** in order of increasing polarity. The total sapogenins (2 g) were chromatographed over an Al_2O_3 column. Sapogenins **1** and **2** were isolated from the first petroleum-ether effluents; **3**, from subsequent petroleum ether:benzene fractions; **5**, from the following benzene:$CHCl_3$ ones.

Recrystallization from methanol of **1**, **2**, and **5** afforded white needle-like crystals. Sapogenin **3** crystallized from acetone as crystalline prisms. Yield of **1**, 0.18 g; **2**, 0.17 g; **3**, 0.03 g; **5**, 0.025 g.

Sapogenin **1**, mp 198-200°C, $[\alpha]_D^{20}$ -74° (*c* 0.5, $CHCl_3$). IR spectrum (ν_{max}, cm^{-1}): 3400 (OH), 1172, 1158, 1132, 1096, 1065, 1047, 1022, 985, 968, 919, 893, 855, 850. The strengths at 893 < 919 cm^{-1} are consistent with the *S*-configuration at C-25. A mixed sample with authentic sarsasapogenin did not depress the melting point and gave a single inseparable spot on TLC.

Acetylation in a mixture of acetic anhydride and pyridine gave the monoacetate with mp 142-144°C, $[\alpha]_D^{20}$ -70° (*c* 1.0, $CHCl_3$) and agrees with sarsasapogenin acetate described in the literature [5, 6]. Based on the results, this compound was characterized as 5β,25*S*-spirostan-3β-ol or sarsasapogenin.

Sapogenin **2**, mp 187-188°C, $[\alpha]_D^{20}$ -65° (*c* 1.0, $CHCl_3$). IR spectrum (ν_{max}, cm^{-1}): 3400, 1270, 1205, 1035, 990, 920, 898, 865; 898 > 920 (25*R*-configuration). A mixed sample with authentic smilagenin did not depress the melting point and gave a single spot on TLC. The sapogenin acetate had mp 149-151°C, $[\alpha]_D^{20}$ -61° (*c* 1.0, $CHCl_3$). Compound **2** was identified as 5β,25*R*-spirostan-3β-ol or smilagenin [5, 6].

Sapogenin **3**, mp 203-205°C, $[\alpha]_D^{20}$ -68° (*c* 1.0, $CHCl_3$). IR spectrum (ν_{max}, cm^{-1}): 3300, 1210, 1158, 1134, 1037, 1025, 995, 962, 921, 900, 870; 900 > 912 (25*R*-configuration). The sapogenin acetate had mp 207-209°C, $[\alpha]_D^{20}$ -75° (*c* 1.0, $CHCl_3$). The mobility on TLC of this compound and its physicochemical properties corresponded with those of tigogenin, 5α,25*R*-spirostan-3β-ol [5, 6].

Sapogenin **5**, mp 266-268°C, $[\alpha]_D^{20}$ -76° (*c* 0.5, $CHCl_3$). IR spectrum (ν_{max}, cm^{-1}): 3420, 1060, 1035, 968, 939, 915, 900, 868; 900 > 915 (25*R*-spiroketal). Acetylation formed a diacetate with mp 242-244°C, $[\alpha]_D^{20}$ -97° (*c* 1.0, $CHCl_3$). A mixed sample with authentic gitogenin gave a single spot on TLC. The results confirmed the sapogenin was 5α,25*R*-spirostan-2α,3β-diol or gitogenin.

Sapogenins **4** and **6** were present in trace quantities in the rhizomes. Work on their isolation and identification is continuing.

Thus, 5β-sterol derivatives of sarsasapogenin and smilagenin dominate in the rhizomes of *Yucca gloriosa*. This differs from the composition of leaves and flowers of this plant.

I. G. Kutateladze Institute of Pharmaceutical Chemistry, Academy of Sciences of Georgia, Georgia, Tbilisi, 0159, ul. P. Saradzhishvili, 36, fax: 995-32-25-0026. Translated from Khimiya Prirodnykh Soedinenii, No. 3, p. 288, May-June, 2005. Original article submitted December 10, 2004.

0009-3130/05/4103-0357

REFERENCES

1. E. P. Kemertelidze and T. A. Pkheidze, *Khim.-Farm. Zh.*, **6**, 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.*, **7**, 15 (1974).
3. T. A. Pkheidze, M. M. Benidze, and E. P. Kemertelidze, *Rastit. Resur.*, **21**, No. 4, 452 (1985).
4. L. S. Chetverikova and O. S. Madaeva, *Med. Promst. SSSR*, **8**, 28 (1958).
5. R. N. Jones, E. Katzenellebogen, and K. Dobriner, *J. Am. Chem. Soc.*, **75**, 158 (1953).
6. C. R. Eddy, M. E. Wall, and M. K. Scott, *Anal. Chem.*, **25**, 266 (1953).