2. É. A. Shaftan, N. S. Mikhailova, N. F. Dyuban'kova, A. V. Pekhova, and N. D. Gol'berg, Rastit. Resur., 17, No. 1, 105-109 (1981).
3. A. D. Dembitskii, R. A. Yurina, and T. I. Krotova, "Features of the terpenoid composition of the essential oils of some species of yarrow in Khazakhstan and Central Asia," in: IVth Symposium on Essential-Oil Plants and Oils, October 1-4 (1985) [in Russian], Simferopol' (1985), p. 69.
4. A. S. Ginzberg, Khim.-Farm. Prom., No. 8-9, 326-329 (1932).
5. K. G. Persidskii and A. P. Chipiga, Handbook for Workers in Laboratories of Essential-Oil Enterprises [in Russian], Legk. Pishch. Prom., Moscow (1981).
6. B. V. Stolyarov, I. M. Savinov, and A. G. Vitenberg, Handbook for Practical Work in Gas Chromatography [in Russian], Khimiya, Leningrad (1978).

A STUDY OF THE CHEMICAL COMPOSITION OF COMMERCIAL ROOTS OF *Panax ginseng*

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The chemical composition of various parts of ginseng (roots, leaves, flowers, fruit) has been studied fairly widely [1-4]. It is known that the biological activity of ginseng is due to glycosides – ginsenosides [1]. A knowledge of the composition of the ginsenosides is important for a correlation of the biological effect on various medicinal forms from ginseng and also for a comparative chemotaxonomic study of species of the genus *Panax*.

According to the literature, 29 ginsenosides have so far been isolated from the roots of *Panax ginseng* C. A. Mey, ("white" and "red" roots) [1-4].

The aim of the present work was to investigate the chemical composition of previously unstudied commercial roots of ginseng grown from seeds of *Panax ginseng* C.A. Mey. in the plantations of the Zhen'shen' Sovkhoz [communal farm] (Maritime Territory, Anuchino region).

The air-dry six-year roots (1.96 kg) were treated with 70% aqueous methanol for the complete extraction of the ginsenosides. After elimination of the solvent, the residue was dissolved in the minimum amount of water and was extracted successively with diethyl ether and water-saturated butanol. By chromatography of the ethereal extract on a column of silica gel we isolated the following compounds, identifying them by the GLC method: fatty acid methyl esters, fatty acids [5], β-sitosterol, esters of β-sitosterol and fatty acids (palmitic and linoleic), 6-O-acyl derivatives of β-sitosterol glucoside, and β-sitosterol glucoside [6]. There is no information in the literature on the presence in *Panax ginseng* of β-sitosterol acylated at C_3 by palmitic and linoleic acids.

In studying the composition of the roots, we devoted our main attention to the ginsenosides. The butanolic extracts, which contained the total glycosidic fraction (TGF) ws chromatographed first on the hydrophobic sorbent Polikhrom-1, which freed it from sugars and amino acids, and then on silica gel (KSK) with elution by the solvnet system chloroform–methanol–water (50:6:1) and by similar systems of gradually increasing polarity. as a result of subsequent repeat chromatography, the following were isolated as the main components of the TGF and were identified by IR, ^1H and ^{13}C NMR spectroscopies, mass spectrometry, and high-performance liquid chromatography (HPLC) [7]: Rg_1 (1.38 mg/g of dry root), Re (1.31), Rf (0.3), Rc (0.61), Rb_2 (0.5), Rb_1 (4.15), Ro (0.38), and also, as minor components, Rd (0.016), NG-R2 (0.03), and Z-R1 (0.026), together with two methyl ethers of the glycosides Ro (0.19) and Z-R1 (0.096). The methyl ether of Ro has been isolated previously from the roots of *Panax japonicus*. C. A. Mey.; however, this could with high probability be ascribed to an artifact. This is the first time that ginsenosides NG-R2 and Z-R1 have been isolated from the roots of *Panax ginseng*.

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0009-3130/91/2702-0253$12.50

LITERATURE CITED

1. E. Fujita, S. Johnes, R. Kasai, M. Node, and O. Tanaka, Progr. Chem. Org. Natl. Prod., 1 (1984).
2. S. Shibata, O. Tanaka, J. Shoji, and H. Saito, Economic and Medicinal Plant Research, Academic Press, New York (1985), p. 217.
3. J. Shoji, Advances in Chinese Medicinal Materials Research, World Scientific Publ. Co., Singapore (1985), p. 455.
4. G. B. Elyakov, Author's Abstracts of dissertation... Doctor of Chemical Sciences [in Russian], Novosibirsk (1967).
5. Ts. M. Dalakishvili, N. V. Angelaeva, É. P. Kemertelidze, L. I. Slepyan, N. V. Mikhailova, and R. I. Vysotskaya, Rastit. Resur., 165, 118 (1980).
6. M. Takahashi and M. Yoshikura, Yakugaku Zasshi, 86, 1051, 1053 (1966).
7. V. V. Makhan'klov, N. F. Samoshina, G. F. Malinovskaya, L. N. Atopkina, V. A. Denisenko, V. V. Isakov, A. I. Kalinovskii, and N. I. Uvarova, Khim. Prir. Soedin., 57 (1990).

SPIROSTANOL GLYCOSIDES OF Yucca gloriosa

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The total steroid glycosides, in amounts of 5% [1] and 10%, respetively, have been obtained from the air-dry leaves and flowers of mound lily yucca Yucca gloriosa L. (family Agavaceae) growing in Tbilisi in an experimental field for medicinal plants of the Institute of Pharmacochemistry of the Georgian SSR Academy of Sciences. As a result of their repeated chromatography on column of silica gel (KSK 50/90) with elution by the solvent system chloroform–methanol–water (65:35:8), individual glycosides were obtained: from the flowers – glycoside 1 with a yield of 0.15% (on the weight of the air-dry raw material, mp 302-304°C, and glycoside 2 in an amount of 0.12% (on the weight of the air-dry raw material), mp 258-262°C. Two individual glycosides have also been obtained from the total glycosides of the leaves, and from their physicochemical constants and mobilities in TLC they proved to be identical with glycosides 1 and 2 from the flowers. Glycoside 1 from the leaves melted at 298-299°C (the yield amounting to 0.13%), while glycoside 2 had mp 262-264°C (isolated in an amount of 0.11%).

All the glycosides isolated gave a positive reaction with the Sannie reagent [2] and a negative reaction with the Ehrlich reagent [3]. Their IR spectra contained absorption bands in the 850-980 cm^{-1} region that are characteristic for a spiroketal grouping, which showed their spirostanol nature.

As a result of the acid hydrolysis of the glycosides (0.1 g each) with 2 N HCl (5 ml, 100°C, 5 h) an aglycon was isolated in all cases the physicochemical properties of which corresponded to tigogenin [4]. In the carbohydrate moieties of the glycoside under investigation (after evaporation of the filtrate) glucose, galactose, and rhamnose were identified by the TLC method in the solvent system butanol–methanol–water (5:3:1) (revealing agent: o-toluidine salicylate). The hydrolysates were reduced with sodium tetrahydroborate at room temperature (12 h) and were then acetylated in a mixture of acetic anhydride (2 ml) and pyridine (2 ml) at room temperature (12 h). By the GLC method, in comparison with authentic samples, the acetates of rhamnitol, dulcitol, and sorbitol were identified in a ratio of 1:1:3 for glycoside 1 and 1:1:4 for glycoside 2.

The PMR and ^{13}C NMR spectra of the glycosides under investigation were taken on WM-250 and AM-300 instruments (Bruker) with working frequencies of 250 MHz for protons and 63 MHz for carbon, and 300 and 75 MHz for solutions of the glycosides in pyridine at various temperatures. The results obtained showed the identiyf of glycosides 1 and 2 with yuccaloesides B adn C which we have isolated previously from the leaves of aloe yucca Yucca aloifolia L. [5]. Thus, glycoside 1 was the 3-O-{[O-α-L-rhamnopyranosyl-(1→4)-O-β-D-glucopyranosyl-(1→3)]-[O-β-D-glucopyranosyl(1→2)]-O-β-D-glucopyranosyl-(1→4)-β-D-galactopyranoside} of (25R)-5α-spirostan-

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