Chemistry of Natural Compounds, Vol. 31, No. 4, 1995

POLYSACCHARIDES OF SAPONIN-BEARING PLANTS. VII. STUDY OF THE POLYSACCHARIDES OF THE ROOTS OF *Allochrusa paniculata*

A. O. Arifkhodzhaev

UDC 547.917

Water-soluble polysaccharides, pectin substances, and hemicelluloses have been isolated from the roots of Allochrusa paniculata. *According to the results of analysis, the neutral polysaccharide found belongs to the glucoarabinogalactan type and differs from the neutral polysaccharide of the roots of* A. gypsophiloides *by the presence of arabinose.*

In the territory of the former USSR, plants of the genus *Allochrusa,* fam. Caryophyllaceae, are represented by six species [1]. Two species grow in Uzbekistan: *Allochrusa gypsophiloides* (soaproot — etmak) and *A. paniculata* [2]. Both are perennial herbaceous summer-vegetating saponin-bearing plants. Their roots have long been used by the local population in the preparation of such oriental sweetmeats as nishalda, halva, parvarda, etc. Saponin-bearing plants are widely used in industry for the preparation of cellular concretes, in the mining industry, for the cleaning of fur, and in the electrolysis of metals; in addition, the roots are exported.

The carbohydrates of these plants have been little studied. We have recently reported an investigation of the carbohydrates of *A. gypsophiloides* [3] which includes a neutral polysaccharide that is a glucogalactan consisting of glucose and galactose in a ratio of 1:5, respectively. In the present paper, we give the results of a study of the polysaccharides of *A. paniculata*.

To eliminate low-molecular-mass carbohydrates and other compounds, the comminuted air-dry roots were first exhaustively extracted with chloroform and alcohol. Then the water-soluble polysaccharides (WSPSs) were isolated by extraction with water. The extract was evaporated in a rotary evaporator and was freed from proteins by Sewag's method [4], and the WSPSs were obtained by precipitation with alcohol in a yield of 8.3%.

The pectin substances (PcSs) were obtained by the subsequent extraction of the raw material with a mixture of 0.5% solutions of oxalic acid and ammonium oxalate at 70°C for 2 h twice. The extract was dialyzed against distilled water and was evaporated, and the PcSs were obtained by precipitation with alcohol in a yield of 3.8%.

The hemicelluloses (HCs) were isolated by a single 2-h extraction with a 10% solution of caustic soda at room temperature. The solution was neutralized with acetic acid, dialyzed against distilled water, evaporated, and precipitated with methanol, which gave a 6.2% yield of HCs.

All the polysaccharides were hydrolyzed with 2 N H_2SO_4 at 100°C, the reaction mixtures were neutralized with $BaCO_3$, and the monosaccharides in the hydrolysate were determined by PC and GLC.

The WSPSs consisted of glucose, galactose, mannose, xylose, arabinose, and rhamnose residues in a ratio of 5.0:11.0:1.0:3.5:4.4:4.0, respectively, the PcSs consisted of galactose, glucose, mannose, arabinose, and rhamnose residues in a ratio of 1.1:1.0:1.0:8.5:2.8, respectively, and the HCs consisted of galactose, glucose, mannose, xylose, arabinose, and rhamnose residues in a ratio of 1.0:2.1:1.6:3.6:3.2:tr., respectively. In addition to the above-mentioned neutral saccharides, all the polysaccharides also contained uronic acids.

Quantitatively, the WSPSs predominated in the roots and this served as a basis for their detailed characterization.

Institute of the Chemistry of Plant Substances, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (3712) 89 14 75. Translated from Khimiya Prirodnykh Soedinenii, No. 4, pp. 549-551, July-August, 1995. Original article submitted October 24, 1994.

0009-3130/95/3104-0455$12.50

By ion-exchange chromatography on a column of DEAE-cellulose (carbonate form) the WSPSs were separated into a neutral and an acid polysaccharide (NPS and APS, respectively). The NPS consisted of galactose, glucose, and arabinose residues in a ratio of 21.0:6.3:1.0:8.1, respectively, and belonged to the glucoarabinogalactan type, while the APS consisted of galactose, mannose, xylose, arabinose, and rhamnose residues in a ratio of 2.6:6.2:2.5:1.1:3.3:3:1.0, respectively, and, in addition to these neutral sugar residues, the APS also contained uronic acid residues.

Thus, the polysaccharides of the roots of *A. paniculata* have been investigated, and water-soluble polysaccharides, pectin substances, and hemicelluloses have been isolated and characterized. The main neutral polysaccharide of the plant is a glucoarabinogalactan. The neutral polysaccharide of *A. paniculata* differs sharply from the neutral polysaccharide of *A. gypsophiloides* in amount, in monosaccharide composition, and, of course, in structure.

EXPERIMENTAL

For PC we used Filtrak FN-3,11,12,16 paper and the solvent system butan-1-ol—pyridine—water (6:4:3), the sugars being detected by spraying with aniline hydrogen phthalate. GLC was performed on aldononitrile acetates and polyol acetates, using a Chrom-5 chromatograph under the following conditions: stainless steel column (0.3 × 200 cm), 5% of Siicone XE-60 on Chromaton NAW (0.200-0.260 mesh), 210°C, carrier gas helium, 60 ml/min, for aldononitrile acetates and polyol acetates. The aldononitrile and polyol acetates were obtained as in [5].

Defatting and Inactivation of the Plant. The comminuted air-dry roots (50.0 g) were first defatted with chloroform in a ratio of 1:10 in the boiling water bath for 1 h twice, the chloroform extract being evaporated, and then the plant residue was inactivated by five treatments with 96% alcohol in a ratio of 1:10 in the boiling water bath for 1 h and was filtered off, and the extracts were evaporated to a syrup. PC showed the presence of glucose, fructose, galactose, mannose, arabinose, xylose, and rhamnose, while pigments and substances of noncarbohydrate nature were detected in the chloroform extract.

Isolation of the WSPSs. After being treated with chloroform and 96% alcohol, the roots were dried and were then extracted three times with water (0.4 liter each time) at room temperature for 2 h. The extracts were combined, the protein was eliminated by Sewag's method [4], the aqueous solution was evaporated in vacuum in a rotary evaporator at 40°C to a volume of 0.3 liter, the polysaccharides were precipitated by trituration in 1.0 liter of alcohol, and the precipitate was separated off by centrifugation and was washed with alcohol and dried in vacuum over P_2O_5. The yield of WSPSs was 4.15 g.

Isolation of the PcSs. The residual raw material after the elimination of the WSPSs was treated twice with a mixture of equal volumes of 0.5% solutions of oxalic acid and ammonium oxalate (1:10) at 70°C for 2 h. The extracts were dialyzed against distilled water, evaporated, and precipitated with alcohol (1:2.5). The precipitate was separated off, dehydrated with acetone and ether, and dried over P_2O_5 in vacuum. The PcSs were obtained in a yield of 1.9 g.

Isolation of the HCs. The residues of the raw material after the isolation of the PcSs were extracted once with a 10% solution of caustic soda (1:10) at room temperature for 2 h. The alkaline extracts were neutralized with acetic acid and dialyzed against distilled water for 2 days. The extract was evaporated and precipitated in methanol (1:2) and the residue was treated in a similar way to the PCSs. The yield of HCs was 3.1 g.

Complete Acid Hydrolysis of the WSPSs, PcSs, and HCs. Samples (0.05 g) of each, separately, were hydrolyzed with 2 N H_2SO_4 at 100°C – the WSPSs for 10 h, and the PcSs and HCs for 45 h. The hydrolysates were neutralized with $BaCO_3$, deionized with KU-2 cation-exchange resin (H^+), and evaporated, and they were studied by PC and GLC.

REFERENCES

1. S. K. Cherepanov, Vascular Plants of the USSR [in Russian], Nauka, Leningrad (1981), p. 154.
2. The Flora of Uzbekistan [in Russian], Uzb. Fil. AN SSSR, Tashkent, Vol. 2 (1941), p. 347.
3 A. O. Arifkhodzhaev and E. S. Kondratenko, Khim. Prir. Soedin., 230 (1983).
4. M. G. Sewag, Biochem. Z., **273**, 419 (1934); R. L. Whistler, Methods in Carbohydrate Chemistry, Academic Press, New York, Vol. 5 (1965), pp. 5-8,
5. D. G. Lance and J. K. N. Jones, Can. J. Chem., **45**, 17 (1995).