POLYSACCHARIDES OF *Ungernia.*

XIII. CARBOHYDRATES OF THE LEAVES OF THE GENUS *Ungernia*

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The present communication gives the results of an investigation of the carbohydrates isolated from the leaves of eight species of *Ungernia*. From a single sample were successively extracted the water-soluble polysaccharides, the glucofructans, the pectin substances, and the hemicelluloses. The qualitative and quantitative monosaccharide compositions of the carbohydrates isolated were dedetermined, and the characteristics of the pectin substances are given.

Continuing an investigation of plants of genus *Ungernia*, we have studied the carbohydrates of the leaves of eight species of *Ungernia* (collected on April 25, 1983 from the experimental plot of the Institute, Tashkent). The polysaccharides were isolated successively from a single sample of air-dry raw material: first the water-soluble polysaccharides (WSPSs) and glucofructans (GFs), and then the pectin substances (PSs) and the hemicelluloses (HCs). The carbohydrates were hydrolyzed with sulfuric acid and the hydrolysates were analyzed by PC and GLC. The results obtained are present in Table 1.

As can be seen from the table, the amount of VSPSs in the various species ranged between 4.1 and 12.8%. The polysaccharides isolated consisted of a cream-colored powder readily soluble in water. Rhamnose, arabinose, mannose, and glucose and, in overwhelming predominance, galactose were detected in the hydrolysis products, which gives grounds for assuming the presence of a galactan in the WSPSs.

The pectin substances, obtained with a yield of 5.4-9.5%, were characterized in more detail. The pectins isolated formed cream-colored powders readily soluble in water and possessing a high positive specific rotation. They included rhamnose, arabinose, xylose, glucose, galactose, and galacturonic acid residues. The amount of the latter was between 51% and 70%. The quantitative characteristics obtained by a titrimetric method [1] showed a low degree of methoxylation of these pectins (Table 2).

The gel chromatography of the pectin substances on Sephadex G-100 showed their polydispersity. These pectins contained no starch impurity as was shown by a negative reaction to iodine.

The alkali-soluble polysaccharides (hemicelluloses I and II; combined yields 4.9 to 11.7%) contained, in addition to neutral sugars, galacturonic acid residues. It is likely that, when the plant was treated with alkali, pectin substances were extracted that did not dissolve on extraction with ammonium oxalate. The HCs had almost identical quantitative compositions but differed in the ratio of the monosaccharide residues. Galactose predominated in the HCs I, while the HCs II contained relatively large amounts of glucose and xylose residues.

Thus, the leaves of plants of the genus *Ungernia* contain no mucilaginous polysaccharides of the mannan type that are characteristic for the bulbs [2, 3].

EXPERIMENTAL

Paper chromatography was performed on Filtrak-FN 11,3 paper in the 1-butanol—pyridine—water (6:4:3) system. The following reagents were used to reveal the spots: 1) aniline hy-

*Deceased.

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TABLE 1. Amounts and Monosaccharide Compositions of the Carbohydrates from *Ungernia* Leaves

Plant species and type of polysaccharide	Yield of polysaccharide, %	Ratio of monosaccharides						Fru	GalUA, %
		Rha	Ara	Xyl	Man	Glc	Gal		
U. spiralis Proskor.									
WSPSs	6,7	1,0	1,7	Tr.	Tr.	Tr.	237,0	—	+
GFs	1,2	—	+	Tr.	—	+	Tr.	+	Tr.
PSs	7,0	1,6	1,5	1,5	1,5	1,0	3 6	—	67
HCs I	5,4	1,0	1,8	3,2	2,9	3,6	16,8	—	+
HCs II	3,7	1,0	3,3	22,9	19,9	45,4	12,8	—	+
U. trisphaera a Bgl.									
WSPSs	4,8	1,5	1,0	Tr.	2,0	1,0	63,0	—	+
GFs	3,8	—	+	Tr.	—	+	Tr.	+	Tr.
PSs	6,0	1,0	2,1	—	—	1,3	18,9	—	51
HCs I	5,6	1,6	1,3	1,0	2,1	3,3	58,8	—	+
HCs II	3,0	4,1	1,0	10,3	3,2	8,0	4,8	—	+
U. oligostroma M. Pop. et Vved.									
WSPSs	4,7	1,3	1,5	Tr.	1,8	1,0	147,8	—	+
GFs	6,1	+	+	Tr.	—	+	Tr.	+	Tr.
PSs	6,0	3,8	3,8	1,0	Tr.	4,4	43,9	—	61
HCs I	3 3	1,0	1,5	1,7	1,4	2,1	13,3	—	+
HCs II	6,4	1,0	1,8	7,1	5,1	12,5	9,0	—	+
U. ferganica Vved.									
WSPSs	9,7	1,0	1,3	Tr.	Tr.	Tr.	117,3	—	+
GFs	1,3	—	+	Tr.	—	+	Tr.	+	Tr.
PSs	6,8	1,2	1,0	1,0	—	Tr.	48,4	—	56
HCs I	3,1	5,8	10,4	15,2	1,0	10,1	20 0	—	+
HCs II	5,8	1,0	1,5	14,8	11,9	22,8	9,6	—	+
U. tadshikorum Vved.									
WSPSs	8,5	1,5	1,5	—	2,0	1,0	212,5	—	+
GFs	2,4	Tr.	+	Tr.	—	+	Tr.	+	Tr.
PSs	9,5	7,0	7,5	1,0	—	3,0	3,6		70,4
HCs I	3,9	1,0	1,4	2,8	2,0	2,0	4 7	—	+
HCs II	4,4	17,3	1,0	5,2	9,0	4,8	4,3	—	+
U. vvedenskyi S. Khamidkh.									
WSPSs	4,1	2,9	2,9	Tr.	2,0	1,0	165,7	—	+
GFs	0,25	—	+	—	—	+	+	+	Tr.
PSs	4,8	5,0	1,0	2,0	2,3	Tr.	42,4	—	52,6
HCs I	3 7	1,1	2,8	3,5	1,0	4,1	8,4	—	+
HCs II	5,8	4,0	1,9	1,0	2,6	4,0	3,1	—	+
U. victoris Vved.									
WSPSs	12,8	1,4	2,0	1,0	Tr.	1,6	121,3	—	+
GFs	1,0	—	+	—	—	+	+	+	Tr.
PSs	7,8	2,5	1,6	Tr.	Tr.	1,0	23 8	—	63
HCs I	3,9	1,5	1,5	5,5	1,0	6,0	3,4		+
HCs II	2,7	1,0	1,1	11,8	11,9	2,5	7,7	—	+
U. sewerzowii (Rgl) B. Fedsch.									
WSPSs	10,0	1,0	2,5	Tr.	2,3	2,3	385,0	—	+
GFs	3,9	—	+	—	—	+	+	+	Tr.
PSs	9,5	3,2	2,2	1,0	—	2,0	23,2	—	52,4
HCs I	3,0	1,0	2,0	8,3	5,6	3,7	9,3	—	+
HCs II	2,6	1,0	1,0	19,2	16,5	39,7	17,5	—	+

TABLE 2. Characteristics of the Pectin Substances of *Ungernia* Leaves

Species of plant	$[\alpha]_D^{+30°}$	η^* of 0.25% soins	Quantitative characteristics†			
			K_f	K_e	% OCH_3	%λ
U. spiralis	+240	1.7	9,5	7,2	5,0	43,2
U. trispnaera	+260	1,2	11,5	7.0	4,8	37,8
U. oligostroma	+2+4	2,5	1 ,3	4,9	3,3	30,1
U. ferganica	+ 10	1,9	13,3	5'4	3,7	28,5
U. tashikorum	+188	2,1	11,4	5,4	3,7	32,2
U. vvedenskyi	+190	1,8	10,0	,2	5,0	42,0
U. victoris	+260	1 2	12,0	3,5	5,5	30,3
U. sewerzowii	+215	1,4	13,1	4,7	3,4	26,6

*Solution prepared in 1% NaCl solution.
†K_f — free carboxy groups; K_e — methoxylated carboxy groups; λ — degree of methoxylation.

drogen phthalate; 2) urea—hydrochloric acid. The GLC of the materials was carried out on a Tsvet-101 instrument with a flame-ionization detector under the following conditions: steel column (200 × 0.3 cm), 5% of silicone XE-60 on Chromaton NAW (0.200-0.250 mm), 210°C, carrier gas helium, 60 ml/min. The monosaccharides were analyzed in the form of aldononitrile acetates [4]. The relative proportions of the sugars were determined from the areas of the peaks on the chromatograms. Optical rotations were determined on a Goers polarimeter, l = 1 dm at 28°C. Viscosities were measured with VPZh-2 capillary viscometer with a diameter of 0.73 mm. The amounts of uronic acids were determined by the decarboxylation method [5].

Isolation of the Polysaccharides. The WSPSs (together with the GFs), the PSs, and the HCs I and HCs II were extracted successively from 20 g of air-dry raw material by a method described previously [6].

The acid hydrolysis of the polysaccharides was carried out with 2 N H_2SO_4 during 6 h for the WSPSs and 24 h for the PSs, HCs I, and HCs II, and with 1 N H_2SO_4 for 3 h in the case of the GFs. The neutralized and purified hydrolysates were analyzed by PC and GLC.

Gel Chromatography of the Pectin Substances. Solutions of 10 mg of the pectins in 1 ml of water were deposited on a column (35 × 1.8 cm) filled with Sephadex G-100. Elution was performed with water. The eluates were collected in 3-ml portions and they were analyzed by the phenol/sulfuric acid method [7].

CONCLUSIONS

An analysis has been made of the group compositions of the polysaccharides of the leaves of eight species of *Ungernia*. The quantitative amounts of water-soluble polysaccharides, glucofructans, pectin substances, and hemicelluloses have been determined. The qualitative compositions and ratios of the component monosaccharides have been determined for the majority of these materials.

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