POLYSACCHARIDES OF SOME PLANT WASTES.

I. CHARACTERISTICS OF THE PECTIN FROM THE LEAVES OF *Ficus carica*

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In view of the importance and urgency of the utilization of plant wastes, we have begun an investigation of the amounts of seed carbohydrates from the fresh residue of grapes *Vitis vinifera* (Vitaceae) (I), the pressed pulp of the sea buckthorn *Hippophae rhamnoides* L. (Eleaegnaceae) (II): the press-cake of amorpha *Amorpha fruticosa* L. (Leguminosae) (after ethanol—chloroform extraction) (III), the rind and seeds from the press-pulp of the pomegranate *Punica granatum* (Punicaceae) (IV), and the leaves of the fig *Ficus carica* L. (Moraceae) (after extraction with aqueous acetone) (V).

One sample was subjected to successive extraction with 82% ethanol to give the ethanol-soluble sugars (ESSs), with water to give the water-soluble polysaccharides (WSPSs), with a mixture of 0.5% solutions of oxalic acid and ammonium oxalate at 70°C to give the pectin substances (PSs), and with 7% and 14% caustic soda solutions to give the hemicelluloses (HCs). Below we show the amounts of carbohydrates in the wastes of the plants (% on the absolutely dry weight of the raw material):

	Plant wastes	*ESSs*	*WSPSs*	*PSs*	*HCs*	
					7%-KOH	*14 %-KOH*
I—	seeds	2.4	4.6	2.6	26.1	13.0
II—	pericarp of the seeds	6.5	1.5	0.8	15.3	5.2
		5.3	1.3	0.5	18.0	3.7
III—	seeds with capsules	12.0	3.0	2.5	8.4	2.0
IV—	ring	11.5	0.7	2.5	1.7	0.3
	seeds	4.5	7.5	3.5	16.8	3.3
V—	leaves	1 5	2.9	10.1	1.6	3.1

As we see, in the majority of wastes the bulk of the carbohydrates consists of hemicellulose and ethanol-soluble sugars. Only in fig leaves does the amount of pectin reach about 10%. After being freed from proteins by Sevag's method [1], the amount of nitrogen in it was 3.86%, $[\alpha]_D^{23}$ + 200° (c 0.5; water). The IR spectrum (tablets with KBr) had absorption bands in the 3400-3600, 1730-1740, 1620, 1430, 1330, 1240, 1120-1020-930, and 840 cm^{-1} regions.

The PSs of the fig leaves were readily soluble in water and 1.0, 0.5, and 0.1% solutions had relative viscosities of 2.8, 1.8, and 1.2, respectively.

The monosaccharide composition of the pectin was determined after complete acid hydrolysis (2 N H_2SO_4, 100°C, 14 h) with the aid of PC in the butan-1-ol—pyridine—water (6:4:3) system and by GLC of the acetates of corresponding aldononitriles on a Tsvet-101 instrument with a flame-ionization detector using steel column (200 × 0.3 cm) filled with 5% of XE-60 on Chromaton N-AW, 0.200-0.250 mm with helium as the carrier gas (55 ml/min) at a column temperature of 210°C. By these methods we found glucose, galactose, xylose, rhamnose and arabinose in a ratio of tr.:1.0:tr.:1.8:2.6, and we also detected the presence of galacturonic acid. On the analysis [2] of the initial pectin we found (%): free carbonyl groups, K_c, 1.7; methanoxycarbonyl groups, K_e, 3.7; degree of esterification, 6.82; methoxy groups, CH_3O, 2.55.

Gel filtration of the PSs on Sepharose 4B showed their heterogeneity. The PSs were fractionated on a column of DEAE-cellulose (phosphate form). Elution with water, phosphate

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buffer (pH gradient 5.8-8.0), and 0.1 N caustic soda gave 6 fractions with yields of 4, 5, 2, 15, 13, and 57%, respectively. The last main fraction had $[\alpha]_D^{23}$ + 190° (c 0.5; water).

Thus, fig leaves, which are a source of the production of furocoumarins [3], contain pectin substances with a low degree of esterification.

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POLYSACCHARIDES OF SAPONIN-BEARING PLANTS.

I. CHARACTERISTICS OF THE POLYSACCHARIDES OF *Allochrusa gypsophiloides*

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Allochrusa gysophiloides Rgl.* (Turkestan soaproot; local name — etmak) has long been used in many ways because of its high content of saponins and at the present time it is being cultivated. Of the components of the roots, only the saponins have been studied chemically [1], while the other carbohydrate components, including the polysaccharides, have not been investigated.

We have studied the polysaccharides of the roots, samples of which were kindly provided by N. Motkhin (Institute of Botany, Academy of Sciences of the Uzbek SSR).

To eliminate low-molecular-weight carbohydrates and other compounds the air-dry comminuted roots were first exhaustively extracted with chloroform and with 96% and 82% ethanol, successively. Then the water-soluble polysaccharides (WSPSs) were extracted with water (1:5) at room temperature for 2 h 4 times. The extract was evaporated in vacuum, freed from proteins by Sevag's method, and precipitated with methanol (1:5).

The pectin substances (PSs) were obtained by the successive extraction with a mixture (1:1) of 0.5% solutions of oxalic acid and ammonium oxalate twice at 70°C for 2 h. The extract was dialyzed against distilled water, evaporated in vacuum, and precipitated with methanol [1:3].

The hemicelluloses (HCs) were obtained by extraction with 10% NaOH (1:3) at room temperature three times for 2 h. The solution was neutralized with acetic acid, dialyzed against distilled water, evaporated in vacuum, and precipitated with methanol (1:4).

All three polysaccharides were hydrolyzed with 1 N sulfuric acid with heating (10 h) and the monosaccharides from the hydrolysate were determined by PC in the butan-1-ol—pyridine—water (6:4:3) system, and by GLC as the acetates of the corresponding aldonotriles on a Tsvet 101. We give the amounts and monosaccharide compositions of the polysaccharides of *A. gypsophiloides*:

*This plant previously had the name of *Acanthophyllum gypsophiloides*.

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