POLYSACCHARIDES OF *Ungernia ferganica*

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The plane *U. ferganica* Vved [1] is widely distributed in the basin of the R. Kugart in the Suzak region of the Osh oblast, KirgSSR, over an area of 112 ha, from which every year are collected about 25 tons of dried leaves, which form the source of the drug lycorine [2]. Continuing an investigation of the chemical composition of the carbohydrates of plants of the genus *Ungernia* [3], we have studied the polysaccharides in the leaves and bulbs of *U. ferganica* in relation to the periods of development. The dried and comminuted raw material (10.0 g) was treated with ethanol and extracted with water. The extract was evaporated to a syrup and poured into a threefold volume of ethanol. The precipitate was dissolved in water and the protein impurities were eliminated by Sevag's method [4]. After reprecipitation with ethanol, the product was washed with acetone and with ether and was dried in vacuum over P_2O_5. This gave the water-soluble polysaccharides (PSS). From the residue of the raw material after the elimination of the PSs we isolated the pectin substances (PCs) [1] (Table 1).

Polysaccharides were detected in the leaves and bulbs in the earliest phases of development and they underwent quantitative changes throughout the vegetation period.

To determine their qualitative carbohydrate compositions, samples of the PSs and PCs were hydrolyzed with 1 N H_2SO_4 (6 and 48 h, respectively) followed by neutralization with $BaCO_3$. For paper chromatography (PC) we used FN-17 and FN-12 papers in the 1-butanol—pyridine—water (6:4:3) system with an exposure time of 24 h. Paper electrophoresis was performed at 1100 V, 10 mA (1% CH_3COOH). A negative iodine reaction showed the absence of starch from the PSs isolated. The polysaccharides of the leaves were chromatographed on DEAE-cellulose. From an aqueous eluate we obtained a neutral polysaccharide giving galactose and arabinose on acid hydrolysis. The polysaccharide fraction obtained by elution with 0.1-0.3 N NaOH gave on hydrolysis galacturonic acid, arabinose, galactose, mannose, and rhamnose.

The polysaccharides of the bulbs consisted of a white fibrous powder soluble in water to form a sticky solution. The polysaccharide purified via the copper complex (70.0% of the initial PSs) did not dissolve in water, and on hydrolysis it gave mannose and glucose.

TABLE 1. Amounts of Polysaccharides (PSs) and Pectin Substances (PCs) in the Leaves and Bulbs of *Ungernia ferganica* (% on the weight of the air-dry raw material)

Date of collection (1975)	Height of the leaves, cm	Leaves		Bulbs	
		PSs	PCs	PSs	PCs
20.III	3—4	3,8	4,5	7,5	4,0
30.III	15—20	4,5	3,0	10,1	6,5
5.IV	25—26	5,1	2,5	9,2	6,0
26.IV	35—45	4,0	3,3	8,0	7,2
22. V	35—45	5,6	14,3	10,1	10,2
12. X	—	—	—	10,1	9,1

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From the mother solution a polysaccharide was isolated which gave galactose, mannose, galacturonic acid, and traces of glucose on hydrolysis.

The pectin isolated from the leaves (collected on May 22), after reprecipitation with ethanol, demineralization, and drying, consisted of a cream-colored powder containing 38% of uronic anhydride and 2.5% of OCH_3 groups; a 0.25% aqueous solution of the pectin formed a viscous colloidal system (η_{rel} 2.0). From a hydrolyzate of the pectin by precipitation with methanol we obtained the barium salts of the uronic acids, which were analyzed by electrophoresis and shown to consist of galacturonic acid. According to paper chromatography, the pectin of the bulbs contained galactose, mannose, galacturonic acid, and glucose.

Thus, it has been established that the polysaccharides of U. ferganica include a glucomannan and pectin.

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A REFRACTOMETRIC STUDY OF PECTIN SUBSTANCES

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We have investigated by refractometry the pectin substances from seaweeds — zosterin [1] — and from ginseng — panaxan [2] — and fragments of them. We have studied the interaction of the biopolymers with low-molecular-weight additives from the nature of the change in the difference of the refractive indices of solution and solvent Δn as a function of the concentration of the biopolymer c and from the increase in the refractive index dn/dc.

The improvement in the solubility of the galacturonan and the apiogalacturonan from zosterin with the addition of urea corresponds to a bend in plots of Δn versus c, and for the apiogalacturonan in 0.8 and 1 M urea singular points appear on these curves (Fig. 1), which, according to well-known refractometric ideas [3], correspond to a process of complex-formation by the biopolymer and the urea. No such relationships and, correspondingly, no significant increase in solubility are observed for zosterin. Additions of small amounts of ammonium hydroxide increase the solubility of the galacturonan, as is shown by an increase in dn/dc. As follows from the results of light-scattering experiments [4], the decrease in dn/dc with the addition of large amounts of NH_4OH corresponds to the aggregation of the biopolymer. The interaction of NaCl with the macromolecules of panaxan and with the galacturonan from panaxan found refractometrically corresponds to an improvement in solubility and to disaggregation in solutions of biopolymers [4]. For zosterin at the threshold of gelatinization [5] an increase of its interaction with acid has been reported. The addition of sucrose to solutions of zosterin does not lead to a change in the refractometric relationships, which shows the absence of appreciable chemical interaction with sucrose.

Thus, the addition of low-molecular-weight additives to solutions of pectin substances frequently leads to their interaction with biopolymers which in some cases is accompanied by a process of disaggregation and in others by aggregation or gelling.

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