POLYSACCHARIDES OF *Eremurus*.

X. CHARACTERISTICS OF THE POLYSACCHARIDES OF *Eremurus lactiflorus* AND *E. Luteus*

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Water-soluble polysaccharides have been isolated from two species of *Eremurus* — *E. lactiflorus* and *E. luteus* — with yields of 13.5% and 20.5%, respectively. They contained mainly glucose and mannose in ratios of 1:5 and 1:3.1. The polysaccharides of *E. lactiflorus* were separated from a column of DEAE-cellulose. The yield of neutral fraction was 10.3%. Gel filtration of the polysaccharides on Sephadex G-200 showed their polydispersity. Homogeneous fractions were obtained by fractional precipitation with ethanol. They have been characterized with respect to monosaccharide composition, molecular weight, and IR spectra.

It has been shown previously [1, 2] that the tuberous roots of *Eremurus* are rich in water-soluble polysaccharides. We have isolated the polysaccharides (PSs) by the method of Stepanenko et al. [3] and have freed them from protein substances as described by Sevag [4]. From *E. lactiflorus* O. Fed. we isolated 13.5% of PSs (A), and in a hydrolysate of these by paper chromatography (PC) we detected arabinose, galactose, mannose, glucose, and uronic acids. The ratio of glucose and mannose according to gas-liquid chromatography (GLC) was 1:5. The amount of O-acetyl groups was 4.1% [5]. From *E. luteus* Bak. we isolated 20.5% of PS (B) consisting of glucose and mannose in a ratio of 1:3.1 and containing 9.1% of O-acetyl groups. In order to separate it from acidic PSs, polysaccharide A was passed through a column of DEAE-cellulose in the acetate form. Water eluted a neutral fraction (A-I) with a yield of 10.3% (on the air-dry raw material) (Scheme 1).

The gel filtration of polysaccharides A-I and B on a column of Sephadex G-200 showed their polydispersity (Fig. 1). Consequently, the polysaccharides were mixtures of polymer homologs.

To obtain homogeneous PCs they were subjected to fractional precipitation with ethanol from aqueous solutions [6]. On fractionation, both PCs gave several fractions: the first fraction from A-1 with a yield of 58% proved to be homogeneous (A-2) (Fig. 2); B gave a second fraction (B-1) with a yield of 60%. Hydrolysates of A-2 and B-1 were found to contain glucose and mannose in ratios of 1:2.8 and 1:3.4, respectively.

Fraction A-2 consisted of a white amorphous powder soluble in water with $\eta_{rel} = 20.5$ [a]$_D^{20}$ $= -21.7^\circ$ (c 0.736; H$_2$O). The IR spectrum of A-2 contained absorption bands at (cm$^{-1}$) 3600-3200 (OH), 1730 and 1250 (ester group), 880 (8-glycosidic bond) and 815 (hexapyranose ring) [7]. A quantitative determination [5] showed the presence of 2.05% of O-acetyl groups.

Polysaccharide B-1 formed a cream-colored powder, a 1% aqueous solution of which formed a viscous colloidal system with $\eta_{rel} = 9.66$. The amount of O-acetyl groups was 7.4%. Its IR spectrum was similar to that of A-2, i.e., it had the same absorption bands.


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The ultracentrifugation of polysaccharides A-2 and B-1 (Fig. 2) showed one peak in each case, indicating their homogeneity.

On treatment with Fehling's reagent [8], polysaccharides A-2 and B-1 formed copper complexes the decomposition of which yielded A-3, with a glucose-mannose ratio of 1:2.7, and B-2, with a ratio of 1:3.6, respectively. The IR spectra of the products A-3 and B-2 obtained differed from the spectra of A-2 and B-1 by the absence of the absorption band of an ester group. Consequently, in their treatment with Fehling's reagent they underwent deacetylation.

The retention of the ratios of the monosaccharides in A-2 and A-3 and in B-1 and B-2, and also the results of gel filtration on Sephadex G-150 (Fig. 3) show that the fractions of polysaccharides obtained were homogeneous and belonged to the glucomannan group.

The weight-average molecular weights of the glucomannans A-2 and B-1 calculated from a calibration curve based on dextrans (molecular weights 110,000, 80,000, and 40,000) [9], were 79,000 and 150,000, respectively. These results are close to the molecular weights found by sedimentation analysis [10] (76,900 and 140,000, respectively).

The monosaccharide ratios and molecular weights of the glucomannans of the species of plants studied differ from those of Eremerus polysaccharides studied previously [1, 11, 12].

According to their botanical classification, E. lactiflorus and E. luteus belong to the section Heningia [13, 14]. However, E. lactiflorus, which contains a glucomannan, is an exception from this classification, since Heningia species do not accumulate glucomannan [15]. Our results from the study of two species of Eremerus have shown that in actual fact both E. lactiflorus and E. luteus, which are rich in glucomannans, form exceptions to this classification.

**EXPERIMENTAL**

Solutions were evaporated in a rotary evaporator at 40°C. IR spectra were taken on a UR-20 instrument in KBr tablets. Paper chromatography (PC) was performed on Filtrak FN-7, -11, and -16 papers (GDR) by the descending method using the following solvent systems (by volume): 1) butan-1-ol-pyridine-water (6:4:3); 2) ethyl acetate-pyridine-water (7:2:1); and 3) propan-1-ol-ethyl acetate-water (7:2:1). To indicate the spots we used aniline hydrogen phthalate (at 105-110°C, 10-15 min) [16]. The samples in the form of the acetates of the corresponding aldonitriles [17] were subjected to GLC on a Tsvet-101 instrument with a flame-ionization detector using a steel column (0.3 x 200 cm) filled with Chromaton N-AW, 0.200-0.250 mm, impregnated with 5% of Silicone XE-60 with helium as the carrier gas at the rate of 60 ml/min, the column temperature being 210°C.