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Plant Mucilages. V.[1] Isolation and Characterization of a Mucous Polysaccharide, "Falcatan," from *Polygonatum falcatum* Rhizomes*

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The rhizome of *Polygonatum falcatum* A. Gray has been used as a crude drug for the purpose of analeptic, but no report on the constituents of this rhizome has been published until present time. We have now isolated a mucous polysaccharide from this material, and its properties are described in this paper.

The fresh rhizomes were extracted with hot methanol, followed by extraction of the residue with hot water. The methanol extract contains fructose, glucose, sucrose and oligosaccharides composed of fructose and glucose. The crude mucilages were precipitated from the water extract by addition of ethanol. The supernatant contains polysaccharides composed of fructose, glucose and galacturonic acid. The solution of the precipitate was applied to a DEAE-cellulose (acetate form) column, and a mucous polysaccharide was obtained from the eluate with water. Thus the outline of the fractionation is similar to the case of odoratan.

The polysaccharide gave one spot on glass-fiber paper electrophoresis in alkaline borate buffer and was homogeneous on gel chromatographies with Sephadex G-200 and Sepharose 4B. The name "falcatan" is proposed for the polysaccharide. It showed a negative specific rotation ($[\alpha]_D^{21}$ $-29.0°$ in H_2O, $c=0.5$). The water solution of it gave the intrinsic viscosity value of 2.75 at 25°.

As the component sugars of falcatan, fructose, mannose, glucose, and galacturonic acid were identified by means of cellulose thin-layer chromatography of the hydrolysate and gas-liquid chromatography of its trimethylsilyl derivative. Quantitative determinations of them showed that the molar ratio was as follows; fructose: mannose: glucose: galacturonic acid was about 25: 10: 5: 1.

The average molecular weight of falcatan estimated from the calibration curve, which is obtained by the gel chromatography of standard dextran fractions of known molecular weights on Sepharose 4B, was *ca.* 420000. The measurement of osmotic pressure gave the value of 410000 as the molecular weight of falcatan.

Less amount of the other polysaccharide fraction was obtained from the DEAE-cellulose column with an elution of sodium acetate solution, and this fraction contains galactose, arabinose, xylose, rhamnose and galacturonic acid as its component sugars. But no fraction showed evident mucosity in water solution except falcatan.

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1) Part IV: M. Tomoda, S. Nakatsuka and E. Minami, *Chem. Pharm. Bull.* (Tokyo), **20**, 953 (1972).

By means of the digestion with β-fructofuranosidase, 95.3% of fructose was liberated from falcatan. And fructose was the single carbohydrate of low molecular weight produced by the enzymic action. The residue after liberation of fructose was homogeneous on gel chromatography with Sephadex G-200 and its molecular weight was estimated as *ca.* 170000 from the calibration curve. This result provided the clear evidence that the estimated fructose in falcatan exists as its component.

As the result of periodate oxidation, 0.81 mole of periodate per one mole of the average component anhydro sugar of falcatan was consumed with 0.03 mole of formic acid liberation. The periodate-oxidized polysaccharide was treated by the Smith procedure, and the analysis of the hydrolysate of the reduction product revealed the presences of glycerol, erythritol and mannose. Quantitative determination of them by gas-liquid chromatography of trimethylsilyl derivatives showed that their molar ratio was about 16: 2: 1.

The formation of a large quantity of glycerol by Smith degradation and the result of the enzymic degradation suggest that fructose exists as 2→1 or 2→6 linked ketohexofuranose residue. The presences of 1→2 and 1→4 linked aldohexopyranose residues were also indicated from the result of Smith degradation, because erythritol was produced in addition to a large quantity of glycerol. It is probable that a part of mannose residues occupies branching positions in falcatan, although the possibility of the presence of some of mannose residues having 1→3 linkage is unable to be denied yet.

As already described in the former report, a mucous polysaccharide, odoratan, has been isolated from the rhizomes of *Polygonatum odoratum* Druce var. *japonicum* Hara and its properties were investigated in this laboratory. Odoratan has the same component sugars as falcatan, although molar ratio of them differs from that of the latter. Both polysaccharides show similar viscosity and have approximately the same molecular weight and it is interesting that they contain many fructose residues as a component. The detail of the structure will be reported in following papers.