

BRIEF COMMUNICATIONS

CARBOHYDRATES FROM *Sophora flavescens* SEEDS

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UDC 582.949.27+547.917

Sophora flavescens Soland (Leguminosae) is a medicinal plant, the roots of which are used widely in Tibetan medicine to treat infectious diseases and diseases of the gastro-intestinal tract and nervous system [1]. The chemical composition of its roots [2] and seeds of Leguminosae plants have been investigated for the presence of galactomannans. Information about the compounds contained in *S. flavescens* seeds is scarce and addresses mainly the alkaloids [3, 4].

The goal of our work was to investigate preliminarily the carbohydrate composition of *S. flavescens* seeds.

Ground seeds of *S. flavescens* (30 g) were extracted in a Soxhlet apparatus with hexane, CHCl_3 , and ethylacetate. The composition of free carbohydrates (FC) was found by extracting the raw material with ethanol (80%). High-efficiency TLC and densitometry detected glucose, galactose, and saccharose in a 33:1.5:1 ratio. The total content of FC determined by the anthrone method [5] was $5.24 \pm 0.12\%$.

After removing FC, raw material was treated with water (ratio 1:100, 100°C) and a mixture of oxalic acid and ammonium oxalate solutions (0.25%, 1:1, 100°C) to produce fractions of water-soluble polysaccharides (WSPS) and pectinic substances (PS) in yields of 2.3 and 14.9%, respectively.

WSPS, $[\alpha]_D^{20} +54^\circ$ (c 0.6, H_2O). A solution of WSPS with Fehling solution did not give a precipitate, which indicated that mannan-type polysaccharides were absent. Fractionation by ethanol produced two components SFW-1 ($c_{\text{EtOH}} = 63\%$) and SFW-2 ($c_{\text{EtOH}} = 74\%$) in yields of 38.8 and 9.0% of the WSPS mass. Gel chromatography over Sephadex G-200 (column 1.5×65 cm, 0.5% NaCl) of the studied polysaccharides demonstrated that they were homogeneous.

It was found that SFW-1 consisted of two compounds, SFW-1' and SFW-1'', with MW $1.4 \cdot 10^5$ and $6.2 \cdot 10^4$ Da in a 1:22 ratio. The monosaccharide composition (Table 1) and a positive reaction with iodine indicated that these compounds were probably glucans. Bands at 840 cm^{-1} in the IR spectrum confirmed that α -bonds were present (Perkin—Elmer IR-Fourier spectrometer on KRS-5 glass). The SFW-2 component was homogeneous with MW $4.8 \cdot 10^4$ Da and galactose as the dominant component.

PS, $[\alpha]_D^{20} +71^\circ$ (c 1.0, 20% NH_3). Titration [6] found that the content of free carboxylic groups (K_C) was $2.20 \pm 0.08\%$; esterified carboxylic groups (K_E), $0.87 \pm 0.05\%$; and degree of esterification (λ), 28-29%. Thus, PS from *S. flavescens* are a slightly esterified pectin with a very low (10.3%) content of GalUA. Fractionation of PS through calcium pectate, alkaline saponification [7], and subsequent purification over DEAE-cellulose in the CO_3^{-2} -form [8] produced acidic and neutral components PS-1 and PS-2 in yields of 12.4 and 32% of the initial amount.

PS-1 was pectic acid with 73% GalUA. The ratio of neutral carbohydrates Gal:Ara:Xyl:Rha:Glc was 8:3:3:2:1. Gel chromatography of PS-1 gave a single peak corresponding to MW $\approx 3.0 \cdot 10^4$ Da and $[\alpha]_D^{20} +92^\circ$ (c 0.8, 20% NH_3).

The hydrolysate of PS-2 did not contain uronic acids. The dominant monosaccharides were Gal and Glc in a 1:2.1 ratio. PS-2 was heterogeneous and a mixture of two compounds PS-2' and PS-2'' with MW $7.4 \cdot 10^4$ and $6.0 \cdot 10^4$ Da in a 3:4 ratio. The monosaccharides contained Glc, Gal, and Ara in 11:3:1 and 8:4:1 ratios for PS-2' and PS-2'', respectively.

The tissue remaining after removal of WSPS and PS was extracted with KOH solution (5%, 1:30, 20°C), neutralized, and extracted with HCl (10%) to afford a fraction of hemicellulose of group A (HC_A). A fraction of hemicellulose of group B (HC_B) was precipitated by ethanol from the solution remaining after removal of HC_A . The yields were 1.22 and 0.15% of the absolute air-dried mass of raw material for HC_A and HC_B , respectively. The main monosaccharides in both fractions were Xyl and Glc in 8:1 and 1:2 ratios, respectively.

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TABLE 1. Monosaccharide Composition of Carbohydrate Fractions from *S. flavescens*

Fraction	Monosaccharide composition, mol %							
	Ara	Gal	Glc	Man	Rha	Sac	Xyl	GalUA
FC	-	4.1	93.0	-	-	2.8	-	-
WSPS	11.3	9.3	74.5	1.4	0.1	-	3.3	-
SFW-1	12.1	2.0	76.8	3.2	0.3	-	5.5	-
SFW-1'	5.7	1.4	89.3	-	0.2	-	3.3	-
SFW-1''	12.7	2.1	75.2	3.8	0.4	-	5.7	-
SFW-2	-	89.8	5.4	-	-	-	4.7	-
PS	6.8	21.4	53.2	-	3.2	-	5.0	10.3
PS-1	4.8	12.7	1.6	-	3.0	-	4.8	73.0
PS-2	9.1	28.7	62.1	-	-	-	-	-
PS-2'	6.6	19.9	73.4	-	-	-	-	-
PS-2''	7.7	28.0	64.2	-	-	-	-	-
HC _A	-	-	10.8	-	1.9	-	87.2	-
HC _B	-	-	65.9	-	-	-	34.0	-

In summary, the data lead to the conclusion that galactomannans are absent in seeds of *S. flavescens*. Bailey [9] investigated earlier the composition of polysaccharides from seeds of several representatives of the genus *Sophora*, section *Edwardsia* (*S. tetraptera*, *S. chrysophylla*, *S. microphylla*) and *Sophora* (*S. tomentosa*), which are close in systematic position to the section *Wightia*, in which *S. flavescens* is placed. Galactomannans were not observed in species of these sections. This confirmed the conclusions about the close relationship of these sections that were made earlier based on morphological data [10] and DNA analysis [11].

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