CARBOHYDRATES OF ALLIUM

IX. POLYSACCHARIDES OF A. suvorovii

UDC 547.917

M. A. Khodzhaeva and M. T. Turakhozhaev

The carbohydrate compositions of all the organs of Allium suvorovii Rgl have been determined and it has been established that the bulk of the fructose accumulates in its bulbs. The dynamics of the accumulation of glucofructans in the bulbs has been studied and it has been found that this accumulation is a maximum in the dormancy stage.

Continuing an investigation of the carbohydrates of Allium L. [1, 2], we have studied the carbohydrate composition of Allium suvorovii Rgl (Tadzhikistan, Western Gissar range) in various organs of the plant (Table 1) and also the dependence of the amounts of alcohol-soluble fraction (AS) and of the water-soluble polysaccharides (WSPSs) on the vegetation period (Table 3).

The carbohydrate composition of the AS fraction was represented by glucose, fructose, sucrose, and raffinose. Glucose and fructose were found in the products of the complete acid hydrolysis of the WSPSs; i.e., they were glucofructans. Gel chromatography of the glucofructans on Sephadex G-75 showed their polydispersity, and their molecular masses, calculated from a graph of the dependence of log MM on the elution volume, ranged from 2000 to 50,000.

Hydrolysates of the HMC-A and HMC-B were found to contain glucose, galactose, and arabinose, and those from the pectin substances contained glucose, galactose, xylose, arabinose, rhamnose, and galacturonic acid. The pectin substances made up a large part of the carbohydrate composition of the leaves and stems of A. suvorovii Rgl, and their physicochemical characteristics are given in Table 2. The pectin substances of all the organs of A. suvorovii Rgl had high positive specific rotations and the absorption bands characteristic for pectins in the IR spectra; they had a low degree of esterification.

As can be seen from Table 3, the amount of WSPSs was a maximum at the beginning of vegetation, but the subsequent growth of the leaves and stems, the formation of buds, and flowering led to the breakdown of the high-molecular-mass water-soluble polysaccharides to form lower oligosaccharides, sucrose, glucose, and fructose, and the amount of the latter reached a maximum by the beginning of the dormancy stage. In the dormancy stage the synthesis of water-soluble polysaccharides of higher molecular weight took place, up to a maximum at the beginning of

TABLE 1. Carbohydrate Components of A. suvorovii Rgl (yield, %)

Plant organ	AS	WSPSs	PcSs	HMC-A	HMC-B
Bulb	26,5	53,8	2 2	0,8	0,6
Stems	26,0	10 2	12,0	4,2	1,1
Leaves	15,0	7 4	8,9	1 3	0.9
Seeds	12,0	1,5	2,5	3,6	1,2

TABLE 2. Physicochemical Characteristics of the PcSs of All the Organs of A. suvorovii Rgl

Pectin substances (PcSs)	Specific rotation (c 0.25, H_2O), deg	Amount of uronic anhydride, %	OCH_3, %	Characteristic absorption bands in the IR spectrum
Bulbs	+180	—	1,4	910, 930, 1030, 1120, 1160, 1330
Seeds	+147	31,0	3,2	1450, 1650, 1750, 2930, 2940,
Leaves	+152	33,0	—	3400—3600
Stems	+164	—	2,38	±5

Institute of Chemistry of Plant Substances, Uzbekistan Academy of Sciences, Tashkent.
Translated from Khimiya Prirodnykh Soedinenii, No. 6, pp. 622-624, November-December, 1992. Original article submitted September 6, 1990.

0009-3130/92/2806- 0540$12.50

TABLE 3. Amounts of Carbohydrates in the Bulbs of A. suvorovii Rgl According to the Vegetation Period (% on the weight of the absolutely dry raw material)

Vegetation period and date of collection	Carbohydrates (%) soluble in alcohol	Carbohydrates (%) soluble in water
Beginning of development 03.09.82	11,3	55,0
Beginning of budding, 03.24.82	12,0	53,0
Budding 04.03.82	14,2	44,0
Beginning of flowering, 04.10.82	24,0	41,7
Flowering, 04.26.82	26,4	40,7
Beginning of fruit-bearing, 05.06.82	40,2	22,5
Fruit bearing, 05.30.82	52,8	20,1
Beginning of the dormancy stage, 06.30.82	58,0	18,0
Dormancy stage, 07.30.82	50,3	23,6
" 08.30.82	45,4	31,2
" 09.30.82	38,0	33,8
" 10.30.82	30,0	46,0
" 11.30.82	21,1	57,0
" 12.30.82	19,1	55,0
Beginning of development, 01.02.83	20,0	49,0
Beginning of development, 03.01.83	23,0	41,0

the new vegetation period. Thus, the amounts of both the alcohol-soluble and the water-soluble carbohydrates of A. suvorovii Rgl change according to the phase of development of the plant.

EXPERIMENTAL

Solutions were evaporated in a rotary evaporator at 40 ± 5°C.

Paper chromatography (PC) was conducted on FN-7, 17 paper by the descending method using the following solvent systems (by volume): 1) butan-1-ol—pyridine—water(6:4:3); 2) water-saturated phenol (lower layer). Aniline hydrogen phthalate was used to reveal the spots.

Specific rotations were determined on a Zeiss polarimeter in tubes 1 dm long with a volume of 10 ml and 0.5 dm long with a volume of 1 ml, at 20 ± 3°C.

IR spectra were taken on a UR-20 instrument in tablets with KBr and in paraffin oil.

The AS and the WSPSs were isolated as described in [1, 2].

The gel chromatography of the glucofructans was conducted on a column of Sephadex G-75, with elution by distilled water. The eluates were collected in 3 ± 1-ml fractions and were analyzed by the phenol/sulfuric acid method [4].

Weight-average molecular masses were determined from a calibration curve of the dependence of log MM on the elution volume, V [5].

Samples of dextran, inulin, and glucofructans were deposited on a column (1.8 × 63 cm) of Sephadex G-75. The column was calibrated by the passage of dextrans with M 40,000 (V_e = 56 ml) and M 20,000 (V_e = 74 ml) and of inulin with M 5600 (V_e = 111.5 ml). The glucofructans from the species of Allium studied were polydisperse.

The pectin substances were extracted by the usual method [6] and their quantitative characterization was made by the titrimetric method [7].

LITERATURE CITED

1. M. A. Khodzhaeva and Z. F. Ismailov, Khim. Prir. Soedin., No. 9, 137 (1979).
2. M. A. Khodzhaeva and E. S. Kondratenko, Khim. Prir. Soedin., No. 2, 228 (1983).
3. M. P. Fillipov, Infrared Spectra of Pectin Substances [in Russian], Shtiintsa, Kishinev (1978).
4. M. Dubois, K. H. Gilles, J. Hamilton, P. A. Rebers, and F. Smith, Anal. Chem., 28, No. 3, 350 (1956).
5. H. Determann, Gel Chromatography, Springer, New York (1968).
6. M. A. Khodzhaeva, M. Khasanov, E. C. Kondratenko, and A. U. Umarov, Khim. Prir. Soedin., No. 1, 14 (1985).
7. G. B. Buzina, O. F. Ivanov, and L. B. Sosnovskii, Khleb. Kond. Prom-st', No. 4, 15 (1965).