POLYSACCHARIDES OF *Aconitum zaravschanicum*

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UDC 547.917

The dynamics of the accumulation of water-soluble polysaccharides and pectin substances of Aconitum zaravschanicum Steinb. over the vegetation periods have been studied. The maximum amounts of polysaccharides have been established and their comparative physicohemical characteristics have been determined.

It is known from the literature that plants of the genus *Aconitum,* family Ranunculacae, are a source of biologically active compounds [1, 2]. Species of the genus *Aconitum* mainly contain alkaloids, which have been well studied in the chemical respect [3, 4], but their carbohydrates have been investigated inadequately [5, 6].

We have studied *A. zaravschanicum* Steinb. for the levels of carbohydrates in it during the vegetation periods. The plant was gathered in the environs of the village of Dzhirgatal' (Tadzhikistan). The raw material was first used for the isolation of alkaloids [3], and the meal for obtaining carbohydrates. The plant was collected in the following phases of development: beginning of vegetation — 1; vegetation of rosette leaves — 2; budding — 3; flowering — 4; fruit-bearing — 5; and ripening of the seeds — 6.

The aim of our investigation was to find the maximum level of water-soluble polysaccharides (WSPSs) and pectin substances (PSs) over the vegetation periods, to determine their monosaccharide compositions, and to study their physicochemical properties. The analytical results are given in Table 1. It can be seen from Table 1 that the WSPSs accumulated to a greater extent in the period of vegetation of the rosette leaves (8.3%), and then a decrease in the level of WSPSs in the plant and a 1.5- to 2-fold increase in the PSs was observed. The amount of pectin over the various phases reached a maximum in the flowering period (5.7%).

To determine the qualitative and quantitative compositions of their monosaccharides, the WSPSs and PSs were subjected to complete acid hydrolysis, and the hydrolysates were studied by PC and GLC [7]. In all the samples of WSPSs and PSs, in addition to the sugars given in Table 1, PC revealed the presence of uronic acids. The monosaccharide compositions of the latter differed only by their relative amounts of sugars. The predominating component in the WSPs in all periods was glucose. A negative reaction of solutions of the WSPSs with iodine showed the absence of glucans of the starch type. Consequently, the polysaccharide that we had isolated belonged to glucans of the nonstarch type. Aconitan A, i.e., an α-(1 $\rightarrow$ 6)-bound glucan isolated from the roots *Aconitum carmichaele* is known in the literature [5].

The PSs consisted of uronic acids, rhamnose, arabinose, xylose, and glucose. The uronic acids made up 32-50% of the PSs. It was observed that the amounts of rhamnose and arabinose in the pectins increased up to the ripening of the seeds (Table 1).

The physicochemical properties of the pectin substances were studied by the titrimetric method (Table 2). It can be seen from Table 2 that at the beginning of the vegetation of the plant the PSs were more methoxylated, and then there was a decrease in the level of methoxy groups as a consequence of which a difference was observed in the water-solubilities of the pectins: PS-1 and PS-2 were completely soluble and the other pectins only partially.

Thus, we have isolated the water-soluble polysaccharides and pectin substances from a meal of *A. zaravschanicum* and have characterized them.

Institute of the Chemistry of Plant Substances, Academy of Sciences of the Uzbekistan Republic, Tashkent. Translated from Khimiya Prirodnykh Soedinenii, No. 3, pp. 357-359, May-June, 1993. Original article submitted November 24, 1992.

0009-3130/93/2903-0297$12.50 ©1994 Plenum Publishing Corporation

TABLE 1. Levels of WSPSs and PSs and Their Monosaccharide Compositions

Carbohydrate	Yield %	Monosaccharide composition					
		Rham	Ara	Xyl	Man	Glc	Gal
WSPS-1	7,5	Tr.	2,0	6,0	1,0	6,5	2,4
PS-1	2,9	1,6	3,4	2,0	—	1,0	—
WSPS-2	8,3	1,0	6,3	10,3	1,3	16,5	6,0
PS-2	3,6	1,4	6,2	1,0	—	1,0	—
WSPS-3	8,0	1,0	3,6	5,2	1,0	10,0	3,3
PS-3	4,6	1,1	5,5	1,0	—	1,0	—
WSPS-4	7,8	1,0	5,0	2,8	1,0	17,0	3,0
PS-4	5,7	4,0	6,7	1,0	—	2,0	—
WSPS-5	4,6	1,0	6,7	2,6	1,0	10,0	2,8
PS-5	5,2	4,0	7,9	1,0	—	2,0	—
WSPS-6	2,4	1,0	7,0	2,7	1,0	9,0	2,6
PS-6	5,3	5,6	8,1	1,0	—	2,0	—

TABLE 2. Titrimetric Analysis of the PSs of *A. zaravschanicum*

PS	K_f	K_e	λ	O — CH_3, %
1	16,1	18,3	53,1	5,5
2	26,2	27,3	51,0	4,0
3	13,1	33,9	72,1	3,3
4	25,3	6,2	19,7	3,0
5	26,3	6,5	19,8	2,5
6	38,3	21,9	36,4	2,4

EXPERIMENTAL

Descending PC was performed on Filtrak FN 11.12 paper in the solvent system butan-1-ol—pyridine—water (6:4:3). Monosaccharides were revealed with acid aniline phthalate. GLC analysis was conducted on a Chrom-1 chromatograph. The aldononitrile peracetate derivatives of the sugars were analyzed under the following conditions: steel column (0.3 × 200 cm), 5% of Silicone XE-60 on Chromaton NAW (0.200-0.250 mm), 210°C, carrier gas helium, rate of flow 60 ml/min.

The complete acid hydrolysis of the WSPSs was carried out with 2 N H_2SO_4 at 100°C for 8 h, while the PSs were hydrolyzed for 48 h. The uronic acids in the PSs were determined by the carbazole method [8]. Titrimetric analysis was done as described in [9].

Isolation of the WSPSs. Separate 50-g samples of meal were extracted with water twice at room temperature, and the following WSPSs were isolated: 3.74 g of WSPS-1, 4.14 g of WSPS-2, 3.16 g of WSPS-3, 3.92 g of WSPS-4, 2.30 g of WSPS-5, and 1.18 g of WSPS-6.

Isolation of the PSs. The residues of the meal after the isolation of the WSPSs were treated with a mixture of equal volumes of 0.5% solutions of oxalic acid and ammonium oxalate at 70°C for 3 h. Extraction was carried out twice. The extracts were combined, analyzed against mains water, and precipitated with methanol (1:3). The precipitates were separated off and were dehydrated with acetone and dried in vacuum over P_2O_5. Yields: 1.43 g of PS-1, 3.61 g of PS-2, 2.30 g of PS-3, 2.85 g of PS-4, 2.60 g of PS-5, and 2.66 g of PS-6.

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