

POLYSACCHARIDES FROM TWO *Cicer* SPECIES CULTIVATED IN CHINA

H. A. Aisa,¹ C. Zhen,¹ A. Yili,¹ Bahang,¹
R. K. Rakhmanberdyeva,² and B. T. Sagdullaev²

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Seeds of plants of the *Cicer* genus (peas, chick peas) (Leguminosae) are a food product. The isolation of starchy carbohydrates from *C. arietinum* has been reported [1]. Chick peas are used in Chinese folk medicine as an antidiabetic [2] whereas the seed husks are a waste of the food industry and a source of pectinic substances (PS).

We studied two *Cicer* species, *C. mediterraneum* (Kabuli) and *C. asiaticum* (Desi), growing in Xinjiang Autonomous District, China. Seeds and seed husks were investigated for carbohydrate content. The carbohydrate complex was isolated as before [3], for which seeds (80 g) and seed husks were inactivated individually with $\text{CHCl}_3:\text{CH}_3\text{OH}$ (1:1) and heated for 1 h. Then extraction of the residual raw material with cold water produced water-soluble polysaccharides (WSPS-C); with hot water, WSPS-H. PS were extracted by a mixture of oxalic acid and ammonium oxalate solutions (0.5%, 1:1); hemicellulose (HC), by base solution (5%). Table 1 shows that seeds of *C. mediterraneum* contained the most WSPS; seed husks, PS.

Seeds of *C. asiaticum* accumulated the most WSPS-H and HC.

WSPS-C were amorphous light yellow powders that were very soluble in water and gave a negative reaction with iodine.

Table 1 indicates that WSPS-C differed quantitatively in the ratio of monosaccharide units.

WSPS-H were amorphous white powders that dissolved partially in water. The main monosaccharide unit in WSPS-H of seeds was glucose, which was indicative of the presence of starch in the WSPS-H. These data were confirmed by a positive reaction with iodine.

The monosaccharide composition of the carbohydrates was determined by total acid hydrolysis with H_2SO_4 (2 N), 100°C, for WSPS, 6 h; for PS, 48 h; for HC, 72 h.

PC of the carbohydrates was performed on Filtrak FN 12.15 paper using butanol:pyridine:water (6:4:3) with development by anilinium biphthalate at 105°C.

GC-MS was recorded on a PE-Turbomass Aidosystem XL, PE 5 MS system using a quartz column (30 × 0.25 mm), 200°C, flow rate 35 mL/min, and N_2 carrier gas. Samples were recorded as the aldononitrile acetates [4].

PS of seeds were cream-colored powders that dissolved partially in water. The reaction with iodine was positive. Therefore, the PS contained some residual WSPS-H. This was especially clear in PS of seeds from both *Cicer* species. All PS contained galacturonic acid in addition to the neutral monosaccharides shown in Table 1 according to PC. The content of free (Af) and esterified carboxylic groups (Ae) and the degree of esterification (λ) of PS were determined by titration [5].

Table 2 gives the quantitative characteristics of the titrations.

The degree of esterification enabled the obtained PS to be classified as highly esterified pectins.

PS of seed husks, in contrast, were very soluble in water and formed viscous solutions. They were highly esterified PS.

HC were amorphous brown powders that were poorly soluble in water. HC of *C. asiaticum* typically had an increased content of glucose; of *C. mediterraneum*, xylose and arabinose.

Thus, the carbohydrate complex of seeds and seed husks of two *Cicer* species were WSPS, PS, and HC.

1) Xinjiang Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Urumqi, 830011, China;
2) S. Yu. Yunusov Institute of the Chemistry of Plant Substances, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (99871) 120 64 75. Translated from *Khimiya Prirodnikh Soedinenii*, No. 3, pp. 288-289, May-June, 2006. Original article submitted February 6, 2006.

TABLE 1. Content and Monosaccharide Composition of Polysaccharides from Seeds and Husks of Two *Cicer* Species

PSa type	Yield, %	Ratio of monosaccharide units					
		Rha	Xyl	Ara	Man	Glc	Gal
<i>Cicer mediterraneum</i> (seeds)							
WSPS-C	8.8	-	1.0	1.3	-	11.0	35.5
WSPS-H	9.6	1.0	1.5	2.0	Tr.	20.0	1.8
PS	0.4	-	1.2	1.0	-	24.3	-
HC	6.6	1.0	8.5	7.8	-	3.8	2.0
<i>Cicer mediterraneum</i> (husks)							
WSPS-C	3.3	1.8	5.0	6.3	Tr.	1.0	7.2
WSPS-H	0.6	1.0	2.2	1.4	1.3	2.6	2.6
PS	3.0	1.5	2.0	1.1	1.0	2.5	2.03
HC	4.4	1.2	2.1	1.3	-	1.0	1.5
<i>Cicer asiaticum</i> (seeds)							
WSPS-C	1.6	-	3.8	1.0	2.8	7.6	3.9
WSPS-H	4.4	-	1.0	Tr.	Tr.	20.0	-
PS	1.4	Tr.	1.0	Tr.	Tr.	13.3	Tr.
HC	9.5	Tr.	1.0	Tr.	Tr.	15.2	Tr.
<i>Cicer asiaticum</i> (husks)							
WSPS-C	3.1	1.0	3.3	3.3	Tr.	1.3	6.0
WSPS-H	0.6	1.1	2.2	2.4	1.0	3.1	2.2
PS	1.5	1.4	1.6	1.9	Tr.	5.2	1.0
HC	1.4	-	2.3	1.3	-	15.2	1.0

TABLE 2. Titration Characteristics of PS from Two *Cicer* Species

Characteristic, %	<i>Cicer mediterraneum</i>		<i>Cicer asiaticum</i>	
	seeds	husks	seeds	husks
Af	4.5	9.6	6.4	3.6
Ae	15	19.8	20.6	50.4
λ	76.9	67.3	76.3	62.5

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