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TECHNICAL NOTE

Characterization of pectic polysaccharides from pulse husks

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Pectic polysaccharides were isolated from the husks of field bean (*Dolichos lab lab*), cowpea (*Vigna sinensis*) and pea (*Pisum sativum*), using HCl (pH 2·0) and 0·5% EDTA at extractants at 70°C, in yields varying from 1·43 to 5·37%. Pectic polysaccharide obtained by 0·5% EDTA extraction was more viscous and gave a higher yield than acid-extracted ones. Acetyl and methoxyl groups had no effect on the viscosities of the polysaccharides. Their compositional analysis indicated mainly arabinose, rhamnose and xylose in addition to high amounts of uronic acid.

INTRODUCTION

Pectic substances are complex polysaccharides present in the primary cell walls and middle lamellae where they play important roles as hydrating agents and cementing materials for the cellulosic network. In the food industry (Rees, 1969), in addition to their use as dietary fibre, they are used for thickening and gelling purposes. Pectic substances are composed of (1 → 4) linked α-D-galacturonopyranosyl residues in either free or methyl ester forms. These homogalacturonan sequences are usually attached at intervals with O-2 linked β-L-rhamnopyranosyl residues, and carry various polysaccharides such as arabinans, arabinogalactans and galactans (Aspinall, 1980; Darvill *et al.*, 1980). Even though there are several reports available on total pectins from various sources (Gordon & Christensen, 1973), the information on pulse husk pectins is very limited (Salimath & Tharanathan, 1982). Since the husks, after endosperm utilization, are mostly discarded as a waste material, attempts are made to study the husk pectic substances from the three commonly consumed pulses namely, field bean, cowpea and pea. Here, we report on the preliminary chemical composition of the above husk pectic fractions.

MATERIALS AND METHODS

Raw materials

Market varieties of field bean, cowpea and pea were separated into husk as well as endosperm, using the mini *dhal* mill developed by the Central Food Technological Research Institute. The husk was powdered to pass through a 60 mesh sieve.

Isolation of pectic substances (Kertesz, 1951)

Husks (20 g each) were separately extracted with dilute HCl (pH 2·0) and 0·5% ethylenediamine tetraacetic acid (EDTA) at 70°C for 2 h followed by centrifugation (2000 rpm, 10 min) and the resulting supernatant was precipitated with three volumes of alcohol. The precipitated material was dialysed and lyophilized (Salimath & Tharanathan, 1982).

Chemical analysis

Sugar (McKelvy & Lee, 1969), uronic acid (Knutson & Jeans, 1968), acetyl (McComb & McCready, 1957) and methoxyl (Wood & Siddiqui, 1971) contents were determined, using D-glucose, D-galacturonic acid, methyl 2,3,4,6-tetraacetylgalactopyranoside and methanol as standards, respectively.

Viscosity studies

The viscosity of aqueous solutions of the polysaccharides (0·5%) was determined in an Ostwald capillary viscometer (Swenson, 1963), which had a flow time of 27 s for water at 27 ± 0·1°C. The relative viscosity (η_γ) was calculated by $\eta_\gamma = t_1/t_2$, where t_1 and t_2 are the flow times of the solution and the solvent, respectively.

Sugar composition

The pectic polysaccharides were hydrolyzed by the complete hydrolysis procedure (Paramahans & Tharanathan,

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1982). The acid hydrolysates were neutralized (solid $BaCO_3$), reduced ($NaBH_4$), acetylated (pyridine–acetic anhydride, 1 : 1, 100°C, 1 h) and then analysed by gas–liquid chromatography (Sawardekar *et al.*, 1967) on an OV-225 column (stainless steel, 8 ft (2·44 m) × 1/8 in (3·2 mm) o.d.), 3% on Chromosorb W (100—200 mesh) at an isothermal temperature of 190°C. Inositol was the internal standard used and the molar response factor was calculated for each sugar for accurate determination.

RESULTS AND DISCUSSION

Pectic polysaccharides were isolated from field bean, cowpea and peas husks by dilute HCl (pH 2·0) and 0·5% EDTA extractions in 1·43 to 5·37% yields. EDTA extraction yielded more (Table 1) material than did HCl extraction. However, polysaccharides obtained by HCl extraction were sugar rich, indicating the role of acid in exclusive extraction of polysaccharides devoid of other contaminants. Nevertheless, EDTA-extracted polysaccharides were more viscogenic and uronic acid rich compared to HCl-extracted material. Pea pectic polysaccharides isolated by EDTA had the highest uronic acid content, i.e. 44% (Table 2) and also the highest relative viscosity (η_γ 2·37, Table 1) compared to that of field bean and cowpea polysaccharides.

The relative viscosity of the pectic polysaccharides was not influenced either by the increase/decrease of O-methyl or O-acetyl groups as was evident in pea EDTA- as well as cowpea HCl-extracted preparations. The pea EDTA-extracted fraction had the highest relative viscosity even though it had the lowest percentage of O-methyl (1·50%) and O-acetyl (0·93%) groups, whereas the cowpea HCl-extracted polysaccharide had the lowest relative viscosity in spite of the presence of more O-acetyl (2·37) and O-methyl (2·00) groups.

Sugar analysis (Table 2) of the pectic fractions indicated high amounts of arabinose along with considerable amounts of rhamnose, xylose and uronic acid in HCl-extracted material. EDTA-extracted polysaccharides had higher amounts of uronic acid with a concomitant decrease in arabinose content. This result is expected as EDTA complexes with the calcium salt of uronic acid and facilitates the extraction of the latter in higher yields. Galactose and glucose are the minor sugars present in field bean preparations, whereas glucose and mannose are minor constituents in cowpea polysaccharides. Cetavlon fractionation of these pectic polysaccharides yielded low amounts of neutral polysaccharides (data not shown). The sugar composition details of these pectic polysaccharides are in agreement with those of earlier reports (Aspinall, 1980; Darvill *et al.*, 1980; Tharanathan *et al.*, 1987). The above results indicate clearly that EDTA is a better extractant than HCl in isolating viscous and uronic acid-rich pectic polysaccharides. Among the three pulse husks used in the present study, pea husk is relatively a good source of quality pectin compared to field bean and cowpea husks as revealed by its viscosity, uronic acid and composition data.

Table 1. Composition (%) and relative viscosity (η_γ)[a] of pectic polysaccharides from pulse husks

	Yield	Sugar	Relative viscosity	—OAc	—OMe
Cowpea					
HCl-extracted	3·78	98	1·12	2·37	2·00
EDTA-extracted	5·37	92	1·29	4·18	2·30
Pea					
HCl-extracted	1·43	95	1·92	1·50	2·08
EDTA-extracted	3·20	90	2·37	0·93	1·50
Field bean					
HCl-extracted	2·82	90	1·12	1·43	1·50
EDTA-extracted	3·50	74	1·55	1·50	1·22

[a] $\eta_\gamma = t_1/t_2$ at 27°C, where t_1 = flow time of solution, and t_2 = flow time of water.

Table 2. Sugar composition (%) of pectic polysaccharides from pulse husks

	Rha	Ara	Xyl	Man	Gal	Glc	Uronic[a] acid
Cowpea							
HCl-extracted	12·1	43·5	21·2	3·9	—	3·3	16·0
EDTA-extracted	24·8	25·0	16·2	5·0	—	3·0	26·0
Pea							
HCl-extracted	3·0	66·8	3·9	—	—	—	26·2
EDTA-extracted	4·1	47·4	4·5	—	—	—	44·0
Field bean							
HCl-extracted	3·0	60·7	14·9	—	9·4	5·4	6·6
EDTA-extracted	2·3	47·8	14·5	—	7·3	1·8	26·2

[a] Neutral sugars are represented as percentage molar ratios, whereas uronic acid content is determined by the modified carbazole method.

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