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The Viscous Mucilage from the Weed *Portulaca oleracea, L*

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ABSTRACT

A polysaccharide complex has been extracted from the invasive and widespread weed *Portulaca oleracea* (purslane) in yields of up to 25 g% (dry wt). The clear and viscous mucilage displays physicochemical properties appropriate for industrial uses, such as food extenders and viscosifier. Toxic collateral effects can be precluded because of the already known uses in home remedies and animal feed. Anion exchange chromatography fractionated the crude complex into a neutral arabinogalactan and polydisperse pectin-like polysaccharides. This fractionation brings about a reduction in the viscosity observed for the native complex, whereas saponification of *O*-acetyl and/or carboxymethoxyl groups increases it.

Index Entries: Purslane; mucilage; viscosity; arabinogalactan; pectin.

INTRODUCTION

Purslane, originating from India (*1*), the Himalayas, or Central Russia (*2*), is a C-4 photosynthetic, very invasive weed in tropical and subtropical cultivated areas throughout the world (*3–5*). One single plant produces about 1×10^4 seeds and, hence, the permanent requirement of herbicide control. Purslane also displays a high water retention ability and, consequently, is resistant to drought, most probably owing to its polysaccharide component(s). Because of its nutritive value (*6,7*), leaves and stems are consumed as hog feed in the Phillipines and used as laxative, diuretic,

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and antiscurvy agents in home medicinal treatments in Brazil (*8*). A crop of purslane is facilitated by its small size and profuse growth. Pectic glycans are included among the group of functional food additives (*9*). The present knowledge of carbohydrates of *Portulaca spp.* is very little and restricted to free sugars (*10*) and a polysaccharide extract obtained using 0.1*M* HCl (*11*). Thus, the extractibility, yields, chemical structure, and rheological properties for purslane glycans deserves attention, which is given in the present work.

MATERIALS AND METHODS

Weed Collection and Polysaccharide Extraction

Portulaca oleracea (purslane) was collected at Universidade Vale do Rio dos Sinos, RS, Brazil (December, 1987), and leaves and stems were separated from the roots and homogenized in a blender in the presence of excess ethanol. The dry residual matter was then finely ground in a Wiley mill. Room temperature acetone and Sohxlet benzene–ethanol (2:1, v/v) extractions resulted in complete depigmentation and fat removal. Leaves (PoL), stems (PoS), and combination of both (PoT) were extracted with 10 vol of distilled water at different temperatures for 12 h, with occasional agitation. The time for the 100°C extractions was reduced to 1 h, in order to preserve the more labile glycosidic linkages (e.g., L-arabinofuranose residues) (*9*). Following filtration through cheese cloth, filtrates were centrifuged at 8000*g* for 20 min and the polysaccharide precipitated with 3 vol of absolute ethanol.

Polysaccharide Purification and Fractionation

The acetone powder of the crude polysaccharides was further deproteinized by the method of Sevag, as described by Staub (*12*) and fractionated on a DEAE-cellulose column (Cl^- form) sequentially eluted with water and a salt gradient. Following dialysis, recovery of polysaccharide fractions was carried out by precipitation with 3 vol of ethanol, acetone washing, and final vacuum drying.

Polysaccharide Analysis

Total carbohydrates were estimated with the phenol-sulfuric method (*13*), reducing carbohydrates with the cupric–alkaline reagent (*14*), uronic acid with 3-*O*-phenylphenol (*15*), *O*-Acetyl groups with hydroxylamine (*16*), and protein with the modified Lowry method (*17*) or by absorbance at 280 nm. The configuration of galactose was determined with galacatose oxidase (*18*). Infrared spectra were obtained in an Acculab TM-10 apparatus (Beckman) and the gas-chromatographic analyses of alditol acetates and partially methylated alditol acetates, carried out as previously de-

scribed for *Pereskia aculeata* polysaccharides (*19*). Trifluoracetic acid hydrolyses were made, according to Albersheim (*20*), and enzymatic hydrolyses with *M. paranaguensis* snail juice, according to Fontana et al. (*21*). Viscosimetric measurements were carried out in a Ostwald viscosimeter using 25°C for reduced viscosity and from 25 to 50°C for temperature effects, using the fixed concentrations of each polysaccharide sample. Other experimental details are included in the legends of the tables and figures.

RESULTS AND DISCUSSION

The acetone powder of the defatted weed yielded 5.9 g%, as referred to the wet and rootless plant. As shown in Table 1, the yield of crude polysaccharide ranged from 10.6 to 28.1 g%, depending on the part of the weed. The corrected figures (total carbohydrate analysis) ranged from 6.1 to 15.2 g%, the difference being accounted for protein, *O*-acetyl substituents, and other constituents with lesser or no reaction with the phenol-sulfuric. Extraction of the weed polysaccharides is quite efficient, even at 0°C, but boiling water extraction results in twice the yield. The ethanolic precipitation of crude polysaccharide usually results in two insolubilized forms: the major one (83–90%) resembling "cord filaments" and the minor one like "resin fines." An enhancement of the D-glucose content in the stem extracts (PoS) accompanies the temperature range of extraction (e.g., 0.3 and 5.2% for "cord" and "fines" subfractions from the 25°C extraction and assuming that the entire glucose content is owing to starch since a chromogenic reaction with iodine–potassium iodide is completely abolished by crystalline α-amylase treatment. Furthermore, dialysis led to the recovery of trace amounts of both maltose and maltotriose). This α-D-glucan contamination was seen in leaf extracts (PoL) only when extraction was performed at the higher temperature (100°C).

In relation to the polysaccharide composition in terms of total carbohydrates, uronic acid, *O*-acetyl, and protein contents, the data on Table 2 show that the similar profiles for purslane leaves and stems are independent of the temperature extraction range. Within each extract, the "fines" subfraction is characterized by the lower content in acidic sugars, *O*-acetyl substituents, and protein, as indicated for both PoT and PoL series (Table 2), so it is enriched in the arabinogalactan component. The deproteinization treatment (*12*) resulted in the removal of 35–38% of the original protein. The sugar composition (Table 3), excluding glucose from the starch contamination, indicated an average distribution of D-galactose:L-arabinose:L-rhamnose:D-xylose:D-galacturonic acid of 40:20:5:1:31 for the polysaccharide complex from the whole rootless weed (PoT), compared to 43:17:6:1:33, as obtained for the leaf polysaccharide alone (PoL). The stem crude polysaccharide (PoS) has the higher uronic acid content (43%) and slightly lower galactose and rhamnose content. This analysis also

Table 1
Yield and Temperature Effect
on the Aqueous Polysaccharide Extraction of *Portulaca oleracea*[a]

Extract or fraction[b]	Gravimetry, gravimetric	G%	total %	Spectrophometry,[c] total %
(cord)[d]	1.56	8.8		
PoT-0°C			10.6	6.1
(fines)	0.33	1.8		
(cord)	1.87	10.9		
PoT-25°C			12.3	6.9
(fines)	0.30	1.7		
(cord)	2.27	13.2		
PoT-55°C			14.7	8.3
(fines)	1.44	1.5		
PoT-100°C (whole)	4.05	23.6	23.6	12.6
(cord)	1.78	9.8		
PoL-0°C			11.5	6.9
(fines)	0.31	1.7		
(cord)	1.94	10.7		
PoL-25°C			12.4	7.5
(fines)	0.31	1.7		
PoL-55°C (whole)	2.56	14.1	14.1	8.5
PoL-100°C (whole)	5.09	28.1	28.1	15.2

[a]Dry weight basis; 17.82 and 18.12 g of acetone powders as sources for PoT and PoL series, respectively.
[b]PoT and PoL = *Portulaca oleracea* total and leaf parts as polysaccharide sources, respectively, followed by the extraction temperature range.
[c]Corrected total percent yield based on the total carbohydrate (phenol–sulfuric acid method, ref. *13*) present in each whole crude polysaccharide extract prior to fractionation.
[d]For "cord" and "fines" meanings, *see* text.

pointed to another significant difference between the "cord" and "fines" fractions: the latter is much richer in D-xylose. Accumulated results on sugar analyses pointed to the need of a more distinct fractionation of the polysaccharide complex, which was accomplished on a DEAE-cellulose column (Fig. 1) for a 55°C extracted leaf sample (PoL). Stepwise elution was carried out with water (tubes 1–65), 1 *M* KCl (tubes 70–130; main polysaccharide peak elution at 0.3–0.4 *M* salt), the same chloride containing 0.1 *M* HCl (tubes 175–244) and finally, 0.2 *M* NaOH (tubes 245–300). Protein coeluted mainly with the larger polysaccharide peak at the initial salt gradient. The elution profile is quite reproducible, and the chemical composition for the main peaks is shown in Table 4. The sum of peaks 1-F, 2-F, and 6-F accounted for 94% of the total carbohydrate of the applied

Table 2
Compositional Analysis of *Portulaca oleraceae* Extracts[a]

Extract or fraction[b]	Total carbohydrate	Uronic acids	*O*-Acetyl groups	Protein
PoT-0°C (cord)	62.3	28.4	3.1	3.5
PoT-25°C (cord)	59.5	29.3	3.0	3.2
PoT-25°C (fines)	88.4	8.2	1.1	1.9
PoT-55°C (cord)	58.5	34.4	3.5	4.2
PoT-100°C (whole)	58.7	31.1	3.3	3.9
PoL-0°C (cord)	60.5	29.7	3.2	3.2
PoL-25°C (cord)	60.3	31.8	3.3	3.2
PoL-25°C (fines)	80.7	14.7	1.6	2.3
PoL-55°C (cord)	60.9	31.4	3.3	3.6
PoL-100°C (whole)	62.2	32.7	3.4	3.7
PoL-(2F) +	53.8	33.3	3.5	7.3
idem + +	60.0	28.7	3.4	4.8
PoS-55°C (whole)*	50.7	43.0	3.9	3.0
idem **	50.1	45.5	4.2	2.1

[a]Analysis and (reference methods): total carbohydrates (*13*), uronic acids (*15*), *O*-Acetyl (*16*), and protein (*17*).
[b]As in Table 1: (+), (+ +): Leaf 2-F subfraction obtained on DEAE-cellulose before and after deproteinization with Sevag's method (*12*); (*), (**): original and deproteinized, 55°C-extracted stem whole polysaccharide.

Table 3
Monosaccharide Composition of *Portulaca oleraceae* Extracts and Fractions[a]

Extract or fraction	Rham	Ara	Xyl	Gal	Gal A
PoT-0°C (cord)	4.0	22.1	1.4	44.1	28.4
PoT-25°C (cord)	4.1	23.8	1.1	42.9	29.3
PoT-25°C (fines)	5.8	31.6	12.8	42.5	8.2
PoT-55°C (cord)	5.1	19.9	0.9	37.8	34.4
PoT-100°C (whole)	5.6	26.0	1.7	35.5	31.1
PoL-0°C (cord)	7.5	16.8	-	48.4	29.7
PoL-25°C (cord)	4.1	17.5	0.7	43.8	31.7
PoL-25°C (fines)	7.7	23.3	8.5	45.7	14.7
PoL-55°C (cord)	5.7	17.6	1.8	39.9	31.4
PoL-100°C (whole)	6.1	18.6	1.9	40.1	32.7
PoL-(2F) +	6.9	18.5	0.7	40.1	33.7
idem + +	6.9	17.7	1.1	46.4	28.7
PoS-55°C (whole)*	3.8	23.8	1.8	27.5	43.0
idem **	3.1	23.5	1.4	24.6	45.5

[a]Trifluoroacetic acid hydrolysis followed by GLC analysis of alditol acetate derivatives for neutral sugars (*19*), and colorimetry (*15*) for uronic acid after binding and elution from Dowex-2-(acetate form) resin.

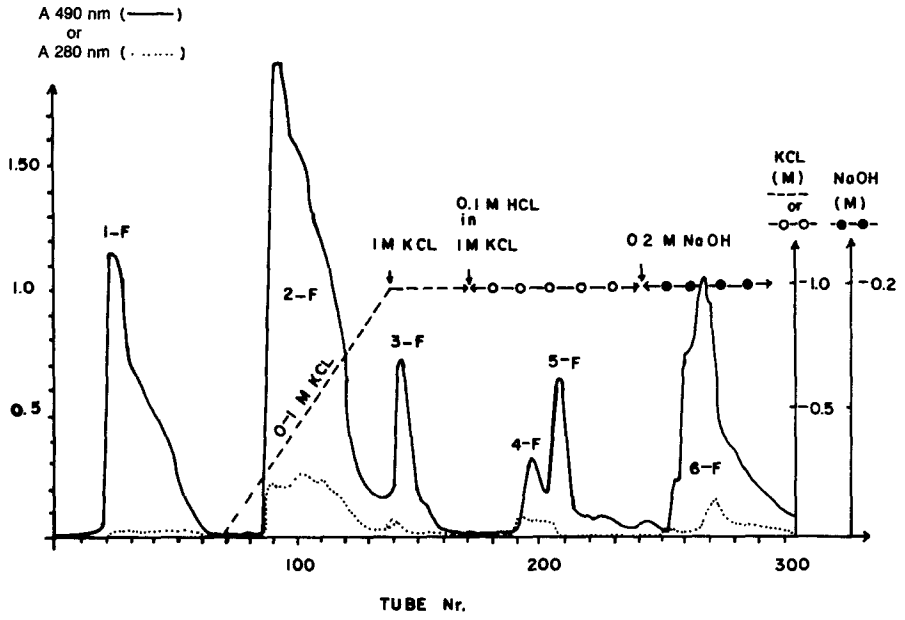

Fig. 1. The elution profile of the weed leaf deproteinized polysaccharide (1 g, PoL-55°C +) on anion exchange chromatography (DEAE-cellulose column, Cl^- form; 2.5×35.0 cm, id×h). Fraction/Tube volume=25 mL; A_{490nm}=total carbohydrate; A_{280nm}=protein. Elution with water (tubes 1–65) was followed by gradient or stepwise elution, as indicated.

sample. The neutral arabinogalactan, 1-F, had a L-arabinose: D-galactose ratio of 1:24 and low content for both the linked *O*-Acetyl and protein components. The acidic fractions (pectin-like poly-D-heterogalacturonans (2-F–6-F) contain all the D-galacturonic acid (ca. 36%) of the whole chromatographed sample and for the neutral monosaccharides, the respective distribution was L-arabinose:D-galactose:L-rhamnose:D-xylose equal to 28:58:14:0 (peak 2-F) to 25:44:11:20 (peak 6-F). The latter obviously includes some of the subfractions previously defined as "fines" since most of the D-xylose was recovered herein. The O-acetyl and protein contents are higher in the major acidic fraction, compared to the neutral component recovered in the void volume of the column.

Since viscosity was noticeable when handling either the neutral or acidic fractions, additional insights were obtained about the neutral one through polysaccharide methylation/fragmentation analysis by Hakomori's procedure (22). As shown in Table 5, the dominant glycosidic linkage is β-1,4 for the poly-D-galactosyl backbone since the 2,3,6-tri-*O*-methylated derivative accounted for 92% of the derived fragments. Anomeric and absolute configurations for the monomer were obtained by polarimetry, infrared spectroscopy—band at 885 cm^{-1}—and enzymatic analyses, the later resulting in complete oxidation with the specific D-galactose oxidase. The observed L-arabinose:D-galactose ratio (1:24) is slightly

Table 4
Yield and Neutral Sugar Composition for Fractions from Anion Exchange Chromatography of *Portulaca oleracea* Leaf Polysaccharide Complex[a]

Fraction no.[b]	Amount, mg	% composition			
		Rham	Ara	Xyl	Gal
1-F	98.1	-	4.2	-	95.8
2-F	660.4	13.7	28.6	-	57.7
3-F	22.9	16.1	30.2	4.2	49.5
4-F	10.3	13.9	28.4	2.4	55.3
5-F	20.7	15.0	26.2	0.9	57.9
6-F[c]	105.8	10.6	25.1	20.1	44.2

[a]Quantitative analysis for polysaccharide as described in the "Materials and Methods" section.
[b]Fraction and eluant for DEAE-cellulose column: 1-F (water); 2- till 6-F (neutral salt, neutral salt in 0.1 *M* HCl, and 0.2 *M* NaOH).
[c]Figures corrected for a small contamination of D-glucose arising from resin solubilization.

Table 5
Partial Structure of the Neutral Component from *Portulaca oleracea* Leaf by Methylation Analysis[a]

Partially *O*-methylated, *O*-acetylated monosaccharide derivatives	% composition	R_T
1,4-di-O-acetyl-2,3,5-tri-O-methyl-L-arabinitol	1.40	0.41
1,4,5-tri-*O*-acetyl-2,3-di-O-methyl-L-arabinitol	2.03	1.08
1,5-di-*O*-acetyl-2,3,4,6-tetra-O-methyl-D-galactitol	3.81	1.21
1,4,5-tri-*O*-acetyl-2,3,6-tri-O-methyl-D-galactitol	91.85	2.24
1,3,4,5-tetra-*O*-acetyl-2,6-di-*O*-methyl-D-galactitol	0.89	3.12

[a]According to (*19*) and (22): GLC run in a OV-225 column at 170°C using 1,5-di-*O*-acetyl-2,3,4,6-tetra-*O*-methyl-D-glucitol as internal standards for R_T (retention time) determination and derivative identification (*29*).

higher than those observed for β-1,4-linked woody plant galactans, the "core"-linking type thus corresponding to those found in compression and tension woods (23). Furthermore, more arabinogalactan was recoverable from leaves (PoL) than stems (PoS) from *Portulaca,* and this agrees with the previous comparison on the low trunk to aerial parts of larchwood (24). Detection of two kinds of arabinose derivatives indicated at least some degree of side-chain substitution more complex than the single-residue mode. "Fines" generation, that is resistance to ethanol precipitation, clearly correlates with the neutral arabinogalactan fraction since the 3.8% of nonreducing terminal D-galactosyl residues (Table 5; 2,3,4,6-tetra-*O*-methyl derivative) points to a low degree of branching and considering that arabinogalactans are usually of low molecular weight (23). Finally,

Table 6
Viscosimetric Determinations on *Portulaca oleraceae* Polysaccharide Extracts and Fractions[a]

Extract or fraction[b]	pH	Intrinsic viscosity (cP)[c]
PoT-0°C (cord)	6.04	690
PoT-25°C (cord)	6.16	700
PoT-25°C (fines)	5.80	35
PoT-55°C (cord)	5.81	420
PoT-100°C (whole)	5.62	235
PoL-0°C (cord)	5.21	680
PoL-25°C (cord)	5.10	700
PoL-55°C (whole)	5.43	600
PoL-100°C (whole)	5.53	140
PoL-55°C +	6.04	540
idem -1F (neutral)	-	410
idem -2F (acid)	-	450
PoL-25°C (cord) *	5.66	860
PoT-25°C (cord) in		
20 g% sucrose	6.14	1,120
idem in 20 g% glucose	6.15	1,240
idem in 0.8 mg/mL		
Mimosa sp. galactomannan	-	850
Citrus pectin	6.00	700

[a]Polysaccharides assayed in the concentration range 0.02 to 0.2–0.32 g% for flow time measurements at 25°C.

[b]As in Table 3: (+) deproteinized sample; (*) previously saponified with 1 *M* NaOH at room temperature for 1 h following dialysis.

[c]Reduced viscosity was calculated as follows: $\eta_{red} = c^{-1} (\eta - \eta_0) \eta_0^{-1}$ where: η_{red} = reduced viscosity; c = polysaccharide concentration in gram%; η = sample relative viscosity; and η_0 = solvent (water) viscosity. Intrinsic viscosity was obtained by the extrapolation to polysaccharide zero concentration (*Y* axis intercept, Fig. 2) and given in centiPoise units (cP).

the presence of an 2,6-di-*O*-methyl-galactose indicated that the insertion of L-arabinose in the main polygalactosyl chain is through a 1,3 glycosidic linkage (creating a 3-*O*-arabinosyl-galactose "building block, discussed later).

Data in Table 6 for intrinsic viscosity of both the whole plant polysaccharide complex (PoT) and its leaf counterpart (PoL) shows the lowering effect, determined by the extraction temperature increasing in the range from 25 to 100°C. Since polygalacturonan is the major type of polysaccharide in the weed complex, this effect can be attributable to the already known properties for pectin whose viscosity reduction on heating occurs at less acidic or neutral media instead of the more acid ones (*25*). "Fines" subfraction being a minor component of the whole polysaccharide mixture (10–17%; Table 1) and also owing to its rheological behavior, seemed, at first glance, to be of less significance in the viscosity observed

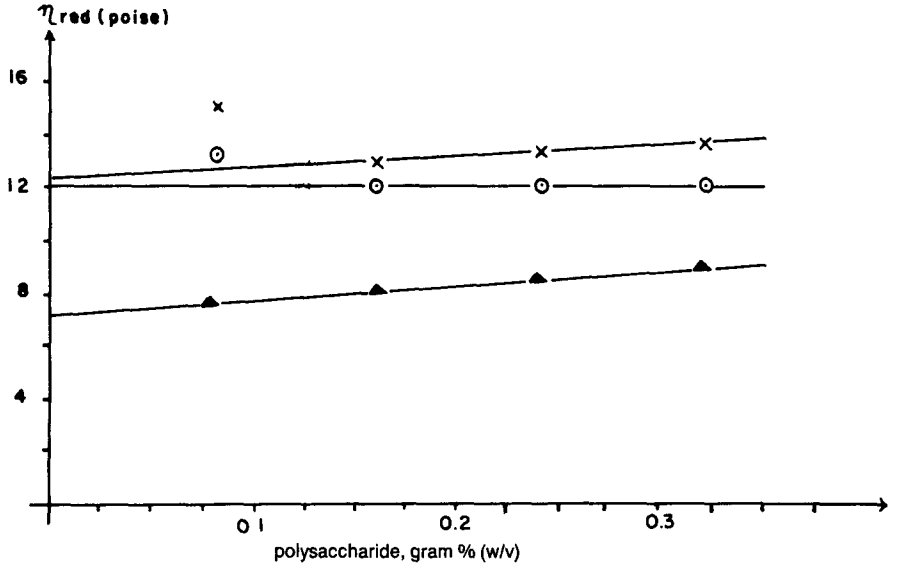

Fig. 2. Determination of the reduced viscosities of the weed polysaccharides (PoT-25°C "cord") in water (—▲—▲—), 20 g% sucrose (—⊙—⊙—), and 20 g% sucrose (—x—x—). Each curve results from the interpolation of reduced viscosity value measurements, and its intercept with the *Y* axis is the intrinsec viscosity value (Poise) at the zero polysaccharide concentration for each sample. (Also, *see* footnote on Table 6).

for the polysaccharide complex. Total hydrolysis of this fraction showed that L-rhamnose and D-xylose (7.7 and 8.5%, respectively; PoL-25 sample, Table 3) are components other than the major ones (D-galactose > L-arabinose > D-galacturonic acid). In this way, neutral arabinogalactan (peak 1-F from DEAE-cellulose column) is not the only component of the "fines" fraction, and its behavior on ethanol precipitation depends on additional factors other than monomeric sugar composition. This concept is reinforced by the respective viscosity values [(35 cP for PoT-25 (fine) and 410 cP for PoL-55-1F)]. Room temperature extraction of *Portulaca* leaves or whole plant leads to clear and viscous solutions equivalent to *Citrus* pectin (range of 700 cP), with the weed polysaccharide displaying the following additional properties (Table 6 and Fig. 2):

1. Partial removal of protein resulted in a 10% loss of viscosity value (fractions PoL 55°C (whole) and PoL 55°C + from Table 6).
2. Resolution of the neutral and acidic components on anion exchange columns (fractions 1-F and 2-F from the PoL 55°C + sample) resulted in a 24 to 17% reduction on viscosity (Table 6), and hence, there is a synergistic effect in the polysaccharide mixture present in the native complex.

3. Alkaline removal of *O*-acetyl and/or carboxy-methoxyl groups results in a 23% increase in the viscosity (samples PoL 25°C (cord) * and PoL 25°C (cord); Table 6). As determined by GLC analysis (for released methanol), a methoxyl content of 1.5% w/v) was found for the PoT-25°C sample. Figures in the range of 10% methanol may be found for pectic polysaccharides, and the methyl ester content influences the jelly formation (*26*). For the HCl-extracted polysaccharides of *Portulaca,* methanol was not detected (*11*).
4. Dissolution of the week polysaccharide complex in sucrose or glucose syrups results, in both cases, in higher viscous solutions (> 1200 cP), compared to dissolution in water (Table 6). The values of reduced viscosity for these viscosimetric runs and their respective intrinsic viscosities (ordinate axis; extrapolation to 0% concentration of weed polysaccharide) are shown in Fig. 2. Previous observations for other viscosifiers of the pectin group had shown viscosity enhancement with sucrose and an opposite effect with glucose, except for guar gum which experiences viscosity reduction in the presence of sucrose (*27*). The unusual behaviour of *Portulacas* polysaccharides, whose structure may be situated between pectin and mucilage, most probably arises from its low carboxyl and/or methoxyl content.

Enzymatic treatments of the main fractions of the weed polysaccharide complex with *M. paranaguensis* snail juice (*21*), *A. niger* pectinase, or Celluclast®, in all cases result in the recovery of free galactose and arabinose as the main hydrolytic products in the overnight incubations (TLC of Fig. 3A; samples A–C). Time kinetics from 15 to 60 min of snail juice action on the main neutral component (fraction 1-F; Fig. 1) resulted in a progressive depolymerization, as indicated by the free sugars:oligosaccharide ratio (lanes F–I). Noteworthy is the concomitant accumulation of three components at the disaccharide zone of migration (lane I), one of them chromatographing with the 3-*O*-β-D-galactosyl-L-arabinose standard (lane D), a characteristic building block for arabinogalactans (*23*). Further insights into the enzymatic pattern of depolymerization for the whole polysaccharide (PoF), neutral (1-F), and acidic fractions (2-F; Fig. 1) were obtained through incubation with pectinase in the range from 5 to 48 h (Fig. 3B): (**A**) free galacturonic acid as the acidic fraction main component in the shorter time (lane 2-F; 5 h) compared to arabinose, galacturonic acid, and galactose as final hydrolysis products (lane 2-F; 48 h); (**B**) accumulation of a series of β-1,4-galactoligosaccharides (lane 1-F; 5 h), as previously found in the acidic hydrolysate of coffee cherry pectic arabinogalactan (*28*), and finally, their breakdown to free galactose (lane 1-F; 48 h). Partial trifluoroacetic acid hydrolysis of the whole complex (PoT) resulted, on the other hand, in the breakdown of the poly-α-D-galacturonate "core" since

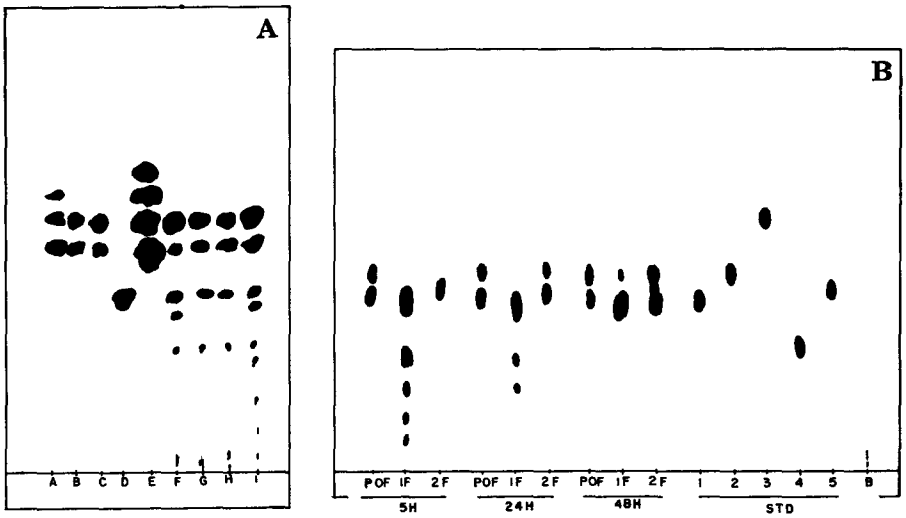

Fig. 3. (**A**) T. L. chromatogram of the weed polysaccharide enzymatic digests. (Plate: Silica Gel 60; solvent = ethyl acetate:acetic acid:formic acid:water, 9:3:1:4; spray:orchinol-sulfuric acid). A, B, and C: digestion of PoT-25 °C polysaccharides with snail gut enzymes, pectinase, and Celluclast®, respectively; D = 3-0-β-galactosyl-arabinose standard; E = monosaccharide standards mixture (in decreasing order of migration): rhamnose, xylose, arabinose, and galactose + galacturonic acid; F to I = time-course of the neutral fraction (1-F; Fig. 1) incubation with the snail enzymes. (**B**): Time-kinetics of pectinase action on the weed leaf polysaccharides (PoF-55 °C +) or its fractions (1-F = neutral and 2-F = acidic); (1, 2, 3, 4, and 5 = standards of galactose, arabinose, rhamnose, galactosyl-arabinose, and galacturonic acid; B = enzyme blank; 5, 24, and 48 H = hours of digestion time). Other conditions as in 3 (**A**).

besides free galacturonic acid, a series of acidic oligosaccharides was detected on paper electrophoresis (pyridine acetate as running buffer; results not shown).

CONCLUSIONS

Appreciable yields of polysaccharide could be readily obtained from the weed *Portulaca oleracea*. The observed rheological properties and the occurrence of high viscosity values for the crude polysaccharide, even when extracted at room temperature, constitute a promising indication for industrial applications other than the current and limited ones, like in animal feed and home remedies. These applications may be as functional food additive (e.g., in jams) and cosmetic thickner. In terms of fine structure aspects, without a doubt the most important are those that can be correlated to the physicochemical properties (*O*-acetyl and methoxyl substituents and, possibly, the low content of L-arabinose and in the arabino-

galactan and D-galacturonic acid in the pectin-like fractions). Viscosity enhancement through saponification or free glucose addition are also uncommon, so mild alkaline extraction of the weed is being considered. The plentiful and cost free occurrence of *Portulaca oleracea* is suggestive of an interesting native polysaccharide source. Work is in progress on the correlation of the fine chemical structure and the physical properties in order to reinforce suggested uses.

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