DETECTION OF FUCOSE FROM THE POLYSACCHARIDES OF SOME JAPANESE LEGUMES

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The presence of fucose as one of the constituent sugars of hemicellulose B_1 of broad bean seeds was found by KAWAMURA and NARASAKI[1-5]. Further, the presence of fucose in the hemicellulose B_1 of defatted soybean meal was confirmed by KAWAMURA and NARASAKI[6]. These findings opened a question whether fucose is a common constituent of legume hemicelluloses or a special component of relatively restricted species of legumes. Then the present experiment was undertaken to clarify the distribution of fucose in some representative Japanese legumes. Kidney bean, pea, sword bean, and peanut were examined and it was found that all the hemicelluloses of these legumes contained fucose as a constiuent sugar.

Experimental

1. Fractionation of Legume Polysaccharides by Successive Extraction

1.1. *Samples*

Following four legumes were used as the sample:

1. Kidney bean, *Phaseolus vulgaris*, "ingen-mame" in Japanese.
2. Pea, *Pisum sativum*, "endo".
3. Sword bean, *Canavalia gladiata*, "natamame".
4. Peanut, *Arachis hypogaea*, "rakkasei".

They were all purchased on the market and in excellent conditions to have complete germinating abilities.

1.2. *Fractionation of Polysaccharides*

Seeds were dehulled, pulverized, and then defatted by extraction with ethyl ether. The defatted seed powders were air dried and then subjected to fractionation of polysacharides according to a scheme outlined in Fig. 1.

1.3. *Yields and Physical Appearances of Fractionated Polysaccharides*

Table I shows the yields of polysaccharides separated from each seeds. All the legumes contained large amounts of polysaccharides soluble in 5% NaOH.

Regardless of the species, all the hot-H_2O-soluble polysaccharides were brown and sticky, the 0.5% $(NH_4)_2C_2O_4$-soluble ones were white powders, the 0.2% NaOH-soluble ones were brown solids, and the 5% NaOH-soluble ones were white powders.

1.4. *Detection of Component Sugars of the Fractionated Polysaccharides by Paper Chromatography.*

Each of the polysaccharides (0.2 g) was hydrolyzed with 2 *N* H_2SO_4 in a sealed glass

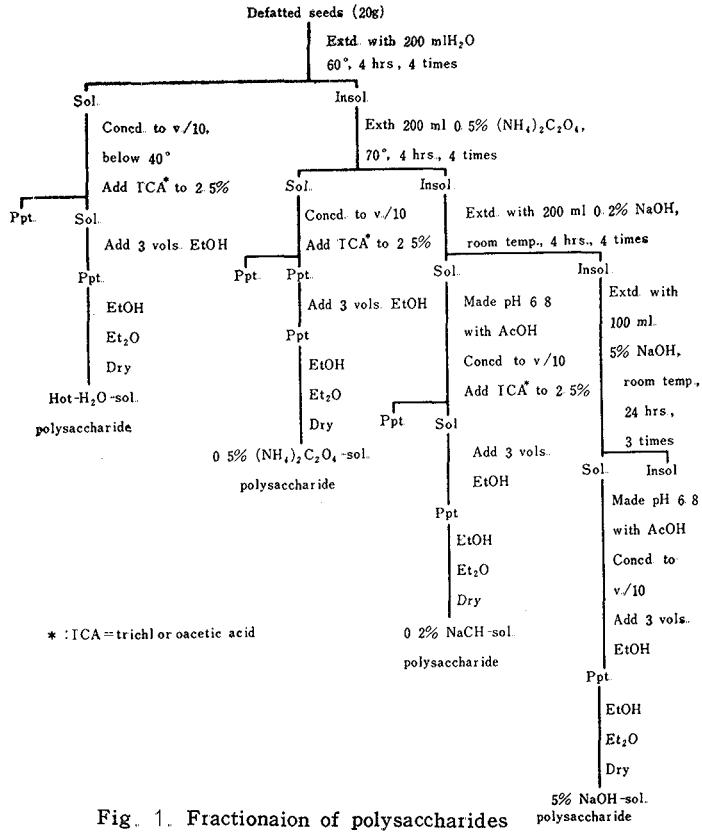

Fig. 1. Fractionaion of polysaccharides

Table I. Yields of polysaccharides

Legumes	Polysaccharides (g from 20 g of defatted seeds)			
	Hot-H_2O-sol.	0.5% $(NH_4)_2C_2O_4$-sol.	0.2% NaOH-sol.	5 % NaOH-sol.
Kidney bean	3.2	2.4	1.9	11.6
Pea	1.6	1.0	0.4	10.8
Sword bean	3.2	3.0	0.8	12.4
Peanut	2.1	2.8	0.8	10.2

tube by heating in boiling water for 4 hrs. The hydrolyzate was neutralized with $BaCO_3$ up to pH 6.8 and the formed precipitate was removed by centrifugation and filtration through Toyo No. 5C filter paper. The neutralized clear hydrolyzate was concentrated to dryness *in vacuo* below 40° C and the residue was taken up in 1 ml 50% aqueous ethanol to be examined by paper chromatography. Two-dimensional paper chromatography was carried out with phenol water (4 : 1) and *n*-butanol-pyridine-water (3 : 1 : 1.5) as the solvent systems and 0.3% *p*-anisidine-HCl in water-saturated *n*-butanol as the spraying reagent. The results are shown in Tables II-V.

Table II. Component sugars of the kidney bean polysaccharides

Polysaccharides soluble in	Rhamnose	Fucose	Xylose	Arabinose	Galactose	Glucose	Galacturonic acid
Hot-H_2O	−	−	+	+++	+++	++	+
0.5% $(NH_4)_2C_2O_4$	−	±	++	+++	+	++	+
0.2% NaOH	±	++	++	+++	+++	+	+
5 % NaOH	±	++	+	+++	+	+++	+

Table III. Component sugars of the pea polysaccharides

Polysaccharides soluble in	Rhamnose	Fucose	Xylose	Arabinose	Galactose	Glucose	Galacturonic acid
Hot-H_2O	−	−	+	++	+	++	+
0.5% $(NH_4)_2C_2O_4$	−	−	−	++	+	++	+
0.2% NaOH	−	−	+	+++	+	++	+
5 % NaOH	−	−	+	+++	+	+++	+

Table IV. Component sugars of the sword bean polysaccharides

Polysaccharides soluble in	Rhamnose	Fucose	Xylose	Arabinose	Galactose	Glucose	Galacturonic acid
Hot-H_2O	−	−	+	++	++	++	+
0.5% $(NH_4)_2C_2O_4$	−	−	±	++	±	++	+
0.2% NaOH	−	−	+	+++	+++	++	+
5 % NaOH	−	−	+	++	±	+++	+

Table V. Component sugars of the peanut polysaccharides

Polysaccharides soluble in	Rhamnose	Fucose	Xylose	Arabinose	Galactose	Glucose	Galacturonic acid
Hot-H_2O	−	−	+	+++	+++	++	+
0.5% $(NH_4)_2C_2O_4$	−	−	++	+++	++	++	+
0.2% NaOH	−	−	++	+++	+++	+	+
5 % NaOH	−	±	++	++	+++	++	+

All the polysaccharides contained comparatively large amounts of glucose, arabinose, and galactose. Fucose was found only in the polysaccharides of kidney bean.

2. Purification of the 5 % NaOH-soluble Polysaccharides by the Treatment with Taka-Diastase and Detection of the Component Sugars of the Purified Legume Hemicelluloses

KAWAMURA *et al.*[17] reported that the crude hemicellulose B of broad bean seeds contained only glucose and arabinose as revealed by paper chromatography. However, when the hemicellulose was purified by the treatment with Taka-diastase, glucose, galactose, xylose, and fucose were detected as component sugars by paper chromatography. This indicates

that the crude hemicellulose B of broad bean seeds consists largely of starch and araban and these two polysaccharides are removed by the treatment with Taka-diastase. Thus the authors purified the 5% NaOH-soluble polysaccharides by the procedure of KAWAMURA *et al.*[7] and the purified hemicelluloses were examined for their component sugars by paper chromatography. The obtained results are given in Table VI. All the hemicelluloses contained rhamnose and fucose as in the case of soybean hemicellulose B_1[6]. These results suggest that fucose is distributed widely in legume seed hemicelluloses as one of the common component sugars.

Table VI. Component sugars of the purified hemicelluloses

Legumes	Rhamnose	Fucose	Xylose	Arabinose	Galactose	Glucose	Galacturonic acid
Kidney bean	+	++	+	+++	+	++	+
Pea	+	+	+	+++	+	+++	+
Sword bean	+	+	+	+++	+	++	+
Peanut	+	+	+	+++	++	+++	+

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豆類多糖類からのフコースの検出

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要旨 ソラマメおよびダイズの子葉部から抽出されるヘミセルロース B_1 はフコースを含んでいた．植物のヘミセルロース構成糖としてフコースが検出されるのはごくまれで，特に種子ヘミセルロースの構成糖としてフコースが検出されたのは著者等の報告以外にはないようである．そこでフコースが，豆類ヘミセルロースの常成分であるか

どうかを確かめるため，インゲンマメ，エンドウ，ナタマメ，ラッカセイからヘミセルロースを抽出精製し，その構成糖をしらべた．その結果これらの豆類子葉部から抽出されたヘミセルロースは，ダイズヘミセルロース B_1 と同様ラムノースのほかにフコースを含んでいる事を発見した．

これらの結果から，フコースは豆類ヘミセルロースの常成分として広く分布しているものと推定した．

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