

- Glucan

1. 2 8% - glucan
(Prentice et al., 1980)
1.0 2.5%
- Mixed linked - (1 3),(1 4)-D- glucan((Newman et al., 1989, Lee and Lee, 1994)
- glucan) - glucosyl unit (1 3)- 16% (Ullrich et al.,
- (1 4)- 가 가 1986) 가 - glucan
(homopolysaccha-
ride) , , , 가 - glucan
(Hockett et al., 1987, Xue et
al., 1991, McIntosh et al., 1991, Ullrich et al., 1986)
가
- glucan arabinoxylan - glucan 가
, glucomannans, cellulose, (Xue et al., 1991,
McIntosh et al., 1991).
- Glucan - glucan
(Bamforth, - glucan - glucan
1985) 가 - glucan
(Campbell and Bedford, 1992) ,
(Andersson and Chen,
1986, Klopfenstein, 1988, Newman et al.,
1989, 1994) - glucan

2.		pronase (70U/100mL -glucan solution)	가
	40	1	.
2.1		2	-glucan
		-glucan	.
	96, 97	AACC	- glu-
	()	96,	can -glucan
97		Holmes	McCleary Glennie-
			(McCleary et al., 1985)
		Megazyme	-glucan assay kit
2.2	- Glucan	(Megazyme Pty. Ltd., Australia)	
		- Glucan	Jones
가	-glucan	Wood	(1972)
(Wood et al., 1977)		Lee	-glucan 2M trifluoro-
1992)		가	acetic acid(TFA) 121 1.5 가
	20% (w/v)	sodium carbonate	alditol acetate GC
pH 10		45 30	. GC SP-2380 capillary
	-glucan		column(0.2 μm film, 0.25mm i.d.×30m,
			Supelco) Hewlett-Packard model
2		2	5890 series mole%
M HCl pH 4가			peak alditol acetate
		50%	isopropyl 2.3
alcohol	가		
crude	-glucan	.	-glucan DMSO EtOH
1	crude	-glucan	가 0.1N NaOH
90	가		0.1N HCl
	ammonium sulfate	30% (w/v)	HPSEC-MALLS-RI (High Performance Size
가	가		Exclusion Chromatography-Multi Angular
	가		Laser Light Scattering-Refractive Index)
acetone	50% (v/v)	가	system . HPSEC-MALLS-
			RI system pump (P2000, Spectra System,
	MWCO 6000 8000	(Spectrum	San Jose, CA), injection valve (Model 7072,
Medical Industry, U.S.A)			Rheodyne, Cotati, CA), guard column (TSK
4		pH	PWH, Tosoh Corp., Japan), TSK Gel 5000
6.9	- amylase (1013U/100mL		PW column (7.8×600mm, Tosoh Corp.,
-glucan solution)	가	40 1	Japan), multi-angle laser light scattering detector
	pH	7.5	(632.8 nm, MALLS, DAWN DSP-F, Wyatt

- glucan 1N KOH
0.45 μm membrane filter
0.05 4.0% (w/w)
Cannon-Fenske (No. 200) crude - glucan 4.98%
25 ± 0.02 3.51% . 1
(specific viscosity, η_{sp}) (intrinsic viscosity, [η]) crude - glucan ammonium sulfate
3. 4.46% 2 - glucan
3.1 - Glucan 1 crude - glucan - glucan
가 5.3% 가 6.5% Forrest Wainwright (1977)
- glucan crude - glucan arabinoxylan
- glucan Table 1
가 5.54% 3.34% 1 crude - glucan arabin-
- glucan % oxylan 30% ammonium sulfate

Table 1. Extraction yield and composition of - glucan isolated from nonwaxy and waxy barley

		Crude - Glucan		Purified - Glucan	
		Nonwaxy	Waxy	Nonwaxy	Waxy
Extraction yield (%)		3.34	5.54	2.29	4.46
Composition (% w/w)	β- Glucan	59.15	62.91	99.60	99.70
	Protein	9.98	5.74	0.46	0.48
	Moisture	11.57	10.43	0.1	0.1
Component sugar (mole%)	Ara			0.21	0.41
	Xyl			1.98	0.55
	Man			0.38	0.30
	Glc			97.43	98.64
	Gal			-	0.10
	Total			100.00	100.00
		- glucan		가	
		85.2% ,	63.0%	0.5%	

99% 2 -glucan . 2
 -glucan
 arabinose, xylose, man- nose
 97 99% glucose
 -glucan
 -glucan ,
 .
 3.2

Fig. 1, Table 2

-glucan 2.0×10^5
 9.3×10^5
 -glucan 5.4×10^5 9.7×10^5
 1.443 1.282 -glucan 가
 -glucan
 6.259×10^5 7.986×10^5
 -glucan ,
 root-mean-square radius 86.2nm,
 89.8nm -glucan

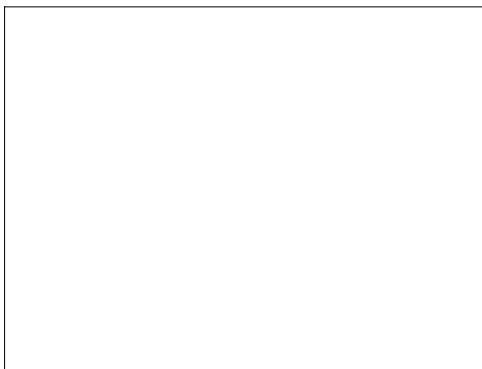


Fig. 1. Molecular weight distribution of -glucan isolated from nonwaxy and waxy barley

Table 2. Molecular characteristics of -glucan isolated from nonwaxy and waxy barley

	Mw ($\times 10^{-5}$)	$\langle r^2 \rangle^{1/2}$	Polydispersity
Nonwaxy -glucan	6.259	86.1	1.443
Waxy -glucan	7.986	89.8	1.282

-glucan . Gomez
 (1997) -glucan
 HPSEC-MALLS-RI system
 2.0×10^5 5.7×10^5
 10^5 가 1.26 1.67
 , root-mean-square radius
 confor- mation
 . Varum
 (1992) -glucan 2×10^4 1.4×10^5 ,
 가 1.2 1.7 ,
 Woodward (1983) -glucan
 2.1×10^5 2.9×10^5 , 가 1.1 1.4
 . Saulnier (1994) crude -glucan
 HPSEC- MALLS-RI system
 -glucan -glucan 2

3.3

-Glucan
 methylation
 . -Glucan methylation 가
 acetylation
 methyl alditol acetate .
 GC GC-MS , Fig. 2
 chromatogram
 -glucan 2 peak

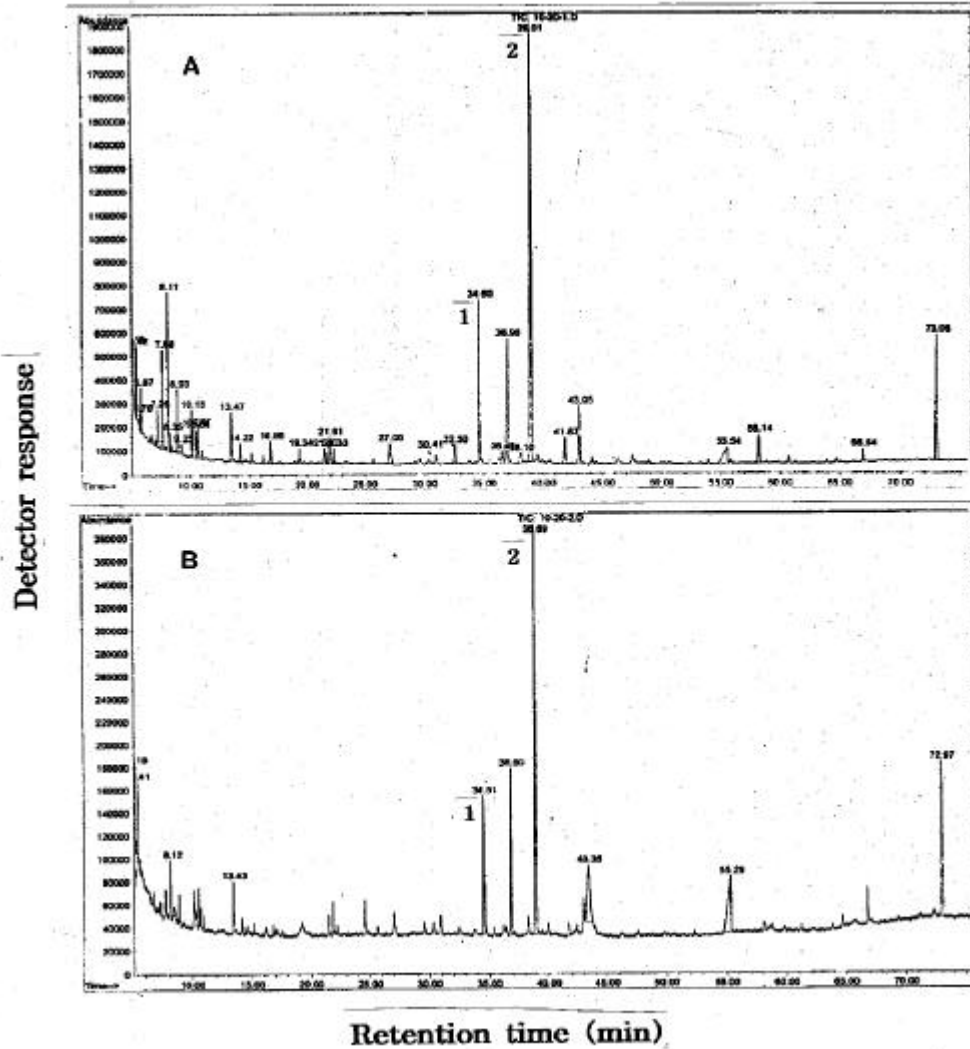


Fig. 2. GC chromatogram of permethylated α -glucan isolated from nonwaxy (A) and waxy (B) barley

mass spectra (Fig. 3)

1,3,5-tri-O-acetyl-2,4,6-tri-O-methyl-D-glucitol - Glucan

1,4,5-tri-O-acetyl-2,3,6-tri-O-methyl-D-glucitol

-glucan - (1 3)-

- (1 4)-

terminal

1,5-di-O-

acetyl-2,3,4,6-tetra-O-methyl-D-glucitol - (1 4)-

Table 3

- (1 3)-

terminal -glucan

25.75%, 70.62%, 3.63%

-glucan 24.90%, 70.89%,

-, - (1 3)-

-glucan

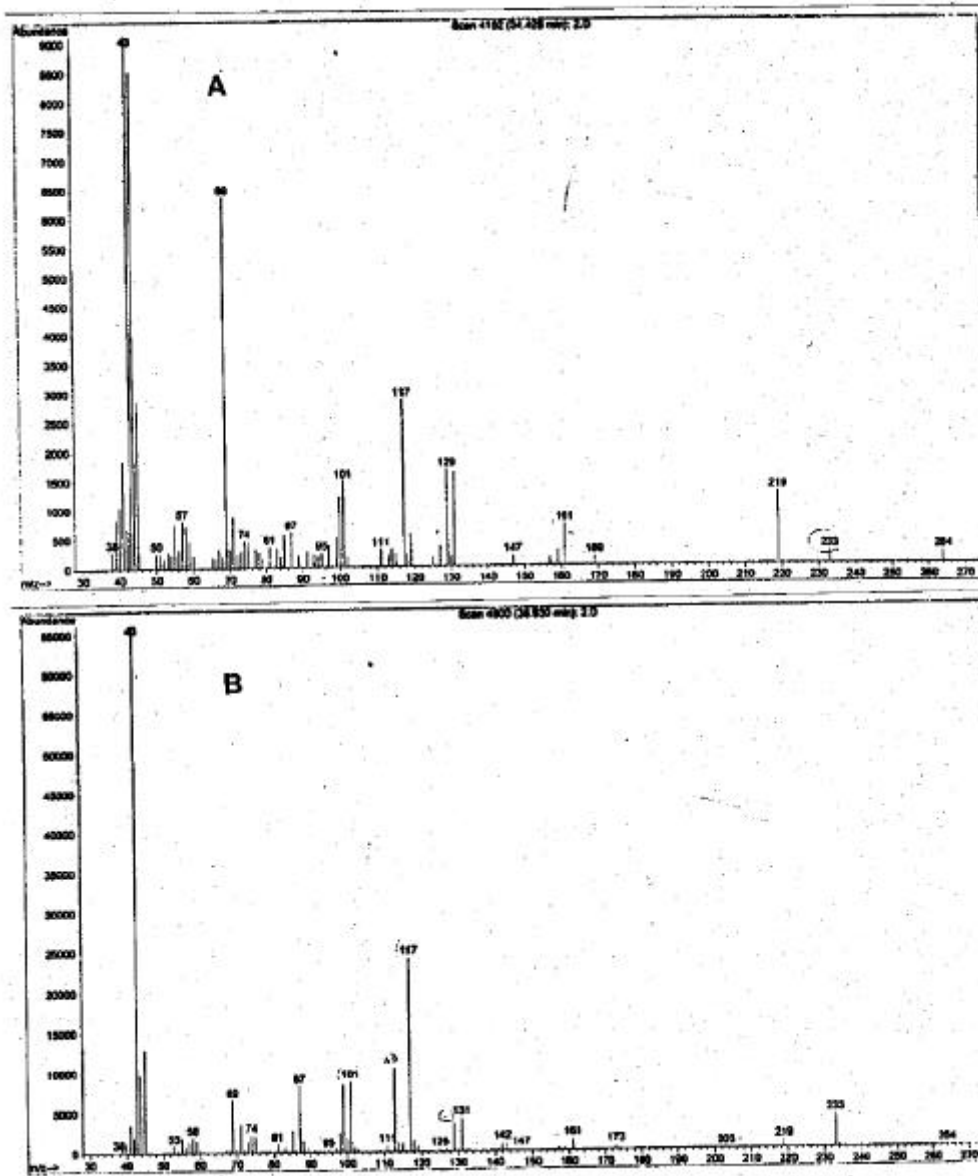


Fig. 3. Fragment ions on GC-MS of permethylated nonwaxy -glucan : A = 1,3,5-tri-O-acetyl-2,4,6-tri-O-methyl-D-glucitol, B = 1,4,5-tri-O-acetyl-2,3,6-tri-O-methyl-D-glucitol

1 : 2.74, -glucan 1 : 2.84 가 -glucan
 -glucan methylation -(1 3)- -(1 4)- 가 1 : 2.6
 가 . Bengtsson (1990) Dais Perlin (1982), Wood (1994),

Table. 3. Glycosyl linkage composition of nonwaxy and waxy -glucan

- Glucan	Glycosyl residue	Position of methyl group	Deduced glycosidic linkage	Mole %
Nonwaxy barley	Glucose	2,4,6	3)- Glcp - (1	25.75
		2,3,6	4)- Glcp - (1	70.62
		2,3,4,6	Glcp - (1	3.63
Waxy barley	Glucose	2,4,6	3)- Glcp - (1	24.90
		2,3,6	4)- Glcp - (1	70.89
		2,3,4,6	Glcp - (1	4.21

Woodward(1983)

3.4 NMR

- glucan 500MHz Spectrometer ¹³C-NMR - glucan ¹³C-

NMR spectra Fig. 4

signal - glucan (Dais and Perlin, 1982) signal

Table 4

- glucan 13 15 signal Dais Perlin(1982)가 . 6 (hexose) anomeric carbon 가 field

(Casu, 1985)

- glucan 103.35, 102.59

- glucan 103.60,

102.72 - anomeric glucose

signal . 103.35

103.60 signal 3-O-linked glucose

C- 1, 102.59 102.72 signal

4-O-linked glucose C- 1

, 103 signal single peak

, 102 signal double peak

3-O-linked glucose 4-O-

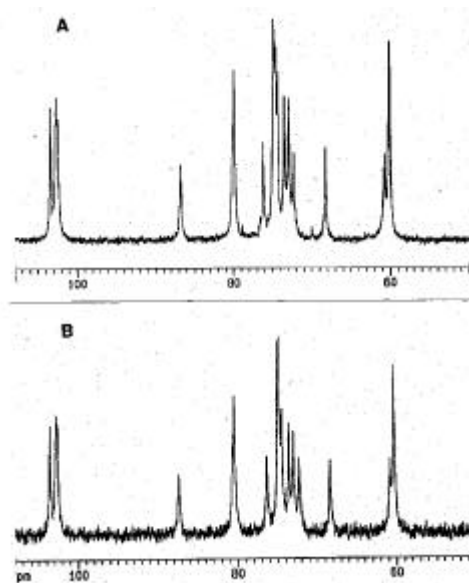


Fig. 4. ¹³C-NMR spectra of nonwaxy(A) and waxy(B) -glucan

linked glucose 1 : (2 3) methylation

- glucan 86.75,

87.29 signal 3-O-linked

glucose C-3 79.85 80.30

signal 4-O-linked glucose C-4

79 80 single

peak 76 peak group(double)

Table 4. ¹³C-chemical shifts of structural groups in nonwaxy and waxy -glucan

	Chemical shift	
	ppm	Carbon assignment
Nonwaxy barley - glucan	103.35	C- 1 of 3G
	102.59	C- 1 of 4G
	86.75	C-3 of 3G
	79.85	C-4 of 4G
	76.12	C-5 of 3G
	74.85, 74.74	C- 3 of 4G
	74.56, 74.30	C-5 of 4G
	74.42, 72.89	C-2 of 4G
	72.24	C-2 of 3G
	68.21	C-4 of 3G
60.70	C-6 of 3G	
60.11	C-6 of 4G	
Waxy barley - glucan	103.60	C- 1 of 3G
	102.72	C- 1 of 4G
	87.29	C-3 of 3G
	80.30	C-4 of 4G
	76.24	C-5 of 3G
	74.77	C-3 of 4G
	74.34	C-5 of 4G
	73.50, 72.91	C-2 of 4G
	72.16	C-2 of 3G
	68.27	C-4 of 3G
60.77	C-6 of 3G	
60.26	C-6 of 4G	

3G : 3-O- substituted glucose residue

4G : 4-O- substituted glucose residue

3-linked glucose 4-linked glucose 3-O-linked glucose signal
 가 1 : (2 3) 가 . singlet field
 Table 4 4-O-linked glucose 3-O-linked
 4-O-linked glucose C-2, C-3, C-5 C-6 doublet 가
 3-O-linked glucose C-2, C-3, C-5 C-6 glucose laminarin
¹³C-NMR signal . - (1 3)- ,

4-O-linked glucose 2 3 - (1 4)-
 - glucan
 NMR (Wood et al.,
 1991, 1994, Lee, 1992, Dais and Perlin,
 1982)

- glucan NMR

3.5

- Glucan - (1 3)-
 oligosaccharide
 - glucan lichenase
 - glucan oligo-
 saccharide ion chromatography

Fig. 5 Table 5 . Fig. 5

lichenase
 oligosaccharide DP 3(celotriose) DP
 4(celotetraose) peak DP 1, 2, 5, 6
 peak , DP 7 peak
 . DP 3 DP 47† 89 91%

lichenase
 , DP 1 DP 27† 3 4%, DP
 5 DP 6 5 6%
 - glucan DP 3 DP 47† 63.08%
 27.55% , - glucan 62.00%,
 27.44% 2.29 2.26

Wood (1994)
 . Wood (1994)
 , , - glucan liche-
 nase oligosaccharide

oligosaccharide oligo-
 saccharide DP 3 DP 47† 91 92%,
 DP 5 DP 6 2 4%, DP 7 DP 8 1%
 DP 9

. 3%



Fig. 5. Ion chromatogram of hydrolysates of nonwaxy -glucan treated with lichenase

Table 5. DP distribution of hydrolysates of nonwaxy and waxy -glucan treated with lichenase

DP	Nonwaxy -glucan(%)	Waxy -glucan(%)
1	1.11	1.12
2	3.21	3.44
3	63.28	62.00
4	27.55	27.44
5	3.44	3.87
6	1.61	2.17
100.00		100.00
DP (3+4)	90.63	89.40
DP 3/DP 4	2.29	2.26

oligosaccharide DP 3
 (40%) DP 7 15
 - glucan DP 5, 6 6.04%

- glucan DP 5, 6 5.05%
 Cameo Wa- xiro
 - glucan Saulnier
 (1994)
 Waxiro DP 3 Cameo
 DP 5 9
 가 - glucan

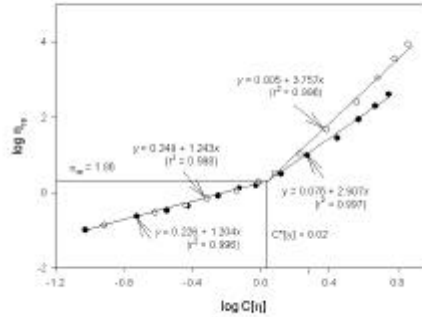


Fig. 6. $\log \eta_{sp}/C$ vs. $\log C$ for waxy(-) glucan solutions

Buliga Brant(1986) DP 5
 oligosaccharide가
 - glucan (chain
 extension)

- glucan C* [g/dL]
 sp가 0.02 1.86 가
 [] C* []
 (C*) - glucan

3.6
 (reduced vis-
 cosity, η_{sp}/C)

1.15%,
 - glucan
 C [] < C* []
 - glucan 1.204 1.243

0
 - glucan 2.38dL/g - glucan
 1.74dL/g 가
 (1993) 2.59dL/g, 1.60dL/g
 가

C [] > C* []
 가 2.907 3.757 critical coil overlap
 parameter 가 가
 - glucan 가가
 - glucan 가

가
 (entanglement)
 가 가 가
 (reduced concentration,
 C [])
 Fig. 6

. C [] < C* [] 가
 (hydrodynamic volume)
 1.0 1.4
 C [] > C* []

critical coil overlap
 parameter(C* [g/dL])
 (critical concentration, C*)

(Launay
 et al., 1986).
 - glucan

- methylation, NMR - glucan
 oligosaccharide 가
 - glucan
 - glucan
 - glucan
 - glucan
 (1 3)- (1 4)-
 oligosaccharide
 - glucan
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