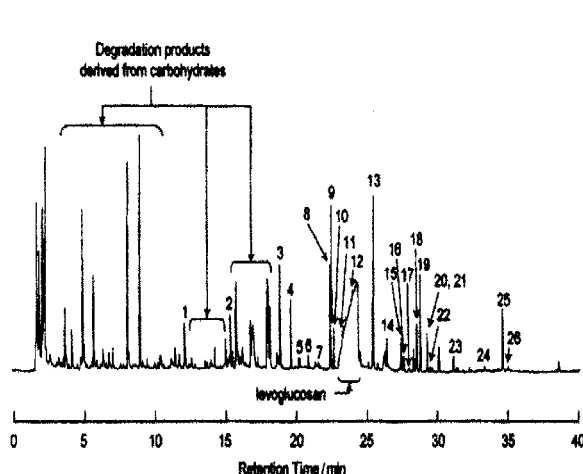


Characterization of within-tree variation of lignin components in *Eucalyptus camaldulensis* by Py-GC

[Background] Lignin in hardwoods such as *Eucalyptus* and beech consists of guaiacylpropane units (G) and syringylpropane units (S) containing one and two methoxy groups, respectively. It is known that the lignin content and its chemical structure have a significant influence in the pulping process, in particular, the ratio of syringyl and guaiacyl units (S/G ratio) in hardwood lignin affects not only the pulping efficiency but also the strength of manufactured pulp and papers. In this work Py-GC was applied to the determination of the S/G ratio in samples from a given *Eucalyptus*. Observed S/G ratios were compared with those obtained by TAM (thioacidolysis method).

[Experimental] *Eucalyptus camaldulensis* tree from Western Australia was used in this work. Debarked wood disks were obtained by cutting the trunk from 0.3m above the ground at 1m intervals. Then wood blocks obtained were cryo-milled into a finely powdered sample. About 100µg of wood sample were pyrolyzed under a flow of He carrier gas at 450°C. Analysis was done by a GC equipped with a capillary column and with an FID or MS as a detector. The lignin S/G ratio was determined by TAM based on the GC peak intensity ratio reflecting the syringyl- and guaiacylpropane units.

[Results] Figure 1 shows a typical pyrogram of a *Eucalyptus* sample at 450°C observed by FID. Pyrolyzates derived from lignin were observed as peaks 1 through 26. Table 1 shows the assignment of these peaks and also summarizes the relative molar yields among the 26 pyrolyzates from lignin for radial samples A-1 through A-7. The distribution of each pyrolyzate in samples A-1 through A-7 showed a similar tendency. The within-tree variation of the S/G ratio in the radial direction at 0.3m above the ground obtained on the basis of the molar yields of the pyrolyzates showed the highest S/G ratio of 2.13 for sample A-1 at the extreme pith side. The S/G ratio then decreased gradually towards the bark with the lowest value of 1.57 for sample A-7. It was found the values obtained by Py-GC were always higher than those obtained by TAM. The within-tree axial variations were similarly determined.



Peak No.	Compound	Origin	Molar yield (%)						
			A-1	A-2	A-3	A-4	A-5	A-6	A-7
1	Guaiacol	G	4.90	4.96	4.96	4.41	4.42	4.12	5.38
2	4-Methylguaiacol	G	5.55	4.95	4.55	4.64	5.04	5.01	4.47
3	Vinylguaiacol	G	6.93	6.75	6.28	6.18	6.42	7.01	5.93
4	Syringol	S	9.24	8.49	9.45	8.17	9.94	7.55	8.06
5	Eugenol	G	0.94	0.85	0.76	0.63	0.94	1.07	1.32
6	Vanillin	G	1.49	1.56	1.49	1.60	1.79	1.88	2.21
7	cis-Isoeugenol	G	0.45	0.43	0.44	0.46	0.57	0.50	0.38
8	Methylsyringol	S	9.29	8.75	8.18	7.78	8.60	8.03	6.54
9	Homovanillin	G	1.86	1.63	1.41	1.63	1.40	1.77	1.44
10	trans-Isoeugenol	G	3.80	3.48	3.32	3.35	4.17	4.03	3.16
11	Acetosyringone	G	1.00	0.93	1.00	1.00	0.95	0.94	1.01
12	Guaiacylacetone	G	0.61	0.48	0.58	0.21	0.61	0.65	0.40
13	Vinylsyringol	S	14.01	14.37	12.68	13.72	11.29	11.80	11.99
14	Allylsyringol	S	2.37	2.43	1.98	1.77	2.04	2.04	1.58
15	Syringaldehyde	S	5.16	5.23	5.22	5.48	6.04	6.32	6.51
16	cis-Propenylsyringol	S	1.46	1.29	1.22	1.18	1.43	1.35	1.06
17	cis-Coniferyl alcohol	G	0.32	0.53	0.64	0.66	0.64	0.60	0.71
18	Homosyringaldehyde	S	3.71	2.92	2.79	2.82	2.71	2.85	1.92
19	trans-Propenylsyringol	S	9.70	8.40	7.91	7.42	8.22	8.19	6.61
20	trans-Coniferaldehyde	G	1.25	1.41	1.49	1.54	1.63	1.55	1.79
21	Acetosyringone	S	2.75	3.11	3.29	3.39	3.59	3.42	3.94
22	trans-Coniferyl alcohol	G	2.46	5.17	6.88	7.69	6.18	6.42	9.25
23	Syringylacetone	S	1.75	1.66	1.39	1.54	1.43	1.45	1.26
24	cis-Sinapyl alcohol	S	0.72	1.27	1.57	1.53	1.24	1.19	1.77
25	trans-Sinapaldehyde	S	6.67	6.71	6.63	6.62	6.69	7.39	7.69
26	trans-Sinapyl alcohol	S	1.61	2.44	3.69	4.58	2.02	2.87	3.62
Total			100	100	100	100	100	100	100

Figure 1. A typical pyrogram of *Eucalyptus* obtained at 450°C (Peak assignments were given in Table 1)

Table 1. Radial variation of pyrolyzates for samples at 0.3m above the ground (S: syringyl unit, G: guaiacyl unit)

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