

목재산업 작업장의 부유분진에 관한 연구

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1. 서론

Tannins are complex polyphenolic substances present in plants. They may be classified as either hydrolysable or condensed tannins, and extracts of the latter type have displayed carcinogenic properties in animal studies (Hausen, 1981). The International Agency for Research on Cancer has determined that exposure to airborne wood dust, especially hardwood dust during furniture manufacture, is a cause of sino-nasal cancer, notably nasal adenocarcinoma. It appears that the carcinogenicity potency is in the wood itself and not in decomposition products or in the substances applied to the wood. Tannins have been implicated because hardwoods are thought to contain proportionally more tannin than softwoods. Furthermore, it has been suggested that the elevated sino-nasal cancer risk in shoemakers may also be due to tannin exposure (Bianco and Savolainen, 1994). In a recent Australian nasal cytological study, it was found that hardwood exposure was more likely to be associated with nasal metaplasia in experienced woodworkers (Pisaniello et al, 1995). Thus it is of interest to determine tannin exposures in woodworking processes, and to assess whether tannin exposure, as distinct from wood dust, is a better indicator of sino-nasal risk. This paper examines the tannin content of a range of woods used in Australian furniture manufacture, and also reports airborne tannin levels in two factories.

2. 실험 방법

Inhalable wood dust was measured according to AS 3640-1989, utilising a sampling strategy reported by Pisaniello et al (1991). Tannin values were determined in triplicate according to methods described in Bianco and Savolainen (1994) and Lau et al (1989). Wood dust samples were extracted with 50% methanol for one hour. All solutions were filtered prior to

spectrophotometric analysis, and all reagents were of analytical-reagent grade. There was no significant influence of extraction time (30 min - 6hrs), or air sampling filter type (PTFE, cellulose ester, glass fibre or PVC) on measured tannin concentration.

3. 결과 및 고찰

The tannin concentration in wood samples varied from 0.43 to 8.72 mg tannic acid equivalent per gram of wood, for reconstituted softwood and turpentine (*Syncarpia glomulifera*) respectively (Table I). This range is somewhat lower than that reported by Bianco and Savolainen, (1994), i.e. 1.6 - 80 mg tannic acid equivalent g⁻¹ of wood, although the wood species are not strictly comparable. Table II indicates that hardwoods generally contain more tannin than softwoods, which is consistent with previous research. Measured concentrations of airborne wood dust and tannin are given in Table III. Note that the inhalable dust concentrations are similar to those published elsewhere, again demonstrating excessive exposures from sanding operations (Pisaniello et al, 1991). Airborne tannin was somewhat lower than that reported by Bianco and Savolainen (1994), and this result may be attributable to the different woods encountered. In the latter study, oak displayed a disproportionately high tannin content. On the other hand, our investigations showed that careful filtration of solutions is necessary to avoid suspended particulate giving high absorbances. This work is in progress and the relationship between tannin concentration and nasal cytological score is currently being examined.

4. 결론

Tannin exposure is thought to be a sino-nasal cancer risk agent for woodworkers. The tannin contents of woods used in Australian furniture manufacture have been measured and varied from 0.43 to 8.72 mg tannic acid equivalent per gram of wood, for reconstituted softwood and turpentine (*Syncarpia glomulifera*) respectively. Airborne tannins were also determined. Mean personal exposures ranged from 3.1 to 15 g / m³. Further research is required to evaluate the health significance of the data.

참고 문헌

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Table I: Tannin content of wood samples (mg tannic acid equivalent g-1 of wood)

Classification*	Name		Tannin conc. (mg /g dust)	Origin
	Common trade	Botanical		
Soft wood	Cedar, western red	<i>Thuja plicata</i>	1.76-4.08	2)3)
	Fir, Douglas	<i>Pseudotsuga menziesii</i>	1.42	1)
	Pine, celery-top	<i>Phyllocladus asplenifolius</i>	2.74	1)
	Pine, hoop	<i>Araucaria cunninghamii</i>	0.65	1)14)
	Pine, Huon	<i>Dacrydium franklinii</i>	0.85	1)
	Pine, kauri	<i>Agathis palmerstoni</i>	0.66	1)
	Pine, lodgepole	<i>Pinus contorta</i>	0.61	1)2)
	Pine, radiata	<i>Pinus radiata</i>	1.24	1)3)4)5)

Table II: Tannin content by wood type

	Tannin concentration (mg /g dust)		
	Softwood	Hardwood	Recon. wood
Minimum	0.61	0.27	0.43
Maximum	4.08	8.72	0.59
Average	1.68	2.22	0.48
Median	1.33	1.83	0.43

Table III: Woodworker exposure to airborne wood dusts and tannins

Activity	Sampling Method	Principal Wood	Inhal. dust (mg /m ³)	Tannin conc. (µg / m ³)	Remark
Sawing	Personal	Nyatoh, Jarrah, Tasmanian oak, Laminated Chipboard, Veneer, Plywood	3.2	9.1	circular saws, band saws, profilers, dimension saws, straight line edgers, trimmers.
	Area		0.72	3.9	
Cutting	Personal	Aningeria, MDF Laminated Chipboard Plywood, Nyatoh, Tasmanian oak	2.4	4.6	planers, thicknessers, moulders, shapers, mortisers, tenoners, spindle, moulders, copy lathes, router.
	Area		0.87	3.1	
Sanding	Personal	Laminated chip -board, Veneer Blackwood, Aningeria, Plywood, Ameri. Walnut,	5.3	14.5	Paper and block, Portable hand sand machines all kinds of sanding machines
	Area		2.2	5.0	