

THE INFLUENCE OF ORGANIC FIBRE DUST EXTRACTS ON AIRWAY PERMEABILITY IN THE GUINEA-PIG

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Byssinosis is an occupational lung disease associated with the exposure of mill workers to the dusts of cotton, flax and hemp. We have investigated the influence of these dust extracts on airway permeability in the guinea pig as an index of epithelial cell damage. This was determined by pulmonary clearance of inhaled ^{99m}Tc -technetium diethylenetriamine pentaacetate (Tc-DTPA) using gamma scintigraphy.

Restrained guinea pigs inhaled a nebulized solution of Tc-DTPA from a settling bag via a mask attachment for 7 min. Sequential images were recorded using a gamma-camera (General Electric Maxi-camera 400A) over the following 30 min. This was repeated following exposure of groups of the same animals to nebulised extract solutions (Bates and Nicholls, 1988) or saline in a sealed chamber for a period of 6 min daily (Monday to Friday) for four weeks, and again following a one week treatment-free period. Activity in the lung region was quantified, corrected for natural background radiation and expressed as percentage counts per minute from the start of recording. Pulmonary half-life ($t_{0.5}$) for Tc-DTPA clearance was calculated as the time (min) for percentage counts to fall to 50% (estimated from the clearance curve if not reached within the 30 min recording period).

Table 1. Tc-DTPA clearance half-lives ($t_{0.5}$) before treatment (Baseline), following chronic exposure to extracts (Exposure) and after a treatment-free period (Rest).

Treatment	$t_{0.5}$ (min. \pm S.D.)		
	Baseline	Exposure	Rest
Cotton-dust extract (n=9)	35 (\pm 11)	11 (\pm 3) *	31 (\pm 8)
Flax-dust extract (n=5)	28 (\pm 12)	12 (\pm 2) *	ND
Hemp-dust extract (n=4)	34 (\pm 4)	10 (\pm 3) *	24 (\pm 6)
Sterile isotonic saline (n=8)	29 (\pm 7)	32 (\pm 7)	ND

* $p < 0.001$ as determined by comparison of baseline and exposure groups by Student's t-test. (ND = not determined)

Tc-DTPA clearance $t_{0.5}$ (Table 1) is significantly reduced following chronic exposure to all the dust extracts when compared to previous baseline clearance in the same animals. Initial pulmonary distribution profiles did not vary, therefore discounting regional differences in the lung clearance (Oberdorster et al 1984). Re-examination of animals exposed to cotton and hemp one week after cessation of treatment indicated that permeability changes were reversible.

The epithelium is the major barrier to trans-alveolar passage of molecules (Sheeberger-Keeby et al 1968) and an increase in permeability may be the result of epithelial cell damage, junction separation and shedding, allowing Tc-DTPA to pass more rapidly from airway to bloodstream. This would be consistent with the observation that these permeability changes are reversible after an extract-free period which allows epithelial cell regeneration.

Bates, P.J. and Nicholls, P.J. (1988) Proc. 12th Cotton Dust Res. Conf. p96.

Oberdorster, G. et al (1984) J. Appl. Physiol. 57: 589.

Sheeberger-Keeby, E. et al (1968) J. Cell Biol. 37: 781.