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Nitrosamine in leather dust extracts

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The interest in the carcinogenic and biological actions of N-nitroso compounds arose following the reports of the hepatotoxicity by Freund[1] and Barnes and Magee[2] and of carcinogenicity (Magee and Barnes)[3] of the simplest nitrosamine: N-nitrosodimethylamine (dimethylnitrosamine) and the subsequent observation of Schoental[4] and Druckrey *et al*[5] on the carcinogenic action of the nitrosamides: n-methyl N-nitrosourethane and N-methyl N-nitrosurea. Magee and Barnes in 1956 showed the carcinogenic effects of N-nitrosodimethylamine (NDMA) in rats.

Evidence that certain consumer and industrial products contain N-nitroso compounds led to speculation that workers in the industries that either use or manufacture nitrosamine precursors (amines and nitrogen oxides) may be exposed to these agents.[6-8] One such industry is leather tanning. Dimethylamine sulphate (DMAS, a precursor of N-nitrosodimethylamine NDMA) is used in leather tanneries as a depilatory agent in the hide process (P Walker *et al*, MITRE Corporation report MTR 7152, 1976).

Following these observations, Rounbehler *et al* carried out a study of human exposure to N-nitrosamine by examining work environments of the leather tanneries.[9] Different amounts of NDMA were detected in air samples taken from different sites in the tannery. The highest levels, up to 47 μg/m^3 were in the retanning, colouring, and fat liquoring area.

Fridman *et al* detected a nitrosamine group attached to various other groups in different samples by using infrared spectroscopy; nitrosamines show an intense band in the infrared region caused by the vibration of the N =O bond.[10]

Materials and methods

Workers in the leather industry may be exposed to leather dust produced in various tanning operations. Chemical dust is produced during the loading of hide processing drums; leather dust impregnated with chemicals is produced during some mechanical operations including shaving, splitting, and buffing.

Samples of leather dust in the form of sweepings were collected from different sites in the tannery and extracts were prepared in different organic solvents such as petroleum, ether, methanol, and acetone using a Soxhlet extraction apparatus. These extracts were purified by using chromatographic techniques including: (*a*) thin layer chromatography, (*b*) column chromatography, and (*c*) preparative thin layer chromatography. The extracts of purified leather dust obtained in the form of different elutes resulting from preparative thin layer chromatography were subjected to infrared spectrophotometers, double beam type, Perkin Elmer 157 of range 4000 Cm^{-1} to 600 Cm^{-1} and Perkin Elmer 577 of range 4000 Cm^{-1} to 250 Cm^{-1} for detecting the nature of the functional groups constituting the organic compounds. The spectra was taken for the range 4000 Cm^{-1} to 250 Cm^{-1} and the various peaks obtained were analysed for the presence of different functional groups.

Results

Twelve extracts were subjected to infrared spectrophotometry, nine of which had a peak of strong or medium intensity at 1450 Cm^{-1} and at 1460 Cm^{-1} (table) indicating the presence of a nitrosamine group.

Discussion

This is the first occupational group in whom exposure to environmental nitrosamines has been found. The

Infrared spectroscopy of extracts of leather dust in different solvents indicating the presence of nitrosamine group

Solvent used for preparing extract	*Wave No (Cm^{-1})*	*Intensity of peak*	*Inference indicates presence of*
Petroleum ether	1450	Strong	Nitrosamine group
Methanol	Neg	Neg	Neg
Methanol	Neg	Neg	Neg
Methanol	1460	Medium	Nitrosamine group
Acetone	1460	Medium	Nitrosamine group
Acetone	1460	Medium	Nitrosamine group
Petroleum ether	Neg	Neg	Neg
Methanol	1460	Medium	Nitrosamine group
Acetone	1450	Medium	Nitrosamine group
Petroleum ether	1460	Strong	Nitrosamine group
Methanol	1450	Medium	Nitrosamine group
Acetone	1450	Medium	Nitrosamine group

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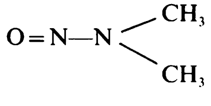
nitrosamines were detected in extracts of leather dust examined by infrared spectroscopy.

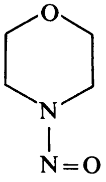
The detection of chemicals by infrared spectroscopy depends on detecting stretching and bending vibrations of atoms and bonds. The frequencies of these vibrations are dependent on the nature of particular bonds but are also affected by the entire molecule and its environment. The vibration causes infrared absorption only when it causes change in the charge distribution within the molecule. The larger the change the stronger the absorption. Absorption bands that appear with a relatively high intensity in a range characteristic for a certain and for some groups characteristic frequencies or characteristic absorption bands are observed.

Various strong and medium absorption peaks were observed and recorded in the leather extracts (table). The peak of strong or medium intensity at 1450 Cm^{-1} and at 1460 Cm^{-1} are characteristic absorption bands arising as a result of stretching vibrations (υ N = O) and indicate the presence of a nitrosamine group, presenting in N-nitrosodimethylamine (NDMA) or N-nitrosomorpholine (NMOR).



$O=N-N(CH_3)_2$

(NDMA)



(NMOR)

Since Magee and Barnes showed the carcinogenic effects of NDMA in the rat in 1956, this compound has been shown to cause cancer in various organs in virtually every species.[11] The information on human exposure to nitrosamines is incomplete, however, and the International Agency for Research on Cancer has concluded that "the general (human) population may be exposed to low levels of N-nitrosodimethylamine, however, no exposed group suitable for epidemiological investigation has yet been identified."[12] The identification of nitrosamines in the leather dust to which tannery workers are exposed suggests that this group may provide such a population for further studies of morbidity, including the prevalence of cancer.

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