

Occupational allergic contact dermatitis associated with dimethyl fumarate in clothing

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Recent reports have highlighted the emergence of allergic contact dermatitis to a potent sensitizer, dimethyl fumarate (DMF), which has been used as a fungicide for storage and transport of furniture made in China and imported into the European Union (EU) (1, 2). We report the case of an occupational contact allergy related to the presence of DMF in a work suit.

Case report

A 40 year-old non-atopic man in good general health developed a severe eczematous dermatitis involving his thighs, buttocks, scrotum, and inguinal folds. This dermatitis appeared 3 weeks after he started wearing a new pair of trousers worn when at work and provided by his employer in the metal industry. He was temporarily removed from his normal work and, following treatment, there was complete remission of skin lesions within 5 weeks. However, the dermatitis relapsed twice within a few days of returning to work

and wearing the trousers. The patient was patch tested with the baseline S.I.D.A.P.A. (Italian Society of Allergological, Occupational and Environmental Dermatology) series (Firma®, Florence, Italy) and with an extensive textile and dye series (Firma). Patch testing was performed according to the International Contact Dermatitis Research Group guidelines and the series were applied to the back for 2 days using Finn® chambers (Epitest, Tuusula, Finland) on Scanpor® tape. The patient was also patch tested with dry and moistened swatches of cloth from his trousers, as well as with DMF 0.01% in petrolatum (supplied by Firma). Of note, the cloth samples were taken from a pair of trousers which had been washed at least 5 times before patch testing and chemical assessments. Readings at 2D and 3D showed positive reactions only to the moistened trousers sample (+) and DMF (+ + +). Patch test with DMF 0.01% pet. in five healthy volunteers gave negative results. The patient was instructed to discontinue wearing the culprit trousers. No relapse of the dermatitis was observed during a 4-month observation period.

Chemical Analysis

The presence of DMF in the trousers was investigated by means of head-space (HS) solid phase microextraction (3) coupled to gas chromatography-mass spectrometry (HS-SPME-GC-MS). A DMF (Sigma-Aldrich Milan, Italy) solution was prepared in chloroform (1 µg/µl) and stored in the dark at 4°C. More diluted solutions were prepared just before use. All chemicals were obtained from Sigma-Aldrich. The GC-MSⁿ system (Thermo electron corporation, TX, USA) consisted of a Finnigan TRACE GC ultra gas chromatograph interfaced to a Finnigan Polaris Q ion trap mass spectrometer. *GC conditions.* Injector temperature: 250°C; transfer line temperature: 280°C; capillary column: SPB-5 (30 m length, 0.25 mm I.D. with 0.25 µm film thickness, Sigma-Aldrich (Supelco); carrier gas (helium) flow rate: 1 ml/min; oven temperature program: 50°C (3 min) to 250°C (15 min) at 2°C/min. *MS conditions.* Operating mode: EI⁺; source temperature: 250°C; electron energy: 70 eV; filament current: 200 µA; spectra acquisition range: 50–300 m/z.

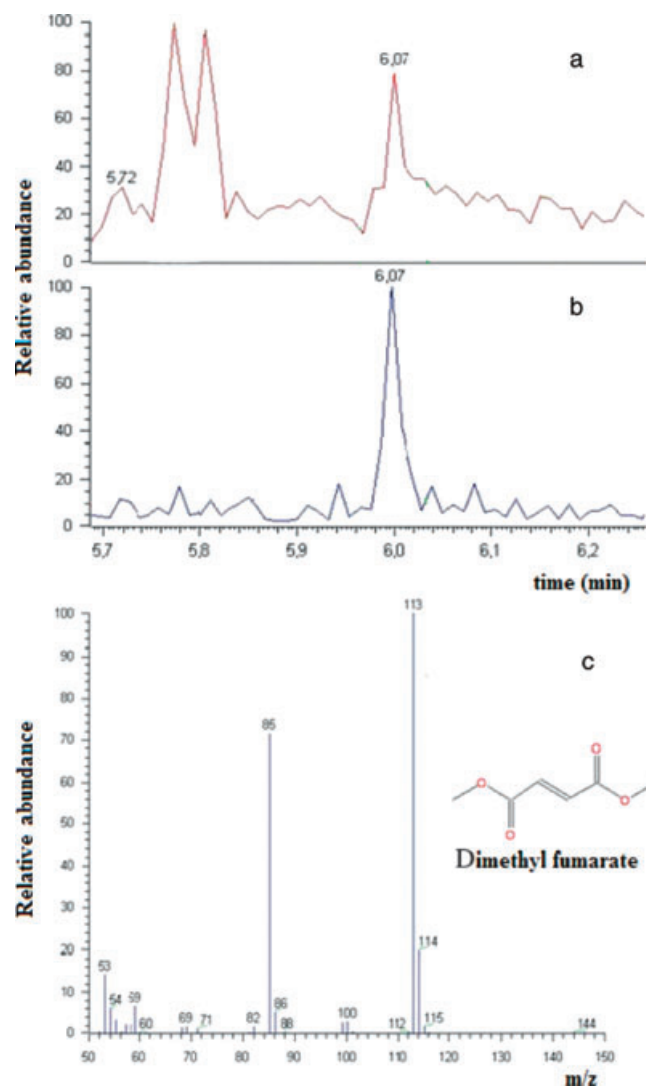


Fig. 1. HS-SPME-GC-MS chromatograms relevant to (a) the analysis of a fabric sample taken from the patient's trousers and (b) the analysis of a standard solution of DMF. (c) EI⁺ mass spectrum of the peak eluted at 6.07 min in Fig. 1a.

A silica fibre coated with 85-µm-thick polyacrylate (PA) film and a manual Solid Phase Micro Extraction (SPME) device (Supelco) was employed. Suite sections of 3 × 3 cm were excised, placed into 5 ml clear vials, the vials sealed with hole caps and PTFE-faced silicone septa (Supelco), equilibrated for 60 min in a thermostatic bath at 80°C and subjected to HS SPME for 30 min. Thermal desorption (5 min at 250°C) was performed into the GC injection port.

Figure 1a shows the HS-SPME-GC-MS chromatogram relevant to the analysis of an excised fabric sample. The chromatographic peak at 6.07 min was attributed to DMF by comparing the relevant MS spectrum (Fig. 1c), with those present in the instrument library. In order to confirm the attribution, the

retention time and the mass spectrum of the compound eluting at 6.07 min were compared with those of DMF standard. Figure 1b reports the HS-SPME-GC-MS chromatogram relevant to the analysis of a DMF standard solution. The standard was eluted exactly after 6.07 min; furthermore, a complete match between the mass spectra was obtained, thus strongly supporting the above hypothesis.

Discussion

DMF was shown to be a potent contact sensitizer, causing allergic reactions at concentrations as low as 1 ppm (1, 4). The high sensitizing potential became known after the so-called 'toxic-sofa' incident, where Chinese manufacturers produced furniture with DMF sachets

inside. After several reports documenting an outbreak of contact eczema to Chinese sofa/chairs in northern Europe, DMF was finally identified as the possible cause of such a dermatitis epidemic (1, 2). DMF is banned for use in the manufacture of goods inside the EU in accordance with the Biocides Directive 98/8/EC. However, manufacturers outside the EU may use DMF as a biocide in order to prevent the deterioration of consumer goods, e.g. furniture or shoe leather, during storage and maritime transport. DMF evaporates, thus impregnating the leather and can penetrate through clothes onto the skin. Due to health risk concerns, EU Member States have recently banned the importation and placing on the market of furniture, footwear, and other consumer products containing DMF (5). Before the adoption of these decrees, DMF-contained fabrics might have been imported in the EU, as suggested by our report. Legal representatives of the industry in which our patient was employed declared that the work suits were manufactured in the EU with textile materials of unknown geographical origin. The responsibility of DMF as the cause of the eczematous dermatitis in our patient was very likely, as supported by patch testing with DMF 0.01% in petrolatum. Chemical analysis revealed the presence of DMF in the patient's work trousers, even though they had been repeatedly washed. To the best of our knowledge, this is the first report of contact dermatitis to DMF contained in clothing.

from: <http://europa.eu/rapid> (last accessed 29 January 2009).

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