

Hidden exposure to formaldehyde in a swab caused allergic contact dermatitis

Ulrik Fischer Friis¹, Jakob Dahlin², Magnus Bruze², Torkil Menné³ and Jeanne Duus Johansen¹

¹National Allergy Research Centre, Department of Dermato-Allergology, Copenhagen University Hospital Gentofte, 2900, Hellerup, Denmark, ²Department of Occupational and Environmental Dermatology, University Hospital Malmö, 20502, Malmö, Sweden, and ³Department of Dermato-Allergology, Copenhagen University Hospital Gentofte, 2900, Hellerup, Denmark

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Formaldehyde is a preservative that is used in many different materials, for example paint (1), metal-working fluids (2, 3), and cosmetics (4–6). Formaldehyde can sometimes be found in products as an impurity, or it can be added as a preservative to the raw material. In this report, we describe a patient who reacted to formaldehyde in an alco-swab, which was labelled as containing water and ethanol only.

Case Report

A 49-year-old woman, with no history of atopic dermatitis but with a history of food and protein allergy and allergy to formaldehyde and chlorhexidine, was admitted to hospital for hysterectomy. She developed peritonitis, and was given parenteral nutrition. She repeatedly developed a rash when a certain alco-swab was used for disinfecting skin prior to blood samples being taken, etc., despite the label of the swab mentioning only 82% ethanol and water as ingredients (Fig. 1).

The patient was patch tested at our clinic with the European baseline series, an extended baseline series, our plastic/glue series, and her own cosmetics and alco-swabs, and prick tested with our standard food series and latex proteins.

The patch tests were applied on the upper back, and occluded for 2 days. Readings were performed on D2, on D3, and on D7, according to the recommendations of the International Contact Dermatitis Research Group (7).

Correspondence: Ulrik Fischer Friis, National Allergy Research Centre, Department of Dermato-Allergology, Copenhagen University Hospital Gentofte, Niels Andersens Vej 65, 2900 Hellerup, Denmark. Tel: +45 39 77 73 07; Fax: +45 39 77 71 18. E-mail: ulrik.fischer.friis@regionh.dk

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Fig. 1. Package of the alco-swab provided by the patient.

The patient reacted positively to formaldehyde 1% (maximum +) and 2% (maximum +), colophonium (maximum +), 4-tert-butylchatechol (maximum +), 2-tert-butyl-4-methoxyphenol (maximum +), chlorhexidine diacetate (maximum +), hydrogen peroxide (maximum ++), and different alco-swabs containing chlorhexidine (maximum +1). She also reacted to the alco-swab (Brenntag Hospitalserviet) (maximum +?), which contained only water and ethanol according to the label. The patient applied the alco-swab to her own skin, and photographed the reaction (Fig. 2).

The formaldehyde SPOT test (chromotropic acid method) was performed in our own laboratory, and gave



Fig. 2. Reaction to the alco-swab, Brenntag Hospitalsserviet.

a positive result. The manufacturer denied the presence of any formaldehyde. Newly manufactured alco-swabs and raw material and ingredients lists for some of the raw materials were provided by the manufacturer. All of the provided material was sent for analysis at the Department of Occupational and Environmental Dermatology at the University Hospital in Malmö.

One half of the alco-swab was cut into small pieces, diluted in 10 ml of water, and extracted for 5 min in an ultrasonic water bath. Dinitrophenylhydrazine (DNPH) (0.4 ml, 0.1%) was added to 1 ml of extract.

The non-woven raw material was cut into the same size as the alco-swab, approximately 14 × 19 cm, and processed as described above. The amount of raw products packaging material, was cut into the same size and processed as the packaging of the alco-swab. One millilitre of the absolute alcohol solution used in the alco-swab was processed in the same way as the other material. Doublet tests were performed on each sample.

All of the samples were analysed with high-performance liquid chromatography (HPLC) (reversed phase, C₁₈ column) with acetonitrile/water 60:40 (wt/wt) as the mobile phase. Formaldehyde–DNPH derivatives were detected at 345 nm.

The HPLC analysis showed that formaldehyde was present in the alco-swab provided by the patient, at a concentration of 76–96 ppm (Table 1). The alco-swabs provided by the manufacturer contained 138–152 ppm (Table 2).

In the provided raw material, only the non-woven material used for the swab showed a high amount of formaldehyde, at a concentration of 133–150 ppm (Table 2).

Table 1. Results of high-performance liquid chromatography analysis of the two alco-swabs. The numbers 9243 and 9245 are batch numbers. Detection limit: 0.018

Material	Concentration of formaldehyde (ppm)
Blank sample	0.018
Alco-swab 9243, 1	76
Alco-swab 9243, 2	76
Alco-swab 9245, 1	89
Alco-swab 9245, 2	96
The wrapping of 9245	1.6

Table 2. Results of high-performance liquid chromatography analysis of the alco-swab and raw material provided by the manufacture. Detection limit: 0.027

Material	Concentration of formaldehyde (ppm)
Blank sample	0.027
Alco-swab January 2016, 1	138
Alco-swab January 2016, 2	152
Alco-swab May 2016, 1	139
Alco-swab May 2016, 2	144
Non-woven, 1	133
Non-woven, 2	150
Absolute alcohol, 1	0.052
Absolute alcohol, 2	0.044
Wrapping, 1	0.75
Wrapping, 2	0.72

In the product datasheet for the non-woven raw material (not shown), it was stated that it contained 'small amounts of formaldehyde'.

Discussion

Patients can react to low concentrations of allergen. This makes it very important for all of the information concerning ingredients in the product to be available to the end user, including information regarding the preservatives used in the production of the raw material. In this report, we present an example of hidden exposure to formaldehyde in an alco-swab, where the reaction was very obvious; however, in other cases, it may be more difficult to suspect that the product has caused a reaction. In a study of 100 moisturizers, 17% contained preservatives that were not declared on the label (8), and in another study, 33% of 67 moisturizers were not labelled regarding their contents of formaldehyde/formaldehyde-releasers (9).

Sensitive spot tests for formaldehyde exist and are used routinely in our clinic, as in the current case, to

identify products that contain formaldehyde and that may be a cause of dermatitis in formaldehyde-sensitive individuals. In a study of products obtained from 314 formaldehyde-sensitized patients, it was found, by use of the chromotropic acid method, that 75% of the patients had come into contact with one or more products containing formaldehyde (10). Such continuous and sometimes undetected exposures may be the source of chronic contact dermatitis. In the current study, the amount of formaldehyde present was quantified by HPLC in Malmö, and found to be between 76 and 96 ppm in those swabs used on the patient, showing that just one exposure to such levels of formaldehyde may elicit allergic contact dermatitis. This level is in the same range as previously found to elicit dermatitis in formaldehyde-sensitive patients (11). This is in conflict with the legislation in this area, where formaldehyde present in a cosmetic product from a formaldehyde-releaser only

needs to be mentioned if it exceeds 500 ppm; legislation for other kinds of product, such as paints or industrial products, is also insufficient, as 1000 ppm is required for a known allergen to be mentioned in the safety data sheet.

In this case, it is not known whether it is an undeclared preservative or some kind of binder in the non-woven material that releases the formaldehyde in the DNPH analysis. The chromotropic acid method measures evaporating formaldehyde. The DNPH method also measures formaldehyde released by hydrolysis, and for this reason the formaldehyde levels are often higher when the DNPH method is used.

This case shows that the handling of patients with formaldehyde allergy requires extra care and in-depth exposure analysis, using not only information from the listing of ingredients on the packages/safety data sheets, but also chemical analysis.

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