Allergic contact dermatitis caused by wet wipes containing steareth-10: Is stearyl alcohol to blame?

Olivier Aerts[1], Tania Naessens[2], Julie Dandelooy[1], Julie Leysen[1], Julien Lambert[1] and Sandra Apers[2]

[1] *Contact Allergy Unit, Department of Dermatology, University Hospital Antwerp (UZA) and University of Antwerp (UA), 2650 Edegem, Antwerp, Belgium and* [2] *Department of Pharmaceutical Sciences, Research group Natural Products and Food – Research and Analysis (NatuRA), University of Antwerp (UA), 2610 Wilrijk, Antwerp, Belgium*

doi:10.1111/cod.12776

Key words: CAS no. 9005-00-9/13149-86-5; case report; cetostearyl alcohol; cosmetics; fatty alcohols; gas chromatography–mass spectrometry; impurities; PPG-15 stearyl ether; steareths; stearyl alcohol; wet wipes.

Steareths, such as steareth-10 (CAS no. 9005-00-9/13149-86-5), are emulsifiers that are apparently associated with a low risk of sensitization. They are prepared by the chemical reaction of ethylene oxide with stearyl alcohol, and the numerical suffix indicates the average number of ethylene oxide units used. We here report a rare case of allergic contact dermatitis caused by steareth-10 present in makeup-removing wet wipes, and we discuss the residual presence of stearyl alcohol in these wipes as a potential culprit.

Case Report

A 36-year-old non-atopic female was referred to us for the evaluation of facial and eyelid dermatitis. Also, previous dermatitis around a leg ulcer had worsened following the application of a corticosteroid cream (Diprosone®; MSD, Brussels, Belgium). Patch tests were performed with the Belgian baseline series, a cosmetic series (containing cetearyl alcohol 20% pet.) (both from Chemotechnique, Vellinge, Sweden), and with the patient's own cosmetics, including 'hypo-allergenic' makeup-removing wet wipes (tested 'as is'), which were strongly suspected by the patient as having contributed to her facial dermatitis. Diprosone® cream was also patch tested 'as is'. Patch test chambers were from Allergeaze (SmartPractice®, Phoenix, AZ, USA), and were fixed with Fixomull® stretch (BSN Medical, Hamburg, Germany). Following 2 days of occlusion, the tests were read on day (D) 2, D4, and D7, according to ESCD guidelines (1). On D4, positive reactions (+) were seen to cetearyl alcohol 20% pet. and to Diprosone® cream. The latter, like several of the patient's cosmetics, contained this emulsifier, thus explaining both leg and facial dermatitis (Fig. 1). No later patch test reactions were observed.

The suspected wet wipes had not caused any skin reactions in the patch test. The wipes contained the following ingredients: aq. (86%), glycerin (4.3%), paraffinum liquidum (4%), perfume (0.2%), PEG-8 with citric acid (0.002%), citric acid (separately) (0.01%), a mixture of phenoxyethanol, methylparaben, and ethylparaben (1.0%), potassium sorbate (0.3%), and four stearyl alcohol-related or stearic acid-related substances: PPG-15 stearyl ether (2.5%), glyceryl stearate, PEG-30 stearate (0.75%), and steareth-10 (0.75%). Both a use

Correspondence: Dr Olivier Aerts, Department of Dermatology, University Hospital Antwerp (UZA) and University of Antwerp (UA), Wilrijkstraat 10, B-2650 Edegem, Antwerp, Belgium. Tel: +32 38214272; Fax: +32 38253428. E-mail: olivier.aerts@uza.be

Conflicts of interest: None.

© 2017 John Wiley & Sons A/S. Published by John Wiley & Sons Ltd

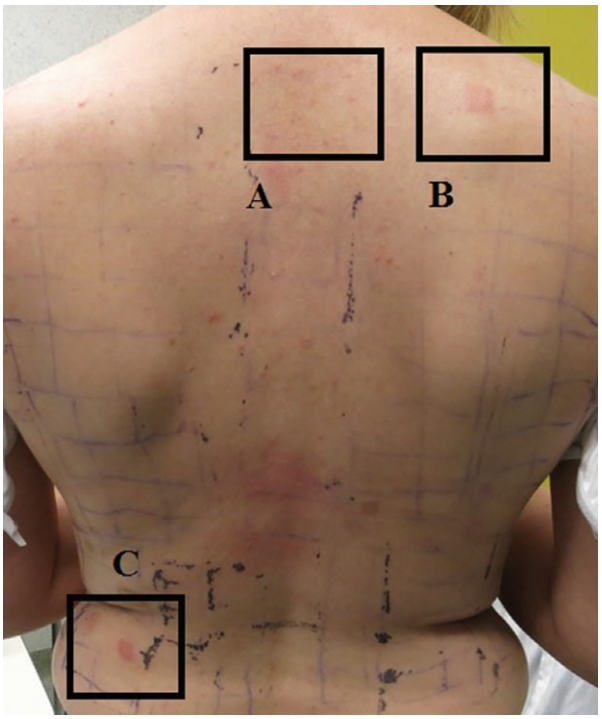


Fig. 1. Negative patch test result with the wet wipes (A), but positive patch test reactions to cetostearyl alcohol 20% pet. (+) (B) and to Diprosone® cream (+) (C).

test and a repeated open application test with the wipes gave positive results, the latter resulting in an itchy, papular reaction after a few days.

For a subsequent patch test, most individual ingredients were prepared according to (2), whereas PPG-15 stearyl ether was tested 5% pet. and the mixture of PEG-30 stearate and glyceryl stearate was tested 20% pet.; additionally, stearyl alcohol was patch tested 10% pet. Only a doubtful reaction (?+) was observed to stearyl alcohol 10% pet., and the results of patch tests with the individual ingredients of the wipes remained negative. Before diagnosing compound allergy, that is, a skin reaction to a finished product without a positive patch test reaction to any of its individual ingredients, we decided to repeat the patch tests with the stearyl alcohol-related ingredients, including steareth-10 diluted 5% aq., which is a semi-clear solution and becomes turbid after being shaken. On this occasion, steareth-10 gave a positive result (+), but only on D4. Twenty control patients had negative patch test results with this ingredient.

The manufacturer of the wipes, following discussions with the supplier of the raw material, informed us that the presence of residual amounts of stearyl alcohol in the steareth-10 ingredient (supplied as Brij™ S10 by Croda, Snaith, UK) could not be fully excluded. Thereupon, chemical analysis by means of gas chromatography–mass spectrometry (GC-MS) (Voyager, Trace 2000 series; Interscience, Louvain-la-Neuve, Belgium) was performed on the liquid from the wet wipes and on the raw steareth-10 material. The liquid of the wet wipes was desalted and extracted with hexane, and steareth-10 was solved in hexane. Samples were applied to an AT-5MS column (30 m; internal diameter, 0.25 mm; 0.25-µm film; Grace, Columbia, MD, USA). The conditions of the GC-MS were as follows: helium as carrier gas; flow rate of 0.8 ml/min; split of 1/65; temperature of 70°C for 1 min, increasing by 10°C/min up to 300°C, which was maintained for 2 min; injector at 275°C; and detection with total ion chromatogram mass spectrometry. The peak was identified with a reference compound of stearyl alcohol (purchased from Sigma Aldrich, St Louis, MO, USA) that had the same retention time (18.4 min), and, additionally, the search for stearyl alcohol in the NIST library gave a positive match. In both the wipes and the steareth-10 raw material, traces (i.e. small amounts) of stearyl alcohol were found (Figures S1–S3). Although not quantified exactly, the amount of residual stearyl alcohol present in the liquid derived from the wet wipes was estimated to be ~50 µg/ml, that is, 50 ppm or 0.005%.

Discussion

Cetearyl alcohol, a mixture of cetyl alcohol (C_{16}) and stearyl alcohol (C_{18}), is widely used in cosmetics and pharmaceutical products. Contact allergy to it is very rare, but may occur when this substance is applied to damaged skin (3). Stearyl alcohol has been almost exclusively reported as an allergen in topical pharmaceutical creams, for example in creams containing corticosteroids, calcipotriol, aciclovir, or 5-fluorouracil. Reactions to fatty alcohols, such as cetyl and stearyl alcohol, are mainly attributed to the presence of impurities (4). Although the patient was clearly sensitized to cetearyl alcohol and to steareth-10, a patch test containing stearyl alcohol 10% pet. yielded only a doubtful reaction. Apart from the sometimes difficult distinction between a '+' and a '?+' patch test reaction (5), different origins of the stearyl alcohol-containing materials, with potentially different (amounts of) impurities, might also account for the observed differences in the reading of these patch test reactions. In the present case, initial sensitization occurred following the application of a corticosteroid cream containing this emulsifier on dermatitis surrounding a leg ulcer, whereas allergic contact dermatitis resulted from the use of several

© 2017 John Wiley & Sons A/S. Published by John Wiley & Sons Ltd

cosmetics containing cetearyl alcohol or related fatty alcohols.

Interestingly, wet wipes containing steareth-10 also elicited a contact-allergic reaction in our patient. Apart from steareth-10 as the actual culprit allergen, hidden, low amounts of stearyl alcohol (or impurities originating from this allergen), used as a primary chemical to produce steareth-10, might also have contributed to the patient's dermatitis; furthermore, a byproduct of the production of steareth-10 other than stearyl alcohol might have been responsible. Moreover, the ingredient PPG-15 stearyl ether, which gave a negative patch test reaction and was not further studied, is also produced from stearyl alcohol, and may theoretically also be a source of residual stearyl alcohol. Although the residual stearyl alcohol content in the wipes was estimated to be very low (~50 ppm), it might be hypothesized that such a low concentration of the emulsifier might still elicit allergic contact dermatitis, especially in strongly sensitized subjects, and with repetitive application. Our patient was, indeed, strongly sensitized to cetearyl alcohol, as the potent corticosteroid betamethasone dipropionate (present in the patch-tested corticosteroid cream) was not able to suppress the contact-allergic patch test reaction.

Instead of just describing steareth-10 as a 'new' allergen, our case report may suggest that a precursor molecule (i.e. stearyl alcohol) of a certain (cosmetic) ingredient (i.e. steareth-10) may still be present in a finished product, and perhaps even in concentrations high enough to elicit skin reactions in individuals who have been strongly sensitized previously.

This may have implications for patients sensitized to stearyl alcohol or related fatty alcohols, and should be considered in the work-up of future cases.

Acknowledgements

We are very grateful to Henkel, Germany for discussing this case with us, and for providing us with the ingredients of the wet wipes, in particular the steareth-10 raw material, for further patch testing and chemical analysis.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Chromatogram showing the reference material stearyl alcohol (99.3% purity).

Figure S2. Chromatogram showing the analysis of the liquid from the wet wipes, containing multiple compounds.

Figure S3. Chromatogram showing the liquid from the wet wipes (detail), containing a molecule peaking at a retention time of 18.39 min, compatible with the presence of stearyl alcohol.

References

1 Johansen J D, Aalto-Korte K, Agner T et al. European Society of Contact Dermatitis guideline for diagnostic patch testing – recommendations on best practice. *Contact Dermatitis* 2015: **73**: 195–221.

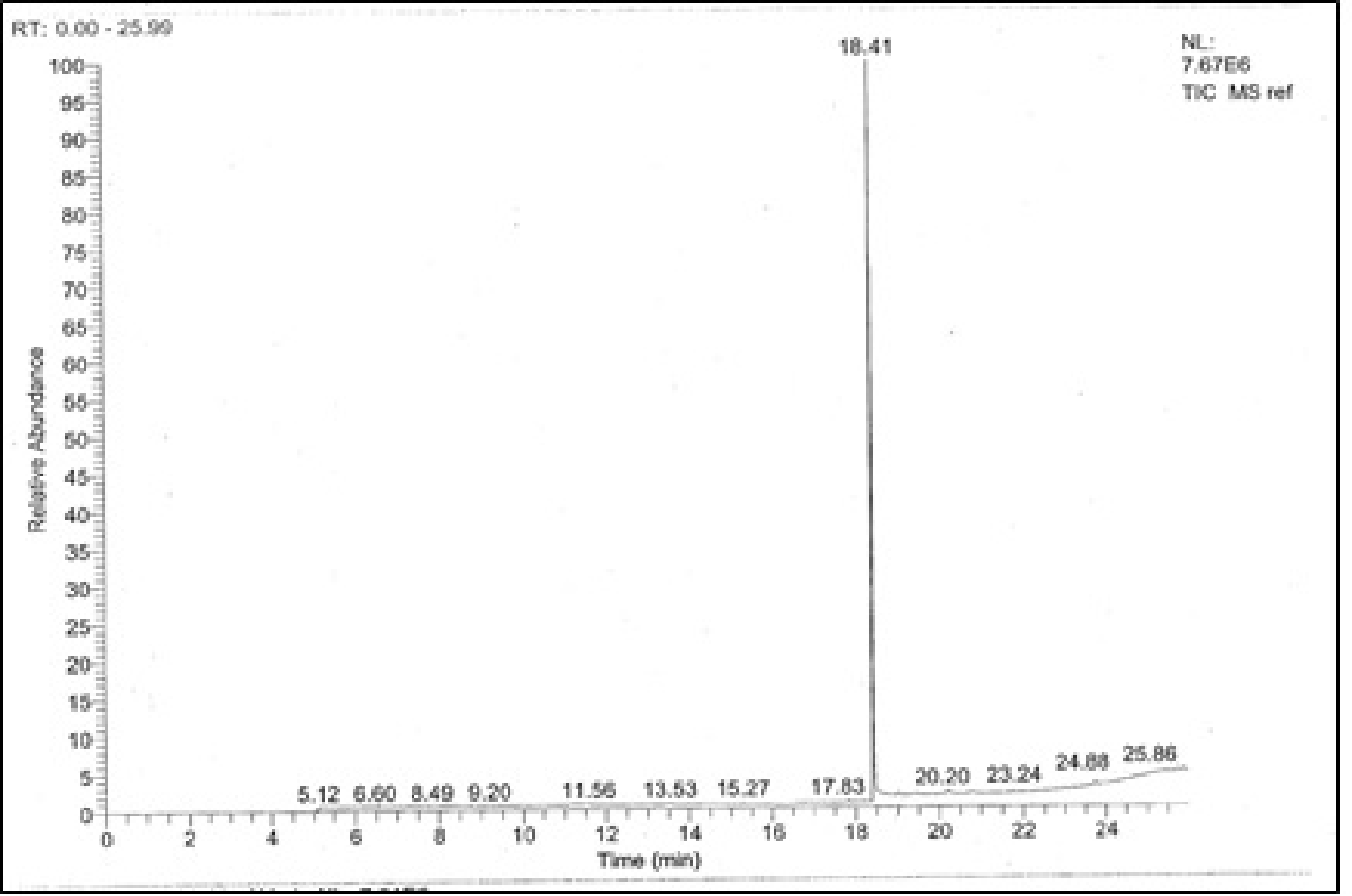
2 de Groot A C. *Patch Testing*, 3rd edition: Wapserveen, Acdegroot Publishing, 2008.

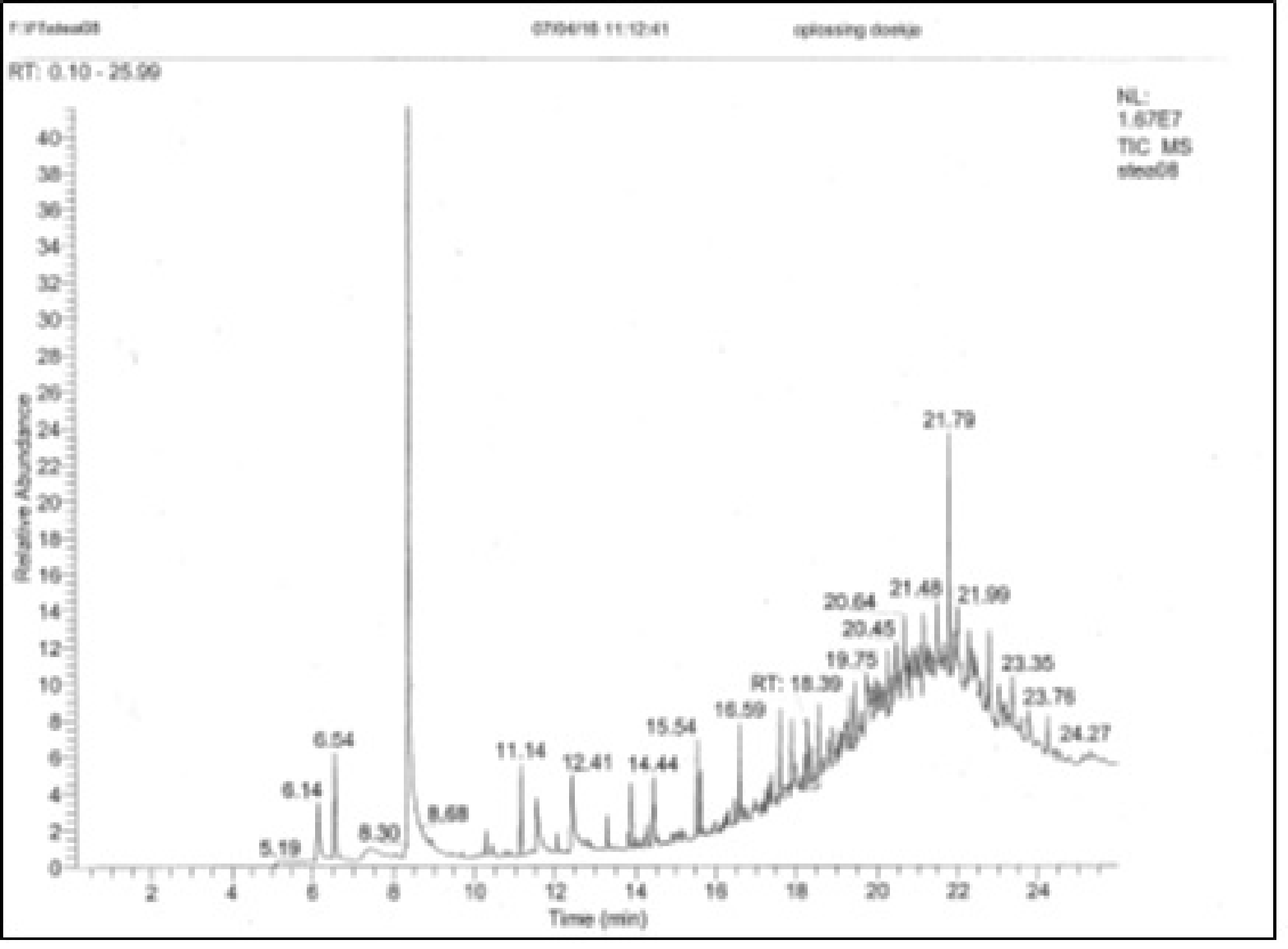
3 Rietschel R L, Fowler J F (eds). Allergy to preservatives and vehicles in cosmetics and toiletries. In: *Fisher's Contact Dermatitis*, 5th edition: Philadelphia PA, Lippincott Williams & Wilkins, 2001: p. 237.

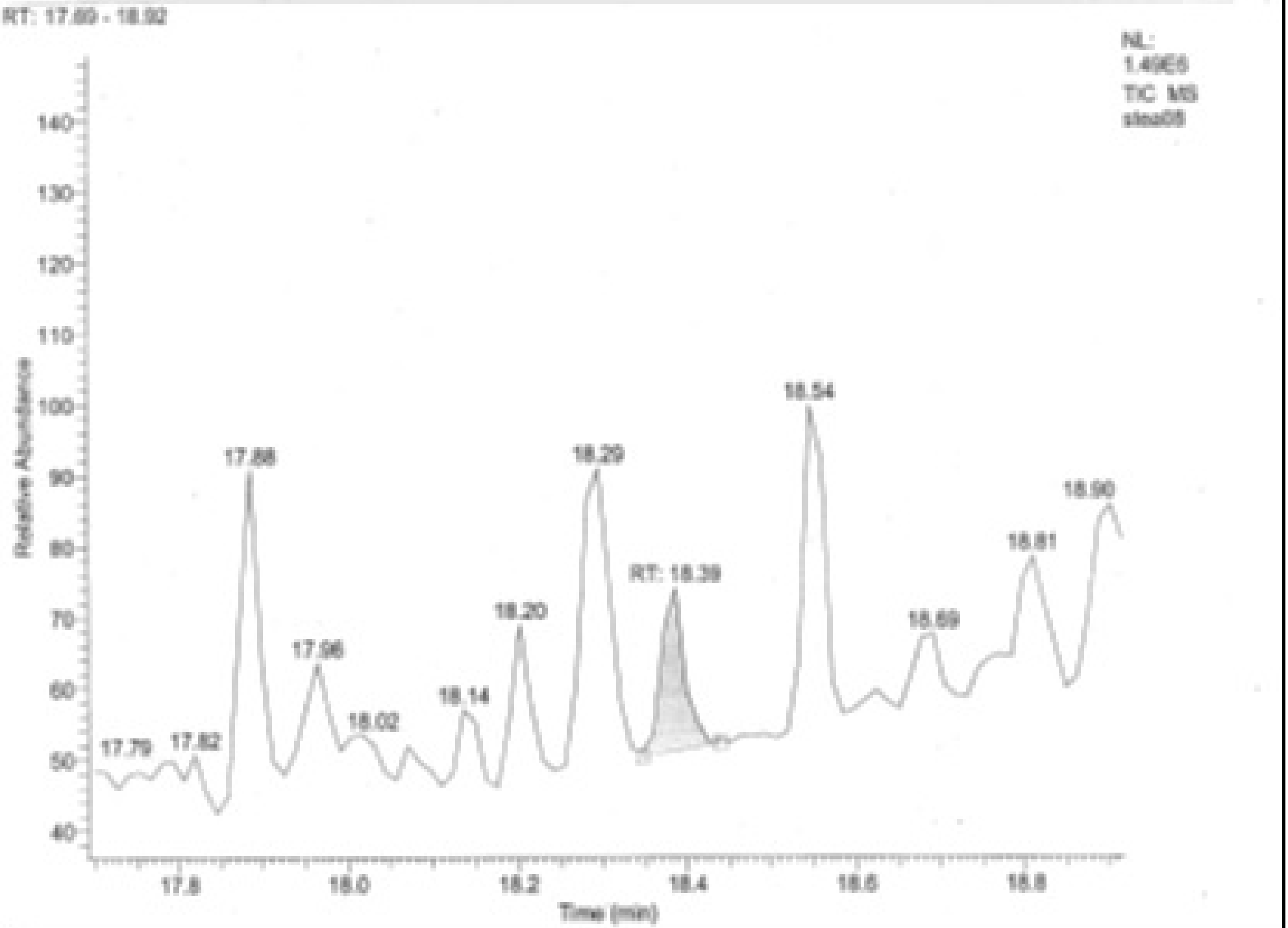
4 Komamura H, Doi T, Inui S et al. A case of contact dermatitis due to impurities of cetyl alcohol. *Contact Dermatitis* 1997: **36**: 44–46.

5 Svedman C, Isaksson M, Björk J et al. 'Calibration' of our patch test reading technique is necessary. *Contact Dermatitis* 2012: **66**: 180–187.

© 2017 John Wiley & Sons A/S. Published by John Wiley & Sons Ltd


RT: 0.00 - 25.99
NL:
7.67E6
TIC MS ref
18.41
5.12
6.60
8.49
9.20
11.56
13.53
15.27
17.83
20.20
23.24
24.88
25.86
Relative Abundance
Time (min)


RT: 0.10 - 25.99
NL:
1.67E7
TIC MS
stest08
Relative Abundance
Time (min)
5.19
6.14
6.54
8.30
8.68
11.14
12.41
14.44
15.54
16.59
RT: 18.39
19.75
20.64
20.45
21.48
21.79
21.99
23.35
23.76
24.27


RT: 17.69 - 18.92
NL:
1.46E6
TIC MS
sha05
Relative Abundance
Time (min)
17.79
17.82
17.88
17.96
18.02
18.14
18.20
18.29
RT: 18.39
18.54
18.69
18.81
18.90