

Contact Sensitization to Emulsifying Agents: An Underrated Issue?

Monica Corazza, MD, Annarosa Virgili, MD, Michela Ricci, MD, Anna Bianchi, PhD, and Alessandro Borghi, MD

Background: The evidence on the safety of topical preparations containing emulsifiers is limited.

Objectives: The aims of the study were to assess (1) the prevalence of sensitization to some emulsifiers commonly found in topical products, (2) the sensitization to emulsifiers in relation to sex, age, and predisposing factors, and (3) the frequency of concomitant sensitization to other common allergens.

Methods: All consecutive patients presenting to the Allergy Unit of our Dermatological Department for allergological investigation were enrolled. All patients were patch tested with the Italian Società Italiana di Dermatologia Allergologica Professionale ed Ambientale baseline series and an additional emulsifiers series. Doubtful patch test reactions were not considered.

Results: Of 310 patients, 50 (16%) were sensitized to emulsifiers with 72 positive reactions. Lauryl polyethylene glycol/polypropylene glycol-18/18 methicone gave 26 positive reactions, glyceryl oleate 19, myristyl alcohol, and Amerchol L101 11. Concomitant sensitization to emulsifiers was found in 16 patients. Patients allergic to emulsifiers showed concomitant allergic reactions to allergens commonly found in cosmetics. No significant differences by sex, age, atopic diathesis, and clinical pattern at presentation were noticed.

Conclusions: Contact allergy to emulsifiers is more frequent than reported. Patients allergic to emulsifiers show frequent positive patch tests to other constituents of cosmetics and topical products.

Allergic reactions to cosmetics are increasingly reported. Fragrances and preservatives are the most common contact allergens, but reactions also occur to any possible cosmetic ingredient.¹ Emulsifiers, common constituents of skin care products, cosmetics, and topical products, enhance the miscibility of the aqueous and fatty components by reducing the interfacial tension between the 2 phases. Emulsifying agents are chemically classified as anionic, nonionic, cationic, or ampholytic depending on their ionization properties in solution.

The number of reported cases of contact dermatitis due to emulsifiers is small, despite their widespread use and the increasing number of commercially available emulsifiers.

The main aim of this study was to investigate the prevalence of sensitization to some emulsifiers commonly found in cosmetic products. Correlation between the prevalence of sensitization to emulsifiers and sex, age, and predisposing factors and the frequency of concomitant sensitization to other common allergens were also assessed.

MATERIALS AND METHODS

For a period of 8 months, all consecutive patients presenting to the Allergy Unit of the Dermatological Department of the University

From the University of Ferrara, Italy.

Address reprint requests to Monica Corazza, MD, University of Ferrara, Department of Medical Sciences, Section of Dermatology, Via Ariosto 35, 44121 Ferrara, Italy. E-mail: czm@unife.it.

The authors have no funding or conflicts of interest to declare.

DOI: 10.1097/DER.0000000000000209

© 2016 American Contact Dermatitis Society. All Rights Reserved.

of Ferrara for allergological investigation were enrolled. Patients were not subjected to any demographic or clinical selection.

Pregnancy, nursing, previous application of topical corticosteroids to patch test sites, systemic treatment with immunosuppressive drugs, refusal, and inability to complete the questionnaire were the only exclusion criteria.

The following data were recorded in a standardized data collection form: demographics, occupation, previous dermatoses, history of atopic dermatitis, diagnosis at referral, localization and clinical features of the current dermatosis, type of cosmetics, and topical medicaments containing emulsifiers used. All enrolled patients were patch tested with the Italian Società Italiana di Dermatologia Allergologica Professionale ed Ambientale (SIDAPA) baseline series (Lofarma S.p.A., Milano, Italy) as well as an additional Emulsifier series. This integrative series, properly set up for the study, contained 10 emulsifiers and 5 fatty and organic alcohols selected according to the frequency of use in commonly marketed cosmetics (Table 1, Fig. 1). The emulsifiers were provided by manufacturers and/or distributors as pure raw materials. The Department of Chemical and Pharmaceutical Sciences diluted the products in petrolatum at the appropriate concentrations, which, according to the literature data,²⁻⁷ were deemed sufficient to elicit an allergic reaction and considered safe as far as avoiding development of irritant responses was concerned. Vehicle and test concentrations are shown in Table 1.

Patch tests were performed with Finn Chambers (diameter, 8 mm; SmartPractice, Phoenix, AZ) on Scanpor tape (Norgesplaster A/S, Vennessla, Norway); allergens were applied on the upper back

TABLE 1. Characteristics of Tested Emulsifiers

Number	International Nomenclature of Cosmetic Ingredients	Trade Name (Chemical Abstracts Service Number)	Features	Vehicle
1	Potassium cetyl phosphate	Anfisol K (19035-79-1)	Anionic emulsifier Promotes O/W creams or lotions	5% pet
2	Sodium stearyl glutamate	Eumulgin SG (38517-23-679811-24-8)	Mild anionic emulsifier Promotes O/W emulsions	5% pet
3	Steareth-2	Brij 72 (9005-00-90 generic) (16057-43-5)	Nonionic emulsifier, PEG ether Promotes O/W emulsions	20% pet
4	Steareth-21	Brij 712 (9005-00-90 generic)	Nonionic emulsifier, PEG ether Promotes O/W emulsions	20% pet
5	Cetearyl glucoside	Tego Care CG90 (246159-33-1)	Nonionic glycosidic emulsifier Promotes O/W lotions and creams	20% pet
6	Glyceryl oleate	Monomuls 90-0-18 (25496-72-4)	Nonionic, glycerol ester emulsifier Promotes W/O soft creams	20% pet
7	PEG-30 dipolyhydroxystearate	Arlacel P135 (70142-34-6)	Nonionic, PEG diester, emulsifier Promotes W/O emulsions	20% pet
8	Acrylates/C10-30 alkyl acrylate crosspolymer	Pemulen TR1 (No CAS number)	Synthetic polymeric emulsifier, gelling agent, viscosity-increasing agent, emulsion stabilizer Promotes O/W emulgels	1% pet
9	Lauryl PEG/PPG-18/18 methicone	Dow Corning 5200 (212335-52-9)	Nonionic silicone emulsifier, PEG, PPG ester Promotes W/O emulsions, W/S emulsions, or multiple emulsions (W/O/W)	30% pet
10	Cetyl PEG/PPG-10/1 dimethicone	Abil EM 90 (134737-04-5)	Nonionic silicone emulsifier, PEG, PPG ester. Promotes W/O emulsions, W/S emulsions or multiple emulsions (W/O/W, O/W/O)	30% pet
11	Stearyl alcohol	Lanette 18 (112-92-5)	Fatty alcohol (C18), emulsion stabilizer, emollient, viscosity-increasing agent	30% pet
12	Cetyl alcohol	Lanette 16 (36653-82-4)	Fatty alcohol (C16), emulsion stabilizer, emollient, viscosity-increasing agent	30% pet
13	Myristyl alcohol	Lanette 14 (112-72-1)	Fatty alcohol (C14), emulsion stabilizer, emollient, viscosity-increasing agent	5% pet
14	Oleyl alcohol	Novol (143-28-29)	Unsaturated fatty alcohol (C18:1), emulsion stabilizer, emollient, viscosity-increasing agent	30% pet
15	Lanolin alcohol	Amerchol L101 (8027-33-6)	A mixture of organic (aliphatic, steroid, and triterpenoid) alcohols obtained from the hydrolysis of lanolin Coemulsifier, emulsion stabilizer, emollient	50% pet

and removed after 48 hours. The sites were examined on removal and 24 or 48 hours after removal; clinical scoring was performed according to the recommended International Contact Dermatitis Research Group guidelines.⁸ Irritant or doubtful reactions were verified by retesting and following up the reactions. To avoid misinterpretations, the doubtful results were not considered in this study.

The protocol was approved by the local research ethics committee, and written informed consent was obtained from all of the participants.

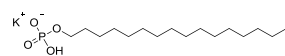
The results of the patch tests were recorded in a database. Statistical evaluation was performed; the χ^2 test and Fisher exact tests were used

to analyze the results according to conditions and a *P* value of less than 0.05 was considered to be statistically significant.

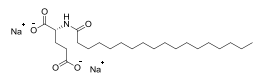
RESULTS

A total of 310 patients, 220 (71%) females and 90 (29%) males, were enrolled in the study. Demographic characteristics, sites of dermatitis, and occupations of the enrolled population are shown in Table 2.

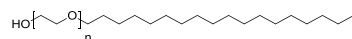
All patients were patch tested with the SIDAPA baseline series; 132 patients (43%) proved positive to at least 1 allergen; a total of

C₁₆H₃₄O₄PK

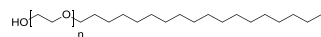
Potassium cetyl phosphate

C₂₃H₄₁NO₅Na₂

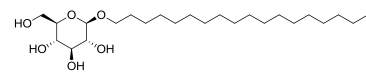
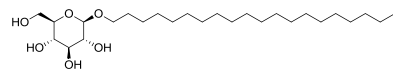
Sodium Stearoyl Glutamate

C₁₈H₃₇(C₂H₄O)_nOH

Steareth-2

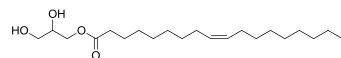
C₁₈H₃₇(C₂H₄O)_nOH

Steareth-21

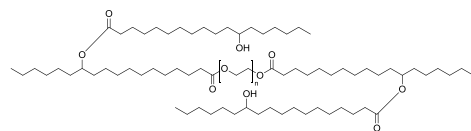
C₂₄H₄₈O₆C₂₆H₅₂O₆

C16-C18 Alkyl glucoside

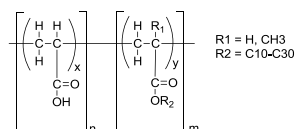
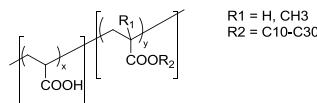
Cetaryl glucoside

C₂₁H₄₀O₄

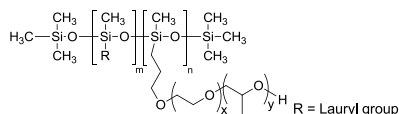
Glyceryl oleate

C₉₆H₁₉₀O₃₃

PEG-30 dipolyhydroxystearate

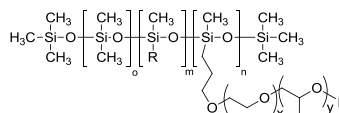
R₁ = H, CH₃
R₂ = C10-C30R₁ = H, CH₃
R₂ = C10-C30

Acrylates/C10-30 alkyl acrylate crosspolymer



R = Lauryl group

Lauryl PEG/PPG-18/18methicone

R = Cetyl group
X=10, Y=1, n=1 to 200, o=1 to 100, m=1 to 40

Cetyl PEG/PPG-10/1Dimethicone

C₁₈H₃₈O

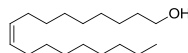
Stearyl Alcohol

C₁₆H₃₄O

Cetyl Alcohol

C₁₄H₃₀O

Myristyl Alcohol

C₁₈H₃₆O

Oleyl Alcohol

Figure 1. Chemical structures of the patch-tested emulsifiers.

216 positive reactions were detected. According to our data, nickel sulfate was the most frequent sensitizing allergen with 61 positive reactions (28%), followed by *Myroxylon pereirae* with 25 (12%), fragrance mix I containing sorbitan sesquioleate with 21 (10%), methylchloroisothiazolinone (MCI)/methylisothiazolinone (MI) with 16 (7%). Three patients (1%) showed a positive reaction to lanolin alcohols.

Patch testing with the Emulsifier series produced at least 1 positive reaction in 50 patients (16%), 40 females (18%), and 10 males (11%), for a total of 72 positive reactions. Positive reactions and their strength are reported in Table 3.

Sixteen patients showed 2 concomitant positive reactions to emulsifiers: 9 (56%) were simultaneously sensitized to glyceryl oleate and to lauryl polyethylene glycol (PEG)/polypropylene

TABLE 2. Demographic Characteristics, Sites of Dermatitis, and Occupations of the Study Population

	n (%)
Patient	310
Sex, female/male	220/90 (71/29)
Atopy	66 (21.3)
Age, yrs	
≤20	21 (6.8)
21–30	51 (16.4)
31–40	50 (16.1)
41–50	61 (19.7)
>50	127 (41)
Site of dermatosis	
Hands	90 (20.6)
Upper limbs	78 (17.9)
Trunk	74 (17)
Face to neck (widespread)	70 (16)
Lower limbs	53 (12.1)
Lips to eyelids (only)	34 (7.8)
Feet	17 (4)
Genitalia	11 (2.5)
Scalp	9 (2.1)
Occupation	
White-collar workers	103 (33.2)
Unemployed/retired/students	77 (24.8)
Manual workers	38 (12.3)
Domestic workers	32 (10.3)
Food sector workers	27 (8.7)
Health care workers	17 (5.5)
Hairdressers, beauticians	9 (2.9)
Farmers	7 (2.3)

glycol (PPG)-18/18 methicone, 3 (19%) to lauryl PEG/PPG-18/18 methicone and myristyl alcohol, 1 (6%) to cetearyl glucoside and lauryl PEG/PPG-18/18 methicone, 1 to lauryl PEG/PPG-18/18 methicone and Amerchol L101, 1 to cetyl alcohol and Amerchol L101, and 1 to glyceryl oleate and myristyl alcohol.

Of the 11 patients sensitized to Amerchol, only 1 patient showed a concomitant sensitization to lanolin alcohols.

A breakdown of the study population by age showed that 3 (14%) of 21 patients younger than 20 years, 12 (24%) of 51 patients aged between 21 and 30 years, 9 (18%) of 50 patients aged between 31 and 40 years, 11 (18%) of 61 patients aged between 41 and 50 years, and 15 (12%) of 127 patients older than 50 years were sensitive to at least one of the emulsifiers tested.

By examining atopic (66) versus nonatopic (244) patients, 12 atopic patients (19%) and 38 nonatopic ones (16%) developed at least 1 positive reaction to emulsifiers.

Considering the frequency of sensitization to emulsifiers, there were no statistically significant differences by sex ($P = 0.31$), age ($P = 0.68$), and atopic diathesis ($P = 0.88$) according χ^2 to test.

Regarding the sites of dermatosis, patients sensitized to emulsifiers showed a predisposition for the hands (15/50, 30%) and the

face (15/50, 30%), locations that seemed to be the most affected in patients not allergic to emulsifiers ($P = 0.32$) as well.

Considering their occupations, of the patients who were positive to emulsifiers, 26 (52%) were white-collar workers, 5 (10%) were manual workers, 5 (10%) worked in the health care sector, 2 (4%) were hairdressers, 1 (2%) was a domestic worker, 1 (2%) was a farmer, 1 (2%) worked in the food industry, and 9 (18%) were unemployed. Comparing the type of occupation, employees and health care workers showed a significantly higher risk of sensitization to emulsifiers compared with housewives and food sector workers, according to Fisher test ($P < 0.05$).

Among the 50 patients with positive reactions to emulsifiers, 27 (54%) had at least 1 positive reaction to common allergens of the SIDAPA series. A total of 41 positive reactions to allergens of the SIDAPA series were detected: 14 patients (34%) showed a positive patch test to nickel sulfate, 6 (15%) to fragrance mix I, 4 (10%) to MCI/MI and *M. pereirae*, 3 (7%) to methylidibromo glutaronitrile and to cobalt chloride, and 2 (5%) to hydroxyisohexyl 3-cyclohexene carboxaldehyde (Lyrall^R), whereas only 1 positive reaction (2%) was detected to potassium dichromate, *p*-phenylenediamine, tosylamide/formaldehyde resin, wool alcohols, and cocamidopropyl betaine.

According to the χ^2 test, patients with positive reactions to emulsifiers did not show significant differences regarding sensitization to common allergens when compared with patients without any sensitization to emulsifiers ($P = 0.29$).

Considering the allergens of the SIDAPA series strictly connected with cosmetics (cocamidopropyl betaine, *M. pereirae*, wool alcohols, methylidibromo glutaronitrile, paraben mix, fragrance mix I, MCI/MI, hydroxyisohexyl 3-cyclohexene carboxaldehyde (Lyrall^R), fragrance mix II), 21 positive reactions (51%) were found among patients with positive reactions to emulsifiers. The rate of sensitization to allergens commonly found in cosmetic products was significantly higher among patients allergic to emulsifiers ($P = 0.0132$).

DISCUSSION

The prevalence of contact allergy to emulsifiers has not been established, and despite the wide chemical variability and large

TABLE 3. Positive Reactions to Emulsifiers (Reading at 72 Hours)

Allergen	No. Positive Reactions	+	++	+++
Steareth-2	1	1		
Cetearyl glucoside	1	1		
Glyceryl oleate	19	17	2	
Lauryl PEG/PPG-18/18 methicone	26	25	1	
Cetyl alcohol	2	2		
Myristyl alcohol	11	4	7	
Oleyl alcohol	1	1		
Lanolin alcohol (Amerchol L101)	11	5	5	1

number of marketed emulsifiers, only few agents have been studied.^{2,3,9} We focused our study on contact sensitization to a series of selected emulsifiers and fatty alcohols commonly used in cosmetics, which we chose selecting different chemical structures, different properties (anionic, nonionic), and frequency of use in cosmetic marketed products.

In the literature, a high prevalence of sensitization to emulsifiers has been found in patients with leg ulcers.² In another study performed in patients with suspected cosmetic or medication-related contact dermatitis, 5.3% gave 1 or more positive patch tests to a small series of emulsifiers.³ Our results confirm that sensitization to emulsifiers is not rare and shows a prevalence of 16% in the studied population. However, the different composition of the series applied and the different inclusion criteria of the patients in the published studies make the results difficult to compare.

In this study, the highest number of positive reactions (36%) observed was to lauryl PEG/PPG-18/18 methicone, an alkoxyated derivative of lauryl methicone containing an average of 18 moles of ethylene oxide and 18 moles of propylene oxide. This silicone derivative is a water in oil (W/O) emulsifier, widely employed in skin and hair care products, in antiperspirants, and in multiple emulsions (W/O/W). New developments in silicone emulsifier technology provide expanded options for their use, and therefore, their employment in cosmetic products is rising. This increasing diffusion may explain the high number of positive reactions in the study.

Approximately 26% of the positive reactions were caused by glyceryl oleate, a nonethoxylated ester of glycerin, and oleic acid. A lipophilic nonionic emulsifier used in W/O emulsions, it is predominantly used in lipsticks, eye shadows, and makeup bases. It is also a skin-conditioning agent and emollient. No data about its sensitizing potential were found in the current literature.

Stearth-2, nonionic ethoxylated ether O/W emulsifier, and cetearyl glucoside, nonionic nonethoxylated glucosidic O/W emulsifier, gave only 1 positive each.

Alkyl glucosides are condensation products of fatty alcohols and glucose. Because of their low irritant potential, they are increasingly used both in rinse-off and leave-on products. Recent reports confirm the sensitizing potential of these molecules.^{10–13}

Lauryl, myristyl, oleyl, cetyl, and stearyl alcohols are fatty alcohols widely used as emulsifying system stabilizer and consistency factors in cosmetic products. A previous study showed positive reactions to these fatty alcohols in 23.2%.⁴ In our study, myristyl alcohol was the most common sensitizer. Contact sensitization to this fatty alcohol has been reported in patients with contact dermatitis due to cosmetics or medical ointments.^{4,14–17} In accordance with the literature, the patch test concentration chosen for the present study was 5%, because frequent irritant reactions to test concentrations equal to or more than 10% have been noticed.¹⁵

Cetyl alcohol (16-carbon aliphatic alcohol) is often used in equal parts with stearyl alcohol (18-carbon aliphatic alcohol) under the name cetylstearyl alcohol. Only occasionally allergy to each or both agents occurs when they are applied on irritated or broken skin

or for prolonged periods.^{18–22} Their weak sensitizing potential may be explained by their long chain, which limits their capability to penetrate intact skin. Our study confirms the low prevalence of sensitization to cetyl alcohol.

Oleyl alcohol is an unsaturated fatty alcohol; its carbon chain contains a double bond that renders the molecule quite reactive, especially in sunlight. Case reports confirming its allergenic potential are present in the literature.^{5,23} A previous Italian study revealed 0.47% prevalence of sensitization.²⁴ As oleyl alcohol may be an impurity of other commercial alcohols (cetyl and stearyl alcohols) and represents a residue of the hydrogenation process, cross-reactions among them may be observed.⁴ In our study, oleyl alcohol gave 1 positive reaction, and no cross-reactions or concomitant reactions with other emulsifiers were found according to other reports.⁵

Amerchol L101 is a commercial product obtained from the hydrolysis of wool fat, containing 10% wool wax alcohols in mineral oil. It is used, albeit rarely nowadays, in the cosmetic and pharmaceutical industry. A higher incidence of positive reactions to Amerchol L101 than to wool alcohols is observed.^{25–28} In an Italian polycentric study performed on consecutive patients, 1% developed a positive reaction to Amerchol L101 50% pet and 1.86% to Amerchol L101 tested as is.²⁴ In our study, only 3 patients were allergic to wool alcohols, whereas 11 were allergic to Amerchol L101; only 1 patient showed concomitant sensitization to both allergens. According to previous experiences, Amerchol L101 seems to increase the detection of lanolin contact dermatitis.²⁷

In the present study, no significant differences were found in patients allergic to emulsifiers considering demographic and clinical features. The sites most commonly involved by dermatosis were the hands and face, both in patients sensitized and not sensitized to emulsifiers. Considering occupation, employees and health care workers showed a significantly higher risk of sensitization to emulsifiers compared with housewives and food sector/industry workers.

It was not possible to achieve reliable results regarding potential associations between sensitization and type of product used; in fact, as extracted from the questionnaire, most patients reported the use of similar products (detergents, gel showers, shampoos, antiperspirants, body lotions).

Patients allergic to emulsifiers generally show multiple positive reactions to other constituents of cosmetics and topical preparations such as parabens and wool alcohols. In accordance with other studies,^{4,5,10} our experience confirms that patients allergic to emulsifiers have multiple sensitization to other cosmetic allergens in a statistically significant manner and show a tendency to develop multiple sensitivity to other emulsifiers.

The results reported herein should be viewed in the light of some limitations. In the first place, emulsifiers, especially of the anionic group, are molecules with mild irritant properties, if applied to damaged skin. To avoid misinterpretations, doubtful or unreproducible reactions were not considered in the study, but patch tests were not performed in healthy control subjects. Secondly, the clinical relevance of positive patch test reactions was not

analyzed, because it did not represent a key objective of the study. A further limit could be found in the population selection, because patients consecutively presenting for a dermatological consultation and not the general population were enrolled in the study.

In conclusion, even though emulsifiers are considered weak sensitizers and are rarely reported as causative allergens of contact dermatitis (probably due to lack of commercial allergens and difficulties in finding these molecules), the study shows that popular emulsifiers should be taken into consideration as a potential source of allergy. The large number and chemical complexity of these molecules deserve further studies to better characterize the allergenic potential of different classes of emulsifiers.

ACKNOWLEDGMENT

The authors thank Silvia Giari and Chiara Casaro for technical and statistical analysis. The authors also thank Dario Cristofaro, from the Department of Chemical and Pharmaceutical Sciences, for assistance in chemical assessments.

REFERENCES

- Pascoe D, Moreau L, Sasseville D. Emergent and unusual allergens in cosmetics. *Dermatitis* 2010;21:127–137.
- Pasche-Koo F, Piletta PA, Hunziker N, et al. High sensitization rate to emulsifiers in patients with chronic leg ulcers. *Contact Dermatitis* 1994; 31:226–228.
- Tosti A, Guerra L, Morelli R, et al. Prevalence and sources of sensitization to emulsifiers: a clinical study. *Contact Dermatitis* 1990;23:68–72.
- Tosti A, Vincenzi C, Guerra L, et al. Contact dermatitis from fatty alcohols. *Contact Dermatitis* 1996;35:287–289.
- Guidetti MS, Vincenzi C, Guerra L, et al. Contact dermatitis due to oleyl alcohol. *Contact Dermatitis* 1994;31:260–261.
- Rietschel RL, Fowler JF Jr. *Fisher's Contact Dermatitis*. 6th ed. Baltimore: Williams & Wilkins; 2008.
- de Groot AC. *Patch Testing. Test Concentrations and Vehicles for 4350 Chemicals*. 3rd ed. Wapserveen, the Netherlands: Acdegroot Publishing; 2008.
- Wilkinson DS, Fregert S, Magnussen B, et al. Terminology of contact dermatitis. *Acta Derm Venereol* 1970;50:287–292.
- Pereira F, Cunha H, Dias M. Contact dermatitis due to emulsifiers. *Contact Dermatitis* 1997;36:114.
- Gijbels D, Timmermans A, Serrano P, et al. Allergic contact dermatitis caused by alkyl glucosides. *Contact Dermatitis* 2014;70:175–182.
- Pereira N, Coutinho I, Andrade P, et al. The UV filter tinosorb M, containing decyl glucoside, is a frequent cause of allergic contact dermatitis. *Dermatitis* 2013;24:41–43.
- Llamas-Velasco M, Delgado Y, Sanchez-Perez J, et al. Allergic contact dermatitis to cosmetics on a radiotherapy area. *Contact Dermatitis* 2010; 21:170–171.
- Foti C, Romita P, Rigano L, et al. Isobornyl acrylate: an impurity in alkyl glucosides. *Cutan Ocul Toxicol* 2016;35:115–119.
- Corazza M, Zauli S, Bianchi A, et al. Contact dermatitis caused by fatty alcohols: may polyethoxylation of the fatty alcohols influence their sensitizing potential? *Contact Dermatitis* 2013;68:189–190.
- Geier J, Lessmann H, Fuchs T, et al. Patch testing with myristyl alcohol. *Contact Dermatitis* 2006;55:366–367.
- de Groot AC, Bruynzeel DP, van Joost T, et al. Cosmetic allergy from myristyl alcohol. *Contact Dermatitis* 1988;19:76–77.
- Pecegheiro M, Brandao M, Pinto J, et al. Contact dermatitis to Hirudoid cream. *Contact Dermatitis* 1987;17:290–293.
- Yesudian PD, King CM. Allergic contact dermatitis from stearyl alcohol in Efudix cream. *Contact Dermatitis* 2001;45:313–314.
- De Berker D, Marren P, Powell SM, et al. Contact sensitivity to the stearyl alcohol in Efudix cream (5-fluorouracil). *Contact Dermatitis* 1992;26:138.
- Von der Werth JM, English JSC, Dalziel KL. Loss of patch test positivity to cetylstearyl alcohol. *Contact Dermatitis* 1998;38:109–110.
- Kiec-Swierczynska M, Krecisz B, Swierczynska-Machura D. Photoallergic and allergic reaction to 2-hydroxy-4-methoxybenzophenone (sunscreen) and allergy to cetyl alcohol in cosmetic cream. *Contact Dermatitis* 2005; 53:170–171.
- Aakhus AE, Warshaw EM. Allergic contact dermatitis from cetyl alcohol. *Dermatitis* 2011;22:56–57.
- Andersen KE, Broesby-Olsen S. Allergic contact dermatitis from oleyl alcohol in Elidel cream. *Contact Dermatitis* 2006;55:354–356.
- Sertoli A, Francalanci S, Angelini G, et al. Gruppo Italiano Ricerca Dermatiti da Contatto e Ambientali (GIRDCA) policentric study about oleyl alcohol and Amerchol L-101 sensitivity. *Boll Dermatol Allergol Profess* 1999;14:3–8.
- Lee B, Warshaw E. Lanolin allergy: history, epidemiology, responsible allergens, and management. *Dermatitis* 2008;19:63–72.
- Warshaw EM, Nelsen DD, Maibach HI, et al. Positive patch test reactions to lanolin: cross-sectional data from the North American Contact Dermatitis Group, 1994 to 2006. *Dermatitis* 2009;20:79–88.
- Matthieu L, Docks P. Discrepancy in patch test results with wool wax alcohols and Amerchol[®] L-101. *Contact Dermatitis* 1997;36:150–151.
- Isaksson M, Olhardt S, Rådehed J, et al. Children with atopic dermatitis should always be patch-tested if they have hand or foot dermatitis. *Acta Derm Venereol* 2015;95:583–586.