

Allergic contact dermatitis caused by alkyl glucosides

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Summary

Background. Alkyl glucosides were not expected to have a sensitizing potential at the concentrations to be used in finished consumer products; however, several contact allergy cases have been published.

Objectives. To report on the patients suffering from allergic contact dermatitis caused by alkyl glucosides observed in our department.

Patients/methods. During a 19-year period (1993–2012), 11 842 patients with suspected contact dermatitis were patch tested with the European baseline series and, if relevant, also with other series and individual allergens. For this study, the clinical data and the sensitization sources in the alkyl glucoside-positive patients were analysed.

Results. In total, 30 patients (24 women and 6 men) presented with a positive reaction to one or more alkyl glucosides. The causal products were shampoos (in 12), skin-cleansing products (in 12, among which were wipes for intimate hygiene), sunscreen products (in 5), skin-care products (in 4), and a deodorant (in 1). Sixteen patients showed multiple sensitivities (defined as three or more contact allergies), not only to other glucosides, but also to non-related chemicals.

Conclusions. Allergic contact dermatitis caused by alkyl glucosides in cosmetics does occur, and might be more frequent than suspected. In view of their common use, their identification as allergenic culprits is important.

Key words: alkyl glucosides; alkyl polyglucose; allergic contact dermatitis; cetearyl glucoside (CAS no. 246159-33-1); coco-glucoside (CAS no. 110615-47); cosmetics; decyl glucoside (CAS no. 58846-77-8; CAS no. 68515-73-1; CAS no. 141464-42-8; CAS no. 54549-25-6); emulsifiers; lauryl glucoside (CAS no. 27836-64-2); surfactants.

Alkyl glucosides (polyglucosides) are the condensation products of fatty alcohols and glucose; they have surfactant, cleansing, and/or emulsifying properties. Since the 1990s, they have, because of their low irritant potential, been increasingly used in rinse-off products (i.e. shampoos, soaps, cleansers, hair dyes, and even surgical disinfectants), but also in leave-on products such

as lotions, creams, fragrances, sunscreens, and tanning products. Furthermore, they may also be found in food.

A recent animal study using the local lymph node assay (LLNA), a method of assessing the skin-sensitizing capabilities of a chemical, reported that some alkyl glucosides, namely C12–C18, C14 and C18 branched glucosides, invoked a response, which it was felt might reflect an irritant reaction similar to that seen with other surfactants in the LLNA, such as sodium lauryl sulfate (1). Moreover, the authors stated that the results from the human repeated insult patch test for the tested glucosides indicated that none of the substances was expected to have a sensitizing potential at the concentrations to be used in the final product. However, we and other authors

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have observed several cases of allergic contact dermatitis caused by them.

Here, we describe 30 cases that were observed at the Department of Dermatology, University Hospital, Leuven, Belgium between 1993 and 2012, including those cases published previously (2).

Materials and Methods

During a 19-year period (1993–2012), 11 842 patients with suspected contact dermatitis were patch tested with the European baseline series and, if relevant, also with other series and individual allergens, among which were alkyl glucosides. The test preparations (Table 1) for coco-glucoside (CAS no. 110615-47) and lauryl glucoside (CAS no. 27836-64-2) were Lamesoft PO-65® and Plantacare 1200®, respectively (both from Henkel, Düsseldorf, Germany) (1), diluted 5% in petrolatum; later, we used the Chemotechnique 'lauryl polyglucose' preparation (obtained from the same manufacturer) diluted 3% in pet. Cetearyl glucoside (Neocare CG 90®; CAS no. 246159-33-1) was provided by Goldschmidt (Hopewell, VA, USA), and diluted 5% in pet. The decyl glucoside (5% pet.; CAS no. 58846-77-8; CAS no. 68515-73-1; CAS no. 141464-42-8; CAS no. 54549-25-6) was initially Oramix NS10® (Seppic, Paris, France), and later Allergeaze (Brial Allergen GmbH, Greven, Germany). Lauryl/tetradecyl glucoside (APG-600®, Henkel) 5% pet. was tested in two subjects (nos. 3 and 20), and some subjects were also tested with aqueous dilutions, or with 10% and 2.5% alkyl glucoside dilutions in pet. (2).

The patch tests were initially applied with Van der Bend® patch test chambers (Van der Bend, Brielle, The Netherlands) applied on the back with Micropore™ (3M Health Care, Borken, Germany), and later with IQ Ultra® patch test chambers (Chemotechnique, Vellinge, Sweden). They were additionally fixed with Fixomull® (Beiersdorf, Hamburg, Germany), and later with Mefix® (Mölnlycke Health Care, Göteborg, Sweden). The patch test readings were performed after 2 and 4 days, and sometimes later than this.

Since 1993, numerous control subjects have been tested with the different alkyl glucosides.

Results

Among the control subjects, patch testing gave negative results with cetearyl glucoside in 109, with coco-glucoside in 553, with decyl glucoside in 536, and with lauryl glucoside in 695.

The clinical data, that is, sex, age, occupation, personal history of atopy, and the localization of the lesions, and



Fig. 1. Hand dermatitis caused by an alkyl glucoside-containing hand cleanser for 'intolerant' skin (patient no. 20).

the positive patch test data of the patients are shown in Table 1 (Fig. 1 illustrates a patient with hand dermatitis).

In total, 30 patients, of whom 24 were women, ranging in age between 15 and 77 years, had a positive reaction to one or more alkyl glucosides; half of them had a history of atopy. The cosmetic products most commonly responsible for the reactions were shampoos (in 12), soaps or other skin-cleansing products (in 12, among which were wipes for intimate hygiene in patient no. 26), and sunscreen products (in 5). The other allergenic culprits were facial and body-care products (in 4, among which was a herbal cream in patient no. 18), and a deodorant (patient no. 26). Sometimes, more than one causal product was involved.

The skin lesions observed with shampoos involved the scalp, sometimes spreading to the face, back, chest, and shoulders; other body parts were affected according to the nature of the causal products. Most patients also suffered from dermatitis on the hands when they came into contact with the products during application; this was particularly so in an occupational setting, such as in nurses (2 cases) and hairdressers (also 2 cases). Some cases of severe dermatitis were related to decyl glucoside contained as a stabilizer in association with the ultraviolet light absorber methylene bis-benzotriazolyl tetramethylbutylphenol in Tinosorb M® (BASF, Ludwigshafen, Germany).

Twenty-three of 26 patients tested with several alkyl glucosides reacted to several derivatives, and 25 of the 30 patients who reacted to alkyl glucosides also had positive test results with non-related chemicals; 16 of

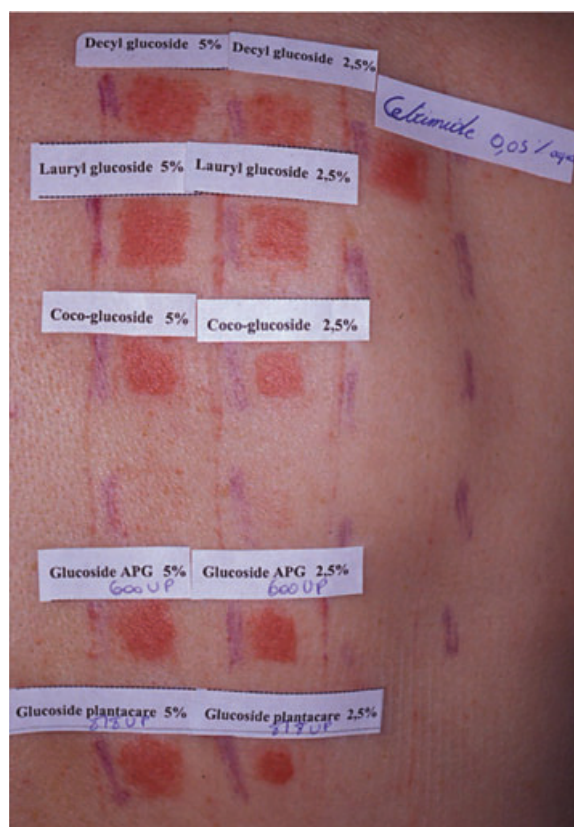


Fig. 2. Positive reactions to alkyl glucosides 5% and 2.5% aqua (day 4 reading) (patient no. 3).

these even had multiple sensitivities (defined as three or more contact allergies (Table 1) (Figs. 2 and 3 illustrate positive reactions to alkyl glucosides).

Upon patch testing, all patients received lists of cosmetic products not containing their specific allergens, including alkyl glucosides, which most often controlled their dermatitis.

We did not, however, take into account the possible presence of alkyl glucosides in food; hence, we did not provide them with dietetic advice.

Discussion

The first cases of delayed-type hypersensitivity to alkyl glucosides were described in 2003 (2–4), resulting from cleansing agents, an antiseptic gel, and a sunscreen product, respectively. Later, several other case reports were published in the literature, particularly involving decyl glucoside, owing to its presence in sunscreen products (3–11). One case concerned allergic contact dermatitis caused by several ingredients in cosmetics that had been applied on a radiotherapy area, among



Fig. 3. Positive reactions to lauryl glucoside 12% aqua, coco-glucoside and lauryl glucoside 10% and 5% pet. [patient no. 19, case 1 in reference (2)].

which was Montanov 68® (Seppic), a mixture of cetearyl glucoside and cetearyl alcohol; however, the authors did not perform tests with the ingredients separately (12). More recently, another alkyl polyglucoside, that is, octyldodecyl xyloside, has been identified as a potential contact allergen in cosmetics (13).

Simultaneous reactions between alkyl glucosides are frequent (Table 1); this is most probably the result of cross-sensitivity, because of structural similarities (they

Table 1. Sex, age, occupation, personal history of atopy, localization of the lesions, patch test results and causal products involved for the patients reacting to alkyl glucosides

Patient	Sex	Age (years) at consultation	Occupation	Atopy	Localization	Positive test reactions to glucosides	D2	D4	D7	Relevance of positive test reactions to glucosides	Other positive test reactions
1. BP	F	47	Administration	+	Head, face	CeG CG DG LG	- + +? +	- + + +	- NR NR NR	Shampoos	-
2. BH	F	65	Retired factory worker	-	Hands, arms, thighs, trunk, neck	CeG CG DG LG	- - - -	- + + +	NR NR NR NR	Sunscreen products	Formaldehyde and releasers, PPD, MDBGN, tosylamide/formaldehyde resin
3. MH	M	77	Retired	-	Scrotum, face	CeG CG DG LG	- ++ ++ ++	- NR NR ++	NR NR NR NR	Skin-cleansing products (probably)	Mitomycin C, thiuram mix, cetrimide
4. BB	F	34	Administration	-	Hands	CeG CG DG LG	- +? - -	- + + +	NR NR NR NR	Shampoo	Cocamidopropyl betaine
5. VL	M	50	Administration	-	Hands, antecubital and popliteal fossae, legs	CeG CG DG LG	++ ++ ++ ++	NR NR NR ++	- - NR NT	Hand soap, sunscreen product	Methylene bis-benzotriazolyl-tetramethylbutylphenol
6. RC	F	67	Household	-	Legs	CeG CG DG LG	NT + + +	NT + + +	NT + + +	Liquid soap	Nickel, diazolidinylurea, lanolin (wool) alcohols
7. DGB	F	44	Administration	+	Generalized	CeG CG DG LG	- - + +	- + NR +	- NR - -	Shower gel, shampoo, hand soap	PPD, cobalt, Myroxylon pereirae, FM I, FM II, HICC, sorbitan sesquioleate, propyl gallate
8. NW	F	29	Administration	-	Neckline, neck, generalized	CeG CG DG LG	NT + + +	NT NR NR -	- - NR -	Sunscreen product, body cream	PPD, nickel, cobalt, formaldehyde and releasers, colophonium, methylene bis-benzotriazolyl tetramethylbutylphenol, limonene

Table 1. continued

Patient	Sex	Age (years) at consultation	Occupation	Atopy	Localization	Positive test reactions to glucosides	D2	D4	D7	Relevance of positive test reactions to glucosides	Other positive test reactions
9. BE	F	35	Teacher	+	Scalp, neckline, shoulders	CG DG LG CeG CG DG LG	+ + + - +? + +?	+ ++ + - +? + +	NR + + NR NR NR NR	Sunscreen product	-
10. SN	F	7	-	+	Face, arms, trunk	CeG CG DG LG CeG CG DG LG	NT NT + NT NT NT NT	- - + - + - -	- - + - - - -	Sunscreen products	Neomycin, <i>Myroxylon pereirae</i>
11. DD	F	63	Household	+	Neck, face, retro-auricular	CeG CG DG LG	NT NT - NT	- - + -	- - + -	Cleansing gel, shampoos	-
12. WB	F	20	Student	+	Face, scalp	CeG CG DG LG	- - +? -	+ + + +	NR NR NR NR	Shampoo	PPD, FM I and II, nickel, mupirocin
13. VG	F	29	Administration	+	Trunk, legs	CeG CG DG LG	- + + -	- + + +	NR NR NR NR	Shower gel	Nickel, cobalt
14. HM	F	74	Household	-	Face, hands	CeG CG DG LG	- +? +? +	- + + +	NR NR NR NR	Day cream	Nickel
15. JJ	F	18	Hairdresser	+	Hands, shoulders, retro-auricular, hands	CeG CG DG LG	- - + -	- - + -	NR NR NR NR	Shampoos, hair-care product	FM I
16. CJ	F	63	Household	-	Scalp, neck	CG DG LG CeG	- + - NT	- + - -	NR NR - -	Shampoos, hair-care product	Formaldehyde and releasers, <i>Myroxylon pereirae</i> , FM I, MCI/MI, MDBGN, SQT mix, ammonium persulfate, coal tar, limonene, latex

Table 1. continued

Patient	Sex	Age (years) at consultation	Occupation	Atopy	Localization	Positive test reactions to glucosides	D2	D4	D7	Relevance of positive test reactions to glucosides	Other positive test reactions
17. SK	M	39	Administration	+	Hands	CG DG LG CeG CG DG LG CeG	+ NT NT - + - - +	+ - - - + - - +	NR - - NR NR NR NR NR	Hand soap, shower gel	Olive oil
18. SR	F	50	Administration	-	Face, feet, legs, arms, anogenital	CeG	+	+	NR	Herbal cream	Chromium, cobalt, nickel, FM I, MCI/MI, MDBGN, 2-bromo-2-nitropropane-1,3-diol
19. DVJ	M	51	Factory worker	-	Face, neck, hands	CG DG LG CeG CG DG LG	- - - NT ++ NT ++	+? +? - - ++ - ++	NR NR NR - NR - NR	Shampoos (probably)	Epoxy resin
20. BMJ	F	53	Nurse	+	Hands, arms, trunk	CeG CG DG LG CeG	+? + +? + +	+? ++ +? ++ +	NR NR NR NR NR	Liquid soap	PPD, IPPD, disperse dyes, nickel, formaldehyde, quinisocaine-HCl
21. VS	F	31	Teacher	+	Hands, feet	CeG CG DG LG	- +? - +	- + - +	NR NR NR NR	Hand soap	Colophonium, FM I and II, sodium metabisulfite
22. LC	F	70	-	-	Eyelids, neck	CeG CG DG LG	+? - - +	+ - - +	NR NR NR NR	Shampoo	Amerchol 101®
23. PP	F	44	Household	+	Face, perianal	CeG	NT	-	-	Unknown	Thiuram mix, colophonium, nickel, MCI/MI, FM II, HICC, MDBGN, hydrocortisone-17-butyrate, 2-bromo-2-nitropropane-1,3-diol, lavender and rosemary oil

Table 1. continued

Patient	Sex	Age (years) at consultation	Occupation	Atopy	Localization	Positive test reactions to glucosides	D2	D4	D7	Relevance of positive test reactions to glucosides	Other positive test reactions
24. TA	F	42	Grocer	+	Hands, face, neck, arms, trunk	CeG CG DG LG	NT – – –	– – – +	– NR NR NR	Unknown	SQTL mix, Compositae mix
25. VS	F	27	Nurse	+	Hands, forearms, face	CeG	–	–	NR	Hand soaps (at work)	–
26. HA	M	55	Retired	–	Ears, face, inguinal folds	CG DG LG CeG	– – – –	– + + +	NR NR NR NR	Deodorant wipes, intimate hygiene	Bufexamac, neomycin, Myroxylon pereirae, FM I, MCI/MI, limonene hydroperoxides
27. HM	M	52	Administration	–	Wrists, hands	CeG CG DG LG	– – – –	– + + +	NR NR NR NR	Body milk	Fusidic acid
28. KC	F	33	Administration	+	Hands, generalized	CeG CG DG LG	– – – ?	– – + +	– – NR NR	Shampoo	–
29. VL	F	15	Student hairdresser	–	Hands, arms, trunk, thighs	CeG CG DG LG	– + + –	– + + –	– NR NR –	Shampoo	PPD, disperse dyes, ammonium persulfate, PTD, cocamide diethanolamine, para-aminophenol
30. DR	F	51	Nurse	–	Trunk, generalized	CeG	–	–	–	Shower cream, shampoo	FM I and II, nickel, palladium, Myroxylon pereirae, colophonium, limonene and linalool hydroperoxides, iodine, lavender oil, MDBGN, carba mix, cyclohexylthiophthalimide

CeG, cetearyl glucoside; CG, coco-glucoside; DG, decyl glucoside; F, female; FM, fragrance mix; HICC, hydroxyisohexyl 3-cyclohexene carboxaldehyde; IPPD, isopropyl *p*-phenylenediamine; LG, lauryl glucoside; MCI/MI, M, male; methylchloroisothiazolinone/methylisothiazolinone; MDBGN, methyl dibromo glutaronitrile; NR, not read; NT, not tested; PPD, *p*-phenylenediamine; PTD, toluene-2,5-diamine; SQTL mix, sesquiterpene lactone mix.

differ only in chain length), but concomitant sensitization is also possible, particularly with coco-glucoside and lauryl glucoside, which are often present in the same cleansing products. A role for the presence of common impurities that persist in the glucoside solutions during their industrial production has been suggested; however, tests with purified alkyl glucosides (provided by Seppic, and data on file) also produced positive reactions in patients sensitized to the commercial samples. We do not have any clue regarding the mechanism by which this apparently unreactive type of ingredient produces a specific immune response.

In our series, 25 of the 30 patients who reacted to alkyl glucosides also had positive test results with non-related chemicals, 16 of these even had multiple sensitivities. An increased risk of polysensitization can be explained theoretically by inherently increased susceptibility, intense, frequent and/or persistent exposure, or acquired susceptibility resulting from barrier disruption and inflammation. The ability to acquire contact allergies increases the risk of polysensitization, but does not seem to be related to the specific allergens themselves (14, 15).

Along with several other authors, we were thus able to show that alkyl glucosides are relevant contact allergens in the concentrations used in cosmetics (Table 1), and that they do not only cause reactions in subjects with an atopic

disposition (1). Moreover, in view of the high number of negative control subjects, the reactions observed cannot be considered to be irritant. Also, testing several cases with lower dilutions gave similar results (data on file).

The same findings have been reported by other authors; for example, no irritation could be observed in 20 healthy volunteers in a study comparing the irritant potential of sodium laureth sulfate and alkyl polyglucoside with that of sodium lauryl sulfate (16).

Conclusions

Allergic contact dermatitis caused by alkyl glucosides in cosmetics (and topical pharmaceutical products) does occur, and might be more frequent than suspected. In agreement with the literature, the positive reactions observed are very unlikely to be attributable to irritation, and most (except, for example, 2 in this series) were relevant to the dermatitis that the patients presented with. However, the mechanism by which these substances unexpectedly cause sensitization is not clear.

In view of the common use of alkyl glucosides (often also in products for intolerant skin), their identification as allergenic culprits is important, particularly in the light of multiple sensitivities. Indeed, one allergen may hide another one!

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