

Alkyl Glucosides in Contact Dermatitis: A Systematic Review

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Ecologically sound because they are synthesized from natural and renewable sources, the mild surfactants alkyl glucosides are being rediscovered by the cosmetic industry. They are currently found in rinse-off products such as shampoos, liquid cleansers, and shower gels, but also in leave-on products that include moisturizers, deodorants, and sunscreens. During the past 15 years, numerous cases of allergic contact dermatitis have been published, mostly to lauryl and decyl glucosides, and these compounds are considered emergent allergens. Interestingly, the sunscreen Tinosorb M contains decyl glucoside as a *hidden* allergen, and most cases of allergic contact dermatitis reported to this sunscreen ingredient are probably due to sensitization to decyl glucoside. This article will review the chemistry of alkyl glucosides, their sources of exposure, as well as their cutaneous adverse effects reported in the literature and encountered in various patch testing centers.

Alkyl glucosides are the products of condensation of glucose and a fatty alcohol. Their use began in the 1960s as nonionic surfactants in rinse-off products such as shampoos, soaps, hair dyes, and mousses, but they were eventually replaced by newer surfactants. The late 1990s saw a revival of popularity for alkyl glucosides because of their low potential for irritation and their ecological characteristics because these surfactants are manufactured from renewable sources. The cosmetic industry has since used them increasingly not only in rinse-off but also in leave-on products such as sunscreens, deodorants, and antiseptics. Beginning in the early 2000s, several case reports described allergic contact dermatitis from alkyl glucosides in different cosmetic and cleansing products.^{1,2} At the same time, decyl glucoside, an important member of the alkyl glucoside family, was also found to be a *hidden allergen* in the new sunscreen ingredient Tinosorb M (BASF, Monheim, Germany).² When patch tested, alkyl glucosides occasionally induce mild irritation, therefore, strong positive reactions probably reflect actual sensitization.³

This article will describe the basic chemistry and cutaneous adverse effects of alkyl glucosides, review the literature and the

results of patch testing in our and other centers, and provide recommendations for patch testing and prevention.

CHEMISTRY AND METABOLISM

Alkyl glucosides are part of a family of organic molecules of vegetal origin composed of 19 different members. In 1893, ethyl glucoside, the shortest and simplest alkyl glucoside, was first synthesized.³ Chemically, alkyl glucosides are produced by the condensation of a sugar, usually a cyclic form of glucose (D-glucopyranose), with a fatty alcohol composed of a linear side chain ranging from 2 to 22 carbons (Fig. 1). Alcoholysis of glucose under acidic conditions is the preferred method of synthesis.³ The anomeric hydroxyl group of the glucose moiety is the site of linkage with the fatty alcohol. The reaction conditions can cause the condensation of 2 or more glucose molecules at either of their hydroxyl groups in a repeating sequence, forming alkyl polyglucosides. These compounds are still called alkyl glucosides, regardless of their number of glucose molecules. Alkyl glucosides are chemically stable; they do not contain chemically reactive sites or polarized structures.⁴

Fatty alcohol is extracted from palm, coconut, or rapeseed oil, and glucose can be obtained from corn, wheat starch, and potato. The average number of carbon atoms composing the side chain of the alcohol determines the name of the alkyl glucoside. For example, decyl glucoside has an average of 10 carbons on its side chain. Other members of the alkyl glucoside family include butyl, caprylyl, undecyl, myristyl, hexadecyl, octadecyl, arachidyl glucosides, caprylyl/capryl glucoside, C10-16, C12-18, C12-20, C20-22 alkyl glucosides, branched isostearyl glucoside, and octyldodecyl glucoside.³

The likely first step in the metabolism of alkyl glucosides is cleavage by the human skin enzyme glucoside hydrolase, leading to

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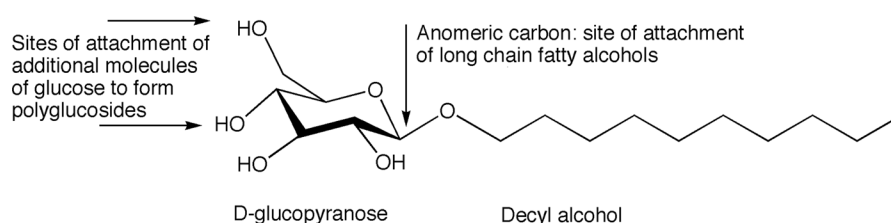


Figure 1. Chemical structure of decyl glucoside.

release of the respective fatty alcohols and glucose.³ According to an in vitro absorption assay on human skin sample with 10% caprylyl/capryl glucoside, transdermal absorption was less than 0.01%.³

FUNCTION AND SAFETY OF USE

After a thorough review of toxicological data, the Cosmetic Ingredient Review Expert Panel concluded that the 19 alkyl glucosides are safe to use.³ Most of the alkyl glucosides are primarily used as mild surfactants in cosmetics and cleansing products for human skin. They can also sometimes function as emulsion stabilizers in sunscreens, skin and hair cleansing agents, and humectants.³ They can be found in certain baby products such as wipes and cleansers.

Alkyl glucosides have been shown to be superior surfactants compared with *classic* polyethoxylated surfactants such as polysorbates. They are not susceptible to oxidation at room temperature and they are used in lower concentration leading to lower skin irritancy potential. The lipophilic hydroxyl groups and the hydrophilic hydrocarbon chains help keep the molecule at the water-oil interface.⁴ Nowadays, decyl glucoside is the most commonly used alkyl glucoside. In 2011, according to information from the Voluntary Cosmetic Registration Program database, decyl glucoside was reported to be an ingredient in 492 cosmetic formulations, mainly rinse-off products.³ Cetearyl glucoside, lauryl glucoside, and coco glucoside are also frequently used. Cetearyl glucoside is probably the most commonly used glucoside in leave-on products other than sunscreens.^{3,5} The concentration of use varies but is higher in rinse-off products. Lauryl glucoside has the highest concentration of use in leave-on products at 8% in a hair color spray and 5% in a skin product, whereas decyl glucoside can be present at a concentration of 33% in rinse-off products.³

Some recent publications suggested that certain alkyl glucosides could potentially be absorption enhancers. Tirumalasetty et al⁶ showed that caprylyl and decyl glucosides could enhance the absorption of insulin in vivo through mucous membrane. Aguirre et al⁷ found that ingestion of coco glucoside could enhance the intestinal permeation of calcitonin and sugar in rats. The Cosmetic Ingredient Review Expert Panel expressed concern that the transdermal absorption of some cosmetic ingredients could lead to untoward effects.³

CUTANEOUS ADVERSE EFFECTS

Irritation

Alkyl glycosides did not cause significant irritant contact dermatitis in clinical studies. An epicutaneous patch test with a 2%

concentration and a soap chamber test at a concentration of 1% with decyl, lauryl, and coco glucosides as well as an occlusive patch test with decyl glucoside 0.5% showed only a slight irritant potential.³ Furthermore, patch testing with a 10% aqueous solution of decyl glucoside did not cause irritant reactions in 100 volunteers.⁸ Lauryl glucoside has a pH of 11.5 to 12.5. Shanmugam et al⁸ recently proposed that lack of correction of pH by suppliers of commercial allergens could render their preparations irritant.

Allergic Contact Dermatitis

Alkyl glucosides in sunscreens, cosmetics, and cleansing products can sensitize by an as yet undetermined mechanism. Decyl glucoside, lauryl glucoside, cetearyl glucoside, and coco glucoside are responsible for most cases. The length of the alcohol chain does not affect the sensitizing potential.

A comparative study used 3 protocols to assess the skin sensitizing potential of 8 related alkyl glucosides. In the local lymph node assay, only C12-C18 glucoside, C4 glucoside, and C18 branched glucoside were mild sensitizers. The authors could not demonstrate sensitization by using the human insult repeated patch test protocol or the guinea pig maximization test.⁹

Case Reports and Case Series

Goossens et al¹ are credited with reporting the first 2 cases of sensitization to alkyl glucosides in cosmetic and cleansing products. Since then, additional publications have described further cases of allergic contact dermatitis.^{1,2,10–23} A retrospective study by Gijbels et al,¹⁰ who reviewed 19 years of data, counted 30 cases of contact allergy to different alkyl glucosides (Table 1).

Analyses of available data have shown similarities between cases. When patch tested, the majority of patients react to multiple alkyl glucosides and women are more commonly sensitized. The median age of patients is 49.6 years. Sensitization can occur in an occupational setting but the majority of cases are not work related. Workers in contact with cosmetic or cleansing products like hairdressers, housekeepers, and nurses have been sensitized. Conditions such as atopic eczema and occupational irritation may enhance the penetration of glucosides by altering the epidermal barrier.³ Hands, face, neck, and scalp are commonly affected by exposure to shampoos, sunscreens, and liquid soaps. Nonexposed sites, such as breast, abdomen, genitals, and folds have been involved from use of anti-septics, skin cleansers, and deodorant wipes. In most cases, strict avoidance of the culprit products and treatment with topical

TABLE 1. Summary of Reported Cases of Glucoside-Induced Allergic Contact Dermatitis

Author, Year	Age and Sex	Clinical Picture	Exposure	History	Work-Related	Patch Test Concentrations and Reactions
Goossens, 2003 Belgium	55-year-old man	Recurrent papular and erythematous-squamous lesions on the face, neck, forearms, wrists, and dorsa of the hands.	Shampoo and shower gel (rinse-off)	No atopy	Yes	Lauryl glucoside 53% aq semiopen test (+++), 5%, 10% pet (++), and 12% aqua (++) coco glucoside 35% aq, 5%, 10% pet (++) Lauryl glucoside 5% pet. (++) coco glucoside 5% pet. (+)
Goossens, 2003 Belgium	46-year-old woman	Severe erythema, scaling, and fissuring on both hands, accompanied by paronychia	Antiseptic body lotion (leave-on)	Atopic eczema	No	
Le Coz, 2003 France	29-year-old woman	Acute eczema at site of umbilical piercing	Chlorhexidine digluconate antiseptic gel (leave-on)	No atopy	No	Decyl glucoside 0.55% aq (++) chlorhexidine (–)
Blondeel, 2003 Belgium	53-year-old woman	Aggravation of atopic eczema on UV-exposed skin and scalp	Sunscreen (leave-on)	Atopic eczema	No	Decyl glucoside 5%, 10% aq (++) possible reaction, but not tested: methylglucose dioleate
Blondeel, 2003 Belgium	52-year-old woman	Eczematous lesions on scalp and trunk	Shampoo (rinse-off)	Occupational hand dermatitis	No	Decyl glucoside 10% aq. (++)
Blondeel, 2003 Belgium	Young woman	Eczematous lesions on hands	Shampoo (rinse-off)	Hand eczema	No	Lauryl glucoside 5% pet (+) coco glucoside 5% pet (+) decyl glucoside 5% pet (+)
Blondeel, 2003 Belgium	16-year-old woman	Painful fissuring on the fingers	Shampoo and hair dye (rinse-off)	Occupational irritation	Yes	Lauryl glucoside 5% pet (+) coco glucoside 5% pet (++) decyl glucoside 10% pet (+) cetearyl glucoside 5% pet (++)
Giordano-Labadie, 2005 France	36-year-old woman	Pruritic erythematous and edematous eruption on face	Sunscreen spray (leave-on)	No atopy	No	Tinosorb M (++) decyl glucoside 5% (–), 10% pet (+)
Horn, 2005 UK	25-year-old woman	Eczematous lesions on upper chest, arms, neck, face, and scalp	Hair mousse (leave-on)	No atopy	No	Decyl glucoside 2% aq (++)
Gonzalez-Pérez, 2007, Spain	54-year-old woman	Persistent facial dermatitis involving forehead and cheeks	Sunscreen (Avene 20) (leave-on)	Not mentioned	No	MBBT (not pure) 2% pet (?)
Andersen, 2006 Denmark	67-year-old man	Sudden exacerbation of widespread vesicular dermatitis related to sun exposure on trunk and extremities	Sunscreen (leave-on)	Atopic eczema	No	Tinosorb M 6% aq (++) decyl glucoside 0.5%-5% aq (+) coco glucoside 2% aq (positive, strength of reaction not mentioned)

(continued on next page)

TABLE 1. (Continued)

Author, Year	Age and Sex	Clinical Picture	Exposure	History	Work-Related	Patch Test Concentrations and Reactions
Krehic, 2009 France	86-year-old woman	Acute eczema affecting the submammary area and lateral sides of the neck	Chlorhexidine digluconate antiseptic lotion (leave-on)	No atopy or eczema	No	Decyl glucoside 1% pet (++), 3% pet (++++) chlorhexidine digluconate 0.5% aq (++) lauryl glucoside (+++)
Krehic, 2009 France	80-year-old man	Acute lower leg eczema	Chlorhexidine digluconate antiseptic lotion (leave-on)	No atopy or eczema	No	Decyl glucoside 1%pet (++), 3% pet (++++) chlorhexidine digluconate 0.5% aq (+/?) Lauryl glucoside (++)
Andrade, 2010 Portugal	66-year-old man	Pruritic erythematous eruption on face and neck	Sunscreen (Avène) (leave-on)	Not mentioned	No	Tinosorb M 10% pet (++) decyl glucoside 5% pet (++) no further aggravation after UV
O' Connell, 2011 UK	75-year-old man	Eczematous eruption, site undisclosed	Sunscreen (leave-on)	No atopy or eczema	No	Tinosorb M 10% pet (+) lauryl glucoside (–)
O' Connell, 2011 UK	85-year-old woman	Eczematous lesions largely distributed on the face, neck, arms.	Sunscreen (leave-on)	Not mentioned	No	Lauryl glucoside 3% pet (+) Tinosorb M 10% pet (+)
Pereira, 2013 Portugal	66-year-old man	Eczematous lesions on face and anterior cervical region	Sunscreen (leave-on)	Not mentioned	No	Tinosorb M 10% pet (++) decyl glucoside 5% pet (++)
Pereira, 2013 Portugal	52-year-old woman	Eczematous lesions on eyelids and anterior cervical region	Sunscreen (leave-on)	Not mentioned	No	Tinosorb M 10% pet (+) lauryl glucoside 3% pet (+)
Pereira, 2013 Portugal	64-year-old woman	Eczematous lesions on face and anterior cervical region	Sunscreen (leave-on)	Not mentioned	No	Tinosorb M 10% pet (++) lauryl glucoside 3% pet (++)
Pereira, 2013 Portugal	64-year-old man	Eczematous lesions on face and anterior cervical region	Sunscreen (leave-on)	Not mentioned	No	Tinosorb M 10% pet (++) lauryl glucoside 3% (++++)
Pereira, 2013 Portugal	39-year-old woman	Eczematous lesions on eyelids	Sunscreen (leave-on)	Not mentioned	No	Tinosorb M 10% pet (++) lauryl glucoside 3% pet (++++)
Gijbels, 2014 Belgium	24 women and 6 men aged 7-77 y	Eczematous lesions depend on the product; hands are affected with soaps whereas scalp and sometimes face, back, chest, and shoulders are affected with shampoos	Shampoos (12/30), skin cleansers (12/30) (rinse-off), sunscreens (5/30), skin care (4/30), and deodorant (1/30) (leave-on)	15/30 had history of atopy	Yes in 4/30	One or more alkyl glucosides (cetearyl, coco, decyl, and lauryl glucoside) 26/30 were polysensitized
de Groot, 2014 Netherlands	56-year-old woman	Itchy, red, and burning eruption on face and neck	Sunscreen (leave-on)	Not mentioned	No	Tinosorb M 8.1% aq (+)

Liuti, 2015 Spain	83-year-old man	Severe eczematous patches on forehead, cheeks, and upper chest	Sunscreen (leave-on)	Actinic keratoses	No	Decyl glucoside 1%, 3%, 5%, 10% pet & aq (positive, strength not specified) Tinosorb M 10% pet (+) lauryl glucoside 3% pet (++) MBBT EPE series (+) (not pure MBBT) pure MBBT 10% pet. (–)
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corticosteroids has led to resolution of the dermatitis. More severe cases requiring treatment with systemic corticosteroids have occurred after exposure to decyl glucoside in Tinosorb M sunscreens.^{11,12}

Cosmetic Rinse-Off Products

Among the rinse-off products, shampoos are the most common cause of contact dermatitis from alkyl glucosides, with approximately 16 reported cases.^{1,2,10} Shampoos often contain a mixture of different alkyl glucosides and their exact composition is not always clear. Some publications report allergic contact dermatitis from liquid, gel, or cream formulations of hand and body soaps. The molecules most commonly implicated include decyl glucoside, coco glucoside, lauryl glucoside, and cetearyl glucoside. Because preservatives, fragrances, and other allergens or irritants are present in shampoos and cosmetics, it is important to test a patient's personal products and their individual ingredients.

Cosmetic Leave-On Products

Sunscreens

The sunscreen ingredient Tinosorb M was introduced in the European, Asian, and Australian markets in the early 2000s. It is not used in the United States because it has not yet been approved by the Food and Drug Administration. Tinosorb M is composed of the new broad-spectrum UV filter methylene bis-benzotriazolyl tetramethylbutylphenol (MBBT, also known as bisoctrizole) (50%) solubilized with decyl glucoside (7.5%), propylene glycol (0.4%), xanthan gum (0.2%), and water (ad 100%).²⁴ Compared with other sunscreen preparations, Tinosorb M offers the advantages of being photostable and protecting the skin by 3 different mechanisms, absorbing UV radiation like an organic filter and reflecting and scattering light as a physical sunblock.⁴ The role of decyl glucoside is to facilitate dispersion of the UV filter microparticles in an aqueous phase. Unfortunately, although decyl glucoside is present in the final preparation, its name does not appear on the ingredient label of some sunscreens, where it therefore represents a hidden allergen.

Blondeel reported the first case of allergic contact dermatitis to Tinosorb M in 2003, and several cases have since been published.^{2,10–18} Between 2009 and 2012, Pereira et al¹⁵ collated the largest case series: 92 patients were photopatch tested, and 87 patients were patch tested with a cosmetics series that included Tinosorb M, Tinosorb S, and lauryl glucoside. In total, 5 of the 179 tested patients had positive reaction to Tinosorb M and to lauryl glucoside, for a positivity rate of 2.8%. Tinosorb S, a chemically unrelated UV filter, has not been shown to cause allergic contact dermatitis. Interestingly, it does not need decyl glucoside as a stabilizer.

The MBBT, used as a synonym for Tinosorb M in previous studies, may have been falsely reported as the sensitizing agent.^{17,18} In fact, pure MBBT was unavailable for testing until January 2014 in the European Photopatch Extended series.¹⁸ Previous tests labeled “MBBT” were in fact performed with a mixture of decyl glucoside and pure MBBT. This confounding factor illustrates the importance of testing with individual allergens and to correctly

label material used for patch testing because of hidden ingredients. To our knowledge, decyl glucoside seems to be the main sensitizer in Tinosorb M.

Antiseptic Lotion, Deodorant, and Hair Mousse

Goossens et al¹ published the first case report of allergic contact dermatitis on the hands from an antiseptic lotion containing coco glucoside and lauryl glucoside. Later, contact allergy from decyl glucoside, involving different parts of the body, was reported in a patient who used a chlorhexidine-based antiseptic gel and 2 patients exposed to a moisturizing lotion.^{19,20} The 2 patients described by Krehic et al¹⁹ reacted positively to lauryl glucoside on initial patch testing and to decyl glucoside more than to chlorhexidine when patch tested to the product ingredients provided by the manufacturer. Gijbels et al¹⁰ described a case of contact dermatitis to deodorant wipes containing an unspecified mixture of alkyl glucosides. The dermatitis involved the ears, face, and inguinal folds, and patch tests were positive for coco glucoside and decyl glucoside.¹⁰

North American Contact Dermatitis Group

In 2009, decyl glucoside 5% in petrolatum was introduced in the North American Contact Dermatitis Group (NACDG) standard series. The results of the 14 members of the group are compiled, tabulated, and published after each cycle of 2 years. During the period 2009-2010, patch testing with decyl glucoside was positive in 1.5% of 4302 patients thus tested, with a global relevance rate of 83.3% and 34.8% if only cases of definite and probable relevance are considered.²⁵ The rate of positive reactions between 2011 and 2012 was established at 1.56% (66 positive cases out of 4231 tested patients), and approximately 50% of cases were considered relevant (4.5% definite, 15.2% probable, and 27.3% possible).²⁶ During the 2013-2014 cycle, 4859 patients were tested, of which 88 (1.7%) had positive reactions to decyl glucoside.²⁷ The rate of global relevance was 88.3% (5.9% definite, 27.1% probable, and 55.3% possible). There is therefore a slight but steady increase in the number of positive reactions detected through the years.

McGill University Health Centre Database

The NACDG standard series is used at the McGill University Health Centre (MUHC). Between January 2009 and June 2016, 3095 patients were patch tested. A total of 20 (0.65%) patients were found to be sensitized to decyl glucoside. During the same period, among the 3095 patch tested patients, 1628 were also tested to lauryl glucoside in a comprehensive cosmetics and vehicles series. A total of 15 (0.92%) of the latter patients gave a positive reaction to lauryl glucoside, 6 of whom were also allergic to decyl glucoside. Interestingly, 9 patients reacted to lauryl glucoside alone. Patients demographics and results of testing appear in Tables 2 and 3. The positivity rate was low in the first years but has steadily increased between 2014 and 2016 when patch testing was positive in 1.37% of 437 patients in 2014, 1.47% of 409 patients in 2015, and 2.2% of 227 patients tested in the first 6 months of 2016. Most of

the patients thus far detected were women (73%) with an atopic background (86%). The average age of the patients was 47.7 years (median, 47 years), and the dermatitis most commonly affected the hands and the face in accordance with previous reports. Only 1 case could be attributed to an occupational exposure.

Groupe d' Etudes et de Recherches en Dermato-Allergologie

Between 2005 and 2007, decyl glucoside 2% in water, provided by the manufacturer of a sunscreen that contained Tinosorb M, was added to the patch testing battery used by the members of the group in France, Belgium, and Switzerland and gave positive reactions in 0.5% of tested patients. It was rapidly replaced in 2008 by lauryl glucoside 5% in Vaseline (Unilever, Rotterdam, Netherlands), which is more easily obtained from suppliers of patch testing allergens. Since 2012, the positivity rate for lauryl glucoside has always been more than 1.5% (2% in 2012, 1.59% in 2013, and 2.59% in 2014).²⁸ These numbers were deemed considerable by the members of the Groupe d' Etudes et de Recherches en Dermato-Allergologie (GERDA). They concluded that this alkyl glucoside should remain in the baseline patch testing series because it is a common emerging allergen.

At a recent meeting of GERDA, one of the authors (M.C.F.L.) presented the following case: a 32-year-old nurse aide with a background of atopic dermatitis, asthma, and allergic rhinitis was seen in 2014 with chronic dermatitis unresponsive to topical corticosteroids. The lesions involved the fingers, the dorsum, and the palm of both hands, with extension to the forearms. She was patch tested in June 2015 with the European baseline series supplemented with a preservative series, her own topical products, nitrile gloves, and products from the workplace. At the 72-hour reading, the only relevant positive reaction (2+) was to a hand cold cream that the patient had been using on a daily basis for a number of months. Her lesions cleared when she stopped using this moisturizer.

In December 2015, additional patch tests were conducted with the 17 ingredients of the cold cream, with 2+ reactions at 48 and 96 hours to a single compound called glucolipide, tested at a concentration of 3% (Fig. 2). It is a mixture of arachidyl alcohol 55%, arachidyl glucoside 15%, and behenyl alcohol 30%. Further tests at concentrations of 1% and 3% of a mixture of arachidyl alcohol and behenyl alcohol, as well as behenyl alcohol alone, were negative, suggesting that arachidyl glucoside was the actual sensitizer. The patient did not react to lauryl glucoside 5% or to decyl glucoside 5%. Semiopen tests with shampoos containing coco glucoside were negative and so was a test under occlusion with a cream containing xylityl glucoside. However, 2+ reactions were elicited with creams containing cetearyl glucoside and octyldodecylxyloside (Fig. 3). The ingredients of the latter products were not tested separately, but the pattern of reactivity again suggests that glucosides and xyloside are the culprits that cross-react with arachidyl glucoside.

Glucolipide (Montanov 202; SEPPIC, Puteaux, France) is an emulsifier of vegetal origin, synthesized from rapeseed fatty alcohols

TABLE 2. Characteristics of MUHC Patients With Positive Reactions to Glucosides

No	Sex	Age	Atopy	Site	Source	Polysensitized	Decyl Glucoside		Lauryl Glucoside	
							48 h	96 h	48 h	96 h
1	F	49	E, A, R	Face	Face cream	Yes	+	+	+	+
2	F	66	R	Face, eyelids	Facial cosmetics	Yes	0	++	0	+
3	F	71	R	Generalized	Moisturizers	Yes	+	+	+	+
4	M	42	E, R	Face, arms, axillae	Deodorants, shaving cream	Yes	?	+	NT	NT
5	M	50	E, R	Hands	Moisturizers	Yes	+	++	NT	NT
6	F	47	E, R	Hands	Hand creams	Yes	?	+	0	0
7	M	20	E, A, R	Face, eyelids	Face cream	Yes	0	+	0	+
8	F	37	E	Face	Facial cosmetics	Yes	0	+	0	0
9	F	51	E, R	Hands	Hand creams	Yes	+	+	0	+
10	F	45	E, A, R	Hands, generalized	Hand creams, moisturizers	Yes	?	+	0	0
11	F	35	E, R	Generalized	Moisturizers	Yes	0	+	0	0
12	M	16	E	Sun exposed	Sunscreens	Yes	0	++	NT	NT
13	M	29	E	Hands	Hand creams	No	+	+	NT	NT
14	F	42	A, R	Face, eyelids	Facial cosmetics	Yes	0	+	0	0
15	F	32	A	Hands	Hand creams	Yes	+	+	+	+
16	F	41	E, R	Face, trunk, arms	Moisturizers, sunscreens	No	+	+	0	0
17	F	62	E, A, R	Perianal, face, neck	Wet wipes, moisturizers	Yes	0	+	0	0
18	F	52	None	Face	Facial cleansers	No	0	+	0	0
19	M	51	R	Hands	Moisturizers	Yes	?	+	0	0
20	F	41	E, A, R	Face, arms	Moisturizers, shampoos	Yes	0	+	0	0
21	M	43	R	Scalp, abdomen, knees	Shampoos, moisturizers	Yes	0	0	0	+
22	F	35	A	Scalp, face	Hair dye	Yes	0	0	0	++
23	F	60	None	Scalp, face, neck	Hair dye	Yes	0	0	0	+
24	F	82	None	Leg ulcer	Moisturizers	Yes	0	0	0	+
25	F	65	E	Generalized	Moisturizers	Yes	0	0	?	+
26	F	45	E	Hands	Hand creams	Yes	0	0	0	+
27	F	54	E, A, R	Chest, arms	Moisturizers	Yes	0	0	?	+
28	M	72	None	Leg ulcer	Moisturizers	Yes	0	0	+	+
29	F	49	E	Neck	Moisturizers	Yes	0	0	+	+

A indicates asthma; E, eczema; F, female; M, male; NT, not tested; and R, rhinitis.

and wheat glucose. Arachidyl glucoside (CAS 100231-68-3) is produced during the manufacturing process and is not available as a separate ingredient. Despite its ominous name, it is not derived from peanuts (*Arachis hypogaea*). It can be found in shampoos, conditioners, creams, and sunscreens. At the time of submission of this article, we believe that this case may be the first report of allergic contact dermatitis to arachidyl glucoside.

Screening and Patch Testing

Leave-on products can be tested undiluted under occlusion, whereas undiluted rinse-off products should be tested with the semiopen technique. Comprehensive baseline and cosmetic series should be used. It is essential to obtain from the manufacturer and to test the individual ingredients of any product that causes an allergic patch test reaction.

The optimal patch test concentration for the detection of allergy to glucosides is still not established. As of this writing, 2 major suppliers (AllergEAZE; SmartPractice, Phoenix, AZ and Chemotechnique Diagnostics, Vellinge, Sweden) commercialize decyl glucoside at a

concentration of 5% in petrolatum, but many cosmetic series have not yet introduced it or other alkyl glucosides. The molecule most frequently used for patch testing is lauryl glycoside 3% in petrolatum because it has been commercialized for a longer period of time. Lauryl glycoside seems to be a good marker of sensitization to the alkyl glucoside family, but cases may be missed because it does not automatically cross-react with other alkyl glucosides. Patients who react to Tinosorb M should be tested to decyl glucoside as recommended by the NACDG and other authors of relevant case reports.

Cross-Reactions

Reactions to multiple structurally related alkyl glucosides seem to be frequent, but not systematic, among patch tested patients and are seen mainly between decyl glucoside, lauryl glucoside, coco glucoside, and cetearyl glucoside. Thus, sensitization seems to be a group allergy with possible cross-reactivity, probably related to the similar structure of glucosides. It is well known, however, that the industrial manufacturing process results in blends of different alkyl glucosides²⁰ and patch test reactions to different glucosides may

TABLE 3. Clinical and Demographic Characteristics of MUHC Patients With Positive Reaction to Glucosides

Characteristics	All Cases (n = 29)
	Tested to Decyl Glucoside (3095)
	Tested to Lauryl Glucoside (1628)
Age, mean, y	47.7
Sex, n (%)	
Female	21 (72.4)
Male	8 (27.6)
Clinical presentation, n (%)	
Face, scalp, neck, or sun-exposed	15 (51.7)
Leg ulcer	2 (6.9)
Hand dermatitis	7 (24.1)
Generalized dermatitis	4 (13.8)
Trunk (abdomen, proximal extremities)	4 (13.8)
Atopy, n (%) (rhinitis, eczema, or asthma)	25 (86.2)
Type of product	
Rinse-off (shampoos, soap)	
Shampoos	2
Soap and skin cleanser	1
Shaving cream	1
Leave-on	
Moisturizers	13
Hand creams	6
Sunscreen	2
Deodorants	1
Facial cosmetics and cream	4
Wet wipes	1
Hair dye	2
Positivity rate	
Decyl glucoside	20/3095 (0.64%)
Lauryl glucoside	15/1628 (0.92%)
Both (cross-reactivity)	5/29 (17.2%)

All the 29 cases were patch tested to decyl glucoside, but 25 were tested simultaneously to lauryl glucoside.

therefore represent concomitant reactions. A recent study, which aimed to identify possible allergenic impurities in commercial samples of alkyl glucosides, found that isobornyl acrylate (Fig. 4) may possibly be a cause of sensitization to many alkyl glucosides, but this finding needs confirmation by further patch tests in patients sensitized to alkyl glucosides.⁵ Isobornyl acrylate is used as plasticizer in various plastic materials and could be leached out of the container by the surfactant properties of alkyl glucosides. The presence of isobornyl acrylate was not verified in the glucolipide mixture that sensitized the arachidyl-allergic patient, but the manufacturer of the cold cream receives it from his supplier in polyethylene bags that likely do not contain this plasticizer.

Wilkinson and Powis²⁹ published a case of allergic contact dermatitis to octyldodecyl xyloside, a constituent of a cosmetic

**Figure 2.** Positive patch tests to cold cream and glucolipide.

serum. This new allergen is closely related to alkyl glucosides. Structurally, xylose replaces glucose and the aglycone moiety is an alcohol with a double-side chain of 12 and 8 carbons instead of the fatty alcohol single-side chain in alkyl glucosides. No patch test was done to verify concomitant sensitization to alkyl glucosides. Interestingly, our patient displayed a strong positive patch test reaction to a cream containing this newer surfactant.

Blondeel² raised the hypothesis of potential cross-reactivity between decyl glucoside and methyl glucose dioleate. He described a patient sensitized to decyl glucoside in a sunscreen who also reacted to Nizoral (Janssen, Beerse, Belgium) shampoo, which contains methyl glucose dioleate. Unfortunately, the patient refused further patch testing to identify the culprit sensitizer.

CONCLUSIONS

Alkyl glucosides are stable molecules made by condensation of glucose and a fatty alcohol. Their range of usage is limited to cosmetic

**Figure 3.** Repeat patch tests with positive reactions to various glucosides.

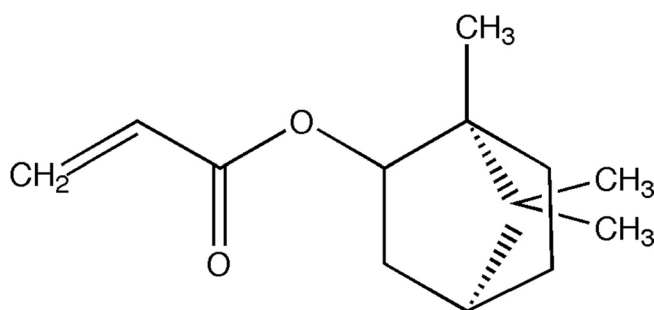


Figure 4. Chemical structure of isobornyl acrylate.

and cleansing materials. Decyl glucoside was also recently introduced as a stabilizer in the sunscreen agent Tinosorb M. Given the increasing number of publications, it seems that the sensitizing potential of alkyl glucosides is important and higher than expected. It may be underestimated because of the absence of systematic patch testing in many cosmetic series. Alkyl glucosides should be included in all patch test cosmetic series and, more specifically, decyl glucoside should be tested if allergy to Tinosorb M is suspected. Because they do not automatically cross-react, it is recommended to test multiple alkyl glucosides to increase the rate of detection. Avoidance of all cosmetic products containing alkyl glucosides and sunscreens containing Tinosorb M is recommended in sensitized patients because cross-reactions are common among tested patients.

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