

Contents of fragrance allergens in children's cosmetics and cosmetic-toys

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Fragrances are one of the major causes of allergic contact dermatitis from use of cosmetics. The aim of the current study was to assess the possible exposure of infants and children to fragrance allergens from cosmetic products and "toy-cosmetics". 25 children's cosmetics or toy-cosmetic products were analysed by gas chromatography – mass spectrometry. Target substances were the fragrance allergens from the fragrance mix and 14 other fragrance substances, most of which have been described as contact allergens. The fragrance mix ingredients were either not present in children's shampoos/shower gels and cream/lotions, or they were present in fairly low concentrations. In hydro-alcoholic products, such as eau de parfum, eau de toilette, several ingredients of the fragrance mix were found: geraniol was present in 7/7 products, hydroxycitronellal in 6/7 and isoeugenol in 2/7 products. Isoeugenol was present in a maximum concentration of 0.07%. In one cosmetic-toy, cinnamic alcohol was present at 3.7% which exceeds the current industry guideline for safe products by a factor of 5. In all types of products other fragrance allergens were frequently found. In conclusion, children are already exposed at an early age to well-known allergens, sometimes at concentrations which are considered to be unsafe. As contact allergy usually persists for life, manufacturers of children's cosmetics should be aware of their special responsibility and apply the highest possible safety standards.

Key words: children; cosmetics; cosmetic-toys; contact allergy; fragrances; fragrance mix; ingredients; chemical analysis © Munksgaard, 1999.

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It is known that fragrances are one of the major causes of allergic contact dermatitis from the use of cosmetics, but the exposure to them of infants and young children is not known. In a previous study (1), a vapo-spray for babies was found to contain 14 of 21 selected fragrance substance. Among these, 4 were contact allergens present in fragrance mix: geraniol, hydroxycitronellal, cinnamic alcohol and α -amyl cinnamic aldehyde. This finding may be of concern, as infants and young children are thus exposed to a variety of well-known fragrance contact allergens.

To evaluate the exposure of infants and children to fragrance allergens, a series of cosmetic products specially marketed for this group of the popu-

lation were analysed. Furthermore, products known as 'cosmetic-toys', a possible additional source of children's exposure to fragrance, were also included.

Materials and Methods

Samples

The study included 25 products comprising 5 shampoos and shower gels, 5 eau de toilettes, 1 eau de parfum, 1 deodorant (roll-on), 4 baby lotions/creams, 1 baby wipes product, 1 baby oil, 2 lip-care products and 5 toy-cosmetic products: a cosmetic-toy set for blending perfumes and a make-up set (lipstick and eye shadow). The samples rep-

resented cosmetic/perfume and toy companies based in Europe and USA. The samples were purchased in the period November 1997-January 1998 in retail outlets in Denmark, Germany, England and Sweden.

Target fragrance substances

The samples were analysed for the chemically defined ingredients in the fragrance mix, used for diagnostic patch testing: α -amylcinnamic aldehyde,

Table 1. Contents of the investigated fragrance substances in shampoos, shower gels, creams and lotions

Fragrance substance	Shampoos and shower gels		Creams and lotions	
	no. of samples	concentration (g/100 g)	no. of samples	concentration (g/100 g)
• α-amylcinnamic aldehyde	1/5	0.004	0/4	
• benzyl acetate	4/5	0.005, 0.006, 0.010, 0.005	4/4	*, 0.012, 0.013, 0.328
• benzyl alcohol	4/5	*, 0.004, 0.005, 0.013	2/4	0.263, 0.652
• benzyl benzoate	3/5	0.002, 0.017, 0.003	4/4	*, 0.001, 0.006, 0.009
• benzyl salicylate	1/5	*	2/4	*, 0.005
• cinnamic alcohol	0/5		0/5	
• cinnamic aldehyde	0/5		0/5	
• citronellol	2/5	*, 0.038	4/4	0.004, 0.009, 0.012, 0.017
• coumarin	3/5	*, 0.003, 0.003	2/4	0.013, 0.013
• eugenol	3/5	*, 0.011, 0.040	0/4	
• geraniol	1/5	*	4/4	0.005, 0.007, 0.010, 0.012
Hedione®	2/5	*, *	2/4	*, 0.015
• α -hexylcinnamic aldehyde	3/5	0.002, 0.003, 0.006	0/4	
• hydroxycitronellal	0/5		1/4	*
• isoeugenol	0/5		0/4	
• Lilial®	3/5	0.005, 0.006, 0.007	2/4	0.003, 0.059
• linalool	4/5	0.005, 0.008, 0.010, 0.023	4/4	0.005, 0.010, 0.026, 0.034
linalyl acetate	2/5	*, *	3/4	0.010, 0.017, 0.021
• Lyrall®	0/5		2/4	*, 0.033
• α -iso-methylionone	0/5		1/4	*
• piperonal	3/5	*, 0.012, 0.014	4/4	0.006, 0.011, 0.012, 0.016

* $\leq 0.001\%$; **Bold**: ingredients of the fragrance mix; •: Reported as allergens in cosmetics and toiletries (20).

Table 2. Contents of target fragrance substances in hydro-alcoholic products: eau de toilette (n=5) and 1 eau de parfum; the table also includes contents in 1 deodorant (roll-on)

Fragrance substance	No. samples	Concentration (g/100 g)	
		range	mean*
• α-amylcinnamic aldehyde	1/7	0.005	
• benzyl acetate	7/7	*-0.112	0.039
• benzyl alcohol	3/7	0.007-0.110	0.045
• benzyl benzoate	7/7	0.003-0.109	0.033
• benzyl salicylate	1/7	0.081	
• cinnamic alcohol	0/7	-	
• cinnamic aldehyde	0/7	-	
• citronellol	7/7	0.004-0.087	0.036
• coumarin	4/7	0.003-0.018	0.011
• eugenol	1/7	0.009	
• geraniol	7/7	*-0.136	0.037
Hedione®	6/7	0.084-1.027	0.506
• α -hexyl cinnamic aldehyde	6/7	0.003-0.333	0.090
• hydroxycitronellal	6/7	0.009-0.305	0.102
• isoeugenol	2/7	0.019, 0.074	
• Lilial®	7/7	0.011-1.170	0.335
• linalool	7/7	0.019-0.311	0.134
linalyl acetate	7/7	0.011-0.317	0.115
• Lyrall®	6/7	0.054-0.630	0.257
• α -iso-methylionone	4/7	0.008-0.231	0.082
• piperonal	3/7	0.007-0.024	0.013

* $\leq 0.001\%$. For calculation of mean values, * were treated as 0.001%.

Bold: Ingredients of the fragrance mix.

•: Reported as allergens in cosmetics and toiletries (20).

cinnamic alcohol, cinnamic aldehyde, eugenol, geraniol, hydroxycitronellal, isoeugenol. In addition 14 other fragrance substances, most of which have been described as contact allergens, were target substances (Tables 1–2).

Analysis

Analysis of fragrance substances was performed by gas chromatography-mass spectrometry (GC-MS), as described before (2). The sample preparation methods for the analysis of fragrance substances in various types of cosmetic products have been described previously (2). Fragrance substances in baby wipes were determined semi-quantitatively: the liquid obtained by squeezing a known amount of baby wipes was analysed.

Results

All of the target fragrance substances were analyzed at the detection limit of approximately 1 ppm (0.0001%). The relative standard deviation (RSD) of the determination of all of the substances was within 10%. However, RSD of the determination of the fragrances present in concentration 0.0001–0.0010% were rather high (20–25%). Therefore, these concentrations are described as $\leq 0.001\%$ in Tables 1–4. The contents of target fragrance substances in shampoos, shower gels, creams and lotions investigated in the present study are described in Table 1. Among the fragrance mix substances, cinnamic aldehyde, cinnamic alcohol and isoeugenol were not found in any of the samples. Eugenol (≤ 0.001 –0.040%) was present in 3/5 of

Table 3. Contents of target fragrances in diverse cosmetic products and cosmetic-toys

Product	Contents of target fragrances (g/100 g)
baby oil	citronellol*, piperonal*
baby wipes	benzyl acetate*, cinnamic alcohol *, citronellol*, coumarin*, geraniol *, hydroxycitronellal *, isoeugenol *, linalool*, piperonal*
eye shadow	α -hexylcinnamic aldehyde (0.005), α -iso-methylionone*
lip balm	benzyl acetate (0.036), geraniol (0.004)
lipstick	benzyl acetate (0.045), benzyl benzoate (0.008), citronellol (0.006), geraniol (0.011), α -iso-methylionone*
lip gloss	benzyl acetate (0.051), benzyl alcohol (0.004), benzyl benzoate (0.134), cinnamic alcohol (0.050), cinnamic aldehyde *, citronellol (0.003), eugenol (0.013), linalool (0.002), linalyl acetate (0.004), α -iso-methylionone (0.010)

* $\leq 0.001\%$; **Bold**: ingredients of fragrance mix.

Table 4. Contents of target fragrance substances in a cosmetic-toy for making own cosmetics

Fragrance substance	Concentration (g/100 g)		
	perfume base lotion	peach essence	lilac essence
• α-amylcinnamic aldehyde	—	*	0.388
• benzyl acetate	*	0.191	3.359
• benzyl alcohol	—	—	0.060
• benzyl benzoate	—	—	0.005
• benzyl salicylate	—	0.029	—
• cinnamic alcohol	—	—	3.680
• cinnamic aldehyde	—	—	0.103
• citronellol	—	—	0.759
• coumarin	*	—	—
• eugenol	—	0.163	—
• geraniol	—	1.764	—
Hedione [®]	*	0.405	—
• α -hexyl cinnamic aldehyde	*	—	0.003
• hydroxycitronellal	*	—	1.180
• isoeugenol	—	—	—
• Liliol [®]	—	0.421	0.480
• linalool	*	0.343	0.003
linalyl acetate	—	1.872	—
• Lyril [®]	—	—	—
• α -iso-methylionone	—	0.012	—
• piperonal	*	*	2.482

* $\leq 0.001\%$. **Bold**: ingredients of the fragrance mix. •: Reported as allergens in cosmetics and toiletries (20).

shampoos and shower gels, and 1 each of these products contained geraniol ($\leq 0.001\%$) and α -amylcinnamic aldehyde (0.004%). All 4 creams and lotions contained geraniol (0.005–0.012%) and 1 of the products also contained hydroxycitronellal ($\leq 0.001\%$). Other target fragrance substances (≤ 0.001 –0.059%) were frequently present in the products investigated. All 7 products of eau de perfume, eau de toilette and roll-on were found to contain geraniol (≤ 0.001 –0.136%), hydroxycitronellal (0.009–0.305%) was present in 6 of the products, isoeugenol (0.019% and 0.0738%) was found in two of the products, and 1 product each contained eugenol (0.009%) and α -amylcinnamic aldehyde (0.005%) (Table 2). None of the 7 products contained cinnamic aldehyde and cinnamic alcohol. All other target fragrances in concentration ≤ 0.001 –1.170% were frequently present in these products.

Various products of diverse cosmetics/cosmetic-toys were found to contain small amounts (≤ 0.001 –0.134) of some of the target fragrances, including the fragrance mix substances (Table 3). Perfume essences of the cosmetic-toy set for blending perfumes were found to contain high concentrations of some of the fragrance mix substances (Table 4). Thus, 1.7% geraniol was found in peach essence; and 0.4% α -amyl cinnamic aldehyde, 1.2% hydroxycitronellal and 3.7% cinnamic alcohol were present in lilac essence.

Discussion

It has been shown that children from 0–8 years can be sensitized when exposed to a strong allergen (3, 4). Under normal circumstances, the risk of sensitization and later elicitation will depend on the nature and quantity of exposure to allergens. In 1981, Hjorth found that contact allergy was less frequent in children than adults, which led him to believe that this was caused by the reduced prevalence of cosmetic allergy in children, and he stated: 'although small girls love cosmetics, they rarely have access to them' (5). Since then the situation has changed: cosmetic products, specially formulated for children, are marketed and used by/on an increasing number of younger children, e.g. perfumes are now available for babies (1).

The contents of such products with regard to fragrance substances, fragrance allergens in particular, has been examined in this paper. It was found that the allergens of the fragrance mix were either not used or they were present fairly low concentrations in shampoo/shower gels and creams/lotions (Table 1). Hydro-alcoholic products (eau de toilette and perfume) and a roll on, however were found to contain the ingredients of the fragrance mix more fre-

quently (Table 2). Isoeugenol was detected in neither shampoos nor lotions, but was found in 2/7 hydro-alcoholic products at a maximum concentration of 0.074%. The fragrance industry (IFRA) adopted recently the highest permissible safe concentration of isoeugenol, due to its allergenic properties, as 0.02% in consumer products (6), representing a reduction to 10% of the previous maximum. In addition to ingredients of the fragrance mix, several other less-established fragrance allergens were detected in all the products (Tables 1–4). The limited number of examined products makes comparison with equivalent adult products difficult, but it seems that the hydro-alcoholic children's products, eau de toilette, etc. (Table 2), less frequently contained fragrance mix allergens and in lower concentrations, compared to those found in the 10 most sold fine fragrance products analysed in a previous study (7). Thus, only 2/7 products contained isoeugenol compared to 7/10 adult perfumes (7); and even though 6/7 childrens perfumes contained hydroxycitronellal, the maximum concentration was 0.3% as opposed to 1.19% in the adult products (7). This may indicate that more care was taken to formulate the product for the children with regard to ingredients of the fragrance mix, even though no special safety factors are applied for children's cosmetics in the EU Cosmetic Directive (8) or in the Guidelines of the Fragrance Industry (6).

Another source of exposure to fragrances is toys. In this study, one cosmetics toy perfume was found to contain 3.68% of cinnamic alcohol (Table 4), while the IFRA guideline states that a maximum of 0.8% is allowed (6). This recommendation is partly based on a human repeated insult patch test showing that 4% cinnamic alcohol in ethanol induced sensitization in 4/150 (2.7%) healthy volunteers (9). In addition the product contained hydroxycitronellal at 1.19% level. The permitted concentration of hydroxycitronellal is 1% in the IFRA guideline (6). Cinnamic aldehyde, a constituent of the fragrance mix, was found at 0.1% concentration in the product (Table 4). The product was from an international company and was an activity toy type, where the child is supposed to mix and dilute the concentrates into a whole perfume. However, a child cannot be expected to follow complicated instructions and failure to respect these would mean a significant risk of sensitization. In addition, spills may occur. The products sold to the consumer as toys and/or cosmetics must be safe as marketed. Exposure to fragrance allergens in cosmetic products and toys starting at an early age of childhood may lead to sensitization and onset of clinical contact dermatitis. Recent studies from Portugal and Denmark have shown that approximately 1.8% of children from the general population were sensitized to fra-

grances when tested with the fragrance mix (10, 11). Fragrances also rank high among the most common causes of contact sensitization in children with eczema. The frequency of positive reactions to the fragrance mix ranges from 0.5%–7.3%, depending on the criteria for selecting patients, time period and geographical area (12–18). Fragrance mix is only one of several indicators of fragrance contact allergy. In a Scottish study of 125 eczema children, accounts were made for the reactions to the fragrance mix, balsam of Peru and individual fragrance ingredients, which lead to a frequency of 19.3% fragrance-sensitive children (18). Overall most cases of contact allergy (92%) were considered relevant (18). A study from Denmark showed an increase in contact allergy to fragrance mix in children and adolescents (<19 years) with eczema. Since 1985/86, about the time where Hjorth believed exposure to cosmetics to be rare in children (5), the frequency of 2.1% of children positive to the fragrance mix has increased to 5.8% children in 1997/98 (19). This may be due to changes in exposure pattern, as shown in the current study. At the same time a decrease in nickel allergy was found in children (19).

Well-known fragrance allergens are used in cosmetic products intended for children. Although it appeared that more care was taken in the formulation of these products compared with the corresponding products or adult population, the contents of well-established fragrance allergens in some products, both cosmetics and toy-cosmetics, exceeded the current industry standards for safe products; and this would pose a significant risk to the infant and child population. A major concern in general is the early start and multiplicity of exposures to many allergens in cosmetic/toy products as shown in this study.

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