

Prevalence of major food allergens in skincare products for atopic dermatitis

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Abstract

Introduction: Food allergy is a common concomitant disease in patients with atopic dermatitis. Sensitisation and subsequent development of food allergy might result from the application of skincare products containing food allergens, particularly when the skin barrier is impaired and inflamed. Emollients are the mainstay of the management of atopic dermatitis; however, the prevalence of food allergens in skincare products used for atopic dermatitis is unknown.

Aim: To analyse the prevalence of major food allergens in skincare products for atopic dermatitis.

Material and methods: Three major online cosmetic retailers in Poland were screened for atopic skincare products. The major food allergens under the mandatory allergen labelling regulation of the European Union were searched for using the INCI nomenclature of cosmetics ingredients.

Results: We screened 396 skincare products, out of which 127 (32.1%) products contained at least one derivative of a major food allergen. The most common allergens were almonds, macadamia nuts, soya and cereals, followed by sesame and milk. There was no significant difference in the presence of food derivatives between leave-on and rinse-off skincare products, as well as between those intended for use by infants and children, and adults only.

Conclusions: Our analysis revealed that major food allergens are prevalent in skincare products for eczema. Applying skincare products containing food derivatives on affected and inflamed skin can promote percutaneous sensitisation. Therefore, clinicians and patients with atopic dermatitis must be careful of products used for treating eczema that may contain derivatives of a major food allergen.

Key words: atopic dermatitis, emollients, food allergens, sensitisation.

Introduction

Food allergy (FA) is a common comorbidity of atopic dermatitis (AD) and is closely related [1]. AD is a chronic inflammatory skin condition where a skin barrier dysfunction can result in increased penetration of food allergens. There is a growing body of evidence supporting that sensitisation and development of FA could be due to food that comes into contact with the inflamed and damaged skin barrier [2]. Therefore, it is essential to avoid risk factors for food allergies. Emollients are widely considered the mainstay of AD management. However, to the best of our knowledge, no study has addressed the prevalence of food allergens in skincare products marketed for AD.

Aim

This study aimed to analyse the prevalence of major food allergens in skincare products used to treat AD.

Material and methods

We screened the websites of three major online pharmacies and cosmetics stores in Poland (DOZ, Gemini and e-Zikoapteka) between September and December 2021 using the term 'atopic'. In this study, we included products (i) containing the terms 'atopic skin', 'atopic dermatitis', 'atopic eczema', 'neurodermatitis' or 'prone to atopy' in the product name or label, (ii) primarily intended for moisturising or washing the skin and (iii) for use on the whole body or a specific body part (e.g. face, eyelids and hands). Products intended for other purposes (e.g. sun protection, anti-wrinkle preparations, deodorants and diaper rash) and duplicate cosmetics were excluded. All skincare products were verified using the manufacturer's website and/or product photographs on the retailer's website. The included products were divided into leave-on and rinse-off products and products that could be used for infants and children.

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We analysed the ingredient labels of these products for the prevalence of the following 13 major food allergens, which according to the European legislation (EU Regulation 1169/2011) must be indicated on food labels: cereals containing gluten (wheat, rye, barley and oats), crustaceans, eggs, fish, peanuts, soya, milk, nuts (almonds, hazelnuts, walnuts, cashews, pecan nuts, Brazil nuts, pistachio nuts and macadamia nuts), celery, mustard, sesame seeds, lupin, molluscs and their products. Sulphur dioxide and sulphites (at concentrations of > 10 mg/kg or 10 mg/l) represent the 14th major food allergen, they were not included in our analysis. Derivatives of the major food allergens that were considered safe and for which the obligation to declare a substance was released (e.g. dextrose, maltodextrins, gelatine and lactitol) were also excluded from our analysis.

Cosmetic ingredients were first searched using the keywords based on the International Nomenclature of Cosmetic Ingredients (INCI) and then the searched terms were manually reviewed. We included ingredients derived from the edible parts of the plants or animals, and ex-

cluded the non-edible parts (such as grain leaf or stem, crustacean shells, fish scales, snail secretion, connective tissue- and bones-derived ingredients). As allergenicity depends on the protein content of the derivative, amino acids (e.g. wheat amino acids) were also excluded from the analysis.

Results

In this study, we analysed 396 skincare products, out of which 249 (62.9%) and 147 (37.1%) qualified as leave-on or rinse-off products, respectively. A total of 127 (32.1%; 127/396) products contained at least one derivative of a major food allergen and 20 (5.1%; 20/396) products contained more than one major food allergen.

Overall, we identified 154 major food-derived ingredients (Table 1). The most common major food allergen was almond (reported in 10.1% of the products; 40/396), followed by macadamia nuts (8.8%; 35/396), soya (8.3%; 33/396) and cereals: barley, oats, and wheat (7.3%; 29/396). Sesame and milk derivatives were present in

Table 1. Total number of food-derived ingredients classified as food allergens and type of the ingredient, which were identified in the analysed skincare products

Allergen	Ingredient type				
	Oil (n = 129) (83.8%; 129/154)	Extract (n = 11) (7.1%; 11/154)	Hydrolysed protein (n = 5) (3.2%; 5/154)	Carbohydrate (n = 4) (2.6%; 4/154)	Others (n = 5) (3.2%; 5/154)
Almond (n = 40; 26.0%; 40/154)	<i>Prunus Amygdalus Dulcis</i> Oil (39)	<i>Prunus Amygdalus Dulcis</i> Seed Extract (1)			
Macadamia nuts (n = 35; 22.7%; 35/154)	<i>Macadamia Ternifolia</i> Seed Oil (19) <i>Macadamia Integrifolia</i> Seed Oil (11) Macadamia Seed Oil (5)				
Soya (n = 33; 21.4%; 33/154)	Glycine Soya Sterol (4) Glycine Soja Oil (28)		Hydrolysed Soy Protein (1)		
Barley (n = 12; 7.8%; 12/154)	<i>Hordeum Vulgare</i> Cera (2) Spent grain wax (10)				
Oats (n = 11; 7.1%; 11/154)		<i>Avena Sativa</i> Bran Extract (1) <i>Avena Sativa</i> Kernel Extract (2) <i>Avena Sativa</i> Extract (2) <i>Avena Strigosa</i> Seed Extract (1)		Oat Beta Glucan (1)	<i>Avena Sativa</i> Kernel Flour (4)
Sesame (n = 11; 7.1%; 11/154)	<i>Sesamum Indicum</i> Seed Oil (10)	<i>Sesamum Indicum</i> Seed Extract (1)			
Wheat (n = 8; 5.2%; 8/154)	<i>Triticum Vulgare</i> Germ Oil (1)		Hydrolysed Wheat Gluten (1) Hydrolysed Wheat Protein (HWP) (3)	<i>Triticum Vulgare</i> Starch (1) Hydrolysed Wheat Starch (2)	
Milk (n = 4; 2.6%; 4/154)		Caprae Lac Extract (3)			Whey (1)

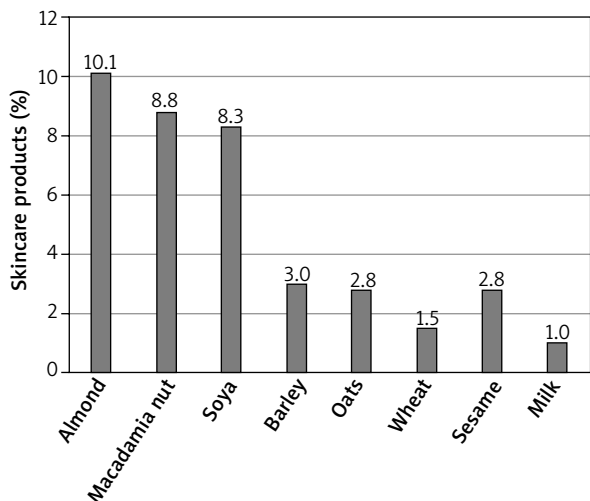


Figure 1. The prevalence of major food derivatives in skincare products for atopic dermatitis

a few skincare products (2.8%; 11/396 and 1.0%; 4/396, respectively) (Figure 1).

Food-derived ingredients were present in various types. The predominant component type was oil-based, accounting for 83.8% (129/154) of the identified ingredients. Only 7.1% (11/154) of the reported ingredients were listed as extracts, 3.2% (5/154) as hydrolysed proteins and single ingredients were present in the form of carbohydrates (2.6%; 4/154). 3.2% (5/154) were other forms such as flour and whey.

There was no significant difference in the presence of major food-derived ingredients in leave-on and rinse-off skincare products ($p > 0.05$), as well as those intended for use by infants and children and for adults only ($p > 0.05$) (Table 2).

Discussion

We revealed that the ingredients derived from major food allergens were prevalent (32.1%) in skincare products for eczema-prone skin. In our study, major food-derived ingredients were present mostly in the oil or extract type. Oils are obtained from grinding and pressing grains or seeds. Extracts are manufactured by macerating e.g. seeds, followed by draining and pressing.

As proteins trigger sensitisation and allergic reactions, the protein content of food derivatives contained in skincare products is crucial. A lack of protein is characteristic of highly refined oils produced from nuts or seeds, however cosmetic manufacturers do not provide detailed information on the degree of refinement of oils. European legislation (Commission Regulation 2017/2228) issued only a regulation specifying the maximum concentration of 0.5 ppm for peanut proteins in peanut-derivative ingredients in cosmetic products. Additionally, the process of manufacturing and type of the component can affect their allergenicity. Studies have shown that hydrolysis of wheat protein can increase its allergenicity [3]. For this reason, European legislation (Commission Regulation 2017/2228) issued a regulation restricting the molecular weight average of the peptides in hydrolysed wheat proteins used to a maximum of 3.5 kDa in cosmetic products. Also, a food matrix, such as oil, promotes the passage of allergens through the epithelial barrier and exhibits immunomodulatory potential [4].

Several studies revealed a direct association between the use of food allergen-containing skincare products and the subsequent development of FA. The Avon Longitudinal Study of Parents and Children (ALSPAC) birth cohort has shown that sensitisation to peanuts may result from applying skincare products containing peanut oil on a damaged and inflamed skin barrier [5]. Percutaneous sensitisation to oat has also been reported previously [6]. Moreover, studies have shown that food-derived ingredients in personal care products can cause immediate- and delayed-type hypersensitivity reactions [7, 8].

Based on the dual-allergen exposure hypothesis which posits that early-life exposure to allergens through the skin causes FAs, whereas early-life oral exposure to allergens causes tolerance [9], choosing a food allergen-free skincare product is particularly essential for infants and children whose skin barrier function is immature and who have not yet developed food tolerance through dietary exposure.

Skincare products containing food-derivative ingredients are widely available on the market [7]. 39.1% of the skincare products for children were shown to contain at least one food allergen [10]. Among the allergens analysed, the most common were almonds, wheat, soya, followed by oats and sesame seeds. These food allergens

Table 2. Proportion of leave-on and rinse-off cosmetics containing major food-derived ingredients and comparison between cosmetics for children and adults. For statistical analysis, Fisher exact test was performed

Variable	Leave-on cosmetics for infants and children, n (%)	Leave-on cosmetics for adults, n (%)	P-value	Rinse-off cosmetics for infants and children, n (%)	Rinse-off cosmetics for adults, n (%)	P-value
Major food-derived ingredient	44 (29)	39 (40)	> 0.05	31 (31)	13 (28)	> 0.05
No major food-derived ingredient	110 (71)	56 (60)	> 0.05	69 (69)	34 (72)	> 0.05

were also often present in our analysis of skincare products for AD. Furthermore, our analysis showed the frequent presence of ingredients derived from macadamia nuts and barley, which were not analysed in the study mentioned.

Nonetheless, there are several limitations of this study. First, it was impossible to precisely determine the protein content of specific ingredients of the skincare product. Additionally, manufacturers did not include the quantity of each ingredient on the labels of skincare products. Therefore, the effective exposure to food allergens through skincare products could not be determined. However, this analysis did not attempt to assess the risk of percutaneous sensitisation by applying proteins-containing skincare products but presented the risk of potential sensitisation by therapeutic moisturisers. Therefore, more studies are needed to evaluate the clinical relevance of food sensitisation caused by skincare products that contain many different food derivatives. Second, we narrowed the analysis to three main online cosmetics stores. Nonetheless, compared to other studies, the high number of skincare products included in this study was representative of most skincare products [11, 12]. In addition, this study analysed the skincare products sold in the Polish market and did not evaluate whether the trend varied in other European countries. However, as Kunkiel *et al.* [11] showed, the differences between the Polish and Spanish cosmetic markets were insignificant.

Conclusions

This study revealed that major food-derived ingredients were prevalent in skincare products used to treat AD. The most common were ingredients derived from tree nuts, soya and cereals. Considering that some of these products may pose a risk of percutaneous sensitisation, the present study highlighted that skincare products used to treat AD must be bland and do not contain food-derived ingredients. However, the lack of state regulations regarding food allergens in cosmetic ingredients may make the detection of food allergens on the ingredient label difficult for consumers. Therefore, dermatologists and allergologists must prescribe specific products to help patients choose the most appropriate skincare product. However, further research is needed regarding the potential sensitisation of food-derived ingredients present in skincare products.

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Conflict of interest

The authors declare no conflict of interest.

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