

Lanolin as a contact sensitizer among cosmetology students and cosmeticians: A pilot study

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Abstract

Lanolin is a lipid—an animal wax obtained from the sebaceous secretions of domestic sheep. According to the European Pharmacopoeia, lanolin is referred to as *Adeps lanae*. Various lanolin derivatives are used in personal care products, cosmetics, and topical medications, including lanolin oil, wax, alcohol, acetylated, and hydrogenated lanolin. Cosmeticians and cosmetology students may be exposed to lanolin through occupational and educational activities. Lanolin is considered a potential contact sensitizer. This study aims to evaluate the prevalence of contact sensitization to lanolin among cosmeticians and cosmetology students. Skin patch testing with lanolin alcohol was conducted on 109 participants: 37 cosmetology students, 26 cosmeticians, and 46 controls. A high positivity rate (30.8%) was observed, particularly among occupationally exposed cosmeticians who regularly use skin care products. This rate was significantly higher than that of students ($p = 0.028$), but not significantly different from that of the control group. Proper risk information and comprehensive programs for occupational skin disease prevention are recommended.

Keywords

lanolin, contact sensitization, cosmetics, occupational exposure

Introduction

Lanolin is a lipid—an animal wax that is obtained from the sebaceous secretions of domestic sheep (*Ovis aries*, fam. Bovidae). According to the European Pharmacopoeia (Ph. Eur.), the substance is known as *Adeps lanae*, although other names are more commonly used by practicing pharmacists—*Lanolinum*, *Cera lanae*, etc. (Europe Council 2017). The latter name is chemically incorrect, as the substance does not consist predominantly of long-chain fatty acid

monoesters with high-chain alcohols. It is a viscous, sticky, yellowish-brown mass with a characteristic sheep-like odor. Lanolin has a melting point between 38 and 48 °C, depending on the sheep breed. Its content in the wool is around 20%.

Lanolin has a variable composition, depending on sheep breeds, habitats, and extraction methods (Souto et al. 2021). The substance consists mainly (c.a. 98%) of esters of cholesterol and isocholesterol with long-chain fatty acids (cerotic, palmitic, and myristic). Large amounts of unesterified free lanosterol, cholesterol, and isocholesterol

are also present in the substance. Due to their content, lanolins form a water-in-oil (W/O) emulsion when hydrated (Schlossman and McCarthy 1979).

Lanolin is extracted from sheep's wool through a laborious process. First, the wool is washed with cold water, followed by washing with soapy water containing sodium hydroxide at 60 °C. During this step, lanolin is emulsified with the soap, forming sodium salts. Subsequently, a solution of calcium chloride is added to precipitate the sodium salts and obtain water-insoluble calcium salts. Lanolin is extracted from the congealed matter using acetone, after which the solution is distilled to remove the solvent. The lanolin obtained at this stage is dark brown; therefore, a bleaching process using sodium hypochlorite, sodium perborate, or potassium permanganate is often employed (Kwan et al. 2014).

The purification process of lanolin varies, resulting in products with different levels of purity available on the market. The process of oxidation is believed to produce chemical residues that may contribute to allergic reactions. Due to the lipophilic properties of many veterinary drugs—such as steroids, antibiotics, and antimycotics—these are considered to be the other major cause of adverse reactions to lanolin. These compounds are excreted in sheep sebum and contribute to the lanolin content. If purification is insufficient, they may remain in the final product (Mesfin et al. 2024). According to the Ph. Eur., highly purified lanolin does not contain unwanted compounds; however, some cosmetic products still use low-quality lanolin (Draelos et al. 2019).

The hydrophobic property of lanolin helps sheep repel water from their fleece. In humans, this hydrophobicity helps retain moisture in the epidermis and may reduce transepidermal water loss by 20–30% (Jenkins and Belsito 2023; Purnamawati et al. 2017). It is a common ingredient in personal care products, cosmetics, topical medications, and industrial materials. Various derivatives of crude lanolin are commonly used in personal care products, including lanolin oil, lanolin wax, lanolin acid, lanolin alcohol, acetylated lanolin, acetylated lanolin alcohol, hydrogenated lanolin, and hydroxylated lanolin (Elder 1980; Jenkins and Belsito 2023).

Despite its benefits, lanolin is considered a potential source of allergic contact dermatitis (ACD) (NCBI 2025).

The first documented positive patch test to lanolin was reported in 1929 (Ramirez and Eller 1929). Subsequent cases of ACD to lanolin were described over the next 30 years, reaching a peak of recognition in the latter half of the 20th century, with positive patch test (PPT) rates ranging from 0% to 7.4%. However, differences in patient populations and patch test formulations (lanolin alcohol 30% pet. and Amerchol L101 50% pet.) were noted across studies (Lee and Warshaw 2008). The appropriate patch test formulation for lanolin remains a matter of debate. Some investigators recommend simultaneous testing with both lanolin alcohol 30% pet. and Amerchol L101 50% pet. (Knijp et al. 2019; Jenkins and Belsito 2023; Johnson et al. 2023).

Studies were performed to identify the potential allergens of lanolin (Schlossman and McCarthy 1979; Giorgini et al. 1983; Takano et al. 1983). A consensus has now been reached regarding the free alcoholic fraction, particularly alkane- α,β -diols and alkane- α,ω -diols, which are produced through the hydrolysis of lanolin (Lee and Warshaw 2008), although other haptens may be generated through its oxidation (Hjorth and Trolle-Lassen 1963). Evidence suggests that hydrogenated lanolin is more allergenic than lanolin alcohol, the hapten included in the European standard patch test series (Jenkins and Belsito 2023).

Allergic contact dermatitis to lanolin remains a matter of debate among dermatologists. Despite its widespread applications, lanolin is considered a rare sensitizer in individuals with healthy skin, whereas those with chronic inflammatory skin conditions are at increased risk of sensitization. Kligman (1998) was concerned about false-positive reactions to lanolin, describing lanolin allergy as a myth, attributed to overzealous patch testing and insufficient recognition of this diagnostic modality's limitations.

Jenkins and Belsito (2023) argued that a positive patch test to lanolin (i.e., contact allergy) does not necessarily indicate clinically relevant ACD, and determining the clinical relevance of a PPT is of utmost importance. Patients with a positive patch test to lanolin may tolerate lanolin application on unaffected skin. In 2023, lanolin was designated the “Allergen of the Year” by the American Contact Dermatitis Society.

Therefore, the aim of the present study was to evaluate the prevalence of contact sensitization to lanolin alcohol among Bulgarian cosmeticians and cosmetology students under both occupational and non-occupational exposure conditions. To our knowledge, no prior studies have specifically investigated this type of occupational exposure.

Materials and methods

A pilot cross-sectional study was conducted involving a total of 109 participants (8 men and 101 women). The results presented are part of the scientific project titled “Evaluation of the Prevalence of Contact Sensitization to Ingredients of Cosmetic Products and Health Risk Management,” funded by the Medical University of Sofia (Contract No. D-169/14.06.2022). The project included 20 haptens, including lanolin alcohol. Ethical approval was obtained from the Medical Ethics Board at the Medical University of Sofia, in accordance with the Declaration of Helsinki.

Participants were divided into three groups: 37 cosmetology students from the Medical College of the Medical University of Sofia (with limited exposure duration), 26 occupationally exposed cosmeticians (with a minimum of two years of exposure), and 46 individuals without occupational exposure to cosmetics, who served as the control group. The demographic characteristics of the groups are presented in Table 1.

Table 1. Demographic characteristics of the studied population.

Group	N	Age, years		
		[Mean ± SD]	Min	Max
Cosmetology students	37	23.70 ± 6.62	18	41
Occupationally exposed cosmeticians	26	32.77 ± 9.60	20	51
Controls	46	31.98 ± 14.54	17	62
Total	109	29.48 ± 11.84	17	62

All participants provided written informed consent after receiving information about the purpose of the study.

Skin patch tests were performed on all participants using the classical Jadassohn–Bloch technique with lanolin alcohol 30.0% pet. (Chemotechnique Diagnostics). The hapten was applied using IQ Ultimate hypoallergenic patches from Chemotechnique Diagnostics (IQ Chambers®, Vellinge, Sweden). The absence of anti-allergic medication for one week prior to and during testing was mandatory. Patches were applied to the upper backs of participants and removed after 48 h. Patch test readings were performed at patch removal on day 2 (D2), after 72/96 h (D3/D4), and again on day 7 (D7).

The reactions were interpreted as negative, doubtful (?+), weakly positive (+), strongly positive (++), extremely positive (+++), and irritant reactions, as recommended by the International Contact Dermatitis Research Group (IC-DRG). For statistical analysis, reactions with at least one plus (+) on D3 or D7 were considered positive, whereas negative, doubtful, and irritant reactions were considered negative.

Statistical analysis was performed using SPSS for Windows, version 20.0. Continuous variables were presented as mean ± standard deviation (SD), while categorical variables were expressed as percentages. The relationship between preservatives and participant groups was evaluated using Fisher's exact test. A two-tailed p-value of < 0.05 was considered statistically significant.

Results

Regarding the age characteristics of the tested groups (Table 1), the mean age of the students (23.70 ± 6.62 y) was significantly lower compared to that of the control group (31.98 ± 14.54 y; $p = 0.006$) and the occupationally exposed cosmeticians (32.77 ± 9.60 y; $p = 0.008$). No significant difference was observed between the control group and the cosmeticians ($p = 0.957$).

Data on the prevalence of sensitization to lanolin alcohol among the defined groups are presented in Table 2.

According to the results, lanolin alcohol may be considered an important contact sensitizer, particularly among cosmeticians occupationally exposed to various skin care products (Table 2). The rate of positive patch test reactions in this group was significantly higher than in the student group ($p = 0.028$), with no significant differences compared to the age-matched control group. Our data show a much higher rate of positive patch test reactions compared to other studies cited below.

Table 2. Prevalence of sensitization to lanolin alcohol in the defined groups.

Lanolin alcohol		Occupationally exposed cosmeticians			Total	p
		Controls	Students	exposed		
Negative	N	38	35	18	91	0.028
	%	82.6%	94.6%	71.2%	83.5%	
Positive	N	8 _{a,b}	2 _b	8 _a	18	16.5%
	%	17.4%	5.4%	30.8%	16.5%	
Total	N	46	37	26	109	

Note: *Fisher's Exact Test; different letters show a statistically significant difference between the proportions (%) in the groups ($p < 0.05$), and the identical letters indicate that there is no significant difference.

Some manufacturers of lanolin-containing products have claimed that modern lanolin is free from sensitizers and no longer causes contact allergy (Clark et al. 1981)—a statement not supported by our findings.

A recently published multicenter study investigated the prevalence of lanolin sensitization among 30,269 patients in Italy who were patch tested between 1997 and 2021. The overall rate of positive lanolin patch test reactions was 1.64%, while 1.83% of patients with occupational contact dermatitis tested positive for lanolin. Lanolin sensitization was significantly higher in males and in patients with leg contact dermatitis aged 49–60 years or over 60. The authors recommend collecting information on potential risk factors for lanolin sensitization—particularly the use of skin care products containing the hapten and occupational exposure to lanolin-containing varnishes (Cegolon and Larese Filon 2024).

These results are consistent with those of a previously conducted multicenter study by the European Surveillance System on Contact Allergies, which involved 58,833 patients from 12 countries patch tested with lanolin alcohol 30% pet. between 2009 and 2012, showing a 1.65% rate of positive reactions (Uter et al. 2016).

Another study conducted by the Information Network of Departments of Dermatology covering the period 2006–2016 reported a 2.38% rate of positive patch test reactions (PPTR) to lanolin alcohols (30% pet.). Of the participants, 2.05% tested positive only to another hapten used in patch testing—Amerchol® L-101 (50% pet.); 1.19% tested positive only to lanolin alcohols (30% pet.); and 1.43% reacted to both haptens, resulting in a total of 4.67% PPTR to at least one allergen (Uter et al. 2018). These results are consistent with ours.

The North American Contact Dermatitis Group reported a 3.3% positivity rate (1431/43,691) among patients tested between 2001 and 2018 with either lanolin alcohol (30% pet.) or Amerchol® L-101 (50% pet.; 10% lanolin alcohol in mineral oil) (Silverberg et al. 2022).

Conclusion

Given the ongoing debate surrounding allergic contact dermatitis (ACD) caused by lanolin, this pilot study was conducted. The results indicate a high incidence of

positive patch test reactions to lanolin. Cosmetologists appear to be a group at particular risk, with a significantly higher prevalence of positive reactions compared to the student group. Furthermore, occupational exposure is presumed to play a role as a risk factor. A possible role of repeated or prolonged exposure to cosmetics in triggering sensitization to lanolin is also suggested. However, certain limitations should be acknowledged, including the cross-sectional design and the relatively small number of patch-tested participants. To our knowledge, no previous studies have specifically focused on lanolin as a contact sensitizer in the context of occupational exposure to cosmetics. Future research should explore lanolin exposure among patients with positive patch test results, with particular attention to personal skin care product use, age-related factors, and potential occupational exposure.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statements

The authors declared that no clinical trials were used in the present study.

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- The authors declared that no informed consent was obtained from the humans, donors or donors' representatives participating in the study.
- The authors declared that no experiments on animals were performed for the present study.
- The authors declared that no commercially available immortalised human and animal cell lines were used in the present study.

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Data availability

All of the data that support the findings of this study are available in the main text.

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