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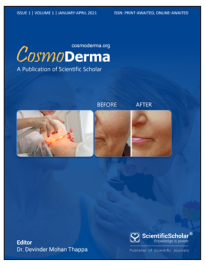

Brief Report

More ingredients may mean more allergens, in sunscreens: A screening analysis of commonly accessed sunscreens in India

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ABSTRACT

Objective: The objective of the study is to evaluate the presence of known allergens in topical sunscreens available in India.

Materials and Methods: Sunscreens across commonly used online marketplaces were included. A total of 135 allergens were screened, with 48 being high prevalence and 87 being low prevalence.

Results: The number of allergens in a sunscreen formulation increased with an increasing number of ingredients. Mineral sunscreens contained significantly fewer ingredients and allergens compared to chemical and hybrid sunscreens ($P < 0.001$).

Conclusion: Patch and photopatch testing are recommended to determine the relevance of these high- and low-prevalence allergens for contemporary sunscreen formulations for Indian skin types. This study initiates the framework for better product selection by consumers and dermatologists.

Keywords: Sunscreens in India, Allergens, Octocrylene, SPF, Skin of color

INTRODUCTION

Sunscreens are important tools for dermatologists treating skin of color (SOC) individuals. Post-inflammatory hyperpigmentation (PIH), a dreaded complication of procedural treatments and naturally occurring conditions such as acne and trivial trauma, is reported in up to 58.2% of individuals.[1] The use of sunscreens post-laser treatments has been known to reduce PIH.[2,3] As a product that is left on, at times even on broken skin for prolonged periods of time, the potential for contact allergy with sunscreen use remains a concern. Keyes *et al*. noted the presence of allergens in all of the sunscreens evaluated by them.[4] Acknowledging the rapid increase in sunscreen use, we aimed to evaluate the presence of known allergens in topical sunscreens available in India.

MATERIALS AND METHODS

Sunscreens were selected using the search terms "sunscreen," "sun screen," "sunscreens," and "sunscreen in India" across commonly used online marketplaces, including Amazon, Flipkart, SkinStore, Tata 1 mg, Nykaa, Purplle, and SkinStore.in and on Google Search and listings within

the first 10 pages from each source included. Sunscreens without approved ultraviolet (UV) filters were excluded. Allergens concluded to be more prevalent (i.e., more than 1%) by the North American Contact Dermatitis Group (NACDG) core data (2019–2020) were considered high-prevalence allergens while allergens linked to allergic contact dermatitis in the literature but not listed by the NACDG were classified as low prevalence allergens.[4-7] Totally, 135 allergens were taken up for screening including 48 high prevalence and 87 low prevalence allergens.

RESULTS

We screened a total of 1048 sunscreens of which 918 sunscreens were eligible for analysis, comprising 159 mineral, 330 chemical, and 429 hybrid sunscreens, the latter containing both chemical and mineral UV filters. Allergens were noted in 899 (98%) sunscreens of the total sunscreens tested, 330 (100%) among chemical sunscreens, 143 (89.9%) among mineral sunscreens, and 426 (99.3%) among hybrid sunscreens, [Table 1]. The most common high-level allergens and the most common low-level allergens in our study were fragrances and octinoxate, respectively.

The number of allergens in a sunscreen formulation increased with an increasing number of ingredients, [Figure 1]. Mineral sunscreens contained significantly fewer ingredients and allergens compared to chemical and hybrid sunscreens ($P < 0.001$). In turn, chemical sunscreens had fewer ingredients than hybrid sunscreens ($P = 0.03$), but the number of allergens did not significantly differ between them. Sun protection factor (SPF) values did not correlate with the number of allergens. A higher number of ingredients correlated with higher SPF for hybrid sunscreens, but not for mineral or chemical sunscreens.

DISCUSSION

Selecting a sunscreen that balances high effectiveness with low allergenicity is essential for the general population. To accomplish this, sunscreens must be assessed not only for their SPF and protective attributes but also for their ingredient composition, focusing on potential allergens.

Allergies to sunscreens have been increasingly reported in recent times, potentially reflecting a rise in global sunscreen use, with up to 95%[8-10] of positive photopatch tests being attributed to sunscreen filters, notably oxybenzone. The list of potential allergens noted in sunscreens based on current literature are listed below [Table 2]. In alignment with previous studies, fragrances emerged as the most common high-prevalence allergens in our dataset, identified in 98% of sunscreens. Literature from New Zealand[11] and other international studies[4] similarly reported fragrances as the predominant allergens in sunscreens. Our study identified octinoxate, a chemical UV filter, as the most common low-prevalence allergen. In contrast, previous literature highlights other chemical UV filters, such as octocrylene, oxybenzone, and avobenzone, as predominant

Table 1: Prevalence of allergens in physical, chemical, and hybrid sunscreens.

Variable	Physical (%)	Chemical (%)	Hybrid (%)	Total (%)
Number of sunscreens assessed	159 (17.32)	330 (35.95)	429 (46.73)	918 (100)
Prevalence of high-level allergens	67 (42.14)	226 (68.48)	290 (67.60)	583 (63.51)
Most common high-level allergens	*Helianthus annuus* (*n*=29, 18.24)	Propylene glycol (*n*=102, 30.90)	Fragrances (*n*=142, 33.10)	Fragrances (*n*=250, 27.23)
Prevalence of low-level allergens	137 (86.16)	329 (99.7)	425 (99.07)	891 (97.06)
Most common low-level allergens	Botanical extracts of *Aloe vera* (*n*=48, 30.19)	Phenoxyethanol (*n*=195, 59)	Octinoxate (*n*=320, 74.6)	Octinoxate (*n*=484, 52.7)
Prevalence of any allergen	143 (89.94)	330 (100)	426 (99.3)	899 (97.93)
Median SPF	50	50	50	50
Average number of ingredients (Mean±SD)	22.97±11.26	26.75±10.32	28.38±12.76	26.86±11.82
Average number of allergens (Mean±SD)	2.68±2.08	7.55±3.06	7.26±3.16	6.57±3.46
Number of sunscreens with SPF 30	50 (31.44)	63 (19)	69 (16)	182 (19.83)
Average number of ingredients in sunscreens with SPF 30 (Mean±SD)	23.94±11.30	25.44±9.74	26.25±12.283	25.34±11.16
Average number of allergens in sunscreens with SPF 30 (Mean±SD)	3.18±2.32	7.14±2.78	7.41±3.29	6.15±3.4
Number of sunscreens with SPF 50	79 (49.69)	195 (59)	283 (65.97)	557 (60.7)
Average number of ingredients in sunscreens with SPF 50 (Mean±SD)	22.44±11.03	27.18±10.644	28.95±13.48	27.41±12.39
Average number of allergens in sunscreens with SPF 50 (Mean±SD)	2.16±1.77	7.71±2.843	7.13±3.19	6.63±3.44

SD: Standard deviation, SPF: Sun protection factor.

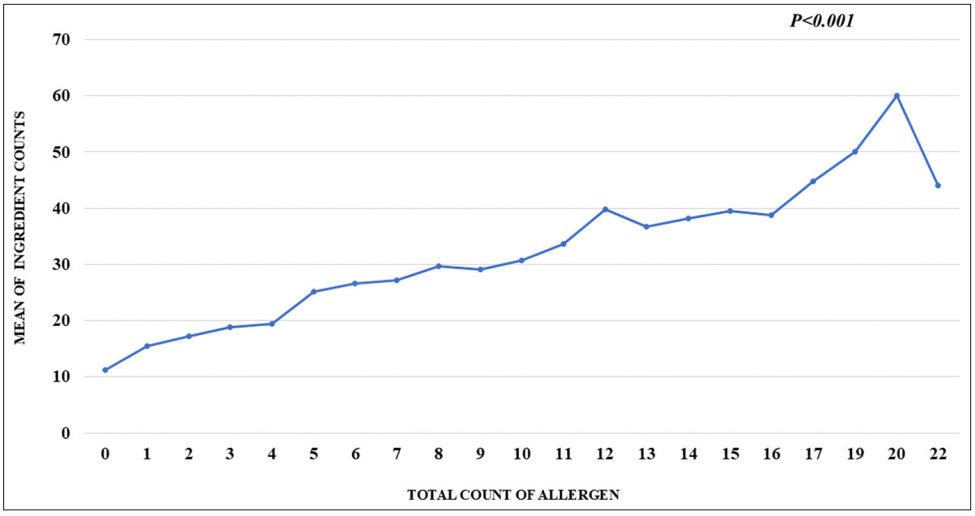

Figure 1: Graph representing an increase in number of allergens with increasing number of ingredients.

Table 2: Potential allergens detected in sunscreens.

Allergen category	Low prevalence	High prevalence
UV filters	Octinoxate	
	Avobenzone	
	Octocrylene	
	Octisalate	
	Benzophenone-3	
	Homosalate	
Preservatives	Phenoxyethanol	Methylisothiazolinone
	Ethylhexylglycerin	DMDM hydantoin
	Sodium benzoate	Iodopropynyl
	Benzyl alcohol	Butylcarbamate
	Sorbic acid	Diazolidinyl urea
	Benzyl benzoate	Methylchloroisothiazolinone
	Triclosan	Imidazolidinyl urea
Botanicals	Botanical extracts	H. annuus/sunflower
	Aloe vera	Matricaria chamomilla
	Jojoba	Calendula officinalis Linne
	A-bisabolol	C. officinalis
	A-tocopherol acetate	Carthamus tinctorius Linne
		Anthemis nobilis Linne
	M. alternifolia/ melaleuca alternifolia	L. Chrysanthemum
		Centaurea cyanus Linne
		Achillea millefolium Linne
Emulsifier	Triethanolamine	Decyl glucoside
	Cetyl alcohol	
	Sorbitan Stearate	
	Sorbitan Oleate	
	Sorbitan sesquioleate	
	Sorbitan Laurate	
	Sorbitan Palmitate	
Fragrance	Butylated hydroxytoluene	Fragrances
	D-limonene	Propylene glycol
	Citronellol	Linalool Hydroperoxide
	Stearyl alcohol	Geraniol
	Benzoic acid	Hydroxy citronellal
	Benzyl salicylate	Eugenol
	Benzyl 2-hydroxybenzoate	Cinnamyl alcohol
	Vanillin	
	Lilial	
	Geranium oil	
	Butylated hydroxyanisole	
	Amyl cinnamal	
	Coumarin	
	Rosa Damascena flower oil	
	Propyl gallate	
	Lyral	
Others	Tocopheryl acetate	Lauryl glucoside
	Parabens	Gold
	Coco-glucoside	
	A. mellifera/Honey	
	L. angustifolia/ lavender	
	Panthenol	
	Isopropyl myristate	

UV: Ultraviolet

low-prevalence allergens.[4] Our study notes a high prevalence of commonly acknowledged allergens in sunscreen products accessed by the Indian public, higher for chemical and hybrid sunscreens compared to mineral sunscreens. The increase in allergen number with increasing ingredient count is highly interesting, considering chemical sunscreens employed more ingredients for similar SPF as mineral and hybrid sunscreens. For the same SPF, choosing a sunscreen with a lesser number of total ingredients may translate into choosing a sunscreen with a lesser number of allergens.

An impaired epidermal barrier post-fractional laser resurfacing was shown to be associated with increased contact sensitization to octocrylene, compared to those with intact skin.[12] However, early use of sunscreens is important to reduce PIH after fractional laser treatments.[3] This raises a dilemma in deciding between sun protection and allergen avoidance for the dermatologist treating SOC patients. To choose sunscreens with lesser allergenicity, physicians may simply consider sunscreens with a lesser number of ingredients when advising patients on these special care circumstances, such as post-fractional laser ablation. Further, mineral sunscreens may be advisable for sensitive skin, in keeping with earlier studies.[8]

CONCLUSION

With an exponential rise in sunscreen awareness and use, it is important to remain vigilant for contact dermatitis to sunscreens. While it would be very useful to know which of these high- or low-level allergens are relevant in modern-day formulations in Indian skin types in prevalent weather through patch testing and photopatch testing, our study provides a good starting point to guide better product selection for consumers and dermatologists alike.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent is not required, as there are no patients in this study.

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Nil.

Conflicts of interest

Authors Renita Lourdhurajan has financial interests in, and Pavithra Sukumaran is employed by, the company Silphion Research Private Limited, in addition to their role as Consultant Dermatologists at RENDER Skin and Hair. All authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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