DERMATOLOGICAL COMPOSITION OF DEODORANTS AND POTENTIAL CUTANEOUS RISKS: A NARRATIVE REVIEW AND CLINICAL IMPLICATIONS

COMPOSIÇÃO DERMATOLÓGICA DOS DESODORANTES E POTENCIAIS RISCOS CUTÂNEOS: REVISÃO NARRATIVA E IMPLICAÇÕES CLÍNICAS

COMPOSICIÓN DERMATOLÓGICA DE LOS DESODORANTES Y POSIBLES RIESGOS CUTÁNEOS: REVISIÓN NARRATIVA E IMPLICACIONES CLÍNICAS

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ABSTRACT

The daily use of deodorants and antiperspirants exposes axillary skin to multiple classes of ingredients in a microenvironment characterized by humidity, occlusion, and friction, which may favor irritation and allergic contact dermatitis. This article presents a narrative review of the literature with a critical approach, addressing the dermatological composition of deodorants and analyzing the cutaneous risk profile of key ingredients in conventional formulations and emerging alternatives. Evidence indicates that fragrances, including those of natural origin, and isothiazolinone preservatives are the main drivers of skin sensitization. Vehicles and surfactants, such as propylene glycol and alkyl glucosides, may also contribute to irritation and increased reactivity, particularly under occlusive conditions. In contrast, aluminum salts remain effective in reducing sweat flow and are mainly associated with local adverse effects that can be mitigated through appropriate application techniques and formulation adjustments. Magnesium hydroxide has been described as a promising anti-odor alternative, acting through the neutralization of odoriferous compounds and pH modulation without occluding sweat ducts, with favorable cutaneous tolerability reported in the literature. In conclusion, careful selection of formulations with lower allergenic potential and proper guidance on use are essential to minimize adverse skin outcomes while maintaining effective odor control.

Keywords: Deodorants, Antiperspirants, Allergic Contact Dermatitis, Fragrances, Isothiazolinones, Magnesium Hydroxide.

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RESUMO

O uso cotidiano de desodorantes e antitranspirantes expõe a pele axilar a diferentes classes de ingredientes em um microambiente caracterizado por umidade, oclusão e fricção, fatores que podem favorecer irritação e dermatite alérgica de contato. Este artigo apresenta uma revisão narrativa da literatura, com abordagem crítica, sobre a composição dermatológica dos desodorantes, analisando o perfil de risco cutâneo dos principais ingredientes presentes em formulações convencionais e em alternativas recentes. A literatura evidencia que fragrâncias, incluindo constituintes de origem natural, e conservantes do grupo das isotiazolinonas representam os principais determinantes de sensibilização cutânea. Veículos e tensoativos, como o propilenoglicol e os alquil glicosídeos, também podem contribuir para irritação e aumento da reatividade, especialmente em condições de oclusão axilar. Em contrapartida, os sais de alumínio permanecem eficazes na redução do fluxo sudoríparo, apresentando predominantemente eventos adversos locais, passíveis de mitigação por técnica adequada de uso e ajustes de formulação. O hidróxido de magnésio surge como alternativa antiodor promissora, por atuar na neutralização de compostos odoríferos e na modulação do pH, sem obstrução dos ductos sudoríparos e com boa tolerabilidade cutânea descrita na literatura. Conclui-se que a seleção criteriosa de formulações com menor potencial alergênico, associada à orientação adequada de uso, é fundamental para reduzir eventos adversos e preservar a eficácia no controle do odor corporal.

Palavras-chave: Desodorantes. Antitranspirantes. Dermatite Alérgica de Contato. Fragrâncias. Isotiazolinonas. Hidróxido de Magnésio.

RESUMEN

El uso diario de desodorantes y antitranspirantes expone la piel axilar a diversas clases de ingredientes en un microambiente caracterizado por humedad, oclusión y fricción, lo que puede favorecer la irritación y la dermatitis alérgica de contacto. Este artículo presenta una revisión narrativa de la literatura, con enfoque crítico, sobre la composición dermatológica de los desodorantes, analizando el perfil de riesgo cutáneo de los principales ingredientes de las formulaciones convencionales y de alternativas recientes. La evidencia disponible indica que las fragancias, incluidas las de origen natural, y los conservantes del grupo de las isotiazolinonas son los principales determinantes de sensibilización cutánea. Los vehículos y tensioactivos, como el propilenglicol y los alquil glucósidos, también pueden contribuir a la irritación y al aumento de la reactividad, especialmente en condiciones de oclusión. En contraste, las sales de aluminio siguen siendo eficaces para reducir el flujo sudoral y se asocian principalmente con efectos adversos locales, que pueden mitigarse mediante una técnica de uso adecuada y ajustes en la formulación. El hidróxido de magnesio se describe como una alternativa antiolor prometedora, al actuar en la neutralización de compuestos odoríferos y en la modulación del pH sin ocluir los conductos sudoríparos, con buena tolerabilidad cutánea reportada. Se concluye que la selección cuidadosa de formulaciones con menor potencial alergénico y la orientación adecuada sobre su uso son fundamentales para reducir efectos adversos y mantener la eficacia en el control del olor corporal.

Palabras clave: Desodorantes. Antitranspirantes. Dermatitis Alérgica de Contacto. Fragancias. Isotiazolinonas. Hidróxido de Magnesio.

INTRODUCTION

The control of axillary body odor is a widely prevalent daily necessity, associated not only with personal hygiene but also with self-esteem, social interaction, and quality of life. From a physiological standpoint, sweating is an essential mechanism for thermoregulation, produced mainly by eccrine and apocrine glands. Sweat itself is virtually odorless. The characteristic odor of the axillary region results from the interaction between sweat secretions, skin pH, and the metabolic activity of the resident microbiota, especially bacteria such as *Corynebacterium* spp. and *Staphylococcus hominis*, which convert lipid and protein precursors into volatile compounds with high olfactory impact, such as fatty acids and sulfanalkanols (Teerasumran *et al*., 2023).

The axillary region presents particular characteristics that make it especially susceptible to adverse cutaneous reactions. It is a microenvironment marked by persistent moisture, frequent occlusion by clothing, mechanical friction, and recurrent microtrauma associated with hair removal practices. These conditions favor both microbial proliferation and increased percutaneous penetration of chemical substances, thereby amplifying the risk of irritation and allergic contact dermatitis (Heisterberg *et al*., 2011; Zirwas & Moennich, 2008). In this context, the daily and prolonged use of deodorants and antiperspirants represents a continuous source of cutaneous exposure to multiple classes of cosmetic ingredients.

Conventional deodorant and antiperspirant formulations include fragrances, preservatives, vehicles, surfactants, and metallic salts, each associated with distinct profiles of dermatological efficacy and safety. Fragrances, whether synthetic or of natural origin, rank among the leading causes of cosmetic-related allergic contact dermatitis, with particular clinical relevance in the axillary region, where local factors potentiate elicitation in sensitized individuals (Heisterberg *et al*., 2011; Rastogi *et al*., 1998). Preservatives from the isothiazolinone group also stand out as important sensitizing agents, especially following their introduction as substitutes for preservatives historically associated with lower allergenic potential, such as parabens (Liszewski *et al*., 2022). In addition, vehicles such as propylene glycol and emerging surfactants like alkyl glucosides have been associated with cutaneous irritation and increased reactivity, particularly in products intended for continuous use and under occlusive conditions (Zirwas & Moennich, 2008; Loranger *et al*., 2017).

Aluminum salts, widely used in antiperspirants, act by reducing sweat flow through the formation of temporary structures within the ducts of sweat glands, thereby decreasing local moisture. Although they demonstrate well-established efficacy in controlling perspiration and odor, these compounds are predominantly associated with local adverse events, such as irritation related to acidification, whose intensity may vary according to formulation, concentration, and application technique (Martini, 2020). The available literature does not establish a consistent causal link between cosmetic use of aluminum salts and serious systemic outcomes, and dermal absorption is considered very low under typical conditions of use (Klotz *et al*., 2017; Liszewski *et al*., 2022).

In parallel, concerns regarding cutaneous tolerability and dermatological safety have driven the development and popularization of alternatives aimed at controlling odor without directly interfering with the physiological function of sweat glands. In this context, magnesium hydroxide has gained prominence as an anti-odor agent, acting through the neutralization of odoriferous compounds and modulation of skin pH, thereby creating an environment less favorable to bacterial proliferation (Michalak *et al*., 2019). Unlike classical antiperspirants, this compound does not promote occlusion of sweat ducts and has been described as well tolerated by the skin, with a low incidence of adverse reactions reported in clinical and laboratory studies (Mori *et al*., 2020; Burnett *et al*., 2021).

Given this scenario, it is relevant to critically analyze the dermatological composition of available deodorants and antiperspirants, as well as the potential cutaneous risks associated with their main ingredients. Thus, the objective of this study is to analyze the available literature on the dermatological safety of the most commonly used components in deodorants, comparing conventional formulations with magnesium hydroxide–based alternatives, with emphasis on the mechanisms involved in adverse cutaneous reactions and the clinical implications of the use of these products.

THEORETICAL FRAMEWORK

The formation of axillary odor results from the interaction between sweat, skin pH, and the metabolic activity of the resident microbiota. Although secretions from eccrine and apocrine glands are initially odorless, their composition rich in lipids, proteins, and sulfur-containing precursors provides substrate for bacteria specific to the axillary region. Microorganisms such as

Corynebacterium spp. and Staphylococcus hominis metabolize these compounds, producing volatile fatty acids, aldehydes, and sulfanalkanols, which are responsible for the characteristic odor, perceptible even at very low concentrations (Teerasumran *et al*., 2023). The axillary microenvironment, characterized by persistent moisture, elevated temperature, and textile occlusion, favors both bacterial proliferation and the volatilization of these compounds.

The continuous use of deodorants and antiperspirants modifies this cutaneous ecosystem. Studies demonstrate that the interruption and reintroduction of these products are capable of altering the composition and diversity of the axillary microbiota, influencing both odor intensity and the local inflammatory response (Callewaert *et al*., 2014). These microbiological changes, combined with repeated exposure to cosmetic ingredients, partially explain the high frequency of adverse cutaneous reactions observed in the axillary region compared with other body areas.

Among the components of conventional formulations, fragrances occupy a prominent position in the dermatological risk profile. Data from specialized contact dermatitis services indicate that deodorants are among the main sources of fragrance sensitization, with consistent clinical correlation with markers such as Fragrance Mix II and hydroxyisohexyl 3-cyclohexene carboxaldehyde (Heisterberg *et al*., 2011). Provocation tests reinforce this association by demonstrating that repeated application of specific fragrances in roll-on formulations is sufficient to elicit axillary dermatitis in previously sensitized individuals (Svedman *et al*., 2003). It is important to emphasize that fragrances of natural origin, often perceived as safer, also present relevant allergenic potential, including essential oils and oxidized products such as limonene hydroperoxides, which have been associated with pigmented dermatitis in the axillary region (De Groot, 2019; Kwong & Lim, 2020).

Preservatives constitute another group of ingredients with significant impact on dermatological safety. The progressive replacement of parabens with isothiazolinones, driven by consumer concerns and marketing strategies, was accompanied by a marked increase in cases of allergic contact dermatitis associated with these preservatives (Liszewski *et al*., 2022). This shift illustrates how regulatory and commercial decisions can alter the epidemiological profile of adverse cutaneous reactions, reinforcing the need for critical evaluation of the risk–benefit balance of each ingredient class.

Vehicles and surfactants also play a relevant role in this context. Propylene glycol, widely used in liquid and roll-on deodorants, has a well-recognized irritant potential and may complicate the interpretation of patch tests, especially under occlusive conditions (Zirwas & Moennich,

2008). Similarly, alkyl glucosides, frequently employed as alternatives considered more sustainable, have emerged as relevant allergens in products intended for continuous use, with increasing reports of sensitization in clinical series (Loranger *et al*., 2017).

Aluminum salts remain the main active agents in antiperspirants, acting through the formation of temporary structures that reduce sweat flow. This action results in decreased local moisture and, consequently, reduced formation of odoriferous compounds. The literature indicates that adverse events associated with these compounds are predominantly local, related to cutaneous irritation caused by acidification, and are influenced by concentration, formulation, and application technique (Martini, 2020). Toxicological and epidemiological studies do not demonstrate a consistent causal association between cosmetic use of aluminum salts and serious systemic outcomes, with dermal absorption considered minimal under usual conditions of use (Klotz *et al*., 2017; Liszewski *et al*., 2022).

In this scenario, alternatives that control odor without directly interfering with the physiological function of sweat glands have gained relevance. Magnesium hydroxide stands out due to its mechanism of action based on the neutralization of volatile acids and modulation of skin pH, creating an unfavorable environment for bacterial proliferation without promoting occlusion of sweat ducts (Michalak *et al*., 2019). Experimental and clinical studies describe good cutaneous tolerability and prolonged efficacy in odor control, with a low incidence of reported irritation (Mori *et al*., 2020). Additional toxicological assessments reinforce its safety profile for cosmetic use, with limited cutaneous absorption (Burnett *et al*., 2021).

Thus, the combined analysis of the literature indicates that the dermatological risk associated with deodorants is not uniformly distributed among their components. Fragrances and isothiazolinones concentrate the greatest sensitization potential, while vehicles and surfactants may act as contributory factors to irritation. In contrast, aluminum salts and magnesium hydroxide present distinct profiles of efficacy and tolerability, the understanding of which is fundamental to guiding safer and clinically appropriate choices in body odor control.

METHODOLOGY

This study consists of a narrative review of the literature, with an analytical and critical approach, aimed at discussing the dermatological composition of deodorants and antiperspirants, as well as the potential cutaneous risks associated with their main ingredients. The

methodological strategy was defined with the objective of promoting an interpretative synthesis of the available evidence, without the application of formal systematic protocols or study selection flowcharts.

The bibliographic search encompassed national and international databases, including PubMed, Scopus, Web of Science, and SciELO, in addition to technical-scientific documents, toxicological reports, and patents relevant to the understanding of the mechanisms of action, efficacy, and dermatological safety of the evaluated ingredients. Studies published predominantly between 1998 and 2025, in Portuguese, English, and Spanish, were considered.

Publications addressing deodorants and antiperspirants were included, with emphasis on fragrances, preservatives, vehicles, surfactants, aluminum salts, and magnesium hydroxide, as well as their cutaneous effects, such as irritation, allergic contact dermatitis, modulation of the axillary microbiota, and clinical implications related to the continuous use of these products. Exclusively experimental studies without translational plausibility for human skin, publications without direct relevance to deodorant products, and opinion texts lacking scientific basis were excluded.

The selection and analysis of the material were conducted qualitatively, prioritizing clinical relevance, consistency of findings, and mechanistic coherence among the studies. The extracted data were organized thematically, allowing comparison between conventional formulations and magnesium hydroxide–based alternatives, with a focus on dermatological safety and the clinical applicability of the discussed evidence.

RESULTS AND DISCUSSIONS

The analysis of the literature shows that deodorants and antiperspirants constitute one of the cosmetic categories most frequently associated with adverse cutaneous reactions, particularly in the axillary region. This finding is explained by the combination of local factors, such as persistent moisture, occlusion by clothing, mechanical friction, and microtrauma resulting from hair removal practices, together with the continuous use of products containing multiple classes of potentially irritating or sensitizing ingredients. Studies demonstrate that the axilla exhibits greater susceptibility to allergic contact dermatitis when compared with other body areas, precisely because it combines conditions that facilitate percutaneous penetration and the elicitation of inflammatory responses (Heisterberg *et al*., 2011; Zirwas & Moennich, 2008).

Among the components of conventional formulations, fragrances consistently stand out as the main determinant of allergic contact dermatitis associated with deodorants. In a large cohort of patients undergoing patch testing, deodorants were identified as the primary source of exposure to fragrance allergens attributable to cosmetics, with strong correlation with markers such as Fragrance Mix II and hydroxyisohexyl 3-cyclohexene carboxaldehyde (Heisterberg *et al*., 2011). These data are corroborated by provocation studies, in which repeated application of specific fragrances in roll-on formulations was sufficient to induce axillary dermatitis in previously sensitized individuals, highlighting the role of the application site and usage pattern in eliciting the allergic response (Svedman *et al*., 2003).

It is important to emphasize that the perception of safety associated with fragrances of natural origin is not supported by the available scientific evidence. Essential oils, absolutes, and botanical extracts contain complex mixtures of chemical compounds with recognized allergenic potential, including oxidation-prone terpenes such as limonene. Oxidative degradation products, such as limonene hydroperoxides, have been associated with allergic contact dermatitis and pigmented dermatitis, particularly in the axillary region, where low-grade inflammation may contribute to persistent pigmentary changes (De Groot, 2019; Kwong & Lim, 2020). These findings reinforce that the natural origin of an ingredient does not imply lower dermatological risk.

Preservatives represent another central axis of discussion in the analyzed results. The literature demonstrates that the progressive replacement of parabens with isothiazolinones, largely driven by consumer concerns and market strategies, resulted in a marked increase in cutaneous sensitization to these compounds (Liszewski *et al*., 2022). Isothiazolinones rank among the preservatives with the highest allergenic potential described in recent clinical series and are frequently implicated in cases of allergic contact dermatitis related to daily-use cosmetics. This phenomenon illustrates how changes in formulation composition, even when well intentioned, may produce undesirable dermatological consequences when not based on rigorous risk–benefit assessment.

In addition to fragrances and preservatives, vehicles and surfactants play a relevant role in the tolerability profile of deodorants. Propylene glycol, widely used as a solvent and delivery agent in liquid and roll-on deodorants, has a well-known irritant potential and may act both as a primary irritant and as a facilitator of the penetration of other allergens (Zirwas & Moennich, 2008). Under axillary occlusive conditions, this effect may be intensified, contributing to

persistent irritation or to the elicitation of dermatitis in sensitized individuals. Similarly, alkyl glucosides, frequently employed as surfactants considered more sustainable, emerge as relevant allergens in products intended for continuous use, with increasing reports of sensitization in clinical studies and patch test series (Loranger *et al*., 2017).

With regard to aluminum salts, the results of the analyzed literature confirm their well-established efficacy in controlling perspiration and, consequently, body odor. These compounds act through the formation of temporary structures within the ducts of sweat glands, reducing sweat flow and the availability of substrate for microbial activity. Adverse events associated with their use are predominantly local, related to cutaneous irritation caused by acidification, the intensity of which varies according to the concentration of the active ingredient, the product formulation, and the application technique adopted by the user (Martini, 2020). Toxicological and epidemiological studies do not demonstrate a consistent causal association between cosmetic use of aluminum salts and serious systemic outcomes, such as breast cancer or neurodegenerative diseases, with dermal absorption considered minimal under usual conditions of use (Klotz *et al*., 2017; Liszewski *et al*., 2022).

In parallel, the literature indicates that the use and discontinuation of deodorants and antiperspirants are capable of modifying the composition of the axillary microbiota. Studies assessing the bacterial ecology of the region demonstrated changes in diversity and dominance of specific taxa following periods of cessation and reintroduction of these products, which may influence both odor intensity and the local inflammatory response (Callewaert *et al*., 2014). These findings suggest that the interaction between cosmetic formulation, microbiota, and cutaneous response is dynamic and dependent on usage patterns, reinforcing the importance of individualized choices.

In this context, magnesium hydroxide emerges as a relevant alternative to conventional deodorants, presenting a distinct mechanism of action and tolerability profile. Unlike aluminum salt–based antiperspirants, magnesium hydroxide does not act by occluding sweat ducts. Its anti-odor effect derives primarily from the neutralization of volatile acids and modulation of skin pH, creating an environment less favorable to the proliferation of microorganisms responsible for odor formation (Michalak *et al*., 2019). Experimental and clinical studies demonstrated that formulations containing approximately five percent magnesium hydroxide were able to suppress odor for prolonged periods, with good cutaneous tolerability and a low incidence of reported irritation (Mori *et al*., 2020).

Additional toxicological evaluations corroborate the safety profile of magnesium hydroxide for cosmetic use, indicating limited cutaneous absorption and absence of relevant systemic effects at the concentrations used in topical products (Burnett *et al*., 2021). Furthermore, technological developments described in patents and industrial applications report good physicochemical stability and sensory acceptability in magnesium-based formulations, aspects that are fundamental for user adherence and the commercial viability of these alternatives.

From a clinical and aesthetic standpoint, the lower propensity for irritation associated with magnesium hydroxide may have relevant implications for the prevention of reactive axillary hyperpigmentation. Low-grade inflammatory processes associated with friction, hair removal, and repeated exposure to chemical irritants are recognized contributors to skin darkening in flexural areas. Thus, strategies that minimize local inflammation tend to reduce this risk, although the literature still lacks standardized clinical trials that directly assess this outcome using objective measurement methods.

In an integrated manner, the analyzed results indicate that the dermatological risk of deodorants is not uniform but depends on the specific combination of ingredients, formulation, usage pattern, and individual skin characteristics. Fragrances and isothiazolinones concentrate the greatest sensitization potential, while vehicles and surfactants act as contributory factors to irritation. In contrast, aluminum salts and magnesium hydroxide present distinct profiles of efficacy and tolerability, the understanding of which is essential to guide safer and clinically appropriate choices in body odor control.

CONCLUSION

The critical analysis of the literature demonstrates that deodorants and antiperspirants represent a relevant source of cutaneous exposure to different classes of ingredients, whose dermatological impact varies according to composition, formulation, and usage pattern. The axillary region, due to its specific anatomical and physiological characteristics, proves to be particularly susceptible to adverse reactions, which explains the high frequency of irritation and allergic contact dermatitis associated with these products.

The findings consistently indicate that fragrances, regardless of their synthetic or natural origin, constitute the main determinants of cutaneous sensitization related to deodorants. Preservatives from the isothiazolinone group also play a central role in this scenario, especially

following their widespread introduction as substitutes for compounds historically associated with lower allergenic potential. Vehicles and surfactants, such as propylene glycol and alkyl glucosides, act as additional factors of irritation and may amplify cutaneous reactivity, particularly under conditions of occlusion and continuous use.

Aluminum salts remain effective active agents in the control of perspiration and body odor, presenting a safety profile characterized predominantly by local adverse events, which can be mitigated through formulation adjustments and appropriate guidance on use. The available evidence does not support a consistent causal association between cosmetic use of these compounds and serious systemic effects, reinforcing the importance of a balanced risk–benefit assessment.

In this context, magnesium hydroxide emerges as a relevant alternative for the control of body odor, with a mechanism of action based on the neutralization of odoriferous compounds and modulation of skin pH, without directly interfering with the physiological function of sweat glands. The available data indicate good cutaneous tolerability and a low incidence of adverse reactions, suggesting a potential advantage in scenarios in which minimization of irritation and sensitization is desired.

In an integrated manner, the discussed results reinforce that the dermatological safety of deodorants depends less on the product category and more on the careful selection of ingredients and appropriate use. The prioritization of formulations with lower allergenic burden, combined with user education regarding application technique and recognition of early signs of cutaneous reactivity, constitutes a fundamental strategy to reduce adverse events without compromising effectiveness in body odor control.

Finally, there is a need for future investigations that further elucidate the long-term effects of these formulations, as well as clinical studies that standardizedly evaluate specific dermatological outcomes, including persistent irritation and axillary hyperpigmentation. Such efforts may contribute to the development of increasingly safe, effective, and clinically aligned products that meet dermatological and population needs.

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