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Research

Potash Alum as a Natural Deodorant: Comprehensive Review of Formulation, Efficacy, and Safety

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Abstract

Potash alum (potassium aluminum sulphate) has resurfaced as a promising natural deodorant in response to global demand for safer, eco-conscious, and effective personal care solutions. Unlike synthetic antiperspirants that block sweat glands, alum acts by modulating skin microflora and exerting gentle astringency, thus controlling odor without altering normal perspiration. This review critically evaluates the chemistry, antimicrobial mechanism, formulation strategies, clinical effectiveness, and regulatory considerations of potash alum. Evidence from recent in vitro, ex vivo, and consumer trials consistently supports its role as a safe, non-irritant deodorizing agent. Comparisons with synthetic aluminum salts highlight its lower irritation potential and compatibility with "clean beauty" philosophies. Emerging research also explores alum's integration into modern delivery systems such as hydrogels, nanocarriers, and hybrid herbal formulations, expanding its relevance in cosmetic innovation. This paper identifies key research gaps, especially regarding long-term dermatological safety and sustainable sourcing, and proposes future directions for advancing alum-based deodorants.

Keywords: Potash alum, natural deodorant, antimicrobial, astringent, cosmetic safety, clean beauty.

1. INTRODUCTION:

Body odor, though physiologically harmless, has profound social and psychological consequences. It arises from the enzymatic degradation of sweat components by axillary microbiota—particularly *Corynebacterium* and *Staphylococcus* species [1]. Modern deodorants and antiperspirants, while effective, often rely on synthetic preservatives, fragrances, and aluminum salts that raise concerns about skin irritation, endocrine disruption, and possible links to chronic diseases [7]. This consumer skepticisms has fueled a shift

towards **natural deodorant alternatives**, where potash alum—an ancient mineral compound—has gained renewed attention.

Unlike traditional antiperspirants, alum does not obstruct sweat ducts. Instead, it subtly alters the axillary microenvironment by reducing bacterial proliferation and tightening skin pores[2]. This distinction has positioned it as an attractive candidate for the **"clean beauty" and dermatologically safe product market [4].** The current review aims to synthesize recent evidence on alum's deodorizing mechanism, highlight its comparative advantages, and explore its evolving role in sustainable cosmetic innovation.

2. Chemistry and Pharmacological Properties:

Potash alum ($KAl(SO_4)_2 \cdot 12H_2O$) is a double sulfate salt with high water solubility and acidic pH in solution, enabling a **microbicidal skin film** formation.

Beyond deodorizing, alum demonstrates **multifunctionality**:

- **Bacteriostatic activity** (inhibits bacterial growth rather than killing outright)
- **Antifungal effects** (notably against *Candida*)
- **Astringency** (protein precipitation → skin tightening)
- **Anti-inflammatory potential** (reduces minor skin irritation post-shaving)

Recent pharmacological studies confirm that alum's ionic dissociation produces **Al^{3+} and SO_4^{2-}**, which destabilize microbial cell membranes, alter protein conformation, and interfere with quorum sensing pathways critical for odor generation.

3. Mechanism of Deodorant Action

Alum's efficacy rests on **two synergistic pathways**:

1. **Antimicrobial Shield**: By forming a thin crystalline salt layer on skin, alum creates osmotic stress that selectively suppresses odor-causing bacteria. Modern metagenomic analyses reveal that alum favors survival of commensals while suppressing *Corynebacterium*, a major odor producer.
2. **Astringent Effect**: Localized protein precipitation contracts epithelial cells, subtly reducing skin moisture and thereby depriving bacteria of an ideal growth medium. Unlike antiperspirants, alum does not occlude sweat ducts—preserving natural thermoregulation.

This dual action ensures **odor control without sweat suppression**, aligning with consumer preference for "body-friendly" deodorants [6,8].

4. Formulation and Stability

Recent advances in cosmetic science have transformed alum from a simple crystalline block into Versatile formats—crystals, roll-ons, gels, creams—employ 5–15% alum with humectants (glycerin, propylene glycol) and buffers (citric acid) . Wet granulation or direct compression yields stable tablets, while emulsions incorporate essential oils (e.g., Nigella sativa) for synergy, achieving 24-month shelf-lives under ICH Q1A conditions . Accelerated stability data confirm <5% potency loss at 40°C/75% RH [3].

Dosage Form	Composition (% w/w)	Preparation Method	Stability (Months)
Crystal	100% Alum	Mining/crystallization	Indefinite
Roll-on Lotion	Alum 10%, Glycerin 5%	Dissolution/emulsification	24
Gel	Alum 8%, Carbomer 1%	Hydration/neutralization	18
Cream	Alum 12%, Emulsifiers	O/W emulsion	12

Key formulation strategies include:

- **Hydrogel systems** with carbopol or xanthan gum for enhanced spreadability
- **Synergistic blends** with essential oils (tea tree, lavender) for broad-spectrum antimicrobial action

- **Nanocarrier incorporation** for controlled release and improved skin adherence
- **Eco-packaging** innovations to appeal to sustainability-conscious consumers [33,41]

Such advances improve both efficacy and user acceptance, broadening market potential.

5. Clinical Efficacy

Several clinical evaluations confirm that 2–5% alum formulations significantly reduce axillary malodor within 1–2 weeks of use. Double-blind trials show comparable outcomes to commercial deodorants, but with fewer reports of irritation or allergic response [8]. Interestingly, consumer perception studies highlight alum's **"light feel" and fragrance-free nature** as major advantages over heavy, perfumed sprays.

Emerging dermatological studies are exploring alum's role in **post-shaving care** and **hyperhidrosis management**, indicating broader therapeutic potential beyond deodorant use.

6. Safety and Toxicological Assessment

A major advantage of alum lies in its **minimal systemic absorption**. Due to its ionic structure and large hydrated size, skin penetration is negligible. Patch-test studies report a very low incidence of irritation, especially when formulations are buffered to mildly acidic pH [43].

Long-term toxicological reviews by FDA, SCCS, and CIR reaffirm that alum poses **no evidence of carcinogenicity or neurotoxicity** within cosmetic concentration limits. Importantly, unlike aluminum chlorohydrate, alum does not accumulate significantly in skin or systemic circulation[35].

Thus, current evidence supports alum's **favorable risk-benefit profile** for daily cosmetic use.

7. Comparative Perspective

Feature	Potash Alum	Aluminum Chlorohydrate
Mode of Action	Antimicrobial + Astringent	Blocks sweat ducts (antiperspirant)
Sweat Reduction	No	Yes
Irritation Risk	Low	Higher potential
Residue	Minimal	Noticeable
Consumer Appeal	Natural, fragrance-free	Synthetic, scented

This comparison explains alum's unique niche: **odor control without sweat suppression**, aligning with consumer demand for natural, gentle, and transparent products [16,18,19,20,21,22,23,25].

8. Regulatory Status

Alum is recognized as safe by the **FDA (GRAS status)** and listed in the **EU Cosmetic Ingredient Inventory**, typically at ≤5% in topical products. Countries such as Japan and Canada similarly classify it as safe when used in cosmetics. This international acceptance simplifies global product development and marketing [34].

9. Future Perspectives & Research Gaps

Despite promising evidence, several research gaps remain:

- **Dermatological Long-Term Studies**→Most trials are short-term; extended studies on chronic users are needed.
- **Molecular Mechanism** → More omics-based investigations (proteomics, microbiome sequencing) can unravel alum's nuanced effects on skin microbiota.
- **Formulation Innovation** → Integration with **nanotechnology, biopolymers, and herbal extracts** could enhance performance.
- **Sustainability** → Life-cycle assessments of alum mining and eco-friendly sourcing remain underexplored.

Future research must integrate alum into **next-generation deodorant systems** that are safe, sustainable, and scientifically validated.

1. Solid Crystal (Traditional Alum Stone) Deodorant

Ingredients

- Potash alum crystals
- Clean purified water (optional, if reshaping)

Preparation Method

1. **Selection & Cleaning**
   - Choose a high-purity potash alum crystal.
   - Rinse the crystal with clean water to remove surface dust.
2. **Shaping (Optional)**
   - If a uniform shape is needed, alum can be lightly moistened and rubbed to smooth edges, or melted gently in hot water and poured into molds.
   - Allow to cool and solidify naturally.
3. **Packaging**
   - Store the crystal in a container that protects from moisture.
   - To use, the stone is lightly moistened and applied to clean skin.

Note: In this form, no chemical additives are required.

2. Potash Alum Deodorant Spray

Ingredients

- Potash alum (powdered or granulated)
- Purified or distilled water
- Optional: mild natural humectant (e.g., glycerin), essential oils (non-irritating varieties)

Preparation Method

1. **Dissolution**
   - Heat purified water to warm (not boiling).
   - Add alum and stir until it dissolves completely.
2. **Filtration**
   - Filter the solution through clean cloth or cosmetic-grade filter paper to remove undissolved particles.
3. **Cooling**
   - Allow the solution to cool to room temperature.
4. **Optional Additions**
   - Add a small amount of humectant to improve skin feel.
   - Add essential oil only if skin-compatible and fully emulsified.
5. **Packaging**
   - Fill the final solution into a clean spray bottle.

Outcome: A clear, mildly astringent odor-neutralizing mist.

3. Alum-Based Gel Deodorant

Ingredients

- Alum solution (prepared above)
- Gel base (e.g., carbomer, xanthan gum, aloe gel)
- Glycerin (optional for moisture retention)

Procedure

1. **Hydrate gel base** in a separate container with a small amount of purified water.
2. Allow the gel to fully swell/hydrate.
3. Slowly add the **cooled alum solution** into the hydrated gel with steady stirring.
4. Mix until a **uniform, lump-free gel** is formed.
5. Add optional ingredients (glycerin, soothing agents).
6. Adjust viscosity if required.
7. Transfer into clean containers.

B. Alum-Based Cream Deodorant

Ingredients

- Aqueous phase: alum solution
- Oil phase: lightweight cosmetic oils + emulsifying wax
- Optional: aloe extract, glycerin

Procedure

1. Heat the **oil phase** and **alum aqueous phase** separately to around **65–70°C**.
2. Add the aqueous phase **slowly** to the melted oil phase while stirring continuously.
3. Continue stirring until emulsification occurs and the mixture forms a **stable cream**.
4. Cool gradually with gentle mixing.
5. Add any temperature-sensitive ingredients when below 40°C.
6. Fill into jars/tubes.

C. Alum-Based Spray Deodorant

Ingredients

- Potash alum
- Warm purified water
- Optional: glycerin, fragrance-free extracts, essential oils (emulsified)

Procedure

1. Dissolve alum completely in warm purified water.
2. Cool to room temperature.
3. Add optional ingredients and mix thoroughly.
4. Filter through fine mesh/filter paper for clarity.
5. Fill into spray bottles.

4. Quality Check Parameters

- **Clarity** (for spray): no visible particles
- **pH**: mildly acidic (acceptable for skin)
- **Viscosity**: uniform for gel/cream
- **Stability**: no separation, crystallization, or microbial growth
- **Skin feel**: non-irritating, smooth application

5. Storage & Packaging

- Store in **clean, airtight** containers.
- Avoid moisture exposure for solid or gel forms.
- Keep away from heat and direct sunlight.

CONCLUSION

Potash alum represents a scientifically grounded, consumer-friendly, and eco-aligned deodorant alternative. Its unique mechanism odor suppression without sweat blockage—distinguishes it from conventional antiperspirants. Supported by regulatory approvals, clinical safety, and growing consumer trust, alum is poised to play a pivotal role in the expanding market for natural body care. Bridging current research gaps through molecular studies, innovative formulations, and sustainability assessments will further elevate its status in dermatological and cosmetic science.

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