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## PHARMACOLOGICAL & PHYSIOCHEMICAL PROPERTIES OF POTASH ALUM: A COMPEHENSIVE REVIEW

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**ABSTRACT:** Potash alum ( $KAl(SO_4)_2 \cdot 12H_2O$ ), a naturally occurring inorganic chemical with important uses in both traditional and modern medicine, is thoroughly examined in this paper. Alum's extensive commercial applications, such as in food processing and cosmetics, are highlighted, along with its historical use in Siddha medicine, where it has been used to treat a variety of infections, control bleeding, and act as an antiseptic. Using techniques including solubility and pH evaluations, flame tests for identifying constituent ions (potassium, sodium, ammonium, and aluminum), and thin layer chromatography for compound separation, the review describes the chemical and pharmacological characterization of alum. Additionally, it summarizes research results that show the wide range of medicinal benefits of alum, such as its anti-hemorrhagic, antifungal, antibacterial, anti-obesity, antineoplastic, mosquito larvicidal, hemostatic, contraceptive, and deodorant activities. Alum is positioned as a prospective contender for future development in both healthcare and industrial applications due to its pharmacological properties, low cost, safety profile, and simplicity of availability. All things considered, the review highlights the diverse potential of alum and urges more study to maximize its application in focused treatments and increase its relevance in contemporary practice.

**INTRODUCTION:** The Siddhars, with their vast knowledge, discovered how to separate these minerals from their ore, their amazing purification techniques, and their indications of various diseases. Minerals are inorganic compounds that occur in nature in pure or impure state. India's soil is enriched with several minerals with its ores, and in addition to its economic wealth for commercial use, it has high medicinal values in curing ailments.

In Siddha literature, Alum is utilized to control bleeding, leucorrhoea, menorrhagia, diarrhoea, vomiting, treat eye diseases, stomatitis, and for wound cleansing. Several medical systems employ it as a hemostatic, antipyretic, antiseptic, and antispasmodic. It is also utilized in a wide range of dosage forms and chemical compositions.

Additionally, it has a variety of commercial applications, such as tanning and baking cosmetics. Because of its significance and advantageous medical reasons, alum is evaluated in this research for its pharmacological and physiochemical characteristics<sup>15</sup>. The astringent impact of protein precipitation at the cell's outer layer causes aluminum potassium sulfate (Alum) to reduce capillary permeability.

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Alum's ability to block sweat pores is very helpful for its antifungal action. By preventing sweat from escaping, it lowers the moisture content of the site of action, which inhibits the growth of fungal infections. Additionally, alum's antifungal activity also inhibits the growth and development of fungal infections, so it reduces fungal infections in two ways. Wintertime skin cracks are avoided since the alum powder dissolves in water. Because oily skin is more likely to result in pimples and acne, it has the power to dry the skin, which reduces the problem<sup>11</sup>.



FIG. 1: POWDER OF POTASH ALUM

#### Vernacular Names<sup>11</sup>:

**English:** Alum

**Marathi:** Turti

**Hindi/Urdu:** Phitkari

**Arabic:** Yamani

#### General Description:

**Common Name:** Potassium alum.

**Chemical Formula:**  $KAl(SO_4)_2 \cdot 12H_2O$

**Chemical Name:** Potassium aluminum sulfate

**Molar Mass:** 258.192 g/mol.

**Appearance:** white crystal or powder form

**Habitat:** Egypt, Italy, England, Germany, and India all have it. primarily found in Punjab, Bihar, and Assam, India. In Silajit, alum earths in Nepal, or alum shales in Punjab, Rajputana, Bihar, and Cutch states, alum is primarily found with iron peroxide. With an annual capacity of 36,000 tonnes of ferric alum and 16,000 million tons of non-ferric alum, Ken-Sun Enterprises, located in Mumbai,

India, is a significant producer of common alum, which is made as aluminum sulphate<sup>17</sup>.

**Distribution:** In Nepal, Rajputana, Punjab, Cutch States, and Bihar, it is primarily found as shells in shilajeet, or alum earth. After processing, it transforms into salt and an active form<sup>11</sup>.

#### Phytochemical Screening:

##### Evaluation Tests for Alum<sup>6</sup>:

**Solubility:** Put 1 millilitre of distilled water and 0.5 grams of solid material in a test tube. Stir carefully with a glass rod. Take note of the observation.

**pH:** Before the pH was measured, the pH meter was calibrated. One gram of prepared alum was dissolved in 100 millilitres of distilled water in a beaker. The pH was measured using a pH meter.

#### Identification Test:

**Flame Test (Test for Potassium):** Potassium was present because a tiny amount of alum was put on a spatula and lit directly in the flame, producing a lavender-coloured flame.

**Flame Test (Sodium Test):** A small quantity of alum was placed on a spatula and ignited directly in the flame, producing a yellow-colored flame, indicating the presence of sodium.

**Test for Ammonium:** When 10 mg of ammonium alum was heated with sodium hydroxide solution, ammonia gas was released, which was identified by its characteristic smell and its ability to turn moist red litmus paper blue, indicating the presence of ammonium.

**Test for Aluminum:** When 20 mg of potash alum was dissolved in 2 ml of water and treated with 0.5 ml of 2M hydrochloric acid and 0.5 ml of thioacetamide reagent, no precipitate formed. Upon the dropwise addition of 2M sodium hydroxide, a gelatinous white precipitate appeared, which dissolved with further addition of sodium hydroxide. The subsequent addition of ammonium chloride solution resulted in the reformation of a gelatinous white precipitate, confirming the presence of aluminum.

**Sulfate Test:** When 50 mg of soda alum was dissolved in 5 ml of water and 1 ml of dilute hydrochloric acid, followed by the addition of 1 ml

of barium chloride solution, a white precipitate was formed, indicating the presence of Sulphate.

#### **Analytical Thin Layer Chromatography (TLC):**

To find the right solvent solution to create the chromatogram, analytical TLC was used. To generate the chromatogram, different solvent systems were applied to the pre-coated TLC plates (Merck, silica gel 60 F254 plate, 0.25 mm). The most effective solvent system among all of them was chloroform: methanol: distilled water (50:40:10), which was employed for both TLC analysis and TLC bioautography analysis. Rf values were calculated after the TLC plates were examined under visible light to determine which compounds had been separated <sup>7</sup>.

#### **Chemical Composition <sup>5</sup>:**

The chemical composition of potash alum are:

- Sulfate range: 38% to 51.06%
- Aluminum: between 9.9% and 28.16%
- Potassium: up to 14.6% of some samples include it.
- Trace quantity of iron: 0.016% to 0.52%

#### **Traditional uses of Potash Alum:**

- As a gargle, alum is used to treat mouth ulcers.
- Halitosis and stomatitis can be effectively treated by applying alum with honey or vinegar, or by gargling with alum in honey water.
- Alum is used to treat keratitis and conjunctivitis; it is also used as a tooth powder to ease toothaches.
- Asthma attacks can be avoided by using ten grains of powdered alum over the tongue.
- Powdered alum is applied topically to treat infected wounds and bleeding from cuts or abrasions; it also acts as a stomach and liver tonic and eliminates nausea and vomiting when taken orally <sup>9</sup>.

#### **Pharmacological Activities:**

**Anti-Hemorrhagic:** The treatment for cyclophosphamide-induced hemorrhagic cystitis in

patients with malignant hemopathies involved continuously irrigating the bladder with potassium alum. Hematuria stopped with a 75% treatment success rate. Aluminum potassium sulphate (>99% pure) was used as a hemostatic agent and a gauze pack on the opposite side in the tonsillar fossae in a trial of 45 tonsillectomy patients. This resulted in a significant reduction in operation time (28.6%), functional blood loss (19.7%), and the number of ties used (33.3%) when compared to the control group <sup>2</sup>.

After being administered to nine patients with severe and ongoing urinary bladder hemorrhage, the effectiveness of alum in intravesical irrigation was examined. Four patients had radiation cystitis, three had bladder cancer, one had cyclophosphamide-induced cystitis, and three had vesicle invasion from cervical cancer as the cause of the hemorrhage. Alum therapy was effective in controlling significant bladder hemorrhage in all patients at first, but in two patients, it was unable to stop the bleeding (78% success rate) <sup>14</sup>.

**Antifungal Activity:** Alum's antifungal action on yeast isolated from oral lesions led to the conclusion that it might likely be utilized to control fungal isolates and stop infections like mouth ulcers and oral thrush <sup>16</sup>. A naturally occurring substance having antibacterial and antifungal qualities is potash alum (KAl (SO<sub>4</sub>)<sub>2</sub>·12H<sub>2</sub>O). In the subcontinent, it is referred to as Phitkari and is a common household item. In small amounts, potash alum is harmless, inexpensive, and odorless. The Food and Drug Administration (FDA) in the United States has authorized it as a food additive because of its lack of toxicity <sup>8</sup>.

**Anti-obesity Effect:** In Wistar rats given a high-fat diet that caused obesity, oral administration of potash alum resulted in a considerable decrease in body weight, food intake, blood triglycerides, total cholesterol, and high density lipo proteins <sup>16</sup>.

The majority of the medication used to treat obesity is organic in nature, while behavioral therapy is used to change eating-related behaviors. Because of its ability to create bonds with other atoms and with itself, carbon is the basis of life on Earth. Researchers in contemporary medical therapy have done little work on inorganic salts. Numerous

disorders have been studied to determine the inorganic salt aluminum's and its compound's therapeutic efficacy. Among these, Potash Alum has been utilized to treat neoplasms *in vivo* without producing any negative side effects, extending life expectancy<sup>1</sup>.

**Antineoplastic Effect:** Potash alum, also known as CF-CpG-alum, has been utilized to treat neoplasms *in-vivo* as a combination conjugate vaccine. CF-CpG-alum suppressed the growth of tumors and strengthened the antigen-specific immune response. The process by which new vascular networks are formed from preexisting vessels is known as angiogenesis. In addition to being essential for many physiological processes, this process also takes place in pathological circumstances such as diabetic retinopathy, rheumatoid arthritis, wound healing, and embryonic development. Therefore, angiogenesis or neovascularization plays a role in tumor growth. Therefore, by preventing tumor growth, anti angiogenesis may be a useful anticancer therapeutic approach<sup>18</sup>.

**Mosquito Larvicidal Effect:** Larviciding mosquitoes may be a useful technique to include in integrated vector management plans to lessen the spread of malaria. By testing its aqueous suspension as a larvicide and growth disruptor of *Anopheles stephensi* in a lab setting, we present the potential of potash alum, a salt that has long been used in Chinese medicine and Indian Ayurveda, in controlling malaria vectors. WHO criteria were used to evaluate mosquitoes in their immature stages. The range of 50 and 90% fatal values across different larvae was 15.78 to 93.11 ppm and 2.1 to 48.74 ppm, respectively. The findings showed that potash alum's larvicidal effects were on par with those of other chemical and biological pesticides<sup>12</sup>.

**Antibacterial Effect:** Dentists who specialize in preventive care are particularly interested in how mechanical oral hygiene methods affect the levels of microorganisms, particularly mutans streptococci, in saliva. Using fluoridated toothpaste is thought to be the cornerstone of preventing dental cavities. However, tooth brushing alone is effective in reducing bacterial counts in the mouth, but not dramatically. Aluminum has demonstrated activity against oral bacteria. Early investigations revealed that certain aluminium salts, particularly

potassium aluminium sulfate (alum), limit the growth of salivary bacteria. More recently, aluminum showed antimicrobial activity against cariogenic streptococci as well as the normal oral flora and periodontal pathogens by significantly reducing the ability of streptococci to colonize on enamel surfaces and decreasing the colloidal stability of oral bacteria<sup>10</sup>.

**Haemostatic Effect:** A tonsillectomy takes up a sizable portion of any hospital's daily operating list, so cutting down on tonsillectomy time will have a big impact on how many surgeries are completed in the allotted time. The majority of tonsillectomy time is devoted to establishing hemostasis, or applying ligatures. A faster tonsillectomy would result in more surgeries being done in a single day, which might help our nation's hospitals, which already have a limited budget. Alum (aluminum potassium sulfate) is a traditional treatment and food addition used to halt superficial bleeding from small wounds or abrasions.

It is effective in treating intravesical hemorrhage brought on by hemorrhagic cystitis or prostate and bladder cancer because of its astringent qualities. Alum can help stop bleeding from oesophageal varices or advanced rectal cancer. Alum is still the recommended medication for persistent vesical haematuria because it has been shown to be both safe and effective. Furthermore, alum-containing mouthwashes have been demonstrated to lessen dental plaque, making them beneficial for preventive dentistry<sup>2</sup>.

**Contraceptive Effect:** Spermicides, which function as vaginal contraceptives, chemically immobilize or destroy sperm and reduce their motility. Homemade vaginal contraceptives are utilized as easy, affordable, and safe spermicides in many regions of the world. The creation of chemical spermicides for general use began when it was discovered that variations in the concentration of the inorganic salts in the medium were the cause of spermicidal actions. reported using salt jelly containing sodium chloride as an intravaginal contraception. The potash alum was chosen, and an *in-vitro* study on human semen ejaculates was conducted in order to evaluate the spermicidal effects of chemicals<sup>13</sup>.

**Antimicrobial Effects against Axillary Malodour Producing Bacteria:** Alum is advised to be applied topically or as an active component in deodorants and antiperspirants due to its strong antibacterial properties against bacteria that cause axillary malodour. Using the broth dilution method, the antibacterial activity of alum against axillary bacterial flora was evaluated *in-vitro* on Luria-Bertani broth at several doses (0.937–20 mg/mL). For every examined bacterium, alum demonstrated outstanding inhibitory properties<sup>4</sup>.

**CONCLUSION:** Due to its diverse pharmacological properties, potash alum is a useful ingredient in both conventional and alternative medicine. Its antibacterial, hemostatic, antifungal, anti-obesity, antineoplastic, mosquito larvicidal, contraceptive, and antimicrobial activities are among its noteworthy qualities. Its distinct chemical makeup, in particular the amounts of potassium, aluminum, and sulfate, is responsible for these various therapeutic effects. Potash alum has a lot of promise for wider use in the pharmaceutical, commercial, and medical sectors due to its well-established safety profile, affordability, and variety of uses. Its usefulness in focused therapies and preventative healthcare measures may increase with more research.

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