



# A COMPREHENSIVE REVIEW ON THE SIGNIFICANCE OF ALUM IN WOUND HEALING AND IT'S APPLICATIONS IN ORAL ULCER

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**Abstract:** Alum is also known as the "Potash Alum" It is a naturally occurring compound known for its astringent, antiseptic, and haemostatic properties. Although traditionally used in medicine, alum has recently studied the possibility of wound-healing action, especially in the case of mouth ulcers. Its antibacterial, anti-inflammatory, and tissue-regenerating properties help it speed up recovery; therefore, it is a great medication. By comparing their potency with traditional therapies, this review analyses alum-based medicines' chemical composition, Pharmacological action, dosage forms, and commercial formulations. Using mechanisms such as protein coagulation, vasoconstriction, bacterial inhibition, and epithelial regeneration, alum helps in damage control, blood reduction, and better tissue repair. Although it has many advantages, alum should be handled carefully since long-term use of alum raises possibilities of irritability and toxicity. Although historical evidence and early research suggest its effectiveness, more clinical trials are needed to set standard guidelines for secure and ideal applications. Alum-based treatments in wound care and oral medicine might have even better therapeutic value in the future with such developments as nano-formulations and bioactive enhancement.

**Index Terms - Alum, Haemostatic property, Anti-inflammatory property, Antibacterial Property, Nano-formulations, Bioactive Enhancement**

## I. INTRODUCTION

Alum is a naturally occurring chemical compound which widely used in many fields, it includes food processing, cosmetics, water treatment, and medicinal purposes. It also exists in other variants, like ammonium and sodium alum, the main chemical compound form is potassium aluminum sulfate ( $KAl(SO_4)_2 \cdot 12H_2O$ ) in which astringent, antiseptic, and haemostatic properties are present which makes alum versatile, it is a useful supplement to both traditional and contemporary treatment approaches.<sup>1</sup>

Oral Ulcers are painful lesions that are smaller in size and also affect human life. These ulcers are formed on the mucous membrane of the mouth and become the common factors of wound healing.<sup>2</sup> Some conditions that cause mouth ulcers are trauma, infections, autoimmune disorders, systemic diseases, and dietary deficiencies. These ulcers might make it difficult to speak, eat, and also to maintain oral hygiene in day-to-day life. The process of wound healing is essential to regenerate the tissues and cure injury.

For this process, there are multiple phases present, including remodeling, proliferation, inflammation, and hemostasis. There are several molecules, cellular, and metabolic processes that occur during biological reactions, which result in the replacement of damaged tissues or the production of new tissues.<sup>3</sup> Patients and healthcare professionals face difficulties in wound healing, because of infections, delayed healing, and scarring. Without the process of healing the new tissues are not re-generated.

Alum is the chemical compound that can speed up the healing process, of aluminum (potassium alum or potash alum). Alum contains astringent, antibacterial, and anti-inflammatory properties, which were used from the ancient period. Alum formulation can improve its accessibility and also it is easy to apply on ulcers which rapidly heals mouth ulcers. Alum can be used as a therapy for mouth ulcers.<sup>4</sup> Furthermore, it is safe and effective for oral health. Long-term use of alum can cause irritation which can damage the mucous membrane.

## II. Historical Background

In ancient Greece, alum was widely used in ancient times which is important for medicinal purposes, especially for wound healing and treating ulcers. Hippocrates, known as the father of medicine, studied and said alum helps in wound healing and tightens the skin. The Greeks, peoples also used the alum to clean water.<sup>5</sup> They introduced that the alum is not only used for wound healing but also used to clean the dirt from water and make the water clean and safe and the water is also used to drink.

In ancient civilizations, alum has been widely used for both industrial and medicinal purposes. In historical accounts, alum shows antiseptic and haemostatic properties this was discovered in Egypt in 2000 BCE. These Egyptian people were using alum as a deodorant, textile dyeing, and as a preservative technique.<sup>6</sup> It helps to keep the fabrics and bodies fresh through its antibacterial properties.

In medieval times, when alum is widely used for medicinal and industrial purposes Islamic scholars, highlight the role of alum in wound healing and also in maintaining oral health. Doctors recommended the alum for fast relief and also for healing processes like, gum disease, and infections in the throat due to its ability to kill germs.<sup>7</sup> It became the most effective treatment at that time for people which rapidly healed the sores and prevented any infection in the mouth. In that time alum became important to people and also became the resource to cure the infection and diseases.

In the modern period, there are some advanced techniques, the researchers studied more deeply about alum's healing and oral health properties. They also found the other properties of alum which are supported by many traditional roles, including its ability to blood clot, work as an antiseptic, protect tissues, and replace damaged tissue with new tissues.<sup>8</sup> As a focus on today's time, alum is widely spread and used by people for various resources like water treatment, wound healing, and oral hygiene. There are different formulations of alum as powder, serum, pastes, etc.



Fig no 1. Alum

## III. Drug Profile of Alum

### Chemical Name and Structure

**IUPAC Name:** Potassium aluminum sulfate dodecahydrate

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

**Molecular Weight:** 474.39 g/mol

**Chemical Structure:** Alum consists of a double sulfate of potassium and aluminum, forming large octahedral crystals when hydrated.

**Molecular Weight:** 474.388 g/mol

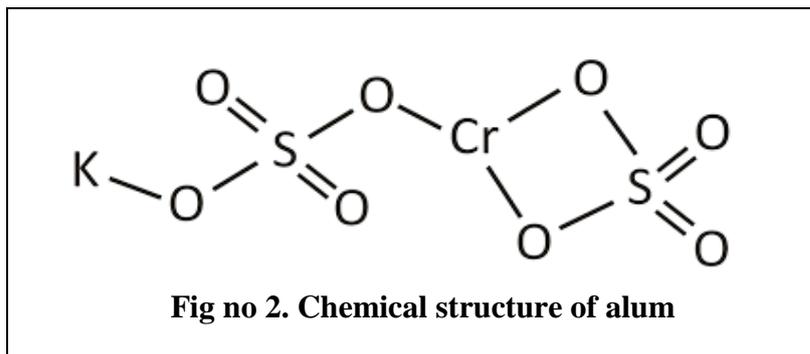
**Melting Point:** 92°C

**Boiling Point:** 330°C

**Density:** 1.757 g/cm<sup>3</sup>

**Appearance:** Colorless cubic crystal, often octahedral in form.

**Solubility:** Soluble in water, with a solubility rate of about 5.90 g per 100 ml at room temperature.



**Fig no 2. Chemical structure of alum**

#### IV. Mechanism of Actions

**Astringent Effect:** Alum is used for mouth ulcers in which the alum works by joining proteins together on mucosal surfaces, it is the moist lining parts of the body like inside the mouth and nose. The alum works as a protective barrier, which helps in decreasing swelling inside the mouth caused by the sores also soothes the skin prevents irritation from the sores, and feel comfortable in the affected area.<sup>9</sup> Alum also shrinks and dries the sores so they do not spread in wide areas.

**Haemostatic Action:** It helps to stop the bleeding of sores or other parts of the body where an injury forms and this can be work through several methods. Firstly, the narrow blood vessels this process is known as vasoconstriction, in which the blood flows slowly to the injury. These narrow blood vessels help to reduce the blood amount that reaches the wound. Another way is by helping the proteins present in blood clumps to form a barrier over the wound.<sup>10</sup> These layers support the faster clotting of blood, and eventually bleeding gets stopped. Alum is known as a haemostatic agent, in which it can stop the flow of blood, blood cells known as platelets stick together, aiding the body's natural clotting process which also can speed up the healing process. Alum can deal with minor cuts, help surgical wounds heal, and control bleeding after tooth extraction.

**Anti-inflammatory Effect:** Alum is also known as an anti-inflammatory agent that reduces the inflammation or swelling of sores or injured areas of the body and also it reduces pain, and irritation caused in tissues of the body. It influences certain chemicals in the body, such as cytokines, prostaglandins, and histamines, which can trigger inflammation. Additionally, alum helps to protect cells from damage caused by free radicals, which are harmful molecules.<sup>11</sup> This protection supports cell repair and lowers inflammation. Another benefit of alum is that it strengthens cell walls and reduces the amount of fluid that can build up at injury sites. This helps in decreasing the pain and swelling even more. Alum is effective for healing wounds and treating sores.

**Antimicrobial Properties:** Alum is used as an antimicrobial property, it is effective at killing bacteria and fungi by changing their cell membranes, which leads to stopping the growth of bacteria and also prevents leaks. It breaks down proteins, dries microbial cells, and disrupts enzymes, making it hard for these microorganisms to survive and multiply.<sup>12</sup> Alum is very acidic in nature it may lead to irritation on the surface of the skin, and lower pH levels which can prevent microbes from sticking on the surfaces, from this, the infection should not be spread all over the surface. Due to these properties, alum is useful in healing wounds, treating mouth sores, and controlling infections.

#### V. Pharmacokinetics

**Absorption:** Topical alum doesn't absorb much through healthy skin because its molecules are large and don't pass through easily. But when it is used in places like the mouth or open cuts, a small amount can enter the fluids in your body.<sup>13</sup> The amount that gets absorbed depends on the concentration of the alum, the

permeability, or whether the alum is healthy for the skin. Although the body doesn't absorb a lot, using too much or for too long might cause irritation or a buildup in the tissues.

**Distribution:** While applying alum on the skin this alum enters the body, and is separated into two parts, which are aluminum and sulfate ions. These are spread into the body with the help of body fluids. Aluminum ions can attach to blood proteins like transferrin and may accumulate in the bones, liver, and kidneys.<sup>14</sup> Sulfate ions are either used in different body processes or excreted. The spread of these ions depends on factors like the quantity taken, in which amounts the alum goes into the body, and the attraction to tissues. Long-term exposure can lead to aluminum accumulating in certain organs.

**Metabolism:** Alum does not break into the body. Instead, when alum enters the body, it is separated into two parts: aluminum and sulfate ions. These ions move around with the body fluids outside the cells.<sup>15</sup> Aluminum ions can attach to blood proteins like transferrin and may accumulate in the bones, liver, and kidneys. Since enzymes do not break down alum. Most of the aluminum that the body absorbs is slowly flushed out through the kidneys. Meanwhile, the sulfate ions are either used in metabolic activities or excreted without changing.

**Excretion:** After the process of metabolism, the alum is mainly cleared from the body through the kidney by urination. Sulfate ions which present in alum are removed in this way. Removal of ions or alum depends upon the function of the kidney. If the kidneys are not working properly then, the aluminum accumulates in the body,<sup>16</sup> especially in bones, brains, and liver, and high concentration alum can damage these body parts. Long-term or frequent use of alum can increase the risk of toxicity inside the body. For people with normal kidney function, the most absorbed alum may filter out, and a risk of high toxicity.

## VI. Adverse Effect:

**Skin and Mucosal Irritation:** Alum is acidic in nature long-term use of alum can cause dryness, redness, itching, or a mild burning and this can irritate your skin and also the mucous membrane. It happens because the alum can pull out the moisture from the skin and tighten the skin after being applied to the skin. This alum makes things worse when the skin is sensitive or the mucous membrane is damaged.<sup>17</sup> People suffering from skin diseases or allergic reactions the alum even more than normal people. To avoid the problems, try to use only a small amount of alum to apply, and stop using it if it feels a lot of discomfort or has an adverse reaction on the skin.

**Toxicity Concerns:** Alum is harsh for use for a long time; alum products should not be used for a long time if they cause toxicity. Too much aluminum is not present in the alum product so it is safer to use. Use. Mostly these alum products are avoided by people with kidney problems. Normally, the body removes aluminum through the kidneys, but if the kidneys do not work well, aluminum gets increased in the body and causes toxicity inside the body. Aluminum gets increased in the body and causes toxicity inside the body.<sup>18</sup> This leads to kidney problems or kidney failure. Long-term use of alum can also affect on brain, lead to memory loss, and possibly be connected to diseases like Alzheimer's. Other health problems include bone problems, anemia (effect on blood health), and also damage to the cells or tissues. To stay safe, aluminum should be not used in excess amounts and also avoid aluminum-rich products.

**Hypersensitivity Reactions:** Alum is highly acidic in nature and this reaction to alum is not very common for people. Sometimes it may lead to skin rash, irritation, itching, swelling, redness, or a mild burning sensation when the alum is applied to the skin areas.<sup>19</sup> Mostly highly skin-sensitive people avoid the excess use of alum otherwise it leads to damaged tissues. In very rare cases, people experience a high side effect of alum on the skin, so they should contact dermatitis or allergic swelling, and this only happens on highly sensitive skin. It is very unusual, but a severe allergic reaction, called anaphylaxis, can happen. If there are any side effects of alum or allergic reactions, then stop using the alum and talk to healthcare professionals. Before applying on a larger area, you should test on a small area so it can be identified whether the skin is sensitive or not.

## VII. Therapeutic Uses

**Wound Healing:** Alum is commonly found in creams and ointments for healing wounds because it tightens the skin, controls bleeding, and fights bacteria. It helps blood clot by making blood vessels narrow and causing proteins to thicken, which helps stop the bleeding.<sup>20</sup> Alum has properties to kill germs and bacteria and also keep away from wounds and reduce the risk of infections. Alum can speed up the process of wound healing and it is also used for minor cuts, scrapes, ulcers, and caring for the wounds after the surgery.

**Oral Ulcers:** Alum products are available in powder and liquid forms which also treat the sores by conditions like aphthous stomatitis and injuries. This alum creates a mucosal membrane as a protective layer on the surface of sores, which helps to ease pain and irritation. Alum can tighten the skin tissues, help speed up the healing process, and also stop the excess flow of blood from leaking outside.<sup>21</sup> It also has properties that fight germs and reduce swelling, which can keep infections away. If the alum is in proper use, then the alum can provide relief from the symptoms and promote quicker healing. Some side effects of alum can cause the dryness of skin and also cause irritation which can damage the tissues.

**Haemostatic Agent:** Alum is a practical solution for stopping minor bleeding. It works by making blood vessels tighten and causing blood to clot, which helps in the control of bleeding. This makes it very useful for dealing with situations like cuts, nosebleeds, and wounds after getting a tooth pulled. Alum also forms a barrier over the wound, which helps prevent additional bleeding and keeps germs away.<sup>22</sup> It's easy to use since it comes in forms like powder, or styptic pencil, making it handy for first aid and minor surgeries. However, using it too much can lead to dry or irritated skin, so it is not good for long-term use.

**Dermatological Applications:** Alum is used for many such as deodorants and antiperspirants and also for wound healing it helps to reduce sweating body odor because it tightens the sweat glands. It kills the bacteria that cause bad odor from the body and alum keeps away these bacteria from your skin. Many people have used alum-based products because they are a natural choice compared to chemical products.<sup>23</sup> These deodorants are safer it does not irritate the skin and leave no mark long term use of alum products or excessive use of alum can irritate the skin. Using them regularly can keep you feeling fresh and dry. If your skin is sensitive, just be sure to check for any irritation or dryness.

**Water Purification:** Alum is a chemical compound. Alum is used for cleaning water by removing tiny particles and bacteria. When alum is added to water the small particles of bacteria or dirt stick together through flocculation and create large clumps that settle at the bottom. This process makes filtering the water much easier.<sup>24</sup> It reduces cloudiness, improves clarity, and removes harmful substances like organic matter, and some microorganisms. This alum-treated water goes to the city water treatment plant, home water purification system, and industrial water processing to make sure that water is safe and clean to drink.

## VIII. Preventions

1. Using too much alum can cause irritation and toxicity. So, while applying alum it's important to avoid excessive exposure.
2. Alum should not be swallowed in large amounts, as it takes for long-term use it may damage the tissues and cells of the body.
3. Excessive use can cause redness, itching, and irritation.<sup>25</sup> Directly applying on large areas of skin should be avoided so if the skin is sensitive, it may lead to irritation.
4. Keep alum-based products out of the reach of children to avoid accidental ingesting and misusing.
5. If symptoms do not abate or get worse during the use of alum, consult professional medical advice about other treatment options.
6. Avoid using alum products too often to stop drying the tissues, especially in oral use.

## IX. Types Of Alum

There are several types of alum present, these alums are as follows:

**Potassium Alum ( $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ):** This is the most frequent and common type of alum. It is mainly applied in medicine, cosmetic, and industrial purposes. In medicine, it is used to heal wounds on those properties of antiseptic and astringent to fight against oral ulcers. In the cosmetic field, potassium alum is frequently used in deodorants to inhibit bacterial growth and consequently decrease the occurrence of body odor. Also, it is a major component of water treatment facilities as it is being used to coagulate pollutants that are carried along with this process making them drinkable.

**Ammonium Alum ( $\text{NH}_4\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ):** Chemically, this type of alum is potassium alum but with ammonium ions. One of the common industrial applications is water treatment, and textiles use it as well.<sup>26</sup> Ammonium alum is a coagulant used in water treatment to precipitate suspended particles from water, thus clarifying the water and making it safer. In addition, often applied in the paper industry for the quality and durability of paper.

**Sodium Alum ( $\text{NaAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ):** The food Additive Form of alum is used in the food industry mostly. Leavened for baking powders, a component in the proper rising of baked goods.<sup>27</sup> Apart from its utility in food processing, sodium alum is also employed as a dyeing and tanning agent for leather where it enables the fixing of dyes to fabrics and stabilizes leather.

**Ferric Alum ( $\text{FeAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ):** Ferric alum is especially that iron is there in its composition than rest alums. Used in industrial water treatment, it is commonly used in municipal water purification plants. Ferric alum is used as a coagulant, where it works with the impurities in water to help remove those impurities.<sup>28</sup> It is also used in papermaking to increase the strength and quality of paper at the manufacturing.

**Chrome Alum ( $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ ):** The type of alum that is used is chromium, which is mostly used for the tanning leather industry.<sup>29</sup> Chrome alum is a thickening agent for the collagen fibers in animal hides, giving them greater strength and resistance to water. It is moreover used in photography, i.e. to harden the photographic gelatin and preparations of certain special dyes, pigments, etc.

**Selenate Alum ( $\text{MAI}(\text{SeO}_4)_2 \cdot 12\text{H}_2\text{O}$ ):** This rare form of alum that has selenium in the place of sulfate, not sulfate. This form has a definite industrial applicability to chemical manufacturing.<sup>30</sup> Selenate alum being a mixed composition is used mostly in research and experimental studies rather than production on an industrial scale.

## X. Marketed Formulations

**Alum Powder:** Used as a folk remedy for initial cuts/wounds, to alleviate skin irritation & since ancient times as a natural deo.

**Alum Crystals:** Both for water treatment and traditional therapeutic applications including mouth rinses for oral ulcers.

**Alum-Based Mouthwash:** Alum in commercial mouth rinses (Solution-phase) for oral hygiene, and ulcer treatment.

**Alum Stick or Block:** Used as a styptic to stop bleeding from minor cuts, particularly in shaving.

## XI. Conclusion

Alum has started to stand out as a promising type of natural product for healing wounds and also soothing sore mouth ulcers. It has astringent qualities and this helps seal wounds with a protective shield, which can reduce leakage of blood fluids and speed up wound healing. Benefits like stopping bleeding and fighting and dealing with little cuts and sores and fighting off bacteria too. Additionally, its anti-inflammatory action aids in reducing pain and swelling, making it an effective remedy for oral ulcers. Though alum-based products have been widely used for centuries, recent research supports the idea of their therapeutic potential. The advantages of the alum gel application and the availability of this product along with its low cost make it a better alternative in the treatment. Still, extensive clinical trials and standardized prescriptions need to be conducted to enhance its usage and confirm its maximum efficacy and safety. It is necessary to be careful when using alum although it has its advantages because the overdose and long-term use can irritate and cause toxicity. It is necessary to follow certain instructions and take a given amount to not suffer from adverse effects. Looking forward to alum products, some new ways for medication include the usage of natural compounds like bioactive agents or the help of nanotechnology to strengthen the healing properties of alum-based treatments.

In conclusion, aluminum gel is a way out to low cost and at the same time efficient wound healing and oral ulcer management. Future developments and clinical trials will help to expand the usage making it an important and safe method of healthcare in the modern time.

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