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Efficacy of Aloe Vera in the Treatment of Skin Burns: A review of its Therapeutic properties and Clinical Applications

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Abstract

Burn injuries represent a considerable medical issue, categorized by depth into first-, second-, third-, and fourth-degree burns, each necessitating different levels of treatment. Burn injuries are one of the most prevalent types of trauma, resulting in financial, psychological, and physical hardships. Effective care is necessary to avoid complications and speed up healing. Aloe vera, a succulent plant with a long history in traditional medicine. Aloe vera has gained significant attention for its therapeutic properties in managing skin burns. A wide range of bioactive substances, such as vitamins, enzymes, polysaccharides, and amino acids, are present in aloe Vera and help to promote wound healing, anti-inflammatory, and antimicrobial effects. These compounds stimulate fibroblast proliferation, enhance epithelialization, and facilitate granulation tissue formation. This review examines its efficacy by exploring its biochemical composition, mechanisms of action, and clinical applications. Clinical studies also demonstrate how well it works to encourage tissue repair and improve patient comfort. Aloe vera's cost-effectiveness and natural origin make it a potential essential component of contemporary burn management plans. Aloe vera is an effective natural remedy for burn treatment, as it promotes healing, alleviates pain, and inhibits infections. However, additional rigorously designed clinical trials are necessary to standardize its application and validate its efficacy across various burn severities.

Keywords: Burn injuries, Aloe vera, Anti-inflammatory, Antimicrobial effects, Bioactive substances.

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1. Introduction

Millions of people worldwide suffer from burn injuries every year, making them one of the most common and incapacitating types of trauma. Burn injuries can happen to anyone, anywhere, at any time, and are an underappreciated trauma. Heat from hot liquids, solids, or fire is the primary cause of burn injuries, though they can also be brought on by friction, cold, heat, radiation, chemicals, or electricity. It is crucial to classify burn injuries based on their severity, including their size and depth, in addition to identifying their cause. Burns that only affect the epidermis, the topmost layer of the skin, are categorized as superficial (first-degree) burns; they cause redness on the skin and cause short-term pain. Although they don't require surgery, superficial partial-thickness (second-degree) burns (previously known as 2A burns) are painful, weep, need dressing and wound care, and may leave scars [1]. To improve recovery and avoid complications, effective treatment is crucial. A succulent plant with a lengthy history in traditional medicine, aloe vera has shown promise as a natural burn treatment. For centuries, people have utilized and recognized the health, beauty, medicinal, and skin-care benefits of aloe vera plants. The Arabic term "Alloeh," which means "shining bitter substance," is the source of the name Aloe vera, while the Latin word "vera" means "true." The aloe vera plant is now utilized in dermatology for a number of reasons. For thousands of years, aloe vera has been used medicinally in Greece, Egypt, India, Mexico, Japan, and China, among other cultures [2]. Aloe vera is well-known for its calming, anti-inflammatory, and restorative qualities. Its efficacy is attributed to a number of bioactive compounds. Its potential is confirmed by current research, which makes it a natural substitute or supplemental treatment for burn care. The objective of this review examines the therapeutic properties of Aloe vera, its mechanisms of action, and its clinical efficacy in burn management.

2. Therapeutic Properties of Aloe Vera

2.1. Bioactive Compounds

Numerous bioactive substances, including flavonoids, terpenoids, lectins, fatty acids, anthraquinones, mono- and polysaccharides (pectins, hemicelluloses, glucomannan), tannins, sterols (campesterol, β-sitosterol), enzymes, salicylic acid, minerals (calcium, chromium, copper, iron, magnesium, manganese, potassium, phosphorus, sodium, and zinc), and vitamins (A, C, E, β-carotene, B1, B2, B3, B6, choline, B12, and folic acid) are also abundant in aloe**.** Aloe may contain polysaccharides in a

variety of forms Table 1. The age of the plant determines their content. Aloe contains a soluble fiber fraction called glucomannan and a hemicellulose component that attaches to certain plants' cell walls' fibroblast receptors to promote their growth. Aloe is known for its lectins, which are a class of glycoproteins that include aloctin A and B [3].

2.1.1. The Polysaccharides

Acemannan, primarily located in the inner leaf gel of A. vera, is regarded as the most extensively characterised polysaccharide extracted from this species. The primary active ingredient demonstrating diverse biological activities has been identified. Acemannan is a composite of β-1, 4-linked acetylated mannan polymers with diverse chain lengths. The gel of A. vera contains a number of different polysaccharides besides acemannan. This species of aloe contains following polysaccharides: glucomannan, arabinogalactan, galactogalacturan, & glucogalactomannan. Thus, these polysaccharides also have the ability to modulate the immune system like A. vera does furthermore, the fresh gel of A. vera has a total polysaccharide content of about 10% of its dry weight [4].

2.1.2. Enzymes

Alkaline phosphatases, amylases, bradykinases, alliinases, carboxyepeptidases, peroxidases, lipases, catalases, and cellulases are among the many enzymes found in aloe vera. Bradykinase reduces inflammation, and other enzymes aid in the breakdown of sugars and fats [5].

2.1.3. Glyoprotein

The gel of the A. vera plant contained a glycoprotein that demonstrated advantageous wound-healing properties. In models of living organisms, the glycoproteins improved epithelialization and granulation. Glycoproteins improved epidermal tissue and boosted cell proliferation activity in the lab [6].

2.1.4. Lectin

A class of glycoproteins known as lectins (aloctin A and B) is unique to aloe. The relationship between the polypeptide chain and oligosaccharide groups varies between them. Through serine or trinine rest, aloctin A binds them to the O-glycosidic bond, whereas aloctin B binds them to the N-glycosidic bond through asparagine rest. The primary functions of lectins are immunochemical and mitogenic. This indicates that they influence the proliferation of B- and T-lymphocytes and promote cell divisions. Cell blastic transformation, which induces the transition of cells from phase G0 (resting phase) to phase G1 (interphase) or synthesis, is the basis for the mechanism of action. In a series of steps, mitotic divisions are triggered [3].

3. Mechanism of Action

3.1. Anti-Inflammatory Properties

Aloe vera, a pioneer plant in the Xanthorrhoeaceae family, has long been used by various ethnic groups to lessen inflammatory symptoms. Aloe vera gel has been shown by researchers to have strong anti-inflammatory, anti-arthritic, anti-nociceptive, and wound-healing effects in suitable model systems. One of the main areas of interest at the experimental level is how the components of the plant gel interact with inflammation modulators [7]. Numerous studies conducted both in vitro & in vivo have demonstrated anti-inflammatory properties of aloe vera gel through bradykinase activity. Bradykinin, an inflammatory chemical that causes pain, is broken down by peptidase bradykinase, which was isolated from aloe. Gel extracts used to isolate C-glucosyl chromone, a novel anti-inflammatory compound .Aloe vera decreases the synthesis of prostaglandin E2 from arachidonic acid and inhibits cyclo-oxygenase pathway [8]. Through the inhibition of IL-6 and IL-8, the decrease of leukocyte adhesion, the elevation of IL-10, and the reduction of TNF alpha, aloe vera effectively inhibits inflammatory reactions. The compound glucomannan, which is abundant in polysaccharides like mannose, is responsible for its regenerative qualities [9].

3.2. Antimicrobial Activity

Aloe vera has antibacterial properties. Since burn plant leaf gel was separated, the purified aloe protein has strong antifungal properties. Bacteria cannot grow on media containing Aloe vera extract because A. vera contains anthraquinones, which function similarly to tetracycline in that they block ribosomal A site, preventing bacterial protein synthesis. Pyrocatechol, a hydroxylated phenol found in burn plants, is known to have a harmful effect on microbes [10]. The natural anthraquinones found in aloe vera have been linked to the plant's antimicrobial properties, as they have been shown to inhibit *Bacillus subtilis* and *Mycobacterium tuberculosis* in vitro. It has been discovered that aloe juice is bacteriostatic against *Salmonella paratyphi*, *Streptococcus pyogenes*, and *Staphylococcus aureus* [11].

3.3. Antioxidant Activity

Quercetin, myricetin, and kaempferol are phenolic compounds that are well-known for their antioxidant properties. However, fresh consumption of aloe vera gel as an antioxidant source is impractical and has an unpleasant odor; therefore, it must be processed into a readily consumable product, like powder. Aloe vera powder and extract's anti-oxidative qualities have been investigated by [12]. Aloe vera extract has a Radical Scavenging Activity (RSA) of 35.17% and a 49.53% inhibition of lipid peroxidation, whereas aloe vera powder has an RSA of 26.05% and a 44.17% inhibition of fat peroxidation [13].

3.4. Moisturizing

Mucopolysaccharides aid in retaining moisture in the skin, which has a moisturizing and anti-aging effect. Aloe increases the production of collagen and elastin fibers by stimulating fibroblasts, which makes the skin less wrinkled and more elastic. Additionally, by binding the superficially flaking epidermal cells together, it has cohesive effects that soften the skin. Zinc tightens pores by acting as an astringent, while the amino acids also soften hardened skin cells. Aloe vera gel gloves' moisturizing properties have also been investigated in the treatment of dry skin linked to occupational exposure, where they enhanced skin integrity, reduced the visibility of fine wrinkles, and reduced erythema. It has anti-acne properties as well [14].

Table 1: Chemical composition of Aloe vera [3]

Compounds	Examples
Non-essential and essential amino acids	Alanine, arginine, aspartic acid, glutamic acid, glycine, histidine, hydroxyproline, isoleucine, leucine, lysine, methionine, phenylalanine, proline, threonine, tyrosine, valine
Proteins	Lectins and lectin-like substance
Anthraquinone and anthrone	Aloe-emodin, aloetic acid, anthranol, aloin A and B (barbaloin), isobarbaloin, emodin, ester of cinnamic acid
Enzymes	Alkaline phosphatase, amylase, carboxypeptidase, cyclooxidase, catalase, cyclooxigenase, lipase, oxidase, superoxide dismutase, phosphoenolpyruvate carboxylase, glutathione peroxidase
Hormons	Auxins and gibberellins
Inorganic compound	Calcium, chlorine, chromium, copper, iron, magnesium, manganese, potassium, phosphorous, sodium and zinc
Saccharides	Mannose, glucose, rhamnose
Carbohydrate	Pure mannan, acetylated mannan, acetylated glucomannan, glucogalactomannan, galactogalacturan, arabinogalactan, cellulose, pectic substance, xylan
Vitamines	B1, B2, B6, B12, C, β -carotene, folic acid, choline, α -tocopherol
Lipids	Arachidonic acid, γ -linolenic acid, sterols (campesterol, cholesterol, β -sitosterol,),triglycerides, triterpenoid, gobberellins
Other compounds	Lignin, potassium sorbate, salicylic acid, uric acid

4. Clinical Applications of Aloe Vera in Burn Treatment

Aloe vera is primarily used to treat burn wounds of the first and second degrees, which shortens the recovery period to nine days. The current treatments, such as petroleum jelly gauze dressing, silver sulfadiazine 1% ointment, and framycetin cream, have not been as successful as aloe vera dressing applied once or twice daily. It has led to a shorter recovery period, no infection of the wound, and no itching or redness. Aloe vera, also referred to as the burn tree and first aid plant, has long been used to treat burns [9]. Clinical therapies for cases utilizing “acemannan (AC)" as biomaterials have surfaced in recent years, particularly in tissue regeneration. The preparation of AC in combination with other substances to create composite hydrogels, aero gels, membranes, and scaffolds has also advanced significantly [15]. Three randomized studies on the effectiveness of aloe vera gel for radiation-induced dermatitis found that the gel was either ineffective against a placebo gel or aqueous cream, or that the application of aloe vera gel in combination with mild soap delayed the onset of skin changes compared to mild soap alone. According to a review of aloe vera for radiation-induced skin damage, there is no proof that the gel has a protective effect, and more carefully planned studies are required to assess any potential advantages. A clinical study assessing the use of aloe vera gel to treat radiation-induced oral mucositis produced similar findings, with no discernible variations from the placebo group [14]. For burn patients, aloe vera gel seems to be a useful remedy for easing pain. Those who received aloe vera gel for second and third degree burns in randomized controlled trials reported statistically significantly lower pain ratings on a visual analogue scale than those who received 1% silver sulfadiazine cream. After seven days of treatment (n = 120 people) and after fourteen days of treatment (n = 120 people), aloe vera gel was better at managing pain. In individuals with second-degree burns, aloe vera was also linked to a quicker recovery to pain-free status (n = 50).The high water content of aloe vera may contribute to its calming properties [16]. Aloe vera has been shown in a study [17] to speed up the healing of burn wounds when compared to a group that received silver sulfadiazine treatment. This is due to aloe vera's antibacterial properties and ability to stimulate cell growth, which accelerates the formation of new skin tissue. According to [18], on the seventh day following treatment, coadministration of adipose-derived stem cells (ASCs) and aloe vera gel successfully reduced the inflammatory response by down regulating the expression of the TGF-b 1 and IL-1 b genes. On day 14, they also noticed a higher rate of angiogenesis and re-epithelialization than other groups [19].

5. Conclusions

The objective of this review was to assess the therapeutic properties, mechanisms of action, and clinical applications of aloe vera in the treatment of skin burns .Aloe

vera's anti-inflammatory, antimicrobial, and wound-healing qualities, which are backed by early research, make it a promising natural treatment for skin burns. Aloe vera is a useful supplement to contemporary burn treatment techniques due to its affordability and accessibility, providing hope for improved patient outcomes and recovery. However, the research is constrained by the absence of extensive, carefully monitored clinical trials and the variations in dosage and application techniques employed in different studies. Future research should concentrate on performing randomized controlled trials using standardized protocols, investigating the long-term effects, determining the best dosages, and contrasting aloe vera with other well-established burn management treatments in order to bolster the evidence.

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