

# Aloe-Vera in Hair Cosmetics: A Comprehensive Overview

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**Abstract:** Aloe vera, a succulent plant known for its multifaceted properties, has gained significant attention in the realm of hair cosmetics due to its diverse composition and beneficial attributes. Aloe vera comprises a plethora of constituents, including polysaccharides, vitamins (A, C, E, B12), minerals (calcium, magnesium, zinc), enzymes, amino acids, and phytochemicals (anthraquinones, flavonoids). Its nutritional profile includes essential vitamins and minerals that contribute to hair health. Phytochemicals like anthraquinones offer anti-inflammatory, antioxidant, and antimicrobial properties, while the gel's medicinal and pharmacological attributes aid in soothing the scalp and promoting hair growth. The gel contains a complex blend of polysaccharides like acemannan, which possesses moisturizing and healing qualities. Amino acids in aloe vera contribute to strengthening hair strands and maintaining their integrity. In hair cosmetics, aloe vera's inclusion revitalizes the scalp, reduces dandruff, nourishes hair follicles, and enhances hair luster and strength. Its emollient nature helps in conditioning and restoring moisture balance, making it a coveted ingredient in shampoos, conditioners, serums, and masks. While aloe vera is generally considered safe, allergic reactions may occur in some individuals. Prolonged topical application can lead to skin irritation or allergic dermatitis. Oral consumption in high doses may result in gastrointestinal discomfort. This abstract provides an overview of aloe vera's multifaceted role in hair cosmetics, encompassing its composition, properties, benefits, and potential risks associated with its usage.

**Keywords:** Alovera, nutrients, phytochemical, antioxidant, pharmacological, dermatological, antidiabetics, anti-inflammatory, hair- tonic, chemotherapeutics.

## INTRODUCTION

Aloe vera is a tropical perennial plant that is drought-resistant and robust. It is a member of the Liliaceae family and has been used medicinally for many years.

It has a significant traditional role in homeopathy, ayurveda, siddha, and unani medicine. Clinical analyses have shown that the aloe vera leaf's rind and gel contain the majority of the plant's pharmacologically active components. Aloe vera is a plant with short or no stems that reaches a height of 60 to 100 cm and spreads by offsets. Mature plants have an average height of 26 to 28 inches and can grow up to four feet in height. Typically, a plant might have 12 to 16 leaves and weigh up to 2-3 kg when it is fully grown. Every six to eight weeks, the plants can be harvested by plucking three to four leaves from each plant. In the second year, throughout the winter, it develops upright, unbranched blooming stalks that reach a height of 90 to 150 cm. It produces orange and brilliant yellow blooms in an auxiliary spike arrangement [1,2]. It has a unique look due to the rosette of thick, meaty leaves it bears. Certain types include white specks on the top and lower stem surfaces, while the leaves range in color from green to grey-green [3]. The leaf's edge features tiny white teeth and is serrated. Summertime sees the production of the flowers, which are pendulous and have a 2-3 cm long yellow tubular corolla. The spike can reach up to 90 cm in height. Aloe vera generates arbuscular mycorrhiza, a symbiotic relationship with other Aloe species that improves the plant's access to mineral nutrients in the soil [4]. The tropical cactus belonging to the genus Aloe is the source of Aloe Vera. Because of the bitter liquid found in the leaves, Aloe Vera gets its name from the Arabic term Alloeh, which means —shining bitter substance, and the Latin word truel, vera [5,6]. Aloe vera possesses qualities that make it useful in medicine. According to study, using aloe vera in food or drink has been shown to lower blood glucose levels, which can help manage diabetes. For the most part, those with diabetes drank herbal tea or combined aloe vera with yogurt. Additionally, it has

been used into moisturizers and lotions for anti-aging and wrinkles. It is best to use a moisturizer or cream

that is not sticky or greasy, dries fast, readily absorbs into the skin, and has no smell [7].

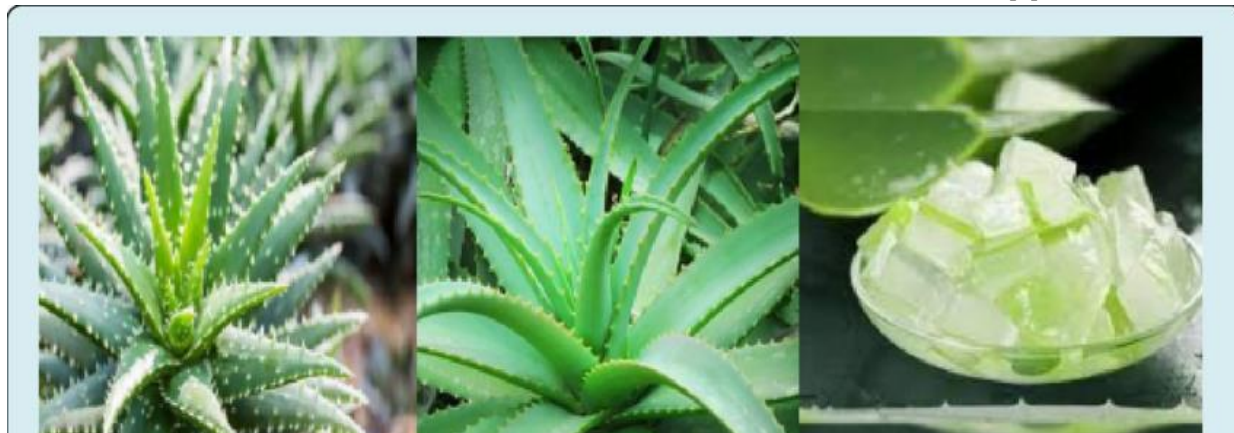


Fig. 1: Alovera Plant and alovera gel [8]

#### Distribution of Aloe vera:

Taxonomists refer to aloe vera as *Aloe barbadensis* in common parlance. Egypt and Mesopotamia have been using it since 1750 BC [9]. The Arabic term for bitterness is *alloeh*, which means brilliant[10]. For thousands of years, several ancient civilizations, including those in Egypt, Persia, Greece, India, and Africa, have documented the benefits of aloe vera [11]. The genus is native to the Mediterranean region, including Southern Italy and Greece, as well as the African continent. It is said to grow wild on the Canary Cape, Cape Veroe, Malta, Sicily, and Cyprus islands. It is also said to have spread throughout dry regions of India. Of the 275 species, 42 are found in the African area of Madagascar, 12–15 are found in the Arabian Peninsula, and the other species are found across tropical South Africa. *Aloe barbadensis* is the most extensively dispersed species of the four species (*Aloe forbesii*, *Aloe inermis*, *Aloe ferox*, and *Aloe barbadensis*) that are known to exist in India. These taxa are divided into many varieties, including their cross, *officinalis*, *chinensis*, and *litoralis*. There are several synonyms for the species: *Aloe indica* Royle, *Aloe barbadensis* Mill., and *Aloe perfoliata* L. var. *vera* and *A. vulgaris* Lam [12,13].

#### PROPERTIES OF ALOEVERA

##### 1. Nutritional Properties of Alovera:

A closer look into aloe vera exposes some of the enchantment that underlies its therapeutic miracles. Numerous important vitamins and minerals, including

folic acid, choline, calcium, phosphorus, potassium, iron, sodium, magnesium, manganese, copper, chromium, and zinc, are present in the plant. Numerous amino acids are also found in aloe, including aspartic acid, glutamic acid, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, valine, arginine, cystine, glycine, histidine, hydroxyproline, proline, serine, and tyrosine[14]. Seventy-five components, including vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids, are potentially active in aloe vera[15]. The trace minerals iridium and rhodium, which are employed in cancer and tumor research studies, are also found in aloe vera[16]. Aloe vera is a plant that is high in antioxidants. It also includes zinc and selenium as minerals, as well as vitamins A, C, and E that function as natural antioxidants. Antioxidants support the body's defenses against free radicals and strengthen the immune system. These anti-free radical fighters eliminate poisons and carcinogens from pollution and low-quality diets from human bodies [16].

##### 2. Phyto-chemical Properties of Alovera:

Flavonoids, terpenoids, and lectins are found in aloe plants [17,18] fatty acids, cholesterol, anthraquinones, and chromones (8-Cglucosyl-7-O-methylaloeol, 8-Cglucosyl-noreugenin, iso-rabaichromone, neoaloesin-A, isoaloesin-D),[19,20] mono and polysaccharides (derived from mannose, acemannan, glucomannan, hemicelluloses, and pectins)[21, 22] tannins, organic acids, saponins, enzymes, vitamins,

minerals, sterols (lupeol, campesterol, and  $\beta$  sitosterol), salicylic acid, and enzymes [23]. Aloin, anthrone, aloe emodin (3-hydroxymethyl-chrysozoin), aloetic acid, choline and choline salicylate, enzymes like catalase, amylase, cellulase, and alliinase, complex mucopolysaccharides that resemble hyaluronic acid, saponins, and alophenol. Many physiologically active substances may be found in aloe vera leaves; the most well-researched ones include lectins, acetylated mannans, polymannans, anthraquinone C-glycosides, anthrones, and anthraquinones [17, 18, 24]. Aloe vera also contains tannins, prostaglandins, magnesium lactate, mannins, resins, proteins such as lectins, monosulfonic acid, and gibberellins [16].

### 3. Medicinal properties:

For millennia, aloe vera has been utilized medicinally in a number of countries, including Greece, Egypt, India, Mexico, Japan, and China [25]. Aloe vera was utilized by the Egyptians to cure TB and to manufacture scrolls that resembled papyrus [26]. Aloe barbadensis preparations such as confections, lotions, and juices are effective treatments for a variety of illnesses [27]. There is little and sometimes conflicting scientific data supporting aloe vera's medicinal and cosmetic benefits [28, 29]. In spite of this, claims about the calming, hydrating, and restorative qualities of aloe vera are frequently made by the alternative medicine and cosmetic sectors, particularly through online advertising [30]. Commercially available lotion, yogurt, drinks, and even desserts use aloe vera gel as an ingredient [31, 32].

### 4. Pharmacological Properties:

#### a. Wound healing property:

Tannic acid and one particular kind of polysaccharide may be useful ingredients for wound healing. The human body uses wound healing as a technique to restore injured tissues [33]. The active component of A. vera's mucilaginous gel, mannose-6-phosphate, is thought to be responsible for wound healing. Collagen thickness and fibroblast count were used to measure the effects of aloe vera on wound healing [34]. It has been documented that aloe vera possesses wound-healing and ulcer-prevention properties that improve the healing of dermal injuries (such as burns, frostbite, skin infections, surgical wounds, inflammation, herpes

ulcers, diabetic foot ulcers, pressure sores, and chronic wounds) [35].

#### b. Antibacterial properties:

Aloe vera, particularly against Gram-positive bacteria that cause food poisoning or infections in humans and animals, inhibits the growth of certain microorganisms such as *Streptomyces pyogenes*, *Shigella flexneri*, and *Klebsiella* sp. [36].

#### c. Anti-oxidant / Antiseptic properties:

Aloe vera has powerful antioxidant properties. Aloe Vera gel was shown to have glutathione peroxidase activity, superoxide dismutase enzymes, and a phenolic anti-oxidant, which may be in charge of these anti-oxidant benefits [37]. Aloe vera improves blood quality, most likely by facilitating the blood's ability to carry nutrients and oxygen to the body's cells more efficiently [38]. Six antimicrobial substances may be found in aloe vera: sulfur, urea nitrogen, salicylic acid, cinnamonic acid, phenols, and luteol. They all have the ability to suppress viruses, bacteria, and fungus [39].

#### d. Anti-inflammatory properties:

The body's natural reaction to an injury is inflammation, which is characterized by swelling, discomfort, redness, and heat and slows down the healing process [40]. Aloe vera gel's anti-inflammatory properties not only reduce pain and discomfort but also hasten the healing process. The anti-inflammatory properties of mannose-6-phosphate are similar to the effects of acetylated mannan in Aloe gel [38, 41].

#### e. Moisturizing and anti-aging effect:

Currently, aloe vera is used in the production of almost 95% of goods with dermatological value. This is due to its unbelievable moisturizing qualities [42]. It helps the skin retain moisture better and eliminates dead skin cells that produce collagen and elastin fibers. This makes the skin less wrinkly and more elastic, which reverses the effects of aging on the skin. Through the action of amino acids and its cohesive effect on superficially peeling epidermal cells, it softens the skin [39].

#### f. Anti-diabetic properties:

It is commonly known that aloe vera gel lowers blood sugar. Hepatic transaminases, plasma and tissue cholesterol, triglycerides, and fasting blood glucose were all markedly decreased by aloe vera gel (alcohol insoluble residue extract) [43]. phospholipids and free fatty acids, as well as notably raising plasma insulin

levels. Aloe vera increases glucose metabolism, which leads to lower blood glucose levels [44].

Chemical Composition of Aloe Vera Gel:

The A. Vera leaf is mostly made up of three layers. The thick outer layer, or rind, is made up of 15–20 cells that produce proteins and carbohydrates. Vascular bundles like phloem and xylem are found inside the rind [45].

Constituents	Number and identification	Properties and activity
Amino acids	Provides 20 of the 22 required amino acids and 7 of the 8 essential ones.	Basic building blocks of proteins in the body and muscle tissues <sup>20</sup> .
Anthraquinones	Provides aloe emodin, aloetic acid, alovin, anthracine	Analgesic, antibacterial
Enzymes	Anthranol, barbaloin, chrysophanic acid, smodin, ethereal oil, ester of cinnamonic acid, isobarbaloin, resistannol	Antifungal & antiviral activity but toxic at high concentrations.
Hormones	Auxins and gibberellins	Wound healing and anti-inflammatory.
Minerals	Calcium, chromium, copper, iron, manganese, potassium, sodium and zinc.	Essential for good health.
Salicylic acid	Aspirin like compounds	Analgesic
Saponins	Glycosides	Cleansing & antiseptic
Steroids	Cholesterol, campesterol, lupeol, sistosterol	Anti-inflammatory agents, lupenol has antiseptic and analgesic properties.
Sugars	Monosaccharides: Glucose and Fructose Polysaccharides: Glucomannans/polymannose	Anti-viral, immune modulating activity of acemannan
Vitamins	A, B, C, E, choline, B <sub>12</sub> , folic acid	Antioxidant (A,C,E), neutralises free radicals

Fig.2 : Chemical constituents of Alovera [46]

### BENEFITS OF ALOEVERA IN COSMETICS

#### 1. Hair products:

Given that hair is thought to be one of the key components that enhances a person's appearance, it is crucial to take proper care of your hair. Hairs are the protrusions from the follicles that are found on the skin and are characterized as "improved epithelial structure formed as a result of keratinization of germinative cells" [47]. Together with additional chemical components like oxygen, carbon, nitrogen, sulfur, etc., keratin makes up hair. There are other forms of keratin, but in vertebrates, alpha-keratin is typically seen and is in charge of nail and hair growth, among other things [48].

An essential part of the human hair system is the scalp. It is made up of layers of soft tissue that cover the head's hair-growing region and the skull. Numerous hair follicles and sebaceous glands are integrated within it [49]. Due to changing environment, excessive heat, dirt and pollution leads to overproduction of sebum in the scalp that further leads to various hair problems such as:

1. Hair loss,
2. Hair thinning,
3. Excessive dandruff,
4. Split ends,

5. Dryness and roughness of hair and
6. Bald patches [50].

Causes of hair loss:

1. Acute illness,
2. Stress,
3. Thyroid dysfunction,
4. Prescription drugs,
5. Prolonged operation/ anaesthesia,
6. High iron deficiency/ anaemia,
7. Hair Styling products and
8. Chemotherapeutic agent [51]

Aloevera as hair tonic:

Hair tonics are one kind of cosmetic that may be used to cure hair loss. A liquid cosmetic preparation called Hair Tonic is a blend of chemicals and other components that are used to support the growth, repair, and maintenance of hair health. Hair tonics have three main purposes: they stop hair loss, stop dandruff and irritation, and encourage hair growth. Because aloe vera includes vitamins A and C, amino acids, copper, isofolate, enzymes, and minerals that help strengthen hair roots and lessen hair loss, it is used as a hair tonic.[52] A stability test was carried out on hair tonic formulations with different concentrations of propylene glycol. Aloe vera and celery extracts are the constituents in each mix. Each formula was then put to

the test in order to be evaluated. The study's findings indicate that each formula is less stable as a result of precipitation on the seventh day. Nonetheless, the 15% propylene glycol content is the formula that most closely satisfies the stability criteria based on the specific gravity and viscosity that have been measured.[53]

Subsequent study then employs honey and aloe vera extract in hair tonic formulations. The purpose of this study was to determine the impact of the ratio of honey to aloe vera extract. In this investigation, two fundamental elements were compared in the following ratios: 1 ml: 5 ml, 3 ml: 3 ml, and 5 ml: 1 ml. Subsequently, the infundation procedure was employed to make aloe vera extract, and the process was assessed. The study's findings indicated that the ratio of aloe vera extract to honey had an impact on the tonic's effectiveness. Subsequently, chemical tests were conducted to determine the contents of the hair tonic X3, which has an aloe vera extract to honey ratio of 5 ml to 1 ml. The results showed that X3 contains 11.81 mg of vitamin A per 100 ml, 9.50 mg of amino acids per 100 ml, 2.45 mg of vitamin B5 per 100 ml, and 4.80 mg of vitamin C per 100 ml. It is so claimed that even after undergoing the two-phase extraction procedure (the aqueous phase and the alcohol phase), the nutritious value of hair tonic X3 remains intact [54]. Three different mixes of aloe vera and lime fruit extract were used in another investigation. The combined formulation (1%:2%) produced the highest physical stability and hair growth outcomes in white male rabbits, according to the study's findings. The mixture of lime and aloe vera extract (5.53-5.83) is acidic according to the pH (3.0-7.0) quality criteria. Color and odor of the hair tonic formulation did not alter as a result of stability [53, 54].



Fig.3: Marketed formulation of hair & scalp tonic made from Aloe vera [55]

Aloe vera as a shampoo:

According to study findings, the aloe vera plant possesses a variety of advantageous traits and characteristics, including anti-inflammatory, anti-fungal, antibacterial, and cell-regenerating capabilities. It also helps to regulate blood pressure, boost immunity against cancer, and reduce blood sugar levels in diabetics. Aloe vera also works well as a shampoo to cleanse the scalp, hydrate the skin, darken hair, and prevent hair loss; when taken orally, aloe vera gel or mucus can ease sore throats, lessen coughing, and loosen the throat; it also functions as an anthelmintic, which means it sheds or gets rid of worms; and it can be used as a cosmetic ingredient.

Hair growth may be accelerated by extracting natural substances like candlenut, aloe vera, apple, and honey and using them in hair tonics or lotions. There have been several aloe vera gel shampoo compositions studied. One recipe calls for 5 ml of lerak extract, 9 ml of blended and filtered aloe vera leaf flesh filtrate, and 0.2 ml of kaffir lime essential oil. Aloe vera powder (10%) mixed with other plant powders, such as Hibiscus rosa Sinensis (15%), Mentha piperita 5%, Citrus lemon (10%), Acacia concinna (15%), Emblica officinalis (15%), Ocimum sanctum 5%, Azadirachta indica 5%, and Lawsonia inermis 5%, proved effective as an anti-dandruff shampoo in another study.

All of the physical characteristics of the lerak-based anti-dandruff shampoo—aroma, color, foaming ability, panelist preference, viscosity, and pH value—are impacted by the addition of aloe vera. The most popular shampoo product among panelists is sample X9, which contains 9 ml of aloe vera and doesn't smell like lerak or aloe vera. It also has a light brown hue, is highly frothy, has a viscosity of 2.21 cp, and a pH value of 5.01. Lerak and aloe vera combined to make an anti-dandruff shampoo may be prepared as a shampoo preparation that satisfies the physical properties test criteria and matches the pH value of the shampoo in SNI, which falls between 5 and 9.

It is considered safe to use aloe vera extract on the scalp when it is used to make anti-dandruff shampoo. Families can benefit from the production of aloe vera extract shampoo by preventing dandruff in members of the family. [56]





Fig.4 : Marketed formulation of Alovera Shampoo [57]

## 2. Beauty care products:

Aloin and its gel are used topically as a skin tonic for acne. Aloe vera is also used to moisturize the skin and soothe it in order to prevent dry, harsh weather-related skin and scalp flaking. Aloe vera may also be used topically to greasy skin as a moisturizer. According to studies, aloe vera helps the skin retain moisture better, helps get rid of dead skin cells, and has a powerful penetration power that makes it easier for good things to pass through the skin. Aloe vera is a perfect component for cosmetic and dermatological products because of all these benefits. Aloe vera is used in more than 95% of dermatologically useful extracts produced globally, making it one of the most significant components in the cosmetics business today. Additionally, moisturizing treatments utilize aloe sugars [58]. Blended with certain essential oils, it creates a fantastic moisturizer that smoothes the skin, a sunscreen lotion that blocks UV rays, and a variety of other cosmetic items. Maharishi ayurveda advises Aloe vera for a variety of skin conditions because of its cooling and soothing properties [59]. Aloe vera extracts have been demonstrated to suppress the growth of fungi that cause tinea and have antibacterial and antifungal properties that may aid in the treatment of minor skin illnesses such as benign skin cysts and boils [60].

### Toxicity of Aloe vera (Alovera Gel):

The disruption of intercellular connections and the creation of cell-free spaces in the monolayers following treatment have verified the cytotoxicity of aloe vera gel in chicken fibroblast monolayers.[61] Three fractions isolated from Aloe barbadensis leaves were used in the cell injury assay: the low molecular weight fraction (LMWF, the dialyzable material), purified gel (the nondialyzable fraction of the native

gel), and native gel (mucilaginous parenchymous tissue scraped from Aloe leaves). Similar cell damage were increased by a 1:10 dilution of native gel and LMWF, although the purified gel behaved like the control at the same dilution. These severe cellular damages may be distinguished with a microscope. Since the high molecular weight components were thought to be the source of the beneficial properties, it was thus claimed that the toxicity was mostly caused by the LMWF from the gel.[61] An Aloe vera dehydrated gel substance caused dose-dependent cytotoxicity in HeLa cells after a 4-hour treatment; the gel's CC50 value was 269.3 mg/ml.[62] In a 14-day trial, the NTP gave groups of four male and four female F344/N rats aloe vera gel in drinking water.[63] The amount of aloin A (barbaloin) and malic acid in the gel was used to gauge its quality. Aloe vera gel drinking water solutions with 0.5%–3% had 5.6–33.3 µg of aloin A/g of water and 1060–6360 µg of malic acid. Following the 14-day exposure, dose-related increases in urine glucose levels were noted in female rats, and at concentrations of 1.5% or higher in female rats and 3.0% in male rats, dose-related declining trends were noted in the serum levels of albumin, cholesterol, and triglycerides. The weight of the testes, serum testosterone levels, sperm count, and sperm fertility were all considerably lower in adult male Wistar rats when they were given an oral dose of Aloe vera gel extract solution (150 and 300 mg/kg/day) for eight weeks, as opposed to the control group.[64] In a different in vivo investigation, B6C3F1 mice were exposed to a commercially stable Aloe vera gel for 13 weeks subchronic exposure. After the trial, there were no changes observed in feed consumption, body weight increase, or blood chemistry testing.[65] Male F344 rats were given crudely peeled Aloe fileet for 5.5 months. At dietary concentrations of 1% or 10% (equivalent to dosages of Aloe vera gel of approximately 0.33 and 3.3 g/kg bw/day), no negative effects were seen on body weight increase, food intake, gastrointestinal transit time, or gross pathology.[66,67] consumption of a modest dosage of 1% for life The rat showed no overt negative effects or negative alterations as a result of the aloe vera fileet.[68]

### Adverse Clinical Effects of the Gel in Humans:

Aloe gels were originally used in therapeutic settings in the 1930s to treat radiation burns.[69] Following

that, various clinical studies of Aloe vera gel in the treatment of burn wounds were conducted[70]. oral lichen planus,[71] hyperlipidemic type 2 diabetic patients,[72] and recurrent aphthous stomatitis.[73] In these investigations, only minimal side effects such as discomfort, pain, and the development of hypersensitive responses were noted. However, a male patient developed extensive eczematous and papular dermatitis after using Aloe vera gel both orally and topically.[74] After applying self-made Aloe vera leaf juice to the legs and eyelids of a 72-year-old lady, pruriginous erythema was seen.[75] After dermabrasion and chemical peel, four patients experienced a very sluggish recovery from dermatitis caused by Aloe vera preparations [76].

### CONCLUSION

Aloe vera stands as a versatile and potent ingredient in hair cosmetics, boasting a rich array of properties that render it a cherished addition to beauty regimes worldwide. Its distribution of nutrients, including vitamins A, C, E, and B12, along with minerals like zinc and magnesium, contributes to its nourishing prowess. Phytochemical compounds such as anthraquinones and polysaccharides offer antioxidant and anti-inflammatory benefits, elevating its therapeutic potential. The medicinal and pharmacological facets of aloe vera are extensive. Its antibacterial, antifungal, and moisturizing attributes make it an ideal candidate for hair care products, promoting scalp health, and strengthening hair strands. Aloe vera gel's chemical composition, primarily comprising water, polysaccharides, glycoproteins, and enzymes, underlies its hydrating and soothing characteristics. The benefits of aloe vera in hair cosmetics are manifold. Its ability to stimulate hair growth, reduce dandruff, and condition hair without leaving a greasy residue make it a favored ingredient in shampoos, conditioners, and serums.

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