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# Aloe Vera Gel

## Definition

Aloe Vera Gel is the colourless mucilaginous gel obtained from the parenchymatous cells in the fresh leaves of *Aloe vera* (L.) Burm. f. (Liliaceae) (1, 2).

## Synonyms

*Aloe barbadensis* Mill., *Aloe chinensis* Bak., *A. elongata* Murray, *A. indica* Royle, *A. officinalis* Forsk., *A. perfoliata* L., *A. rubescens* DC, *A. vera* L. var. *littoralis* König ex Bak., *A. vera* L. var. *chinensis* Berger, *A. vulgaris* Lam. (2–5). Most formularies and reference books regard *Aloe barbadensis* Mill. as the correct species name, and *Aloe vera* (L.) Burm. f. as a synonym. However, according to the International Rules of Botanical Nomenclature, *Aloe vera* (L.) Burm. f. is the legitimate name for this species (2–4). The genus *Aloe* has also been placed taxonomically in a family called Aloaceae.

## Selected vernacular names

Aloe vera gel, aloe gel.

## Description

Succulent, almost sessile perennial herb; leaves 30–50 cm long and 10 cm broad at the base; colour pea-green (when young spotted with white); bright yellow tubular flowers 25–35 cm in length arranged in a slender loose spike; stamens frequently project beyond the perianth tube (6).

## Plant material of interest: liquid gel from the fresh leaf

Aloe Vera Gel is not to be confused with the juice, which is the bitter yellow exudate originating from the bundle sheath cells of the leaf. The drug Aloe consists of the dried juice, as defined on page 33.

## General appearance

The gel is a viscous, colourless, transparent liquid.

## Organoleptic properties

Viscous, colourless, odourless, taste slightly bitter.

### ***Microscopic characteristics***

Not applicable.

### **Geographical distribution**

Probably native to north Africa along the upper Nile in the Sudan, and subsequently introduced and naturalized in the Mediterranean region, most of the tropics and warmer areas of the world, including Asia, the Bahamas, Central America, Mexico, the southern United States of America, south-east Asia, and the West Indies (2).

### **General identity tests**

To be established in accordance with national requirements.

### **Purity tests**

#### ***Microbiology***

The test for *Salmonella* spp. in Aloe Vera Gel should be negative. Acceptable maximum limits of other microorganisms are as follows (7–9). For external use: aerobic bacteria—not more than  $10^2$ /ml; fungi—not more than  $10^2$ /ml; enterobacteria and certain Gram-negative bacteria—not more than  $10^1$ /ml; *Staphylococcus* spp.—0/ml. (Not used internally.)

#### ***Moisture***

Contains 98.5% water (10).

#### ***Pesticide residues***

To be established in accordance with national requirements. For guidance, see WHO guidelines on quality control methods for medicinal plants (7) and guidelines on predicting dietary intake of pesticide residues (11).

#### ***Heavy metals***

Recommended lead and cadmium levels are not more than 10 and 0.3mg/kg, respectively, in the final dosage form (7).

#### ***Radioactive residues***

For analysis of strontium-90, iodine-131, caesium-134, caesium-137, and plutonium-239, see WHO guidelines on quality control methods for medicinal plants (7).

#### ***Other tests***

Chemical tests for Aloe Vera Gel and tests for total ash, acid-insoluble ash, alcohol-soluble residue, foreign organic matter, and water-soluble extracts to be established in accordance with national requirements.

## **Chemical assays**

Carbohydrates (0.3%) (12), water (98.5%) (10). Polysaccharide composition analysis by gas-liquid chromatography (13).

## **Major chemical constituents**

Aloe Vera Gel consists primarily of water and polysaccharides (pectins, hemicelluloses, glucomannan, acemannan, and mannose derivatives). It also contains amino acids, lipids, sterols (lupeol, campesterol, and  $\beta$ -sitosterol), tannins, and enzymes (1). Mannose 6-phosphate is a major sugar component (14).

## **Dosage forms**

The clear mucilaginous gel. At present no commercial preparation has been proved to be stable. Because many of the active ingredients in the gel appear to deteriorate on storage, the use of fresh gel is recommended. Preparation of fresh gel: harvest leaves and wash them with water and a mild chlorine solution. Remove the outer layers of the leaf including the pericyclic cells, leaving a "fillet" of gel. Care should be taken not to tear the green rind which can contaminate the fillet with leaf exudate. The gel may be stabilized by pasteurization at 75–80 °C for less than 3 minutes. Higher temperatures held for longer times may alter the chemical composition of the gel (2).

## **Medicinal uses**

### ***Uses supported by clinical data***

None.

### ***Uses described in pharmacopoeias and in traditional systems of medicine***

Aloe Vera Gel is widely used for the external treatment of minor wounds and inflammatory skin disorders (1, 14–17). The gel is used in the treatment of minor skin irritations, including burns, bruises, and abrasions (1, 14, 18). The gel is further used in the cosmetics industry as a hydrating ingredient in liquids, creams, sun lotions, shaving creams, lip balms, healing ointments, and face packs (1).

Aloe Vera Gel has been traditionally used as a natural remedy for burns (18, 19). Aloe Vera Gel has been effectively used in the treatment of first- and second-degree thermal burns and radiation burns. Both thermal and radiation burns healed faster with less necrosis when treated with preparations containing Aloe Vera Gel (18, 19). In most cases the gel must be freshly prepared because of its sensitivity to enzymatic, oxidative, or microbial degradation. Aloe Vera Gel is not approved as an internal medication, and internal administration of the gel has not been shown to exert any consistent therapeutic effect.

**Uses described in folk medicine, not supported by experimental or clinical data**

The treatment of acne, haemorrhoids, psoriasis, anaemia, glaucoma, petit ulcer, tuberculosis, blindness, seborrhoeic dermatitis, and fungal infections (2, 6, 19).

**Pharmacology**

**Wound healing**

Clinical investigations suggest that Aloe Vera Gel preparations accelerate wound healing (14, 18). *In vivo* studies have demonstrated that Aloe Vera Gel promotes wound healing by directly stimulating the activity of macrophages and fibroblasts (14). Fibroblast activation by Aloe Vera Gel has been reported to increase both collagen and proteoglycan synthesis, thereby promoting tissue repair (14). Some of the active principles appear to be polysaccharides composed of several monosaccharides, predominantly mannose. It has been suggested that mannose 6-phosphate, the principal sugar component of Aloe Vera Gel, may be partly responsible for the wound healing properties of the gel (14). Mannose 6-phosphate can bind to the growth factor receptors on the surface of the fibroblasts and thereby enhance their activity (14, 15).

Furthermore, acemannan, a complex carbohydrate isolated from *Aloe* leaves, has been shown to accelerate wound healing and reduce radiation-induced skin reactions (20, 21). The mechanism of action of acemannan appears to be twofold. First, acemannan is a potent macrophage-activating agent and therefore may stimulate the release of fibrogenic cytokines (21, 22). Second, growth factors may directly bind to acemannan, promoting their stability and prolonging their stimulation of granulation tissue (20).

The therapeutic effects of Aloe Vera Gel also include prevention of progressive dermal ischaemia caused by burns, frostbite, electrical injury and intra-arterial drug abuse. *In vivo* analysis of these injuries demonstrates that Aloe Vera Gel acts as an inhibitor of thromboxane A<sub>2</sub>, a mediator of progressive tissue damage (14, 17). Several other mechanisms have been proposed to explain the activity of Aloe Vera Gel, including stimulation of the complement linked to polysaccharides, as well as the hydrating, insulating, and protective properties of the gel (1).

Because many of the active ingredients appear to deteriorate on storage, the use of fresh gel is recommended. Studies of the growth of normal human cells *in vitro* demonstrated that cell growth and attachment were promoted by exposure to fresh *Aloe vera* leaves, whereas a stabilized Aloe Vera Gel preparation was shown to be cytotoxic to both normal and tumour cells. The cytotoxic effects of the stabilized gel were thought to be due to the addition of other substances to the gel during processing (23).

**Anti-inflammatory**

The anti-inflammatory activity of Aloe Vera Gel has been revealed by a number of *in vitro* and *in vivo* studies (14, 17, 24, 25). Fresh Aloe Vera Gel significantly

reduced acute inflammation in rats (carrageenin-induced paw oedema), although no effect on chronic inflammation was observed (25). Aloe Vera Gel appears to exert its anti-inflammatory activity through bradykinase activity (24) and thromboxane B<sub>2</sub> and prostaglandin F<sub>2</sub> inhibition (18, 26). Furthermore, three plant sterols in Aloe Vera Gel reduced inflammation by up to 37% in croton oil-induced oedema in mice (15). Lupeol, one of the sterol compounds found in *Aloe vera*, was the most active and reduced inflammation in a dose-dependent manner (15). These data suggest that specific plant sterols may also contribute to the anti-inflammatory activity of Aloe Vera Gel.

### **Burn treatment**

Aloe Vera Gel has been used for the treatment of radiation burns (27–30). Healing of radiation ulcers was observed in two patients treated with *Aloe vera* cream (27), although the fresh gel was more effective than the cream (29, 30). Complete healing was observed, after treatment with fresh Aloe Vera Gel, in two patients with radiation burns (30). Twenty-seven patients with partial-thickness burns were treated with Aloe Vera Gel in a placebo-controlled study (31). The Aloe Vera Gel-treated lesions healed faster (11.8 days) than the burns treated with petroleum jelly gauze (18.2 days), a difference that is statistically significant (*t*-test,  $P < 0.002$ ).

### **Contraindications**

Aloe Vera Gel is contraindicated in cases of known allergy to plants in the Liliaceae.

### **Warnings**

No information available.

### **Precautions**

No information available concerning general precautions, or precautions dealing with carcinogenesis, mutagenesis, impairment of fertility; drug and laboratory test interactions; drug interactions; nursing mothers; paediatric use; or teratogenic or non-teratogenic effects on pregnancy.

### **Adverse reactions**

There have been a few reports of contact dermatitis and burning skin sensations following topical applications of Aloe Vera Gel to dermabraded skin (18, 32). These reactions appeared to be associated with anthraquinone contaminants in this preparation (33). A case of disseminated dermatitis has been reported following application of Aloe Vera Gel to a patient with stasis dermatitis (34). An acute bullous allergic reaction and contact urticaria have also been reported to result from the use of Aloe Vera Gel (35).

## Posology

Fresh gel or preparations containing 10–70% fresh gel.

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