

Cosmeceutical applications of Aloe gel

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Abstract

Aloe vera is considered as a cosmeceutical herb i.e. a blend of cosmetic and pharmaceutical product. The gel from its leaves finds a wide range of cosmetic and therapeutic applications which include anti-wrinkle creams, moisturizers, sunscreens, haircare products and wound healing, treatment of burns, frostbite, inflammation, diabetes and cancer. It is also used as protective against radiation exposure and as antimicrobial agent. The present article discusses the chemistry, cosmetic and medicinal applications of Aloe gel and its adverse effects.

Keywords: *Aloe vera*, Cosmeceutical, Pharmaceutical product.

IPC code; Int. cl.⁷— A61K 7/00, A61K 35/78, A61P 17/00

feeling that some of the variable results reported in the literature may be due to treatment of the gel subsequent to harvest (Marshall, 1990; Briggs, 1995; Agarwala, 1997). The emphasis was changing towards the definition of the active constituents, so that they can be used accurately in formulations (Reynolds, 1998).

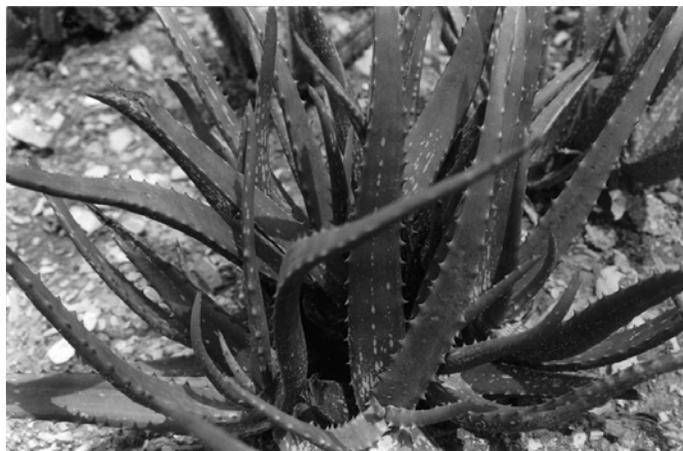
The collected gel degrades very rapidly at room temperature or when exposed to air. The medicinal properties of collected gel also degrade or decompose very rapidly when exposed to heat or air. This degradation can be prevented by drying the gel or by adding suitable preservative and antioxidants or an addition of algal sulphated polysaccharide (Yaron, 1993). The Aloe gel can be dried by freeze-drying or spray drying. The spray drying is done by

Introduction

Aloe plants have been used therapeutically, since 1750 B.C. and different properties were being ascribed to inner, colourless, leaf gel and to the exudates from the leaves. The plant commonly referred as Burn plant, First aid plant or Medicine plant is *Aloe vera* Tourn. ex Linn. (*Aloe barbadensis* Mill.), (Wendell, 2001). Since last decade, interest and use of gel has increased dramatically in the field of health care and cosmetics. Aloe gel has been added to shampoos, bubble baths, after-sun lotions, burn relief products, local antiseptic products, sunscreen products, dry skin lotions, hydrocortisone preparations, antifungal liquids and even to the plastic edges of disposable razor cartridges (Larry, 1995). The gel has been sold in various concentrations and modified products. Due to high interest both clinical and chemical research was

going on in reaching more closely towards the active ingredients and their biological activity. Some harmful reactions of this gel were also recorded infrequently (Hunter & Frumkin, 1991; Schmidt & Greenspoon, 1991).

There was confusion till 1993, between the leaf exudate and the gel. Some researchers clearly distinguish between them (Caposso *et al*, 1998; Watson, 1983) and described how the gel was prepared (Agarwala, 1997). Sometime there was much discussion about the relative efficiency of decolorized and colorized gels (Danof, 1987; Agarwala, 1997). There was also a



Aloe plant

spraying the gel with a suitable matrix to form the powder, which remain stable in air for long term storage. In freeze-drying method it needs minimum 12% of solids for its efficient drying. So gel should be concentrated before freeze-drying, which needs 2 to 10 days. Another method for making powder form is dehydration. The pure aloe fillets are first washed to remove aloin if any present. Then they are placed in the dehydration chamber, where warm air is passed over the fillets to dry them. It looks like lufa sponge, which on grinding form the powder. Normally it takes 2 days for the operation (<http://conaloe.com>). Aloe gel alleviates the itching associated with insect bites and stings, itching of the scalp, prevents scarring, temporarily improves the appearance of the skin cleanses the skin and sunburn. It also has the properties likes moisturizing and nourishing the skin to remove wrinkles, conditioning the hair and prevents dandruff. It is also incorporated in the products like bath powders, first aid sprays, anti-acne preparations, toothpastes, lipsticks, oral rinse and in health drinks.

The Aloe gel composed of water, 99 %; mono and polysaccharides 25% of the dry weight of the gel. The most prominent monosaccharide in the gel is mannose-6-phosphate and the most common polysaccharides are glucomannans (β -(1,4) acetylated mannan) (Shelton,1991). This glucomannan has been isolated as acemannan and marketed by Carringtons Lab as Carrisyn™. Recently an antiallergic properties of a glycoprotein, alprogen (http://www.sachhealth.com/Aloe_Vera.html) and a novel anti-inflammatory compound, C-glucosyl

chromone (Hutter & Salmon *et al*, 1996) has been isolated from the gel. Aloe gel also contains lignan, salicylic acid, saponins, sterols, triterpenoids and vitamins like vitamin A, C, E, B₁₂, thiamine, niacin and folic acid as well as the minerals sodium, potassium, calcium, magnesium, manganese, copper, zinc, chromium, iron, sulphur and germanium (Shelton, 1991). It also contains enzymes such as bradykinase, glutathione peroxidase and superoxide dismutase (Sabeh *et al*,1993). The amino acids present in aloe gel are: alanine, arginine, aspartic acid, glutamic acid, glycine, cysteine, hydroxy proline, leucine, isoleucine, histidine, lysine, phenyl alanine, methionine, serine, threonine, tyrosine, proline and valine. There are three basic types of polysaccharides found naturally in the inner gel of the aloe leaf. They are β -1-4 glucomannan, which is most closely related to cellulose.

Therapeutic properties of gel

Wound healing

Aloe gel has been used both externally and internally for its wound healing effects. Aloe gel provides moisture and make a protective layer on the skin to protect the wound. Aloe gel is topically effective on a wide range of skin conditions including mild cuts and abrasions as well as insect stings, bruises, acne and blemishes, poison ivy, skin ulcers, eczema and burns. It also helps to stimulate healthy cell regeneration and possesses astringent, emollient, antifungal, antibacterial and antiviral properties. Aloe gel is effective in healing of pressure sores (Cuzzell, 1986) and rapid maturation of

collagen in rat by incision wound (Udupa *et al*, 1994). In a study, a skin punch wound healed more rapidly when treated with decolorized gel than with colored gel (Davis *et al*, 1986). When gel injection was given daily to rat it reduced the wound diameter, increased skin circulation and seemed to reduce scarring (Davis *et al*, 1987a, 1989a, 1989b). Topical application of gel stimulates the fibroblast activity and collagen proliferation (Thompson, 1991; Chithra *et al*, 1998a). A low molecular weight component of freeze-dried aloe gel is reported to stimulate blood vessel formation in a chick chorioallantoic membrane, while a methanol soluble fraction of gel stimulated proliferation of artery endothelial cells in an *in vitro* assay and to induce them to invade a collagen substrate (Lee *et al*, 1998). Healing of an excised wound was promoted by topically applied aloe preparation and this was enhanced when the gel was combined with a nitric oxide inhibitor (Hegggers *et al*, 1995). A precipitate formed by treatment with 50% aqueous ethanol seemed to have most of the wound healing activity observed in the raw gel when used against punch wounds in mouse skin. The supernatant liquid glycoprotein showed anti-inflammatory activity. Healing of an incision wound by aloe gel was found to be accompanied by higher levels of hyaluronic acid and dermatan sulphate produced more rapidly. This was the result of stimulation of collagen synthesis and fibroblast activity (Chithra *et al*, 1998). There are reports on increased activity of β -glucuronidase and N-acetyl glucosaminidase, which increase carbohydrate turnover in the wound matrix. Fibroblast proliferation *in vitro*



Aloe leaves pieces



Aloe gel

and *in vivo* was observed after treatment with the acetylated mannan fraction Carrisyn™ (Mc Annalley, 1988). Increased collagen formation is found in wounded diabetic rats treated orally and topically with Aloe vera gel (Chithra *et al*, 1998). Acemannan shows an equal healing and bactericidal effect on shave biopsy wounds (Phillips *et al*, 1995). Effects may also vary with the type and location of wound. Using a proprietary aloe dressing on pad wounds of dogs, it was concluded that healing processes during the first seven days were speeded (Swaim *et al*, 1992).

Effects on burns

Healing of burns was often inconclusive due to inadequate controls and replication and an imprecise correlation of cause and effect. A clinical trial was done by using aloe gel against controlled thermal and radiation burns on rats and rabbits compared with clinical studies on human patients (Ashley *et al*, 1957). The growth of new blood capillaries is a part of tissue regeneration and vascularity of burn tissue of guinea

pig was reestablished by topical application of aloe gel (Heggers *et al*, 1992). The gel was found to penetrate tissue, relieve pain, reduce inflammation and increase blood supply by inhibiting the synthesis of thromboxane A₂, a potent vasoconstrictor. Gel preparations delayed the inflammatory response and speeded the recovery time for first and second degree burns and epithelialization was rapid. Hot plate burns to guinea pig skin healed more quickly after topical aloe gel application and interestingly, the bacterial count was reduced by 60% (Rodriguez-Bigas *et al*, 1988; Kivett, 1989). Gel preparations delayed the inflammatory response and speeded the recovery time for first and second degree burns and epithelialization was rapid but third degree burns proved more intractable (Bunyaphatsara *et al*, 1996a). A synergism was noted between the gel and the cream base used. Partial thickness burns were observed to heal more rapidly when treated with aloe gel, compared with Vaseline (Visuthikosol *et al*, 1995). The topical application of aloe gel to the burn tissue of a guinea pig was observed to be regenerative and vascularity of the burn tissue.

Protection from radiation

Aloe gel has shown protective effects on skin against radiation damage. Topical gel containing acemannan reduced the skin damage when experimental mice were exposed to the gamma radiation (Roberts *et al*, 1995). The animals, which received the gel treatment for at least two weeks immediately after irradiation shows best result. The protective effect was seen in mouse skin exposed to soft X-ray radiation (Sato *et al*, 1990). An antioxidant protein metallothionein was induced in the skin and liver within twenty-four hours of aloe gel administration. Aloe gel was found to scavenge hydroxyl radicals and prevent suppression of superoxide dismutase and glutathione peroxidase in the skin when exposed to X-rays. In mice and in epidermal cell culture an immunomodulatory effect of aloe gel was observed in protecting the skin cells from the damaging effects of UVB radiation. UVB radiation is known to suppress the ability of Langerhans cells in the epidermis to support antibody primed T-cell mitogenesis. In one study, aloe gel

prevented UVB-mediated suppression within the first 24 hours of irradiation in murine epidermal cell culture (Lee *et al*, 1997). Immunomodulatory activity was found in a number of low molecular weight compounds present in aloe gel. A more recent study reports the isolation of these small immunomodulatory substances from aloe gel (Lee *et al*, 1999). Topical application of these compounds prevented UVB-induced immune suppression in mouse skin. UV-induced suppression of delayed type hypersensitivity was prevented by reducing the production and release of skin keratinocyte derived immunosuppressive cytokines, such as interleukin-10 (IL-10) (Byeon & Pelley, 1988). The UVB burns produced with a penlight were unaffected by aloe gel (Crowell *et al*, 1989).

Effect on frostbite

Direct and indirect cellular injury arising from frostbite can be regarded as a type of burns (Heggors *et al*, 1990), which classifies into four degrees. To observe the effect of aloe gel frostbite was produced by exposing rabbit ears to ethanol and solid carbon dioxide; positive effects were noticed (Heggors *et al*, 1993). The main function of Aloe gel in healing frostbite is the reduction of thromboxane levels which is a powerful vasoconstrictor and pain producer (Raine *et al*, 1980). In a clinical trial with humans, 68% of the aloe treated patients achieved full healing, while 33% of those receiving other treatments were fully healed (Heggors *et al*, 1990). Systemic pentoxifylline and topical AG cream were both found to improve tissue

survival in the frostbitten ears of New Zealand rabbits (Miller & Koltai, 1995).

Effect on inflammation

The inflammatory processes are a natural response to injury and may hinder healing. It may also be undesirable to suppress them in an unstructured way before their purpose is accomplished. Inflammation may be caused by invasion of microorganisms. For testing the efficacy of aloe gel or its various components for inflammation tests have been carried out. Aloe gel healed the inflammation produced by croton oil to a great extent (Davis *et al*, 1989b; Davis *et al*, 1991). A low molecular weight component extracted from aloe gel showed the cytotoxic effects similar to barbaloin (Avila *et al*, 1997). Mannose-6-phosphate has shown the anti-inflammatory activity resembling to the activity of acetylated mannan from the gel (Davis *et al*, 1994a). Mustard induced oedema of the paw was reduced 45 to 70% while infiltration of polymorphonuclear lymphocytes into a skin blister was reduced by 58%. Similarly inflammation induced with croton oil in mouse ear was reduced by 67% of topically applied gel (Davis *et al*, 1987b). Aqueous or chloroform extracts of the gel reduced a carrageenan-induced inflammation and migration of neutrophils (Vazquez *et al*, 1996). When aloe gel was injected it decreases 48% of inflammation in the right paw and also inhibiting 72% of immunological response in the left paw (Hanley *et al*, 1982). Lupeol, campesterol and β -sitosterol of aloe gel constituents were found to be significantly anti-inflammatory

in wounded mice (Davis *et al*, 1994b). C-glucosyl chromone is the anti-inflammatory compound recently isolated from aloe gel extracts and it is similar in potency to hydrocortisone when tested in a mouse ear bioassay (Hutter *et al*, 1996).

Adverse effects of Aloe gel

There are some unwanted reactions which occur with aloe gel on topical applications as well as on internal consumption. In some cases severe burning sensations were noted followed by long-term erythema (Hunter & Frumkin, 1991). If aloe gel was contaminated with anthraquinone and administered orally causes symptoms of abdominal cramps and diarrhoea. Several reports on aloe gel say that the plasma glucose level was lowering in human and also in laboratory animals (Ghannam *et al*, 1986; Ajabnoor, 1990). It was postulated in one study that this hypoglycaemic effect was mediated through the stimulation and release of insulin from the β -cells of pancreas (Ajabnoor, 1990). Therefore, caution should be exercised when using oral AG in patients with diabetes.

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