



ALOE VERA: ITS BIOLOGICAL PROPERTIES AND CLINICAL EFFECTIVENESS

Parimal Katolkar and Ekta Wadbudhe*

Kamla Nehru College of Pharmacy, Butibori, Nagpur (MS) 441108 India.

***Corresponding Author: Ekta Wadbudhe**

Kamla Nehru College of Pharmacy, Butibori, Nagpur (MS) 441108 India.

Article Received on 16/09/2021

Article Revised on 06/10/2021

Article Accepted on 26/10/2021

ABSTRACT

The purpose of this review article is to understand more about Aloe Vera, including its biological properties and cosmetic applications. Aloe Vera is a significant ingredient in the culinary, pharmaceutical, and cosmetics sectors, as well as in Ayurveda medicine. Despite the lack of scientific evidence for its therapeutic value, alternative medicine (a commercial product) is sold as having restorative qualities. It can also be used as a moisturiser and anti-irritant for facial tissues. Several research has connected oral administration to clinical success. The processing of aloe Vera leaves includes washing, pre-treating, peeling, and hand filleting. To extract gel from Aloe Vera pulp, cold extraction gel and purification of Aloe Vera gel are utilised. The key operations in the manufacturing of Aloe Vera leaf gel are raw material, filleting, grinding/homogenization, addition of enzyme, filtration, addition of vitamin C and crucial acid, deaeration, pasteurisation, flash cooling, and storing. The quality parameters of Aloe Vera gel are viscosity, refractive index, optical density, stabilisation of Aloe Vera gel, and product preparation from Aloe Vera, and the timing of the leaf process, leaf harvesting and handling, flash cooling, pasteurization, concentration, freeze or spray drying, and clinical effectiveness and cosmetology are important.

INTRODUCTION

Aloe Vera, commonly known as the "miracle" or "wonder" herb, has been used for generations to treat a variety of ailments because the inner gel of its leaves has been used to heal a range of diseases.^[1] In humans, aloe Vera is a potent herbal plant with a wide range of medicinal and pharmacological properties. Many civilizations across the world use aloe Vera for therapeutic purposes. Aloe Vera is an antibiotic that kills or inhibits the growth of bacteria, fungi, protozoa, and other parasitic organisms. Antibiotics either kill or inhibit bacteria, or prevent them from growing and becoming micro biostatic, Aloe Vera is a medicinal plant that looks like a cactus and has fleshy, narrowing, spiky, emarginated leaves that are packed with a clear white sticky gummy gel. Aloe Vera is a tough, perennial, tropical, and drought-resistant succulent plant.^[2] Aloe Vera is a xerophytes plant that grows in subtropical areas and is used for its medicinal benefits in Ayurveda, Homoeopathic, and Allopathic medicine.^[3] Aloe Vera has been utilised for therapeutic purposes for thousands of years. It was used in ancient civilizations like India, Egypt, Greece, Rome, and China. Aloe Vera is an antibiotic that kills or slows the growth of germs like bacteria, fungus, protozoa, and other parasitic organisms. Antimicrobial medications either kill or suppress bacteria, or they prevent them from multiplying and becoming micro biostatic Aloe Vera is a medicinal plant.

Burn plant, first aid plant, and medicinal plant are just few of the labels given to aloe Vera. Its name is derived from the Arabic word "Alloeh," which means "gleaming bitter material."^[4] Aloe Vera has been known and utilised for its nutritional, therapeutic, and skin care or cosmetic properties for millennia. In dermatology, the aloe Vera plant has been utilised for a variety of purposes.^[5] It was seen as a boon to mankind by ancient physicians. Aloe Vera, also known as the "wonder plant" or "nature healer," is a plant full of surprises.^[6] Aloe Vera contains active vitamins, enzymes, minerals, carbohydrates, lignin, saponins, salicylic acids, and other substances. The building blocks of life are amino acids. the most important elements Aloe.^[7] Aloe Vera (Ghrithkumari, Kumara; Hindi: Guarpatha, Ghikanvar) is a perennial succulent xerophyte plant with water-storage tissue in the leaves that allows it to thrive in dry environments with little or no rainfall. The plant has stiff grey-green lance-shaped leaves with a core mucilaginous pulp holding transparent gel. The polysaccharides found in the gel of Aloe Vera leaves are thought to be responsible for the plant's health benefits.^[8] The therapeutic properties of aloe Vera have long been known. The antiseptic and antibacterial chemicals included in Aloe Vera gel have the power to attack, diminish, control, or even eliminate infections since the gel penetrates directly into the deeper layers of the skin. Its analgesic nature contributes to its pain-relieving

effects. Aloe Vera polysaccharides are a vital immune system stimulant and also act as a catalyst for aloe Vera's therapeutic effects.^[9]



Fig. 1.



Fig. 2.

Taxonomy

Kingdom- Plantae
Order- Asparagales
Division- Spermatophyte
Subdivision- Angiospermae
Class- Monocotyledoneae
Genus- Aloe
Species- Barbadensis Mill

Biological source

Aloe is the dried latex of leaves of various species of Aloes, namely:

Aloe barbadensis Miller (or Curacao Aloe);
Aloe ferox Miller (or Cape Aloe);
Aloe perryi Baker (or Socotrine Aloe);
Aloe Africana Miller and *Aloe spicata* Baker (or Cape Aloe).

Family - It belongs to the Liliaceae family.

Morphology

Taste: - Bitter

Odour: - characteristic nauseous.

Size & Shape: - Plant growing to 60-100 cm in shaped with elongation.

Strands Colour: - Leaves are green

Root: - Root fibbers that can reach 30-40 cm in length.^[10]

Anatomy

Each leaf of this plant is made up of three layers: triangular, fleshy leaves with serrated edges; each leaf is made up of three layers:

- 1) An interior clear gel made up of galactomannans, amino acids, lipids, sterols, and vitamins that includes 99 percent water.
- 2) The bitter yellow sap in the intermediate layer of latex, which contains anthraquinones and glycosides.
- 3) A rind is a protective layer of 15-20 cells that synthesises carbohydrates and proteins and serves as a protective covering. Vascular bundles are found inside the rind and are responsible for transporting chemicals such as water (xylem) and starch (phloem).^[11]

Table 1: Active components present in Aloe Vera with properties.^[12]

Constituent	Chemical components	Properties and activity
Fatty acids and steroids	Cholesterol, camp sterol, β sit sterol and lupeol.	All these have anti-inflammatory action.
Anthraquinones	Provide aloe emodin, aloetic acid, alovin, anthracene.	Analgesic, antibacterial.
Enzymes	Anthranol, barbaloin, chrysophanic, ethereal oil, ester of cinnamic acid, iso barbaloin, resistannol.	Antifungal and antiviral activity but toxic at high concentration.
Hormone	Auxins and gibberellins.	Wound healing and anti-inflammatory.
Minerals	Calcium, chromium, copper, iron, manganese, potassium, sodium, zinc.	Essential for good health.
Salicylic acid	Aspirin like compound.	Analgesic.
Saponins	Glycoside.	Cleansing and antiseptic.
Steroids	Cholesterol, campesterol, lupeol, sitosterol antiseptic and analgesic properties.	Anti-inflammatory agents.
Sugar	Monosaccharides- glucose, fructose. Polysaccharide- glucomannans/polyominoes	Antiviral, immune modulating activity Acemannan

Vitamins	Vitamin A, C, E antioxidants contain vitamin B1, B6, B12, folic acid.	Antioxidant Neutralizes free radicals.
Non-essential amino acid	Histidine, arginine, aspartic acid, glutamic acid, proline, glycine, tyrosine, alanine and hydroxyproline.	
Essential amino acid	Methionine, phenylalanine, isoleucine, leucine, valine, lysine.	
Other	Lignin, saponins (soapy substance from about 3% of gel and have cleansing and antiseptic properties)	When an inert material is added to a topical formulation, it improves the penetrative effect.

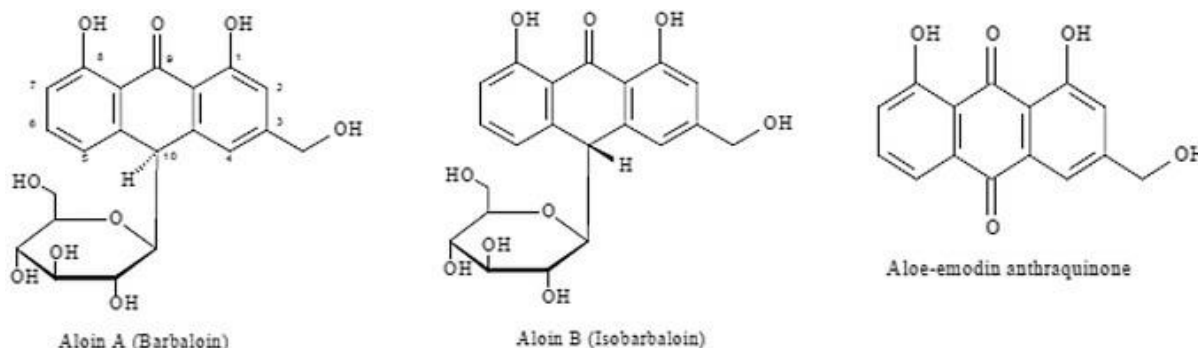


Fig. 3: Aloin A (Barbaloin), Aloin B (Isobarbaloin) Aloe-emodin anthraquinone.^[13]

Hydroxyl anthracene derivatives (HAD) include Rhein, chrysophanol, aloe-emodin, physcion, dianthrone, and anthrone, as well as their glycosides, which are naturally occurring in plants and have an anthraquinone backbone structure. Plant extracts with high quantities of these chemicals are widely employed in traditional herbal medicine or food supplements to improve bowel function because they have significant laxative effects. HAD is found in modest concentrations (less than 1%) in aloe Vera leaves, primarily as aloin (or barbaloin) A, B, and aloe-emodin and is found in the rind (outer green skin protecting the gel) and latex (yellowish discharge from the rind), but not in the inner leaf.

The fundamental characteristic of the Aloe Vera plant leaf is its high-water content, which ranges from 99.0 to 99.5 percent. However, the remaining 0.5 percent to 1.0 percent of the plant leaf is said to contain over 75 potentially bioactive chemicals, including phenolic compounds like aloin. Aloin A and aloin B, also known as barbaloin and isobarbaloin, are Di stereoisomers of a throne C-glycoside aloin, which is a key component of Aloe Vera latex.

Aloe Vera latex has laxative characteristics, and the main compounds responsible for the cathartic actions of Aloe Vera latex in humans and animals are aloin A and aloin B.^[13]

Phytochemical composition

The plant contains flavonoids, terpenoids, lectins²⁰⁻²², fatty acids, cholesterol, anthraquinones, Chromones (8-C-glucosyl-7-O-methylaloe diol, 8-C-glucosyl-noreugenin, Isoaloesin D, isorabachromone, neoaloesin A)^{23,24}, mono and polysaccharides (pectins, hemicelluloses, glucomannan, acemannan, and mannose derivatives)^{25,26}, tannins, sterols (lupeol, campesterol,

and β sitosterol), salicylic acid, organic acids, enzymes, saponins, vitamins, minerals²⁷, aloin, anthrone, aloe emodin (3-hydroxymethyl-chrysazin), aloetic acid, choline and choline salicylate, complex mucopolysaccharides similar to hyaluronic acid, sapogenins and enzymes such as catalase, amylase, cellulase and alliinase. Minerals such as calcium, magnesium, potassium, sodium, aluminum, iron and zinc. Amino acids such as arginine, asparagine, glutamic acid, aspartic acid and serine²⁸. Vitamins such as B1, B2, B6, C, β -carotene, choline, folic acid, α -tocopherol are present. Free monosaccharides consisted of D-mannose and D-glucose in a molar ratio of 5:4 and trace amounts of xylose, rhamnose, galactose, and either arabinose or fucose were found. Mannose 6-phosphate is a major sugar component in aloe Vera.^[14]

History

In Sanskrit, Aloe is known as Ghita Kumari, where Kumar means child, and it was believed that this plant gave women the energy of youth and renewed their nature. In Hindu culture, the Aloe Vera plant is treasured as one of the Atharva Veda's flora, where it is known as "the silent healer." Ayurveda thought aloe to be a body rejuvenator (the ancient Indian science of health and life). According to Ayurveda, aloe Vera has four flavours: sweet, sour, bitter, and astringent. It is utilised for a variety of purposes in Indian Ayurveda medicine, including rejuvenating therapies, menorrhoea issues, and cardiovascular system stabilisation. Aloe is regarded as the pitta, kapha, and vata balance plant, and it is one of the few plants with these characteristics.

Aloe Vera has been used medicinally in Greece, Egypt, India, Mexico, Japan, and China for ages. It was part of the regular beauty practises of Egyptian monarchs Nefertiti and Cleopatra. Alexander the Great and

Christopher Columbus, both used it to cure troops' wounds. John Goodyew's 1655 translation of Dioscorides' medical book *De Materia Medica* was the earliest English reference to Aloe Vera. By the early 1800s, aloe Vera was being used as a laxative in the United States, but it wasn't until the mid-1930s that it was successfully utilised to treat chronic and severe radiation dermatitis.^[15]

Handling of Aloe Vera leaves

Aloe Vera *barbadensis* can reach a height of 100 cm, however most specimens are between 30 and 60 cm tall. It has rosette-shaped thick leaves that grow in a rosette pattern. There is a lot of pulp in the parenchyma cells of the leaves. The serrated-edged fleshy leaves that emerge from the central root grow to approximately 30–50 cm long and 10 cm wide at the base. Every 6 to 8 weeks, the plants can be harvested by removing 3 to 4 leaves per plant. Aloe Vera leaves are generally sensitive to temperatures below freezing. The processing timetable for Aloe Vera is heavily influenced by the weather. The Aloe Vera plant is harvested by pulling back on the green leaf and cutting at the white base. To avoid biodegradation, the Aloe Vera leaf is carefully picked from the mother plant and removed away from the rind.

The microbial degradation of the gel causes the loss of biological activity. When the plant's leaves are harvested, the inner gel is initially exposed to bacteria. Microbial counts in the end product will be considerably increased if the base of the leaf is not intact and sealed. The biological activity of the substance is greatly reduced when the bacteria count is high. The rind of the leaf is another major source of microbial contamination. The gathered leaves were kept chilled in an icebox between 4 and 5 degrees Celsius before being delivered to the processing facility.

Processing of Aloe Vera

Processing of Aloe Vera products, such as heating, dehydration, and grinding, is often required before they may be used. Unfortunately, aloe products contain very little or no active components as a result of incorrect processing, thus it is critical to develop a better technique of preservation to extend the shelf life and maintain the quality of Aloe Vera gel.

Washing of Aloe Vera leaf

When Aloe Vera leaves are collected, dirt and other contaminants are present. For processing and product purity, the yellow fluid discharge from harvested leaves should be fully eliminated from the leaf. With a mechanical washer, the leaves were completely washed with fresh water. Leaves are first washed in a sterilising solution, a 200-ppm sodium hypochlorite solution, in the Aloe Vera processing sector (Waller *et al.*, 2004). When leaves are sent to the gel factory, they are pre-washed in a basin of deionized water if they are excessively dirty. In other circumstances, scrubbing the leaf rind with soft brushes is part of the pre-wash process.

Pre-treatment for Aloe Vera

Processing Sun drying, shade drying, and steaming are all used to cure Aloe Vera leaves. When compared to fresh leaves, two days of sun or shade drying gave the maximum crude gel recovery and the shortest residual period without aloin. They also discovered that mature leaves have a higher crude gel recovery rate than young leaves. Immature leaves take longer to manually as well as mechanically treat for gel extraction. The scrapper method with brine treatment is the best suitable for extraction of gels, according to a study on gel extraction efficiency using various pre-treatments such as brine, lye, water, and without treatment (control).

Peeling of Aloe Vera leaf

Because of the shape of the Aloe Vera leaf, removing the outer skin and rind is the most time-consuming procedure for a mechanical machine. To keep the purity of the products, precautions should be made to avoid contamination of the inner area with exudate secretion.

Hand filleting

In order to avoid contaminating the internal fillet with the yellow sap, the lower portion i.e., 25 mm of the leaf base (the white part attached to the large rosette stem of the plant), the tapering point (50–100 mm) of the leaf top, and the short, sharp spines located along the leaf margins are removed by a sharp knife. The mucilage layer below the green rind avoids the vascular bundles and the top rind is also removed with the help of a knife. The bottom rind is similarly removed.

Gel extraction process from Aloe Vera pulp

To avoid contaminating the internal fillet with yellow sap, the hand-filleting method of processing Aloe leaves was devised. The rind is removed using a sharp knife in this approach, keeping the anthraquinonoid level low, but the majority of the mucilage is left on the working table. The lower 25 mm of the leaf base (the white section attached to the plant's huge rosette stem), the tapering point (50–100 mm) of the leaf top, and the short, pointed spines located along the leaf edges are removed with a sharp knife during the processing step. The knife is then inserted into the mucilage layer behind the green rind to remove the top and bottom rinds, respectively.

The gel extraction from Aloe Vera leaves was done by scraping away the mucilage and extracting the exudates with a blunt edged knife. To make the mucilage consistent, it was vigorously mixed in a blender. This solution was strained and filtered through a muslin cloth. Cold-extracted gel (CEG) and hot-extracted gel (HEG) were both extracted from this homogeneous solution (HEG).

Cold extracted gel (CEG)

The crude gel was precipitated from the extract by progressively adding 95 percent alcohol while stirring and acidifying the solution with hydrochloric acid (HCL)

with a pH of 3.50. Centrifugation was used to obtain the gel.

Purification of Aloe Vera gel

The removal of cellular material from the gel is the next step in the gel processing process. Gel fillets are cut into small chips and sieved to extract the pulp. Gel fillets can also be liquidised and filtered to remove cellular particles, as in the fruit juice business. Only the liquid gel remains once the fibre has been removed. The gel is sold as a commercial product in its cured state, but it can also be blended with activated charcoal, filtered, stabilised (preserved), and dried. Any anthraquinonoid molecules in the gel are eliminated after treatment with activated charcoal. 0.05 percent w/v charcoal is added to 2000 L gel in the A. Vera industry.^[16]

Processing of Aloe Vera Leaves

Basic methods of processing Aloe Vera leaves are

- Traditional hand filleted Aloe processing
- Whole leaf Aloe Vera processing
- Total process Aloe Vera processing

Traditional hand filleted Aloe Vera

The traditional hand-filleting method of preparing Aloe leaves was devised to avoid contamination of the inside fillet with the yellow sap. A sharp knife is used to remove the lower 1 inch of the leaf base (the white part attached to the plant's large rosette stem), the tapering point (2-4 inch) of the leaf top, and the short, sharp spines located along the leaf margins. The knife is then introduced into the mucilage layer beneath the green rind, avoiding the vascular bundles, and the top rind is removed. The bottom rind is removed in the same way, and the rind pieces that still have a large amount of mucilage attached are discarded. A piece of the mucilage layer had gathered on the filleting table's top. This is a major concern because this layer contains the highest concentration of potentially beneficial Aloe constituents, as it represents the constituents synthesised by the vascular bundle cells, which are fuelled by energy generated by sun-induced photosynthesis in the green (chlorophyll-containing) rind cells. Following their synthesis, the components of the mucilage layer are disseminated to the fillet's storage cells (cellulose-reinforced hexagons), a process that is accompanied by dilution due to the water (the predominant fillet constituent) that is stored in the fillet cells. More than 99 percent of the fillet is water. The fillet is then rinsed one more to ensure that there is no bacterial contamination before being inserted into the pulped. When the holding tank is filled, the pulped features a chilled system that reduces the temperature of the resulting juice for optimal conversion; it is left for 24 hours to decant. Each tank is analysed and certified scientifically, which takes about 170 hours. The method for extracting the inner gel from the leaf is crucial. The latex component of the leaf is placed between the rind and the inner gel, as previously stated. Remove the gel from the leaf without disrupting this area so that no latex (aloin) gets into the gel. If latex

gets into the gel, it becomes extremely bitter. This bitter taste can be distinguished from the vegetable taste of the inner gel with little experience. The bitterness of Aloe juice does not imply that it contains 100 percent pure Aloe juice from the inner fillet. If the gel is extracted mechanically, the Latex may mix with the inner gel, causing the purity to be compromised. Only by hand filleting the leaf it is able to cleanly separate the gel from the rind. The pulp is removed when the gel is reduced to a liquid. All of this is done on the farm, so only the freshest leaves are used. Hand filleting takes a lot of time and effort. Because of this, machines have been devised and used to try to replicate hand filleted procedures, although the end result often includes more anthraquinones laxatives than the conventional hand filleted approach.

Whole leaf Aloe Vera processing

The cellulose (skin) is disintegrated, and detectable levels of aloin are extracted, thanks to the whole leaf method used in the production of aloe juice. The entire procedure is completed using a cold process therapy. As a result, maximum efficiency is ensured, resulting in a polysaccharide-rich product. The base and tip of the leaf are removed as before, and the leaf is then split into parts and pulverised into particle slurry. The process of making whole leaf Aloe Vera begins with the whole leaf being placed in a Fitz Mill grinding device, which pulverises it into a soup-like substance. The material is then treated with special chemical products that break down the hexagonal structure of the fillet, releasing the constituents. The rind particles are then removed using a series of coarse and screening filters, or passage through a juice press. The expressed juice is then passed through various filtering columns to remove the undesirable laxative agents. The liquid is then pumped into massive, sterilised stainless steel holding tanks. The aloin and aloe emodin have been taken out. After that, the filtered product is transferred to a second holding tank. This holding tank now has a press filter with five-micron filter paper attached to it. The Aloe liquid is filtered through this media until no residue is visible. Before the Aloe liquid can be stabilised, it must go through a final purification technique called cold filtering.

Total process Aloe Vera processing

The Aloe leaves are manually filleted by the traditional, old-fashioned, labour-intensive way in this new revolutionary approach. The green rinds and mucilage layer from the table top are then treated using a proprietary procedure that was developed recently. Total Process Aloe is created by combining the products of these two techniques, resulting in an aloe product with an enviable high concentration of beneficial elements and almost no unwanted laxative anthraquinones. The exceptional quality of Total Process Aloe is achieved by combining the classic Hand-Fillet process with newly developed proprietary treatment of the traditional methods' trash (green rinds and table top mucilage) and a geographical area where aloe plants thrive. Total Process

Aloe has much greater quantities of total solids, calcium, magnesium, and malic acid, the primary quality parameters used and recommended for certification by the International Aloe Science Council (IASC).

Major Unit Operations in Processing of Aloe Vera Leaf Gel

Reception of raw materials

After harvesting, the Aloe Vera leaves were carried from the field to the processing facility in refrigerated vans. To preserve all of the active components in full concentration, the leaves must be sound, undamaged, mold/rot free, and developed (3-4 years). Seasonal, climatic, and soil fluctuations, on the other hand, have a minor impact on the composition of these active components. Because the dissolution of the gel matrix happens on cutting owing to natural enzymatic processes and the activity of bacteria that are generally present on the leaves, the handling/treatment of the leaves after harvesting is an important element to consider. The end product's quality may be harmed as a result of this degradative process. As a result, the freshly removed leaves must be refrigerated within 4-6 hours or the raw material must be put into production immediately. Visual inspection can provide some information about the quality of a batch of Aloe leaves.

Filleting operation

After the aloe leaf was removed from the plant, the loss of biological activity appeared to be due to enzymatic activity. In fact, it was discovered that aloe gel that had been taken from the leaf was more stable than gel that had been left in the leaf. The filleting procedure must be conducted within 36 hours of harvesting the leaves to avoid biological activity degradation. Non-enzymatic browning of aloe gel products, on the other hand, was caused in part by anthraquinone.

Grinding/homogenization

Crushing or grinding are two of the most important processes in this procedure. At room temperature (25°C), crush and homogenise the aloe gel fillets using a professional high-speed tissue crusher. The longer the crushing/grinding time, the higher the browning index in Aloe Vera gel juice due to the enzymatic browning response. To avoid the enzymatic browning response of Aloe Vera gel, crushing or grinding should be done within 10-20 minutes.

Addition of pectolytic enzyme

Enzymatic treatment of Aloe Vera gel for a long time prior to processing is harmful to biologically active compounds like polysaccharide, which is aloe's most important ingredient. Polysaccharides have been the subject of numerous studies. The enzyme treatment at 50°C for 20 minutes did not result in the loss of biological activity of polysaccharide in aloe Vera gel, according to one study.

Filtration

The stability of Aloe Vera gel juice is affected by this operation. The result, for example, displayed particle sedimentation when the filtration operation lost control.

Addition of vitamin C and citric acid

To reduce browning, improve the flavour of Aloe Vera gel juice, and stabilise it, unpasteurized aloe gel juice was treated with vitamin C and citric acid. To improve the flavour of Aloe Vera gel juice, the pH was changed between 3.0 and 3.5 by adding citric acid.

Deaeration

The goal of the deaeration step is to prevent ascorbic acid from oxidising, extending the shelf life of the Aloe Vera gel juice.

Pasteurization

This stage, like that of other vegetable juice processing, can impact the taste, look, and biological activity of aloe gel products. The HTST treatment (at 85-95°C for 1-2 minutes) is an effective way to keep the Aloe Vera gel's flavour and biological activity.

Flash cooling

The juice is flash cooled to 5°C or below within 10-15 seconds after pasteurisation. This is an important step in preserving the Aloe Vera gel's biological activity.

Storage

Relative humidity and temperature are two most important environmental parameters that affect product quality. Those two parameters can also affect the amount of the volatile substances of the juice absorbed by the packaging material and consequently, affect the shelf-life of the product.^[17]

Quality parameters of Aloe Vera gel

Fibre content, viscosity, refractive index, optical density, and total soluble solid all play a part in determining the quality and purity of the extracted gel from Aloe Vera leaf. A. Content of fibre the amount of fibre in a gel is directly proportional to its purity, and thus becomes a criterion for the efficiency of a gel filtration unit. More fibre content indicates a clogged filtration system. The amount of fibre in crude gel is determined by the difference between crude gel recovery and pure gel recovery. The fibre content ranged from 0.074 to 0.088 percent of the fresh weight of pulp.

Viscosity

The viscosity of the gel is a critical component in determining the quality of biological compound activities. As time passes, the viscosity lowers. The thick pseudo plastic nature of Aloe Vera gel is lost immediately after extraction, possibly due to enzymatic degradation. This is due to the presence of polysaccharides made of a combination of acetylated galactomannans. These findings indicate that various

biological processes are linked to gel viscoelastic behaviour.

Refractive index

The refractive index of a gel is a physical parameter that determines its purity in comparison to double distilled water. The optimum treatment for extraction is a gel with the lowest refractive index.

Optical density

The optical density of a gel is a physical parameter that determines its purity in comparison to double distilled water. The ideal treatment for the extraction process is a gel with the lowest optical density. The presence of contaminants in the extracted gel is indicated by a higher optical density. Aloe Vera leaves had optical densities ranging from 1.020 to 1.437 (abs).

Stabilization of Aloe Vera gel

Unless considerable care is used to solidify the gel, many of Aloe Vera's best properties can be lost in the processing. When extracted, aloe Vera gel, like most natural juices, both fruit and vegetable, is an unstable product that is susceptible to browning and deterioration due to microbial contamination. Sulphated polysaccharides from the red microalga *Porphyridium aeruginosum* are used to stabilise Aloe Vera gel. The solution was then kept at room temperature for 6 months to observe the polysaccharide structure and uniformity. The addition of the algal sulphated polysaccharide resulted in a homogeneous, stable product: the algal polymer may prevent aloe polysaccharide breakdown and browning.

Product preparations from Aloe Vera

Aloe Vera is a commercial crop that has been used in the culinary industry to make health drinks, beverages such as tea, milk, ice cream, and confectionary. Aloe Vera gel is used to make creams, lotions, soaps, shampoos, and facial cleaners in the cosmetic and toiletry industries. It can be difficult to find useful Aloe Vera products. Enzymes begin to break down some of the long chain sugars that make Aloe Vera gel an efficient healing solution once a leaf is cut, therefore the plant must have been treated and stabilised appropriately. Commercial gel products that have been stabilised may not perform as well as fresh gel, however cold processing is thought to improve performance. Although commercially available, stabilised gel products may not perform as well as fresh gel, cold processing is expected to preserve the most advantageous qualities.^[16]

Time Temperature and Sanitation (TTS) Process

The stages of this innovative process technology are discussed

Timing of leaf process

When leaves are held at ambient temperatures for 6 hours after harvest, they begin to lose biological activity. Even if the rate of activity loss is greatly reduced, a drop

in activity is visible when the leaves are chilled. After the leaf is removed from the plant, the activity appears to be lost due to enzymatic activity. In fact, it has been demonstrated that gel retrieved from the leaf is more stable than gel left in the leaf. This means that even at refrigerated temperatures, exporting leaves will result in a loss of biological activity. The TTS production phase's overall time is vitally important. Within 36 hours of harvesting the leaves, the processing must be done.

Leaf harvesting and handling

The microbial breakdown of the gel also contributes to biological activity. When the plant's leaves are harvested, the inner gel is initially exposed to bacteria. Microbial counts in the end product will be considerably increased if the base of the leaf is not intact and sealed. To avoid contamination of the gel, the leaves are carefully handled and bathed in a food-grade sanitizer, which successfully lowers the bacteria count on the leaf exterior to safe levels.

Flash cooling

Following gel extraction, the gel should be cooled below 5°C in 10 to 15 seconds to retain biological activity. Rapid cooling causes the gel to degrade enzymatically and microbial, but it also helps to reduce microbiological levels in the product.

Pasteurization

When the gel is heated to 65°C for less than 15 minutes, biological activity remains active. Longer lengths of time or greater temperatures will result in significantly lower levels of activity. The optimum pasteurisation method is HTST (High Temperature Short Time), which involves exposing the gel to high temperatures for 1 to 3 minutes. The gel is flash cooled to 5°C or below once it has been heated.

Concentration

Without losing biological activity, the gel generated during pasteurisation and flash cooling can be condensed under vacuum. The concentration procedure must be carried out under a 125 mm mercury vacuum at a temperature below 50°C for no more than 2 minutes. Increases in vacuum and temperature, as well as longer concentration durations, will reduce activity.

Freeze or spray drying

Without losing biological activity, the concentrated product can be freeze-dried at temperatures between -45 and 30°C or spray-dried at temperatures below 60°C.^[17]

Clinical efficacy and mechanism of action

Burn wound healing effect

Inflammation is a complex process, then wound healing is much more so and the intervene of aloe gel is likely to be multifaceted. A wound to the skin may pierce two layers, the epidermis and dermis as well as damaging appendages. Aloe Vera may have a direct effect on the wound healing process that Direct impact increases the

rate of wound contraction. Aloe Vera's effect on wound contraction and collagen synthesis has been confirmed. The mannose-6-phosphate found in Aloe vera gel is thought to be responsible for this property. Polysaccharides from Aloe promote both the proliferation of fibroblasts and the production of hyaluronic acid and hydroxyproline in fibroblasts, which play important roles in extracellular matrix remodelling during wound healing. Acemannan, significantly increases periodontal ligament cell proliferation, upregulation of growth differentiation factor, type I collagen and alkaline phosphatase activity in primary human periodontal ligament cells. In a clinical study, to check the efficacy of Aloe Vera gel compared with 1% silver sulfadiazine cream as a burn dressing for the treatment of superficial and partial thickness burns, healing of burn wounds was remarkably early in Aloe Vera treated patients than those patients treated with 1% silver sulfadiazine. Polysaccharides isolated from Aloe Vera induce matrix metalloproteinase (MMP)-3 and metalloproteinase inhibitor-2 gene expression during the skin wound repair of which directly helps to regulate the wound healing activity of Aloe Vera gel.^[18]

Intestinal absorption

Drugs with poor bioavailability due to extensive efflux, aloe material has been used to improve absorption. *Lactobacillus brevis* strains were isolated from naturally fermented Aloe vera gel which inhibited the growth of many harmful enteropathogenesis without restraining most normal commensals in the gut and hence were named POAL (probiotics originating from Aloe leaf) strains; these and exhibit discriminative resistance to a wide range of antibiotics. Aloin, present in the gel, is metabolized by the colonic flora to reactive Aloeemodin, which is responsible for the purgative activity. Aloeemodin isolated from Aloe Vera inhibits colon cancer cell migration by down regulating MMP-2/9 and also inhibits a homolog family member B and vascular endothelial growth factor (VEGF) via reducing DNA binding activity of nuclear factor κ -light-chain-enhancer of activated B cells. Aloe Vera gel has been shown to contain five phytosterols, which are able to reduce visceral fat accumulation, and influences the metabolism of glucose and lipids in animal model experiments, where they reduced large-sized intestinal polyps and ameliorated reduction in plasma.^[19]

Antioxidant effect

Antioxidants found in Aloe Vera include (vitamin E), carotenoids, ascorbic acid (vitamin C), flavonoids, and tannins, and it has been suggested that antioxidant activity may be an essential property of plant medicines used in the treatment of various diseases. Topical Aloe treatment has shown antinociceptive and anti-inflammatory effects in ultraviolet B-induced sunburn model via its antioxidant components present in gel. Administration of ethanolic extract of Aloe Vera gel on tissue antioxidants led to reduction in blood glucose level in diabetic rats, which helps to prevent excessive

formation of free radicals through various biochemical pathways and also reduces the potential glycation of the enzymes. In vitro and in vivo antioxidant potentials of a polysaccharide isolated from A. Vera gel were investigated. Enzymatic extracts were prepared from A. Vera gel using 10 digestive enzymes including five carbohydrates and five proteases. A. Vera leaf skin extracts and a significant correlation was established between the total phenolic content and the antioxidant capacity. The methanol extracts of leaf skins and flowers of A. Vera were also screened for their antioxidant and anti-cytoplasmic activities, and in vitro antioxidant activities of both extracts exhibited antioxidant activity, with the leaf skin extract being the most active.^[20]

Denture Adhesive

One of the key ingredients in Aloe Vera gel is complex mannose carbohydrate, which has a natural stickiness and viscosity. This property prompted the creation of up in both dry and wet conditions. The denture adhesive formulations tested consisted of five combinations of acemannan with varying concentrations of preservatives. The dental uses of Aloe Vera are multiple. It is extremely helpful in the treatment of gum disease; it reduces the bleeding of the gums; it is powerfully antiseptic in gum pockets and its antifungal properties help greatly in the problem of denture stomatitis.^[21]

Other applications in dentistry:

- 1) Direct applications at periodontal surgery sites.
- 2) Chemical burns caused by accidents with aspirin are quickly relieved.
- 3) When aloe Vera is applied to extraction sites, they react well and no empty spaces form.
- 4) Burning mouth syndrome;
- 5) Patients with sore gums and teeth with dentures maladaptive may also benefit;
- 6) Aloe Vera can also be used around dental implants to control inflammation caused by bacterial contamination.^[22]

Anti-inflammatory activity

Inflammation is an innate response of the body against an injury, characterized by swelling, pain, redness and heat, resulting in delay in the healing process. The anti-inflammatory action of Aloe Vera gel not only relieves pain and discomfort, but also accelerates the healing process. The effects observed for acetylated mannan in Aloe gel resembles the anti-inflammatory action of mannose-6-phosphate.¹⁴ Aloe Vera also inhibits the cyclooxygenase pathway, reducing the production of prostaglandins, thereby reducing the inflammation. In a study conducted by the aqueous and chloroform extracts of Aloe Vera were found to have anti oedema effects. Further, they were found to decrease the neutrophil count progressing towards the peritoneal cavity. A. Vera also showed a great anti-inflammatory potential for the treatment of *H. Pylori* infection.^[23]

Effects on skin exposure to UV and gamma radiation

Aloe Vera gel has been shown to protect the skin from the effects of radiation. Though the exact function is unknown, when Aloe Vera gel is applied to the skin, metallothionein, an antioxidant protein that scavenges free radicals, is produced. Prevent the suppression of superoxide dismutase and glutathione peroxidase, the antioxidant enzymes in the skin. Studies reveal that administration of Aloe prevents UV-induced suppression of delayed type hypersensitivity by reducing the production and release of skin keratinocyte-derived immunosuppressive cytokines such as interleukin-10 (IL).^[24]

Effects on the immune system

Alprogen inhibits calcium influx into mast cells, thereby inhibiting the antigen-antibody mediated release of histamine and leukotriene from mast cells. In a study on mice that had previously been implanted with murine sarcoma cells, acemannan stimulates the synthesis and release of interleukin-1 (IL-1) and tumour necrosis factor from macrophages in mice, which in turn initiated an immune attack that resulted in necrosis and regression of the cancerous cells. Several low-molecular-weight compounds are also capable of inhibiting the release of reactive oxygen free radicals from activated human neutrophils.^[25]

Cosmetology importance

Cosmetics are externally applied preparations that change or enhance the beauty of skin, hair, nails, lips, and eyes. Cosmetology is the study of cosmetics and their uses, and cosmetics are externally applied preparations that change or enhance the beauty of skin, hair, nails, lips, and eyes. Aloe Vera has been used to treat infections and burns since ancient times. However, with the improvement in cosmetology, it has been proved that Aloe Vera is a very important component of cosmetics. It contains almost 20 amino acids, minerals like calcium, magnesium and sodium in sufficient quantities, enzymes, vitamins, polysaccharides, nitrogen and other components that make it a miracle beauty herb.

Aloe Vera promotes the development of collagen and elastin, which helps to avoid skin ageing. Aloe Vera is used in cosmetics such as soaps, shampoos, creams, and lotions. Aloe Vera gel lightens dark spots on the face while still reducing the colour of pigmentation. It also helps to repair damaged hair. To make it, simply combine aloe Vera gel and lemon juice. After shampooing your hair, apply this mixture to it. Allow for a 4- to 5-minute cooling period before thoroughly rinsing with water. It speeds up skin repair and hydrates your skin, leaving you with healthy, radiant skin. People with oily skin should avoid the development of pimples.^[26]

Pigmentation

Melanin is the pigment that determines a person's skin colour. Hyperpigmentation is a condition in which a considerable amount of melanin is produced. Excessive

sun exposure to the skin is frequently the culprit. Melanocytes in the skin begin to generate melanin in response to UV radiation in sunbeams. The appearance of darkish areas on the skin is caused by an increase in melanin production. Aloe Vera has the ability to reduce pigmentation and dark patches on the skin.

Direct application of aloe Vera gel to pigmented skin may also help to diminish pigmentation over time. Aloe Vera's key element, aloes in or aloin, could help reduce skin pigmentation, according to a study published in the journal *Planta Medic* Trusted Source that used tadpole cells. More research on human skin, on the other hand, may aid in achieving a better result.

Acne

Aloe Vera works as an anti-inflammatory and immune booster, which helps to get rid of acne scars. Aloe Vera-based beauty products can help to reduce the severity of acne. It also contains chemical components that have the ability to protect the skin from the onset of acne. Aloe Vera gel contains two hormones: Auxin and Gibberellins, which help to treat body acne. These two hormones help to heal wounds and have anti-inflammatory effects, which helps to minimise skin inflammation. Gibberellin is a growth hormone found in Aloe Vera that stimulates the formation of new cells. It allows the skin to recover more quickly and organically, resulting in fewer scars. Aloe Vera is calming and can help the skin heal faster by reducing inflammation, blistering, and itching. Aloe is also utilised in Ayurveda medicine to treat chronic skin conditions such as psoriasis, acne, and eczema. It helps to slow down the ageing process. Everyone becomes concerned about the development of fine wrinkles and the loss of flexibility in their skin as they grow older. Aloe leaves include a variety of antioxidants, including beta carotene, vitamin C, and vitamin E, which can help enhance skin firmness and hydration. Stretch marks are less visible as a result of this treatment.^[27]

Skin Eruption

Aloe Vera-based creams can aid with skin outbreaks. Aloe Vera gels have been demonstrated to be the safest treatment for burns and wounds. Aloe Vera is good for skin eruptions because of its cellular regeneration, antibacterial, and antifungal characteristics.

Aloin and its gel are used to treat pimples on the skin. Aloe Vera is frequently used to soothe and moisturise the skin, which aids in the prevention of flaky scalp and skin in dry weather. Aloe Vera can also be used as a moisturiser for dry skin. According to studies, aloe vera improves the skin's ability to moisturise itself, aids in the elimination of dead skin cells, and acts as a penetrating astringent.^[28]

Scalp and other skin problems

Aloe Vera is really beneficial for skin problems. It can also be used to treat stings, sprains, sunburns, eczema,

aching muscles, arthritis, scrapes, cold sores, scalds, abrasions, psoriasis, bruises, and other skin conditions.

Pimples on the skin are treated with aloin and its gel. Aloe Vera is frequently used to soothe and moisturise the skin, which aids in the prevention of flaky scalp and skin in dry weather. It can also be used as a moisturiser for oily skin. Aloe Vera improves the skin's ability to moisturise itself, aids in the elimination of dead skin cells, and has a penetrating ability that aids in nutrient delivery. Because of all of these factors, aloe Vera is an excellent cosmetic and dermatological component. Aloe Vera is also one of the most widely used substances in the cosmetics sector, accounting for more than 95 percent of dermatologically helpful extracts produced around the world. Moisturizing products are also made with aloe sugars. A mix of essential oils is used to make it. Because of its relaxing and cooling characteristics, Maharishi Ayurveda recommends aloe Vera for a number of skin ailments. Antibacterial and antifungal qualities of aloe Vera extracts make them useful for treating minor skin diseases such as boils and benign skin cysts, as well as reducing tinea Pedis growth.^[29]

Skin aging

Aloe Vera stimulates the production of elastin and collagen. These proteins are necessary for the prevention of skin ageing.

Aloe gel (Muco-polysaccharides) has a cooling effect as well as hydrating properties. It can also help to rejuvenate ageing skin. Aloe Vera gel gloves increased skin integrity, reduced acne wrinkle appearance, and reduced erythema. The applied form of amino acids included in gel softens the tough skin cells. Zinc acts as a pore-tightening astringent.^[30]

Freshness

The skin functions similarly to a large piece of elastic that may expand and contract to support growth. The suppleness of the skin might be affected if it stretches too much, too quickly (due to pregnancy, rapid weight increases or decrease). It's because of this that those unattractive stretch marks appear. These marks form as a result of tiny tears in the skin's layers produced by severe stretching.

Aloe Vera provides you a sense of well-being. It assists in blood transport, making oxygen exchange between cells simpler and so supplying sustenance. Aloe Vera's bioactive characteristics are also medicinal, and the plant has a long history of use around the world. The plant's transdermal characteristics are well-known. It has the ability to reach deeper body tissues, allowing it to absorb all of the Aloe's nutrients into the skin. These strong transdermal and anti-inflammatory qualities can help inflammatory skin conditions like eczema, psoriasis, and acne. Glycol-nutrients also act as humectants, compounds that absorb or aid another substance retain water and moisture, according to the findings. Aloe helps

damaged tissue retain moisture by allowing water and other moisturisers to penetrate deep into the skin, refilling lost fluids and regenerating the fatty layer. Uronic acids (which remove the detrimental effects of poisonous chemicals) can permeate deep into Aloe Vera, making the cleansing astringent characteristics of Aloe more effective.^[31]

Sunburn

Aloe Vera is well-known for its ability to alleviate the agony of sunburn. This is why it's applied straight to the skin. Sunburns can be cured using the plant's fresh juice or after-sun lotions containing Aloe Vera.

Aloe Vera relieves sunburn by acting as a potent healer at the epithelial level of the skin, which is a layer of cells that covers the entire body. It serves as a protective layer for the skin and aids in moisture replenishment. The skin heals faster as a result of its nutritional and antioxidant capabilities.^[32]

Apply a coating of pure gel taken from the inside of an aloe Vera leaf on sunburned skin to soothe it. Aloe Vera plants can be grown at home, or aloe Vera extract can be purchased. When aloe Vera is in 100% aloe Vera gel form and kept cold, it is at its optimum. If you have a sunburn, apply aloe Vera to the sunburned region several times a day. Before using aloe, consult a doctor if you have a severe burn, commonly known as sun poisoning. Sunburns are caused by UV radiation from the sun or artificial sources such as tanning beds, which breaks the DNA within skin cells. The process through which cells die is known as apoptosis. The immune system responds by releasing inflammatory proteins as a result of the fast cell death. To transport immune cells to the wounded skin, blood arteries widen to improve blood flow. The skin becomes red, itchy, and painful as a result of the inflammatory process. The intensity of burns, including sunburns, can be classified as follows:

A first-degree burn affects only the outer layer of the skin, resulting in minor pain, redness, and oedema.

Second-degree burns create blisters and white, glossy skin, as well as damage to the deeper layers of the skin.

All layers of the skin are damaged with a third-degree burn.

The skin is damaged in a fourth-degree burn, which can also affect the joints and bones.

Burns of the third and fourth degrees are medical emergencies that must be treated in a hospital. Do not use aloe Vera to treat third- and fourth-degree burns at home.^[33]

Moisturizing

Aloe Vera can also be used to the skin to moisturise and soften it. There are various products on the market that

contain Aloe Vera that can be used to soften the skin after showering. When aloe Vera gel, cream, or lotion is applied to the face, it forms a delicious barrier against dust and other potentially dangerous natural factors. Aloe contains mucopolysaccharides, which aid in the adhesion of moisture to the skin. Aloe helps fibroblasts to produce collagen and elastin fibres, resulting in smoother, wrinkle-free skin. It also softens the skin by forming a cohesive action on the surface peeling epidermal cells.^[34] moisturising effects of cosmetic formulations containing different concentrations of lyophilised A. Vera gel were studied, showed that only formulations with higher concentrations (0.25 % w/w and 0.5 % w/w) increased the water content of the stratum corneum after a single application. When the formulations were applied twice daily for a period of 2 weeks, all the formulations (containing concentrations of 0.1 % w/w, 0.25 % w/w and 0.5 % w/w of A. Vera gel powder) had the same effect. However, the trans epidermal water loss was not changed by inclusion of the A. Vera gel in the formulations compared to the vehicle used in the formulations. It was proposed that the A. Vera gel containing products improved skin hydration.^[35]

Bacterial and Fungal infection

This happens when a virus enters the stratum corneum and infects the inner layers of the skin. Viral skin illnesses include herpes simplex, shingles (herpes zoster), and warts. Chicken pox and measles are two instances of skin-damaging systemic viral diseases. Virus infections are unaffected by antibiotics.

Infections are caused by bacteria of numerous types, the most common of which are staphylococci and streptococci. Bacteria can infiltrate the top layers, follicles, and deeper layers of the skin. If not treated properly, these infections will spread throughout the body. Examples include: folliculitis, cellulitis, and Lyme disease. Antibiotics are more effective in the treatment of bacterial infections. Harmless fungi are always present on the surface of the skin. Infection occurs when these organisms enter into the body. These infections are usually superficial, affecting the skin, hair, nails and include athlete's foot, lock itch and ringworm. However, in people with suppressed immune system or who have been taking antibiotics for long period the fungi may spread to deep within the body, causing more serious disease.^[36]

Future Prospects

The development of herbal remedies has highlighted the importance of studying the mechanism of action rather than relying on individuals and stories as in the past. Several techniques to utilising the world's herbal abundance in phytomedicine have investigated several compounds from a variety of plants. Even with the few information on mechanism of action, it is obvious that a range of mechanisms are likely to be involved in a specific herbal medicine's varied functions. Since the beginning of time, aloe Vera has been proved to be a

strong contender for usage as a powerful medicinal agent. Aloe gel is well-known for its usage in cosmetics and other areas of medicine, such as its ability to heal cancer and treat AIDS. Plants are used in traditional medicine to demonstrate the presence of medicinal substances. In this light, assessing the biological activity of Aloe Vera and similar plants necessitates a unique technique. A variety of experimental approaches are available to find a potential medication candidate from Aloe Vera. A screening toolbox with two indices has been established, index 1 for screening plant extracts, active components, and pure compounds, and index 2 for drug characteristics, pharmacological, and pharmacokinetic properties. This would both speed up and aid in the selection of relevant screening models. Consideration of the compounds' bioactivity, as well as isolation of their pure forms, necessitates prompt research. Although there is a tremendous opportunity for the development of Aloe Vera, which has a high economic value, there is still a dearth of knowledge about its cultivation and maintenance. The recent water use efficiency research and biomass production in this facility are among the few publications available. Furthermore, bioactivities that have been demonstrated in animal studies should be translated into human clinical trials. This is due to the fact that, with all of the Furthermore, bioactivities that have been demonstrated in animal studies should be translated into human clinical trials. This is because, based on all of the purported benefits, Aloe Vera could be a treatment for a variety of diseases.^[37]

Tissue engineering has attracted much attention as a therapeutic tool aiming at replacing or repairing damaged tissues or organs. Aloe vera has a promising future for tissue engineering applications because of its unique and appealing physicochemical and biological properties. Aloe vera based gels, films, and nanofibrous scaffolds can be prepared with good control on their composition, function, and morphology. Aloe vera has been shown to be useful for tissue engineering as a wound dressing material, drug-eluting implant, and scaffold material. Aloe vera and aloe vera based biomaterials have attracted many researchers around the world because of attractive features, including efficacy of bioactive molecules, biodegradability, biocompatibility, hydrophilicity, and production of mimic ECM structure. However, some fundamental aspects of aloe vera for tissue engineering remain to be explored and improved through in vitro and in vivo studies. It is imperative that important technologies need to be developed to confirm the translational issues on the role of bioactive molecules of aloe vera and their real impact on tissue engineering.^[38]

CONCLUSION

Aloe Vera leaf gel was determined to be a very functional and helpful product with rather astounding biological features of significant interest in the cosmetic, pharmaceutical, and food industries after an investigation into its processing. It also revealed current processing

technologies, such as gel stabilisation, aloe leaf gel biological activity, and the effect of heat treatment on antibacterial, antiviral, and anticancer properties of various aloe Vera gel ingredients that aid in wound healing and the treatment of a variety of oral ailments. To assure the use of numerous therapeutic agents, proper diagnosis and understanding of traditional medicine, as well as application of that knowledge to treatment, are essential. Aloe Vera and its components have properties that can be used to keep skin moisturised and healthy. It's also utilised as a cosmetic to make you look better. A research study using Aloe Vera in the treatment of cancer and diabetic patients has already been approved by the Food and Drug Administration. To determine how beneficial Aloe Vera is, more research will be required.

REFERENCES

1. Akev N, can, a sultupinar N can do Ken E posit, N Ozdenb, T, Y Tamarah, R and been E, twenty year of research on aloe Vera Istanbul universities Eczacilik fakultesi dergisi, 2015; 45: 191-21.
2. Pathak D and Sharma Review on Aloe Vera medicinal plant IJAIE, 2017; 3(1): 661-671.
3. Lanka s review on Aloe Vera the wonder medicinal plant. Journal of drug delivery and therapeutic, 2018; 8(5-s): 94-99.
4. Ahlawat. and Khatkar, B. S, processing, food application and safety of aloe vera products: review. Journal of food science and technology, 2011; 58(5): 525-533.
5. Surjushe, A. Vasani,R.and saple D.G., Aloe Vera short review Indian journal of Dermatology, 2008; 45(1): 163.
6. Mehta, I., history of Aloe vera (a magical plant)."IOSR J Humanti SoC science, 2017; 22: 21-4.
7. Vogler,B.K and Ernst,E., aloe Vera: a systematic review of its clinical effectiveness of general practice, 1999; 49(447): 823-838.
8. Malhotra's, Gupta. K and. pharmacology attributes of Aloe Vera revalidation through experiment and clinical studies. Yu, 2012; 33(2): 193.
9. Satyanarayan,B.C, Banu A and channannavar,G., Efficacy of fresh Aloe Vera gel against multi drugs resistant bacteria in infected leg ulcers. The Australasian medical journal, 2012; 5(6): 305.
10. Pegu,A.J.and Sharma,M.A., Review on Aloe Vera. Int J Trend sci Res Dev, 2019; 3(4): 35-40.
11. Upadhyay R. K Nutraceutical therapeutic and pharmaceutical potential of aloe vera: A review international journal of green pharmacy (IJGPI, 2018; 130(01).
12. Maan, A.a., Nazir, A., Khan,M.K.I., Ahmad,T.,Zia,R.,Murid,M.and Abrar,M., The therapeutic properties and application of aloe vera A review. Journal of herbal medicine, 2018; 12: 1-10.
13. Hu, J, Lloyd, Hobbs, C., Cox, P., Burke, K., Pearce, G, Streicker, M.A., Frankos V., Absence of genotoxicity of purified Aloe vera whole leaf dry juices a by an in vitro mouse lymphoma to assay and in vivo comet assay in male F344 Rats Toxicology report, 2021; 8: 511-519.
14. Boudreau, M. D, Olson, G.R., Tryndyak V.p., Bryant,M.D., Felton,R.P.and Beland,F.A., from the cover:Aloin,a component of the Aloe vera plant leaf,induces v pathological changes and modulates the composition of microbiota in the large intestine of F344/N toxicological science, 2017; 158(3): 302-318.
15. Joseph,B and Raj S J Pharmacognostic and phytochemical properties of Aloe vera linn an overview, 2010.
16. Sikarwar, M.S., Patil, M.B., Sharma, S. and Bhat, V. Aloe vera: plant of immortality. Int J Pharm Sci Res, 2010; 1: 7-10.
17. Chandegara, V.K. and A.K Varshney, Aloe vera L Med Aroma plant, 2013; 3(4): 492-506.
18. Ramachandra C.T. and Rao. P.S processing of aloe vera leaf gel a review American Journal of agricultural and biological sciences, 2008; 3(2): 502-510.
19. Reynolds,T, and A.C Dweck."Aloe Vera leaf gel: a review update. Journal of ethnopharmacology, 68(1-3): 3-37.
20. Grundmann O. aloe vera research review an overview of clinical uses and proposed mechanisms of action nature medicine J, 2012; 4.
21. Radha,M.H.and Laxmipriya, N.P, Evaluation of biological properties and clinical effectiveness of aloe vera: A systematic review journal of traditional and complementary medicine, 2015; 5(1): 21-26.
22. Gupta, A and Rawat, S. clicinal importance of aloe vera research journal of topical and cosmetics sciences, 2017; 8(1): 30.
23. Sajjad, Arbaz, any Samia Subhani Sajjad "aloe vera an ancient herb for modern dentistry A literature review". journal of Dental surgery, 2014.
24. Vazuez,B,Avila G.Segura p and Escalante B antiinflammatory activity of extracts from aloe vera gel journal of ethnopharmacology, 1996; (55): 68-75.
25. Choi,s.and Chung M.H, March. A review on the relationship between Aloe Vera components and their biological effects. In seminar in integrative medicine (bol.1, ni .1 pp.53-62). WB Saunders, 2033.
26. Sahu, P.K., Giri, D.D., Singh, R., Pandey, P., Gupta, S., Shrivastava, A.K. and Pandey, K.D. Therapeutic and medicinal uses of Aloe vera: a review. Pharmacology & Pharmacy, 2013; 4: 599-610.
27. Rajeswari,R., Umadevi,M,Rahale,C.S.,pushap ,R., Selva Venkadesh,S., Kumar, Kumar,K.S. and Bhowmik, D., aloe vera: the miracle plant its medicinal and traditional uses in India. Journal of pharmacognosy and phytochemistry, 2012; 1(4): 118.
28. Qadir, M. I, medicinal and cosmetological importance of Aloe Vera Int J Nat Ther, 2009; 2: 21-26.

29. Nandal. U and Bhardwaj R.L. aloe vera:A valuable wonder plant for plant for Food, medicine and cosmetics use a review.Int J pharm sci Rev, 2012; 13(1): 59.
30. sánchez,M González- Burgos E,iglesias ,l and Gomez- Serranillos, M.P pharmacological update properties of aloe vera and its major active constituents. molecules, 2020; 25(6): 1324.
31. Sandeep Kumar Yadav Medicinal and Cosmetics Uses of Aloe Vera: A Review,Lecturer, Department of Botany, Govt. Dungar College, Bikaner (Raj.), India, 2017; 4(7): 126-127.
32. minjares -Fuentes, R,Femenia,A,Comas Serra F,Rossello,C, Rodriguez to Gonzale V,M.Gonzalez LaredoR.F., Gallegos- Infante J and Medina Torres, L. Different drying procedure on physicochemical properties and flow behaviour of AloeGel.WT, 2016; 74: 378-386.
33. Orafidiya, L.O., Agbani, E.O., Oyedele, A, O., Babalola,A O.O.,Onyemi O and, OandAiyedun. F.F., the effect of Aloe vera gel on the antiacne properties of essential oil of Ocimum gratissimum Linn lead a preliminary clinical investigation. International Journal of aromatherapy, 2004; 14(1): 15-21.
34. Hekmatpou D, mehrabi, K Rahzani, K and Aminiya, A The effectof aloe vera clincical trial on preventive and healing of skin wound a systemic review Iranian journal of medical sciences, 2019; 44(1): 1.
35. Hamman, josisa.H." Composition and application of Aloe vera leaf gel molecules, 1599-1616.
36. Tabassum, N and Jamdani M, plant use to treat skin disease pharmacognosy Review, 2014; 8(15): 52.
37. Danish, P., Ali, Q., Hafeez, M.M. and Malik, A., Antifungal and antibacterial of aloe vera plant extract. Biological and Clinical Sciences Research Journal, 2020; (1).
38. Shekh, R. and PrincetonCand Narayan, B. Aloe vera for tissue engineering applications J. Funct. Biomater, 2017; 8.