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Review Article

A Review on Therapeutic applications of Aloe Species

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Abstract

In modern days, researchers are trying to confirm the scientific way of using these plants in both in vitro and in vivo trials for their therapeutic efficacy, responsible bioactive compounds, toxicology and dosages. Because Aloe species have a naturally occurring color, they are used as thickening agents and in biotechnology applications for textile pretreatment and coloration. Taking into account their numerous health benefits and valuable chemical composition, the Aloe species could be regarded as economically significant matrices for the cosmetics, pharmaceutical, food, beverages, agricultural chemicals, printing, and dye industries. In summary, Aloe species extracts are used to boost the efficacy of various applications.

Key words: aloe species; cosmeceutical applications; pharmaceutical applications; and nutraceutical applications

Introduction:

The *Aloe* plants have been used for food and medicine for thousands of years. Because their preparations, instructions, practices, skills, and knowledge are profitable, traditional medical systems all over the world have a significant role modern development. Many of the traditional uses of *Aloe* species have been confirmed by scientific studies **[1, 2]**. *Aloe* species are commonly used in the production of bioactive compounds, traditional medicine, and commercial food products **[3]**. *Aloes* are produced as lovely plants and contain a wide range of chemical compositions that can be used to make pharmaceutical, personal hygiene, and cosmetic products, as well as medical and beauty products **[4]**. The plant's fleshy leaves, gel, and latex are primarily used commercially in the food, cosmetics, and pharmaceutical industries as pills, jellies, creams, drinks, liquid, sprays, ointments, and lotions **[5]**.

Aloe gel processing from the plant's leaf pulp has become a significant global industrial raw material due to its applications in the cosmetics, pharmaceutical, food, and beverage industries **[6, 7]**. Mesophyll, or "gel," is a colorless, spongy substance derived from the leaves of *Aloe* plants. It is used as a natural product ingredient in foods, household goods, topical medications, and cosmetics, with a significant global market **[8]**.These plants are used industrially for a variety of purposes, including beverages, ice cream, food supplements, and more products **[9]**. Several species of *Aloe* have recently been included in a range of skin and hair care products **[10]**. Numerous products, such as lotions, creams, soaps, shampoos, ointments, pills, and capsules, are made with *Aloe* gel moisturizing and excipient qualities **[11]**. *A. vera*, for instance, is frequently used in toothpaste, mouthwash, shaving creams, deodorants, moisturizers, cleansers, sun lotions, and shampoos in the toiletry and cosmetic industries [**12**]. These days, a lot of companies are industrializing a range of goods made from *Aloe* extracts. However, there is a lack of thorough data illustrating the incorporation of *Aloe* extracts into manufactured goods. Therefore, the current objective is putting comprehensive data for the therapeutic applications of *Aloe* species.

2. Chemical Components of *Aloe* species

A quantitative chemical technique for determining and communicating a food nutritional value is called proximate analysis. As a percentage of dry fuel weight, it presents the fuel's moisture content, ash (minerals), crude fiber, crude fat, and crude protein (total nitrogen) **[13]**. Proximate analysis, also known as "conventional analysis," is a method of nutrient investigation that identifies the gross components as opposed to the specific nutrients, such as monosaccharides, fatty acids, and amino acids **[14]**. Moisture content, crude protein, crude fiber, crude fat, ash content, and carbohydrate make up the proximate composition. *Aloe* species have been found to be high in fat, protein, and carbohydrates in literature, which suggests that *Aloe* species have nutritional value **[15]**.

Aloe species are rich in minerals such as potassium, sodium, phosphorus, magnesium, zinc, iron, manganese, copper, lead, and so forth, as the mineral analysis revealed **[16]**. Determining the amount of ash and minerals in food helps evaluate its nutritional value. It involves identifying the components and confirming whether the food contains certain minerals in amounts that are harmful to the consumer's health, whether those minerals are naturally occurring or have been added to processed, preserved, or other food items **[17]**.

Phytochemical screening determines whether secondary metabolites are present or absent in the in the extract. Basic characteristics of phytochemical

screening include (1) plant parts such as leaves (gel, latex, or skin), roots, or flowers; (2) weather and soil type; (3) harvesting period; (4) extraction solvent (methanol, ethanol, ethyl acetate, chloroform, hexane, etc., or their ratio); and (5) other factors that determine whether phytochemicals are present or absent even for the same plant **[18]**. To display the reports of the phytochemical screening, some *Aloe* species and the part of the plant are taken into account.

Several bioactive compounds which are classified into chromone, anthraquinone, flavonoids, phenylpropanoids, coumarins, phytosterols, naphthalene analogs, lipids and others have been isolated from *Aloe* species **[19]**. The chemical components of *Aloe* have been analyzed using a variety of techniques, including capillary electrophoresis, thin layer chromatography, size exclusion chromatography, gas chromatography, gas chromatography-mass spectrometry, high performance liquid chromatography, liquid chromatography/mass spectrometry, atomic absorption spectrometry, and counter current chromatography. In addition to chromatographic techniques, spectroscopic instruments used to characterize the structure of the isolated compounds **[4, 7, 20]**.

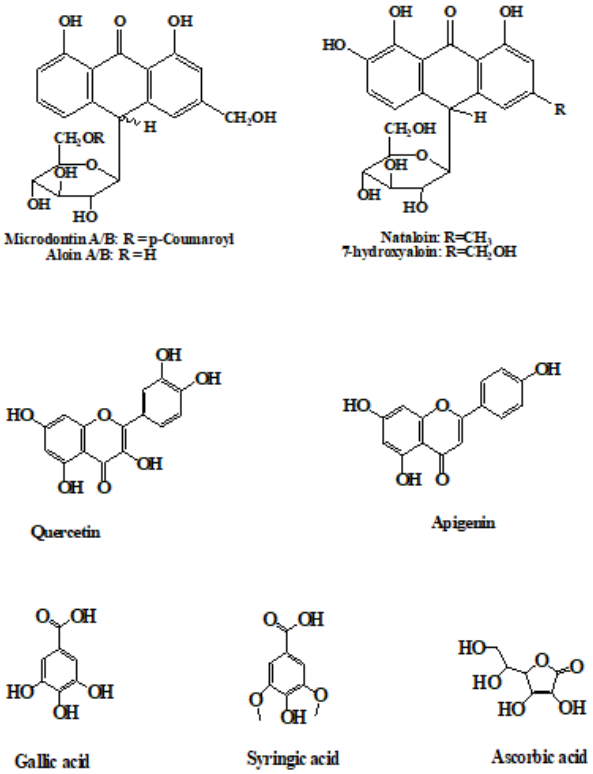

Figure 1: Some compounds isolated from *Aloe* species

Phenolic compounds, carbohydrates, proteins, lipids, minerals, vitamins, enzymes, hydrocarbons, fatty acids, indoles, pyrimidines, aldehydes, and ketones, dicarboxylic acids, alkaloids, and others are among the active chemical constituents found in *Aloe* species. The phytochemicals are what give *Aloe* species their biological activities. *Aloe* species are known for their biological activities, which include anti-inflammatory, anti-cancer, anti-inflammatory, gastrointestinal, hepato-protective, and antimicrobial properties. They are also known for their beneficial effects on skin conditions like wounds and other infectious diseases **[1, 2, 20, 21]**. Because of this, *Aloe* plants have a wide range of applications due to their numerous chemical constituents and biological activities.

Many researchers are currently interested in conducting studies on aloe and related fields of study. For this interest, the three primary elements that are interconnected are: (1) *Aloe* species chemical composition; (2) *Aloe* species biological activity; and (3) *Aloe* species applications. This indicates that the active chemicals found in aloe species are abundant and are in charge of a variety of biological processes. *Aloe* species have a wide range of uses as a result of their diverse biological activities. *Aloe* species are of interest to researchers due to their many applications. Thus, the Aloe-research cycle is made up of these connected points. In general, it can be summed up as follows: the more biological activities and applications a plant has, the more active constituents it has.

3. Applications *Aloe* species

3.1Cosmeceutical applications

Aloe species are used in the preparation of traditional hair washing shampoos which are transformed to preparation of industrial in cosmetic and personal care products today **[22].** *Aloe*s ability to penetrate the epidermis, dermis, and hypodermis, expelling grease and bacteria from pores and inducing new cell production, which speeds up healing, is why the plants used in cosmetics **[23]**. *Aloe* gel is added to cleansers, moisturizers, shampoos, suntan lotions, and sunburn screens in the cosmetics industry. Aloesin has potential as a pigmentation-altering agent for cosmetic and medicinal uses because it inhibits tyrosinase competitively, which modulates melanogenesis **[24]**. *A .vera* gel is widely used in cosmetics, where it is now a key component in product sales. It serves as a foundation for a number of formulations, such as suntan lotions and moisturizers, which are humectants in skin preparations **[25]**. Because *A. vera* has beneficial moisturizing and calming properties, its gel and powder are used in a wide range of cosmetic products, including cleansers, shampoos, and moisturizing creams. One benefit of *A. vera*-based prepared soaps is that they don't irritate skin or leave it feeling parched. *Aloe* extracts are also included in some shaving lotions and creams in the USA and Asia to speed up the healing of shaving wounds. In shaving creams, *A. vera* gel's mucilaginous quality aids in its ability to act as a barrier of defense between the skin and beard **[26, 27]**.

Lotions and sunblocks are used to treat a wide range of skin conditions, including sunburns, flaky or dry skin, hair and scalp issues, psoriasis, stretch

marks, and dandruff. Because of its high nutritional content and antioxidant qualities, *A. vera* is well known for its potent healing activity, even at the epithelial level of the skin. This results in the skin having a protective layer that speeds up healing [**28**]. *A. vera* is applied before mineral-based makeup to prevent the skin from drying out. It is ideal for oily skin because of its moisturizing properties without leaving a greasy feeling behind. Giberellin, a growth hormone found in *A. vera*, promotes the formation of new cells and promotes skin healing with little scarring. Ayurvedic medications for persistent skin conditions like psoriasis, acne, and eczema contain *A. vera* [**29**]. *A. vera* leaves contain antioxidants such as β-carotene, vitamin C, and E, which help to maintain the skin's moisture balance and natural firmness [**26, 30**].

Any product that calls for mildness or moisturizing can benefit from the addition of *A. vera* gel. However, the gel's compatibility with the product system is essential to the development of such products successfully. *A. vera* gel generally works well with non-ionic, cationic, and anionic systems. Anionic systems, on the other hand, can only incorporate a limited amount of gel where quinones can react with the base to discolor the product. Furthermore, the product system may become neutralized if the gel's natural pH is added in a concentration greater than 30% **[31]**.

3.2Pharmaceutical applications

Traditionally people used *Aloe* species for impotence in men, malaria, stomach ache, fire burn, caught, gonorrhea, swollen foot, strain, ascariasis, anthrax, internal parasite, wound, asthima, psychiatric disease, sprain, diabetes, liver disease, and eye aliments. In modern days, researchers are trying to confirm the scientific way of using these plants in both in vitro and in vivo trials for the therapeutic efficacy, responsible bioactive compounds, toxicology and dosages. That means *Aloe* in one form or another is a common domestic medicine and is the basis of most pharmaceutical preparations which lead to drug delivery **[32, 33]**. *Aloe* species phytochemical traits and pharmacological qualities have been thoroughly investigated and assessed **[34]**. A variety of therapeutic activities for gastrointestinal disorders, burns, skin regeneration, inflammation, kidney infections, bladder conditions, asthma, bronchitis, and arthritis have been reported for more than 200 compounds derived from *A. vera* [**35**]**.**

A patent composition for oral administration that aims to reduce appetite and manage weight includes *Aloe* as a main ingredient **[36]**. Aloin, which is extracted from the yellow exudate of leaves, is utilized by certain pharmaceutical industries to make diacerein, a medication that is prescribed for the treatment of osteoarthritis **[37]**. Pharmaceutical companies produce acemannan, a polysaccharide derived from the *Aloe* species **[38]**. Because of its proven medicinal qualities, studies have given *A. vera* more significance, and it is now used to make pharmaceutical products like ointments, tablets, and capsules **[26]**. After gathering, the aloe leaves are thinly sliced, the bitter sap is extracted, sun-dried, and then ground into a powder (known as whole leaf powder). The powder is mixed into the formulation in a ratio of 30–70%, and the remaining portion is made up of bentonite or kaolin. The mixture is then formed into granules or tablets **[2]**.

3.3Nutraceutical applications

The gel and flowers of *Aloe* species are eaten as cooked or raw vegetables traditionally in varies parts of the world. The study evaluated the nutritional value of *Aloe* species and their possible use as a food. Nowadays, incorporating *Aloe* extracts to the raw material of food industry is used to manufacture functional foods, nutraceutical foods, edible coating/films and antimicrobial agent foods **[20]**. Due to the nutritional components of *Aloes*, which include proteins, carbs, lipids, vitamins, minerals, amino acids, and active enzymes that combine to produce these beneficial and biological effects, *Aloes* are also utilized as a food product and beverage ingredient **[29]**. Because it is a new source of bioactive components, *Aloe* species is currently one of the most important ingredients in the food industry. Owing to its advantageous characteristics in managing conditions like constipation, coughs, diabetes, headaches, arthritis, and immune system deficiencies, *A. vera* gel's possible application in the food industry is primarily concentrated on the creation of functional foods **[39]**. Several species of edible aloes are mentioned in the literature for their applications as cooked vegetables, snack foods, famine foods, and preserves ingredients. That does not imply that all aloe species are edible, though **[12]**. Because *A. vera* contains nutrients, a lot of commercial food product manufacturers have increased the use of *A. vera* juice or gel in one way or another **[27]**. *A. vera* gel is used in the nutraceutical industry as a supplement in other food products and as a mineral source for a range of functional foods that are used to make different health drinks and beverages **[11]**.

Because *A. vera* gel is used in the food industry, its processing from the plant's leaf pulp has grown to be a significant global industry **[6]**. *A. vera* is used by the food industry to produce functional goods, particularly yogurt, cranberry, orange, grape, raspberry, pineapple, and strawberry beverages, as well as jam and jelly and health drinks **[40]**. Additionally, *A. vera* gel is used in the preparation of other food products like ice cream, milk, confections, etc. as a food preservative and flavoring **[41]**. *A. vera* appears to hold promise as a safe, all-natural, and environmentally friendly substitute for traditional synthetic preservatives because it has no effect on the taste or appearance of food. To extend the safety and quality of fresh products, *A. vera* gel can be applied as an edible coating **[42]**. *Aloe* gel-coated table grapes considerably slowed down the breakdown of useful substances like ascorbic acid and total phenolic. *A. vera* does, in fact, prevent food spoilage and the growth of microorganisms that cause foodborne illnesses in humans or animals **[26, 43]**. The FDA in the US has authorized gel's internal use as a "dietary supplement." *A. vera* is permitted to be used by the feed industry as a sensory additive functional group known as "flavoring compounds" by the European Commission (EC) in Annex I of Regulation No. 1831/2003 in order to improve the smell or palatability of feeding materials **[44, 45].**

4. Conclusions

It is crucial to conduct more research on the integration of *Aloe* extracts into industrial products based on the traditional applications as these will expand the field of study on *Aloe* species and technology stack such as drug discovery, nano biotechnology, and etc. Thus, taking into account its numerous health benefits and valuable chemical composition, the *Aloe* species could be regarded as economically significant matrices for the cosmetics, pharmaceutical, food, beverages, agricultural chemicals, printing and dye industries. As a result, controlled research will be needed in the future to demonstrate the *Aloe* species efficacy in a variety of settings while maintaining the species. In summary, *Aloe* species extracts are used to boost the efficacy of modern industrial inputs for varies products by combining them with other useful materials.

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