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JPSP JOURNAL OF PLANT SCIENCE AND PHYTOPATHOLOGY
ISSN 2575-0135

Review Article

Food applications of *Aloe* species: A review

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Abstract

Plants have a high concentration of biologically active molecules. *Aloe* plants tend to store water and important chemical constituents in their swollen and succulent leaves due to their ability to survive in hot and dry conditions, which makes them a unique source of phytochemicals. The *Aloe* leaf contains more than 200 nutritional substances, including vitamins, minerals, amino acids, and active enzymes. These constituents are analyzed as phytochemical screening (qualitative analysis) or proximate and mineral content analyses (quantitative analysis). *Aloe* is used as a food product and beverage ingredient. Functional and nutraceutical foods, edible coatings/films, *Aloe* species as cooked vegetables, and raw eating of *Aloe* species are how the *Aloe* plant is considered in food applications. The researchers reported edible *Aloes* for several species. However, it is not mean that all species of *Aloe* are edible. It is not only the leaves of *Aloe* that have nutritional values also other parts of the plant do. The study evaluated the nutritional value of *Aloe* flowers and their possible use as edible flowers. *Aloe* species are increasingly being incorporated into different health drinks, foods, and beverages due to the beneficial biological activities of the phytochemicals.

More Information

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Submitted: April 19, 2022
Approved: May 03, 2022
Published: May 04, 2022

How to cite this article: Yadeta AT. Food applications of *Aloe* species: A review. J Plant Sci Phytopathol. 2022; 6: 024-032.

DOI: 10.29328/journal.jpsp.1001070

Keywords: Food applications; Nutritional substances; Aloe species; Phytochemicals screening; Proximate analysis; Minerals analysis

1. Introduction

Natural products are sources of bioactive compounds with a wide molecular and functional diversity. Plants have a high concentration of biologically active molecules [1]. The physical-chemical properties and activity of natural products are a function of the type of extract, the plant species, the post-harvest conditions, and the raw materials utilized [2]. In addition to that, the plant age, and growth conditions [3], such as geographical distribution, soil quality, water availability, solar radiation, and temperature determine the chemical composition of plants [4]. *Aloe* plants tend to store water and important chemical constituents in their swollen and succulent leaves due to their ability to survive in hot and dry conditions, which makes them a unique source of phytochemicals [5]. Combinations of active molecules extracted from *Aloe* species have been indicated to confer a variety of biological effects with different mechanisms of action [6]. The nutrients and ant-nutrient that have been identified in *Aloe* plants include vitamins, minerals, enzymes, simple and complex polysaccharides, fatty acids, indoles, alkanes, pyrimidines, aldehydes, dicarboxylic acids, ketones, phenolic compounds, phytosterols, and alkaloids with potential biological and toxicological activities [7-9].

Aloe plant leaves, which are the most commonly used medicinal parts, are heterogeneous and can be divided into three major parts, namely: (i) the outer green epidermis, which majorly consists of structural components; (ii) the outer pulp region below the epidermis, consists of vascular bundles where the bitter latex or sap is derived; and (iii) the inner leaf pulp, consists of *Aloe* gel and containing parenchyma cells. Regarding the different compositions of these leaf portions, they are also likely to have distinct classes of bioactive compounds, which are believed to contribute to the different biological properties of leaves [10]. The outer thick layer (rind) consists of 15-20 cells which give protection to the gel matrix and helps in the synthesis of carbohydrates and proteins [11]. The middle layer (latex), a bitter yellow sap contains anthraquinones and glycosides. The inner layer (gel) consists of soft, clear, moist, and slippery tissues having large parenchyma cells [12]. This is a transparent mucilaginous jelly-like material. It contains water (99%), glucomannans, amino acids, lipids, sterols, and vitamins [13]. Although leaves are the most used part of the plant, recently some studies have reported the bioactive roots [14] and flowers [15] of the plant (Figures 1,2).

Aloe species are increasingly being incorporated into different health drinks, foods, and beverages due to the beneficial biological activities of the phytochemicals [18]. Several constituents from various phytochemical classes such

Figure 1: *Aloe* elegans. (Photo taken by Mudin) [16].

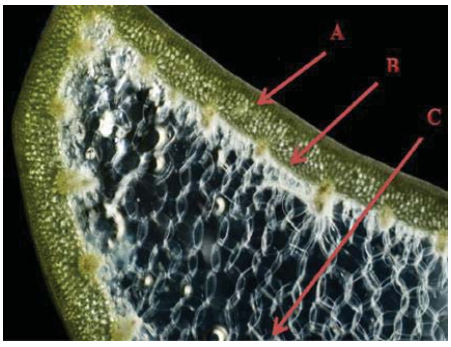

Figure 2: A cross-section illustration of *Aloe* leaf; A: epidermis or the outer rind, B: the outer leaf pulp, sap/exudate (latex) C: mesophyll or the inner leaf pulp (gel) [17].

as alkaloids, anthrones, chromones, flavonoids, glycoproteins, naphthalenes, and pyrones have been isolated from different *Aloe* species [19]. Interest in the antioxidant properties of *Aloe* species is mainly related to their therapeutic and curative uses, however, nowadays there is also growing interest in the use of health-promoting food additives and natural antioxidants for extending the shelf life without the need for synthetic antioxidants [20].

2. Nutritional composition of *Aloe* species

The *Aloe* leaf contains more than 200 nutritional substances, including vitamins, minerals, amino acids, and active enzymes, which work in synergy to bring about these biological and healing effects. *Aloe* is also used as a food product and beverage ingredient [21]. The literature includes references to several species of edible *Aloes*. However, it is not mean that all species of *Aloe* are edible [22]. Nowadays, many commercial food-product producers have pushed up the usage of *A. vera* gel or juice in one form or the other due to its nutrient ingredients [23]. It is not only the leaves of *Aloe* that have nutritional values also other parts of the plant do. The study evaluated the nutritional value of *Aloe* flowers and their possible use as edible flowers [24]. For instance, the overall nutritional content of *A. greatheadii* var. davyana pollen appears to be a good source [25]. But most of the works of literature state the nutritional value of *A. vera*, due to it is widely known and available everywhere.

2.1 Qualitative analysis

2.1.1. Carbohydrates: Several researchers have tried the separation of the *A. arborescens* gel carbohydrate polymers into their polysaccharide components [26]. However, the types and molecular sizes of the polysaccharides extracted from *Aloe* gel appear very diverse which makes to separate. The difference in the previous reports may be due to plant species or different geographical origins, seasonal and cultivar variation, technical differences used to isolate the polysaccharide, or degradation of polysaccharides by endogenous enzyme activity [27-28]. The investigators isolated crude water-soluble polysaccharides from gel juice, skin juice, and flowers of *A. arborescens* by ethanol precipitation and their result indicates that skin juice contained 2.4 times the level of polysaccharides than gel juice from one plant [26].

2.1.2. Protein and amino acids: Glycoproteins have been isolated from Aloe species that possess different bioactivities. Lectins and lectin-like substances having hemagglutinating activity were isolated from *A. vera* gel [29]. The proteins aloctin A (molecular weight of 18 kDa consisting of 7.5 and 10.5 kDa subunits having 18% carbohydrate fraction) and aloctin B (molecular weight of 24 kDa having two 12 kDa subunits and 50% carbohydrate fraction) have also been isolated [30]. Among the eight amino acids essential for humans, seven of them are present in the gel of Aloe. Among 22 amino acids, 20 are present [29].

2.1.3. Lipids: Among the commonly known lipids, fatty acids are bioactive compounds and an important part of the phytochemical content of *Aloe*, being widely used as feedstocks in the food industry [31] Dried *A. vera* (L.) Burm f. flowers are a valuable source of lipid constituents. This study evaluated the nutritional value of *Aloe* flowers and their possible use as edible flowers [24].

2.1.4. Vitamins: *A. vera* gel contains ascorbic acid, carotenoids, tocopherols, vitamin B1 (thiamin), vitamin B2 (riboflavin), vitamin B6, niacin, and folic acid. The majority of these possess antioxidant potential. Minute quantities of vitamin B12 have also been detected in the gel [32].

2.1.5. Enzymes: *A. vera* gel includes at least six different enzymes: cellulose, carboxypeptidase, amylase, bradykinase, oxidase, and catalase. These enzymes help in digestion and aid in the nutrient absorption of the food by decomposition of fats and sugars [29].

2.1.6. Minerals and trace elements: Magnesium, calcium, iron, copper, zinc, and chromium are existent in *A. vera* gel. The antiallergic properties of *A. vera* gel are attributed to magnesium lactate is present. As compared to most other plants, *A. vera* contains greater amounts of potassium and chloride, but a lesser quantity of sodium [29]. Elements in biological sources are more efficient than pure element status [33]. Minerals are nutritive elements that are present in the tissues and fluids of all bodies. Minerals may be classified as

Macro and Micronutrient. The macronutrients are Ca, P, Na, and Cl while micronutrients are Cu, Co, K, Mg, I, Zn, Mn, Mo, F, Cr, Se, and S [34].

2.2.Quantitative analysis

2.2.1. Proximate analysis: Proximate analysis, also known as Weende analysis is a quantitative chemical method of assessing and expressing the nutritional value of a feed. It reports the moisture, ash (minerals), crude fiber, crude fat, and crude protein (total nitrogen) present in the fuel as a percentage of dry fuel weight [35]. Proximate analysis is a system of investigation of nutrients also termed "conventional analysis", which determines the gross components rather than the individual nutrients amino acids, fatty acids, monosaccharides e.t.c. [36]. Generally, proximate analyses give the overall nutritional composition of the sample in question, which is briefly complemented by the antinutrient, and mineral composition of the sample [37].

Moisture content: Moisture determination satisfies the technological, analytical, commercial, and regulatory necessities in the processing, testing, and storage of food products and is an index of economic value, stability, and nutritional quality of food products [38]. The dry matter that remains after moisture removal is commonly referred to as total solids [39]. Therefore, moisture content has great economic importance to a food manufacturer because water is an inexpensive filler. The main feature of all the *Aloe* leaves was their high moisture content [40]. Too much moisture in any sample has been proved to cause caking, especially in flour, and can also determine the storage/shelve life and the viability of microorganisms' growth [37].

Ash content: Ash refers to the inorganic residue remaining after ignition or complete oxidation of organic matter in a biological material [41]. Ash content is a measure of total minerals and is a reliable index of nutritional value for many foods and feed and is recognized as a useful tool in determining the nature and distribution of mineral constituents of the sample [38]. Ash is known as the residue left after all the moisture and organic matter has been removed at high temperatures. Therefore, the high ash content of the plants is generally a measure of mineral richness [42]. The well-studied *Aloe* spp., *A. vera* has high ash content [35].

Carbohydrate content: Carbohydrates biomolecules are present in all foods (grains, vegetables, fruits, and milk), and are classified into simple monosaccharides (fructose, glucose, galactose, sorbitol), oligosaccharides (maltose, sucrose, lactose, raffinose, stachyose, verbascose), and more complex polysaccharides (starch, cellulose, etc.) [38]. These molecules are important in foods as a major source of energy, to impart crucial textural properties, and as dietary fiber which influences physiological processes [39]. Carbohydrates also have contributions, including bulk, body, viscosity, stability to emulsions and foams, water-holding capacity, freeze-thaw stability, browning, flavors, aromas, and a range of desirable textures. They also provide satiety. *A. vera* leaves are a rich source of fibers [40]. *Aloe* species have a high content of carbohydrates. Carbohydrates provide readily accessible fuel for physical performance and regulate nerve tissue [37]. Due to these actions, *Aloe* species have such applications in nutritional values.

Protein content: Nitrogen is the most distinguishing element present in proteins. However, nitrogen content in various proteins ranges due to the variation in the specific amino acid composition of proteins. Generally, proteins rich in basic amino acids contain more nitrogen [39]. *Aloe* species have protein, which would be serving as an enzymatic catalyst, mediate cell responses, and control growth and cell differentiation [43].

Lipid/fat content: Analysis of lipids in foods is important for accurate nutritional knowledge [39]. The analysis of lipids in food has three distinctive objectives: to determine (1) total lipid content, (2) the composition, and (3) the quality of lipids [38]. In living organisms, fats are the usually stored form of energy. They are the main structural element of phospholipids and sterol [44].

Vitamins: Vitamins are defined as relatively low-molecular-weight compounds required in small quantities for normal metabolism. With few exceptions, humans cannot synthesize most of the vitamins [39]. Vitamin analysis of biological samples has played a critical role in determining human nutritional requirements. The presence of important antioxidant vitamin C in *A. vera* has been reported [40].

There are many data that show the total contents of moisture, ash, carbohydrate, protein, and lipid. Many factors affect the values of these parameters even within the same species. Table 1 indicates such values. From the table, it should be considered as leaf powder for both works. That is why moisture content is too minimum than leaf gel.

2.2.2. Minerals analysis: The determination of ash/minerals in food contributes to an assessment of a food's nutritional value and refers to elements and verifying if the food contains some minerals in quantities dangerous to the health of the consumer, whether their presence is natural or adulteration of certain foodstuff/processed or stored food products [38]. Minerals are essential for the proper functioning of tissues and act as second messengers in some biochemical cascade mechanisms [45]. As the mineral analysis showed, *A. barbadensis* is rich in minerals like potassium, sodium, phosphorus, magnesium, zinc, iron, manganese, copper, and lead [37]. The high percent content of potassium and magnesium indicates the ability of *A. barbadensis* to help lower blood pressure [46]. The high sodium content and calcium in *A. barbadensis* indicate its importance in the

Table 1: Proximate parameters of *Aloe* leaves.

Aloe species	Part of *Aloe* analyzed	Proximate parameters' values (%)					Ref.
		Moisture content	Ash content	Carbohydrate content	Protein content	Lipid (fat) content	
A. barbadensis	leaf extracts powder	11.71 + 0.02	2.36 + 0.01	73.08 + 0.04	4.73 + 0.01	0.27 + 0.01	[37]
A.vera (A. *barbadensis)*	leaf extracts powder	10.51	0.5	78.88	0.613	3.5	[44]

Values were reported as *Mean Triplicate + Standard Error*, in the first row.

formation of bones and teeth as well as muscle contraction by calcium. The high value of phosphorus content in this study which is very vital in bone formation indicates the importance of the *A. barbadensis* in our body system [44].

Selenium has been described as an indispensable element with the unique anti-oxidative potential required to sustain the antioxidant defense mechanism in the human body [47]. The reports indicate the presence of Se in *Aloe* gel which makes it effective for nutraceutical applications [48]. Generally, the values of some minerals analyzed from *A. vera* (*A. barbadensis*) are given in Table 2. In both literatures, the value of potassium (K) is high.

3. Food applications of *Aloe* species

In addition to the biological effects on the human body, the antioxidant activity of *Aloe* makes it a safe natural ingredient in food processing to increase the shelf life and nutritional value of food [49]. Literature state several species of edible *Aloes*, for their uses in snack foods, famine foods, as a cooked vegetable, and as an ingredient in preserves [22].

The cultivated species *A. arborescens* and *A. vera* have been used commonly in foodstuffs, especially in dairy products such as yogurt and ice cream, in Asia and the United States. A perceptible increase in the different manufactured food products containing *A. ferox*, such as fruit juice blends and confectionary mirrors the global rise in popularity of *A. vera* leaf mesophyll in food products in South Africa [50]. *A. vera* food and supplement market has grown rapidly in recent years, likely owing to increasing consumer awareness of these purported health benefits [51]. The *A. vera* juice contributes wide application in food and beverage products like production of ready to serve the drink, soft drink, laxative drink, sherbet, *Aloe* sports drink with electrolyte, *A. vera* lemon juice, diet drink with soluble fiber, health drink, hangover drink with B vitamin, amino acids and acetaminophen, healthy vegetable juice mix, tropical fruit juice with *A. vera*, *A. vera* yogurts, *A. vera* mix for whiskey and white bread, cucumber juice with the addition of *A. vera* [52].

Table 2: In both literatures, the value of potassium (K) is high.

	Minerals value											Ref.
	Mg	Ca	Zn	Fe	Mn	Cu	Pb	N	P	Na	K	
Minerals (%)	0.033	-	0.007	0.003	0.013	0.002	0.00017	-	0.665	0.517	1.062	[37]
Minerals (mg/kg)	1.00	0.45	-	-	-	-	-	0.01	5.69	10.00	55.00	[44]

(-) indicates unanalyzed value

3.1. Functional and nutraceutical foods

In the nutraceutical industry, *A. vera* gel is being used as a mineral source for different functional foods and as a supplement in other food products for the production of various health drinks and beverages [48]. The food industry uses *A. vera* in the production of functional products, especially health drinks, yogurt, beverages of orange, grape, raspberry, pineapple, cranberry, strawberry, jam, and jelly [53]. Other food products including ice cream, milk, confectionery, etc. are also prepared using *A. vera* gel as a flavoring component and food preservative [54]. Despite the bitter test of the latex of *Aloe* species, some of them have sweet test flowers that attract insects, birds, and other animals including human beings. *A. greatheadii* var. davyana, is used for migratory beekeepers, who move their hives to the aloe fields to utilize the strong nectar and pollen flow to build up their colonies and obtain a substantial honey crop [55].

Among the *Aloe* species, the most studied *A. vera* has become one of the most important raw materials in the food industry since it represents an emerging source of bioactive components which have different applications [56]. One of the active components of *Aloe,* polysaccharides have prebiotic potential. Therefore, it has been used for the preparation of prebiotic foods [57]. Conversely, the addition of small doses of *A. vera* pulp not only enhanced the nutritional values but also does not affect the taste or appearance of cheese products. In addition to this, it may improve the activity of probiotic bacteria as it serves as a good prebiotic functional material in cheese production [58].

Nowadays, new and modified food and beverages are prepared from *A. vera.* A fermented South Asian dairy product (*dahi*) was formulated by replacing skim milk with *A. vera* gel [59]. *A. vera* gel enriched beverages (sweetened *A. vera* juice, ready-to-serve juices, and squashes) have also been reported which are claimed to have the potential to maintain good health [60]. Other health foods developed from *A. vera* include ice cream, lassi (a traditional fermented dairy beverage of South Asia), mango nectar, and carbonated beverages [61]. *Aloe* species have a different processed form to use as food and drinks. For instance, *A.vera* has been processed as *A.vera* juice, *A.vera* concentrate, and *A.vera* powder in many food applications [52].

In the United States, the Food and Drug Administration (FDA) has approved the internal use of gel as a "dietary supplement". In addition to this, according to Annex I of Regulation No. 1831/2003 of the European Commission (EC), *A.vera* can be used by the feed industries as sensory additive

functional group "flavoring compounds", to increase the smell or palatability of feedings stuff [62].

3.2. Edible coatings/films

One of the simple, non-toxic and biodegradable methods that have been recently tested is the use of edible coatings from natural sources such as plant extracts [63]. Edible coatings are defined as a thin layer of an edible material that can act as a barrier to restrain the exchange of moisture, oxygen, and the solute movement of horticultural products, thus reducing water loss, respiration, and oxidation reaction rates [64]. This means plants such as *Aloes* are used to prepare edible coatings/films due to they are simple, non-toxic, and biodegradable and these coatings/films are used as a barrier to restrain the exchange of moisture, oxygen, and the solute movement of horticultural products, thus reducing water loss, respiration, and oxidation reaction rates, especially in fruits. *Aloe* species such as *A. vera* gel is considered among one the best edible and biologically safe coatings for different food applications due to their film-forming properties and biodegradability. The polysaccharides of *A. vera* act as a natural barrier to moisture and oxygen that are the main agents of the deterioration of fruits and vegetables [11]. As investigated, the post-harvest quality of sweet cherries coated with *A. vera* gel-based coating. The characteristics such as respiration rate, weight loss, color changes, softening, ripening, and stem browning were reduced as compared to uncoated fruits while maintaining the taste, aroma, and flavor [65].

In addition to Table 3, other previous studies have also noted that the use of an *A. vera* gel coating in products such as apple fruit [75], Table grape [76], Nectarine [77], Apricot fruit [78], pomegranate arils [65], Stonefruits [79], Blueberry [80], Tomato fruit [81], Litchi fruit [82], White button mushroom [83] and Fresh-cut guava [84] to reduce respiration rates, moisture loss, softening, microbial decay and maintaining the other quality characteristics which could extend the fruits shelf-life. In addition to the contribution to food safety, the incorporation of *A. vera* gel also prevents them from microbial spoilage. A variety of antimicrobial compounds are present in *A. vera* gel and antimicrobial activity is exhibited due to their synergistic effect [85]. *A. vera* gel can efficiently inhibit the growth of food-borne spoilage and pathogenic microorganisms [86].

3.3 *Aloe* species as cooked vegetables

Flowers that can be consumed by a human being safely are known as edible flowers. The analysis revealed that the nutritional and bioactive attributes make the edible flowers a complete form of nutrition available for human beings and need further exploration for value-added product development [87]. The *Aloe* species have edible flowers [24]. These flowers are either eaten cooked or uncooked. Like vegetables, some *Aloe* species are eaten by cooking their flowers. The flowers of *Aloe boylei* Baker, *Aloe cooperi* Baker, and other species are cooked as a vegetable. The flowers of *Aloe macrocarpa* Tod are eaten by various tribes, and used as a seasoning herb in cooking in West Africa [88].

3.4. Raw eating of *Aloe* species

In addition to functional and nutraceutical foods, edible coating/films, and antimicrobial agent food applications of *Aloe* species, some *Aloe* species are eaten without incorporating them with any other substances. For instance, the gel of *Aloe zebrina* Baker and *Aloe maculata* All., however, is used as famine food in case of an emergency, and the flowers of several species, including *A. ferox*, contain nectar that is eaten by children [89]. In different parts of Africa, flowers of various species are eaten. Young flowering shoots of *Aloe kraussii* Baker and *Aloe minima* Baker are eaten as raw vegetables by Zulus [88]. Most *Aloe* species produce diurnal and tubular brightly colored flowers, usually yellow or red [90]. These flowers produce nectars [91], which are eaten by

Table 3: *A.vera* edible coatings on foods and drinks.

Aloe spp. coating	Coated products	Coating function	Ref.
A.vera gel	kiwifruit slices	Retarding the yellowing process, reducing microbial growth, and improving total pectin and texture retention	[66]
A.vera gel	Papaya fruit	Increase the post-harvest storage life of papaya	[67]
A.vera gel	Sweet cherry fruit	Physical barrier and thus reduced the weight loss and lowered the respiration rate during postharvest storage. delayed color changes, softening and TA losses, maintaining fruit quality.	[68]
A.vera or *A.arborescens*	Peach and plum fruits	Retarding postharvest ripening, which could be attributed to their effect on delaying climacteric ethylene production and quality losses.	[69]
salicylic acid and *A.vera* gel	Orange fruit	Maintained the qualitative characteristics of fruit during storage, Salicylic acid ameliorated chilling injury by fortification of antioxidant systems which reduced the malondialdehyde content and *A. vera* gel suppresses the microbial growth and reduces the deterioration due to bioactive components such as aleonin and aloe-emodin	[70]
A.vera gel	Fish gelatin films	Lowers the solubility of the films significantly without causing a significant change in the thickness, color, and surface microstructure of the films.	[71]
A.vera gel and Spirulina platensis	Mango fruit	Reduced the respiration rate and the weight loss of the mango fruits	[72]
A.vera gel	Pomegranate arils	Maintaining quality parameters of minimally processed arils such as firmness, color, and bioactive compounds.	[65]
A.vera gel with gum arabic, garlic extract, and ginger extract	Puava fruits	Postharvest quality and storability	[73]
A. vera gel with ferulic acid	fresh-cut apples	Delaying quality changes and ensuring the safety	[74]

different living things including humans, especially children due to the sweetness of the flowers [89].

4. Toxicity and safety

The scientific community is divided into two groups regarding the safety of *A. vera* products. One group warns to use *A. vera* with caution and utmost care to avoid contamination of its components due to some components being hazardous, while another group advocates that the *A. vera* is quite safe for human consumption [52]. Although natural products and plants are a good candidate to use in *Aloe* species, it should be considered that they are not as safe as the public thinks, and may cause problems in long-term use. Some species of this genus such as *A. ferox* are potentially toxic [17]. However, most Aloe species are not toxic but a few are extremely poisonous. Therefore, it is necessary to use medicinal plants by evaluating their possible adverse effects [92].

There is insufficient data available to properly evaluate the safety of aloe products [93]. Reports of allergic conditions and hypersensitivity to aloe preparations have been noted and several single-case reports are available [94]. The oral using of *A.vera* with furosemide or digoxin treatment for irregular heart rhythms and congestive heart failure can lower the level of potassium in the body. Hence, it should not be consumed with these drugs. Use of *Aloe* latex or *Aloe* juice for longer periods or in high doses can cause an imbalance of electrolytes – loss of sodium can result in secondary hyperaldosteronism, and loss of potassium can result in hypokalemia leading to fatigue, muscular weakness, weight loss, mental problems and dis-functioning of kidneys [95]. During pregnancy, lactation, or childhood, and for persons suffering from abdominal pain, appendicitis, or intestinal obstruction, *Aloe* should not be used internally [52].

The European Commission presented a report on the advisability of incorporating additional categories of substances into the existing legal provisions allowing the use of herbal substances and preparations in medicines as well as in food supplements by July 2007 [96]. In that report, the dried juice and concentration of leaves were evaluated. Lastly, it was concluded that in view of existing possible risks, such traditional use cannot be recommended and referred to in the "Community list of herbal substances, preparations, and combinations thereof for use of traditional herbal medicinal products [92]." The *Aloe* gel is expensive, therefore it is not surprising that some producers try to increase their business profits by adding water to the *Aloe* components [97].

The food industry has developed Management quality (ISO 9000:2000) and safety systems (HACCP) to certify the biological activity, sensorial constancy, and value of ultimate produce made from *Aloe* [98]. Safety control points include a pasteurization step and addition of vitamin C and citric acid whereas the quality control points include the collection of raw material, filleting step, homogenization, and the addition of pectolytic enzymes, filtration, deaeration, sterilization, flash cooling, and storage [99].

5. Conclusion and future aspects

The analyses carried out on *Aloe* plants indicate their nutritional and phytochemical composition. The miraculous medicinal plant Aloe has been proved to be a good source of water, carbohydrate, protein, lipids, vitamins, enzymes, and minerals. All of them are good indications of high nutritive value. It could, therefore, be used as an important dietary source of nutrients in a food-based approach for combating nutrient deficiency. Despite the presence of some Anti-nutrient that could serve as mineral inhibitors, Aloe species can still be used as sources of these minerals. The Phytochemical content is also an indication as the plant has a potential protective agent against degenerative diseases.

The *Aloe* plant owing to its beneficial therapeutic effects has found wide applications in a variety of products including food applications. Its consumption in various fields can be maximized by developing appropriate processing techniques. It is expected that its applications will increase with time. However, there are some complications linked to the use of *Aloe* that needs to be addressed precautions need to be considered while using aloe in some specific conditions and with some specific compounds. It is recommended that its continuous use for an extended period should be avoided to avoid any possible complications.

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