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Aloe vera Gel - As an Edible Coating for Post Harvest Application on Fruits: A Review

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A B S T R A C T

Nowadays, fruits and vegetables have high demand in market because of its nutritional value but they are highly perishable as they contain 80–90% water by weight. About 30% fruits and vegetables are affected by insects, microorganisms and during transportation and preservation. Preservation of fruits and vegetables is a big challenge for the world. Edible coating is an effective method to solve this problem. It extend the shelf life of fresh fruits and vegetables by reducing moisture and solute migration, gas exchange, respiration, and oxidative reaction rates as well as by reducing or even suppressing physiological disorders.

Introduction

Edible coating is a thin layer of edible material applied to the product surface in addition to or as a replacement for natural protective waxy coatings to provide a barrier to moisture, oxygen, and solute movement for the food (Pramod *et al.,* 2016). *Aloe vera* leaves contain 2 parts: Aloe juice (contain: Anthraquinone glycosides: aloin, aloe-emodin, barbaloin) and Soft, colourless inner gel parenchyma. The polysaccharide present in *Aloe* gel is believed to have antiviral properties. Mannose 6-phosphate is a major sugar component present (Luta and Analley, 2005).

The botanical name of Aloe is *Aloe barbadensis* miller. It belongs to Asphodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, xerophytic, succulent, pea-green color plant. The aloe plant has long (up to 20 inches long and 5 inches wide), triangular, fleshy leaves that have spikes along the edges. The fresh parenchymal gel from the center of the leaf is clear; this part is sometimes dried to form aloe vera concentrate or diluted with water to create aloe juice products. The sticky latex

liquid is derived from the yellowish green pericyclic tubules that line the leaf (rind); this is the part that yields laxative anthraquinones.

The flowers (not used medicinally) are yellow. Aloes are indigenous to South Africa and South America, but are now cultivated worldwide except in tundra, deserts and rain forests.

Action of edible coatings

Fruits and vegetables continue to respire even after harvest and use up all the oxygen within the produce and carbon dioxide accumulates within the produce because it cannot escape as easily through coating. Eventually the fruit and vegetable will shift to partial anaerobic respiration that requires less oxygen (1–3%). With less oxygen, the production of ethylene is disrupted and physiological loss of water is minimized. Thus, the fruits and vegetables remain firm, fresh, and nutritious for longer period and their shelf life almost doubles.

Properties of edible coating

The coating should be water-resistant so that it remains intact and covers a product adequately, when applied.

It should not deplete oxygen or build up excessive carbon dioxide. A minimum of 1–3% oxygen is required around a commodity to avoid a shift from aerobic to anaerobic respiration.

Improve appearance, maintain structural integrity, improve mechanical handling properties, carry active agents (antioxidants, vitamins, etc.) and retain volatile flavor compounds.

It should be easily emulsifiable, non-sticky or should not be tacky, and have efficient drying performance.
It should never interfere with the quality of fresh fruit or vegetable and not impart undesirable order.

Fruits which has been coated

Fruits which has been coated are- Orange, Apple, Grapefruit, Cherry, Papaya, Lemon, Strawberry, Mango, Peach etc. and fresh-cut Apple, fresh-cut Peach, fresh-cut Pear etc.

Different types of edible coatings

Hydrocolloids

Hydrocolloids are hydrophilic polymers originated from animals, vegetables, microbial or synthetic, they are hydrophilic polymers (Fig. 1). They have hydroxyl group and may be poly electrolytes such as Alginate, Carrageenan, Pectin, Carboxy Methyl Cellulose, Xanthan gum and Gum Arabic. Today, hydrocolloids are used in wide range as a coating forming solution to coat and control the colour, texture, flavour and shelf life of fruits and vegetables. Generally, all hydrocolloids are partially or completely dissolve in water and principle use of this is to increase the viscosity of the aqueous phase (continuous phase) i.e., gelling agent thickness (Pramod *et al.,* 2016). They act as an emulsifier due to this stabilising effect. The hydrocolloids are divided into two classes; Polysaccharide-based edible coating (gum, starch, pectin etc) and protein based edible coating (collagen, gelatin, zein etc).

Lipid

The lipid based edible coatings are used from many years for preservation of fruits and vegetables. They provide shiny and glossy appearance to food. Most common lipid based coating materials are carnauba wax, bees wax, paraffin wax, and mineral or vegetable oil. Lipids are having good water barrier capacity (Morillon *et al.,* 2002). Wax coatings contain very good moisture barrier properties as

compare to other lipid based coating and non-lipid coating. Oil, fat and wax based coatings are not easily applied to the surface of fruits and vegetables because of its greasiness and thickness and it gives rancid flavour (Robertson, 2009). Combination of lipid and polysaccharides, protein are used in coating material improve their barrier properties. Lipid based coating materials are waxes (carnauba wax, bees wax, paraffin wax) and fatty acids.

Composites

Composites contain combination of protein, polysaccharides and lipid based material. This is used to enhance and improve mechanical strength, moisture and gas barrier properties of edible coatings and films (Phan *et al.,* 2008). Composites are divided into two categories; Bilayer composites and conglomerates.

Herbal edible coatings

Herbal edible coating is a new technique for food industry. It is made from herbs or combination of other edible coatings and herbs, most common herbs used in edible coatings are such as *Aloe vera gel*, Neem, Lemon grass, Rosemary, Tulsi and Turmeric (Pramod *et al.,* 2016). Herbs have antimicrobial properties, it consists vitamins, antioxidants and essential minerals. Recently *Aloe vera* gel is widely used in coating on Fruits and Vegetables, because of its antimicrobial (against bacteria, fungi and viruses) property (Ibrahim *et al.,* 2019), it also reduces loss of moisture and water.

Beneficial effects of *Aloe vera* gel on coated fruits

Forms a moisture & O_2barrier over the fruit. Edible coating form a thin film over fruit and improve quality, can be safely eaten and don't add unfavorable properties (Pramod *et al.,* 2016). Have anti-microbial property, reduced spore survival by 15-20 % in *Penicillium, Botrytis and Alternaria* (Saks and Barkai, 1995) and mycelial growth by 22-38 % in *Rhizoctonia, Fusarium and Colletotrichum* (Rodriguez *et al.,* 2005).

Aloe gel alone is more efficient in prevention of the decay caused by *Rhizopus stolonifer, Botrytis cinerea* and *Penicillium digitatum* than *Aloe* in combination with thymol (Ibrahim *et al.,* 2019).

Effect of *Aloe vera* gel coating on physico-chemical properties of fruit

Reduces gas exchange and loss of water

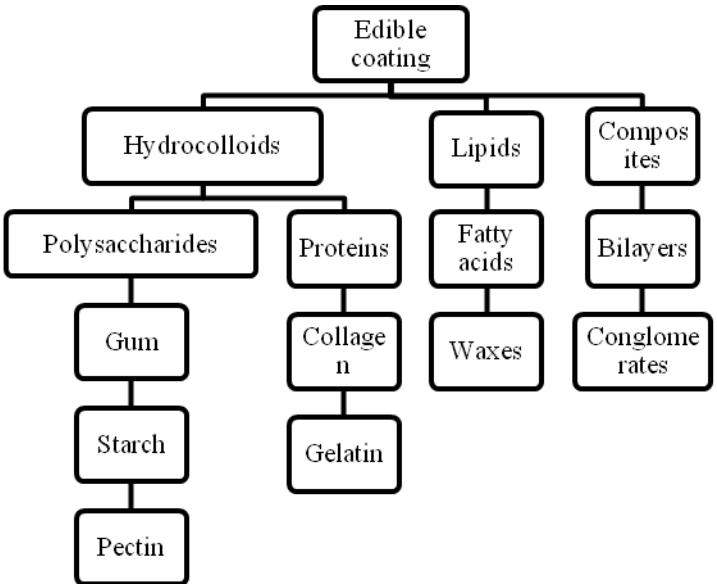
This is due to hygroscopic property of Aloe gel that forms a barrier to diffusion of gas and water between the fruit and the surrounding environment.

Thus, preventing its external transferences. Interestingly, *Aloe vera* gel mostly composed of polysaccharide which is highly effective as a barrier against moisture loss without incorporation of lipid.

Retains the original colour of the fruit: The modified atmosphere created by the *Aloe vera* gel coating material retarded the ethylene production rate, therefore, delaying ripening, chlorophyll degradation, anthocyanin accumulation and carotenoid synthesis thus ultimately delaying color change of fruits (Misir *et al.,* 2014).

Reduces the firmness losses by reducing the activity of cell wall degrading enzymes (Misir *et al.,* 2014). Lower increase in total soluble solids due to reduced respiration there by metabolism of sugar (Misir *et al.,* 2014).

Fig.1



Greater titrable acidity content retention of coated fruits: due to low oxygen permeability of coating which delay the deteriorative oxidation reaction of organic acid content (Misir *et al.*, 2014).

Aloe vera gel: A promising alternative to synthetic preservative

A section of unscrupulous traders use carbide in fruits like bananas, pineapples, oranges, grapes, apricots, papayas etc. to keep them fresh. They also use textile dye in papaya, pomegranate and other fruits. Harmful plant growth hormones and chemicals are also indiscriminately used in fruit orchards. To ripen faster, papaya fruits are dipped into calcium carbide and ethephone. These chemicals are highly toxic and pose great risk to consumer's health

Aloe vera gel is an edible, invisible, odorless and does not affect the taste of fruits and vegetables on which it is applied.

It also poses no risk to human health. It holds the potentiality to preserve fruits effectively due to its anti-microbial action. By this we can say that, *Aloe vera* gel is a promising alternative to synthetic preservative.

Preparation of *Aloe vera* gel

Harvest mature, sound, undamaged, mold/rot free and matured (3-4 years) leaves in order to keep all the active ingredients in full concentration. Wash with mild chlorine solution (25 %). Separate gel matrix from outer cortex of leaf later grind the colorless hydro-parenchyma in blender or commercial high speed tissue crusher at room temperature (25°C). Filter to remove the fibers and to obtain fresh *Aloe vera* gel. To this add Ascorbic acid (1.9-2.0 g/L) to avoid browning reaction, to improve the flavor of *Aloe vera* gel juice and to stabilize the juice and also add Citric acid (4.5-4.6 g/L) to maintain pH at 4.

Pasteurize at 70°C for 45 min or at 85-95°C for 1-2 min. The juice is flash cooled to 5°C or below within 10-15 sec. This is a crucial step to preserve biological activity of the *Aloe vera* gel. To this add 1 % commercial gelling agent to improve viscosity & coating efficiency. Stored in brown amber colored bottle (Prevents oxidation) (Misir *et al.*, 2014).

Aloe vera gel is an appropriate alternative to the conventional wax/other coatings with incorporated fungicides. Having natural biocidal activity, it is effective against the fruit spoiling fungi. Reduces the PLW of fruits to a greater extent due to hygroscopic nature of *Acemannan*. Retards the ripening process by creation of modified atmosphere around the fruit surface. Retains the firmness of many fruits due to its activity against cell wall degrading enzymes.

Efficacy of *Aloe vera gel* extracts on all fruits has to be tried. The active compounds responsible for anti fungal activity should be studied, Other *Aloe spp.* have to be exploited for their varying bioactive components and the inhibiting concentrations of *Aloe* gel for particular fungi should be standardized.

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