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Edible Coating: An Innovative Technology for Extending Shelf Life of Fruits and Vegetables

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SUMMARY

Nowadays, fruits and vegetables are highly demanded in the market because of its nutritional value. Fruits and vegetables are perishable commodities requiring technologies to extend their postharvest shelf life. About 25-30% fruits and vegetables are affected or damaged by insects, microorganisms, pre and post harvesting conditions during transport and preservation. So, preservation of fruits and vegetables is a big challenge for world. Edible coating is an effective method to solve this problem. Edible coatings are an eco-friendly technique, which slows deterioration of fruits and vegetables by controlling gas exchange, moisture transfer, and oxidation. Major advantage of these coatings is to improve nutritional and sensory quality of food by incorporating active ingredients into the polymer matrix that are consumed with food products. It positively affects physical (moisture retention, glossiness, appearance, firmness), physiological (respiration rate, ethylene evolution rate), and biochemical (cell wall degrading enzymes) attributes of fruits and vegetables.

INTRODUCTION

Fruits and vegetables are essential constituents of daily diet and are highly demanded in the recent years from most of the population. They are reservoir of vitamins, essential minerals, antioxidants, bio-flavonoids, dietary fibres and flavour compounds which fall easily victim to abiotic and biotic adversities. Fruits and vegetables are extremely perishable and more susceptible to postharvest spoilage due to high moisture content (80%–90%) limiting storage period and marketing life and causing economic loss (Dhall, 2013). The postharvest loss of fresh fruits and vegetables are estimated to be 20–30% (Sharma *et al*., 2019).After they are harvested, fruits and vegetables continue the respiration process, consuming O_2 and releasing CO_2 and water. Consequently, lipids, proteins, organic acids, and carbohydrates are metabolized and energy replacement is compromised, as the vegetable or fruit is separated from the mother plant. Over time, quality characteristics such as color, flavor, weight, nutritional value, and bioactive compounds continue to deteriorate as a result of senescence. The water released during the respiration process plays an important role in the postharvest quality of fresh fruits and vegetables and can result in loss of nutritional value, soft texture, sagging, wrinkling, and withering (Nunes and Emond, 2007).

Owing to big losses in harvested fruits and vegetable, farmers are facing income losses all over the world. Hence, there is a need to adopt advance techniques and post-harvest processing to reduce these losses which are quantitative and qualitative as well.One of such promising postharvest treatment used for extending the market life of lively respiring horticultural produce is 'Edible coating technology'. Edible coatings indicate the application of commercial food grade waxes or films to protect the loss of natural glossiness during the postharvest period. The best part of the edible coating is that these are edible, healthy and biodegradable in nature, unlike other chemical postharvest treatments which leave a residue (Kumar and Kapur, 2016).Edible coatings have high potential to control browning, discolour activity, off flavour, microbial activity of fruits and vegetables. In present years, new edible films and coatings have been developed with the addition of natural and edible herbs, antimicrobial compounds to store the fresh fruits and vegetables. It helps in controlling the maturation, development and respiratory rate.

Definition of edible coating:

Edible coating is defined as are thin layers of edible material applied to the product surfaces as a replacement for natural protective waxy coatings that extends the storage life of fresh fruits without anaerobic conditions and reduces the decay without affecting the quality of the produce. These coatings allow that exchange of gases along with other features that maintain freshness, flavor, aroma, texture and nutritional value.

Need of edible coatings

- Edible coatings offer a number of advantages over synthetic coatings. Some are mentioned below:
- Edible films and coatings act as barrier to gases and moisture that creates modified atmosphere within the fruit and which, in turn, extends the shelf life and retains the quality of fresh fruits and vegetables.
- These also act as a barrier against microbial invasion and hence contribute towards hygiene.
- Several active ingredients such as anti-browning agents, colorants, flavors, nutrients, spices can be incorporated into the polymer matrix and consumed along with the fruits, thus enhancing safety or even nutritional and sensory attributes.
- The edible coatings help in the reduction of synthetic packaging waste, because of their biodegradable nature.

Classification of Edible Coatings

The edible coatings are classified into three types based on the derived sources (Mahajan *et al*., 2018):

Edible coatings based on biomolecules

Edible coatings can be prepared from biomolecules such as polysaccharides, proteins and lipids. These can either be applied as thin film to form wraps or pouches, or as coatings on food. Coatings derived from different type of biomolecules are discussed below.

Polysaccharides

Starch and starch derivates, cellulose derivates, alginate, carrageenan, chitosan, pectin, and several gums are the main polysaccharides that can be included in edible coating formulations.

Proteins

Protein based edible coatings are mostly found from plants and animal. The plant-based protein edible coating material: corn-zein, wheat gluten (WG), soy protein, whey protein, pea protein, rice bran protein, cotton seed protein, peanut protein, and keratin. The animal-based protein is milk protein casein, egg albumen, collagen etc. Protein based edible coating consist excellent barrier properties for oxygen, aroma, and oil and it gives strength but it is not effective for moisture barrier.

Lipids

Lipids based coatings generally have good barrier properties against moisture, since it has very low affinity for water. Edible lipids used to develop edible coatings are: beeswax, candelilla wax, carnauba wax, triglycerides, acetylated monoglycerides, fatty acids, fatty alcohols, and sucrose fatty acid esters. Lipid coatings and films are mainly used for their hydrophobic properties, representing a good barrier to moisture loss. This factor is extremely important as a large number of studies deal with the use of coatings on fresh fruits and vegetables to control their desiccation. Besides preventing water loss, lipid-based coatings have been used to reduce respiration, thereby, extending shelf life and improving the appearance by generating a shine on fruits and vegetables. In contrast, the hydrophobic characteristics of lipids form thicker and more brittle films. Consequently, these must be associated with film forming agents such as proteins or cellulose derivatives.

Other plant based edible coatings

Aloevera gel

In postharvest technology, extending the storage life of fruits and vegetables by utilizing plantbased products have been practiced for a long time. Recently, the uses of plant-based products have been started in fresh fruits and vegetables as bio-preservatives. Aloevera gel is one of the promising bio-preservative, which has a great potential to become a common use for most fresh fruits and vegetables. Aloe vera gel is applied to most fruits and vegetables as an edible coating.

Herbal extracts

Fruits and Vegetables are normally exposed to large number of microorganisms, which may be soil born, air born or may be introduced from the surface of plant. The spoilage of the fruits and vegetables during post-harvest storage is due to infection of these microorganisms, which gain entry through stomatal openings, lenticels, growth cracks or surface injuries. Several plant extracts or plant products have broad spectrum antimicrobial

properties. They can be recognized as bio-preservatives having no harmful effects on human health. Therefore herbal extracts are promising for use on fruits and vegetables to enhance the shelf life. They are safe and non-toxic. Their application is simple and do not lose their efficacy at normal storage temperature. The use of herbal extracts as edible coating of fruits and vegetables has opened a new avenue for the control of post-harvest losses.

Natural volatiles/Essential oils

Natural oils/Essential oils and phenolics of plant origin are antioxidants that have century's old use in Indian cuisines. Growing awareness on Indian food and its beneficial effects on human health have promoted the use of spices in the food system. Lately, significant research is being conducted on the spices and the essential oils derived from these like vanillin. To explicit their antioxidant properties, the essential oils derived from spices and other plant derived compounds can be used as coating or supplemented in the packaging films for enhancing the storage life as well as adsorbing off orders. Though, these plant derivatives are regarded as safe and can be used in place of chemical agents, their commercial viability is yet to be chalked out.

Nanoemulsions

Another environment friendly approach is the use of nanoemulsions. A nanoemulsion is defined as conventional emulsion with particle size varying between 1 and 100 nm. The entrapment of naturally occurring substances with functional properties, into nanoemulsions is enabling the development of edible coatings with antimicrobial properties and hence proves better than conventional emulsions.

Disadvantages of Edible Coatings

In application of edible coatings; factors such as allergic reactions, food safety, cost increase, lack of information and machine using, scarcity of the material could be used, need for a second packing material in most cases for consumer health because they have lesser physical and chemical resistance compared to petroleum-derived materials.

CONCLUSION

Edible coatings have been used for many years in the food industry to store fruits and vegetables. It is both safe and environmentally friendly and can be consumed alongside fruits and vegetables. Edible coatings increase shelf life by reducing water and moisture loss, delaying the ripening process and preventing microbial growth, particularly in fresh fruits and vegetables. Herbal edible coatings and coatings incorporated with anti-microbial substances like turmeric and essential oils is a new trend in the edible coating that has recently been introduced. Combining such coatings can open new avenues for research in nutrition and medicinal substance edible coatings.

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