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A Novel Packaging Technique: An Edible Films and Coatings

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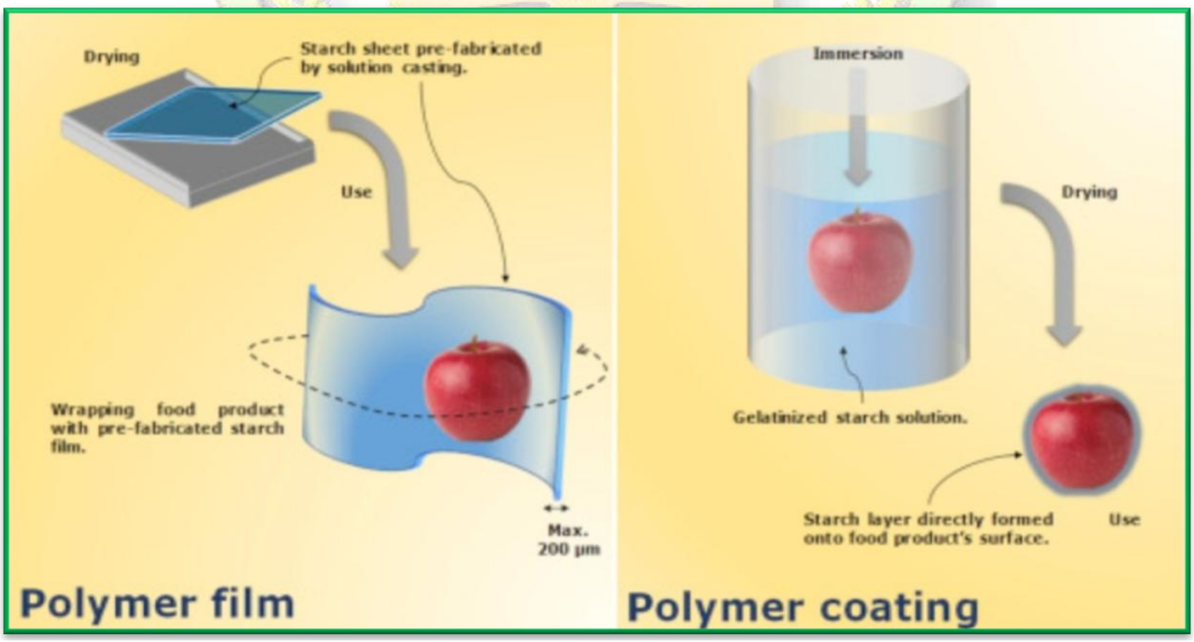
The postharvest loss of fresh fruits and vegetables are estimated to be 20–30%. The perishable nature of fruits and vegetables makes their shelf life limited due to some extrinsic factors such as some environmental conditions and preservation conditions as well as some intrinsic factors such as respiration rate, ethylene production and transpiration. Among the other post-harvest technologies available, edible coatings seems to be one novel method which has been verified to have a positive and safe approach to extending the shelf life of products. Edible films and coatings may be defined as protective thin layers generally not exceeding 0.3mm, created around food surface by applying solutions made from edible polymers like polysaccharides, proteins, lipids or their combinations. The protective layer thus created, acts as a barrier between the food surface and spoilage causing factors thereby enhancing the shelf life of coated food. This protective layer results in improvement of gas and moisture barrier properties, mechanical properties, sensory quality and even the nutritional characteristics of coated/ wrapped food. Active or functional compounds; Antioxidants, antimicrobials, nutrients, vitamins, anti-browning agents, enzymes and probiotics that could be applied into coating matrix to help preserving products quality. Edible films and coatings can be differentiated from biodegradable packaging on the basis of edibility and non- toxicity which is the basic and foremost requirement of any edible film/coating.



History of Edible Films and Coatings

Wax was the first edible coating used on fruits and vegetables. The Chinese applied wax coatings to oranges and lemons in the twelfth and thirteenth centuries (Hardenburg, 1967). Although the Chinese did not realize that the full function of edible coatings was to slow down respiratory gas exchange, they found that wax coated fruits could be stored longer than non-waxed fruits. In the 1930s hot-melt paraffin waxes became commercially available as edible coatings for fresh fruits such as apples and pears. In 15^{th} century an edible film- Yuba was used in Japan. Enrobing of foods with fat-Larding was used in 16^{th} century in England. In the 19^{th} century –US patent for, preservation of various meat products by Gelatin. In the early 1950s, carnauba wax Developed for coating fruits and vegetables.

Classification of Edible Films and Coatings

Edible films and coatings are classified on the basis of their principal ingredients. Four broad categories of edible films and coatings include:

- **Polysaccharide based edible films and coatings:** Polysaccharides like starch, pectin, cellulose, exudate gums, seaweed extracts etc. are used for making edible films and coatings. These ingredients are selected after checking their suitability in terms of the physical, mechanical and functional properties of edible films and coatings. Polysaccharide based films and coatings are characterized by poor moisture barrier properties but are moderately less permeable to O2 and selectively permeable to O2 and CO2. This makes them suitable for preservation of fruits and vegetables where they can reduce the respiration rate by modifying the environment inside the product. Pea starch based edible films by incorporated with guar gum and glycerol resulted in improvement of food and non-food applications of pea starch films.
- **Protein based edible films and coatings:** The modification of proteins results in films and coatings with enhanced functional and technological properties. This aspect of protein related films and coatings is receiving increasing interest from scientists and manufacturers. Animal proteins like gelatin and plant-based proteins like soy protein, gluten etc. can be utilized for development of edible films and coatings. For example, sesame seed protein was effectively utilized for development of edible films.
- **Lipid based edible films and coatings:** Lipids have a long history of use as edible coating for preservation of food articles. Wax coatings were used in ancient China for preservation of citrus fruits. Later, larding (use of lards or fats) was practiced in England to enhance the shelf life of meat products. Some of the lipids, waxes and resins used for development of edible films and coatings are mentioned as: Lipids: Sunflower oil, palm oil, coconut oil, cocoa butter etc.; Waxes: Bees wax, Carnauba wax, Jojoba oil, Candelilla wax etc.; Resins: Gum arabic, Mesquite gum, Tragacanth gum etc.
- **Composite edible films and coatings:** Composite edible films and coatings are developed by the use of more than one ingredient mentioned above. The logic behind using more than one ingredient is to take advantage from synergistic reactions between them. Tragacanth-locust gum bean blend films were reported to have better physical and barrier properties than their individual counter parts.

Methods of Application of Edible Coating and Films

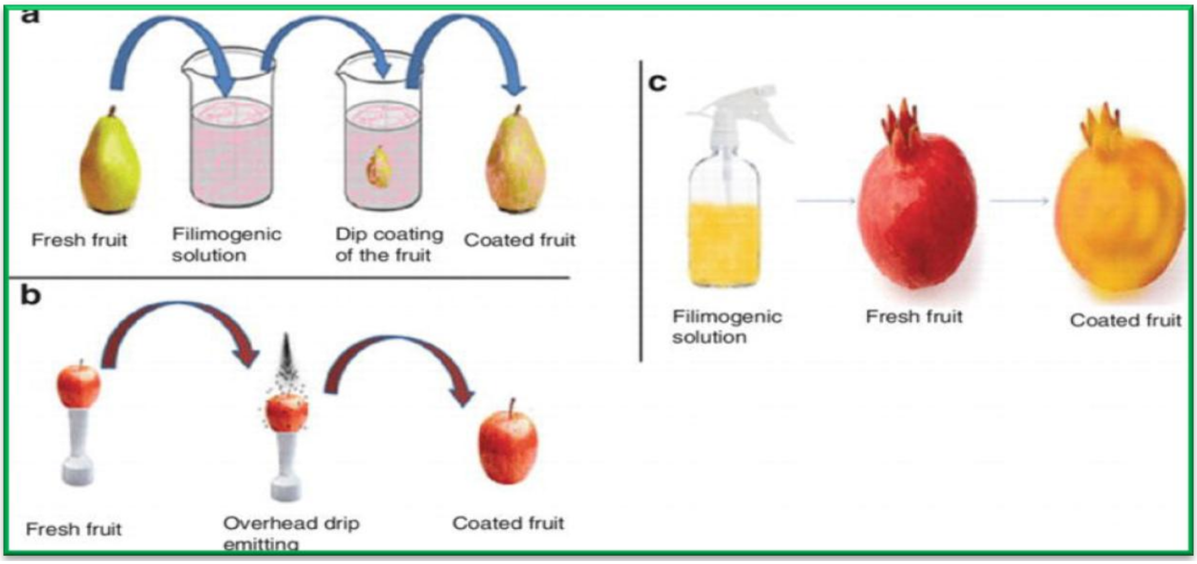
Dipping: This technique is the oldest commercial technique but still relevant until now. The concept of dipping technique is by immersing the fresh food produce into the coating solution to allow complete wetting of the surface of the food material. After that the coating solution is drained out to remove excess coating from the food surface. Finally, the fruit is dried to form a well intact coating with the food surface. This can be applied to a wide range of viscous coating solutions.

Layer by layer method: Layer by layer method is based on alternate deposition of oppositely charged polyelectrolytes that result in a more effective control of the coating properties and functionality. This method leads to the production of several layers of the films which can help to improve the effectiveness of the edible coating.

Vacuum impregnation technique: Vacuum impregnation technique is a further advancement of the dipping method. The difference is having a vacuum environment during fruit dipping. That is, instead of dipping the food material in a normal dipping tank, the fresh food is submerged in an airtight vacuum application. The food material is subjected to atmospheric restoration while it remains immersed in the coating solution under atmospheric pressure.

Spraying method: Spraying method is more suitable for less viscous coating solutions which can be sprayed at high pressure. Formation of polymeric coating using spraying system is affected by drying time and temperature. The advantage of applying the spraying technique is, the surface area of the liquid coating increase through the formation of droplets and distribution over the fruit surface.

Foaming and dripping method: Foaming and dripping method are considered as traditional methods in coating application. These methods are now gaining low popularity among researchers and industrial practitioners in fruit industries. With the dripping technique, the coating is being applied directly to the fruit surface using brushes However with the foam application, a foaming agent is added to the coating. Then, compressed air is blown into the air of applicator tank. Extensive tumbling action is applied to break the foam for uniform distribution.



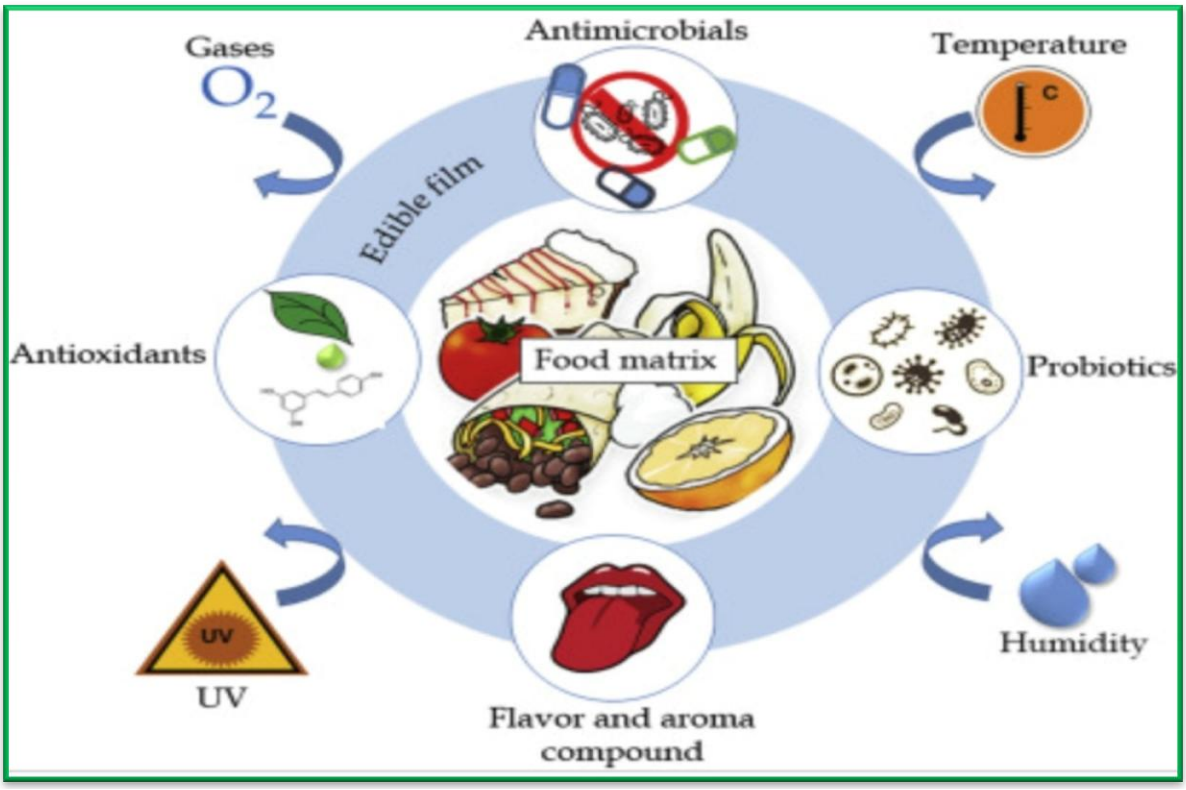
Role of Edible Films and Coatings

Antimicrobial agents: Incorporating antimicrobial compounds into edible film or coatings provides a novel way to improve the food safety and shelf life of ready-to-eat foods. Common antimicrobial agents used in food systems, such as benzoic acid, sodium benzoate, sorbic acid, potassium sorbate, and propionic acid, may be incorporated into edible films and coatings. Example: Starch based coating containing potassium sorbate were applied on the surface of fresh of fresh strawberries for reducing microbial growth and extending storage life. Chitosan coatings containing potassium sorbate were shown to increase antifungal activity against the growth of Cladosporium and Rhizopus on fresh strawberries.

Moisture barrier: These films prevent moisture loss, aroma loss or water uptake by the food material or even penetration of oxygen which produces a good storability condition for these food products, Edible coating enhance the texture and improves the product appearance and prolong the shelf life by creating semi-permeable barriers.

Antioxidants and anti-browning agents: Enzymatic browning in minimally-processed fruits and vegetables is linked to discoloration and discoloration of phenolic compounds catalyzed by polyphenol oxidase (PPO) enzyme, which converts polyphenolic substrates to dark pigments in the presence of oxygen. Edible coating especially incorporated with anti-browning substances can control PPO activity, and in the other hand, can provide a strong barrier for oxygen. The anti-browning substances mostly used are ascorbic acid, thiol-containing compounds (cysteine and glutathione), carboxylic acids (citric and oxalic acid), phenolic acids and resorcinols. These reduce o-quinones resulted from the action of PPO enzymes, back to their phenolic substrates. Antioxidants can be added into coating matrix to protect against oxidative rancidity, degradation and discoloration of certain foods. Eg. nuts were coated with pectinate, pectate, zein coatings BHA, BHT, and citric acid to prevent rancidity and maintain their texture.

Nutrients, flavors and colorants: Edible films and coatings are excellent vehicles to enhance the nutritional value of fruits and vegetables by delivering basic nutrients and nutraceuticals that are lacking or are present on only low quantity.



Disadvantages of Edible Films and Coatings

- While coatings have very desirable effects in reducing color changes, firmness loss, decay, there are some disadvantages.
- These could be overcome by suitable selection of the type and thickness of the coating and by avoiding treatment of immature, flavorless fruit and storage of coated fruits at high temperature.
- However, since consumers are concerned with additives, including wax, acceptability of edible coatings must be recognized.

Conclusion

Edible films and coatings are fast emerging as alternatives to the synthetic packaging materials. The use of edible films and coating as suitable packaging for the food industries. Research and development efforts have resulted in many new types of edible films and coatings which are at par with their synthetic counterparts in terms of functionality. Their biodegradability and edibility make them obvious choice for packaging of food commodities. This coating and films exhibit various function when used, such as inhibition of the migration of moisture. oxygen, carbon di-oxide, lipids aromas. It has ability to carry food ingredients and the ability to improve the mechanical property at the food.

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