

Edible Coatings for Fruits and Vegetables- A New Opportunity for Farmers

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The herbal extracts such as rosemary, oregano, thyme, and cinnamon are being used in active edible coatings for fruits and vegetables. These extracts contain natural antioxidants and antimicrobial compounds that can extend the shelf life and prevent spoilage. Studies have shown that coatings made with rosemary extract significantly reduced the decay of strawberries during storage, while coatings made with cinnamon extract effectively inhibited bacterial growth on apple slices. These findings suggest that herbal extracts can serve as natural alternatives to synthetic preservatives in edible coatings. This emphasizes that these extracts contain natural antioxidants and antimicrobial compounds that can help to preserve the quality of fruits and vegetables.

Edible coatings or films are a combination of polysaccharides, proteins, lipids, and plasticizers, used to enhance the functional properties and the general quality parameters of fruits and vegetables, such as texture, colour, acidity, total soluble solids, thus preventing their browning and oxidation. Casting (wet process) and extrusion (dry process) are two prominent methods used to fabricate edible thin films. General techniques for applying edible coatings are dipping, spraying, coating, panning, using a fluidized bed, and film wrapping. Active edible coatings or films are developed with herbal extracts to improve the functional properties, i.e., antioxidant and antimicrobial quoted from (Murugan et al., 2022).

Methodology

Some examples of foods that commonly use edible coatings include fresh produce such as strawberries, grapes, and apples, as well as meat and poultry products. The use of edible coatings has been shown to extend the shelf life of these foods by reducing spoilage and preventing contamination. For instance, a chitosan-based coating significantly reduced the decay rate of strawberries during storage (Pham et al., 2022). A whey protein isolate-based coating effectively reduced the weight loss and spoilage of chicken breasts during refrigerated storage (Pham et al., 2022). Overall, edible coatings offer a

sustainable and eco-friendly alternative to traditional packaging materials, as they are biodegradable and can be consumed along with the food. However, further research is needed to optimize the formulation and application of edible coatings for different types of foods and to ensure their safety for human consumption and poultry products. The use of edible coatings has been shown to extend the shelf life of these foods by reducing spoilage and preventing contamination. However, further research is needed to optimize the formulation and application of edible coatings for different types of foods and to ensure their safety for human consumption.

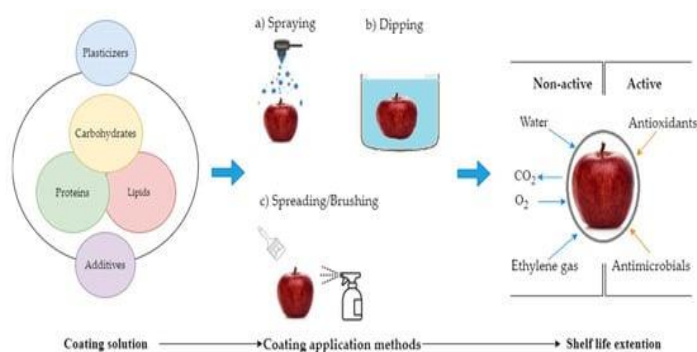


Fig 1. Process of Coating in the Fruits and vegetables

However, the effectiveness of these coatings may depend on factors such as the type of fruit, the concentration of antimicrobial compounds, and the application method. A chitosan-based coating with added essential oils significantly reduced the microbial load and spoilage of strawberries during storage (Pham et al., 2022). A coating containing a combination of chitosan and grapefruit seed extract effectively controlled the decay of kiwifruit during storage (Pham et al., 2012). Overall, the use of antimicrobial compounds in edible coatings has the potential to significantly reduce the microbial load and diseases in fruits, which can result in improved quality and safety for consumers. However, further research is needed to optimize the formulation and application of these coatings for different types of fruits and to ensure their safety for human consumption and the application method.

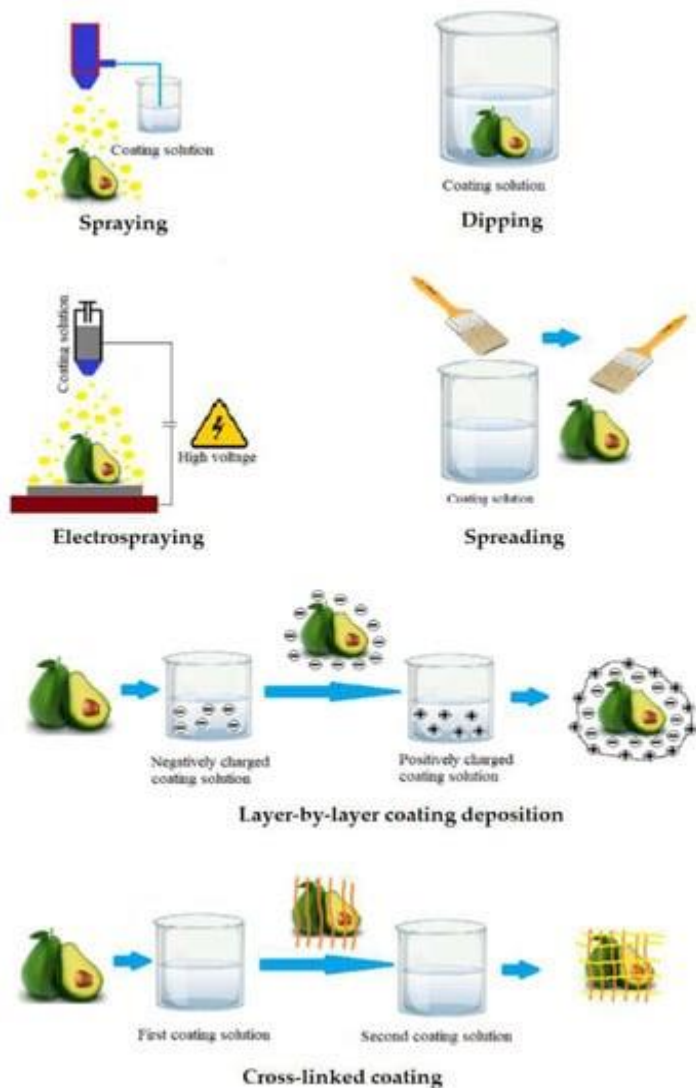


Fig 2. Classification and types of coating process for farmers (Pham et al., 2023)

Edible coatings to replace and decrease the usage of chemicals and synthetic compounds. An edible coating is a covering sheet composed of biological or chemical ingredients and utilized as a monolayer film or multilayer films on the surface of the product (Pham et al., 2022). Edible coatings maintaining the phytonutrients (antioxidants, phenolics, pigments) and controlling physicochemical qualities (inhalation and exhalation rate, weight loss, total dissolved matters, pH) of fruits for longer time. Due to this fruit deterioration is delayed, fruit quality is improved, and fruit shelf life is extended. To be effective, edible coatings must meet several functional requirements (Fig. 2), including (i) being free of toxic materials and harmless for human beings; (ii) having superb boundary capabilities regarding water, humidity, O_2 , CO_2 , and C_2H_4 ; and (iii) improving the

visual as well as textural properties of the coated products.

Dipping is the simplest method consisting of three steps: (i) immersion and dwelling, (ii) deposition and (iii) evaporation of solvents (Pham et al., 2022). After the excess solution has been drained away, the food is typically dried at ambient condition or treated with a dryer. Previous studies showed that the density and morphology of coatings precipitated by dipping are significantly affected by several factors including time for immersion, speed of withdrawal, number of cycles for dip-coating, coating solution parameters such as density, viscosity, surface tension, substrate surface characteristics, and drying conditions. Satisfactory results are not attained due to thickness of coatings causing respiration rate of the fruit and vegetables affected severely, density of the fruit and vegetables are also affected etc.

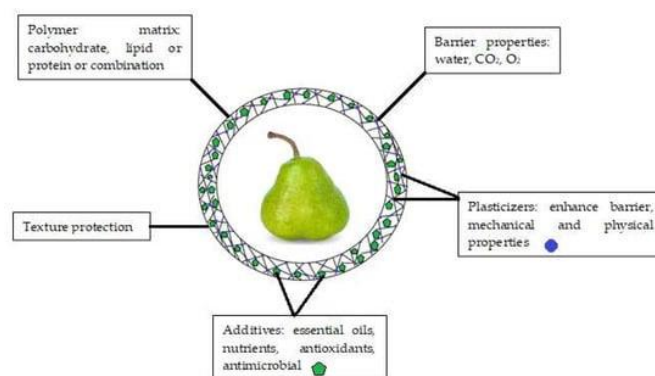


Fig 3. Outcome of Coating on Fruits and Vegetables (Pham et al., 2023)

Latest Advancements

A biodegradable, edible coating solution can extend the shelf-life of fresh produce, such as green chillies and tomatoes. The coating can reduce the load of food-borne pathogens, retain firmness, and prevent the weight loss of fruits and vegetables when stored for a month. This coating will reduce post-harvest loss significantly. The coating solution by mixing de-oiled crude ethanolic extract of a marine green alga with a chitosan-based solution. They made dried, edible films from the coating solution and found that this film was thermally stable, blocked ultraviolet and visible light, and showed antioxidant properties. (Excerpts from the Nature India magazine)



Fig 4. Mechanism and benefits of coating
(Gianfranco and Marwa, 2022)

The material was tested on potato, tomato, green chili, strawberry, Khasi Mandarin, apple, pineapple and kiwifruit and was found to keep these vegetables fresh for nearly two months. And a mix of an extract of a marine microalga called *Dunaliella tertiolecta* and polysaccharides to produce it. The microalga is known for its antioxidant properties and has various bioactive compounds such as carotenoids and proteins. It is also used to produce algal oil, a non-animal source of omega-3 fatty acid and is considered a good source of biofuel. After the oil is extracted, the residue is usually discarded. And extracts from this residue used in formulating their film, in combination with chitosan, which is a carbohydrate. It also has antimicrobial and antifungal properties and can be made into an edible film. (Excerpts from the down-to-earth magazine)

However, the development and application of edible coatings are not without challenges. Some of the limitations and drawbacks of edible coatings include:

- 1. High production costs:** The use of natural biopolymers and other ingredients in edible coatings can result in higher production costs compared to synthetic coatings.
- 2. Limited shelf life:** While edible coatings can extend the shelf life of fruits, they may also have a limited shelf life themselves, requiring careful storage and handling to prevent spoilage.
- 3. Variability in effectiveness:** The effectiveness of edible coatings may vary depending on factors such as the type of fruit, the coating formulation, and the application method.

4. Potential for allergic reactions: Some biopolymers used in edible coatings, such as chitosan, may cause allergic reactions in some individuals.

5. Impact on sensory properties: Edible coatings may affect the sensory properties of fruits, such as texture and flavor, which could impact consumer preferences.

6. Environmental impact: While edible coatings are biodegradable, their production and disposal could still have an environmental impact, particularly if large quantities are used.

Overall, while edible coatings offer many benefits for preserving fruits and reducing the use of synthetic chemicals, further research is needed to address these limitations and ensure their safety and effectiveness for consumers.

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