Edible Coating

An edible film that improves Quality and Shelf Life of Fresh Produce

Introduction

The edible coating is a solution to improve the quality and shelf life of fresh produce ranging from meat, poultry, fish, and dairy products to post-harvest fresh fruits and vegetables. Edible coating/s and film/s reduce packaging waste, prevent the incorporation of chemical preservatives, and result in a minimally-processed natural fresh product with an extended shelf life.

Edible coating/s and film/s made of composite materials and agro-industrial waste materials are the most researched as a sustainable and cost-effective option.

EXHIBIT 1: Uses of Edible Films and Coatings

| Aesthetic          | Edible Coating/s & Film/s | Shelf Life                        | Sustainable                      |
|--------------------|---------------------------|-----------------------------------|----------------------------------|
| - Delays ripening  |                           | - Water vapor barrier             | - Valorization of by-product     |
| - Prevents flavour & aroma loss |               | - Oxidation prevention            | - Reduce plastic waste           |
|                    |                           | - Weight loss reduction           | - Bio-based and edible            |
| Protection         |                           |                                   |                                  |
| - Light & UV       |                           |                                   |                                  |
| - Microbial growth |                           |                                   |                                  |
| - Water & gas barrier |                       |                                   |                                  |
| Bioactive          |                           |                                   |                                  |
| - Functional properties |                       |                                   |                                  |
| - Nutraceuticals addition |                   |                                   |                                  |
| - Antioxidants     |                           |                                   |                                  |

Source: FutureBridge Analysis
Edible Films and Coatings - Material Types

The composition of edible coatings and films are categorized based on the biomolecule used. The biomolecules used include polysaccharides, proteins, lipids, composite materials (i.e., blends of materials), and agro-industrial waste.

Polysaccharides

The polysaccharides come from plant sources, seaweed, insects, animals, and agro-industrial wastes.

Polysaccharides have excellent gas barrier properties but lack natural moisture barrier properties owing to their hydrophilic nature.
Protein

The protein used for edible coatings and films can be from plant origin, including soy protein, corn Zein protein, wheat gluten, and animal-sourced protein, including casein, whey, albumin, keratin, and collagen. Protein has suitable barrier properties for oxygen, carbon dioxide, and lipid at low relative humidity.

Lipids

Lipids are excellent coating materials owing to their hydrophobic properties. They act as an excellent barrier to moisture loss while also reducing the respiration property of the fresh produce, thus increasing its shelf life.

Composite

The composite coating is a bilayer coating formed by blending one or more types of material. This blending combines different materials’ beneficial properties and creates a superior quality of layer or film. The coating can be homogenous or heterogeneous. Further, it can offer better mechanical and barrier properties.

Agro-Industrial Waste

The solid waste residues like peel, pomace, and seed fractions of some fruits possess higher antioxidant and nutrient properties than the whole food. Biopolymers produced through by-product and waste residues of the food industry have been a subject of recent patent filing and studies. This biopolymer’s extraction from waste residue is economical and does not require higher energy for processing.

Edible Films and Coatings - Methods of Application?

The application method refers to the technique or way the coating or film adheres to the food surface.

Dipping

Dipping is the most common method to apply highly viscous coatings to fruits and vegetables. Under controlled conditions of density and surface
tension, the product is dipped in coating solutions between five to thirty seconds.

**Spraying**

For non-viscous solutions, the spraying method is used. The food product is introduced into the coating system and sprayed by controlling the spray solution's final drop size.

**Brushing**

The brushing method is used in some products, such as fresh beans and strawberries when reducing moisture loss is a challenge.
**EXHIBIT 4: Application Methods**

A. Dipping

Uncoated Product → **STEP-1** Dipping → **STEP-2** Evaporation → Coated product

B. Spraying

Uncoated product → Spray bar → Coated product

C. Brushing

Uncoated product → Brushed Equipment → Coated product

**Source:** FutureBridge Analysis

---

**Edible Films or Coatings - Industrial Application**

Notable Examples of Commercialized & Pre-commercialized Coatings
A. Edipeel- Agricultural by-product as Edible Coating

Edipeel, a product by USA startup Apeel Sciences, uses leftover leaves, stems, and peels of fruits and vegetables to produce a spray-based edible coating. The technology is relevant for fruits and vegetables.

Apeel’s products are entirely plant-based, edible, and FDA GRAS (generally recognized as safe) approved.

Edipeel is proven effective on bananas, lemons, limes, mangos, blueberries, tomatoes, strawberries, avocados, green beans, and raspberries.

B. Composite Coating - Wheat Straw and Oat Bran Edible Coating

National Agri-Food Biotechnology Institute Mohali, India, has developed a composite non-toxic, edible coating by extracting the polysaccharides from wheat straw and oat bran. An emulsion is made from the blend and coated on apple, peach, and banana. The coating helps to extend the shelf life, delay ripening, and maintain sensorial properties. The formulation effectively increases an apple’s shelf life to more than 30 days, a peach’s to 6-8 days, and banana’s to nine days under ambient storage conditions.

Whitespace – Challenges & Opportunities

Food Safety & Regulation
Edible films and coatings come in direct food contact. Thus, it needs to face regulatory scrutiny. To be accepted and commercialized as edible film, the material would need approval from FDA, EFSA, and respective regional food authority bodies. It should be a food-grade, non-toxic, and come from a processing facility that should **meet a high standard of hygiene**?

**Barrier Properties**

- Most of the biomolecules used for edible coatings and films are hydrophilic. Therefore, they show poor or inadequate moisture barrier properties.
- Some chemical treatment can resolve the hydrophilic nature; however, it adds another layer of scrutiny for applications in food-grade materials.
- The use of composite or nanocomposite materials, which combines two different materials to form superior coatings and films, can be the space to explore.

**Functional Ingredient & Challenge**

- Edible coatings can also increase the functional properties of fruits and vegetables by adding ingredients like vitamins, minerals, and probiotics.
- The addition of these products enhances not only the function but also the mechanical property of the layer or film.

**Material Selection**

- Due to its sustainable and cost-effective nature, the use of agro-industry waste is under research. The waste from these industries also comes with useful functional properties.

**References**

1. Prolongation of the Shelf-life of Perishable Food Product using Biodegradable Films and Coating
2. Natural Coatings for Shelf-Life Enhancement and Quality Maintenance of Fresh Fruits and Vegetables - A Review
3. Alginate-Based Edible Films and Coatings for Food Packaging Applications
4. Pectin-based edible coating preserves antioxidative capacity of plum fruit during shelf life
5. Importance of edible coating on fruits and vegetables: A review
6. Edible coating materials to improve the shelf life of fruit crops
7. Recent advance in edible coating and its effect on fresh/fresh-cut fruits quality
8. Postharvest Application of Aloe vera Gel-Based Edible Coating to Improve the Quality and Storage Stability of Fresh-Cut Papaya
9. Novel Edible Coating of Starch-Based Stenospermocarpic Mango Prolongs the Shelf Life of Mango “Ataulfo” Fruit
10. Improving storage life of cut apple and potato with edible coating
11. Importance of edible coating on fruits and vegetables: A review
12. Effect of Alginate and Chitosan Edible Coating Enriched with Olive Leaves Extract on the Shelf Life of Sweet Cherries (Prunus avium L.)
13. ALOECOAT 1-BIO is a New Aloe Based Edible Coating to Improve Food Safety in the Fresh Produce Industry
14. Palm-based Edible Coating (ElaeisCOAT) Extends the Shelf-life of Fruits and Vegetables