

The Application of Edible Polymeric Films and Coatings in the Food Industry

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Abstract

Edible polymeric packaging materials can be made from polysaccharides, proteins and lipids. These can be made into films and can be used as wrapping materials, stand-alone films, or can be fabricated into pouches and bags for subsequent packaging use. Films are made from molten ingredients or solutions of the same, and dried to form materials of predetermined thicknesses. Edible coatings are similarly made, but are applied directly to the food product in a liquid form and then allowed to dry on the substrate. Edible packaging is generally used to improve the mechanical properties of the food, minimize respiration in fruits and vegetables, limit the movement of moisture and other gases, provide antimicrobial or antioxidant capabilities to the product, enhance the sensory properties, and extend the shelf life of the product. In some cases, blended films and coating are made by combining polysaccharides with proteins and or lipids. This is usually done to harness the advantages of the individual components to produce a material with superior properties.

Keywords: Edible polymers; Food packaging; Polysaccharides; Proteins; Lipids

Introduction

An edible coating or film could be defined as primary packaging made from edible components. In this process thin layer of edible material can be directly coated to a food or formed into a film and be used as a food wrap without changing the original ingredients or the processing method. Edible films and coatings have been used to improve the gas and moisture barriers, mechanical properties, sensory perceptions, convenience, and microbial protection and prolong the shelf life of various products [1,2]. Other applications of its use include health benefits by incorporating nutrients such as vitamins, minerals and bioflavonoids within the film matrix [3-5]. In addition, the biodegradable and environmental friendliness of edible films and coatings are other desirable benefits associated with their use [6,2].

Edible films are distinguished from coatings by their method of manufacture and application to the food product. Films are dried preformed thin material structures that are used on or between layers of food components. Edible films are usually between 50 to 250 μm in thickness and can be used to wrap the product or make pouches and bags. Several films can be combined to form laminated sheets. Edible coating are also defined as thin layers of edible materials, but these are usually applied as a liquid of varying viscosity to the outer surface of the product by spraying, dipping, brushing or other appropriate methods. If desired, they could also be applied between layers of food components. To accomplish their intended functions, coatings are usually allowed to dry on the product after contacting the surface.

Polysaccharides, proteins, and lipids are the three main polymeric ingredients used to produce edible films. In many instances two or all of these ingredients could be blended to produce composite edible films [7]. Polysaccharide based edible films (e.g. chitosan, carrageenan) are hydrophilic and provide strong hydrogen bonding that can be used to bind with functional additives such as flavors, colors, and micronutrients. Due to the ability of adjacent chains in the polymer to cross-link, these films have good oxygen but poor moisture barrier properties. Protein based edible films are also hydrophilic and have good mechanical strength and can be used on fruits to reduce injuries during transportation [8,9,2,4]. As is the case with polysaccharides,

protein films also have poor moisture barrier because of their hydrophilic properties. Lipid based edible films have good moisture barrier, but low mechanical properties due to their hydrophobic nature. The manufacture and use of composite films help to minimize the disadvantages of the individual components while making use of the strength in their properties [7].

Edible films are usually produced by continuous film casting, mold casting or draw-down bar methods. The continuous film casting method is accomplished by coating a wet film onto a belt conveyor and then passing it through a drying chamber. Mold casting and draw down bar are simple and inexpensive methods that can be used as lab-scale edible film production techniques. Edible films are easy to produce and handle since they require less heat and no toxic solvents when compared to traditional petroleum-based food packaging (e.g. polyethylene, polypropylene) [10].

Applications of Edible Packaging

Barrier properties

One of the functions of packaging is to act as a barrier that separates and protects the product from exposure to the environment. Quintavalla [11] stated that edible films have been commercially used to protect meat, fruits, and vegetables from pathogenic microbial contamination. Other functions include the barrier to moisture, oxygen and other gases, fats and oils. These barriers can be applied to ready-to-eat food and fresh produce such as fruits and vegetables [10]. The extent of the barrier is influenced by the chemical properties of the material

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used. However, environmental conditions, such as temperature, relative humidity and the stress of handling the product by consumers can influence the barrier performance of the package [12].

Carrier properties

During the raw material blending process, active compounds can be added to edible films and coating solutions. These include antioxidants, antimicrobial agents, flavoring, pigments and nutrients. In such cases, the functional groups from the edible material would be bonded to the additives within the polymeric matrix. For example, nisin added to alginate edible films showed antimicrobial activity against *Staphylococcus* when applied to beef. Pigment additives carried by edible materials could improve the appearance of selected products during storage. Mei et al. [13] demonstrated that edible films made with a mixture of xanthan gum, calcium lactate and α -tocopherol can decrease the white discoloration, but increase the orange color of baby carrots during 3 weeks of storage. Also, the study showed that the edible film helped maintained the β -carotene content, and increased the nutrition value of vitamin E and calcium in the carrots [13, 14]. An edible coating can be made to act as a part of a food because it is in direct contact with the product and can be consumed. As a result, if used as a carrier for drugs or other medications the dosage and the usage would be subjected to regulations.

Enhancement properties

The ability of edible coating to improve the mechanical properties of some fragile products has been previously discussed. For example, chitosan coating on strawberries decreased mechanical damage during storage, processing and transportation of the fruit in a study reported by [14]. However, protein and carbohydrate-based edible materials have less tensile strength because of their strong cohesive energy density. Because of this, they tend to form brittle films without the addition of plasticizers. However, this property could be used to provide a hard shell-like protective to the outer layer to certain products. Examples of plasticizers that could be used in these films include glycerol, mannitol and sorbitol. Edible coating may also enhance the appearance and

flavor of a product. The wax on fruits (e.g. lemons, oranges, apples) polishes the surface and makes the product appear glossy. It also acts as a moisture barrier that reduces wilting of the product [13, 14].

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