Chapter 14
Antimicrobial Edible Films and Coatings for Fruits and Vegetables

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ABSTRACT

Non-degradable packaging materials are doing much damage to the environment. So the interest has been developed in biodegradable films and coatings these days. Use of edible films and coatings is eco-friendly technology used for enhancing the shelf life of the fruits and vegetables. The use of antimicrobial compounds in edible coatings of proteins, starch, cellulose derivatives, chitosan, alginate, fruit puree, and egg albumin has been successfully added to the edible films and coatings. This chapter focuses on the development of edible films and coatings with antimicrobial activity, effect of these coatings on the target microorganisms, the influence of these antimicrobial agents on mechanical & barrier properties and application of antimicrobial edible coatings on the quality of fresh fruits and vegetables.

INTRODUCTION

The demand for minimally processed, easily prepared and ready-to-eat (RTE) 'fresh' food products, globalization of food trade, and distribution from centralized processing pose major challenges for food safety and quality. Recent food-borne microbial outbreaks are driving a search for innovative ways to inhibit microbial growth in the foods while maintaining quality, freshness and safety. One option is to use packaging to provide an increased margin of safety and quality. These packaging technologies could play a vital role in extending shelf-life of food(s) and reduce the risk from pathogens. Antimicrobial polymers may find use in other food contact applications as well (Rooney, 1995). It acts to reduce, inhibit or retard the growth of pathogen microorganisms in packed foods and packaging material (Vermeiren, *et al*. 1999).

Most food consumed comes directly from nature, some of them eaten directly after harvesting from the tree, vine or ground. With increased transportation distribution systems, storage needs and advent of ever larger supermarkets and warehouse stores, foods are not consumed just in the orchard, on the

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field, in the farmhouse, or close to processing facilities. It takes much time for a food product to reach the table of the consumer. During this whole process time-consuming steps are involved in handling, storage and transportation, the food product start to dehydrate, deteriorate and lose loose appearance, flavor and nutritional value. If no special care is provided, damage can occur within hours or days, even if this damage is not immediately visible. Today various modern methods, including combinations of these such as refrigeration, controlled atmosphere storage, and sterilization by both UV and gamma radiation are used to keep food safe. Nevertheless, for many kinds of food, coating with edible film continues to be one of the most cost effective ways to maintain their quality and safety.

Edible films and coatings made by use of agricultural commodities and wastes of food products have gained considerable attention in last few years. The biopolymers i.e. polysaccharides, proteins and their blends plays an important role as a carrier for different additives like antimicrobial, antioxidants, nutraceuticals and flavouring agents. Organic acids, chitosan, nisin and lactoperoxidase system and plant extracts & essential oils are the most commonly used antimicrobials. The main objectives of this chapter are to discuss the use of edible films and coatings, the applications and legislations concerning edible films and coatings. The information provided in this chapter helps to improve the design, development, applicability of edible films and coatings, their safety aspects that might be important while planning the future trends and better functionality of edible films as a preservation technique to enhance the shelf life of the food products.

BACKGROUND

Edible films and coatings like wax have been used for long time to prevent moisture loss and to stop the respiration process. These practices are still carried out in the present time. The association of edible fruits and vegetables are 50 years old. In 1967, edible films had very little use and were limited to wax layers only. A good business came out from this concept and by 1996, numbers grew to 600 companies. In twelfth century citrus fruits were preserved by placing them in box and pouring molten wax on them to preserve them for Emperor's table. Later in fifteenth century edible films made up of boiled soy milk were used in Japan for maintaining the food quality and appearance. In the nineteenth century, a US patent was used for preservation of various meat products by gelatin. But these days, many other methods and combination of these methods are used to keep the food safe. Use of edible films and coatings continues as one of the most cost effective method of food preservation.

HISTORY OF EDIBLE FILMS AND COATINGS

The use of wax coating of fruits by dipping is one of the old methods that became into vogue in the early 12^{th} century (Krochta & Mulder-Johnston 1997). This was practiced in China, essentially to retard water transpiration loss in lemons and oranges. Application of lipid-based coatings to meats to prevent shrinkage has been a traditional practice since the sixteenth century, while later in the last century, meat and other foodstuffs were preserved by coating them with gelatin films. Yuba, a protein edible film obtained from the skin of boiled soymilk, was traditionally used in Asia to improve appearance and help preservation of foods since the fifteenth century. In the nineteenth century, sucrose solution was applied as an edible protective coating on nuts, almonds and hazelnuts to prevent their oxidation and rancidity during storage.