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Mini Review

Edible Coatings: A Novel Technique for Shelf Life Extension of Fresh Cut Vegetables

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Abstract

Edible coatings have gained significant importance recently for the shelf life extension of fresh-cut fruits and vegetables. Food commodities being extremely perishable resulted in quality deterioration easily during storage. Edible coatings help to reduce post-harvest losses including moisture loss, ripening, and physio-chemical qualities. The use of edible coating offers hope for extending shelf life while maintaining product quality. Foods may be coated with edible materials as an alternative to non-biodegradable packaging materials. This current mini-review presents edible coatings, their types for fresh-cut vegetables, their advantages, and their futuristic scope with the incorporation of active ingredients to enhance the antimicrobial effect of edible coatings.

Introduction

Recent trends in consumer patterns, consumption of fresh-cut vegetables is increasing day by day and new products are continually being developed. Nowadays, consumers demand food products that have good nutritional value, and fewer additives along with the fact that they should be fresh and should retain their natural colour, texture, and aroma [1,2]. A recent study conducted by IFPA showed that 76% of consumers buy fresh-cut produce at least once a week [3]. The growing desire for such products will mark the extension of this market sector in the approaching years. The term fresh cut defines as "fresh fruits and vegetables that have undergone processes like cutting, peeling or trimming into a 100% usable product that has been packaged to offer consumers high nutrition and flavor while still maintaining its freshness and physical properties". Fresh-cut salad vegetables such as carrots and cucumbers are widely used in fresh-cut produce because of their high nutritional value and easy processing procedures. Cucumbers belonging to the Cucurbitiaceae family contain approximately 95% water, 3.6% carbohydrates, and 0.65% protein, (150 kcal kg^{-1}) calories and are good sources of phytonutrients such as flavonoids, lignans, and triterpenes with antioxidant, anti-inflammatory, anti-carcinogenic, anti-elastase and anti-hyperglycemic benefits [4,5]. During winter, carrot is in great demand which is highly nutritious being a good source of proteins, carbohydrates, fats, dietary fiber, vitamin, minerals (sodium and potassium), antioxidants, and molybdenum [6]. Carrot (Daucus carota L) is a root vegetable that belongs to the family Umbelliferae. Carrot is known as vitaminized food because of the presence of phenols, L- (+)-ascorbic acid, tocopherol, polyacetylene, and beta-carotene which act as anticarcinogens [7], and immunity enhancers [6]. But production of fresh-cut products (fruits and vegetables) gets restricted due to product deterioration caused by types of tools used, water used for washing, handling conditions, the exposed surface area of the product, and storage conditions like temperature, humidity, packaging, and sanitation. Mechanical injury causes disruption of surface cells, and tissues and exposure of cytoplasm surface which leads to undesirable physiological changes, biochemical deterioration, microbial development, cellular damage of tissues, loss of texture and nutritional value which ultimately lowers the quality of the fresh product during storage [8].

Minimal processing of fruits and vegetables causes the removal of protective epidermal layer which causes exposure of the product to environmental surroundings and increases the chances of microbial contamination. Moreover, low pH, available nutrients, and high-water activity provide optimum conditions for the growth of pathogenic microorganisms like Coliforms, Escherichia coli O157:H7, Listeria monocytogenes, Salmonella sp., yeasts, and molds, etc [9]. The shelf-life extension and preservation of fresh-cut products are still major concern since they were available to consumers. However, their perishable nature and nutritional properties need to be maintained under fresh conditions to be consumed as salad vegetables. The coating is considered one of the safest and most convenient methods and hence, is an area of focus in food industries nowadays [8]. Among coatings, edible coatings are preferential because of their edible and biodegradable nature, ease of application, and serving as good barriers against environmental contaminations. Edible coatings are soluble formulations that are applied to food surfaces in such a way that they form a thin layer of the edible film directly on the food surface or between layers of components to stop the migration of oxygen, moisture, and solute into the food [9]. Edible coatings are used to extend the shelf-life of minimally processed produce thereby, stabilizing the product by forming a barrier that reduces loss of moisture and firmness, retards respiration rates, and ethylene production, and hinders gas and solute movement. Moreover, the edible coating prevents the loss of chlorophyll which further reduces discoloration in fresh produces. Edible coatings seal in flavour volatiles, control microbial load, and improve the appearance of a food product. Other additives like essential oils, spices, etc. are added to these coatings to provide antioxidant and antimicrobial properties to the final food product. The most important benefit of edible coatings is that they can be consumed along with food, can provide additional nutrients, may enhance sensory characteristics, and may include quality-enhancing antimicrobials [10].

Proteins, lipids, and polysaccharides are the three main components that should be taken into account while developing edible coatings (Figure 1). Polysaccharides are naturally occurring basic polymers that are widely utilized to develop edible coatings as well as films. Polysaccharides contain a well-organized form of hydrogen-bonded network that forms them effective oxygen blockers. Chitosan, pectin, starch, cellulose, pullulan, alginate, and their derivatives are all examples of polysaccharides. Various types of fibrous proteins or globular proteins have been used to create healthy and consumable coatings which include corn zein, soy protein, whey protein, casein, and wheat gluten. Protein-based coatings are known to be highly effective oxygen blockers even at decreased Relative Humidity (RH).

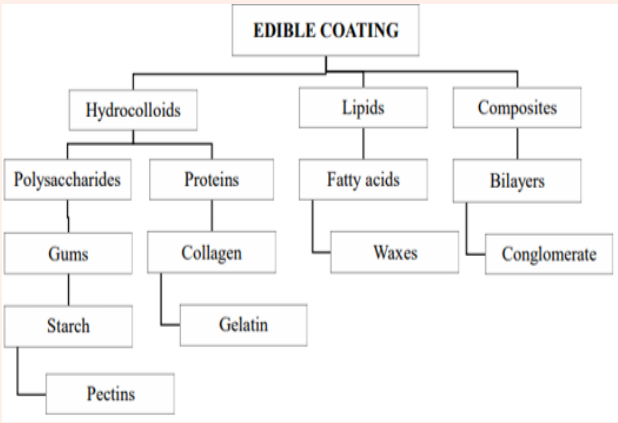

Figure 1: Classification of edible coatings.

Type of coating to be selected for a particular fruit or vegetable used to be evaluated according to the physicochemical characteristics of the product. Hence, the selection of an edible coating is a prime concern matter for fresh-cut industries. The effectiveness of coatings on freshly cut fruits and vegetables is greatly influenced by other factors like temperature, coating type, thickness, and dipping time [10]. Optimization of these parameters helps to maintain the integrity of the coating over the fresh-cut produce during the storage period. Low nutritional value fruits and vegetables can have formulations including vitamins, fatty acids, and minerals applied to them through coatings to increase their nutritional value. It is necessary to carefully examine the nutrient concentrations that will be added to the coatings in order to understand the affectivity and functioning of edible coatings [11]. More possible uses for edible coatings that contain antimicrobials, essential oils, and other active substances are for preventing food spoilage. Utilizing different proteins, lipids, and polysaccharides from waste biomass helps to valorize the waste, and can reduce the economic cost of production of edible coatings. The storage life of extremely perishable foods can be extended more with these inventive and creative types of edible coatings.

The safety and reactivity of the active chemicals contained in the coatings still need to be thoroughly studied. Overall, edible coatings are the alternative source to increase the shelf life of fresh produce as compared to other preservation techniques due to their eco-friendly nature.

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