



Edible Waxing on Fruits and Vegetables

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Vegetables and fruits are highly perishable as they contain 80–90% water by weight. If they are left without cuticle, the water quickly begins to evaporate, resulting in poor product shelf life. Major losses in quality and quantity of fresh fruits and vegetables occur between harvest and consumption. When the fruit is harvested, there is a change of the gaseous balance between the consumption of oxygen and the production of carbon dioxide. In this new condition, the cells are not renewed and the gas transfer rates increase, causing a metabolic loss and taking the fruit to a gradual maturation and eventual senescence. The gas transfer rate depends upon internal and external factors. The internal factors include the species, cultivar, and growth state, while the external factors include the atmospheric composition (O₂, CO₂, and ethylene ratios), the temperature, and other stress factors (Kluge *et al.*, 2002). In addition, contamination of the fruits and vegetables flesh can occur from the skin increasing the fruits and vegetables spoilage leading to biochemical deterioration such as browning, off flavour and texture break down, decreasing the fruits and vegetables quality and the risk to the consumers due to the presence of pathogenic microorganism (Han *et al.*, 2005). Fresh produce's texture, color, appearance, flavor, nutritional content, and microbiological safety are key quality aspects that affect its marketability. Plant variety, ripening stage, maturity stage, pre-harvest, and post-harvest are used to measure these quality variables circumstances (Lin *et al.*, 2007). Preservation of fruits and vegetables is a big challenge for world. External appearance is an important attribute of overall fruit and vegetable quality. It is the first attribute that buyers notice. A protective edible coat on fruit and vegetable which protect them from transpiration losses and reduce the rate of respiration is called waxing. Waxing consists of applying a thin layer of edible wax to the outer surface of the product. The benefits obtained by the product from waxing include an improved appearance, less moisture loss and shrivelling, reduced postharvest decay, and a longer shelflife. Fruits and vegetables have a natural waxy layer on the whole surface (excluding underground ones). It may be obtained from both animal and vegetable sources. Nature of edible coating may be of protein, lipid, polysaccharide, resin alone or in combination. It acts as a barrier for moisture and gases during processing, handling and storage.

History of Edible coating

Edible coatings or edible films have been used for centuries in the food industry to preserve food products this is not a new preservation technique. For example waxing on fruits and

vegetables and cellulose coating in meat casings. Edible coatings have been used since 12th century in China. It was not until 1922 the waxing on fruits was invented and first time was commercially applied on fruits and vegetables. Edible films and coatings form a barrier for chemical, physical and biological changes. At the time of purchasing fruits and vegetables, consumer judge the freshness and quality of the produce on the basis of its appearance. Recently, various edible coatings were applied successfully for preserving fruits and vegetables such as orange, apples, grapefruit, cherries, cucumber, strawberry, tomato and capsicum were applied successfully. Edible coating of fruits and vegetables is successful or not totally depends on the control of internal gas composition.

Advantages of Waxing

- ✚ Edible coatings play a very important role to handle this situation. Edible Coatings are applied on whole and fresh-cut fruits and vegetables (Youssef *et al.*, 2015). Fruits and vegetables which has been coated are: Orange, Apple, Grapefruit, Cherry, Papaya, Guava Lemon, Strawberry, Mango, Tomato. Cucumber, Capsicum, Cantaloupe and minimally processed Carrot, fresh-cut Potato, fresh-cut Cabbage, fresh-cut Tomato slices, fresh-cut Onion, Lettuce.
- ✚ Edible coatings improve retention of acids, colour, flavour and sugar.
- ✚ Maintain quality of fruits and vegetables during storage.
- ✚ Reduce weight loss and firmness loss.
- ✚ Decrease polymer packaging and waste.
- ✚ Edible coatings can be consumed along with fruits and vegetables; they contain health beneficial nutrients.

Types of waxes

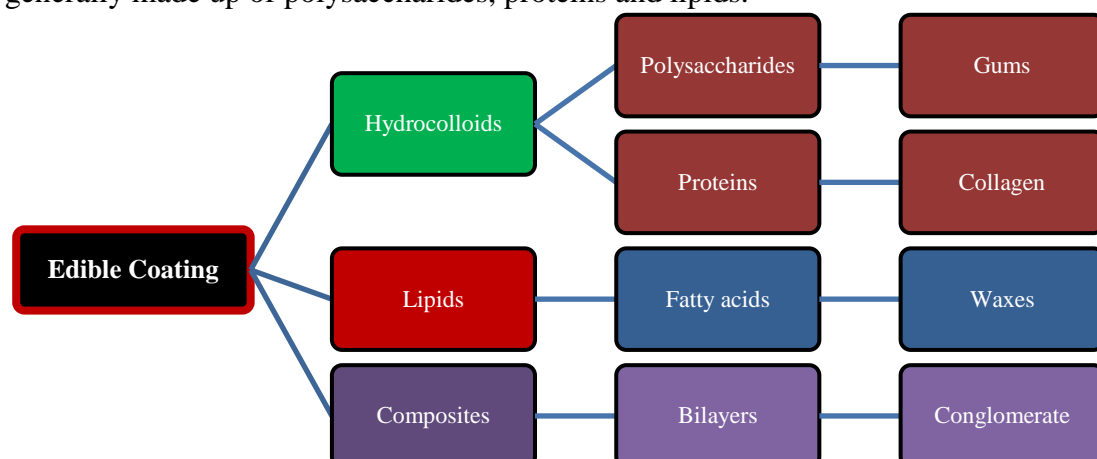
Solvent Waxes: Solvent waxes widely used in citrus are composed of 70 to 80% aliphatic. Hydrocarbons and solvents such as acetone, ethyl acetate. The solvent will contain either a synthetic resin or a natural wood resin plus one or more plasticizers.

Water Waxes: Water waxes are a second major type. The most extensively used being resin solution waxes and emulsion waxes. Resin solution waxes are simply solution of one or more alkali soluble resin or resin-like materials such as shellac, natural gums or wood resins. Emulsion waxes are composed of a natural wax such as carnauba or paraffin or synthetic wax such as polyethylene emulsion.

Paste or Oil Waxes: These are mainly composed of paraffins that are different in melting point and blended to give a desired viscosity. These are often used on vegetables.

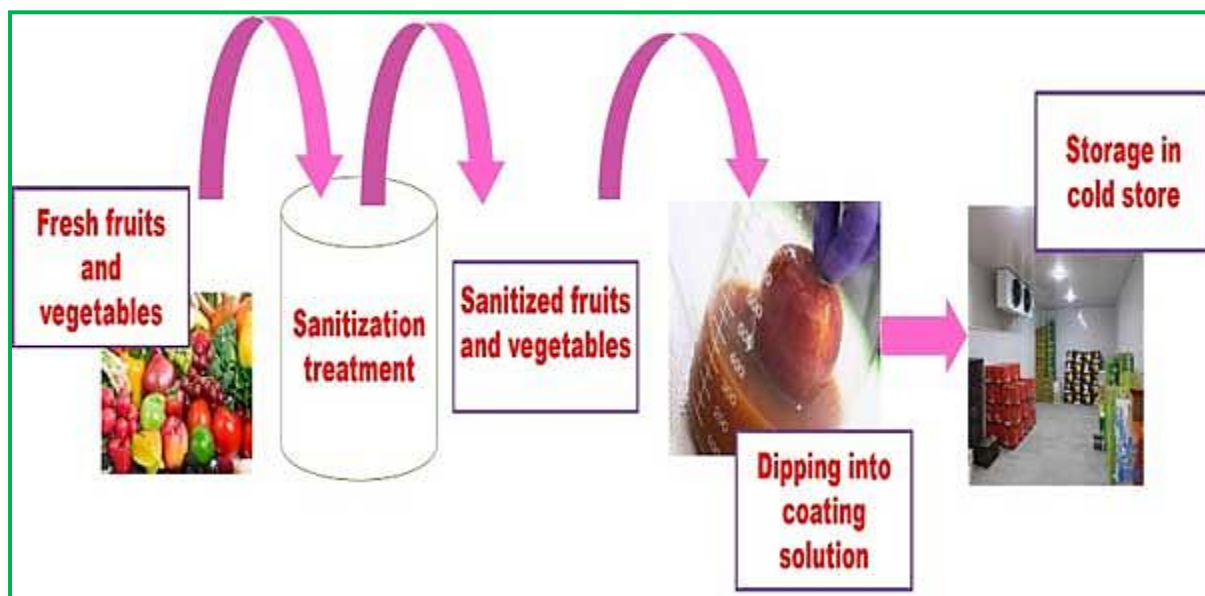
Classification of Edible Coating

Edible coatings are having hydrophobic group, for example lipid-based or waxes, and hydrocolloids or hydrophilic group, for example polysaccharides-based, proteinbased or combination of both groups to improve function of edible coating. Edible coating materials are generally made up of polysaccharides, proteins and lipids.



Applying methods of Edible coating

Edible coatings should be applied on fruits and vegetables by different methods. These methods are a) Dipping b) Brushing c) Extrusion d) Spraying e) Solvent casting. The dipping method is used widely for applying edible coatings on fruits and vegetables, in this method Fruits and Vegetables are dipped in coating solution for 5-30 seconds. It is easy to apply on mostly fruits. While Brushing method gives good result, Edible Coatings applied on generally, Beans and highly perishable Fruits and Vegetables such as strawberry, berries. Other three methods spraying, extrusion and solvent castings are also used in food industry. Extrusion method depends on thermoplastic properties of edible coatings; it is best technique for applying of EC for industrial purpose as compared to other methods.



Herbal Edible Coatings: A New Concept

Herbal edible coating is a new technique for food industry. It is made from herbs or combination of other edible coatings and herbs, most common herbs used in Edible coatings are such as Aloe vera gel, Neem, Lemon grass, Rosemary, Tulsi and Turmeric. Herbs have antimicrobial properties, it consists vitamins, antioxidants and essential minerals (Douglas *et al.*, 2005). As recently Aloe vera gel is widely used in coating on Fruits and Vegetables, because of its antimicrobial property, it also reduces loss of moisture and water. Ginger essential oil, clove bud oil, turmeric neem extract, mint oil, other essential oil and extracts are also used in edible coating of Fruits and Vegetables.

Conclusion

The most sophisticated method of food packaging is the edible coating. It has been shown that edible coating technology lowers waste materials in the packaging sector. The ingredients used to make these coatings might be synthetic or natural, and they are edible. The primary structural constituents with favorable gelation qualities include carbohydrate, protein, fat, wax, and oils. Plasticizers were applied to improve the gelation qualities as well as other features including the oxygen and water barrier properties. Sorbitol, mannitol, sucrose, and glycerol are all suitable food-grade plasticizers. Fruits and vegetables may be kept fresher longer on the store while still maintaining their nutritional value thanks to edible coatings. Edible coatings can be applied to the surface of fruits and vegetables using a variety of techniques, including dipping, spraying, brushing, and film creation. The purpose of herbal coating is to add antioxidants and useful elements to food items to improve their nutritional value. It produces improved outcomes and health advantages.

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