Sustainable food packaging: Biopolymers and edible coatings

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Global food production witnessed a quantum jump during second half of the twentieth century. Advanced technology and industrialization resulted in huge surplus of agricultural produce particularly in developed countries; which led to increased focus on improving postharvest management. In fact, the ability to reduce postharvest losses and provide quality food becomes one of the important indices of a developed economy. Unfortunately, underdeveloped nations still suffer 25-60 per cent postharvest losses in fresh produce (Nussinovitch and Lurie, 1995; Mahadeviah, 2002). Food packaging remains the bedrock of any worthwhile postharvest management strategy as it is not only the essential part of processing and distribution, but also has a role in the preservation of foods. Non-biodegradable petro-based packaging material heralded the era of 'Mass and Easy to Handle' food packaging (Mahadeviah, 2002). However, the chances of influx of health hazardous/harmful constituents from packaging materials into food and environmental concerns, spawned the need to develop an edible, biodegradable coatings (Dutta *et al.*, 2006). Such food packaging could improve or even replace many of the existing food preserving techniques, besides improving mechanical handling properties of the produce (Baldwin, 1994). These coatings can serve as vehicles to incorporate additives targeted for specific microorganisms or interfere in food spoilage processes.

Food packaging is considered as an index of civilization. The purpose of efficient packaging is to minimize food losses, improve quality and ensure safe and wholesome products. Food components such as proteins, lipids and carbohydrates maintain food stability during storage, but get affected due to environmental and storage factors (Bala Subramanian and Chinnon, 1997). Microorganisms also act upon these components and carry out undesirable changes. The use of suitable covers and barriers not only retard deterioration processes during storage but also retains the quality of the product (Cha and Chinnon, 2004). In this regard, conventional food packaging serves only as covering and do not provide barriers against the target microorganisms and other environmental and processing conditions. The basic materials used in such approaches are plastics, glass and metal. Plastics, though very attractive, colorful and durable cause certain undesirable changes in the food like nutrient loss, colour and texture deterioration and mold growth, while glasses are fragile and metal containers are expensive. At the same time, such type of packaging are not easily degradable and thus, does not only become a source of hazardous and recalcitrant wastes but also cause environmental pollution (Arvanito *et al.*, 1997). Further, non-availability of advanced

technology for recycling and disposal of such types of packaging has led to the use of eco-friendly biodegradable material, known as biologically based packaging which contains raw material originating from agricultural and marine sources. In recent past, new approaches towards the development of appropriate packaging, its design and interaction with the food have been studied, developed and adopted. These include biological system such as microorganisms, plants and animals besides chemical synthesis from sugars, starch, natural fats, oils etc. These packaging have replaced many techniques used for preservation of fresh produce. Waxing of fruits can be traced back 13th century in China (Hardenburg 1967). Gelatin films has been in use of meat and other products since 1930. Many polysaccharide coatings have been developed for preservation of fruit, vegetables, nuts, dates, etc. However, extensive waxing has been commercial used mainly on apple pears, citrus, banana, mango, tomato and cucumbers. Different types of waxes like carnauba wax, beeswax, and shellac wax is now-a-days manufactured for commercial use.

These packaging must, however, remain stable without change in mechanical and barrier properties and should function properly during storage till final disposal of the product. The packaging includes edible films and coatings which are produced by casting and drying of foaming solution on level surface and subsequent drying or by extrusion. While complementing the concept of biopackaging, the entire interaction between food, packaging material and ambient atmosphere have to be considered (Dutta *et al.,* 2006). Other properties like water vapour permeability, gaseous permeability, mechanical and tensile strength should be taken into consideration while developing such a film. The main three sources from which these packaging are derived are as under :

a. **Polymers directly extracted or removed from the biomass:** These include polysaccharides such as starch, cellulose, chitin, and protein such as casein, whey protein, collagens gluten and Soya protein.
b. **Polymers produced by chemical synthesis using biobased monomers:** These include poly-lactic acid (PLA) a biopolymer produced from lactic acid monomer.
c. **Polymers produced by microorganisms genetically modified bacteria:** This category of biopolymers includes bacterial cellulose, poly-deoxy-alkaonates (PHA), poly-hydroxybutyrates (PBA) and poly-3-hydroxybutane.

The coatings not only improves the mechanical handling properties of produce but also help in maintaining structural integrity, retain volatile flavor compounds and serve as carriers for preservatives bactereocins, enzymes, antioxidants and other antimicrobial agents which facilitate targeting of the specific spoilage microorganisms.

Recent developments with polysaccharide coatings like chitosan, chitin, and bilayer film/coating from stearic and palmitic acid and hydroxyl propyl cellulose have made use of such coating more purposeful. Development of coating designed for particular produce may be the way forward in achieving the maximum benefits. Religious, social and other safety

issues have however, restricted the use of coating materials as they become important edible components of packaged food.

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