Edible Films and Coatings from Tropical Fruits

Henriette M. C. Azeredo

Abstract

Difficulties have been encountered in disposing of the huge waste volumes generated by food packaging which is mostly non-biodegradable. Biopolymers have been studied as film forming materials to be used as biodegradable and/or edible films in food packaging. Edible films from fruit purees combine the film forming properties of biopolymers with colors and flavors provided by pigments and aroma compounds from the fruit. The production of edible films from fruit purees is an interesting way of reducing the huge post-harvest losses of tropical fruits in Brazil. The main limitation is related to the relatively poor mechanical and barrier properties of biopolymers when compared to synthetic polymers. Nanofillers such as cellulose nanofibers have been shown as effective reinforcements to biopolymers but there is a need for accurate information on the effects of nanomaterials on human health.

Introduction

Food and beverage packaging accounts for more than half the worldwide packaging market (Stevens 2002). This large volume of food packaging is meant to be quickly discarded, and the waste volume has not been greatly reduced by the recycling programs, because of high recycling costs and difficulties related to polymer separation (Azapagic and others 2003).

Several biopolymers such as polysaccharides or proteins have had their film-forming properties studied in order to produce edible films to be used in food packaging. They are not intended to completely replace synthetic plastics but rather to improve their efficiency, thus reducing the amount of synthetic polymers required for each application. An edible film is obtained by drying a thin layer of a film-forming material which is subsequently applied to a food surface; edible coatings, on the other hand, are produced by direct application of the film-forming material on the food surface and then drying.

Fruit Purees as Film-forming Materials

Researchers from USDA/ARS/WRRC (Albany, CA, USA) were the first to study fruit purees and concentrates as film-forming edible materials (McHugh and others 1996; McHugh and Senesi 2000; Senesi and McHugh 2002). Such application of fruit purees is related to the presence of biopolymers (predominantly polysaccharides such as pectin, starch and cellulose derivatives) in their composition (Kaya and Maskan 2003). Edible films produced from fruit purees can combine the mechanical and barrier properties from the film-forming components with the color and flavor provided by the pigments and volatile compounds of the fruit. Moreover, the production of edible films is an interesting and promising way of using co-products of fruit processing. Films produced from fruit purees have been shown to be good barriers to gas diffusion but poor barriers to water vapor, properties which make them able to create a modified atmosphere when applied to fresh produce (Baldwin 1994).

The variety of flavors found in tropical fruits is appreciated worldwide. Some tropical fruits, however, are hardly known in temperate regions, because of the high costs and technical difficulties related to their importation from tropical countries. On the other hand, tropical fruit losses in Brazil are estimated to be higher than 40% of production, or about 14 million tons per year (Silva *et al*. 2000). Most losses are due to inadequate handling, transportation, and storage facilities. One of the primary goals of fruit processing is to convert perishable fresh fruits into more stable products, thereby reducing postharvest losses. The production of fruit purees is an interesting way of reducing such losses, since purees, in contrast to products made from whole fruits, can be produced from fruits with minor superficial damage, provided the quality of the pulp is preserved. Fruit purees are usually commercialised as frozen purees, or processed into juices and nectars. The production of edible films and coatings can be a very interesting way of using tropical fruit purees. Some studies have been made on edible films from tropical fruits such as banana (Sothornvit and Pitak 2007) and mango (Sothornvit and Rodsamran 2008; Azeredo *et al*. 2009). Such films and coatings can function as primary packaging materials for a variety of foods, such as fresh and processed fruits, cheeses, nuts, and confectionery products, improving the protective efficiency of the synthetic secondary packaging, and incorporating color and flavor onto the food surface.

Limitations and Future Prospects

The commercial use of films based on biopolymers has been limited because of their typically poor mechanical and barrier properties when compared to synthetic polymers. Several nanocomposites have been developed by adding reinforcing compounds (nanofillers) to biopolymers, improving their properties and enhancing their cost-price-efficiency (Sorrentino and others 2007). A uniform dispersion of nanofillers leads to a very large matrix/filler interfacial area, which changes the molecular mobility and the consequent thermal and mechanical properties of the material. High aspect ratio fillers such as nanofibers are particularly interesting because of their high specific surface area, providing better reinforcing effects (Azizi Samir and others 2005). Azeredo *et al*. (2009) reported that the incorporation of cellulose nanofibers into a mango puree matrix noticeably enhanced the performance of the resulting films.

However, there are many safety concerns about nanomaterials, as their size may allow them to penetrate into cells and eventually remain in the human organism. While the properties and safety of the materials in their bulk form are usually well known, the nano-sized counterparts frequently exhibit different properties from those found at the macro-scale, and there is limited scientific data about their eventual toxicological effects. So the need for accurate information on the effects of nanomaterials on human health following chronic exposure is imperative before any nanostructured food packaging is available for commercialisation.

References

Azapagic, A, Emsley, A, and Hamerton, I. (2003) *Polymers - The Environment and Sustainable Development*. New York: Wiley & Sons; 234 pp.

Azeredo, HMC, Mattoso, LHC, Wood, D, Williams, TG, Avena-Bustillos, RJ, and McHugh, TH. (2009) Nanocomposite edible films from mango puree reinforced with cellulose nanofibers. *J. Food Sci*. 74(5): N31-N35.

Azizi Samir, MAS, Alloin, F and Dufresne, A (2005) Review of recent research into cellulosic whiskers, their properties and their application in nanocomposite field. *Biomacromol*. 6(2): 612-26.

Baldwin, EA. (1994) Edible coatings for fresh fruits and vegetables: past, present, and future. In: Krochta, JM, Baldwin, EA and Nisperos-Carriedo, MO (Eds) *Edible Coatings and Films to Improve Food Quality*. Lancaster: Technomic; pp. 25–64.

Kaya, S and Maskan, A (2003) Water vapour permeability of pestil (a fruit leather) made from boiled grape juice with starch. *J. Food Eng*. 57(3): 295-9.

McHugh, TH, Huxsoll, CC and Krochta, JM (1996) Permeability properties of fruit puree edible films. *J. Food Sci*. 61(1): 88-91.

McHugh, TH and Senesi, E (2000) Apple wraps: a novel method to improve the quality and extend the shelf life of fresh-cut apples. *J. Food Sci*. 65(3): 480-5.

Senesi, E and McHugh, TH (2002) Film e coperture eduli com matrici a base di fruta. *Ind. Aliment*. 41(420): 1289-94.

Silva, JS, Finger, FL and Corrêa, PC (2000) Armazenamento de frutas e hortaliças. In: Silva, JS (Ed). *Secagem e armazenagem de produtos agrícolas*. Viçosa: Aprenda Fácil. 469-502.

Sorrentino, A, Gorrasi, G and Vittoria, V (2007) Potential perspectives of bionanocomposites for food packaging applications. *Trends Food Sci. Technol*. 18(2): 84-95.

Sothornvit, R and Pitak, N (2007) Oxygen permeability and mechanical properties of banana films. *Food Res. Int*. 40(3): 365-70.

Sothornvit, R and Rodsamran, P (2008) Effect of a mango film on quality of whole and minimally processed mangoes. *Postharv. Biol. Technol*. 47(3): 407-15.

Stevens, ES (2002) *Green Plastics: An introduction to the new science of biodegradable plastics*. Princeton: Princeton University Press; 272 pp.

Dr Henriette Azeredo is a Researcher in Food Packaging and Nanotechnology at Embrapa Tropical Agroindustry, R. Dra. Sara Mesquita, 2270, CEP 60511-110, Fortaleza, CE, Brazil; E-mail: ette@cnpat.embrapa.br

Printer Friendly Version

 IUFoST | IFT | CONTACT