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Biodegradability of Antimicrobial Edible Films and Coatings: What's the Real Thing?

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Opinion

Most food products are susceptible to chemical deterioration and microbiological spoilage and therefore represent a high risk for consumer health and also to food producers' economy. Moreover, the presence of food-borne pathogens in a country food-supplier not only affects the health of local population but also represents a potential for pathogens spread by tourists and consumers where these food products are exported [1]. In the last decades, there have been increasing research activities about formulation, development, and use of edible films and coating to release antimicrobial constituents in food packaging as a form of "active packaging" that could extend the shelf-life of a product and provides microbial safety for consumers. Edible films are obtained from food grade filmogenic suspensions that are usually cast over an inert surface, which after drying can be placed in contact with food surfaces. Films can form pouches, wraps, capsules, bags, or casings through further processing and one of the main differences between films and coatings is their thickness. On the other hand, edible coatings are food grade suspensions which may be delivered by spraying, spreading, or dipping, which upon drying form a clear thin layer over the food surface. Coatings are a particular form of films directly applied to the food surface and are regarded as part of the final product [2,3].

Both edible films and coatings are an alternative to extend the shelf life of food-products by acting as barriers to water vapor, oxygen and carbon dioxide. In addition, this kind of package systems can act as carriers of substances to inhibit pathogenic and spoilage microorganisms. In such sense, several natural antimicrobial agents and additives have been incorporated into the corresponding suspensions, including organic acids, enzymes, fungicides and natural compounds such as spices and essential oils, adding functionality to the obtained "active" edible film or coating [4].

Other key issues around this promising packaging technology are sustainability through the use of biodegradable materials and applications of by-products from the food industry that can generate added value. In recent years, concerns about the environmental pollution caused by plastics have led to attempts to develop biodegradable films and coating by incorporating degradable components. In such sense, an increasing number of natural polymers have been investigated for the production of edible films and coating such as proteins, polysaccharides (carbohydrates and gums), lipids, or a mixture of these compounds [2,3]. However, in general most of such biopolymer-based film formulations require the addition of a plasticizing agent above a minimum threshold to reduce film fragility and to confer certain plastic properties. The plasticizer molecules lead to decreasing intermolecular forces along the polymer chains, thus improving flexibility, extensibility, and toughness, but decreasing mechanical resistance and barrier properties. In general, the most commonly used plasticizers in edible films and coatings are polyols, mono-, di- or oligosaccharides. Moreover, most biopolymers are relatively hydrophilic compared to commercial plastic materials. So, plasticizers and other additives are also combined with the film-forming biopolymers to modify the physical properties or other functionality of the resulted packaging material [5].

In spite of all the advances to date in edible films and coatings technology, for a real industrial use of this promising sustainable packaging alternative, it is still necessary to conduct more scientific research to identify the film-forming mechanisms of biopolymers to optimize their properties. Furthermore, much more research is needed in order to prove edible films and coatings biodegradability, since this behavior it frequently underestimated because of its biopolymers-based composition [2]. In addition, it is also suggested that

feasibility studies be performed regarding the commercial uses of edible films and coatings by extending the results of research and development to commercialization studies, such as new process evaluation, safety and toxicity determination, regulatory assessment, and surveys to potential consumers.

Finally, in this scenario of unsolved drawbacks, there are still non investigations about the biodegradation potential of antimicrobial edible films and coatings, and how the presence of antimicrobial agents as a constitutive part of the packaging material can interfere with the microbial degradation. So, what is true about this promising bioactive and sustainable packaging technology? Can researchers working at the food packaging science and technology really combine antimicrobial activity and biodegradability in one biopolymer-based edible material? Or we have very high expectations about this developing technology?

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