

## Functional Edible Coatings for Fresh Food Products

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### Introduction

Fresh and minimally processed foodstuffs like fresh-cut produce, meat, fish as well as ready-to-eat meals with fresh components (e.g. vegetables, herbs) are important market sectors in retail food industry. However, because of their fresh nature, mild processing technologies or increased surfaces as consequence of cutting processes, these products are very sensitive to food quality changes. Deterioration can occur by chemical, physical as well as microbiological processes like water loss, enzymatic based and light induced colour changes (e.g. browning), oxidation, loss of cellular integrity (softening) or a growth of microorganisms. Relevant for food safety are foodborne pathogens, especially psychotropic bacteria like *Listeria monocytogenes*, which can grow in the cooling chain and species of the family Enterobacteriaceae like *Salmonella enterica* or *Escherichia coli*. Current prevention strategies are versatile and include distribution in the cooling chain, modified atmosphere packaging, controlled atmosphere storage or the application of preservatives. Functional edible coatings could be an interesting approach for overcoming some of the mentioned quality losses.

### Functional Edible Coatings

Edible coatings are consumable films, which enable supporting structures and protective layers on food surfaces. By selection of suitable matrices and incorporation of functional additives food quality changes by moisture transfer, oxidation processes, respiration, loss of volatile flavors or microbial growth can be reduced or even prevented.

Various raw materials are suitable for the development of edible coatings: hydrocolloids based on proteins of animal or plant sources (e.g. whey, soy, corn, legumes) or polysaccharides (e.g. cellulose derivatives, alginates or starches), lipids (e.g. waxes, shellac, fatty acids) or even synthetic polymers (e.g. polyvinyl acetate) [1]. Their selection depends on the requirements on barrier properties (water vapour, oxygen, carbon dioxide), mechanical strength, gloss and durability. Examples for functional components could be antimicrobials (e.g. organic acids, fatty acid esters, polypeptides, essential oils), antioxidants (e.g. ascorbic acid, oxalic acid, cysteine), texture improvers (e.g. calcium salts), aroma or nutraceutical compounds (e.g. vitamins) [2-4].

The application of the coating can be realised by dipping or spraying methods followed by film formation processes like removing the solvent (normally water), coagulation of proteins, solidification of gel structures or chemical reactions. Relevant factors for the film formation are the chemical composition of the coating material (hydrophilic or hydrophobic), the concentration and viscosity, which influence the homogenous distribution, flexibility and the barrier properties (gas exchange) of the layer as well as the release of the functional component by diffusion.

Generally, the application of edible coatings on foodstuff has been known for centuries, for example the coating of fruits with waxes in early china in order to prevent water loss and structural changes [5].

There are also edible films for specific food products commercially available like sucrose fatty acids for fresh produce or collagen casings for sausages [6].

In the last years a lot of research has been conducted on advanced functional edible coatings for broader food applications with promising results [1,2,6,7].

For example, Rojas have reported that edible films based on alginate/gellan and N-acetylcysteine as antioxidants can prevent the fresh-cut apple wedges from browning within a storage period of 21 days [8]. The effects of essential oils as antimicrobial agents in alginate-based edible coatings on apple surfaces were investigated by Raybaudi-Massilia et al. [9]. They have observed that low concentrations of lemongrass and cinnamon oil can inactivate more than 4 log of *Escherichia coli* O157H7 on the surface and extend significantly the shelf life of cutted apples.

An essential aspect in this research field is the knowledge about the specific foodstuff properties (e.g. oxygen sensitivity, microflora, respiration) as well as their main deterioration pathways, which are a prerequisite for the development of effective functional coatings without adverse effects on the quality. Furthermore, the effects of the edible films on the internal gas atmosphere and their consequences on the food quality and sensory properties have to be determined [6]. This underlines that such functional edible coatings have to be tailor made according to the requirements of each product.

### Conclusion

Further to many other technologies like modified atmosphere packaging or active packaging, functional edible coatings could be a promising approach for preserving the quality and increasing the safety of fresh products. Current research have shown that adjusted edible coatings could be a benefit for fresh products like meat or fresh-cut produce and an opportunity to decrease the use of non-renewable packaging materials and the amount of waste in this commodity group. The technical challenge is the development of tailor made coatings with appropriate functions according to the specific requirements of the various foodstuffs, which is still subject of current research. Beside their effect on the food quality further practice relevant aspects like influence on the sensory properties, the technical and financial feasibility as well as the consumer acceptance and legal aspects have to be considered for industrial implementation.

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