Functionalization of Food Antimicrobials by Nano-encapsulation

This research effort focuses on the completion of fundamental and applied microbiological research to improve the utility of differing naturally occurring food antimicrobials. In the United States today, many differing types of food antimicrobials are incorporated into the foods we eat every day, many of them originating from natural sources. Examples of such preservatives include organic acids like citric and malic acids, microbially-produced polymers such as the cheese preservative nisin and the compound natamycin, differing microbial organisms known to produce various chemicals with antimicrobial properties (e.g., the lactic acid bacteria), and a host of plant- and spice-derived compounds that possess antioxidant properties as well as antimicrobial efficacy. Nevertheless, many of these compounds can be degraded by enzymes present in some foods or become sequestered in lipid phases of high-fat foods or be highly volatile, eliminating the opportunity for long-term inhibition of contaminating microorganisms like Salmonella, Escherichia coli, and Listeria monocytogenes in foods such as dairy products, fresh and processed meats, and fresh and minimally processed fruits and vegetables.

Researchers at Texas A&M University’s Food Safety Laboratory seek to overcome limitations to the use of these compounds in various foods, primarily by encapsulation of the antimicrobial prior to its delivery to the food. Many previous studies demonstrated that, when antimicrobial compounds are entrapped in a carrier system that is optimized for the food product, the antimicrobial efficacy is retained for longer periods of time than when the antimicrobial is delivered in an unencapsulated state. Such research has been completed on several types of antimicrobials, including those mentioned above, for fresh meats, pasteurized fluid milks, and various fermented ripened cheeses. These studies point to the opportunity for encapsulated antimicrobials to be used synergistically with unencapsulated antimicrobials in a food process in order to maintain a significant level of microbial inhibition during transport and retail of many foodstuffs.

Recently scientists at this laboratory initiated trials to determine the potential utility of encapsulated organic acids and spice-derived antimicrobials for inhibition of foodborne pathogens such as Salmonella and E. coli O157:H7 that contaminate the surfaces of differing produce commodities (peppers, tomatoes, melons, and leafy greens). The laboratory has received financial support from the U.S. Department of Agriculture for these research studies. Our researchers are also in discussions with corporate entities interested in designing nano-encapsulation and delivery technologies for dairy and beverage processors seeking high-efficacy, high-impact inhibition of microbial pathogens in their products and for their customers.

Technical Aspects and Anticipated Outcomes

At the conclusion of USDA-funded research, scientists will provide data and novel technologies capable of improving the microbiological safety of pre-harvest and post-harvest produce by increased inhibitory pressure against bacterial pathogens that cross-contaminate food items. The slow release of entrapped antimicrobials during storage, transportation, and retail of produce will exert inhibition of pathogens, resulting in enhanced produce safety for Texas and U.S. consumers. Other research efforts are designed to produce encapsulation systems that deliver highly functional broad-spectrum antimicrobials that will dramatically improve the microbiological quality and safety of many food products, including processed and fermented dairy and fruit- and vegetable-derived juices and beverages in which consumers seek reduced processing so as to maintain enhanced nutrient density and flavor.

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