Chapter 11
Nanoencapsulation of Food Ingredients

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ABSTRACT

Nanoencapsulation of food ingredients is one of the important applications of food nanotechnology. Nanoencapsulation is a technique used to produce nanocapsules from core materials packed within a wall material. Food manufacturers need to incorporate food ingredients with specific functional properties into food products. However, these ingredients may slowly degrade and lose their activity, or become hazardous due to various chemical reactions. They can also react with other components in the food system, which may lower their bioavailability, or change the color or taste of a product, allowing the food item to become prone to spoilage and deterioration. The protection of food ingredients against degradation and interaction with other food components may be done using the nanoencapsulation technique. It also, helps to enhance the bioavailability of food ingredients by protecting them during the digestive processes, improved uptake in the gastrointestinal tract and enhanced transport to the target sites. Nanosized materials provide a larger surface area for interaction with the biological substrates than microsized materials. Various techniques such as emulsification, coacervation, nanoprecipitation, solvent evaporation, spray drying and freeze drying are widely used techniques for nanoencapsulation of food ingredients.

INTRODUCTION

Nanotechnology has emerged as one of the most promising scientific fields of research in decades. It deals with the production, processing, and application of materials with sizes less than 1,000 nm. Particle size reduction to nanoscale range increases surface-to-volume ratio, which in turn increases their

DOI: 10.4018/978-1-5225-5207-9.ch011

reactivity by many folds with change in mechanical, electrical, and optical properties (Ezhilarasi et al., 2013). These properties offer many unique and novel applications in various fields. Nanotechnology has been revolutionizing the entire food system from production to processing, storage, and development of innovative materials, products, and applications. The application of nanotechnology to the food sector could generate innovation in the macroscale characteristics of food, such as texture, taste, other sensory attributes, coloring strength, processability, and stability during shelf-life, leading to a great number of new products (Huang et al. 2010; McClements et al. 2009). Moreover, nanotechnology can also improve the water solubility, thermal stability, and oral bioavailability of bioactive compounds. At present, applications of nanotechnology in food industries are nanocomposites in food packaging material for controlling diffusion and microbial protection, nanobiosensors for detection of contamination and quality deterioration, and nanoencapsulation for controlled delivery of probiotics and bioactive compounds (Weiss et al., 2006; Ezhilarasi et al., 2013).

Nanoencapsulation technology is expanding rapidly with a number of potential applications in the areas of food and pharmaceutical industries (Mir & Shah, 2014). Nanoencapsualtion is a process by which nanoencapsules are produced by enclosing the core materials within the wall materials. Nanoparticle delivery systems are finding increasing application in the food, pharmaceutical, personal care, and other industries. Traditionally, food manufacturers have utilized delivery systems to encapsulate functional ingredients designed to improve food quality and safety, such as flavors, colors, antioxidants, enzymes, and antimicrobials. More recently there has been interest in the use of delivery systems to encapsulate bioactive components that have been shown to be beneficial to human health. This research has been stimulated by the food and beverage industries' interest in creating products specifically designed to promote human health and wellness, and to prevent chronic diseases, such as cardiovascular disease, diabetes, hypertension, obesity, osteoporosis, and cancer. The technical challenges involved in encapsulating these components into desirable commercial products has led to rapid developments in methods for encapsulating, protecting, and delivering functional food ingredients to improve food quality, safety and health. A well-designed delivery system can be used to overcome many of the technical challenges normally associated with incorporation of these active ingredients into commercial food and beverage products (McClements, 2014).

BACKGROUND

Food ingredients are added to food products serve specific functions like colors, flavors, antimicrobials, antioxidants, nutraceuticals (bioactive compounds), and preservatives. These ingredients have been used for centuries e.g., our ancestors used salt to preserve meats and fish, added herbs and spices to improve the flavor of foods, preserved fruit with sugar, and pickled cucumbers in a vinegar solution. Today, consumers demand and enjoy a food supply that is flavorful, nutritious, safe, convenient, colorful and affordable.

Incorporation of some of the food ingredients into food products is not always easy as there are many technological hindrances such as they are physically or chemically unstable, they are incompatible with the product matrix, or they lack the appropriate functional attributes. The functionality of active substances often is declined during processing and storage, and during passage to the gastrointestinal tract. These challenges can often be overcome by modifying the food ingredients before they are introduced into the final product (McClements, 2014). One of the strategies to modify the food ingredients is to incorporate the ingredients into some delivery system. A "delivery system" is a system designed to