PhD Seminar *Particle Engineering: Application to Food Technology*

Abstract

Particle engineering involves the controlled transformation of liquid droplets into functional particles through processes such as spray drying, enabling the design of particle size, morphology, composition and physicochemical properties. These principles have broad applications across several fields, including inhalable drug delivery, aerosol science, pharmaceutical formulations and food powder production. In food technology, particle engineering offers significant opportunities to develop innovative ingredients and functional foods by controlling the encapsulation, protection and delivery of valuable compounds. Bioactive substances, including vitamins, antioxidants, polyphenols and lipophilic compounds, can be incorporated into engineered particles to improve their stability, dispersibility and bioavailability. This approach can support the development of fortified plant-based milk alternatives, protein-derived fat replacers and powdered supplements containing poorly water-soluble or oleophilic compounds. Furthermore, particle engineering can be used to tailor ingredient functionality, improve powder handling and reconstitution, and enhance the nutritional and sensory properties of food products. By bridging fundamental principles of droplet drying, mass and heat transfer, and material science with food formulation and processing, particle engineering provides a versatile platform for developing next-generation food ingredients and sustainable, value-added food products.