

# Flavonoid-protein nanoparticles and their application in functional foods

**Ali Rashidinejad** and **Harjinder Singh**

Riddet Institute Centre of Research Excellence, Massey University, Private Bag 11 222, Palmerston North, New Zealand.

The oral delivery and clinical efficacy of hydrophobic flavonoids are very limited because of their poor solubility in both water and oil, resulting in a low dissolution rate and poor bioavailability. Moreover, these bioactive compounds can undergo chemical and enzymatic degradation in the environment as well as gastrointestinal tract. Therefore, there is an increasing demand for delivering flavonoids in a protected (nanoencapsulated) form for which a wide range of promising delivery systems have already been tested; i.e., emulsions, liposomes, coacervates, and gels, composed by different natural polymers such as polysaccharides, proteins, and phospholipids. These encapsulation/delivery methods mitigate flavonoid degradation, but they often give low encapsulation efficiency and/or loading capacity. Several are not suitable for use in the food formulations due to the use of toxic solvents, and others use processing methods that are expensive or difficult to scale up in the food industry.

One promising system for encapsulating bioactive compounds is nanocomplexation with proteins such as those from bovine milk. These proteins have advantages such as abundance, inexpensiveness, biocompatibility, biodegradability, nontoxicity, and sustainability. In this presentation, a simple, cost-effective, and organic solvent-free nanoencapsulation system developed in our laboratories for delivery of concentrated hydrophobic flavonoids and incorporated into functional foods will be explained. This delivery system has the potential of incorporation of high concentration of lipophilic flavonoids (e.g., rutin, naringenin, hesperidin, curcumin) into different foods, such as liquids (e.g., drinks and beverages), semi solids (e.g., yoghurt), and solids (e.g., bars). The advantages and opportunities associated with this method, manufacture, mechanisms, properties, limitations, and future directions will be discussed.

*Keywords:* flavonoid delivery systems; flavonoid encapsulation; milk proteins; protein self-assembly; functional foods.