Nano-food engineering: amylose-based nanocapsules as edible controlled delivery systems

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Unbalanced western-style diet and a sedentary lifestyle are increasingly recognized as important contributors to the observed increase in obesity and chronic diseases in the western world. Supplementing foods with health promoting bioactive ingredients poses a major technological challenge since some of these constituents, like omega-3 poly-unsaturated fatty acids (PUFA), exhibit poor chemical stability as well as distinct effects on the taste and smell of the product. One underused but advocated approach to meet this challenge is to develop controlled and targeted delivery systems based on edible food carbohydrates, such as starch and one of its constituents, amylose.

This lecture will discuss some of the insights gained from testing the hypothesis that guest chemistry affects the structure of nanocapsules, which are based on the complexation of amylose and hydrophobic ligands. This, we believe, will affect some of the functional properties of the nanocapsules, such as controlled and targeted delivery of bioactive fatty acids, designed for oral ingestion. Nanocapsules were produced via two different methods using pure amylose or various starches, including high amylose corn starch (HACS). These nanocapsules were studied structurally and functionally.

Experimental data collected for amylose-fatty acid (FA) complexes shows them to be stable both thermodynamically ($T_m>85^\circ$C) and in simulated stomach conditions (1M HCl). Light scattering based particle sizing shows that the degree of FA unsaturation affects the particle size of the nanocapsules, a finding which has also been corroborated microscopically (AFM). Digestion in conditions simulating the small intestine was used to follow the release of the various FA’s over 24 hours, showing that increased degree of unsaturation leads to a more rapid release. In addition, using corn starch and HACS, a new method for the continuous production of such nano-carriers has been employed successfully, yielding food grade particle of diameters varying from 40nm up to 3.5μm.

This study demonstrates the effects of guest fatty acid chemistry on the structure and functionality of the resulting amylose based nanocapsules. These insights will be used in tailoring such edible systems for oral delivery of various bioactives to the lower gastrointestinal tract.

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