***In vivo* and *in vitro* monitoring of hydrocolloids in encapsulation systems**

A. Brodkorb

*Teagasc Food Research Centre Moorepark, Fermoy, Co. Cork, P61 C996, Ireland*

A distinctive feature of many bioactive components in food, whether added or already present in its natural form, is their vulnerability to harsh environments during food production, storage or gastro-intestinal (GI) digestion. The detrimental consequences of this inherent instability are their degradation and inactivation prior to reaching their target site. For this reason, the development of food or food ingredients with bioactive functionalities is an on-going challenge within food research and development. Encapsulation is one method of improving the stability and GI delivery of bioactives in food.

This paper describes approaches used in our group to overcome the limited stability and poor delivery of bioactives such as fatty acids, peptides or bacteria in food. Probiotic bacteria LGG® (*Lactobacillus rhamnosus* GG ATCC 53103, Valio Ltd., Helsinki, Finland) was encapsulated by entrapment in acid-induced gel beads of heat-denatured whey protein according to Doherty et al.1. Micro-beads were formed using a vibrating nozzle droplet encapsulator. Probiotic release and survival under gastro-intestinal conditions were monitored *in vitro* (static GI digestion method), *ex vivo* (static GI digestion using porcine gastric and intestinal juice) and *in vivo* (porcine model; enumeration in gastric, duodenal, jejunal and ileal content after the sacrificing). Whey proteins were also used to stabilise and improve the delivery of fatty acids, which were associated to native or heat-treated aggregated proteins at lab- or pilot-scale. The bio-accessibility and bio-availability of bioactives were assessed using the INFOGEST *in vitro* digestion method 2 coupled with assays simulating the intracellular transport of fatty acids into enterocyte-like monolayers (Caco-2)3. *In vivo* digestion models included healthy, adult human subjects (wireless capsule endoscopy and nasogastric tube sampling)4. A full range of physico-chemical methods was used to characterise the encapsulation systems, such as static and dynamic light scattering, zeta-potential measurements, SDS-PAGE, HPLC, Nuclear Magnetic Resonance (NMR), confocal laser light microscopy, Scanning and Transmission Electron Microscopy (SEM, TEM) and Atomic Force Microscopy (AFM).

Acknowledgements

The presented work by the author and co-workers was supported by national programs (FIRM Department of Agriculture, Food and the Marine, Dairy Levy Research Fund, Walsh Fellowship) and international networks (Bioencapsulation Research Group BRG, COST INFOGEST FA1005).

References

1 Doherty, S. B., Gee, V. L., Ross, R. P. *et al.* Development and characterisation of whey protein micro-beads as potential matrices for probiotic protection. *Food Hydrocolloids* **25**, 1604-1617, (2011).

2 Minekus, M., Alminger, M., Alvito, P. *et al.* A standardised static in vitro digestion method suitable for food - an international consensus. *Food & Function* **5**, 1113-1124, (2014).

3 Le Maux, S., Brodkorb, A., Croguennec, T. *et al.* β-Lactoglobulin-linoleate complexes: In vitro digestion and the role of protein in fatty acids uptake. *J. Dairy Sci.* **96**, 4258-4268, (2013).

4 Sullivan, L. M., Kehoe, J. J., Barry, L. *et al.* Gastric digestion of α-lactalbumin in adult human subjects using capsule endoscopy and nasogastric tube sampling. *Br. J. Nutr.* **112**, 638–646, (2014).