food colloid capers

By *Dr. Lara Matia-Merino*, Institute of Food, Nutrition and Human Health (IFNHH), Massey University, and *Dr. Simon Loveday*, Research Scientist, Riddet Institute, Massey University.

'So what do you do?' he asked. *'I'm in Food Colloids'* I replied. *'What?'*

It seems that the term 'colloid', from the Greek words kolla (glue) and eidos (like), is not a household name, even though the very first food all of us have is a colloid – milk! In fact we are exposed to colloidal systems every day: from the face cream we apply in the mornings, to the mayonnaise we put in our sandwiches, to the paints we use on our houses.

All these materials are in a 'colloidal' state…a fourth state of matter following the classical 'gas, liquid and solid' states. Colloids contain particles between one micrometre (μm, 10^{-6} metres) and one nanometre (nm, 10^{-9} metres) suspended in a solid, liquid or gas continuous phase. Colloid science is not new; Thomas Graham in 1861, was the first to classify substances such as starch and gelatin as colloids.

The most common food colloids are:

Emulsions: oil droplets dispersed in an aqueous (water-based) phase – think of Baileys!

Foams: air bubbles dispersed in a liquid or solid continuous phase – think of Pavlova!

Dispersions and suspensions: particles such as sugar crystals, starch granules, flavour particles etc. dispersed in an aqueous phase – think of vinaigrette with herbs suspended in it!

Gels: where any of the systems above can form a network that holds liquid – think of jelly!

As you can imagine, many foods are complex combinations of these systems, and something as appetizing as ice cream can be an emulsion, a foam, a dispersion, and a gel, all in one!!

But focusing on 'white' milk, what makes it a colloid?

Well, it is the protein and the fat particles. In milk, casein proteins bunch together in clusters called 'micelles' 30–300 nm in diameter (a solid suspended in liquid). Milk also contains dispersed fat globules 2-6 μm wide in raw milk, and <1 μm in homogenised milk (an oil-in-water emulsion).

Why is milk white?

The same reason the sky is blue – diffraction! These tiny particles in milk diffract light passing through, so you can't see your hand through the glass. So next time you pour milk on your Weetbix, think of it as a colloidal dispersion of casein micelles and an oil-in-water emulsion – that's Food Science in action!

Making yoghurt from milk involves transforming one colloid (a suspension and emulsion) into another (a gel). When bacteria slowly produce lactic acid using the sugar present in milk (lactose), the pH is lowered, causing the casein micelles to lose stability. This happens because the negative charges on the micelle surface are neutralised by the H^+ ions from the acid, and micelles stop repelling each other. The casein micelles come together and form a network that holds water – now we have a gel!

The microstructure of yoghurt is shown in the picture below – light-coloured strands are the aggregated network of casein micelles; dark areas are the water held by the network.

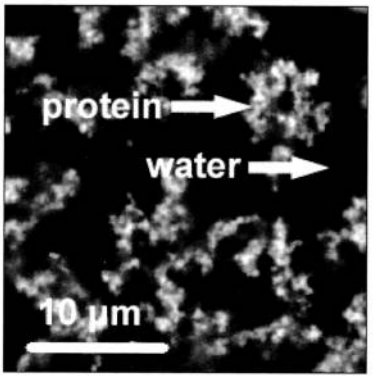

Figure 1: Yoghurt structure photographed with a con-focal scanning laser microscope, showing the protein aggregate gel surrounding water-filled pores.

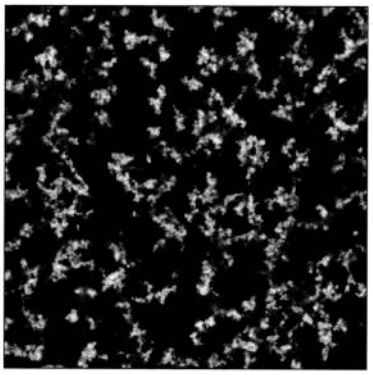

Figure 2: Microstructure of yoghurt.

The acidification process must be slow, otherwise the protein comes together in a chaotic way, precipitating out. Just try adding lemon juice to milk! Too much acid can lead to a weak protein network that doesn't hold water properly, and a layer of liquid appears on top of your yoghurt.

In commercial yoghurts the casein network is often reinforced with other network-forming ingredients such as starch, gelatin and gums. These make the protein network firmer, with smaller pores (dark areas in the picture), and hold the water even tighter – that's Food Technology in action!

'So you're a Food Technologist … is that like a chef?'

No! Food Technologists use science and engineering to create great-tasting, nutritious foods based on knowledge of how they're put together at the molecular level. We figure out how to manufacture foods and keep them fresh and safe after shipping around the country or around the world!

Food colloid science is just one of the interesting topics in the four year Bachelor of Food Technology (Hons) offered at Massey University's Auckland and Palmerston North campuses. Massey's Food Technology graduates are highly sought-after because of their hands-on experience during the degree.

For information about the Bachelor of Food Technology (Hons) degree, visit: **http://foodtech.massey.ac.nz/**

For simple Food Science experiments you can do in the classroom visit: **www.nzifst.org.nz** or contact Dr. Simon Loveday: **s.loveday@massey.ac.nz**