Process Engineering for Functional Foods

Ken Morison
Department of Chemical and Process Engineering
University of Canterbury

Food research at the University of Canterbury is mostly contained within the School of Biological Sciences and the Department of Chemical and Process Engineering. There is no specific department devoted to food science or technology. The Biomolecular Interaction Centre was recently formed to bring together common interests between Biological Sciences, Chemistry, and Chemical Engineering. Its research includes the fundamental behaviour of proteins as well as the separation of these and other components for the manufacture of foods.

My own research comes from my background as a chemical engineer with 8 years experience working in the New Zealand dairy industry. This has been followed by 17 years at the University continuing research into dairy process engineering and broadening into other food processing. Here I will outline a few of the different research projects.

Formal design of evaporator and membrane processes (ultrafiltration and reverse osmosis) has led onto many other aspects of each. In evaporators the rheology of concentrated milk is critical in performance once the concentration gets high. With excessive concentration or age-thickening a gel is formed. The removal of the milk requires dissolution of the gel, normally using sodium hydroxide solution. The study of cleaning overlapped with some work at Cambridge University and led me to research the diffusion of multiple ions in protein (or polyelectrolyte) gels. Maxwell-Stefan diffusion is well suited to this even though it is mathematically complex. It is hoped that a well developed model with allow the design of proteins, or polyelectrolyte, gels for optimised drug release or other such applications.

Most of my membrane work so far has been on membrane characterisation but this is closely linked to interactions between food, cleaning systems, and membranes. Effective separation of foods by membranes depends on a clear understanding of these interactions and the limitations of the processes.

A range of new products have been dried on our Niro spray dryer. Some novel proteins-based foods have dried easily while protein denaturation has limited production of others. We have successfully dried fruit juice by adding vegetable fibres to it to act as a carrier. This proves superior to the alternative maltodextrin.

A recent project concerned the optimisation of a process to separate starch and protein from oat cereal. Oat is normally associated with porridge and horse food, but it contains starch with a small granule size. The starch was successfully isolated and dried, forming very interesting spherical agglomerates.

Other research at the University of Canterbury by Professor Conan Fee has focussed on the separation of high value proteins from milk. Projects have included on-farm extraction, mixed ion-exchange membrane separation, and surface plasmon resonance analysis to determine effective ligands for separation. Another member of the Biomolecular Interaction Centre is Professor Juliet Gerrard who is interested in manipulation of protein structure for texture and digestibility. Her team have researched protein cross-linking by enzymes and by the Maillard reaction.

This presentation will show that the University of Canterbury has expertise in processing and science that support the development of functional foods.