Massey University

Characterisation of the rehydration behaviour of milk protein concentrates in the presence of sugar

M.Phil Thesis

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Abstract:

The main focus of this study was to characterize the hydration of milk protein in high protein powders to provide insights and strategies that might improve the use of these powders in foods. While the majority of hydration studies reported in the literature have been conducted on systems where there is an excess of water there has been little research characterising hydration in models that more closely approximate powder hydration in real food systems. This study investigates the impact on protein powder hydration of one of the most common ingredients in food systems: sugar. Results from this study show that rehydration of MPC85 powders is much more sensitive to aging compared to rehydration in water. An aged MPC85 powder was found to have the same solubility profile with respect to temperature in pure water compared to the fresh powder. However the degree of solubility was markedly reduced when the same powder was rehydrated in water containing sugar (20%). This should also be kept in mind while calculating the solubility of milk powders during the processing as other ingredients will interfere with them to affect solubility of milk powders which in turn will affect the shelf life of the food products.

It was also shown that the specific volume of the insoluble material sedimented during solubility studies increased as the solubility of the overall increased to about 50%. At higher degrees of solubility the specific volume of the sediment material decreased. Microscopy showed that in the lower solubility range predominantly small particles dissolved and the large particles retained their structural integrity through centrifugation and thus the volume of sediment was relatively unchanged despite material dissolving and becoming part of the supernatant. At higher levels of solubility the large particles dissolve primarily through the outer particle surface which therefore resulted in a progressive decrease in volume with solubility. The rate of change in the specific volume of the sediment and mass of the sediment with the increase in the solubility and temperature was also dependent on the solvent. The rate of change in water was higher than in the 20% sugar solution.

A new mechanism for MPC powder rehydration was also proposed wherein water ingress into the particles occurs over a very short time scale. Water ingress equilibrium was assumed to occur when the concentration of sodium ions reached equilibrium on the assumption that all sodium salts are highly soluble and that the sodium salts are evenly dispersed throughout the primary powder particle. This occurred over a time-period of a

couple of minutes compared with about thirty minutes for the bulk total soluble solids as measured through centrifugation. Increases in solubility with increasing rehydration temperature is proposed to result from shrinkage of the micelles in the particles due to increased hydrophobic bonding that in turn separates the micelles from each other allowing further ingress of water and solubilisation.

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