
Development and validation of models for heat treatment of concentrated skim milk in batch and continuous process

YUN G. (1,2), HASHEMIZADEH I. (2), RIPBERGER G. (2), GILLIES G. (2), WHITBY C. (1), BRONLUND J. (1)

1 Massey University, Palmerston North, New Zealand

2 Fonterra Co-operative Group Ltd, Palmerston North, New Zealand

Milk undergoes many chemical and physical changes during heat treatment that may lead to undesirable properties such as coagulation and gelation. This heat instability is often associated with milk proteins, such as the denaturation and aggregation of beta-lactoglobulin (β -lg). The majority of kinetic studies to date have been conducted under isothermal batch conditions. Incorporating the heat transfer phenomena is important to transfer the kinetics from batch to continuous systems as tubular heat exchangers are commonly used in dairy processing.

Processing at higher milk concentrations improves sustainability of production through higher energy efficiency and lower transportation volumes. Higher concentrations increase reaction rates and also the viscosity of the product, affecting fluid flow and the resulting time-temperature distributions during processing. In this study, the kinetics of heat-induced β -lg denaturation reaction in concentrated skim milk were coupled with models for heating and residence time distributions in tubular heat exchangers. The resulting model allows for an understanding of how processing conditions can be manipulated to optimize milk quality at an industrial scale. Model predictions are compared with experimental data collected from a pilot-scale UHT processing unit.