Role of calcium and casein micelle on the thermal denaturation of whey protein solutions and fouling mechanisms

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Fouling of heat exchangersin the dairy industry during pasteurization or UHT treatments is a persistent issue which is not yet totally understood and consequently is still a challenge to overcome.
Many previous works demonstrated the key role of protein in the initiation of fouling and mentioned that the denaturation of ?-lactoglobulin (?-LG) is key factor responsible of the fouling build up.
However, less studies in the literature addressed comprehensively the influence of mineral or casein-micelle and its consequence on the amount of fouling. The objective of this work is to contribute to this field.
For that, fouling experiments (at the pilot scale) and kinetics parameters of denaturation obtained with reconstituted solutions at different calcium/protein molar ratio and at different casein/protein molar ratio were analysed and discussed.
Results established that both the ?-LG denaturation rate constants and the distribution of fouling in the PHE were strongly impacted by the calcium/protein molar ratio for casein free solutions and that presence of casein radically changes fouling rate. It was concluded that casein micelle acts as a natural calcium chelator during thermal processing and therefore mitigates whey protein fouling. Moreover more dissociated caseins into the serum phase might be sufficient to perform chaperone-like functions.
For the conditions investigated, results established that the total deposit mass increased with the increase of the calcium/protein molar ratio. This investigation clearly shows that limiting protein concentration is not necessary a pertinent pathway to decrease fouling mass. However, it suggests that controlling the mineral balance is a key lever.