Kinetics of heat-induced denaturation of whey proteins and characterization of protein aggregates in model infant formulas

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Introduction: Clearly state the purpose of the abstract

Methods: Describe your selection of observations or experimental subjects clearly

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Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Introduction: In 2018, about 60% of world's newborns received cow milk-based infant formulas (IF) instead of human milk (UNICEF). The process of manufacturing IF involves heat treatments altering the physicochemical properties of milk components, especially whey proteins (WP). The objective of the study was to investigate the impacts of thermal treatments on the denaturation of WP of IF, particularly for those mimicking the protein profile of human milk, and to characterize the heat-induced protein structures.

Methods: Three model IF were produced with a caseins:WP ratio of 40:60 at 1.3% and 5.5% of total proteins, differing in the quality of WP. The kinetic of heat-induced denaturation of each WP was investigated between 67.5°C and 80°C by quantification of the residual native proteins by RP-HPLC. The heat-induced protein structures were studied by dynamic light scattering, electrophoresis and asymmetric flow field flow fractionation coupled with MALLS.

Results: The quantification of native WP fractions revealed an enhanced denaturation of α-lactalbumin in presence of both β-lactoglobulin and lactoferrin, an increased denaturation of β-lactoglobulin in presence of lactoferrin, and an increased denaturation lactoferrin in presence of β-lactoglobulin. At similar rate of total WP denaturation at 67.5°C and 80°C, the protein composition of the heat-induced aggregates changed between formulas, protein concentrations and heating temperatures but disulfide bonds were the main intermolecular links. The aggregates were larger and of fractal shape (apparent fractal dimension dfapp = 2.1) in formulas at 5.5% proteins whereas they were of spherical shape (dfapp = 2.9) in formulas at 1.3% proteins.

Discussion: Effets of heat treatment on the denaturation of α-lactalbumin, β-lactoglobulin and lactoferrin and the protein structure are influenced by the WP quality of IF. These results will give to industrials reliable data on the protein structures formed during the heat treatments of IF. The impact on digestibility will be subsequently investigated.