DEPARTMENT OF FOOD TECHNOLOGY
MASSEY UNIVERSITY
PALMERSTON NORTH
NEW ZEALAND

RENNET COAGULATION PROPERTIES OF HEATED MILKS

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ALGANE WAUNGANA

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ABSTRACT

The effects of heat treatment at temperatures in the range 80 - 140°C for 4 s in a spiral flow indirect UHT plant on (i) the denaturation of whey proteins, (ii) their association with the casein micelles and incorporation into rennet gels and (iii) rennet coagulation properties of skim milk were determined.

The extent of denaturation of β-lactoglobulin (β-Lg) and α-lactalbumin (α-La), as determined by the decrease in the amounts of native protein (Native-PAGE) in the ultracentrifugal supernatants (100,000*g* for 1 h) of heated milks, increased with the severity of heat treatment. At all temperatures, β-Lg was more sensitive to thermal denaturation than α-La. The extent of association of β-Lg and α-La with the casein micelles, as determined by the total amounts of these proteins (SDS-PAGE) remaining in the ultracentrifugal supernatants of heated milks, also increased with the severity of heat treatment. At any given temperature, association of these proteins with casein micelles was much less than the amount that denatured. The extent of incorporation of β-Lg and α-La into rennet gels increased with temperature and could be related to the levels of denaturation of β-Lg and its association with casein micelles.

Heat treatment impaired the rennet coagulation properties of milk as indicated by an increase in gelation times and a decrease in gel strengths (both determined using the Bohlin VOR Rheometer). There was a close correlation between the extents of association of β-Lg with the casein micelles and the changes in gelation time or gel strength. When heated milks were acidified to pH 5.5 and re-neutralised to pH 6.5 (pH cycled), the adverse effects of heat treatment on rennet coagulation were reduced, except for those milks heated at temperatures above 120°C. The rennet coagulation properties of heated milks were markedly improved by addition of low concentrations of $CaCl_2$, but no additional improvement

resulted when $CaCl_2$ addition was combined with pH cycling.

Concentration of skim milk by ultrafiltration (UF) lengthened gelation time but increased gel strength, the effect being dependent on the volume concentration ratio (VCR). Heat treatment of milk (140°C for 4 s) before or after UF increased gelation times and lowered gel strengths with weaker gels being formed from milks heated prior to UF. pH cycling of heated milk before UF or of heated UF concentrates had an adverse effect on rennet coagulation properties of the UF concentrates. When 3X UF concentrate was heated at temperatures in the range 80 - 140°C for 4 s, gelation time did not change with temperature between 80 and 120°C but more severe heat treatments caused an increase. In contrast, the gel strength decreased gradually with increase in heating temperature. These changes in rennet coagulation properties were related to the extent of denaturation of β-Lg and its association with the casein micelles.

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