Suitability for enzymatic coagulation of cheese milk analogues made from emulsions obtained by conventional and ultra-high pressure homogenisation

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INTRODUCTION

Functional foods are products that offer health benefits that extend beyond their nutritional value. Milk and dairy fat have been rejected by its high saturated fat and cholesterol content, so functional food has been formulated to replace the **saturated fat** in milk with **unsaturated fat** from vegetables oils rich in ω-3 and ω-9 that can help to reduce cardiovascular risk factors.

OBJECTIVES

- To determine the technological suitability for cheese making of milk cheese analogues (MCA).
- To compare the enzymatic coagulation properties of MCA obtained by conventional and ultra-high pressure homogenisation.
- To study the functionality of the gels obtained by analysing the processes of draining and potential cheese yield.

MATERIALS AND METHODS

- ✓ Cheese milk analogues (CMA) containing skim milk and emulsions made by **conventional** (CH, 30 MPa) or **ultra-high pressure homogenisation** (UHPH, 200 MPa)
- ✓ Particle size and distribution by **Mastersizer** 2000: D3,2 and D4,3
- ✓ Coagulation properties by **Optigraph** device: Rennet Clotting Time (RCT), Rennet Curd Firming (RCF) and Firmness al 30, 60 and 80 min (F30, F60, F80)
- ✓ **Confocal Laser Microscopy**: Fast Green for protein and Nile Red for fat.

RESULTS

Particle size and distribution

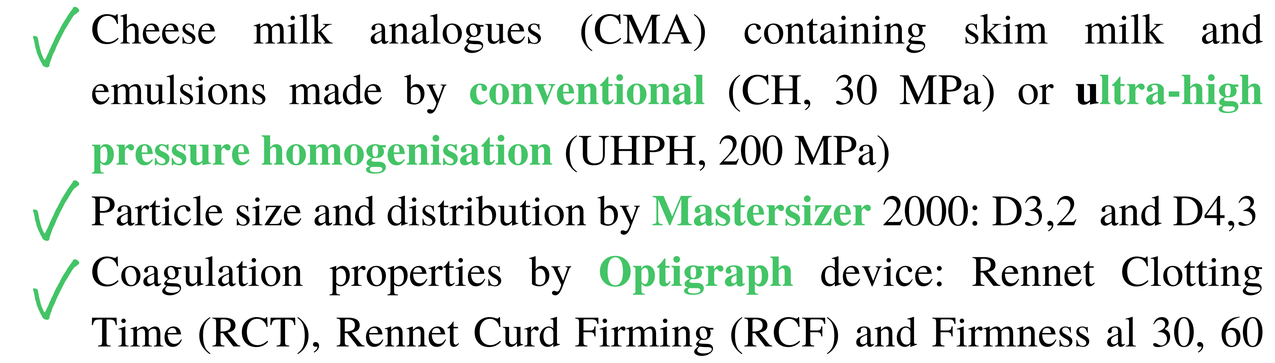

Figure 1. Functional foods are products that offer health benefits that extend beyond their nutritional value. Milk and dairy fat have been rejected by its high saturated fat and cholesterol content, so functional food has been formulated to replace the saturated fat in milk with unsaturated fat from vegetables oils rich in ω-3 and ω-9 that can help to reduce cardiovascular risk factors.

Rennet coagulation characteristics and cheese yield

Parameters	Treatments	
	CH	UHPH
RCT (min)	20,58[a] ± 3,01	21,88[a] ± 3,96
RCF (mA/min)	0,77[a] ± 0,22	0,78[a] ± 0,22
F30 (mA)	7,35[a] ± 1,76	7,73[a] ± 1,82
F60 (mA)	12,81[a] ± 2,33	13,91[a] ± 2,52
F80 (mA)	14,92[a] ± 2,10	16,63[a] ± 2,41
CY (%)	23,88[b] ± 0,58	27,60[a] ± 1,48
CD (%)	13,18[a] ± 2,76	5,85[b] ± 1,18
Curd moisture (%)	66,61[b] ± 0,51	70,58[a] ± 0,53
Whey total solids (%)	8,86[a] ± 0,04	8,73[b] ± 0,10

Table 1. Means and standard desviations of enzymatic coagulation parameters, rennet clotting time (RCT), rennet curd firming (RCF), gel firmness at 30, 60 and 80 minutes (F30, 60, 80), potential cheese yield (CY) curd draining (CD), curd moisture and whey total solids of cheese milk analogues containing emulsions obtained by conventional (CH) or ultra-high pressure homogenisation (UHPH)

Confocal laser microscopy of enzyme gels

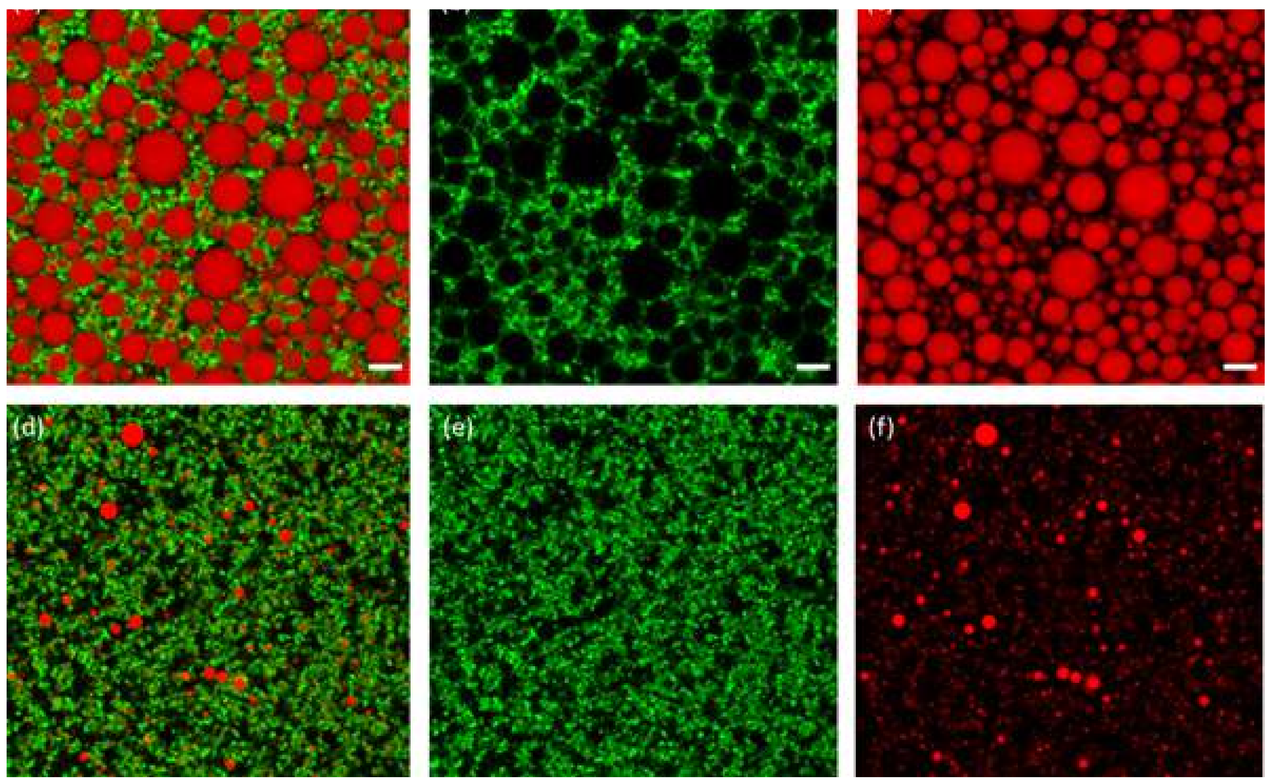

Figure 2. Confocal laser micrographs of the rennet gels obtained at 63× magnification from the cheese milk analogues made by mixing skimmed milk and emulsions produced by conventional homogenisation at 30 MPa (a, b, c) or by ultra-high pressure homogenisation at 200 MPa (d, e, f). The figure shows the protein network (b, e), the oily phase (c, f) and both together (a, d). Scale bar = 5 µm.

CONCLUSIONS

The UHPH technology at 200 MPa, compared to CH at 30 MPa, has proven to be more effective on the particle size reduction of emulsions. No differences in rennet coagulation properties were observed between MCA obtained by mixing skimmed milk and emulsions. However, a more compact three-dimensional protein network capable of retaining more water, obtaining a higher cheese yield was obtained from MCA including UHPH-treated emulsions.