
Future cheeses produced by extrusion of renneted curds

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Objective: The possibility to structure milk curds by extrusion, in order to create cheeses with customized properties in terms of texture and meltability has not been studied. Hence, the aim of this study was to investigate the shearing process of renneted curds in a twin-screw extruder, and understand the effect of the extrusion parameters on cheese composition, structure and texture.

Methods: A lab twin-screw extruder with a cylindrical cooling die was used for the shearing process. Four parameters at two levels were selected: heating temperature (Th, 80 or 90 °C), screw speed (SP, 50 or 150 rpm), barrel length (L, half or full) and cooling temperature (Tc, 10 or 30°C). Residence time (RT) and specific mechanical energy (SME) were calculated. Exit temperature (Texit) of the extrudates was measured at the exit of the cooling die. The effect of controllable parameters (Th, SP, L and Tc) on measured and calculated parameters (SME, Texit and RT) and curd properties (water content and distribution, textural properties – elasticity and melt strength, and microstructure by X-ray micro-computed tomography) were evaluated.

Results: Extruded curd products with a variety of properties were obtained, which were significantly influenced by controllable extrusion parameters Th and Tc. A higher Th enhanced curd elasticity and reduced melt strength while a higher Tc induced lower water content (42.8–48.6%) and melt strength. The measured and calculated parameters could comprehensively summarize the effect of multiple controllable parameters and their interactions. Easily separated, longer and finer fibers were formed at lower SME 23–27 kJ·kg⁻¹, higher Texit 50–54 °C and shorter RT 55–60 s, conditions that were reached at Th of 90 °C, SP of 150 rpm and full-L of the extruder. Microstructure of the parallel protein fibers separated by fat particles was clearly observed.

Conclusions: The relation between controllable extrusion parameters, characteristics of the extrusion process and properties of the curd provided new insights that can be further explored to produce structured cheese products with customized properties.