Structure development of soft cheese curd

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Purpose of the study

The structure development of a soft cheese curd model has been studied in relationship to its rheological and biochemical properties (partition of minerals, proteolysis) at different technological steps including cutting, drawing, three turns throughout drainage and demoulding.

Methods and Materials

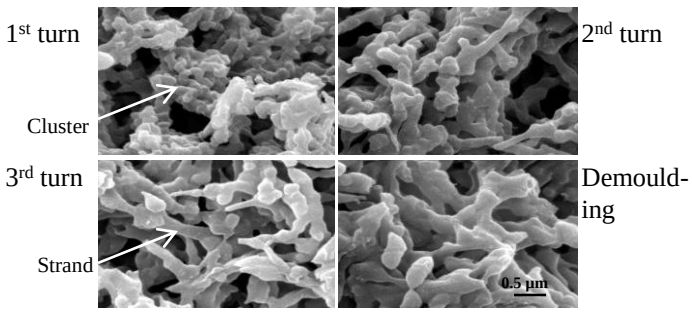
Manufacture of model soft cheese

Raw skim milk was microfiltered (1.4 µm, 35°C) and inoculated with *L. lactis* AM2. Renneting was carried out at pH 6.35 using recombined chymosin. At 31.5 min (3x the average clotting time of 10.5 min), the coagulum was cut in 1.5x1.5x1.7 cm cubes and gently stirred 10 and 25 min after cutting. 22% of whey were drained off and the curd was poured into 10.8 cm diameter moulds. The moulds were turned three times 1.5, 3 and 6 hours after renneting and removed after 20h (demoulding).

Characterisation of model soft cheese curd

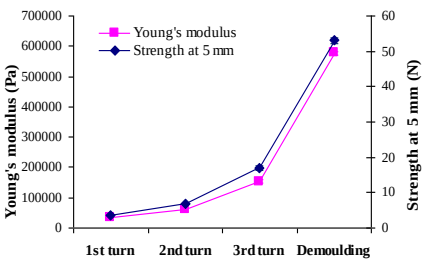
Some curds were collected at each processing step and analysed immediately using scanning electronic microscopy SEM (2x2x3 mm pieces were fixed in 2.5% glutaraldehyde for 24h at 4°C, dehydrated in alcohol series and critical point dried. Observations were made after gold coating). Rheological analyses were performed on fresh curd whereas curd was frozen until required for biochemical analysis (electrophoresis and a part of minerals content presented).

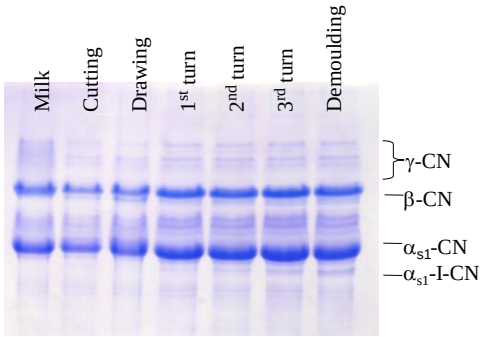
Results

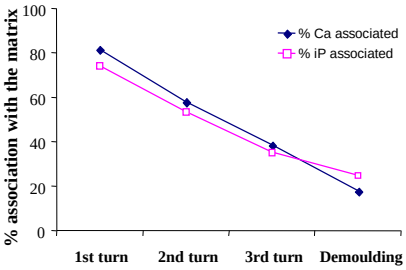


Observation of the structure using SEM

Water was removed during sample drying, leaving only the casein matrix and the bacteria to be visualised. Observed particles supposed to be micelle aggregates (≈ 0.25-0.5 µm) agglomerated to form clusters (0.5-4.0 µm) visible at the 1st turn. Particles within the clusters rearranged into strands and the micelle agregates, still visible at the 2nd turn, became difficult to visualise at the 3rd turn. The fusion between particles progressed, thus thickening and smoothing the strands until the curd has lost the cluster structure leading to the completely fused amorphous network at demoulding.







Rheological properties

A powerlaw dependance of the Young's modulus on the casein concentration was found with exponent value of 1.38 :

Young's mudulus = cste x (TN - SN)$^{1.38}$

Similarly, the strength at 5 mm, G' and G" depended on the casein concentration with exponent values of 1.30, 1.12 and 1.11, respectively.

Urea-PAGE of insoluble curd fraction

The enrichment of α_{s1}- and β-caseins throughout the drainage was visible while their concomitant degradation was evidenced by the appearance from the 2nd turn of bands corresponding to α_{s1}-I- and γ-casein, respectively.

Partition of calcium and phosphate

In relation to the acidification, the mineral content associated with the casein matrix (in contrast to the one in the aqueous phase) decreased during the formation of the curd. At the end of drainage, 20% of calcium and inorganic phosphate were still associated with the casein matrix.

Conclusions

- Changes in casein matrix composition (see urea-PAGE) can explain the initial increase of rheological characteristics at the 2nd turn.

- The appearance of α_{s1}-I-casein may facilitate rearrangement of the remaining casein particles and thus prepare the change of texture happening thereafter.

- In the structure development of soft cheese curd, the role of minerals is underestimated and even at the end of drainage (pH 4.8), minerals can still participate in the structure of the curd by formation of bridges between two negative sites on casein molecules and/or inorganic phosphate.

- Combination of SEM observations with dynamic rheological measurements and biochemical assessments provided increased knowledge about the structure of soft cheese during drainage, an important but poorly understood making stage.

Boutrou et al. (2002). Structure development in soft cheese curd model during manufacture in relation to its biochemical characteristics. JDR, 69, 4.