Protein interactions in stirred yoghurt

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Introduction

Stirred yoghurt is obtained after pumping, cooling and packaging of set yoghurt at pH ≈ 4.6. The viscoelastic properties of the gel decrease on shearing, but re-increase on storage at 4°C. This phenomenon is known as "rebodying". The nature of bonds that are responsible for this rebodying was investigated.

Materials & Methods

Reconstituted heated milk (90°C-10 min) was inoculated with non ropy yoghurt cultures. The gel was stirred through a mesh of 350-400 µm-holes and then in a home food processor (Renan et al., 2008), and characterised by low amplitude dynamic oscillation for 24 h (short-term rebodying) and viscosity (long-term rebodying) during 28 d of storage at 4°C

① Set yoghurts were stirred at pH 4.4 to 5.0 and stored at 4 - 20°C for 24 h, with or without NaN_3 (using a Box-Benken design);

② A constant set yoghurt was stirred in different physicochemical conditions applied on stirring

Results & Discussion

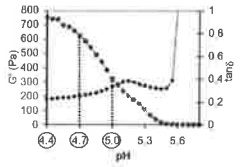

Fig.1: pH and G' of set acid gels versus pH

Set yoghurt stirred at lower pH values had a higher G' value (Fig.1). This led to a higher short rebodying (Fig.2) → <u>electrostatic interactions involved</u>.

No effect of the storage temperature of the stirred yoghurt during 24 h on short-term rebodying without over-acidification (Fig.2) → <u>hydrophobic interactions were not involved</u> in short-term rebodying.

Over-acidification took part in rebodying (Fig.2) .

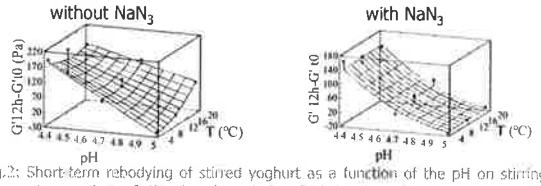

Fig.2: Short-term rebodying of stirred yoghurt as a function of the pH on stirring and the storage temperature of stirred yoghurt during 24 h (as the increase in G' during 12 h)

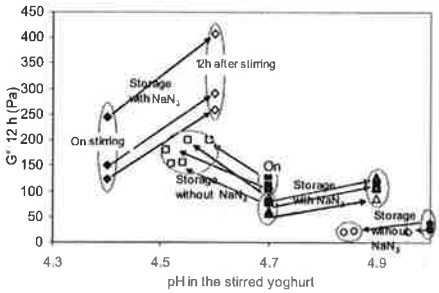

Fig.3. G' of stirred gels just after stirring and 12 h after stirring as a function of the pH in stirred yoghurt just after stirring and 24 h after stirring (the pH hardly decreased between 12 and 24 h)

With NaN_3 addition, the pH of the stirred gel increased by 0.2 unit on stirring.

Changes in G' during short-term rebodying were very complex (Fig.3), depending on the pH on stirring but also on its evolution during storage.

<u>$CaCl_2$ (CA^+) or Na-Citrate (CA^-) addition on stirring</u>:

$CaCl_2$ addition on stirring reduced the short-term rebodying (Fig.4). The same ionic strength increase with NaCl had no effect.

At 20 h:

$tan\delta_{CA^-} > tan\delta_{ctrl} > tan\delta_{CA^+}$

- CA^+ gel
- control gel
- CA^- gel

↑ More solid-like gels

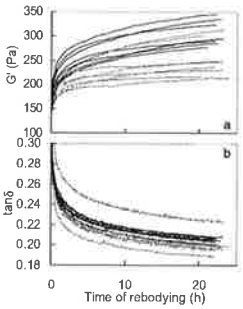

Fig.4: Short-term rebodying: control
+ $CaCl_2$ (+67 mmol.kg^{-1})
+ Na-citrate 100 mmol.kg^{-1}

<u>Very few significant effects on long-term rebodying</u>:

+ NaCl → No long-term rebodying

+ Na-citrate stirred gel had the highest viscosity increase in 28 d (Fig.4).

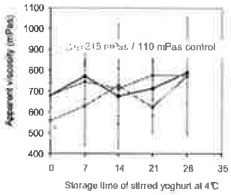

Fig.5: Long-term rebodying: control
+$CaCl_2$ (+67mmol.kg^{-1})
+Na-citrate 100 mmol.kg^{-1}

Estimations of calcium partition (Mekmene et al., 2008) give a higher content in Pserine and carboxylic acid bound calcium with $CaCl_2$ addition and a lower one with Na-citrate addition.

Conclusions

Concerning the rebodying process, electrostatic interactions were suggested as seen from the effect of the pH on stirring on short term rebodying and the fact that NaCl addition prevented the long-term rebodying. Probably, hydrophobic interactions were of minor importance. Rebodying was partially explained by over-acidification. Calcium addition plays a negative specific role on the rebodying of stirred yoghurt. Calcium bridges between proteins likely formed, that could prevent protein rearrangements in the stirred gel.

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