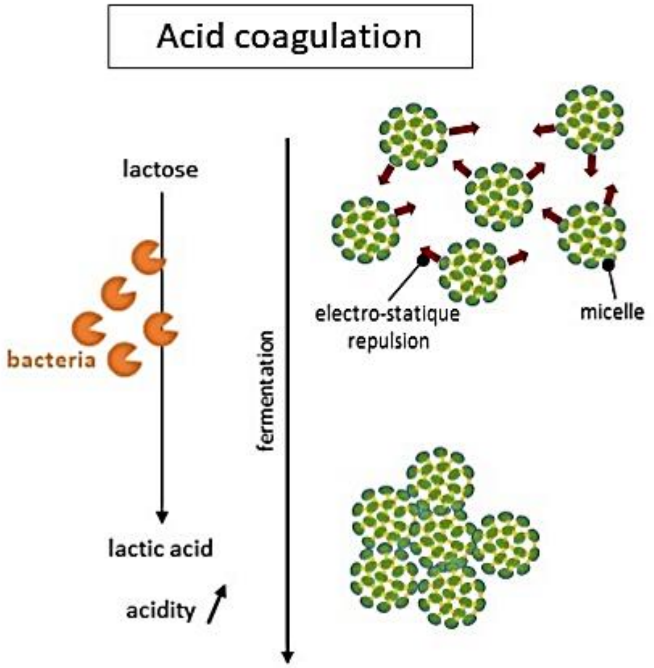

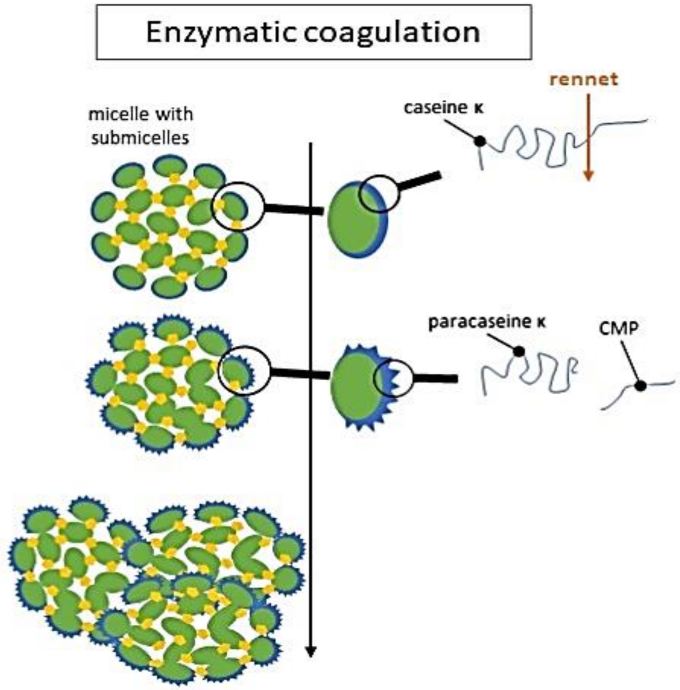

Acid Coagulation

- Lactic acid bacteria (e.g., *Lactobacillus*, *Streptococcus*) ferment lactose into lactic acid.
- This fermentation gradually lowers the milk pH to about **4.6**, which corresponds to the isoelectric point (pI) of caseins.
- In fresh milk, casein micelles are stable due to:
  - the κ-casein coating that provides negative charges on their surface,
  - and electrostatic repulsion between micelles (red arrows in the figure).
- As acidity increases (pH decreases):
  - negative charges are neutralized,
  - colloidal calcium phosphate dissolves,
  - electrostatic repulsion disappears.

  → Micelles begin to aggregate into a continuous three-dimensional network, forming the acid gel.

This mechanism underlies the production of: Yogurt, leben, raïb, and acid casein.

The resulting gel is smooth and cohesive, retaining both water and minerals within its structure.

Enzymatic Coagulation

- Triggered by rennet, an enzyme preparation containing chymosin.
- Chymosin specifically cleaves κ-casein at the Phe105–Met106 peptide bond**.**
- κ-casein, located on the micelle surface, acts as **a** protective "hairy layer" providing steric and electrostatic stability.
- After enzymatic cleavage:
  - the hydrophilic fragment (the *caseinomacropeptide*, CMP) is released into the serum**,**
  - while the hydrophobic fragment (*para-κ-casein*) remains attached to the micelle.
- Without the stabilizing κ-casein layer, micelles lose their repulsive forces and, in the presence of Ca^{2+} ions**,** aggregate into a dense curd network**.**

This mechanism is the basis of cheese manufacture**:**

1. Enzymatic coagulation by rennet,
2. Cutting and draining of the curd,
3. Separation of the whey (liquid phase).

The resulting gel is firm, elastic, and cohesive**,** unlike the softer acid gel.