



Curd Formation

3) COAGULATION AND CURD SEPARATION

The milk is acidified by:

- Heating it up
- Adding an enzyme called Rennet
- Adding good bacteria
- Adding acid



These actions cause the milk to coagulate

The pudding-like milk is then cut and drained of the liquid whey



Curd Formation

Curding

Denaturation and aggregation of proteins and coagulation of fat globules – requires physical changes to proteins whose job is to keep micelles and globules separate

Curd formation (disruption of casein micelles) by:

- acidifying milk
- increasing temperature
- action of rennet.





Acid denaturation of Milk

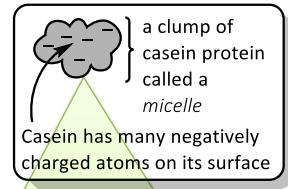


Milk

Decrease pH to 4.6

Acid Soluble
(Whey)
protein (e.g.
lactoglobulin
and albumin)

Acid Insoluble
(Curds)
protein (e.g. caseins)
fats

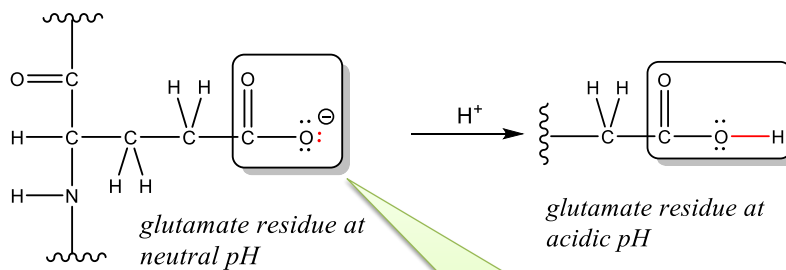


What is "acid denaturation" and coagulation?

The protein in curds is made entirely of denatured and coagulated casein. The protein casein is particularly unstable to *acid denaturation* because it has so many negative charges.



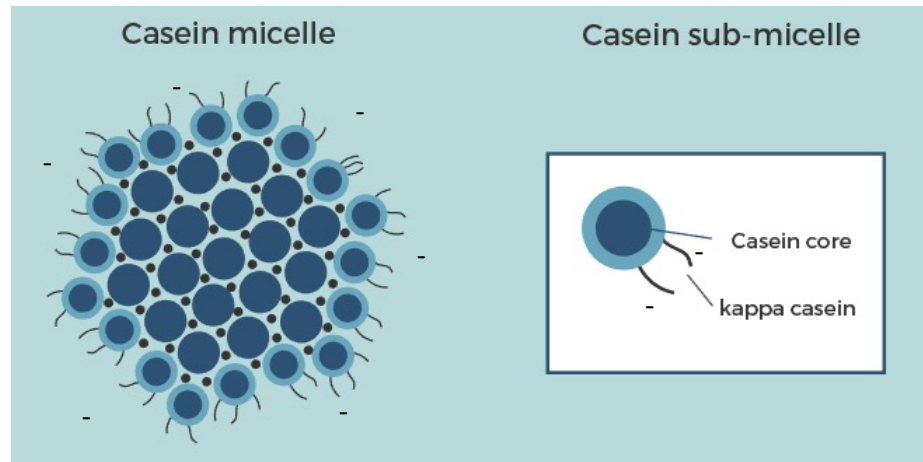
Some amino acid side chains react with the protons (H^+) in acid. Amino acid residues aspartate or glutamate have side chains that gain a proton (H^+) upon the addition of an acid are said to be **protonated** (gain of H^+).



Casein proteins have many negative charges on their surface



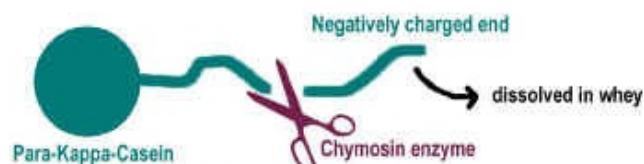
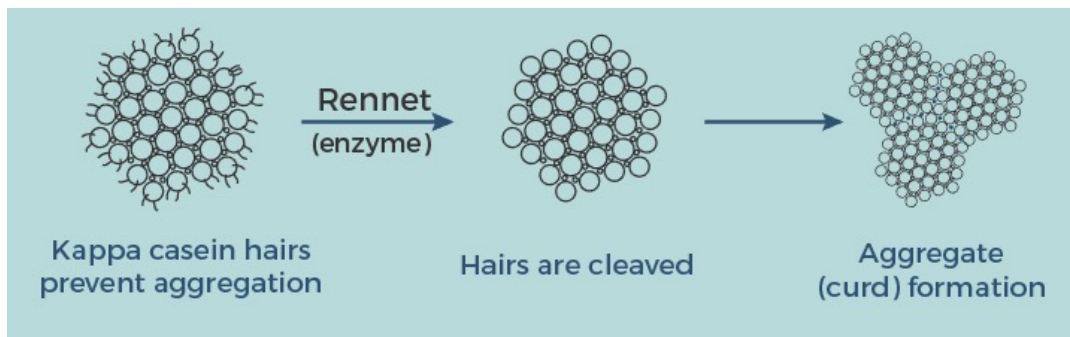
Casein – key for cheese



- κ -casein caps the growing micelle – **negatively charged**
 - binds water
 - repels interactions with other casein micelles



Rennet





Acid vs. Rennet/Rennin

Combination of acid, rennet and heat make for tight curds.

Acid denaturation = Ricotta



Acid + Rennet/Rennin denaturation = Mozzarella



Cutting the cheese curd

Heating and stirring curds continues denaturation of proteins to release water from curd

- exposed hydrophobic protein amino acid side groups will not interact with water reducing “holding” capacity



Activates bacteria and enzymes for more acid and creation of new flavor compounds

- increase [fermentation rates](#)

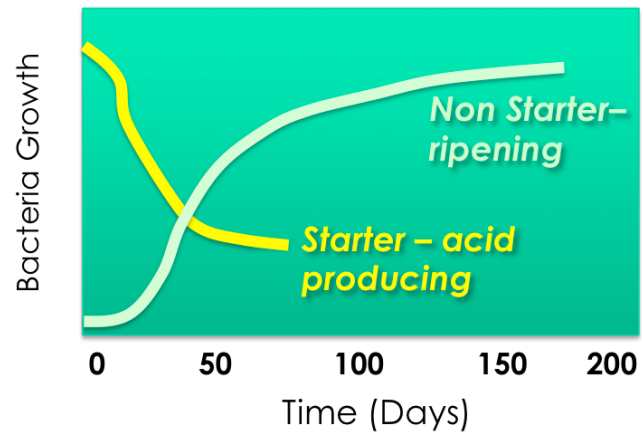


Different types of bacteria

Lactobacteria use **lactose** for fermentation.

Used as “starter” culture to begin fermentation

- Can use **mesophilic** (moderate temp) and **thermophilic** (heat tolerating) lactobacilli strains
- If cooking curds, **thermophilic** cultures are needed
- Neither can tolerate more than **moderate** acidic conditions
- This is called “**ripening**”



- A second “finishing/non-starter/ripening” bacteria is used to produce more acid and produce new flavor producing compounds