

CHEESE



Definition of Cheese

Cheese is the fresh or matured solid or semi-solid product obtained by coagulating milk, skimmed milk, partly skimmed milk, cream, whey cream, or buttermilk, or any combination of these materials, through action of rennet or other suitable coagulation agents, and partially draining the whey resulting from such coagulation.

Cheese Family

Acid coagulated (Cottage, Quark, Queso Blanco)

Bacterial surface ripened (Munster, Limburger, Port Salut, Taleggio, Tilsit)

Mould ripened → **Surface (Brie, Camembert)**
→ **Internal (Roquefort, Gorgonzola, Stilton)**

No eyes (Grana, Cheddar)

With eyes

Dutch (Gouda)

Swiss (Emmental)

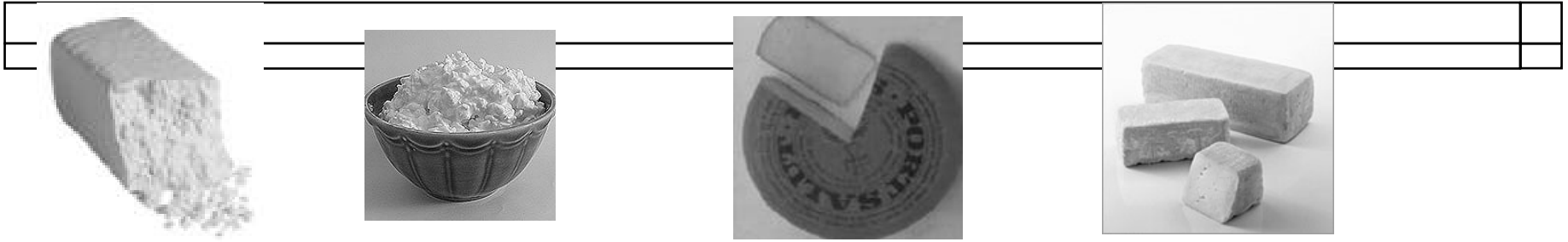
Only internal Bact ripening

High Salt (Feta)

Pasta filata (Mozzarella)

Rennet coagulated

Cheese



**Queso
Blanco (1)**

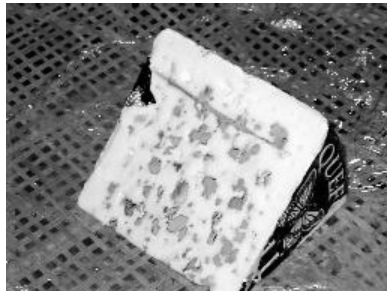
**Cottage cheese
(1)**

Port Salut (2)

Limburger (2)



Camembert (3)



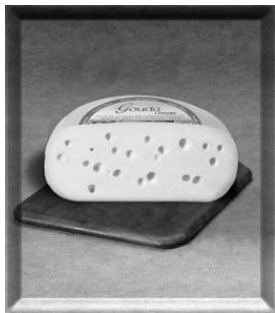
Roquefort (4)



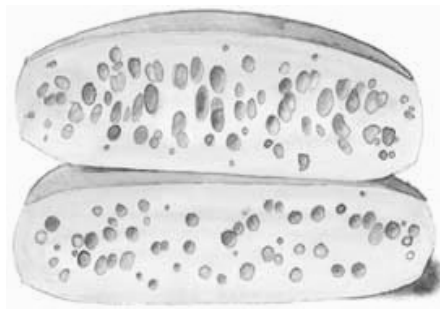
Cheddar (5)



Grana (5)



Gouda (6)



Emmental (6)



Feta (7)



Mozarella (8)

1. Fresh Cheese

3. Mould surface

5. No eyes

7. High salt

2. Bact surface

4. Mould internal

6. Eyes

8. Filata

Other classification of cheese type

1. Animal species.

- Cow
- Sheep
- Goat
- Buffalo

2. Shape

3. Fat content

4. Pasteurised/un-pasteurized milk

5. Moisture content

- low : 13-34%
- medium : 34-45%
- high : 45-55%
- very high : 55-80%

6. Consistency

- Firm (hard, semi-hard) or soft

Consistency depends on: Fat, salt and water content, acidity and protein degradation. (last 3 most important)

The raw material: milk selection

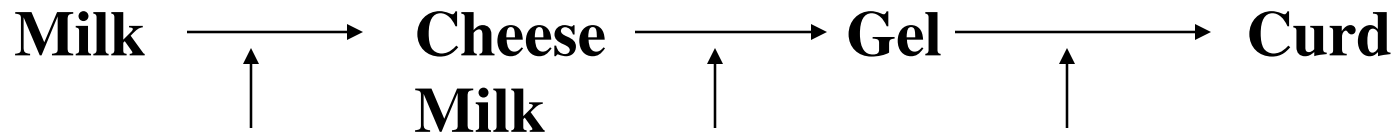
The composition of cheese is strongly influenced by:

- fat
- protein
- calcium
- pH

Milk should:

- have a good microbiological quality
- free of chemical taints and free fatty acid → off flavor
- free antibiotics

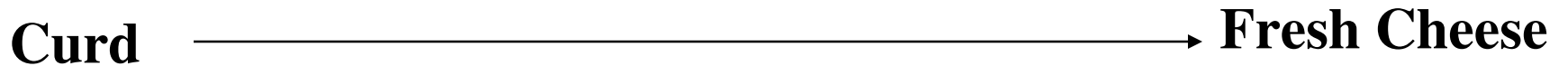
General protocol for cheese making



Pre-treatment
Standardisation

Addition:
- Starter
- Colour (opt)
- CaCl₂ (opt)
- Rennet

Cut gel / coagulum
Stir
Heat (opt)
Washing (opt)
Acidification
Separation of whey



Acidification ↑
Special operations (e.g. Cheddaring, stretching)
Brining (opt)
Moulding
Pressing (opt)

Cheese – milk treatment

- Thermization

- Standardization
- Pasteurization
 - killing pathogenic and harmful m.o.
 - inactivation alkaline phosphatase
 - consequences of a severe heat treatment
 - cleaning
- Bactofugation
- Cold storage and pre-warming
- No damage to fat globules
- No homogenization

Standardization ratio fat : protein

- Removing some fat by natural creaming / centrifugation
- Adding skimmed milk
- Adding cream
- Adding milk powder

Acidification

- Using LAB
- Acid: lactic acid, HCl, or acidogen (GDL)

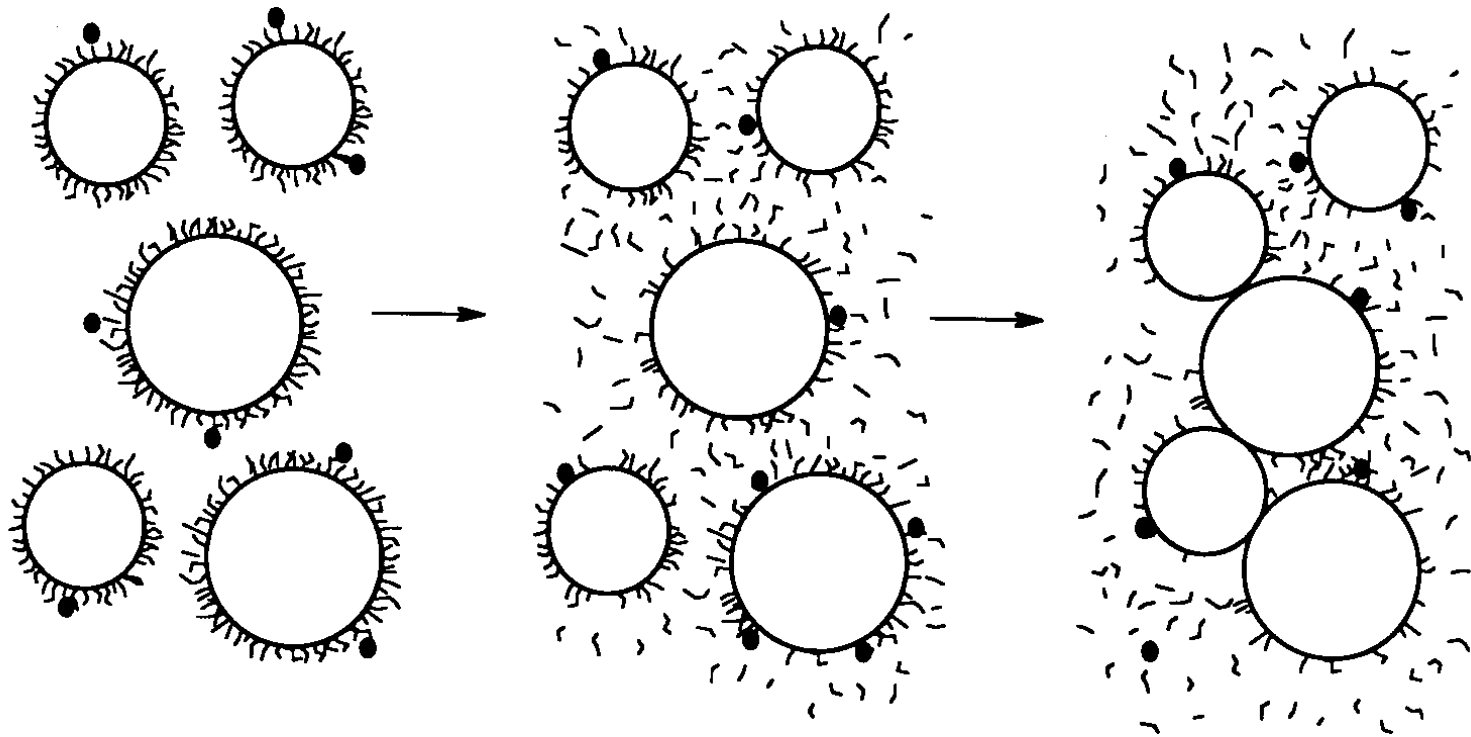
The ultimate pH for most rennet-coagulated cheeses: 5
– 5.3

The pH of acid-coagulated cheese: 4.6

Coagulation

- Selected proteinase (rennets)
- Acidification to pH 4.6
- Acidification to pH ~5.2 and heating to ~90°C (minor varieties), usually produced from:
 - Rennet cheese whey
 - Blended whey and skim milk
 - Ex: Ricotta (Italy)

Attack of chymosin on casein micelles



Chymosin is shown as small black circles

Cheese - Rennetting

Activity Rennet depends on:

- pH, lowering pH increases activity
- Slight influence of temperature (η)
- Concentration of rennet

Flocculation rate depends on:

- Calcium concentration
- Temperature
- pH

Syneresis

Factors affecting syneresis:

- Surface area of the curd
- Pressure (stirring)
- Acidity
- Temperature
- Fat content, $[Ca^{2+}]$, protein content

Cutting

- The curd is cut into grains with various sizes → depend on the type of cheeses (3-15 mm).
- The finer the cut, the lower the moisture content in resulting cheeses.
- Cutting can be followed with pre-stirring → to expel whey (pre-drainage) from the grains.

Heating/cooking/scalding

- It is required to regulate the size and acidification of the curd.
- The heat promotes contraction of the curd accompanied by syneresis.
- Heating can be done by:
 - Steam
 - Steam combined with the addition of hot water
 - Hot water addition to the curd/whey mixture

Syneresis of curd

- Rennet-induced milk gels are stable for several hours
- Rapid syneresis after disturbance by cutting
- Main method for controlling moisture content of the cheese
- Main process for differentiation between cheese varieties
- Curd particle size
 - Stirring intensity
 - Time
 - Scalding temperature
 - Amount of whey removed
 - Amount of water added

Final treatment of curd

- After all the free whey has been removed, the curd can be treated as followed:
 - Transferred direct to moulds (granular cheeses)
 - Pre-pressed into a block and cut into pieces of suitable size for placing in moulds (round eyes cheeses)
 - Sent to cheddaring

Pressing

The purpose of pressing after being moulded/ hooped:

- to assist final whey expulsion
- to provide texture
- to shape the cheese
- to provide a rind on cheeses with long ripening periods

Moulding

- E.g. pasta filata cheese – occurs in various shapes: ball, pear, sausage, etc.
- The plastic curd enters the moulds at 65-70°C).
- The moulded cheese must be cooled to stabilize the shape of the cheese and facilitate emptying the moulds.



Salting

- Retarding starter activity and bacterial processes
- Causing more moisture to be expelled
- The salt content: 0.5-2% (in some cheeses can reach 3 – 7%)
- The curd exposed to salt at a pH of 5.3-5.6
- Salt and water content dependent on:
 - Initial water content
 - Fat content
 - Surface/mass
 - Salt content brine
 - Duration of brining

Salting modes

- Dry salting:

the salt is spread as evenly as possible over the curd after all whey has been discharged.

- Brine salting:

Placing the cheese in a container with brine. The containers should be placed in a cool room at about 12-14°C.

Ripening

- Lactose decomposition by lactase enzyme
- Protein decomposition by enzymes systems of:
 - Rennet
 - Microorganisms
 - Plasmin
- Fat decomposition

Storage

- Creating the external conditions which are necessary to control the ripening cycle of the cheese (specific temperature and RH).
- Cheese with rinds (hard and semi-hard cheeses) can be provided with a plastic emulsion or paraffin or wax coating.
- The purpose of covering cheeses:
 - To prevent excessive water loss
 - To protect the surface from infection and dirt

Washing

If syneresis is not intensive



Moisture content higher



Buffering capacity lower + more lactose retained



pH lower (to low for Gouda Cheese)



Removal of lactose by washing

Washing also influences moisture content

(quantity of water, temp, stirring rate)

References

- Bylund, G. 1995. Dairy Processing Handbook. Tetra Pak Processing Systems AB. Sweden.