

# 10\_MILK AND DERIVATIVES

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## 6.4. Milk and its derivatives.

- \* Chemical composition and food value
  - \* Technology and Applications:
    - \* Whole/skimmed/powdered milk
    - \* Whey
    - \* Caseins
  - \* Utilization and nutritional value of each derivative.
- Milk replacers.
- Feed legislation.

## 6.4. Milk and its derivatives

- Legal definition:
- Milk is the integral product of the total and uninterrupted milking of a healthy, well-fed and not overworked dairy female. It must be collected cleanly and must not contain colostrum.

# Colostrum

- is the product secreted by the udder the first week after the part. Viscous, acidic, salty, yellow liquid with a strong smell and bitter taste.
- rich in immunoglobulins (antibodies), 200 g/l of soluble protein.
- Very rich in fat (50-60 g/l) and vitamin A.
- In calves, colostrum is almost essential for survival, because antibodies cannot cross the placental barrier.
- In dogs, 90% of antibodies come from colostrum.
- The term "milk" (without further clarification) refers to cow's milk. Milk from another species must be designated by a denomination

# Milk composition/ Dairy farming

- Fluid milks are characterized by two criteria:
- the physical treatments applied for their conservation:
- immediate refrigeration on the farm,
- homogenization in the dairy then
- sterilization, pasteurization or microfiltration;
- their fat content: skimmed, skimmed or whole milk.
- Standardisation in fat is the only change, in terms of composition, authorised by the regulations.
- Fluid milks do not contain any additives.

- Raw milk contains on average:
- Water..... 87%
- Carbohydrates..... 4,8%
- Fat..... 4,2 %
- Protein..... 3,2 %
- Minerals and trace elements..... 0,7%.... of which 120 mg calcium
- Vitamins: (A, D, B...).

Heat-treated fluid milks are offered according to their fat content

Fat:

Whole milk (3.5%);

Skimmed milk (1.5 --1.8%);

Skimmed milk; (< 0.5%).

# The energy value of milk

depends largely on the content of:

fat (64 Kcal per 100 ml of whole milk,

45 Kcal for 1/2 skimmed milk and

33 Kcal for skimmed milk).

Skimmed milk contains half the amount of vitamins A and D (fat-soluble),

Skimmed milks are devoid of Vit A and Vit D

The calcium content of all milks is comparable.

# Milk technology

- Milk technology encompasses the scientific and industrial processes to transform milk into a wide range of products:
- Pasteurization
- Skimming,
- Homogenization,
- Concentration (evaporation, drying)
- Membrane filtration,
- Fermentation (yoghurts, cheeses, curds, sour milk)
- Sterilization (UHT).

- Its applications are numerous:
- production of drinking milk,
- cheeses,
- yoghurts,
- butter,
- dairy powders, and
- Other:

# Les caséines

- Milk technology is a branch of agri-food engineering that studies the processing, preservation and packaging of raw milk into a variety of dairy products for consumption. Its applications are wide-ranging, from everyday consumer products to specialty ingredients used in other industries.
- Technological Principles and Processes
- Dairy technology relies on scientific principles to ensure the safety, quality, nutritional value, and shelf life of products. Key processes include:
- Reception and standardisation: Raw milk is first tested, filtered/clarified, and then standardised by adjusting its fat content (whole, semi-skimmed, skimmed).
- Heat treatment: Techniques such as pasteurization (partial destruction of microorganisms for short-term preservation) and UHT sterilization (destruction of all microorganisms for a very long shelf life at room temperature) are fundamental to food safety.

- Separation: Centrifugation separates cream (fat) from skimmed milk, for the production of butter or cream.
- Concentration and drying: These processes (evaporation, spray drying) make it possible to produce condensed milk or milk powder, greatly extending the life of the product and facilitating transport.
- Fermentation: The use of specific bacterial cultures transforms milk into fermented products, developing unique flavors and textures (yogurts, cheeses, fermented milks).
- Other technologies: Ultrafiltration, refrigeration, freezing and packaging are also an integral part of industrial processes.

- Clarification
- Clarification is the process by which milk is subjected to centrifugal force in order to extract denser particles, such as cellular debris, leukocytes and foreign matter. Without this treatment, these particles would sediment in the homogenized milk, to the point of becoming visible in the transparent containers.

- Thermization
- In many major dairies, it is not possible to pasteurize and process the milk immediately after receipt. Some of the milk must be stored in storage tanks for several hours or days. Under these conditions, even extensive refrigeration is not enough to prevent a serious deterioration in quality.
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- Many dairies therefore preheat milk to a temperature below the pasteurization temperature, to temporarily inhibit the growth of bacteria, especially pathogens. This process is called thermization. The milk is heated to 63-65°C for about 15 seconds, a combination of temperature and time that does not inactivate the phosphatase enzyme.

# Industrial Applications

- The applications of dairy technology are very diverse and cover the entire food industry:
- Dairy products for consumption: Fluid milk (sterilized, pasteurized), creams, butters, yogurts, cheeses (fresh, soft, pressed, melted, etc.), ice creams and dairy desserts.
- Food ingredients: Dairy proteins (caseins and whey proteins), lactose, and milk fat are used as functional ingredients in a wide variety of products, such as:
  - Bakery and confectionery;
  - Soups and sauces;
  - Infant formula;
  - prepared meals.

# Pasteurisation /Sterilisation

- Industrial milk pasteurization is done by the HTST (High Temperature Short Time) process, where raw milk is heated rapidly to about 72-74 °C for at least 15 seconds, then cooled immediately, in order to destroy pathogens while preserving the nutritional and taste qualities, all in a continuous flow thanks to plate exchangers for prolonged storage in the refrigerator.
- For longer storage, the UHT (Ultra High Temperature) treatment (130-140 °C for a few seconds) is used followed by aseptic packaging, allowing a long shelf life at room temperature.

# HTST pasteurization (the most common)

- Heating: Raw milk flows through a plate heat exchanger where it is heated rapidly to 72-74 °C.
- Hold Time: It is held at this temperature for at least 15 seconds in a resting section.
- Cooling: The milk is then cooled rapidly to around 4°C.
- Homogenization (optional): Milk is often homogenized (fat globules are broken) before or after pasteurization to prevent the cream from rising.
- Packaging: The milk is packaged, then needs to be refrigerated and consumed within a few days.

# Pasteurization UHT

UHT pasteurization (for long shelf life)

Extreme heating: The milk is heated to a very high temperature (130-140°C) for only 3 to 4 seconds.

Cooling: Cooled rapidly to 70-80 °C, then homogenized.

Aseptic packaging: Milk is packaged in sterile containers (aseptic packaging).

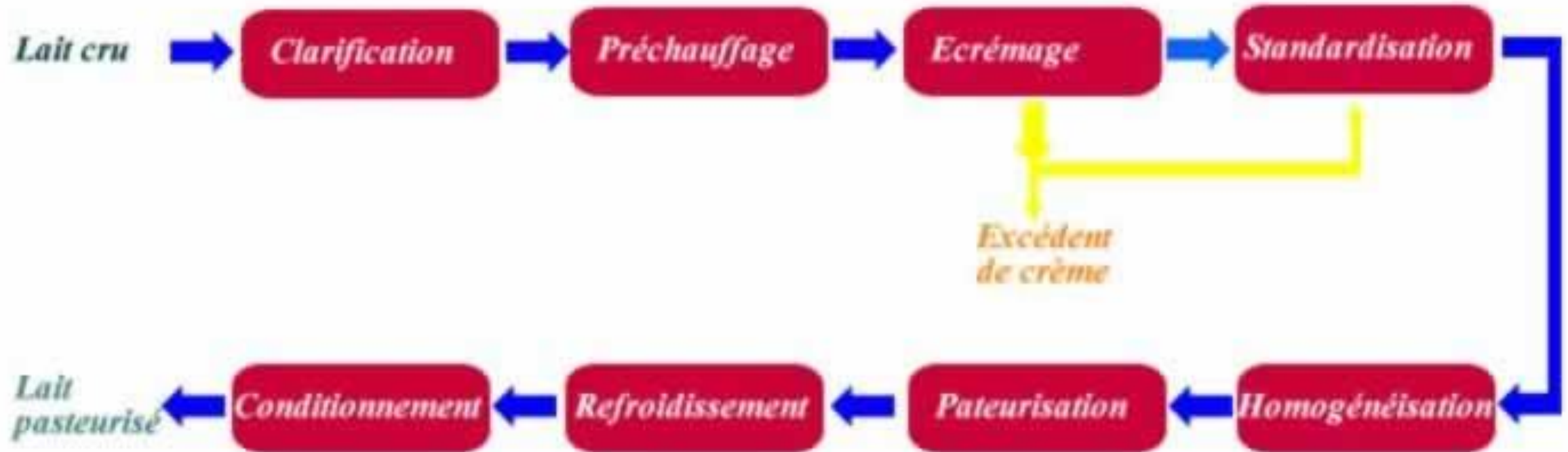
Storage: This milk can be kept for several months at room temperature.

- Goal:
- Eliminate harmful bacteria (such as salmonella, E. coli) and extend the life of milk.
- Difference:
- The main difference is in temperature and time:  
conventional pasteurization (HTST) is gentler, while UHT is a form of sterilization

# Cooling

- Since not all microorganisms are eliminated by pasteurization, this heat treatment must be followed by a sudden cooling. Thus, after pasteurization, the milk is cooled to a temperature close to the freezing point in order to slow down the development of the germs still present.
- At the post-pasteurization stage and during packaging, it is also important to avoid contamination, especially by psychrotrophic bacteria, which are the main culprits in the subsequent deterioration of pasteurized products. Greene and Jezeski (1954) showed that pasteurized milk inoculated with *Pseudomonas fluorescens* deteriorated after four days at 10°C, 16 days at 5°C and 36 days at 0°C.

<https://scientecal.com/lait-pasteurise-lait-sterilise-et-lait-uht/>



*Figure 6 : Diagramme de fabrication du lait pasteurisé*