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Processing of Dairy Products

Cultured Dairy Products:

Fermented milks had been made since early times, when warm raw milk from cows, sheep, goats, and camels was naturally preserved by common strains of lactic acid bacteria. These **harmless** lactic acid producers were effective in suppressing spoilage and pathogenic organisms, making it possible to preserve fresh milk for several days or weeks without refrigeration.

The production of cultured milk is the initial **fermentation process**, which involves the partial **conversion of lactose (milk sugar) to lactic acid**. At temperatures of approximately 32 °C (90 °F), these bacteria reproduce very rapidly, perhaps doubling their population every 20 minutes.

Dairy starters (bacteria, yeasts, and molds or their combinations) are the 'heart' of fermented milk products, the most crucial component in the manufacture of high-quality fermented milks. In the dairy industry, some **enzymes/rennet** are required for the production of cheeses, yogurt, and other dairy products, while others are used in a more specialized fashion to improve texture or flavor.

Rennet:

Rennet or **rennin** are general terms for any enzyme used to coagulate milk. Technically rennet is also the term for the lining of a calf's fourth stomach.
Animal rennet is a milk clotting enzyme isolated from calf stomachs. The major components of rennet are **Chymosin (rennin)** but in **commercial preparations** of rennet other proteases, typically bovine pepsin, are found in various concentrations.

Chymosin is a **proteolytic** enzyme related to **pepsin** that synthesized by chief cells in the stomach of some animals. Its role is to coagulate milk in the stomach.

1. Cheese Making:

A) Like most dairy products, cheese milk must first be subjected to **pasteurization** treatment, HTST pasteurization (72° C for 16 sec) is often used. Homogenization **is not** usually done for most cheese milk because it disrupts the fat globules.

B) Additives:

The following may all be added to the cheese milk:

1. **Calcium chloride:** $CaCl_2$ is added to replace calcium redistributed during pasteurization. Milk coagulation by rennet during cheese making requires an optimum balance among ionic calcium and both soluble insoluble calcium phosphate salts.
2. **Nitrates**: Sodium or potassium nitrate is added to the milk to control the undesirable effects of some microorganisms.
3. Color: Because milk color varies from season to season, color may be added to standardize the color of the cheese throughout the year.
4. **Lipases**: normally present in raw milk, are inactivated during pasteurization. The addition of kid goat lipases is common to ensure proper flavor development through fat hydrolysis.

C) Inoculation of Dairy starters (Milk Ripening):

The basis of cheese making relies on the fermentation of lactose by lactic acid bacteria (LAB). LAB produce lactic acid which lowers the pH and in turn assists coagulation, promotes syneresis, contributes to cheese **texture, flavor** and keeping quality After inoculation the starter culture, the milk is held for 45 to 60 min at 25 to 30° C to ensure the bacteria are active, growing and have developed **acidity**. This stage is called **ripening** the milk and is done prior to renneting.

D) Milk Coagulation:

Coagulation is essentially the formation of a gel by destabilizing the casein particles causing them to aggregate and form a network which partially immobilizes the water and traps the fat globules in the newly formed matrix. This may be accomplished with:

1. **Enzymes (rennet):** used for enzyme coagulation.
2. **Acid treatment**: Lowering the pH of the milk results in casein particles destabilization or aggregation. **Acid curd** is more fragile than **rennet curd** due to the loss of **calcium**.
3. **Heat-acid treatment:** Heat causes denaturation of the whey proteins. The denatured proteins then interact with the caseins. With the addition of acid, the caseins precipitate with the whey proteins. In **rennet coagulation, only 76-78%** of the protein is recovered, while in **heat-acid coagulation, 90%** of protein can be recovered.

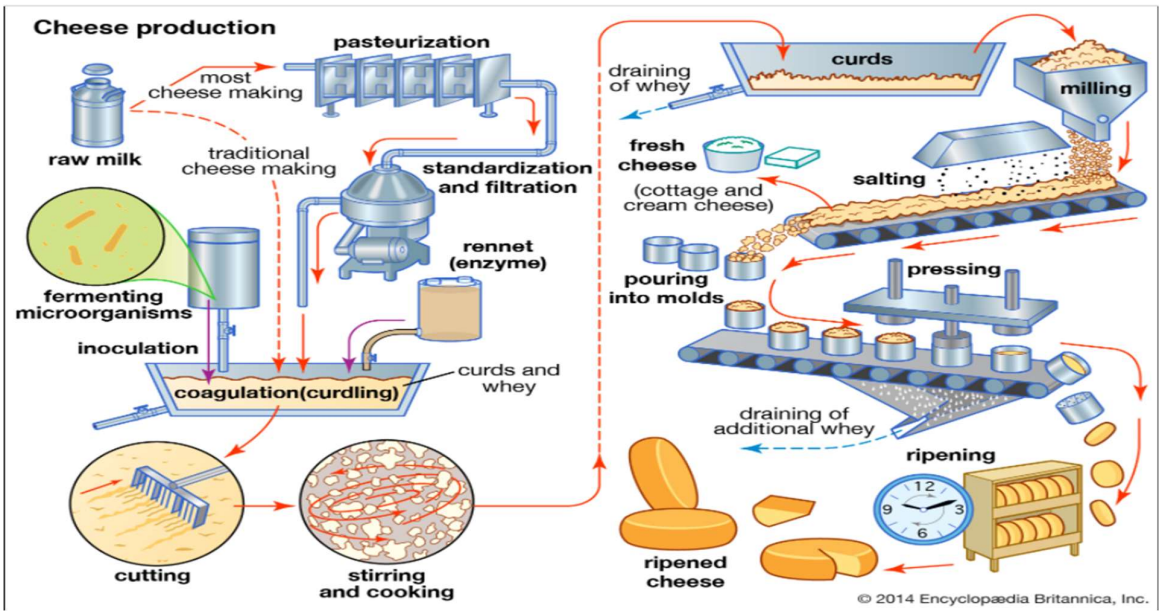
E) Curd Treatment:

After the milk has gel has been allowed to reach the desired firmness, it is carefully **cut into small pieces** with knife blades or wires. This shortens the distance and increases the available area for whey to be released. The curd pieces immediately begin to shrink and expel the greenish liquid called whey. When the curds have reached the desired moisture and acidity they are separated from the whey. The whey may be removed from the top or drained by gravity. Curd handling from this point on is very specific for each cheese variety.

F) Cheese Ripening:

Except fresh cheese, the curd is ripened, or matured, at various temperatures and times until the characteristic flavor, body and texture profile is achieved. **The ripening agents in cheese are: Bacteria** and **enzymes** of the milk, lipases, added molds or yeasts.

This final stage varies from weeks to years according to the cheese variety.



HACCP PLAN OF CHEESE MAKING PLANTS