



BUTTER MANUFACTURE

Summing up- What?

Butter

Butter is essentially the fat of milk.

Usually made from sweet cream and is salted. Salt-less (sweet) butters are also available.

Can also be made from acidulated or bacteriologically soured cream.

(Now a days bacterial acidifying and heat treatment are more common.)

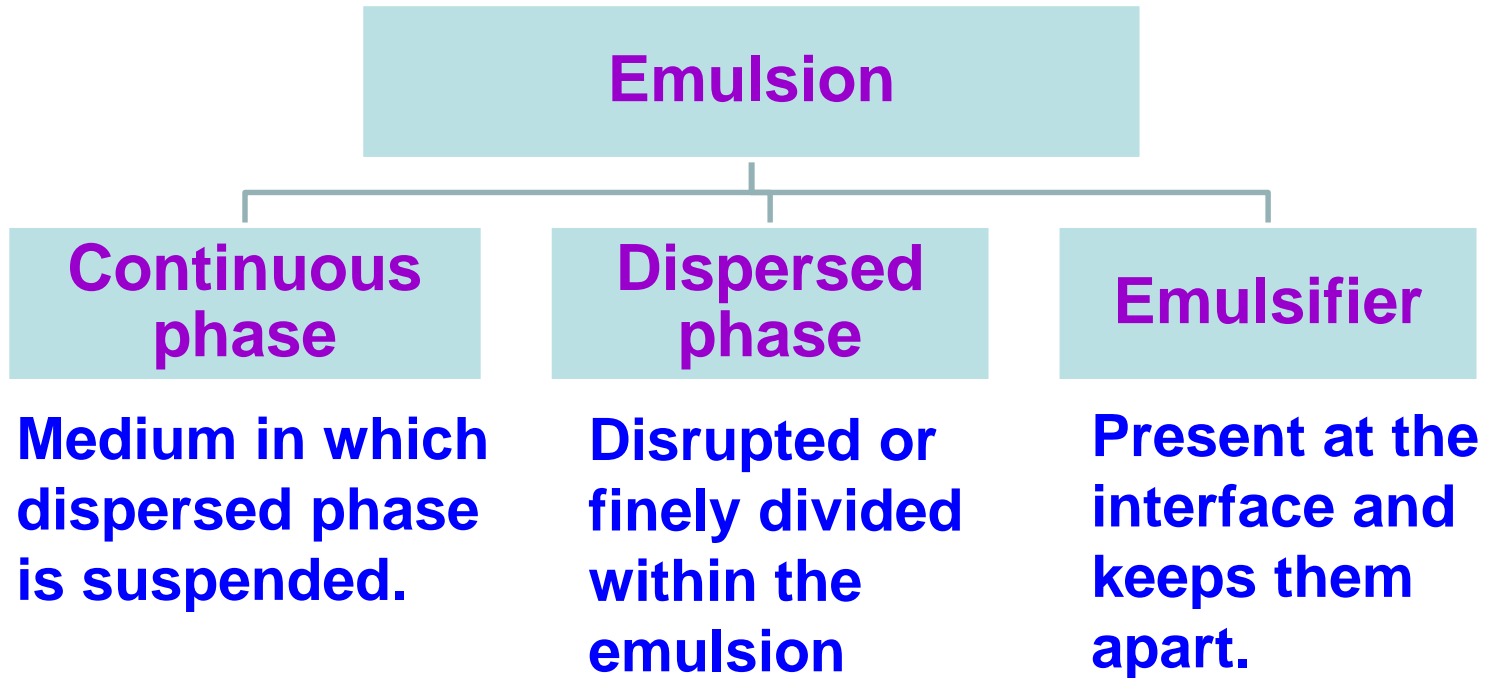
Summing up- What?

Butter

A water-in-oil emulsion, comprised of >80% milk fat, but also containing water in the form of tiny droplets, perhaps some milk SNF, with or without salt (sweet butter).



Summing up- What?



Principal constituents of butter

	Normal salted butter	Indian butter
• Fat	80 - 82%	80.2 %
• Water	15.6 - 17.6%	16.3%
• Salt	about 1.2%	2.5%
• Protein, Ca, P	about 1.2%	1.0%

- Also contains fat-soluble vitamins A, D and E.

As per PFA rules (1976), table / creamy butter should contain not less than 80 percent fat, not more than 1.5% curd and not more than 3 percent common salt.

Butter

Butter should have a uniform colour, be dense and taste clean.

The water content should be dispersed in fine droplets so that the butter looks dry.

The consistency should be smooth so that the butter is easy to spread and melts readily on the tongue.

Butter making

Even in the 19th century, butter was still made from cream that had been allowed to stand and sour naturally.

The cream was then skimmed from the top of the milk and poured into a wooden tub.

Butter making was done by hand in butter churns.

The natural souring process is, however, a very sensitive one and infection by foreign micro-organisms often spoiled the result.



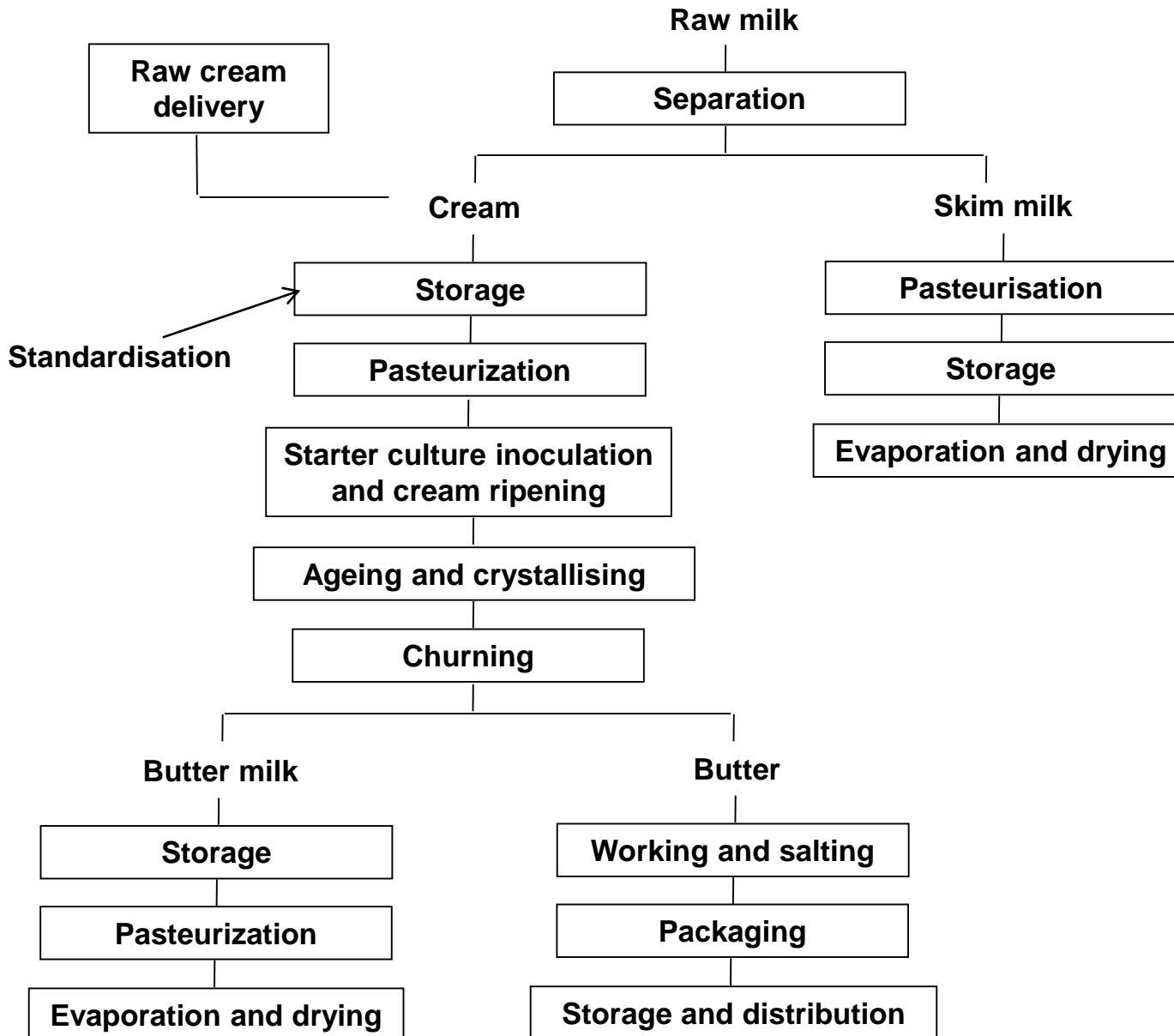
Butter making

The commercial cream separator was introduced at the end of the 19th century, the continuous churn was commercialized by the middle of the 20th century.

Four types of butter making processes:

- Traditional batch churning from 25- 35% mf. cream;
- Continuous flotation churning from 30-50% mf. cream;
- The concentration process whereby "plastic" cream at 82% mf is separated from 35% mf cream at 55°C and then this oil-in-water emulsion cream is inverted to a water-in-oil emulsion butter with no further draining of buttermilk;
- The anhydrous milk fat process, whereby water, SNF, and salt are emulsified into butter oil in a process very similar to margarine manufacture.

Butter making process



Butter making process

Collection of raw material and standardization

- The cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer.
- The cream should be sweet (pH >6.6, TA = 0.10 - 0.12%), not rancid and not oxidized.
- The cream is cooled and kept in a transitional storage tank where the fat content is analyzed, and if necessary adjusted to the desired value.

Butter making process

Pasteurization

- Usually done at 82-88°C or more.
(The high temperature is needed to destroy enzymes and micro-organisms that would impair the keeping quality of the butter.)
- The skim milk from the separator is pasteurized and cooled before being pumped to storage. It is usually concentrated and dried.

Butter making process

Ripening

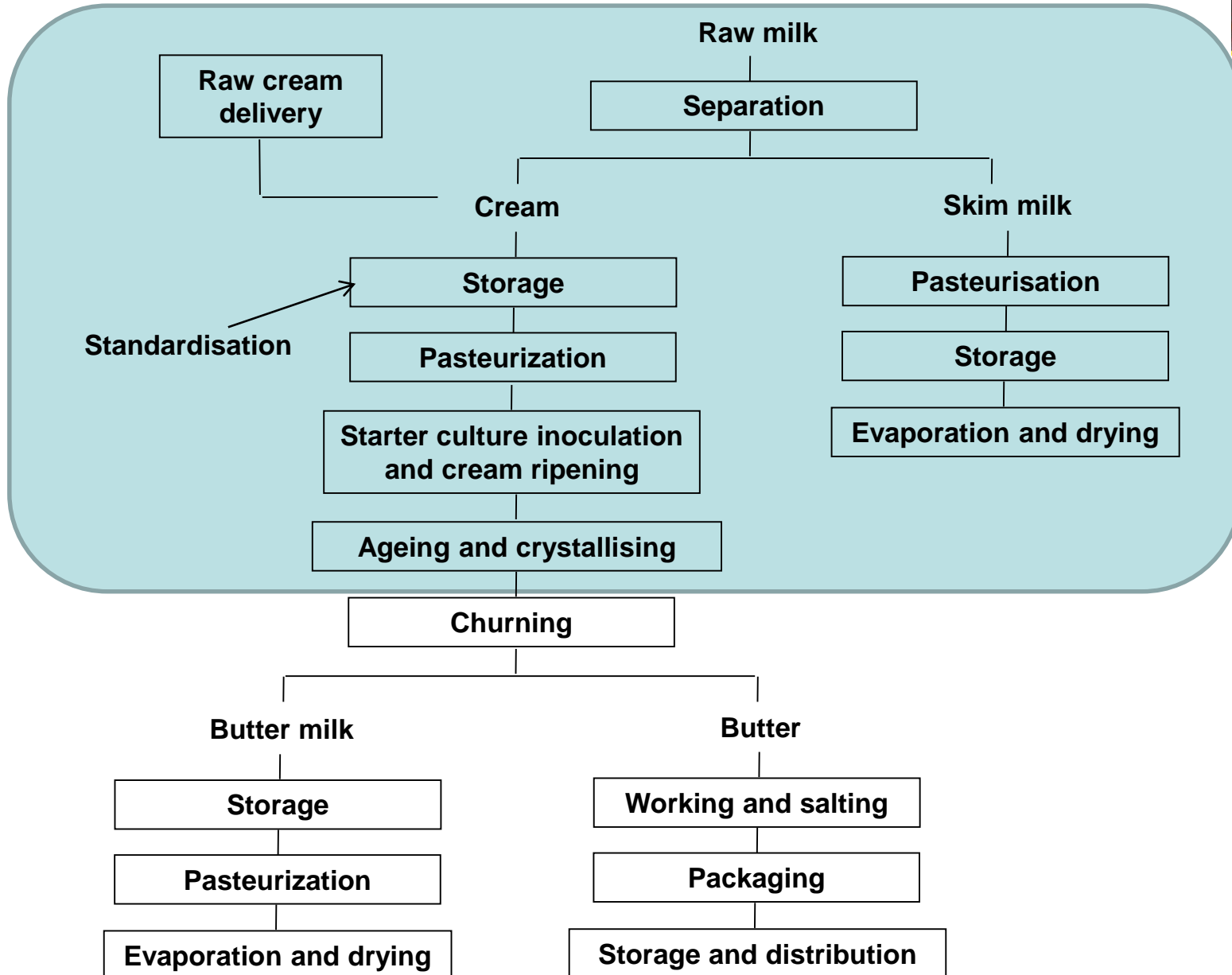
- Ripening is the fermentation of cream with the help of desirable starter culture.
- Mixed cultures of *Streptococci cremoris*, *Str. Lactis*, *Str. diacetyl lactis*, *Leuconostoc citrovorum*, *Leuc.destranicum*, are used.
- The cream is ripened in 2 stages; 1st stage at 21°C to pH 5.5 and then 2nd stage at 13°C to pH 4.6.
- (Most flavor development occurs between pH 5.5 - 4.6. The lower the temp. during ripening, the more is the flavor development relative to acid production. Ripened butter is usually not washed or salted.)
 - The typical flavor of butter from ripened cream is mainly the effect of diacetyl (biacetyl) and to a smaller extent of acetic and propionic acids.
 - The average normal diacetyl content of ripened cream butter is 2.5 ppm and rarely over 4 ppm.

Butter making process

Ageing and crystallizing

- In the ageing tank, the cream is subjected to a program of controlled cooling that helps to give the fat the required crystalline structure. (The program is chosen to accord with factors such as the composition of the butterfat.)
- The optimum temperature for Indian condition is usually 5-10°C.
- The time requirement is 12 - 15 h (at least 2-4 h).
- 0.2% citric acid or sodium citrate may be added for flavor.

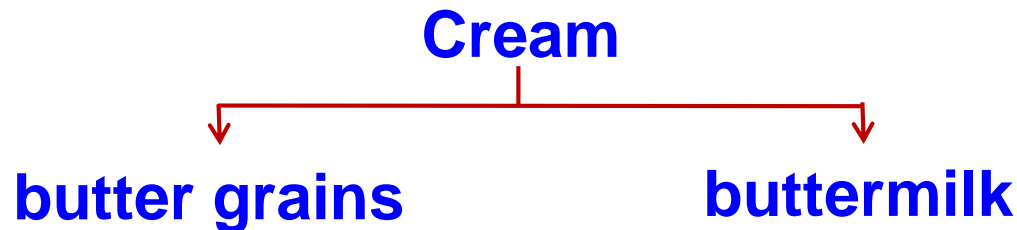
Butter making process



Butter making process

Churning

- Churning of cream consists of agitation at a suitable temperature until the fat globules adhere forming larger and larger masses, and until a relatively complete separation of fat and serum occurs.
- In the churning process, the cream is **violently agitated for 5-10 min** to break down the fat globules, causing the fat to coagulate into butter grains, while the fat content of the remaining liquid (buttermilk) decreases.



Butter making process

Churning

Optimum churning temperature: 9-11°C.

From the aging tank, the cream is pumped to the churn or continuous butter maker via a plate HE, which brings it to the requisite temperature.

Butter making process

Churning- effect of temperature

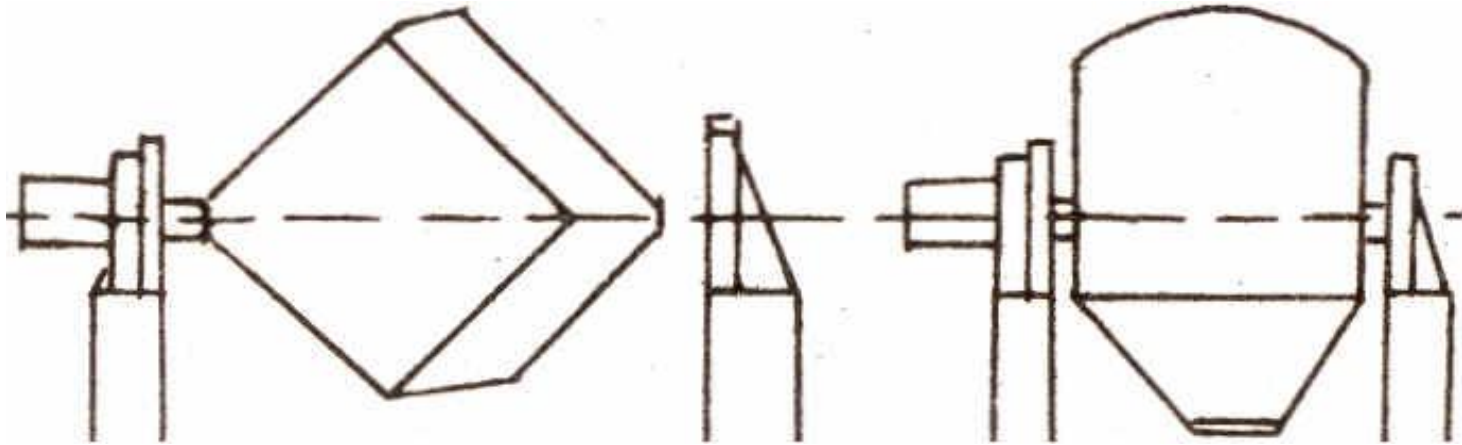
- High cooling and ageing temperature → less churning period, yield large fat losses in butter milk. Butter gets a soft greasy texture.
- Improper cooling and ageing of the cream → fat is not sufficiently solid → the fat loss in buttermilk will be excessive, and the butter obtained will have an unsatisfactory, weak body.

Butter making process

Churning- effect of temperature

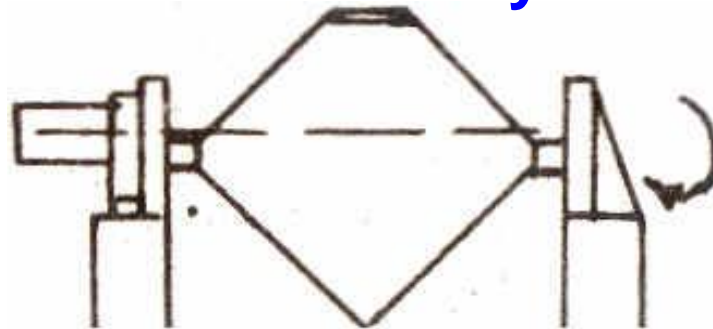
- **Low cooling and ageing temperature → prolong the churning period, decrease fat losses, produce a firm body, that has a satisfactory standing up capacity.**
- **Cooling to abnormally low temperatures, and ageing near that temperature → fat globules become so firm that they band together during churning only with difficulty, thus, the churning process is prolonged. Butter becomes too brittle.**

Butter churns



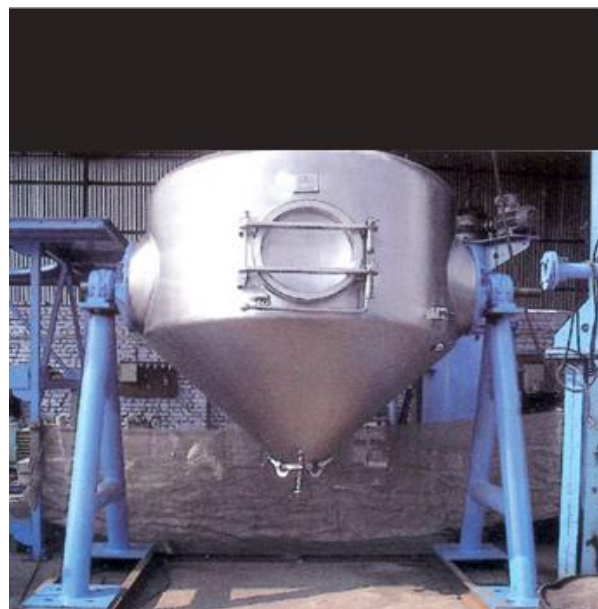
Cubical

Cylindrical-conical



Double cone

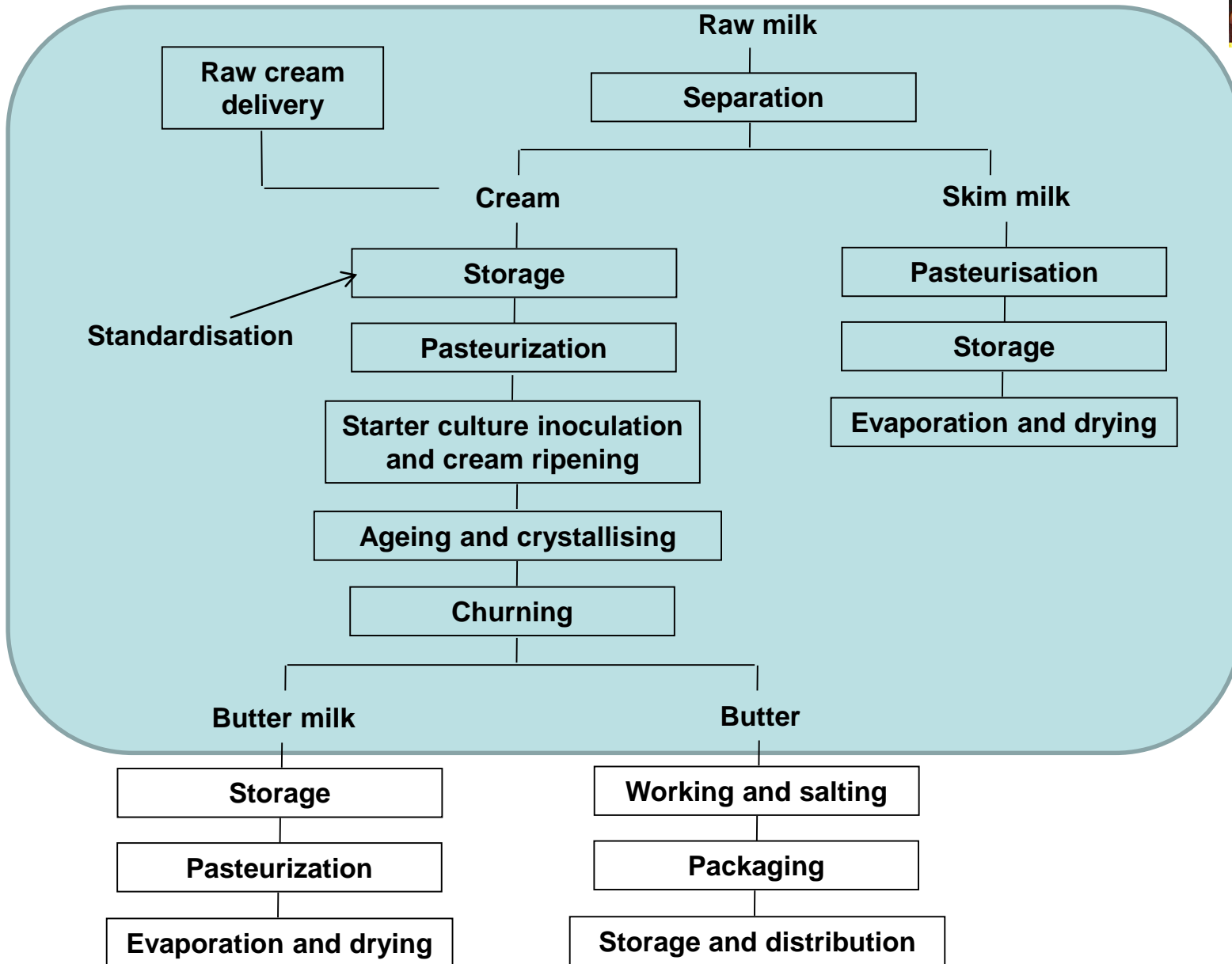
Butter churns



Butter churns



Butter making process



Butter making process

Working and salting

- After draining, the butter is worked (kneaded) to a continuous fat phase containing a finely dispersed water phase.
- If the butter is to be salted, in batch process, salt (1-3%) is spread over its surface.
- In the continuous butter maker, a salt slurry (10% concentration) is added to the butter.
- After salting, the butter must be worked vigorously to ensure even distribution of the salt.

Butter making process

The working of the butter- why?

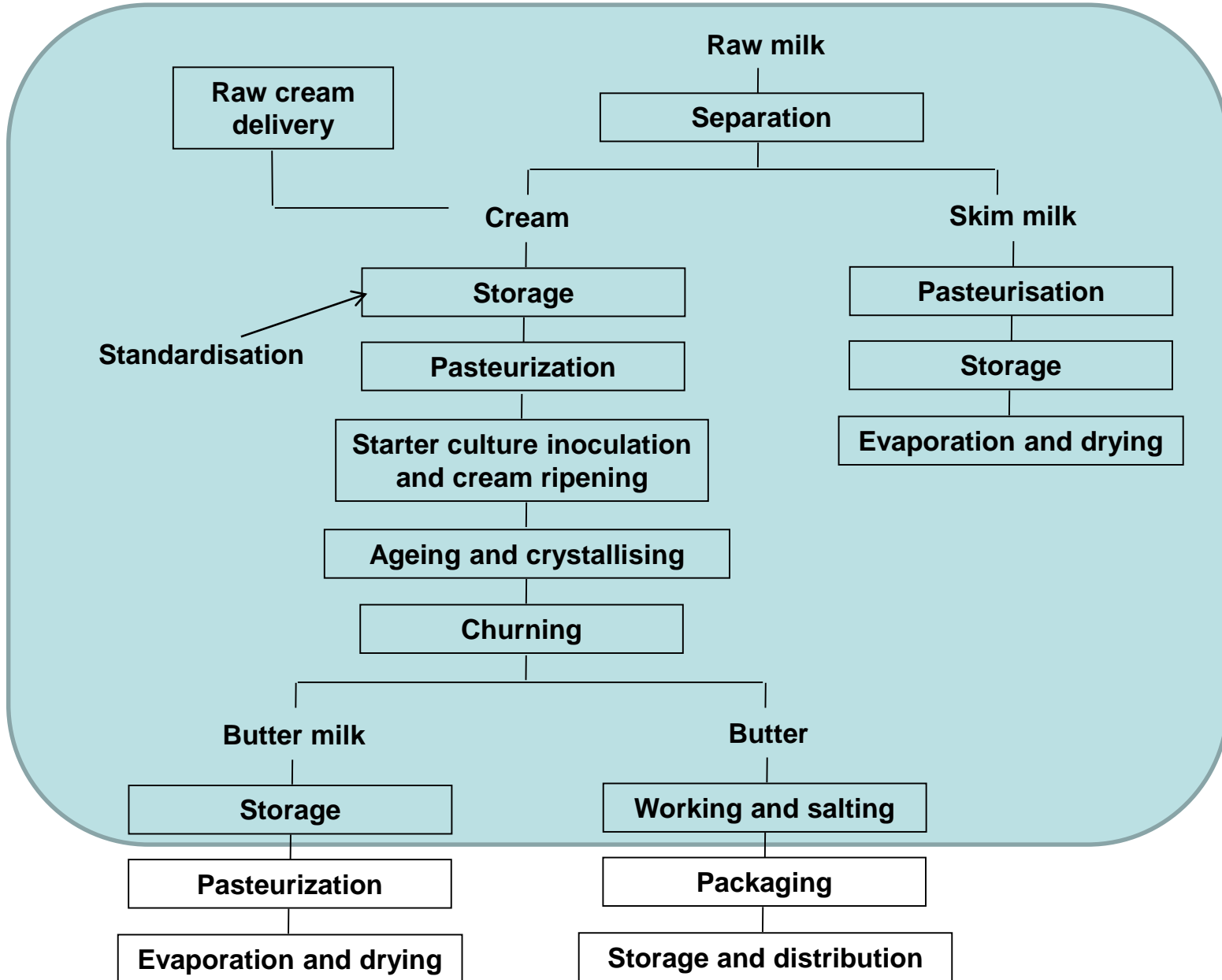
- Working helps to obtain a homogenous blend of butter granules, water and salt.
- Forms a continuous fat phase containing a finely dispersed water phase. (During working, fat changes from globular to free fat. Water droplets decrease in size and should not be visible in properly worked butter.)
- Influences the characteristics by which the product is judged such as aroma, taste, keeping quality, appearance and colour.
- Salt is used to improve the flavor and the shelf-life.

Butter making process

Working and salting

- Normally worked butter has 0.5-10 ml air per 100 g butter. Air content is important as it affects density of butter, microbial spoilage and oxidative spoilage.
- Overworked butter will be too brittle or greasy depending on whether the fat is hard or soft. Some water may be added to standardize the moisture content. Precise control of composition is essential for maximum yield.

Butter making process

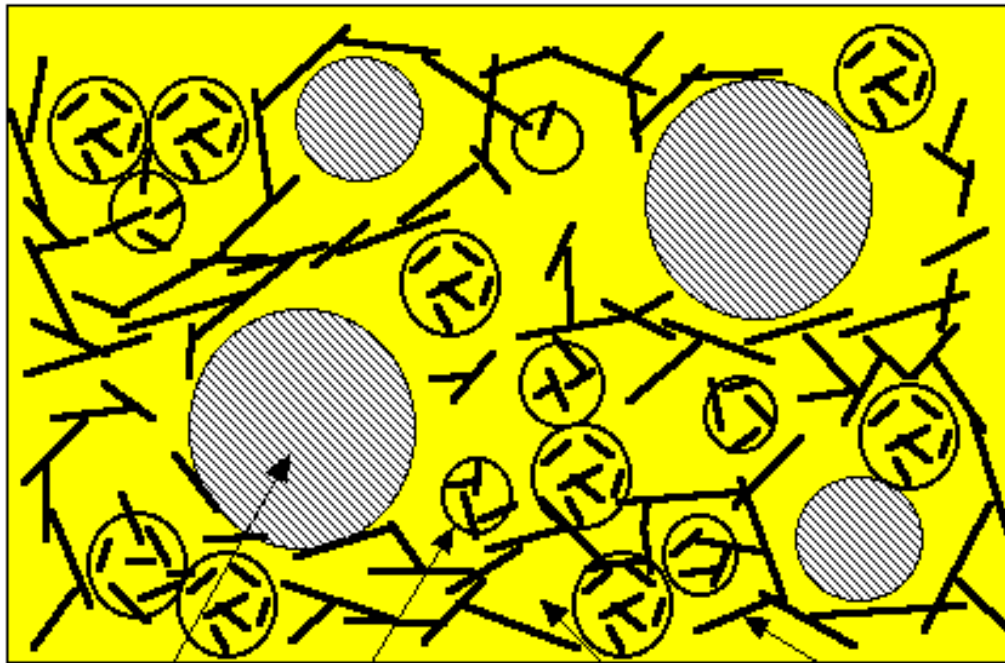


Butter making process

Packaging



Butter structure



Moisture droplets containing SNF and salt

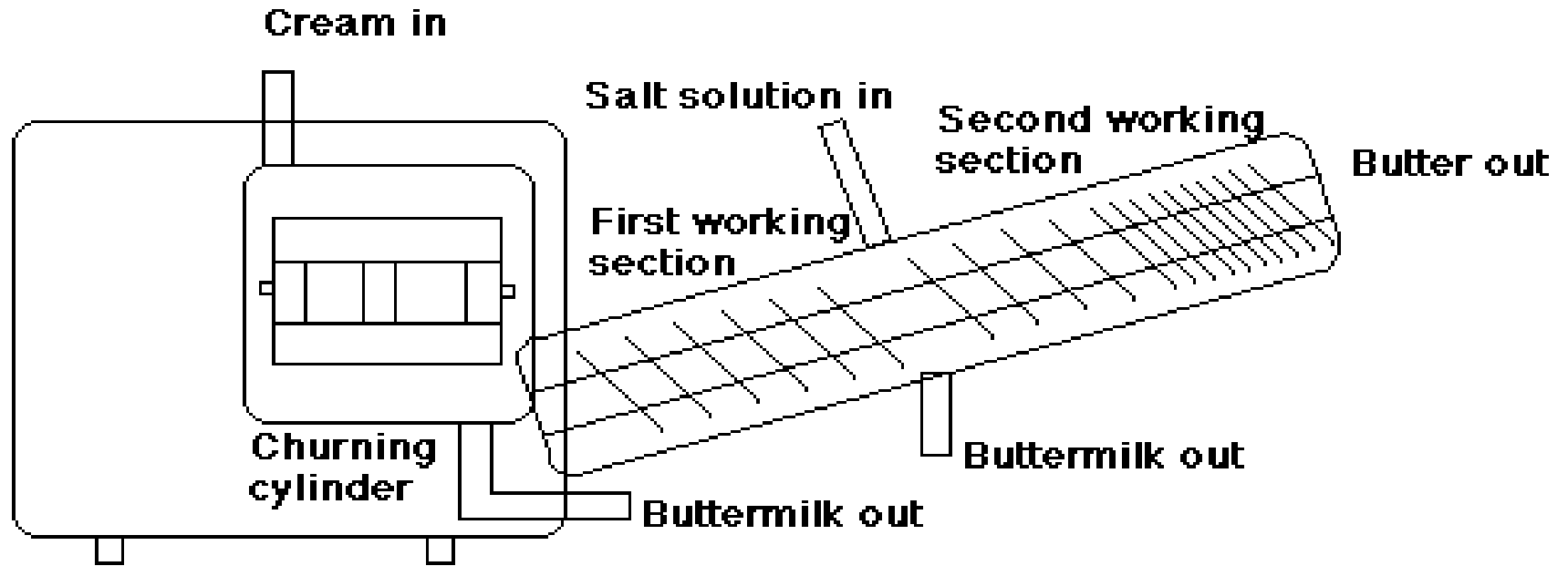
Fat globules, partially crystalline

Non-globular fat, continuous phase

Fat crystals, semi-continuous networks



Continuous Flotation Churns



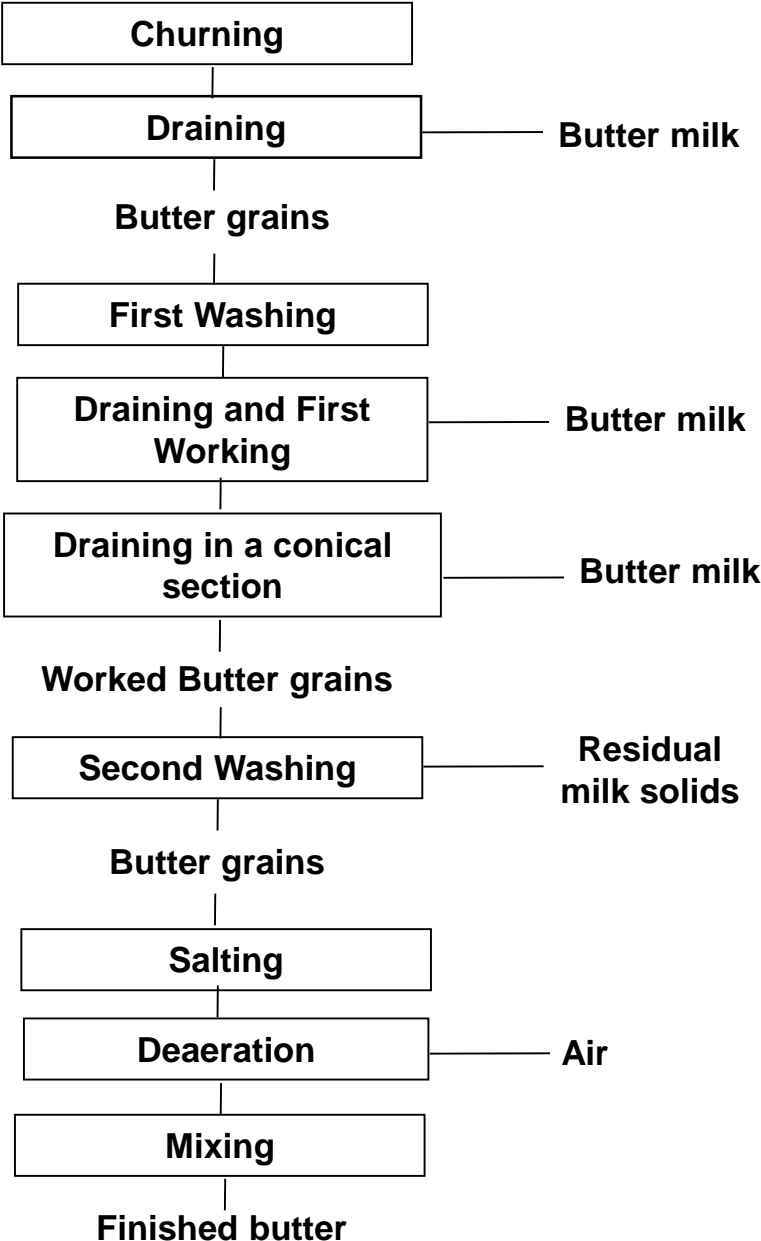
Continuous Butter Churn



Continuous Flotation Churns



Continuous Flotation Churns



Continuous Flotation Churns

- The cream is first fed into a **churning cylinder** fitted with beaters that are driven by a variable speed motor.
- Rapid conversion takes place in the cylinder, and, when finished, the butter grains and buttermilk pass on to a **draining section**.
- The **first washing** of the butter grains sometimes takes place en route- either with water or recirculated chilled buttermilk.
- The **working of the butter** commences in the draining section by means of a screw, which also conveys it to the next stage.
- On leaving the working section, the butter passes through a **conical channel** to remove any remaining buttermilk.

Continuous Flotation Churns

- Immediately afterwards, the butter may be given second washing, this time by two rows of adjustable high-pressure nozzles
(The water pressure is so high that the ribbon of butter is broken down into grains and consequently any residual milk solids are effectively removed).
- Following this stage, salt may be added through a high-pressure injector.
- The third section in the working cylinder is connected to a vacuum pump. Here it is possible to reduce the air content of the butter to the same level as conventionally churned butter.

Continuous Flotation Churns

- In the final or mixing section the butter passes a series of perforated disks and star wheels. There is also an injector for final adjustment of the water content.
(Once regulated, the water content of the butter deviates by less than $\pm 0.1\%$)
- The finished butter is discharged in a continuous ribbon from the end nozzle of the machine and then into the packaging unit.

Thank You