

Milk Products

* Milk —

— not just liquid. it is complex fluid.

— Milk is complete food becz

It contains: ① water (87%)

② fat (3-4%)

③ proteins (casein + whey) → 3-4%

④ sugar (Lactose) → 5-7%

⑤ minerals (calcium, phosphorus) 0.7%

— Milk products → Curd, Butter, Ghee, Paneer, Cheese, Yogurt, Ice cream, milk powder.

— milk products are made by changing milk's physical, chemical or biological properties

* Milk properties —

① Biological —

② milk is a biological product because it comes from living animals.

③ It supports growth of B'a because it contains nutrients.

Types : ① Lactic acid B'a.

② spoilage B'a.

③ Pathogenic B'a.

④ Milk is excellent growth medium because:

① It contains sugar (Lactose)

② Neutral pH (~6.6)

③ water presence

④ proteins.

→ That's why milk spoils easily.

① Enzymes present in milk : ① Lipase (fat breaks)
② protease (breaks protein)
③ Lactase (breaks Lactose)

- These enzymes also cause spoilage if not controlled.

② Immunological Component → ① Antibodies
② Lactoferrin
③ Lysozyme.

This protects newborn animals.

* How Biological properties are controlled —

① Pasteurization → Heat treatment at 72°C for 15 sec.

- Kills harmful bacteria.

② Refrigeration → milk stored at 4°C to slow microbial growth.

③ Hygienic Milking → Clean equipment & healthy animals preferred for milking.

④ UHT processing → Ultra High temperature (135°C - 150°C) for 2-5 seconds.

- It makes milk shelf stable.

② Chemical properties of Milk —

① pH & acidity —

- Normal milk pH is 6.6

- As bacteria grows Lactose sugar converted to lactic acid & pH decreases.

- At decreased pH (up to 4.6) casein protein coagulates.

(ii) milk proteins are (casein $\rightarrow$ 80% . and whey $\rightarrow$ 20%)

(iii) Milk fat exists as small fat globules .

- it contains : (A) Triglycerides
- (B) Phospholipids
- (C) fat soluble vitamins .

(iv) Milk sugar is Lactose which provides sweetness & energy to milk .

(v) Milk contains minerals like calcium, phosphorus, potassium .

- calcium is important for curd formation .

* How Chemical properties are controlled ?

① PH control $\rightarrow$ pH measured using pH meter & if acidity increases (pH decreases) milk gets rejected .

② Addition of calcium chloride $\rightarrow$ which improves curd formation in cheese .

③ Heat treatment to prevent protein degradation .

④ Avoid oxidation $\rightarrow$ milk is stored in closed containers to prevent fat oxidation .

③ Physical Properties of Milk $\rightarrow$

(i) Milk is white in colour due to casein micelles and fat globules scattering light .

(ii) Milk density = 1.028 — 1.035 g/ml which used to detect adulteration .

(iii) Viscosity — milk is slightly thicker than water.

— viscosity increases when fat increases or protein increases.

(iv) milk freezes at -0.55°C & if freezing point changes it detects water adulteration suspected.

Q. How physical properties are controlled —

① Homogenization $\rightarrow$ fat globules broken into small particles which prevents cream separation and makes milk uniform.

② Standardization $\rightarrow$ Adjust fat content to control viscosity.

③ Quality Testing $\rightarrow$

- density testing using Lactometer.
- freezing point test.

④ Temperature control $\rightarrow$ cold storage (low temp.) prevents physical instability.

* Cheese production —

* History of cheese —

- Long ago around 5500 BC, cheese was discovered by accident.
- A traveller carried milk in a bag made from sheep stomach.
- Inside stomach there was an enzyme called rennet.

* (Rennet is natural enzyme mixture obtained from inner lining of stomach of young animals like → calves, goats, or sheeps.)
→ young animals only drink milk
so, the rennet enzyme helps them to digest milk.

- Young animals only drink milk so their stomach contains chymosin enzyme which separates milk into solid & liquid part.
- Chymosin acts on casein & makes it stick together to form curd.

* Because of heat & enzyme, milk separated into,
① Solid part → Curd
② Liquid part → whey.

- When that traveller drank liquid & ate curd, he liked taste, this was first cheese.
- After that cheese making started in middle East & Mediterranean region.
- Romans improved method.
- Later it spread to Europe, America, Australia & New Zealand.

- Today there are more than 400 varieties of cheese.

- eg. of cheese types:

① Cheddar	③ Gouda
② Swiss	⑤ Cream
④ Cottage	⑦ Roquefort
⑥ Parmesan	
⑧ Camembert	

* Steps of Cheese production —

- ① Control of Milk Properties —
- ② Coagulation of milk.
- ③ Separation of curd & whey
- ④ Shaping of curd
- ⑤ Ripening of Cheese.

- Cheese production is a controlled fermentation process where milk proteins are coagulated, curd is separated from whey, shaped & stored to develop flavor.

ie. Milk $\longrightarrow$ Curd $\longrightarrow$ Cheese.

① Control of Milk properties —

- Milk quality affects cheese quality.

- Milk can come from:

- ① Cow (Common)
- ② Goat
- ③ Sheep
- ④ Buffalo
- ⑤ Camel

- Good milk should have —

- ① Low harmful bacteria
- ② Good fat content.
- ③ Good protein content.

- If milk contains too many bacteria, cheese may develop bad smell or gas bubbles & it causes milk spoilage.

- If milk is spoiled $\rightarrow$ cheese quality becomes poor.

② Coagulation of milk —

- milk proteins clump together to form a soft solid called curd.

- How coagulation happens ?

① Lactic acid fermentation —

$\rightarrow$ where bacteria convert lactose to lactic acid & pH decreases which starts casein protein coagulation.

eg. similar like paneer making.

③ Separation of curd & whey —

- After coagulation, solid curd is separated from liquid whey by cutting curd with curd knives, stirring, heating or draining whey.

④ Shaping of curd — means curd is pressed & molded into the final cheese shape.

- steps $\rightarrow$ curd is placed in molds.

$\downarrow$
Salt is added

$\downarrow$
pressing removes extra whey.

- function of salt $\rightarrow$ Improves flavour.
 - Controls bacterial growth
 - Increases shelf life.

⑤ Ripening (Cheese Aging) —

- cheese is stored under controlled temp. & humidity to develop flavour & texture this process called cheese ripening.

* Enzymes present in milk —

— milk naturally contains many enzymes:

- catalase
- Phosphatase
- protease
- peroxidase
- Lipase
- Amylase.

→ These enzymes affects cheese making.

— like Lipase breaks fat & helps create cheese flavours.

— protease breaks proteins during cheese ripening

* Yield of Cheese —

— yield means how much cheese we get from milk.

— Important component → milk fat & casein.

— more fat & casein → more cheese production

* Coagulation of Milk —

— Coagulation means milk turning into curd.

— It happens because of:

① Acid

② Enzymes

③ Heat

④ Salts.

— main milk protein is casein which forms a solid network trapping fat & water.

* Lactic starter culture —

— special bacteria added to milk which convert lactose to lactic acid.

— eg of Bacteria → Streptococcus sp.
Lactobacillus sp.

* ② Milk Clotting Enzymes —

— are the enzymes used to form curd.

eg. Rennet (chymosin enzyme)

↳ Source : calf stomach

— microbial enzyme

— It functions for casein protein breaks for curd formation.

* Separation of curd & whey —

— After coagulation milk divides into:

① curd (solid) → becomes cheese

② whey (liquid) → used in protein drinks.

• Methods to Remove whey —

① Setting method → curd settles at bottom & whey flows out.

② Perforated molds → Curd kept in molds with holes & whey drains out.

③ Cloth method → Curd collected in cloth & whey squeezed out.

eg. Paneer separation in home.

* Cheese Ripening —

— Ripening means aging of cheese to develop taste & texture.

— During ripening → ① proteins break down

② fats break down.

③ flavour compounds form

— Microorganisms helps in ripening are —

① Propionibacterium → Swiss cheese holes.

② Penicillium roqueforti → Blue cheese.

- Flavours compounds formed are :
 - fatty acids
 - carbonyl compounds
 - sulphur compounds
- They gives aroma & taste to cheese.

* Cheese Packaging —

- cheese packaging is the process of protecting cheese after production to maintain its quality, taste, texture & shelf-life ~~are~~ during storage & transport.
- proper packaging prevents contamination, moisture loss, oxidation & microbial growth.

● Important factors in cheese packaging —

① Temperature → packaged at low temp. to prevent microbial growth.

② Moisture → Packaging material should maintain proper humidity so cheese does not dry out or spoil.

③ Oxygen Control → Too much oxygen cause oxidation & mold growth, so packaging often reduces oxygen.

④ Hygiene → Packaging area must be clean & sterile to prevent contamination.

* Cheese packaging Methods —

① Wax coating → In this method, cheese blocks are coated with paraffin wax.

Steps → ① Cheese block is dried
 ② Deeped [↓] in melted wax
 ③ wax forms protective layer

② Vacuum packaging → Air is removed from package before sealing.

Steps → ① Cheese placed in plastic film,

② Air removed using vacuum machine.

③ Package sealed tightly.

③ Modified Atmosphere packaging (MAP) —

— Air inside package is replaced with gases like

★ CO_2 → Inhibits microbial growth.

★ N_2 → Prevents oxidation.

④ Plastic film Wrapping → cheese is wrapped with plastic films or aluminium foil to prevent contamination & easy storage & transportation.

* Common packaging materials used —

① plastic films (Polyethylene, Polypropylene)

② Aluminium foil

③ Wax coating

④ Paperboard boxes

⑤ Vacuum pouches.

* Processed cheese —

— Is made by :→ a) Grinding natural cheese
b) by heating (up to $71 \rightarrow 80^\circ\text{C}$)
c) Adding emulsifiers
d) Re-molding into blocks or slices

— It melts uniformly.

— eg. cheese slices in burgers.

— is heated up to $71-80^\circ\text{C}$ & has pH $5.6 - 5.8$.

— Contains as much milk fat & moisture as original natural cheese.

* Processed cheese food —

- It contains : →
 - a) Less natural cheese
 - b) more milk solids
 - c) more moisture
 - d) Added stabilizers

- It is cheaper & softer.

- is heated up to $79-85^{\circ}\text{C}$ & has pH $5.2-5.6$
& not more than 44% water all ~~at~~ less than 23% fat milk.

* Processed cheese spread —

- Is soft, easily spreadable
- Have high moisture content
- Used like butter.

- eg cheese spread on bread.

- Is heated up to $89-91^{\circ}\text{C}$ & has pH 5.2
- It contains 44-60% water not less than 20% milk-fat.