

MILK CHEMISTRY

Composition of Milk:

Composition of milk varies from species to species & even within one species it varies from breed to breed. Composition of milk depends upon various factors as;

- ♣ Age of the animal,
- ♣ Health of animal,
- ♣ Season,
- ♣ Feeding,
- ♣ Area,
- ♣ Environmental conditions (temperature, air, humidity etc),
- ♣ Time of milking,
- ♣ Lactation period.

Density of milk is 1.029-1.032 g/cm³.

Composition of milk includes:

1. Milk Fats,
2. Proteins,
3. Lactose,
4. Vitamins,
5. Minerals,
6. 6. Enzymes.

MILK FAT

Fat is present in milk in oil-in-water emulsion. Milk fats exist in form of small globules or droplets, which are dispersed in the milk serum. The diameter of fat globule ranges from 0.01 to 20 µm. But average diameter is about 3-4 µm. And there are about 15 billion globules in one (1) ml of the milk.

~ Composition of Fat Globules:

Each globule is covered by a thin membrane which is called as fat globule membrane. Its thickness is 5-10 nm. This membrane is responsible for the stability of emulsion.

Milk fat consists of triglycerides (major part of milk fat, about 92-98%), di-glycerides & mono-glycerides, fatty acids, sterols, carotenoids (color of milk fat is due to carotenoids) & fat soluble vitamins (A, D, E & K). Some trace elements are found in fat globules.

~ **Composition of Fat Globule Membrane:**

The composition of fat globule membrane is very complicated. It consists of phospholipids, lipoproteins, cerebrosides (carbohydrates & lipids), proteins, nucleic acid, enzymes, some trace metals & bounded water molecules.

The composition & thickness of membrane are not constant. Because the components of the membrane are being exchanged with the surroundings milk serum.

The fat globules are largest particles in the milk but at the same time these are the lightest particles in the milk because the density of milk fat is 0.93 g/cm^3 .

That is why they tend to raise to the surface of the milk when it is left to stand for sometime. And this process is called as Creaming.

Creaming is the collection of fat globules on the surface of the milk. The smaller the size of fat globules, the slower will be the process of creaming.

The process of creaming is also accelerated by the aggregation of fat globules under the effect of a protein called the *Agglutinin* (A protein found in the globule membrane).

These aggregates rise to the surface much faster than the individual fat globule. These aggregates can be broken up by heating or mechanical treatment (homogenization).

Agglutinin is denatured by heating the milk up to 65°C for 10 minutes or at 75°C for 2 minutes & thus possibility of aggregation almost disappears.

~ **Chemical Composition of Fat Molecules:**

About 97% portion of fat is made of triglycerides. Fat is a group of substances which are called Esters. These are formed by the combination of alcohols & fatty acids.

Milk fat is composed of an alcohol called the Glycerol & fatty acids. Major portion is triglycerides because glycerol can attach three (3) fatty acids to its one molecule. Fatty acids make about 90% portion of milk fat. Fatty acid molecule is composed of hydrocarbon chains & a carboxyl group.

In saturated fatty acids carbon atoms are linked by one or more than one double bonds.

Each glycerol molecule can bind three molecules & these molecules may be same or different. The characteristics of milk fat vary with the presence of different fatty acids & their quantities.

~ **Saturated Fatty-Acids in Milk Fat:**

Sr. no.	Name:	Average %age in Total Milk Fat:
1	C ₄ – Butyric Acid	3-4.5%
2	C ₆ – Caproic Acid	1.3-2.2%
3	C ₈ – Caprylic Acid	0.8-2.5%
4	C ₁₀ – Capric Acid	1.8-3.8%
5	C ₁₂ – Lauric Acid	2-5%
6	C ₁₄ -- Myristic Acid	7-11%
7	C ₁₆ -- Palmitic Acid	25-29%
8	C ₁₈ – Stearic Acid	7-8%

~Unsaturated Fatty Acids in Milk Fat:

1	C _{18:1} – Oleic Acid	30-40%
2	C _{18:2} -- Lenoleic Acid	2-3%
3	C _{18:3} – Lenolenic Acid	Less than 1%
4	C _{20:4} – Arachidonic Acid	Less than 1%

~ Iodine Value:

It is the measure of double bond present in fatty acids (more iodine value more double bonds) because it gives the quantity that the fat can bind & this iodine is taken up by the double bonds of the unsaturated fatty acids. By iodine value we can measure oleic acid contents of fat because the oleic acid comprises the major portion of unsaturated fats.

Melting point of oleic acid is 14-15⁰C so at room temperature fat is liquid. So fat containing more oleic acid is soft at room temperature. So that fat is softer than others.

~ Refractive Index:

Refractive index of the milk between 40-46. If it is less than 40, so it is not pure “Desi Ghee”.