



Status and types of fat rich dairy products in India and abroad

Status of Milk Lipids

- 1. Total milk production of India during the year 2010-11 is 116 million tones out of which 33% was converted into ghee.**
- 2. As per FAO statistics, about 3.08 million tones of butter and ghee is being marketed in India during the year 2007.**
- 3. The amount of table butter produced in organized sector is 0.055 million tons during the year 2005 both in cooperative and private dairies and the value is 7,700 million rupees, which will be increased to 0.1 million tons and 22,500 million rupees respectively during the year 2011.**

- 1. Milk contains approximately 3.4% fat.**
- 2. Of all edible fats, milk fat has the most complex fatty acid composition (400 individual fatty acids (FA)).**
- 3. Approx. 15-20 FA make up 90% of the milk fat.**
- 4. Major FA in milk fat are saturated, straight chain fatty acids having 4 to 18 carbons (C4:0, 6:0, 8:0, 10:0, 12:0, 14:0, 16:0, 18:0) monounsaturated FA (C16:1, 18:1) and polyunsaturated FA (C18:2, 18:3).**
- 5. Some FA are found in very small amounts but contribute to the unique and desirable flavor of milk fat (C14:0 and C16:0 β -hydroxy FA spontaneously form lactones upon heating which enhance the flavor of butter).**

The FA composition of milk fat is not constant throughout the cow's lactation cycle. In early lactation, the animal's energy comes largely from body stores and FA used for milk fat production are obtained from the diet (long chain C16:0, 18:0, 16:1 and 18:2 FA. In late lactation, FA in milk are formed in the mammary gland so that the concentration of the short chain FA (C4:0 and 6:0) are higher than in early lactation.

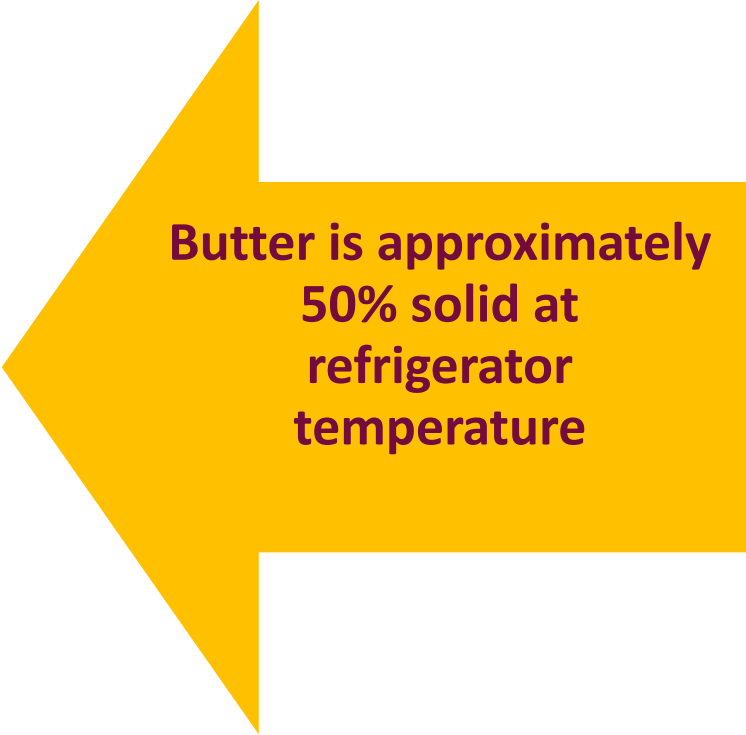


4 to 14 FA are synthesized in the udder

C16 FA are made by the animal and some come from the animal's diet.

C18 FA come from the animal's diet.

Milk fat melts over a wide temperature range, from approximately - 40°C to 40°C.



**Butter is approximately
50% solid at
refrigerator
temperature**



**20% solid at room
temperature**

The melting properties of milk fat are a result of the melting points of the individual FA that make up milk fat and their arrangement on the triglyceride molecule.

- The triglycerides of milk fat are in the form of globules.
- The globules are surrounded by a protein and phospholipid membrane that stabilizes the globules in the serum (water) phase of milk.
- The native globules range in size from $<1\ \mu\text{m}$ to $>10\ \mu\text{m}$.
- The uneven size distribution allows the larger globules to float in a process called creaming (cream line at the top of the container).
- Homogenization reduce the size of the large globules to $<1\ \mu\text{m}$, creating uniform distribution of globules throughout the serum phase, and minimize creaming.

Degradation of Milk Fat:

Enzyme action

- Lipases split fatty acids from the glycerol backbone of the triglyceride causing undesirable rancid flavors in milk.

Exposure to light

- Produces a characteristic off-flavor and majority of this off-flavor is caused by protein degradation.

Oxidation

- Attack on double bonds in the FA by oxygen. Oxidation of the unsaturated phospholipids in milk produces off-flavors that are described as painty, fishy, or metallic.

General composition of Milk Fat

- Milk fat imparts richness and smoothness to fat containing dairy products.
- The colour of fat depends upon its carotene content and varies with the species, breed and feed of animal.
- Yellow colour of cow milk is because of carotene. Buffalo milk does not contain carotene.
- Milk fat also contains cholesterol (0.23-0.1%) and phospholipids (lecithin, phosphatidyl serine, sphingomyelin, inositol and cerebrosides) acting as antioxidants.
- The shelf life of fat rich products is longer than that of milk.
- Fat rich products are utilized since years as wound healing agent, lighting the wicks of cotton and using ghee as cooking medium.

Fat Globule Membrane (FGM):

Consists of proteins, lipids, lipoproteins, phospholipids, cerebrosides, nucleic acids, enzymes, trace elements and bound water.

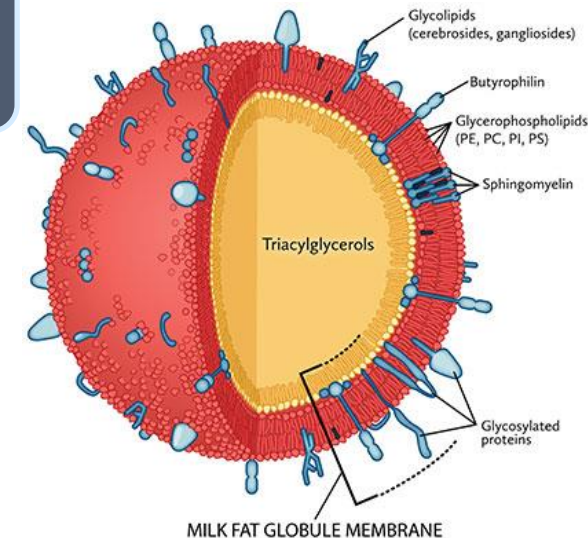
Keep fat from separating as free oil when subjected to physical abrasion during handling/processing of milk.

Protects milk lipids against the action of lipase.

Alkaline phosphatase and xanthine oxidase attached.

5-10 μm thickness

Iron and copper attached to it.



Component	Buffalo	Western cow
Lipid content	38.5	35.7
Neutral lipids	74.4	65.7
Phospholipids	19.7	18.6
Triglycerides	52.7	45.5
Diglycerides	7.4	5.5
Sphingomyelin	4.3	3.2
Phosphatidyl serine	3.1	2.4
C _{18:0} Stearic acid	34.4	24.1
C _{16:0}	22.4	23.8
C _{18:1}	14.5	14.5
C _{14:0}	12.6	14.4
Protein (g/100 g fat globule)	1.36	1.8

Average compositions of milk fat globules membranes

Fatty acid profile of milk fat:

- 1. Both buffalo and cow-milk fats consist chiefly of the triglycerides (95-99% of milk fat).**
- 2. Diglycerides (about 4.1% in buffalo milk and 1.26-1.59% in cow milk),**
- 3. Monoglycerides (about 0.7% in buffalo milk and 0.016-0.038% in cow milk).**
- 4. High, medium and low mol wt. triglycerides in buffalo milk occur in the proportion of 42.5, 17.1 and 40.5% respectively and corresponding values for cow milk fat are 52.9, 18.9 and 28.2% respectively.**
- 5. Free FA content of buffalo milk fat is lower (0.22%) as compared to cow milk fat (0.33%).**
- 6. Milk fat contains approx. 65% saturated, 30% monounsaturated, and 5% polyunsaturated FA.**

Fatty acids	Common name	Composition (wt/wt %)	
		Buffalo milk	Cow milk
C _{4:0}	Butyric	4.36	3.20
C _{6:0}	Caproic	1.51	2.11
C _{8:0}	Caprylic	0.78	1.16
C _{10:0}	Capric	1.28	2.57
C _{10:1}	-	-	0.31
C _{12:0}	Lauric	1.78	-
C _{14:0}	Myristic	10.81	11.93
C _{14:1}	Myristoleic	1.27	2.12
C _{15:0}	-	1.29	1.23
C _{16:0} (branched)	-	0.18	0.30
C _{16:0}	Palmitic	33.08	29.95
C _{16:1}	Palmitoleic	1.99	2.16
C _{17:0}	-	0.58	0.34
C _{18:0} (branched)	-	0.24	0.35
C _{18:0}	Stearic	11.97	10.07
C _{18:1}	Oleic	27.15	27.42
C _{18:2}	Linoleic	1.51	1.49
C _{18:3}	Linolenic	0.47	0.59

Fatty acid profile of buffalo and cow milk fat

Cholesterol:

- 1. Cholesterol content of milk is significantly affected by the species, breed, feed, stage of lactation and season of the year.**
- 2. Higher in the western breeds of cattle (317-413 mg/100 g fat), followed by zebu (desi) cow (303-385 mg/100 g fat).**
- 3. Lowest for buffalo (235-248 mg/100 g fat). Generally lowest at the beginning of lactation period, the cholesterol content progressively rises towards the end.**

Phospholipids:

- 1. Total phospholipid content of buffalo milk fat averages 21.04 mg/100 ml and for cow milk, it is 33.71mg/100 ml.**

Physico-chemical Properties	Buffalo milk fat	Cow milk fat
Softening point range	34.3 - 36.3°C	33.5 - 35.9°C
Melting point range	33.4 - 46.4°C	31.5 - 35.2°C
Acid value	0.17 - 0.352	0.26
Refractive index	1.4515 - 1.4533	1.4498 - 1.4530
BR reading	41.00 - 43.50	41.05 - 42.40
Saponification number	218.23 - 236.10	221.0 - 238.0
Iodine value	27.00 - 33.90	27.70 - 37.32
Reichert-Meissel value	27.83 - 35.50	24.60 - 29.70
Polenske value	0.70 - 1.60	1.30 - 1.80
Density	0.905 - 0.917 g/ml	0.888 - 0.911 g/ml
Grain size	0.20 - 0.41 mm	0.098 - 0.190 mm
Fat globule size	4.15 - 4.60 μm	3.36 - 4.15 μm
Unsaponifiable matter	392 - 398 mg/100ml	414 - 450 mg/100ml

Some physico-chemical properties of buffalo and cow milk fat

Types of Fat Rich Dairy Products

1. Cream:

- Yellowish component of milk, rich in fat globules, that rises to the surface naturally if milk is allowed to stand.
- Homogenization of cream reduces the size of the fat globules, and the resulting product is less suitable for whipping.
- Defined as:
 1. Portion of milk, which is rich in milk fat
 2. Portion of milk into which has been gathered and which contains large portion of milk fat



Categories of Cream

Low Fat Cream

- Contain milk fat not less than 25.0 percent by weight.

Medium Fat Cream

- Contain milk fat not less than 40.0 percent by weight

High Fat Cream

- Contain milk fat not less than 60.0 percent by weight

2. Butter:

- Defined as fat concentrate, obtained by churning cream, gathering the fat into a compact mass and then working it.
- Consists of 80-90% fat with maximum of 16% water and permitted additives are water, salt and butter colours.
- The fat free dry matter contains should not exceed 2%.



3. Fat spreads:

- Solid plasticized foods of water in fat type of emulsion which contain an aqueous phase as well as fats and oils.
- These fats and oils are foods on the basis of fatty acids have a vegetable, animal, marine or milk origin.



4. Cream Powder:

- Product obtained by partial removal of water from cream obtained from milk of cow and / or buffalo.
- The fat and/or protein content of the cream may be adjusted by addition and/ or withdrawal of milk constituents in such a way as not to alter the whey protein to casein ratio of the milk.
- Uniform colour, pleasant taste, free from off flavour, rancidity, vegetable oil, mineral oil, added flavour and any foreign substance.



5. Ghee:

- Pure heat clarified fat derived solely from milk/curd/cooking butter/cream where no colouring matter or preservative added.



6. Butter oil:

- Fatty products derived exclusively from milk which result in almost total removal of water and milk solids not fat.
- Pleasant taste, free from off odour, rancidity, vegetable oil/ fat, animal body fat, mineral oil, added flavour and any other substance foreign to milk.
- May contain permitted food additives such as antioxidant **ascorbyl stearate** (500 mg/kg maximum), **Propyl gallate**, **Octyl gallate**, **Ethyl gallate** (1000 mg/kg maximum for each) and **Butylated hydroxy anisole** (175 mg/kg maximum)

