



Definition, structure of milk and factors affecting composition of milk

Dr. Soma Maji

Assistant Professor

Department of Dairy Technology, CUTM, Odisha

- 
- 
- Milk is a complex fluid
 - Containing many components in different states of dispersion.



Definition of milk:

- ▶ “Milk” means the normal mammary secretion derived from complete milking of healthy milch animal, without either addition thereto or extraction therefrom, unless otherwise provided in these regulations and it shall be free from colostrum. (FSSR, 2017)
- ▶ In legal terms (PFA, 1954) milk is whole, fresh, clean, lacteal secretions, obtained by complete milking of one or more healthy milch animals, excluding that obtained 15 days before or 5 days after or such periods as may be necessary to render the milk practically colostrum free and containing legally prescribed minimum percentage of fat and solids-notfat (SNF).
- ▶ However in chemical terms milk may be defined as a complex chemical substance in which fat is present in the form of an emulsion, protein and some mineral matter in the colloidal state and lactose with some minerals and soluble proteins in the form of true solution.

Approximate composition of cow milk

Component	Average Content (%, w/w)	Range (% (w/w))	Average (% On Dry matter basis)
Water	87.3	85.5 -88.7	
Solids not fat	8.8	7.9-10.0	69
Fat in dry matter	31.0	21.0-38.0	
Lactose	4.6	3.8-5.3	36
Fat	3.9	2.4-5.5	31
Protein	3.25	2.3-4.4	26
Casein	2.6	1.7-3.5	20
Mineral substances	0.65	0.53-0.80	5.1
Organic acids	0.18	--	1.4
Miscellaneous	0.14	--	1.1

(Source: Dairy Chemistry and Physics, Walstra and Jenness, 1984)



Differences in the composition of milk from various sources

- Buffalo milk is having the maximum fat while the fat content in sheep milk is also bit same. The fat percent in goat milk is much similar to cow milk.
- Variation among the protein percent is also very less among these species.
- The lactose content in human milk is characterized by having higher percent of lactose while the protein and ash content is much less when compared with other species.

Compositional difference of different breed's milk

Species of Animals	Composition (g/100g)						Energy (kcal/100g)
	Water	Fat	Casein	Whey proteins	Lactose	Ash	
Human	87.1	4.5	0.4	0.5	7.1	0.2	72
Cow	87.3	3.9	2.6	0.6	4.6	0.7	66
Zebu	86.5	4.7	2.6	0.6	4.7	0.7	74
Water Buffalo	82.8	7.4	3.2	0.6	4.8	0.8	101
Goat	86.7	4.5	2.6	0.6	4.3	0.8	70
Sheep	82.0	7.2	3.9	0.7	4.8	0.9	102
Reindeer	66.7	18.0	8.6	1.5	2.8	1.5	214
Horse	88.8	1.9	1.3	1.2	6.2	0.5	52
Rabbit	67.2	15.3	9.3	4.6	2.1	1.8	202
Camel	86.5	4.0	2.7	0.9	5.0	0.8	70

(Source: Jenness and Sloan, 1970, Dairy science abstracts, 32, 599-612)

Legal standards of different type of milk

Type of milk	Fat (%)	SNF (%)
Buffalo milk	6	9
Cow milk	3.2	8.3
Goat/sheep milk	3.5	9.0
Camel milk	2	6
Standardized milk	4.5	8.5
Mixed milk	4.5	8.5
Toned milk	3	8.5
Doubled toned milk	1.5	9
Skim milk	Not more than 0.5	8.7
Full cream milk	6	9



FACTORS AFFECTING MILK COMPOSITION

- **Animal factor**
 - **Environmental and**
 - **Miscellaneous factors**
- 

Animal Factor

1. **Genetic:**Inherited character influenced by genes. By modifying it by proper planning of breeding practices, plays role in the quality and quantity of milk produced
2. **Species:**
 - The faster the rate of growth the more concentrated are the milk components needed for this growth.
 - For instance Cat milk contains about 7.0% protein since the new born has to double its birth weight in 9.5 days, similarly the lamb will double its birth weight in about 15 days as such the sheep milk has only 4.8% protein.
 - Human infants take substantially longer time (180 days) to double their birth weight, since the human milk least protein content (~ 1.0%).
3. **Breed:**
 - Milk fat being the costliest component of milk, there is considerable selection among the breeds to ensure milk with a considerably higher fat content.
 - To a considerable extent this being an inherited trait selection of suitable breed will be based on the fat percentage in the milk produced by that breed.



Individual Cow:

- This also depends on the genetic characteristics of the individual animals.
- By following good breeding practices it is possible to get higher fat per cent in the individual or milch animal.
- A similar variation could be observed in the protein and lactose levels in individual animals within a given breed.
- Thus, selective breeding can be used to upgrade milk quality apart from the inherited characteristics the environment and various physiological factors influence the composition of milk produced by individual animal.



➤ **Lactation Period:**

- Fat content is higher after parturition, which decreases to a low during the first and second months of lactation and then gradually increases during the remaining period of the lactation.
- A slight decrease in Lactose percentage could be observed during the last stage of lactation.
- An increase in the chloride content was observed with the advancement of lactation,
- Calcium concentration reduces to a minimum and further increase whereas the total phosphorous declines throughout the lactation period.
- Natural acidity was observed to be at higher level at the beginning of lactation and will decrease to normal value during the first three months and remains fairly steady during the remaining lactation period till the last month it declines sharply.

ENVIRONMENTAL

Interval between milking:

- ▶ The fat content of milk varies considerably between the morning and evening milking due to shorter interval of time.
- ▶ If cows are milked at 12- hour intervals, the variation in fat content between milkings would be negligible.
- ▶ Normally, SNF content varies a little even if the intervals between milking vary considerably.

Age:

- ▶ As cows grow older, the fat content of their milk decreases by about 0.02 percentage units per lactation. The fall in SNF content is much greater.



➤ **Feeding Regime:**

- All the precursors of milk constituents are derived from blood of milch animal. As such providing the suitable and well balanced feed to milking animal, plays an important role in maintaining requisite levels of constituents in the milk produced.
- Underfeeding a lactating animal will only reduces the milk yield but also level of fat and SNF. However changes in SNF content are more sensitive to the feeding level than the fat content. Fat content and its composition are influenced more by the roughage (fiber) intake.

➤ **Disease:**

- Milk production, being a physiological function of a lactating animal, general health condition of individual cow plays a very important role in maintaining good milk composition.
- Specific diseases have great influence on the composition of milk, both fat and SNF contents reduce when animal suffers from any specific disease.
- Mastitis, being a disease specific to the udder, has substantial effect on milk composition; it reduces lactose content with a corresponding increase in salt content of milk.

➤ **Completeness of Milking:**

- During the interval between the two milking, milk will be held in gland cistern and teat cistern, consequently there is possibility that fat being the lightest component of milk would be moving to the surface, resulting in the variation of fat percentage in different portions of milk during the process of milking.
- It is advised to draw the milk completely from the udder during each milking. This will not only ensure that all the milk produced by the animal is drawn but also the fat is not left in the udder.



➤ **Season:**

➤ There is wide variation in climate and also type of vegetation available in different seasons of the year. Due to seasonal variation in the availability of fodder, there are changes in the milk composition. In India, butter fat content in milk is maximum in the month of May and minimum in the month of November. Similarly the SNF is highest in October , and minimum in July and September . The variation in the milk production is dependent on several other factors *viz.*, temperature, hours of sun shine, length of the day, exercise, rain fall, drought, stall feeding or pasture feeding, etc. that are associated with the season.

➤ **Weather:** In dry months the total yields of milk tend to decrease along with a decrease in SNF and increase in fat percentage. In wet months there may be a decrease in both SNF and fat percentage along with or without the increase in the yield of milk which depends on the level of nutrition.

MISCELLANEOUS FACTORS

➤ **Exercise:**

- Subjecting the lactating animal to regular exercise will ensure good blood circulation through out the body and keeps the animal in good condition.
- In order to ensure sufficient reserve of energy such animals will eat more which would indirectly increase the milk yield. It was observed that the feed consumption of the animal will increase resulting in an increase in milk yield along with an increase in the fat percentage when compared with the period of rest.

➤ **Excitement:**

- Hormones play an important role in the animal, especially during the milking time. Favourable conditions during milking of animals result in good milk yield .
- On the contrary, harassment and frightening conditions such as barking of dog, presence of strangers, bursting of crackers,etc. disturbs the animal and reduces milk yield.



THANK YOU

