



Unit I - Topic 1

Milk- Composition and Nutritional value

Definition of milk:

- Milk is a whitish liquid containing proteins, fats, lactose various vitamins and minerals that is produced by the mammary glands of mammals.
- Early lactation milk is called colostrum which contains antibodies that strengthen the immune system.





NUTRITIVE VALUE

The nutritional value of milk is particularly high due to the balance of the nutrients that compose it. The composition varies among animal species and breeds within the same species, and also from one dairy to the other, depending on the period of lactation and diet (Table 1). For instance, goat milk is 88% water and 11.4% solids; it contains 3.2% fat and 8.13% of fat solids. It is also comprised of calcium (0.11%), phosphate (0.08%) and magnesium (0.21%).

energy	63kcal
CARBOHYDRATE	4.6g
PROTEIN	3.2
FAT	3.0
CALCIUM	125 mg
SODIUM	50g
MAGNESIUM	10mg



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POTASSIUM	150mg
citrate	200mg
Chloride	Mg
bicarbonate	20mg
Sulphate	10mg
Vitamin A IU	200

COMPOSITION OF MILK:

MILK COMPOSITION IN DAIRY ANIMALS

COW MILK

Water – 83%

Water – 83%

Fat – 5.5 to 9%

Protein – 4 to 5.9%

Solid content – 18%



YAK MILK

Water -87%

Fat – 5.5 to 9%

Protein – 4 to 5.9%

Solid content – 18%

GOAT MILK

Water – 87%

Fat – 4%

Protein – 3.6%

Lactose- 4.5%

Minerals – 0.9%

SHEEP MILK

Water – 80%

Fat – 8%

Protein – 5.6%

Lactose – 4.8%

Minerals - 0.9%

BUFFALO MILK

Water – 82%

Minerals – 0.8%

Protein – 4.5%

Lactose – 4.8%

Fat – 7 -9%



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Milk contains several groups of nutrients. Organic substances are present in about equal quantity and are divided into elements builders, proteins, and energy components, carbohydrates and lipids. It also comprises functional elements, such as traces of vitamins, enzymes and dissolved gases, and contains dissolved salts, especially in the form of phosphates, nitrates and chlorides of calcium, magnesium, potassium and sodium. It also contains dissolved gases (5% by volume), mainly carbondioxide (CO₂), nitrogen (N) and oxygen (O₂)

Water : For all animals, water is the nutrient required in the highest quantity, and milk contains a lot of water (88.6%). This amount of water is controlled by the amount of lactose synthesized by the secretory cells of the mammary gland.

Carbohydrate : Lactose is the main carbohydrate of milk. It is formed by the union of one molecule of D-galactose (engaged by its semiacetyl function) and one molecule of D-glucose (committed by its hydroxyl 4 position). It has a β -galactoside 1,4 bond (which is hydrolyzed by a β -galactosidase) and is a 4-Dglucopyranosyl- β -D-galactopyranose. Although lactose is a sugar, it does not have a sweet flavor. Its concentration varies slightly in milk (4.5 to 5.2 g / 100 g) contrary to the concentration of fat, that of lactose cannot be easily modified by feeding and true step of a dairy race to another. It is used as substrate during the fermentation of milk by lactic acid bacteria, differing in the fermented products such as yoghurt and cheese. It plays a role in fermented milk production. The amount of lactic acid produced by lactic acid bacteria in a fermented milk product depends not only on the bacterium itself (the bacterial strain more less active) and operating parameters, but also on the available amount of lactose bacteria.

Proteins The proteins in milk are of great quality, that is to say, they contain all the essential amino acids, and elements that our bodies cannot produce. It is important to remember that proteins are the building blocks of all living tissue. Milk proteins have roughly the same composition as the egg protein, except for the amounts of methionine and cystine, significantly lower. Indeed, the sulfur amino acids are the limiting factors in milk. Casein and, even more, the complex milk protein contains good proportion



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of all amino acids essential for growth and maintenance . The denomination crude protein (CP) includes protein (TP) and non-protein nitrogen (including urea). The protein content is an important feature of the milk. The TP determines the market value of milk, the higher the TP value is compared to a reference, the more money the producer will get. In fact, the more TP, the higher the yield of cheese making. Milk proteins represent 95% of crude protein, but the remaining 5% is: free amino acids, small peptides and nonprotein nitrogen. Protein comprise either only amino acid (β -lactoglobulin, α -lactalbumin) or amino acid and phosphoric acid (α and β casein) with a carbohydrate portion (sometimes even k casein). The base of the precipitation at pH 4.6 (20°C) or under the action of the rennet separates two components: caseins (α , β , γ and k) and the soluble protein or whey protein

Casein The four major caseins that exist naturally in milk are α_1 caseins; α_2 , B and k. Caseins are distinguished by their low solubility at pH 4.6 and are differentiated on the basis of the distribution of exchange and sensitivity to precipitation by calcium.

Casein k Among the most studied casein is casein k (k-CN), probably because of its importance in the stability of the micelle and its role in dairy processing. The k-CN is also the only casein having carbohydrate residues in its constitution. Caseins (α , β and κ) in the presence of calcium phosphate, form stable casein micelles (colloidal phase), which are balanced with the soluble phase of milk. It is possible to adjust the balance in terms of temperature, pH and the addition of salts. So long as the lactic acid bacteria converts lactose into lactic acid, it lowers the pH of the milk thereby decalcifying the casein micelles. There is another way to destabilize casein micelles and it is by using an enzyme such as chymosine.

Whey protein Other milk proteins are present in the whey serum and whey proteins are defined as soluble proteins in the whey after precipitation of caseins at pH 4.6 and at 20°C. Serum proteins include a first protein fraction (80%) consisted of β -lactoglobulin (β -LG), β -lactalbumin (- LA Da), bovine serum albumin (BSA) and immunoglobulin. A second non-protein fraction (20%) is composed of proteose, peptone and nitrogen compounds .

Fat

In milk, fat is the main source of energy. Goat and cow milk are low in polyunsaturated fatty acids that are necessary for human metabolism. Fat is present in milk in the form of an emulsion of fat cells; the



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concentration of the fat content of milk can be found in small cells suspended in water which varies considerably by race and composition of feed. The unsaturated fatty acids are lipid molecules containing at least one double bond, according to the structure of this or of these double bonds. It is possible to distinguish the cis fatty acids and trans fatty acids. Most unsaturated fats in our diet are in the cis form, and a lower proportion are in the trans form. The fat content of goat milk is slightly greater than that of cow milk, in both cases; triglycerides represent more than 95% of total lipids. Phospholipids comprise 30 to 40 mg/100 ml of cow milk which contains 8 to 10 mg of lipid, cholesterol is from 10 to 20 mg per 100 ml, most of which is in the free form. During the homogenization of milk, the fat globule increases in number and considerably decreases in diameter (less than 1 micron). Therefore, the contact area increases about 20 times. This change prevents fat from rising (in the long-life milk) and promotes digestion. The lipid composition of milk includes two major groups: simple lipids (triglycerides) and complex lipids (phospholipids). The milk fat has a nutritional role by energy intake, 9 kcal/g as dietary lipids. It also has a role in the construction of the body; we tend to charge animal fat of all disadvantages, but experts point out that health risks exist only if consumption is excessive. The fat has a very important sensory role during tasting; it gives a creamy texture appreciated, smooth, and velvety, fondant, etc. On the other hand, many flavors are associated with fat; it intervenes in intensity, balance, after taste of these aromas.

Minerals: They play an important role in the structural organization of casein micelles, the main minerals present in milk. The major salt constituents, potassium, sodium, calcium, magnesium etc., are distinguished if the content is greater than 0.1 g per liter of those containing trace amounts

Vitamins : Levels of vitamin A, D and E are variable; depending on the season as there is a slight increase during the pasture season (spring-summer). They are fat-soluble, so it is found in fat and can be lost during skimming. Other vitamins are water soluble and are found in the serum. In the case of ascorbic acid (C), it is present in small quantities in fresh milk and is destroyed by contact with air and also during pasteurization . For cow milk, the milk processing techniques can significantly change the amount of vitamin C



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