Dr. Mohanad Faris Abdulhameed
PhD in Public Health
University of Basrah
Class-Milk Hygiene (3)
Post-graduate students/Master degree

Milk and its constituents

1-Water- Water is the medium in which all the other components of milk (total solids) are dissolved or suspended. Water content varies from 83.18 per cent to 87.2 per cent in milk of different species of cows and buffaloes. In commercial milk, the range is 83.18 to 86.50 per cent.

2-Fat- Milk fat, though quite bland in taste, imparts richness/smoothness to fat-containing dairy products. In freshly secreted milk, it occurs as a microscopic globular emulsion of liquid fat in an aqueous phase of milk plasma. Fat is the most variable component of milk. The average size of fat globules in buffalo milk is larger (4.15 to 4.60 μm) than that of cow milk (3.36 to 4.15 μm.).

Both buffalo and cow milk fats consist chiefly of the triglycerides of fatty acids, which make up 95-99 per cent of milk fat. The remaining portion of milk fat is composed of di-glycerides (about 4.1% in buffalo milk and 1.26-1.59% in cow milk), mono- glycerides (about 0.7% in buffalo milk and 0.016-0.038% in cow milk). High, medium and low molecular weight triglycerides in buffalo milk occur in the proportion of 42.5, 17.1 and 40.5%, respectively. Corresponding values for cow milk fat are 52.9, 18.9 and 28.2%, respectively. Free fatty acid content of buffalo milk fat is lower (0.22%) as compared to that in cow milk fat (0.33%).

3-Phospholipids- The total phospholipids content of buffalo milk fat averages 21.04 mg/100 ml of milk, whereas for cow milk the corresponding value is 33.71 mg/100 ml.

4-Proteins- Casein, the principal milk protein, makes up 80 per cent of the total protein content, and whey proteins the remaining 20 per cent. These fractions, shown to be heterogeneous, consist of many proteins.

5- Casein: Typical of milk proteins, caseins display a distinctive structure as well as physical, biological and nutritional properties. These exist in milk as particles called casein micelles, which are made up of calcium phosphate and casein compounds.

6-Whey Proteins: Whey proteins consist of β **-** lactoglobulin and α - lactalbumin, bovine, serum albumin, immuno-globulins (mainly IgG1, IgG2 and IgM), lactoferrin, proteose-peptone, serum transferring, glycoprotein and enzymes.

A-β – lactoglobulin: This is the major whey protein present in buffalo and cow milk. The buffalo milk β **-**lactoglobulin displays molecular weight of about 38500 daltons, as compared to that of 37600 daltons observed in the cow milk β – lactoglobulin. This enzyme act as antioxidant and boost immunity especially for a newborn.

B-Immunoglobulins (Ig): They are antibodies synthesized in response to stimulation by specific antigens. These offer non-specific humoral response to Gram-negative enteric and respiratory bacteria. There are five major classes of immunoglobulins, viz., IgA, IgD, IgE, IgG and IgM

C-Lactoferrin: This glycoprotein displays a strong inhibitory effect towards Gram-negative enteropathogenic bacteria by virtue of its ability to bind free ionic iron, which is essentially required for the growth of enteropathogenic microorganisms

D-Proteose-Peptone: The average level of Proteose-Peptone in buffalo milk at about 330.5 mg/100ml is significantly higher when compared to 240 mg/100ml in cow milk.

E-Lactose: Also called milk sugar, lactose in the major carbohydrate of milk. It is a disaccharide of one residue each of D- glucose and D-galactose. Buffalo milk contains lactose in the range of 4.7-5.0 per cent, while cow milk has slightly lower amounts of lactose in the range of 4.5-4.8 per cent.

7-Minerals: Average normal milk contains 0.70 per cent ash, and this amount represents a salt content of about 0.90 per cent. The percentage of salt and ash in milk varies with the breed, feed, season, and stage of lactation and disease.

8-Enzymes: Milk is a repository of a variety of enzymes. Over 20 enzymes have been isolated and characterized in cow milk. However, information on enzymes in buffalo milk is very limited. Several enzymes in milk are utilized for quality testing and control. Some important enzymes from the processing point of view are listed below:

A-Alkaline Phosphatase: This enzyme has assumed significance because of the relationship between the temperature at which it is inactivated, and the temperature employed for pasteurization of milk. Buffalo milk on an average contains about two-thirds the activity of

alkaline phosphates as that of cow milk. Alkaline phosphates are distributed through milk although its concentration is higher in the cream fraction. (phosphatase test is used for testing pasteurisation of milk)

B- Lactoperoxidase (LP): This enzyme is naturally present in milk. One of its unique biological functions is an antibacterial effect in the presence of hydrogen peroxide and thiocyanate. Both these substances are naturally present in milk in varying concentrations. This enzyme has gained significance in view of its supportive role in preserving raw milk under ambient conditions through the LP-system. Lactoperoxidase activity in buffalo milk ranges between 5.2-9.8 units/ml, which is on average higher than the corresponding value of 4.4-7.2 units/ml for cow milk. This enzyme has benefits as antimicrobial agent for *Pseudomonas* spp and E. *coli* infection.

C-Lysozyme: This is a relatively small, single peptide chain protein. Its content in cow milk is about 13 μg/100 ml. recently emphasis has been focused on the antibacterial role of lysozyme as a natural defense in milk. During mastitis, lysozyme levels in milk tend to increase considerably, being in the range of 100 to 200 μg/100 ml.

9-Pigments: In cow milk, carotene is the major pigment and it is derived from feed. It gives cow milk a pale yellow appearance. However, buffalo has the ability to convert carotene into Vitamin A before passing it into milk and so it appears white. Milk also contains bile pigments. Among them, biliverdin predominates.

Functions of Hormones in Milk Production

The control of lactation is regulated by **galactopoeitic** hormones. Galactopoesis is defined as the maintenance of lactation. Many of the hormones involved in mammary growth are also responsible for fetal development. These hormones include: prolactin, growth hormones, thyroid hormones and steroid hormones.

PROLACTIN

Every time milk is removed from the cow the hormone prolactin is released which causes stimulation. Prolactin remains a key factor in milk secretion during lactation. Also, extended light periods increase concentrations of prolactin associated with milk production.

GROWTH HORMONES

Growth hormones help coordinate changes in physiological processes and in body tissues. Growth hormone is essential for maintaining lactation as it supports increase in synthesis of lactose, protein and fat in the mammary gland.

OVARIAN HORMONES

Ovarian steroids such as estrogen and progesterone are not necessary for maintenance of lactation. Progesterone alone has no effect because there are no progesterone receptors in the mammary gland during lactation. Increased blood concentrations of estrogen may affect milk production.

OXYTOCIN

Stimulation of the mammary gland, particularly the teats, results in the secretion of the hormone oxytocin. Oxytocin travels via the blood to the mammary gland and ultimately results in the physical removal of milk from the alveoli. Oxytocin is essential for milk removal.

THYROID HORMONES

Thyroids hormones are essential for maximum secretion of milk as they stimulate oxygen consumption, protein synthesis and milk yield. In addition, there is an inverse relationship between a cow's milk yield and blood levels of thyroid hormones in early lactation.