

# Milk and Milk Products Technology

## LPT (Unit- I)

By-

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# Composition of milk

- **Water** is the principal constituent of milk.
- Milk provides **essential nutrients** and is an important source of dietary energy, high quality **proteins** and **fats**.
- Milk consists of nutrients like **calcium, magnesium, selenium, riboflavin, vitamin B12 and pantothenic acid**.
- Milk and milk products are nutrient dense foods and their consumption can add diversity to plant based diets.
- Animal milk can play an important role in the diets of children in populations with very low fat intakes and limited access to other animal source foods.
- The colour, flavour and composition of milk depends on the species of dairy animal, its breed, age and diet, along with the stage of lactation, parity (number of parturition), farming system, physical environment.

# Milk composition in dairy animals



## Cow milk

Water -87%

Fat – 3-4%

Protein – 3.5%

Lactose - 5%

Minerals -0.8%



## Yak milk

Water – 83%

Fat – 5.5 to 9%

Protein – 4 to 5.9%

Solid content – 18%



## **Equine milk( Horse and Donkey milk)**

**Water – 91%**

**Fat – 1.9%**

**Protein – 2.5%(particularly caseins)**

**Lactose – 6.3% (rich)**

**Minerals – 0.3%**



## **Camel milk**

**Water – 86.5%**

**Fat – 4%**

**Protein – 3.6%**

**Lactose – 5%**

**minerals – 0.4%**

## **Human milk**

**Water – 87.6%**

**Fat – 4%**

**Protein – 1.2%**

**Lactose – 7%**

**Minerals – 0.4%**



## 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 to9%

very high fat content



## ***Milk is formed of***

- 1) Water: form 87%.**
- 2) Solids: form 13%.**
  - ❖ Organic constituents of milk.**
    - 1. Protein**
    - 2. Lipid.**
    - 3. Carbohydrate.**
  - ❖ Inorganic constituents of milk:**
    - 1. Minerals.**
    - 2. Vitamins.**

# Organic Constituents of Milk

## 1- Protein:

- Milk protein less in human than in cow's milk.
- All milk protein synthesized in the mammary gland.
- Milk protein of high coefficient digestibility (85 – 95%)

## Characterized by:

### 1. Protein of **high biological value** as:

- It contains all essential amino acids.
- Easily digested.
- Easily absorbed.
- Easily metabolized.

2. It contains moderate amount of non essential amino acids to decrease stress on body cells.

3. Essential to keep positive nitrogen balance (nitrogen intake more than nitrogen output).

4. Essential to maintain growth of newborn.



## Types of Milk Proteins are:

1. Casein.
2. Lactalbumin.
3. Lactoglobulin.
4. Milk enzymes.

### 1) Casein

- It is the main and most **dominant milk protein**.
- It represents 25% in human's milk and 83% in cow's milk.
- It is a compound protein (Phospho-protein) of high biological value.
- The high phosphate content of casein allows it to associate with calcium and form calcium phosphate salts.
- Casein contains  
    0.7% phosphorous and 0.7% sulphur.
- Casein is the only milk protein that **not coagulated on boiling**.
- The net charge of milk protein is negative charge, so protein molecules remain separated from each others due to repulsion forces.



## 2. Lactalbumin

- Represent **87%** of whey protein.
- Protein precipitation by full saturation with ammonium sulphate.
- Rich in cystein and cystin *so* give +ve result with sulphur test.
- **Simple protein.**
- **Soluble protein.**
- **Easily digested.**

### 3- Lactoglobulin

- Represent **13%** of whey protein.
- Protein precipitation by half saturation with ammonium sulphate solution.
- Rich in cysteine and cystine so give +ve result with sulphur test.
- Simple protein.
- Soluble protein.
- Easily digested.
- Consists of two fractions:
  - $\alpha$  Lactalbumin  $\longrightarrow$  32% of whey protein.
  - $\beta$  lactoglobulin  $\longrightarrow$  55% of whey protein.



## **4- Milk enzymes:**

- 1. Catalase.**
- 2. Peroxidase.**
- 3. Xanthin oxidase.**
- 4. Alkaline phosphatase.**
- 5. Amylase.**
- 6. Lipase.**
- 7. Aldehyde oxidase.**

# ENZYMES

**Lipases** are enzymes that degrade fats. The major lipase in milk is lipoprotein lipase.

It is associated with the casein micelle.

Agitation during processing may bring the lipase into contact with the milk fat resulting in fat degradation and off-flavors.

Pasteurization will inactivate the lipase in milk and increase shelf life.

## Proteases

The major protease in milk is **plasmin**.

Some proteases are inactivated by heat and some are not. Protein degradation can be undesirable and result in bitter off-flavors, or it may provide a desirable texture to cheese during ripening. Proteases are important in cheese manufacture, and a considerable amount of information is available in the cheese literature.

**Alkaline phosphatase** is a heat sensitive enzyme in milk that is used as indicator of pasteurization. If milk is properly pasteurized, alkaline phosphatase is inactivated.

### **Lactoperoxidase**

most heat-stable enzymes found in milk. When combined with hydrogen peroxide and thiocyanate, has antibacterial properties. It is suggested that the presence of lactoperoxidase in raw milk inhibits the disease causing microorganisms (pathogens) present in milk.

## 2- Lipids

Human's and cow's milk contain the same amount **3.5 gm/dl** but **buffalo's** milk is a little higher **7 gm/dl**.

- Easily separated on standing.
- Responsible for white color of milk
- It consists mainly of **triacylglycerol** distributed as coarse emulsion which contains oleic, myristic, palmitic and stearic fatty acids.
- Also contain small amounts of:
  - phospholipids 0.1%
  - Cholesterol 0.01%.

## 3- Carbohydrates

- **Lactose (milk sugar)** is the only carbohydrate of milk.
- It is a reducing disaccharide consists of glucose and galactose.
- Human's milk contains **7% lactose** while cow's milk contains **5% lactose**.
- Lactose may be excreted in urine during last third of pregnancy physiologically so it should be differentiated from glucose by osazon test.

# MILK FAT

Milk fat consists of

- triglycerides (the dominating components),
- di- and monoglycerides,
- fatty acids,
- sterols,
- carotenoids (giving the yellow colour of the fat)
- and vitamins (A, D, E, and K)



# Inorganic constituents of milk

## 1- Minerals:

- Human milk contain less mineral elements (0.4%) than cow's milk (0.8%).
- Milk rich in **Ca** and **P** which are present in their proper ratio for absorption (2:1) in human milk while in cow's milk (1:2)
- Ca and P are essential for:
  1. Growth of bone and teeth.
  2. Stability of casein.
- ✓ Milk contain adequate amount of **Na, K, Mg**.
- ✓ Human milk contains Na:K (1:2) which is suitable for the optimal growth of newborn.

## 2- Vitamins:

- **Milk is deficient in:**
  - **Vitamin C.** ( form – Ascorbic acid 1.5mg in 100ml cow milk)
  - **Vitamin D.**
  - **Vitamin K.**
- **Milk contain adequate amount of vitamin B complex which are sufficient for first week of life**

*e.g:*

**Pantothenic acid.**

**Riboflavin (gives the whey the greenish tint in sunlight)**

# Major and Minor Constituents of milk

- The **major constituents of milk** are Water, Fat, Protein, Lactose, Ash or Mineral matter.
- The **minor constituents of milk** are phospholipids, sterols, vitamins, enzymes, pigments etc



# FACTORS THAT AFFECT COMPOSITION

- Species
- Breed
- Individuality
- Interval of milking
- Completeness of milking
- Frequency of milking
- Irregularity of milking
- Disease
- Portion of milk
- Stage of lactation
- Yield
- Feeding
- Season
- Age
- Condition of cow
- Excitement
- Drugs and other

THANKS