



# Dairy Science (Fundamentals)

- Lecture 5, for [Desert Land Reclamation and Cultivation](#), level 2, 2019-2020

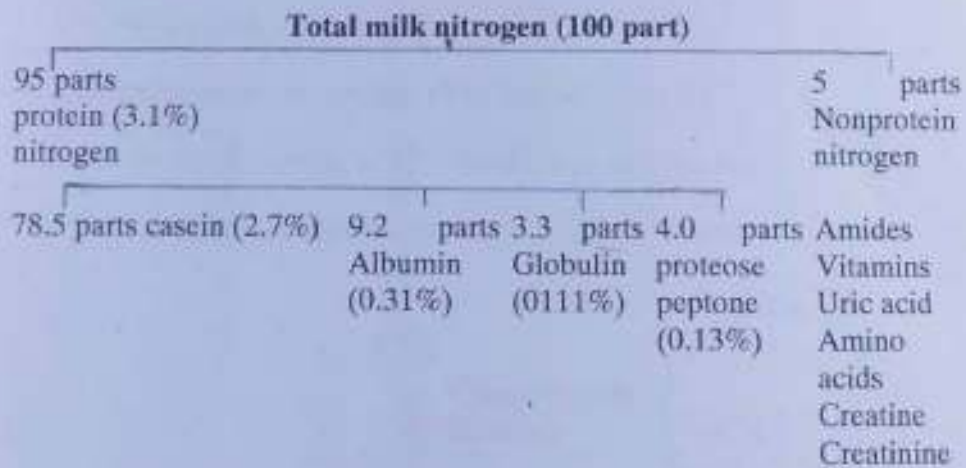
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### Milk Proteins

Milk contains considerable amount of proteins. In cows milk of average composition, with a fat content of about 3.8%, the protein content will be approximately 3%. In the case of buffaloes milk, the protein content is relatively higher to give an average of about 4%. Proteins of the mentioned milks yield a nitrogen content of about 0.5% and 0.6% in cows and buffaloes milks respectively. Milk nitrogen is distributed within a number of compounds as shown in the following diagram.



The figures between brackets show the nitrogen percent determined as milk protein.

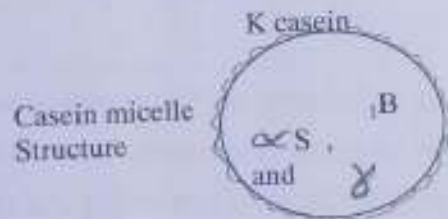
### 1- Casein:-

It is the most important protein of milk comprising about 80% of the total protein. Casein is specific to milk and exists in a state of suspension. Casein may be defined as the protein which is precipitated from milk at a pH of 4.6-4.7 (Iso-electric point), while the other milk proteins (whey proteins) do not precipitate by this treatment.

Casein is coagulated by (a) dilute acids, (b) certain enzymes such as rennin, pepsin and trypsin, (c) salts of heavy metals such as copper and mercury, (d) Ultra high temperatures for long time heat, (e) Neutral salts solution, e.g. sodium chloride, ammonium sulphate, and magnesium sulphate, (f) alcohol.

From recent studies it appears that milk casein consists of at least three species of molecules which have slightly different isoelectric points and solubility characteristics. These have been designated as follows:-

- 1-  $\alpha$  casein: This constitutes about 75%, the most highly heterogenous fraction, subfractioned to:
  - a-  $\alpha_s$  casein, 60%, sensitive to  $Ca^{++}$ .
  - b- kaba-casein (K-casein), 15%, insensitive to  $Ca^{++}$ .
- 2- B- casein, amounting to 22% sensitive to calcium ion.
- 3-  $\gamma$  casein, being about 3%, sensitive to calcium ions.



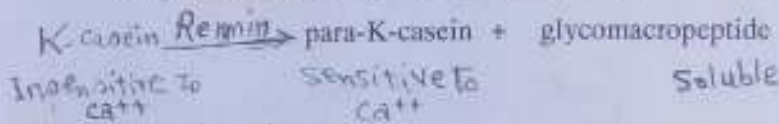
All casein fractions are held together as given in the sketch where K-casein (the insensitive fraction) protects  $\kappa$ ,  $\beta$  and  $\gamma$  casein (the sensitive fractions) and thus keeps casein micelles suspended in milk.

**Effect of rennet on the casein coagulation:-**

This can be summarized in the following steps:-

1- The Primary phase:-

K-casein acts as a substrate for rennin action.



2- The Secondary phase:

Three steps were reported to happen in this phase:

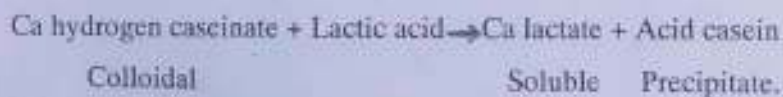
- a- Disaggregation.
- b- Reaggregation and coagulation (in the presence of  $Ca^{++}$ ).
- c- Synthesis of whey

3- The Tertiary phase:

Protein degradation starts from the primary phase and is more pronounced in this phase.

**Effect of acid on the casein coagulation:-**

Developing lactic acid acts in the same manner as an added acid, coagulation occurs in milk when reaches the Iso-electric point at pH 4.6 - 4.7 (about 0.5 to 0.6% acidity).



If additional acid is added, it will combine with casein and dissolve it. Generally, if the solution is either more acid or more alkaline than the isoelectric point the solubility of the casein will be increased.

2- Whey proteins:-

The term whey proteins is applied to several protein substances left in the whey after the removal of casein from milk by acid or rennin

Rennet Coagulation

Acid Coagulation

## CHEESE

Cheese making is the oldest and the most complex branch of dairy industry. The manufacture of cheese is a means of preserving the two most important constituents of milk mainly fat and casein, and at the same time of providing a palatable, easily-digestible, long-keeping, nourishing food. The casein in milk can be coagulated by acid, rennet or by combination of the two, the cheeses obtained differing greatly in keeping quality, in flavor and in composition. After agulation, a portion of water is removed by cooking, stirring, or draining the curd or by mechanical application of pressure. The cheese may or may not ripened, but if ripened, the nature of the process depends upon the particular variety of cheese.

Whether acid (Lactic acid produced by bacteria) or rennet is used, when the casein coagulates it carries the fat with it; yields of cheese obtained from milk depend therefore on the percentages of fat and casein.

### CLASSIFICATION OF CHEESE

Hard cheese 30-40% moisture	Semi-Hard cheese 40-50% moisture	Soft cheese 50-70% moisture
1) Without gas holes cheddar, Cheshire, derby, cephalotyre (known in U.A.R. as Ras cheese). 2) With gas holes Swiss Cheese.	1) Ripened by bacteria Brick, Menfease cheese (cheese 26). 2) Ripened by mold Roquefort, Stilton.	1) Ripened by Bacteria: Limburger, Domiati 2) Ripened by mold: Camembert, Coulommier. 3- Unripened cheese curish cheese cottage cheese.

Some cheeses, such as process cheese, cheese spreads and cheese foods which are manufactured from other cheeses and the whey cheese which consists mainly of albumin and globulin, are not included in the above mentioned classification.

Coagulation of milk for cheese making :-

1. Rennin coagulation
2. Acidic coagulation
3. Combination between the rennin and acidic coagulation
4. In the manufacture of few varieties of cheese the proteins of milk are precipitated at high temperatures by adding small amounts of dilute acid. (Coagulation by acid heat or Rennin)

Classification of cheese according to moisture content and ripening.

Hard cheese	Semi hard cheese	Soft cheese
50-40% moisture	40-50% moisture	50-70% moisture
1- without gas holes cheddar, cheshire, derby, Kds cheese	1. Ripened by Bacteria Brick, Manfese	1. Ripened by Bacteria Domesti, Limburger
2- with gas holes swiss cheese	2. Ripened by mold Roquefort, Stilton	2. Ripened by mold Camembert.
		3. Unripened cheese Kareish cheese

Definition of cheeses.

Cheese is the fresh or matured product obtained by the draining (of liquid) after the coagulation of milk, cream, skimmed or partly skimmed milk or combination of these.

Whey cheese is the product obtained by concentration or coagulation of whey with or without the addition of milk or milk fat.