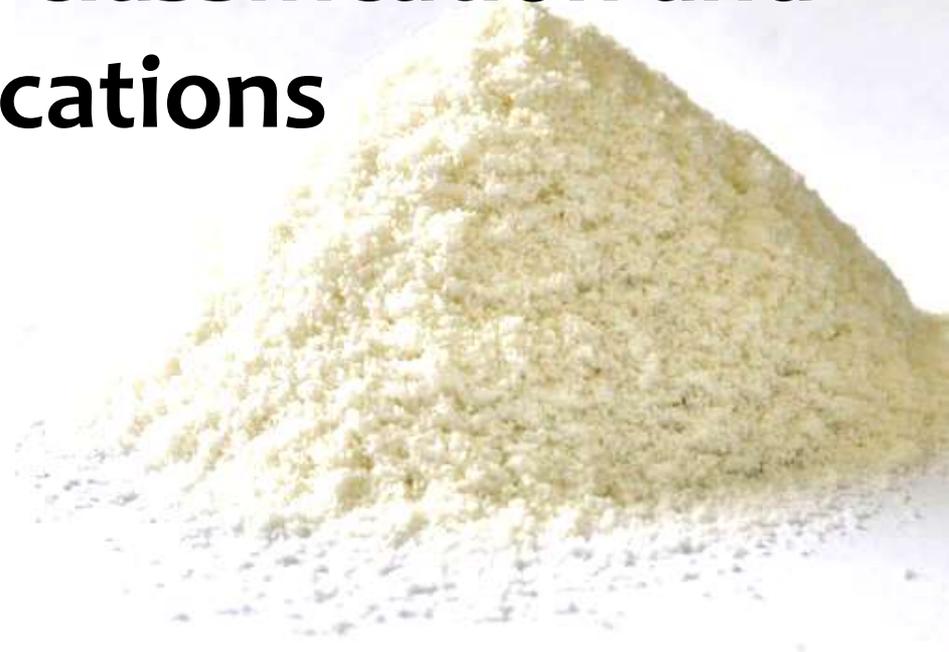
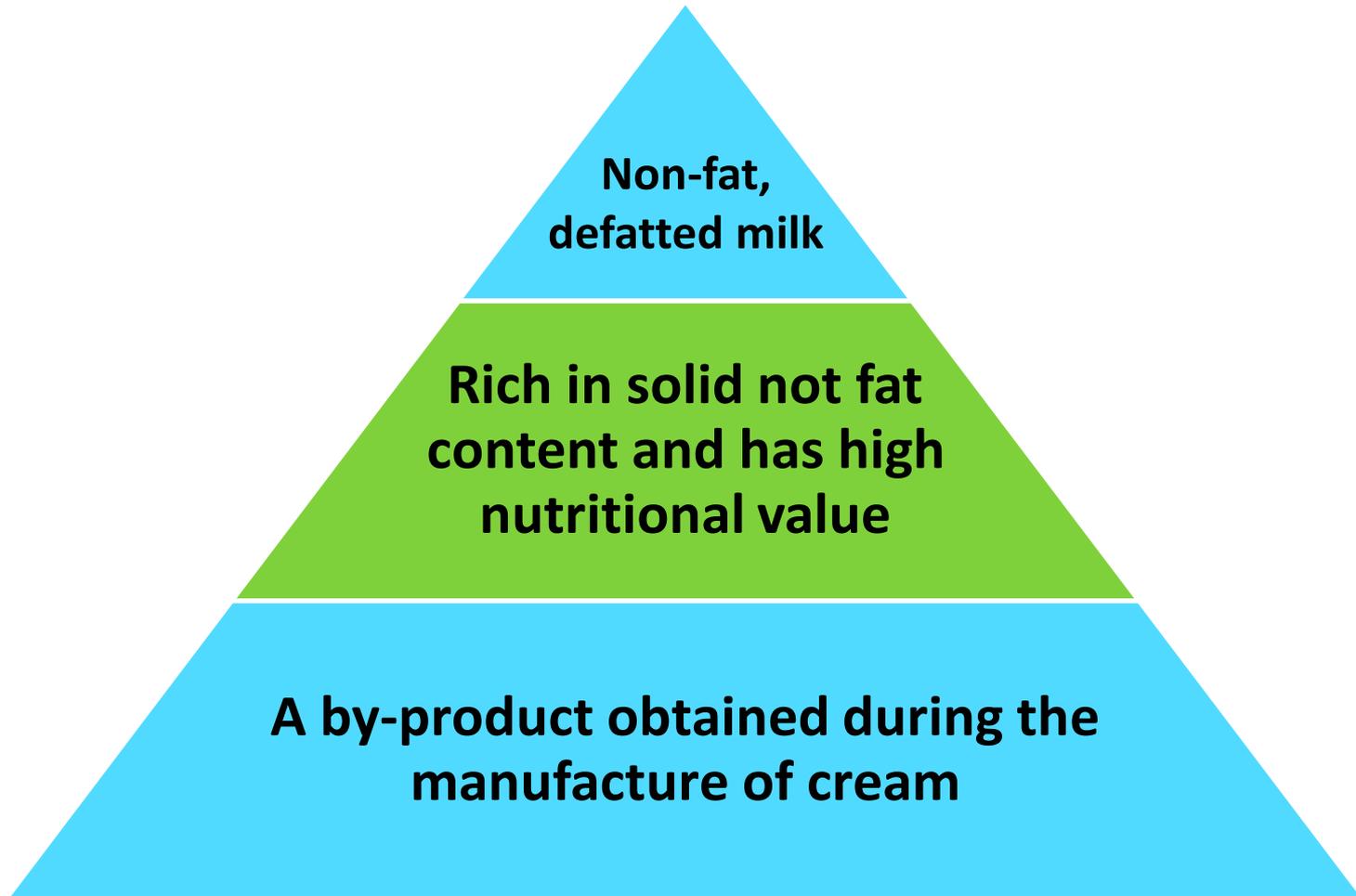




# **Physico-chemical characteristics of skim milk, casein classification and specifications**



# What is Skim Milk???



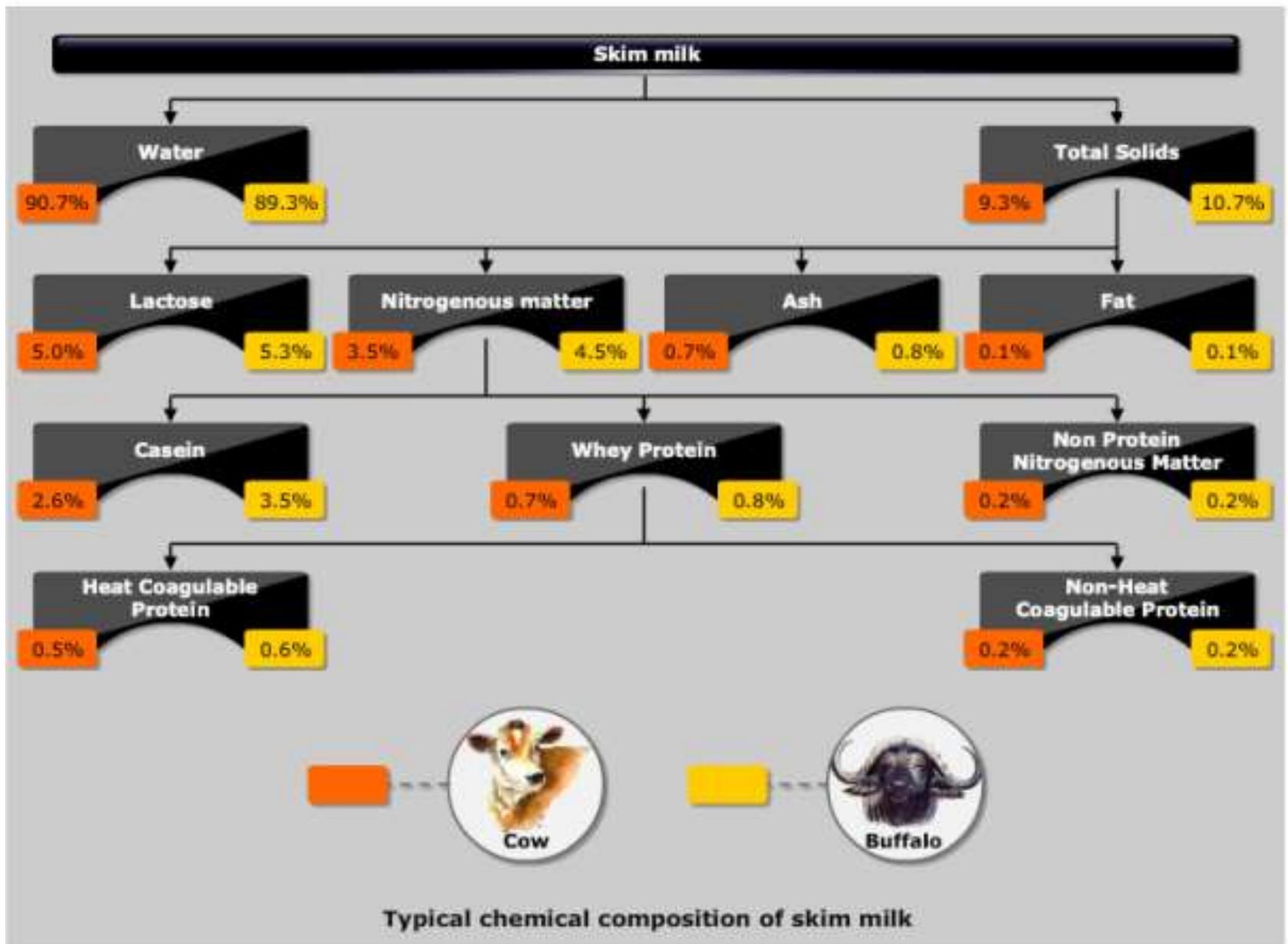
# Physico-Chemical Characteristics of Skim Milk

## 1. Chemical composition

- Skim milk and cream are the products of whole milk separation through a cream separator.
- Skimmed milk is the product prepared from milk from which almost all the milk fat has been removed mechanically and it should have not more than 0.5% fat and minimum 8.7% milk SNF (FSSAI, 2011).
- Buffalo skim milk contains higher total solids (about 10.7% including higher lactose and casein) as compared to cow skim milk (9.3% total solids).

## 2. Density/ Specific gravity

- Density of milk is determined by its % composition, temperature and processing treatments.
- Specific gravity of skim milk at 15.5°C is 1.036.



### 3. Viscosity

- Viscosity of milk depends on the temperature, amount and state of dispersion of the solid components.
- Representative values at 20°C for skim milk is 1.5 cP.
- Caseinate micelles are important contributors to the viscosity. Decline of viscosity from 5 to 30°C, reflecting a decrease in voluminosity of the caseinate micelles.
- Above 30°C, the decrease is less marked upto 65°C, where the whey proteins begin to denature.

### 4. Surface and interfacial tension

- Area of contact between two phases is called “interface”.
- Properties of interfaces and surfaces are determined by the number, kind and orientation of molecules located in them.
- Surface tension of skim milk at 20°C is 51 dynes cm<sup>-1</sup>

## 5. Electrical conductivity

- EC of milk is mainly due to Na, K, and Cl etc.
- Fat globules of milk reduce the conductivity by occupying volume and by impeding the mobility of ions. So, conductivity of the whole milk is less than that of skim milk by about 10%.
- The production of acid by bacterial action increases the conductivity of milk.
- Conductivity increases about  $0.0001 \text{ ohm}^{-1} \text{ cm}^{-1}$  per  $^{\circ}\text{C}$  rise in temperature.

## 6. Refracting index

- Refracting index of a substance is defined as the ratio of the speed of light in a vacuum to its speed in that substance. One consequence of refraction is to change the direction of a light ray as it enters or leave the substance.
- Refractive index of skim milk falls in the range of 1.3440-1.3485.

## 7. Solubility

- Between pH 3.5 and 5.5, caseins are very insoluble which restricts its use in low pH foods.

## 8. Heat stability

- Skim milk normally withstands heating at 140°C for 20 min, while concentrated skim milk (20% TS) is usually stable at 120°C for 20 min.
- Heat induced interaction between  $\beta$ -Lg and  $\kappa$ -casein plays a major role in determining the heat stability and rennet clotting behavior of milk.

## 9. Heat capacity and thermal conductivity

- Heat capacity of substance is the quantity of heat required to raise the unit temperature of a unit mass.
- Expressed as  $\text{cal g}^{-1} \text{ } ^\circ\text{C}^{-1}$ .
- Skim milk exhibits small but definite linear increase in heat capacity between  $0\text{-}50^\circ\text{C}$  from about  $0.933$  to  $0.954 \text{ cal g}^{-1}\text{ } ^\circ\text{C}^{-1}$ .
- There is a marked decrease in heat capacity as the total solid contents of the sample is increased.
- Dried skim milk products have heat capacities of  $0.28\text{-}0.32 \text{ cal g}^{-1} \text{ } ^\circ\text{C}^{-1}$  in  $18\text{-}30^\circ\text{C}$ .

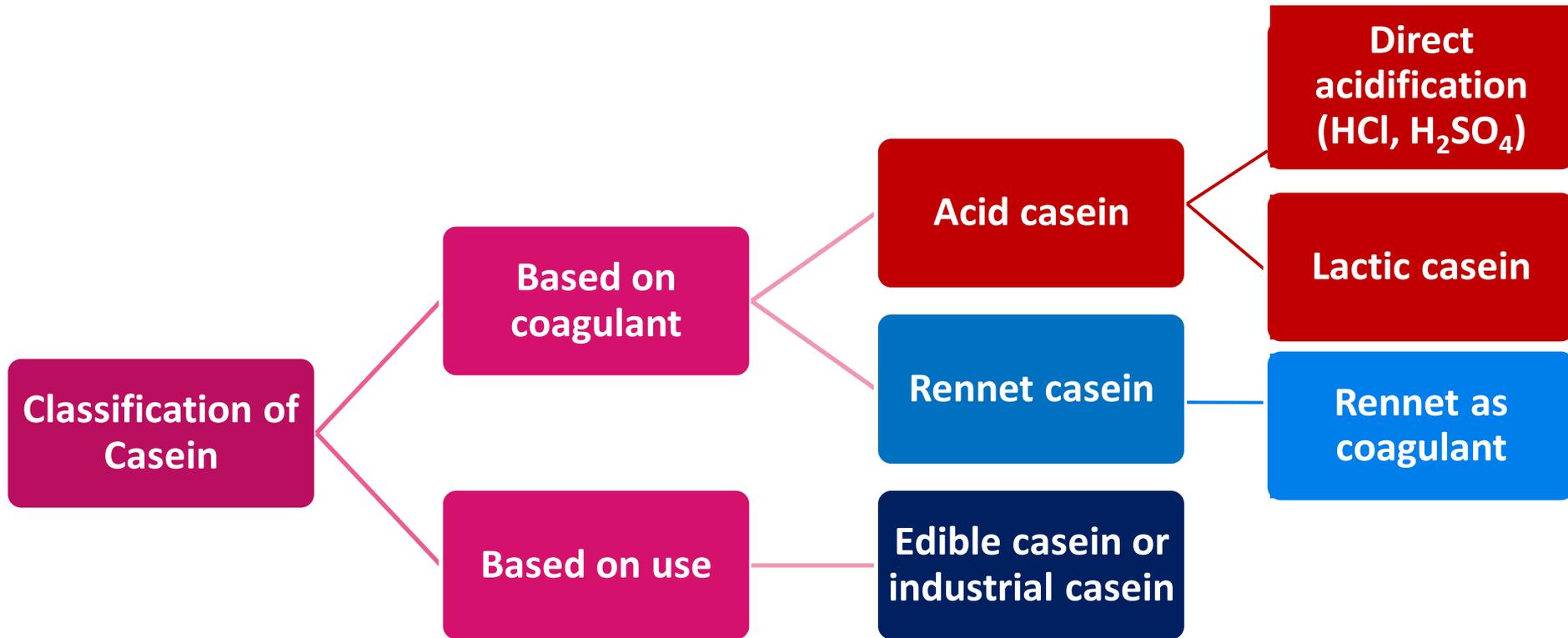


# **Casein: Classification & Specifications**



**Casein** is the principal protein in milk.

- 1. Edible casein is a established dairy by-product finding its use as an ingredient in many dairy and food products.**
- 2. Its manufacture differs from that of non-edible casein (industrial casein) in that it is produced under sanitary conditions, food grade chemicals to be used and sufficiently heat treated to make it safe for human consumption.**
- 3. Manufacturing technologies and introduction of efficient plant designs improved the technology of caseins.**



# Specifications: **Standards for edible casein**

## National Standards

### FSSAI Standards

Standards, edible casein products mean the products obtained by separating, washing and drying the coagulum of skimmed milk.

**Edible acid casein:** Obtained by separating, washing and drying the acid precipitated coagulum of skimmed milk.

**Edible non-animal rennet casein:** Obtained after washing and drying the coagulum remaining after separating the whey from the skimmed milk which has been coagulated by non-animal rennet or by other coagulating enzymes.

**White to pale cream or have greenish tinge**

**Free from lumps and any unpleasant foreign flavour.**

**May contain food additives permitted in these regulations.**

### BIS Standards

**Casein shall be prepared from skim milk of either cow/buffalo or a mixture of both.**

**White/pale cream in colour and have no undesirable odour/any foreign matter.**

**Free from any added colour or preservative.**

**Size of the particles shall be such that 100% by weight of casein shall pass through 500  $\mu$  IS Sieve.**

## FSSAI (2011) compositional standards for edible casein

Requirements	Acid Casein	Non-animal rennet Casein
Moisture	Not more than 12.0 percent m/m	Not more than 12.0 percent m/m
Milk Fat	Not more than 2.0 percent m/m	Not more than 2.0 percent m/m
Milk Protein (Nx6.38) on dry weight	Not less than 90.0 percent m/m	Not less than 84.0 percent m/m
Casein in Protein	Not less than 95.0 percent m/m	Not less than 95.0 percent m/m
Ash including P <sub>2</sub> O <sub>5</sub>	Not more than 2.5 percent m/m	Not less than 7.5 percent m/m
Lactose	Not more than 1.0 percent m/m	Not more than 1.0 percent m/m
Free Acidity	Not more than 0.27 percent	-

## Specifications: **Standards for edible casein**

**International Standards**      **The International Standard (FIL-IDF 45, 1969) defines the quality of edible acid casein. Dry casein is in the form of a coarse powder of white to cream-yellow colour that has odour and flavour of pure milk.**

**European Communities Standards**      **According to official standards of European countries, edible rennet casein means edible casein obtained by precipitation using the technological adjuvants.**

**National and International Standards for edible acid casein**

Requirement for edible casein	International Standards (FIL-IDF 45:1969)		BIS Standards (IS:1167-1965)
	Extra grade	Standard grade	
Moisture, % by weight, max.	12	12	10
Total ash, % by weight, (on dry basis), max.	-	-	2.5
Copper, max.	5 ppm	5 ppm	-
Lead, max,	5 ppm	5 ppm	-
Iron, max.	20 ppm	20 ppm	-
Acid insoluble ash, % by weight (on dry basis) max.	-	-	0.1
Fat % by weight (on dry basis) max.	1.7	2.25	1.5
Nitrogen, % by weight (on dry basis), min.	-	-	14.5
Protein, % by weight (on dry basis), min.	95	90	-
Total acidity in terms of ml. of 0.1 N NaOH/g.	-	-	6-14
Free acidity in terms of ml of 0.1 N NaOH, max.	0.20/g	0.27/g	5.6/10 g
Lactose, % by weight, max.	0.2	1	-
Bacterial counts, per g, max.	30,000	100,000	50,000
Coliform count, max.	Negative in 0.1g		10 per g
Mould count, per g, max.	-	-	50
Moulds and Yeasts, per g, max.	50	100	-
Thermophillic organisms, per g, max.	5,000	5,000	-
<b>Optional Requirements</b>			
Staphylococci (beta haemolytic coagu- lase positive), per g.	Negative	Negative	-
Salmonella, per 100 g.	Negative	Negative	-

**European Communities Standards (237/30, 1983) for edible rennet casein**

<b>a) Essential factors of composition</b>	
1. Maximum moisture content	10% by weight
2. Minimum milk protein content calculated on the dried extract of which minimum casein content	84% by weight 95% by weight
3. Maximum milk fat content calculated on the dried extract	2% by weight
4. Minimum ash content (P <sub>2</sub> O <sub>5</sub> included)	7.50% by weight
5. Maximum anhydrous lactose content	1% by weight
6. Maximum sediment content (burnt particles)	22.5 mg in 25 g
<b>b) Contaminants</b>	
Maximum lead content	1 mg/kg
<b>c) Impurities</b>	
Extraneous matter (such as wood or metal particles, hairs or insect fragments)	Nil in 25 g
<b>d) Harmless technological adjuvants suitable for human consumption</b>	
–rennet	
–other milk-coagulating enzymes	
<b>e) Organoleptic characteristics</b>	
1. Odour	No foreign odours
2. Appearance	Colour ranging from white to creamy white; the product must not contain any lumps that would not break up under slight pressure.

## Standards for industrial casein

The International Standard (FIL-IDF 45, 1969) defines the quality of casein for industrial use. The mineral content is substantially lower in acid casein than in casein coagulated with proteolytic enzymes.

Component (max)	Rennet Casein			Acid Casein		
	Extra Grade	First Grade	Standard Grade	Extra Grade	First Grade	Standard Grade
Moisture (%)	12.0	13.0	13.0	12.0	12.0	13.0
Milk fat (%)	--	--	--	2.0	2.25	2.5
Milk fat (% on dry basis)	1.0	1.25	1.50	2.25	2.5	3.0
Ash (%) (P <sub>2</sub> O <sub>5</sub> included)	--	--	--	2.3	2.5	3.0
Ash (% on dry basis)	7.5	7.5	7.0	2.5	2.7	3.3
Free acid (ml of 0.1N NaOH/g total solids)	--	--	--	0.33	0.88	1.32
Sediment/10 g (mg)	--	--	--	15.0	22.5	--

**International Standards (FIL-IDF 45:1969) for quality of industrial casein**