Dairy Science &Technology

(Animal Husbandry and Dairying)

E –Content

Topic-Manufacture of Casein

by

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E –Content(Pre Ph D Course work)

(Dairy Science &Technology (Milk and Milk product Technology)

Topic- Manufacture of Casein

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An important utilization of skim milk is in the production of casein because of its demand in the throught out the world. Casein is the primary protein found in milk and exist as individual protein molecules; it is present as casein micelles, which are colloidal particles ranging from approximately 50–500 nm in diameter.

Importance in Casein Manufacture

- The stability of casein micelles determines their coagulation behavior.
- Changes in pH or enzymatic action destabilize micelles and lead to casein precipitation.
- Understanding micelle structure helps optimize casein yield, quality, and processing conditions.

Quality Standards of Food-Grade Casein

Parameter	Typical Value
Moisture	8–12%
Protein	≥ 90%
Fat	< 2%
Ash	2–3% (acid casein)
pH	4.5–5.0
Microbial count	As per food safety standards

Type of Casein- (i) Acid casein (ii) Rennet Casein

Mechanism of Acid Coagulation

Acid coagulation occurs in three major stages:

1. Dissolution of Colloidal Calcium Phosphate

- As the pH decreases, CCP dissolves into the serum phase.
- This reduces the internal stability of the casein micelle.

2. Reduction of Surface Charge

- At normal milk pH (~6.6), casein micelles carry a net negative charge.
- Acidification reduces this charge, decreasing electrostatic repulsion between micelles.

3. Aggregation and Precipitation

- At **pH 4.6**, casein reaches its **isoelectric point**.
- The attractive forces between molecules increase, causing casein micelles to aggregate and form a curd.

Mechanism of Rennet Coagulation

Rennet coagulation occurs in two phases:

Primary Phase: Enzymatic Hydrolysis

- The enzyme **chymosin** specifically cleaves κ-casein between **phenylalanine (Phe105) and methionine (Met106)**.
- This produces:
  - **Para-κ-casein**, which remains associated with the micelle.
  - **Glycomacropeptide (GMP)**, which is released into the whey.

Secondary Phase: Micelle Aggregation

- Removal of the protective κ-casein layer allows casein micelles to aggregate.
- Calcium ions promote the formation of a firm three-dimensional gel network.

Industrial Equipment Used in Casein Manufacture

Milk Processing Equipment

- Milk storage tanks
- Plate heat exchangers
- Cream separators

Coagulation Equipment

- Acidification vats
- Continuous coagulation systems
- pH-controlled reactors

Separation Equipment

- Rotary screens

- Decanter centrifuges
- Filter presses

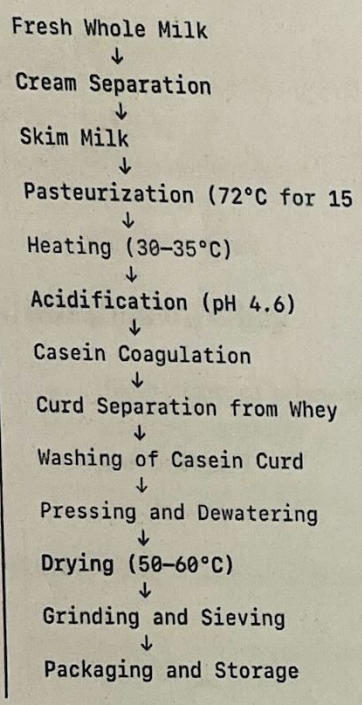
Drying Equipment

- Fluidized-bed dryers
- Tray dryers
- Spray dryers (for specialized products)

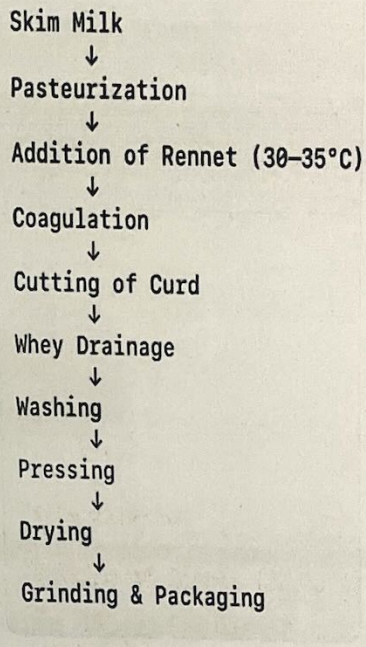
Grinding and Powder Handling Equipment

- Hammer mills
- Pin mills
- Sieving machines

Method of manufacture flow chart



Acid casein



Rennet casein

Yield of Casein-The yield of casein is equal to the percentages of casein in skim milk ranges from 2.8-3.2%, Casein yield depends on several factors:

Species of animal (cow/buffalo milk)

Protein content of milk

Efficiency of coagulation

Losses during washing

Processing conditions and operational efficiency

Defects in Casein and Their Causes

Defect	Cause
Dark color	Excessive heating during drying or poor drying conditions
High acidity	Inadequate washing after coagulation
High ash content	Incomplete removal of minerals
Poor solubility	Excessive heat treatment or improper processing
Off-flavor or odor	Microbial growth or use of poor-quality milk

Environmental Aspects of Casein Manufacture

Casein production generates a large amount of **acid whey**, which contains:

- Lactose
- Whey proteins
- Minerals
- Organic acids

Utilization of Whey

- Production of whey protein concentrate (WPC)
- Lactose recovery
- Animal feed
- Production of biogas and bioethanol

Proper whey management reduces environmental pollution and improves process sustainability.

Modern Technologies and Innovations in Casein Manufacture

- Microfiltration and ultrafiltration for concentration of casein
- Continuous casein production systems
- Computer-controlled pH and temperature regulation
- Low-temperature drying technologies
- Development of nano-casein particles for drug delivery systems
- Production of biodegradable casein-based films for food packaging

BIS Specification -

Characters	Requirements
Moisture%	10
Total Ash%	2.5
Fat%	1.5
Total acidity%	6.14
Bacterial count/gm	50,000
Coliform count/gm	10
Mold count/gm	50

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BIS (Bureau of Indian Standards).IS standards related to **edible casein and dairy product**