Unit V - Topic 6

Milk Products – Paneer – Casein – Probiotic Dairy Products – Milk Plant Sanitation Requirements - Cleaning In Place Unit and its Functions

Processing and Machinery

2.1 Introduction

Paneer is a very common indigenous dairy product in Indian subcontinent, is similar to an unripened variety of soft cheese which is used in the preparation of a variety of culinary dishes and snacks. It is obtained by heat and acid coagulation of milk, entrapping almost all the fat, casein complexed with denatured whey proteins and a portion of salts and lactose. Paneer is marble white in appearance, having firm, cohesive and spongy body with a close-knit texture and a sweetish-acidic-nutty flavour. Preparation of paneer using different types of milk and varied techniques results in wide variation in physico-chemical, microbiological and sensory quality of the product. Paneer blocks of required size are packaged in laminated plastic pouches, preferably vacuum packaged, heat sealed and stored under refrigeration. Paneer keeps well for about a day at ambient temperature and for about a week under refrigeration (7 °C). The spoilage of paneer is mainly due to bacterial action.

As per Food Safety and Standards Regulations (FSSR), 2011 Paneer is the heat assisted coagulated product resulted from the coagulation of cow or buffalo milk or a combination thereof with the help of lactic acid or citric acid. The paneer must have the moisture content less than 70 %. The fat per cent of paneer shall be greater than 50.0 of the dry matter. Milk powder may also be used in the preparation of paneer. The moisture and fat percent of low-fat paneer shall not be more than 70 and 15 respectively on dry matter basis. According to Bureau of Indian Standards (IS 10484:1983), paneer shall contain a minimum of 50% fat on dry matter basis but the moisture content shall not go beyond 60%.

Step wise detail of paneer manufacturing

1. Receiving milk: Milk is received in a clean and sterilised Stainless Steel (SS-304) multipurpose vat. Milk is standardized for Fat and SNF (fat: SNF 1:1.65) in a. Then milk is heated to 85-900C and hold it for 5 minutes, maintaining the same temperature. This process is also referred to as batch pasteurization. Purpose of batch pasteurization is to reduce the microbial load. Temperature of the pasteurized milk is then brought down to 700C.

2. Prepare 1% citric acid solution with respect to the milk, which is used as a coagulant. The temperature of

coagulant is maintained at 700C, which is same as the temperature of milk at the time of addition of coagulants.

3. The coagulant is added in optimum quantity and stir them slowly, so that a clear whey separation shall be achieved. The green colour of the whey indicates proper coagulation. Stirring should not be intense otherwise this will lead to the break up the curd mass.

4. Once the pH of whey reached in the range of 5.7 to 6.0, allow the curd mass to be settle for about 5 - 10 minutes. Allow the whey to be drained out through a muslin cloth and the coagulated curd remains in the vat/cloth. It is advised that the whey temperature should not fall below 630C during the whole process.

5. The curd mass shall be filled in the SS hoops lined with muslin cloth and pressed for 15- 20 min. Pressing can be achieved through a manual press or pneumatic press.

6. Immersed the pressed paneer blocks in chilled water (4- 6 0C) or 5% brine solution (4- 6%) for 2 - 3 hours to achieve firmness. Further the paneer blocks were cuts and dried to remove extra free water.

7. At last, the paneer slices were packed in a vacuum-package made of high-density polyethylene (HDPE) and stored at 5 - 8 0C for further sales/distribution.

CASEIN: CLASSIFICATION & SPECIFICATIONS

5.1 Introduction

Casein, the principal protein in milk, has been produced commercially for more than a century. Edible casein is a long established dairy by-product finding its use as an ingredient in many dairy and food products. The general development in technologies and the new uses in foods have ever increased the production and demand of this by-product. Its manufacture differs from that of non-edible casein (also called industrial casein) in that it is produced under sani-tary conditions. Further, during its manufacture, food grade chemicals are to be used and sufficiently heat treated to make it safe for human consumption. Appropriate National and International standards for this by-product call for rigorous control during its manufacture. The intensive investigation in manufacturing technologies over the years and the introduction of efficient plant designs, have immensely improved the technology of caseins.

5.2 Classification

5.2.1 Classification based on coagulant

5.2.1.1 Acid casein

Acid casein can be further classified as follows:

- Direct acidification with mineral acids: Hydrochloric acid casein, sulphuric acid casein etc.
- Lactic casein: Produced by growth of lactic starter culture.

5.2.1.2 Rennet casein

Rennet casein is obtained by using rennet as the coagulant.

5.2.2 Classification based on use

Based on use of casein, it can be classified as 'edible casein' or 'industrial casein'.

SANITATION IN MILK PLANT

Sanitation implies the destruction of all pathogenic and almost all non pathogenic micro organism

Definitions for Sanitizing Terms

- **Antiseptic** - an agent used against sepsis or putrefaction in connection with human beings or animals.
- **Disinfectant** - an agent that is applied to inanimate objects; it does not necessarily kill all organisms.
- **Sanitizer** - an agent that reduces the microbiological contamination to levels conforming to local health regulations.
- **Germicide** - an agent that destroys microorganisms.
- **Bactericide** - an agent that causes the death of a specific group of microorganisms.
- **Bacteriostat** - an agent that prevents the growth of a specific group of microorganisms but does not necessarily kill them.
- **Sanitization** - the process of reducing microbiological contamination to a level that is acceptable to local health regulations.
- **Sterilization** - the process of destroying all microorganisms.

The premises surrounding the dairy plant shall be kept in a clean and orderly condition, and shall be free from strong or foul odors, smoke, or excessive air pollution. Construction and maintenance of driveways and adjacent plant traffic areas shall be of cement, asphalt, or similar material to keep dust and mud to a minimum.

A suitable drainage system shall be provided which will allow rapid drainage of all water from plant buildings and driveways including surface water around the plant and on the premises, and all such water shall be disposed of in such a manner as to prevent an environmental or health hazard.

The immediate surroundings shall be free from refuse, rubbish, overgrown vegetation, and waste materials, to prevent harborage of rodents, insects, and other vermin.

Detergent should have the following desirable properties :

- Wetting and penetrating power
- Emulsifying power
- Saponifing power
- Deflocculating power
- Sequestrating and chelating power
- Quick and complete solubility
- Should be non corrosive to metal surfaces.
- Free rinsing.
- Economical
- Stability during storage
- Should be mild on hands
- Should possess germicidal action.

Dairy detergents broadly classified into 4 different groups:

- Alkalies :Sodium hydroxide, Sodium bi carbonate, Sodium phosphates, Sodium silicate/sulphite etc.
- Acids :Mild-Phosphoric, Tartaric, Citric, Gluconic. Mild acids can be used for milk stone removal. Strong-Nitric.
- Polyphosphates and chelating chemicals :These are used together withacids and alkalis. Examples Tetraphosphate, Hexa meta phosphate, Tri poly phosphate, Pyrophosphate etc
- Surface active/Wetting agents: These are used either alone or in conjunction with acids or alkalies. Examples-Teepol, Acinol N, Idet-10, common soaps etc.

Principles of cleaning and sanitization

- Cleaning or washing of dairy equipment implies the removal of soil from the surface of each machine.

Sanitization or sterilization

- Implies the destruction of all pathogenic and all most all non pathogenic micro organisms from the surface of the equipment.
- Detergent s are the substances capable of assisting cleaning.
- Sanitizers are substances capable of destroying all pathogenic and almost all non pathogenic micro organisms.

Principles of cleaning and sanitization

- In the selection of any particular detergent consideration should be given to type of soil, quality of water supply, material of surface and the equipment to be cleaned and method of cleaning viz., soaking, brushing, spraying and or re circulation
- Heat is most reliable sanitizer especially when both temperature and time are controlled. Thus effective sanitization can be done by steam (15psi / 5 minutes or 0 psi / 15 minutes) or scalding water (90 – 950C/10 minutes)
- Drainage: To remove any residual loose milk and any other matter
- Pre rinsing: With cold or hot tap water to remove as much milk residue and other matters as possible
- Warm to hot detergent washing: With detergent solution of 0.15 to 0.60% alkalinity to remove the remaining milk solids.
- Hot water rinsing: To remove traces of detergents
- Sanitization: To destroy all the pathogenic and almost all the non pathogenic MO.
- Drainage and drying: To prevent bacterial growth and corrosion. Drying readily accomplished by heat and ventilation.

Dairy detergents			
Alkalies • NaOH • Na_2CO_3, • Sodiumphosphate • Sodium bi carbonate, Sodium silicate • Strongalkalies saponify the fat • Weak alkalies dissolve protein	**Acids** • Tartaric, phosphoric, citric, gluconic and nitric acids • Mild acids used to remove milk stone • Strong acids should not be used at more than 1%	**Polyphosphates and chelating agents** • Tetraphosphate • Hexametaphosphate • Tripolyphosphate • Pyrophosphate • All are used along with acids and alkalies	**Surface active or wetting agents** • Teepol • Acenol – N • Idet – 10 • Common soap • Used alone or in conjunction with acids and alkalies

Sanitizers

- Non toxic
- Quick acting
- Relatively non corrosive to hands and equipment
- Easily and quickly applied
- Relatively in expensive

The commonly used dairy sanitizers are steam, hot water and chemicals like chlorine compounds, iodophor and quaternary ammonium compounds. The methods of chemical sanitization broadly consists of flushing, spraying, brushing, fogging and submersion

Name of the sanitizer	Mode of action
Chlorine compounds like chlorine gas, chloramines-T, hypochlorites, hexachlorophenol, dichloroisocyanic acid and trichloroisocyanic acid	Cl_2 + H2O ------ à HOCl + H^+ + CH^- HOCl is highly bactericidal Nascent H^+ destroys microbes by inhibiting enzymic reactions and glucose oxidation
Iodophors like iodine	Acts through halogenation and oxidation of sulphhydral groups. Dissociation of iodine from the surfactant is responsible for bactericidal action
Quaternary ammonium compounds like acetyl trimethyl	Acts on cell membrane causes disintegration and denaturation of proteins essential for growth and metabolism. Inactivates special enzyme system essential for

ammonium bromide	respiration of cells.

Methods of cleaning dairy equipment: These include hand washing, mechanical washing and Clean – in – place or CIP method.

Hand washing

- Prepare 0.8 to 1.0% of detergent mixture in tap water so as to give a minimum alkalinity of 0.5% in a wash up tank and maintain the temperature at about 50°C
- Thoroughly rinse the utensils with clean cold water
- Introduce the detergent solution in to the equipment thoroughly brush the equipment surface, inside and out side with a clean can brush
- Wash the utensils with enough fresh cold water using a clean brush again if needed to remove all traces of detergents
- Allow the equipment to drain thoroughly and let it dry for at least one or two hours
- Sanitize the equipment surface by steam or hot water after cleaning and or by rinsing with chlorine solution (200 ppm available chlorine) just before using

Mechanical washing: This consists mainly of can and bottle washing

- Can washing
  - Drainage stage for liquid milk residue
  - Pump-fed pre rinsing with cold or Luke warm water
  - Drainage stage
  - Pump fed jetting with detergent at not less than 70°C
  - Drainage stage
  - Rinsing stage – Pump fed or by steam and water ejector at not less than 88°C
  - Final fresh water rinsing with steam and water ejector at 88 – 93°C
  - Live steam injection
  - Hot air drying at 95 – 115°C
- Bottle washing
  - Pre rinse using water at 32 – 38°C
  - Detergent wash usually with 1 – 3 % caustic soda together with chelating and wetting agents, given preferably in two stages at different temperatures with in 60 – 75°C. Sanitize the bottles as well
  - Warm water rinse: To remove all traces of detergents. Reduce the bottle temperature for next stage. Water temperature varies from 25 – 45°C and is usually re circulated.
  - Cold water rinse: Normally re circulated chlorinated water (containing 35 to 50 ppm available chlorine) is used to prevent re contamination of bottles
  - Draining after the bottles come out of the machine

Cleaning – in – place: This refers to that system of cleaning and sanitization which does not require the daily dismantling of dairy equipment.

- Pre rinse with cold water till discharge water runs clear
- Acid rinse with phosphoric acid solution of 0.15 to 0.60% acidity, re circulated at 65 to 71°C for 20 to 30 minutes (wetting agent may be added to increase cleaning ability)
- Drain out acid solution
- Hot water rinse with water at 65 to 71°C for 5 to 7 minutes. Rinse water should drain out
- Alkali rinse with alkali detergent solution of 0.15 to 0.60% alkalinity, re circulated at 65 to 71°C for 20 to 30 minutes (wetting agent may be added to increase cleaning ability)
- Drain out alkali solution
- Final hot water rinse with water at 71 to 82°C till the whole system has been heated. Rinse water should be drained out.

Merits of CIP system

- Ensure that all equipment receives uniform heat treatment day after day by eliminating the human factor
- Less damage to equipment
- Saving of total clean up costs and in man hours
- Reduces possibility of contamination through human error
- Improved plant utilization and appearance

Success factors

- Proper selection of pipes and fittings, installation and development of circuits
- Proper temperature of cleaning solution

- Adequate velocity of cleaning solution
- Use of detergents designed specifically for re circulation cleaning
- Proper concentration of detergent solution
- Sufficient cleaning time

Merits

- Eliminates the human factor
- Less damage to equipment
- Time saving
- Reduces the possibility of contamination through human error
- Improved plant utilization and appearance

Types of CIP systems

- Manual control
- Automation
  - Low level
  - Medium level
  - High level

Cleaning is the process of removing food and other types of soil from a surface, such as a dish, glass, or cutting board. Cleaning is accomplished using a cleaning agent that removes food, soil, rust stains, minerals, or other deposits.

Introduction

Cleaning-in-place (CIP) is now a commonplace activity in almost all dairy, beverage and processed-food production plants. The processed food industry has seen a major shift towards CIP over the past 10–15 years, and the beverage industry, which has been broadly in line with the dairy industry technology, has seen increased demands from customers in terms of CIP verifi cation and validation to provide improvements in plant hygiene, fi nished product quality, and related shelf-life and microbiological considerations.

The highest standards of plant hygiene are an essential prerequisite for the production of any high-quality product being produced for human consumption. The cleaning and subsequent disinfection or sterilisation of any item of processing plant or equipment must be carried out with the utmost care and attention if the fi nal product quality is to be fully assured. In earlier days, cleaning tended to be a manual process; indeed, it still is today in many small-scale operations, especially in the processed food sector, where a combination of manual strip-down clean and rebuild is common. Where manual cleaning is still practised, it is vital that there is meticulous attention to detail, because – for reasons of the health and safety of the operative – only mild and comparatively cool chemical solutions, detergents and disinfectants can be used, and strict adherence to cleaning procedures is critical. In largerscale operations, and where more complex plant and equipment may be involved, the most usual approach today is to employ CIP, and it is to this aspect of cleaning technology that this book is primarily devoted, with a view to providing an understanding of the concepts and application of CIP in the processed food, pharmaceutical, dairy and beverage sectors.

Cleaning-in-place (CIP): definition In the 1990 edition of the Society of Dairy Technology manual CIP: Cleaning in Place, CIP was defi ned as: The cleaning of complete items of plant or pipeline circuits without dismantling or opening of the equipment and with little or no manual involvement on the part of the operator. The process involves the jetting or spraying of surfaces or circulation of cleaning solutions through the plant under conditions of increased turbulence and fl ow velocity. This was taken from the National Dairyman's Association (NDA) Chemical Safety Code, which was published in 1985; although the NDA has been superseded, their definition of CIP is still felt to be quite appropriate. 1.3 CIP systems: hardware CIP units comprise vessels for storage and recovery of cleaning solutions, along with valves, pumps, pipelines and field instrumentation to allow cleaning to take place, usually automatically. They vary in complexity and degree of automation, and hence their efficiency and cost-effectiveness are also variable. For example, the single-use CIP units tend to be very expensive to operate (detergent, water and energy requirements are high), but can be much more hygienic as the chance of cross-contamination and potential spore formation is greatly reduced. Full recovery systems with large detergent storage tanks are usually multifunctional and tend to be relatively economic in operation, but need to be closely monitored to prevent the build-up of soil residues in the dilute detergent or recovered rinse tanks due either to the inherent recovery efficiency of the set or perhaps to poor pre-rinsing. It is therefore very important to refresh cleaning solutions on a regular basis.

The processes of cleaning

The cleaning processes, whether manual or automated and throughout all industry sectors, tend to follow similar principles, and will usually consist of a series of discrete stages or cycles, generally including:

- removal of gross debris (product recovery)
- pre-rinse
- detergent recirculation
- intermediate rinse
- second detergent recirculation (optional)
- intermediate rinse
- disinfection
- final rinse