TVET CERTIFICATE IV in FOOD PROCESSING

Module Title: Fermented Milk Making

Code: FOPFM401 Make Fermented Milk

Competence

Credits: 9

Learning hours: 90hrs

Sector: Agriculture

Sub-sector: Food Processing

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Purpose statement

Fermented milk processing is an important sub-sector in food processing industry in Rwanda where the demand of these product is high on the market. However, there is insufficient fermented milk processing plants as well as skilled personnel. The competence of fermented milk focuses on equipping the learners with hands-on experience in making fermented milk products, thereafter the learner can work in milk processing plants or be self employed. This competence is intended for learners who have successfully completed the certificate IV. At the end of this competence, learners will be able to prepare the work area and equipment, and processing raw milk into ikivuguto and yogurt. Learners will work in dairy industry performing a range of tasks related to fermented milk with high degree of efficiency and effectiveness, under minimum supervision. Basic knowledge of Chemistry (groups of organic minerals, titrations), biochemistry (bio-molecules: basics in carbohydrates, lipids, proteins, vitamins and minerals)

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Introduction to fermented milk making

Fermented milk products prepared by lactic acid fermentation (e.g. yoghurt) or acombination of this and yeast fermentation (e.g. Kefir) are called fermented or cultured milks. Fermented milk is the collective name for products such as yoghurt, ymer, kefir, cultured buttermilk, (Scandinavian sour milk), cultured cream and koumiss (a product based on mares' milk).

The generic name of fermented milk is derived from the fact that the milk for the product is inoculated with a starter culture which converts part of the lactose to lactic acid. Dependent on the type of lactic acid bacteria used carbon dioxide, acetic acid, diacetyl, acetaldehyde and several other substances are formed in the conversion process, and these give the products their characteristic fresh taste and aroma.

Fermented milks are very old products. If raw milk is kept, it spoils by microbial action. At moderate temperatures, lactic acid bacteria generally are predominant, and the milk becomes ‘‘spontaneously’’ sour.

The fermented milk thus obtained has a longer keeping quality and, often, a pleasant flavor. It is also much safer to the consumer because pathogenic bacteria have been killed and contamination with pathogens afterward can almost never lead to growth of these organisms. Moreover, individuals suffering from lactase deficiency can tolerate the product quite well. The conversion of lactose into lactic acid has a preservative effect on milk. The low pH of cultured milk inhibits the growth of putrefactive bacteria and other detrimental organisms, thereby prolonging the shelf life of the product.

On the other hand, acidified milk is a very favourable environment for yeasts and moulds, which cause off-flavours, blown packages etc. if allowed to infect the products.

The digestive systems of some people lack the lactase enzyme. As a result, lactose is not broken down in the digestive process into simpler types of sugars. These people can consume only very small volumes of ordinary milk. They can, however, consume fermented milk, in which the lactose is already partly broken down by the bacterial enzymes

In the production of fermented milk, the best possible growth conditions must be created for the starter culture. These are achieved by heat treatment of the milk to destroy any competing microorganisms. In addition, the milk must be held at the optimum temperature for the relevant starter culture.

When the best possible flavour and aroma have been achieved, the cultured milk must be cooled quickly, to stop the fermentation process. If the fermentation time is too long or too short, the flavour will be impaired and the consistency wrong. In addition to flavour and aroma, correct appearance and consistency are important features. These are determined by the choice of pre-processing parameters.

Adequate heat treatment and homogenization of the milk, sometimes combined with methods to increase the MSNF content, as for milk intended for yoghurt, are essential “foundation stones” for the construction of the coagulum during the incubation period.

Some of the most important fermented milk products are described below.

The production techniques for other fermented products have many similarities; the pre-treatment of the milk, for example, is almost the same. The process descriptions for other products therefore concentrate primarily on the production stages which differ from those in yoghurt production.

Learning Unit 1 – Prepare work area, equipments, tools and utensils

LO 1.1 – Describe work area

The ceiling, walls, floor and all work surfaces of milk preparation area must be in a good state of repair and made so that they can be effectively cleaned.

- Topic 1: Work area description

✓ Floors of milk processing premises must be made of hard washable surface. Walls should be smooth and washable to about 2 meters from floor level and painted with light color.

✓ Doors should be self-shutting while windows should be rendered insect proof by mosquito netting to keep flies out.

✓ Rooms should be kept clean and in good repair.

✓ All product-contact surfaces should be kept clean immediately before use or as often as necessary, by cleaning techniques appropriate to the equipment and process.

✓ Equipment and utensils should be disinfected immediately before use, and whenever there has been possibility of accidental contamination.

✓ Equipment repairs and maintenance must be carried out after processing.

✓ Whenever machines have to be fixed during production runs, reasonable precautions should be taken to prevent contamination of dairy products.

- **Topic 2:** Processing flowchart of cleaning work area

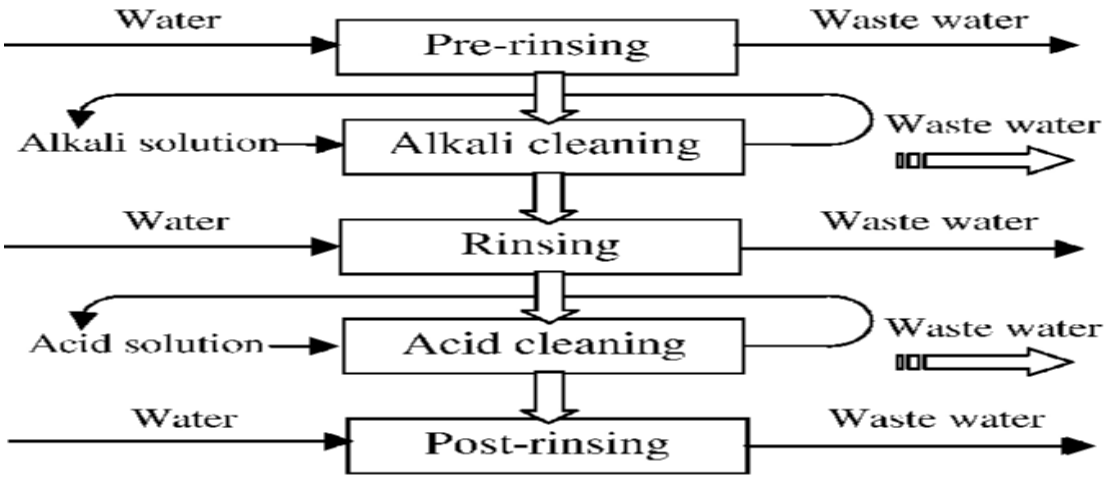


Fig1. Cleaning steps of the CIP process in dairy plants

A: **The basic steps of cleaning work area and equipments**

1. Rinsing with water to remove excess soil. Cold or lukewarm water (40-50° C) may be used, but hot water of up to 85◦C may be used for buffer nuking equipment.
2. Washing with a detergent must continue until the surface of the equipment is cleaned. This may be used in conjunction with physical scrubbing or ClP cleaning depending on the type of equipment.
3. A final rinse with cold potable water should be done until the surface of work area and/ equipment is cleaned.

B:Disinfection of dairy equipment may be carried out by means of:

- ✓ Steam - Steaming should be done for 10- l5 minutes after the condensate has attained 85°C.
- ✓ Hot water - Hot water at 80° C (use soft water only to prevent deposition of salts) for at least 20 minutes in circulation cleaning for 15 minutes at 85°C.
- ✓ Detergents/disinfectants - used as part of the cleaning operation at temperatures between 45-60°C in physical cleaning and for cold milk lines, storage tanks and tanker.

C: The cleaning cycle in a dairy work area comprises the following stages:

- ✓ Recovery of product residues by scraping, drainage and expulsion with water or compressed air
- ✓ Pre-rinsing with water to remove loose dirt
- ✓ Cleaning with detergent
- ✓ Rinsing with clean water
- ✓ Disinfection by heating or with chemical agents (optional); if this step is included, the cycle ends with a final rinse, if the water quality is good.
- ✓ Each stage requires a certain length of time to achieve an acceptable result.

- **Topic 3:** Localization of equipments

Equpments are localized according products processing line,this processing line can be help cleaning process,save the cleaning products and cleaning time etc.

Fig2**:Cleaning according to equipments and tools localization**

- Topic 4: critical points Identification

- ✓ Milk contact surfaces area must be appropriately cleaned and disinfected immediately after each milking.
- ✓ All equipment in work area must be kept clean and in good condition.
- ✓ Bulk tanks must be cleaned and disinfected after each milk collection and kept in good condition.
- ✓ Roof or loft floors should be made of dust proof sheet material and be easy to clean.

- ✓ All drainage of work area should discharge to a suitable drainage system.
- ✓ A suitable bin should be available for the disposal of used towels and other waste. This should be emptied and cleaned after each processing.
- ✓ Within a milk processing area all floors, walls, fittings and touch points should be cleaned thoroughly after every processing.
- ✓ The upper walls and ceiling of work area should be kept free from accumulations of dust and cobwebs. Any soiling of the milk processing equipment must be washed.

The interior surfaces of the tank must be cleaned each time the tank is emptied.

- Rinse with potable water.
- Clean with sanitizer solution.
- Rinse with potable water

The exterior of the storage tank should be kept clean.

LO 1.2 – clean work area

The work area environment influences employees' productivity, performance and well-being. Maintaining a clean work area may help keep staff members safe, milk as food healthy and efficient.

- Topic 1 : Cleaning products

Disinfectants

Fig3:**Disinfctants**

It is important to ensure that the correct cleaning products are used to ensure safety and hygiene in the work area.

For example:

- ✓ **Detergents:** These are used to remove food debris, grease and dirt. They cannot kill bacteria and microorganisms. Detergents are usually used to wash crockery and cutlery and are especially designed for use either by hand or in a dishwasher.
- ✓ **Disinfectants:** These are used to destroy the harmful bacteria which can remain on equipments even work area and cause food contamination and cross-contamination. Disinfectants include diluted bleaches and antibacterial solutions. Equipment and food contact surfaces must be disinfected between two different types of food preparation.
- ✓ **Sanitizers:** These contain both detergents and disinfectants and may be used in washing floors, shelves and walls.

Dirty equipment and machinery may contaminate milk products.

- ✓ Equipment used for handling milk and products should preferably be cleaned and disinfected after each period of use and at least daily.
- ✓ Equipment used in handling fat rich products such as butter and cheese should be cleaned as required, but in any case not less than once a week.
- ✓ Prevent damage by taking care when using equipment and machinery will make them last longer and not waste time or money repairing them.
- ✓ Have machinery ready for use will prevent delays and accidents if there is a hand-over to staff on the next shift.

The basic steps of cleaning work area and equipment are:

1. Rinsing with water to remove excess soil. Cold or lukewarm water (40-50° C) may be used, but hot water of up to 85◦C may be used for buffer nuking equipment.
2. Washing with a detergent must continue until the surface of the equipment is cleaned. This may be used in conjunction with physical scrubbing or ClP cleaning depending on the type of equipment.
3. A final rinse with cold potable water should be done until the surface is well clear.

- Topic 2 : cleaning products types

Main Types of Cleaning Agents

✓ **Water -** the simplest cleaner of all. Applied under pressure it cleans hard surfaces such as floors and walls. Water can also be used to rinse out dirt removed from a surface by other cleaning agents.

✓ **General purpose or neutral detergents** - these are able to penetrate moderately greasy and dirty surfaces. They are suitable for cleaning floors and walls.

✓ **Sanitizers** - these agents clean and disinfect surfaces. However, they do not replace the need for thorough washing with a detergent. Sanitizer wipes are available for wiping small areas and specialized equipment such as temperature probes. These should be discarded after use.

✓ **Hard surface cleaners** - these are used for heavier or more specialized tasks. Care should be taken as they are corrosive and may damage surfaces if used incorrectly.

✓ **Solvents** - dissolve heavy grease and oil which water based cleaners cannot dissolve.

✓ **Abrasive powders** - mostly used for cleaning enamel and ceramic surfaces like tiles, e.g. Ajax.

- Topic 3 :Handling cleaning products (Storage conditions, Safety precautions, shelflife)

- ✓ If any of the products used for cleaning at your workplace are capable of injuring people or damaging property, they are considered hazardous chemicals and must be stored safely.
- ✓ Cleaning products must be clearly labeled, and stored safely away from food service areas, this will help processor u understand his/her legal obligations when storing cleaning products at work.
- ✓ One of the most important aspects of storing cleaning products is making sure they are clearly labeled. It is so easy for cleaning products to be mixed up and confused with other items.
- ✓ Cleaning products usually arrive from your supplier in bulk containers.

These usually act as the permanent storage containers and must be clearly marked with:

- Name of the chemical
- Pictogram code
- Signal word
- Hazard Statement

When labeling portable containers you need to name the chemical (along with it's hazards) on the bottle or beaker. You also need to make sure:

- the label is legible and easy to read
- the label is permanent and cannot be defaced or washed off
- Safety Data Sheet (SDS) are still accessible
- Staff are trained to use the chemical and know the location of the SDS in the event of an emergency.

Some specifications of your storage space should include:

- Store in a clean, cool, dry space. Some cleaning chemicals can have hazardous reactions when they experience extreme temperature fluctuations or high levels of humidity.
- Store in well-ventilated areas. This helps prevent any fumes from spreading to other areas of the facility.
- Store no higher than eye level, and never on the top shelf of a storage area.
- Do not overcrowd shelves and include anti-roll lips to avoid falling containers.

- Never store cleaning chemicals on the floor, even temporarily.
- Oxidizers, flammable chemicals, and combustible chemicals should be stored away from ignition sources such as flames, heat, sunlight, work operations that might cause a spark, and in some cases, even static electricity.

Shelf life of some cleaning products:

- Window cleaner should be effective for about two years.
- All-purpose cleaners begin to lose their effectiveness after two years.
- Antibacterial cleaners have a shelf life of about one year, however if the product is diluted or exposed to extreme temperature, the shelf life will likely be shorter.
- Most metal polishes should be replaced after two years.
- Unopened laundry detergent will start to degrade at about nine months; if opened, shelf life is only about six months.
- Lysol cleaning products tend to remain effective for about two years.
- Spray air fresheners lose effectiveness after about about two years.

Product group	*Shelf life in container that has been opened*
Alcohol-based hand disinfectants	12 months (shelf life can vary when used in dispenser, see "Shelf life when using hand/skin products in wall dispensers")
Alcohol-based skin disinfectants	12 months
Skin-/hand-cleaning products Exception: Stellisept med gloves	12 months 1 week
Skin-/hand-care products	12 months
Instrument disinfectants	12 months
Surface disinfectants Exception: Bacillol Wipes Bacillol Tissues Bacillol AF Tissues Bacillol 30 Tissues Mikrobac Tissues Mikrobac Virucidal Tissues Kohrsolin extra Tissues Kohrsolin FF Tissues	12 months 4 weeks 3 months 3 months 3 months 3 months When used daily, use for a maximum of four weeks. Once opened, the package must be discarded if not used for more than one week. 3 months 3 months
Surface cleaner	2 months

Source: BODE chimie GmbH, a company of the HARTMANN GROUP

It is the user's responsibility to label products concerning their shelf life after opening.

- Topic4 : Effectiveness of the cleaning products

Effective cleaning requires a correctly designed and installed milking system, adequate volumes of water at an appropriate temperature, with cleaning chemicals added at the correct rate. It is also critical that a regular, monitored routine is followed by everyone involved in the plant-cleaning operation.

While effective plant sanitisation is an essential component of a Bactoscan control programme, effective cleaning is also essential to control levels of thermoduric bacteria. Thermodurics are heat-resistant bacteria that can survive the pasteurisation process and cause serious problems for milk processors, especially in the cheese-making process. Many milk processors now monitor thermoduric levels in milk routinely, and it seems likely that this will soon form part of some milk-supply contracts.

The vast majority of milking systems are sanitised after milking using a method described as circulation cleaning. This form of cleaning comprises three distinct phases:

- **Pre-rinse** – to remove milky residues.
- **Circulation** – to remove fats, proteins and minerals.
- **Final rinse** – to remove chemicals from the plant to prevent contamination of milk; certain disinfectants can be added to the final rinse.

- Topic5 : Cleaning methods/techniques

Cleaning Methods There are many different cleaning options available to manufacturers depending on the contaminant to be removed and the level of cleanliness required. Cleaning method choice should consider both ability to remove the contaminant and the cost effectiveness of the method.

A. Dry cleaning is one of the easiest methods to reduce cleaning requirements.

✓ when using dry cleaning techniques, remove as much product from plant and equipment as possible. In some cases product can also be recovered and returned for processing or sold as a by-product, for example, sawdust for compost

- ✓ use drip/catch trays or lips on equipment and benches to help reduce the amount of material landing on the floor or into drains
- ✓ use scrapers, brushes and vacuum devices to pre-clean containers, equipment and conveyors prior to washing. Scrubber and vacuum cleaners can wet or dry clean floors and remove gross soiling before washing with water.
- ✓ These cleaners are fast and efficient and reduce chemical use, but may be unsuitable for small areas, or areas with restricted access.

B. High-pressure cleaning systems

- ✓ High-pressure cleaners are a water efficient option for floor and equipment washdown. Cleaning with high-pressure water can use up to 60 per cent less water, compared with using mains hoses.
- ✓ Mobile high-pressure cleaners have flow rates ranging from 4 L/min to 20 L/min with pressures of up to 500 kPa. To reduce the time required to set up mobile pressure washers, it is worth considering installing a ring main system.
- ✓ It is important that high-pressure cleaners complement cleaning procedures and should not replace dry cleaning. The use of high-pressure cleaning systems may not be suitable for some areas of the plant as aerosols from spray and splash can cause the deposition of microorganisms from the floor to settle back onto equipment and product.

C. Clean in Place

- ✓ A clean-in-place (CIP) system automatically delivers a standard number of wash and rinse cycles to the internal surfaces of a closed system. CIP systems can allow equipment, tanks and pipes to be cleaned without being disassembled, saving labour and eliminating human contact with chemicals.
- ✓ A CIP system usually consists of several chemical and rinse water-holding tanks, associated pumps and piping to allow the recirculation of rinse water and cleaning chemicals.
- ✓ Full recovery systems can recover up to 99 per cent of the cleaning solution.

The effectiveness of CIP systems can be improved by:

- ✓ maintaining and calibrating in-line monitoring instrumentation

- ✓ reviewing cleaning cycle lengths to ensure they have not become excessive
- ✓ assessing chemicals, blends and concentrations to ensure that they achieve effective cleaning, but are safe for the operator, and environment
- ✓ checking for excessively high or low temperatures
- ✓ checking for opportunities to recover more rinse water and spent solution
- ✓ training operators and adequately supervising to improve efficiency and safety
- ✓ regularly monitoring equipment and repairing promptly.

Once any changes have been made, the system must be validated to ensure safety of the product.

There are many different cleaning options available to manufacturers depending on the contaminant to be removed and the level of cleanliness required.Cleaning method choice should consider both ability to remove the contaminant and the cost effectiveness of the method.

The following table provides a comparison of some different cleaning methods.

Cleaning method	Description and Application	Advantages	Disadvantages
Caustic cleaners	Traditional cleaner containing sodium. Used as a general cleaner and removes organic components such as	Cheap, widespread.	Contributes to high total dissolved solids (TDS) (e.g. sodium) levels in wastewater stream. Difficult

	proteins and fats.		to remove from wastewater streams without energy intensive membrane treatment.
Potassium cleaners	Replaces sodium of the caustic cleaners with potassium, Same applications as caustic cleaners.	Irrigation with wastewater streams containing low levels of potassium can provide nutrient benefits to plants.	High levels in wastewater streams can have detrimental impact on soil structure and function if used for irrigation. Costs more

			than sodium based cleaning products.
Steam	Water is turned into steam at high pressure and temperature. Applications include removal of fats, oils and microorganisms and dislodging soiling.	High pressure steam dissolves fats and oils, and kills microbes. Dry steam cleaning can clean sensitive areas in processing plants. Dry steam is very water efficient with only 5-6% moisture.	High pressure can spread airborne bacteria if not properly controlled.

Electrolysed water	Generated from brine solution using electrolysis. Produces an alkaline solution – pH 11-13; and acidic solution – oxidising agent. Applications include killing bacteria, viruses, protozoa, algae, fungi and spores.	More effective than sodium hypochlorite at similar concentrations. Does not require rinsing. No hazardous chemicals required.	Increases total dissolved solids levels in wastewater stream compared with cleaning system such as ozone. System requires backwashing to remove calcium build up on membranes.
Ozone	Ozone is generated and oxidises	Oxidation gives antimicrobial	Needs to be generated on site

	when it comes into contact with the object to be cleaned. Effective on a broad spectrum of microorganisms including bacteria, fungi, viruses, protozoa, bacterial and fungal spores.	properties. Degrades to oxygen at room temperature in both air and water. Can be used in wastewater treatment system to reduce Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD).	immediately prior to use. Can degrade rubber in high concentrations. Higher capital and maintenance costs compared with chemical methods but operating costs are only electricity. Can be expensive operating costs due to the

			amount of energy required. Does not provide residual sanitisation.
Thermal cleaning	Heating the object to temperatures which remove organic material through oxidation. Removal of organic material.	Can clean large quantities of parts simultaneously. Cleaning results are consistent. Cost of cleaning relatively low. Removed multiple contaminants – e.g. oil, grease, paint, gaskets	Flash rusting may occur on cleaned parts from moisture present in the air. Subsequent treatment is required to remove ash and/or rust from part surfaces.

		and rubber. Reduction in amount of waste to be disposed of. Not labour intensive.	Unacceptable softening of substrates may occur, particularly aluminium.
Aqueous cleaners	Water is primary solvent with detergents, surfactants, pH buffers, emulsifiers etc as required. Acidic aqueous solutions remove: scale, rust and oxides	Alkaline aqueous cleaners used at a broad range of temperatures. Can be used in pressure spray washing, ultrasonic and immersion	Acidic aqueous cleaners can attack metal objects. Wastewater and sludge generated.

	from metals. Alkaline aqueous solutions remove: salts, organic soils, oxides, metal chips, grease.		
Semiaqueous cleaners	Made of natural or synthetic organic solvents, surfactants or corrosion inhibitors and other additives. Removes waxes, heavy greases, tar and baked-on	Often used with immersion or ultrasonic systems. Water soluble or insoluble.	Can contain VOCs. Concerns of aquatic toxicity, human health effects and flammability. May alter wastewater discharge

	organic materials . Reduced volatile organic compoun ds (VOCs) emissions .		requirem ents.

Source: www.coldjet.com.au/dry_ice_faqs.html

LO 1.3 : Prepare the machines

Topic 1: Identifying the machines

Requirements to process equipment, machinery, tools, ware and tare.

Technological equipment, machinery, ware, tare, tools, film and articles made of plastic and other synthetic materials designed for packaging of milk and milk products shall be made from materials permitted by the bodies of the State Sanitary and Epidemiological Supervision for food contact.

Tanks, metal ware, chutes, conduits, gutters, etc., shall have smooth, easy to clean interior surfaces, without cracks, gaps, protruding screws 25 or rivets, which hamper their cleaning. Using wood and other materials that are badly washed and disinfected shall be avoided.

Working surfaces (coatings) of the tables used for food processing shall be smooth, without cracks and gaps, made of stainless metal or polymeric materials permitted by bodies of the State Sanitary and Epidemiological Supervision for food contact.

Technological equipment and machinery shall be painted from the outside with light tone paint (except for the equipment made of or lined with stainless material) that does not contain harmful impurities. Painting of ware and tools with paints containing lead, cadmium, chromium is not allowed.

Layout of technological equipment shall be made in accordance with the technological scheme, ensure a continuous performance of the technological process, short and

direct layout of milk lines, eliminate counter flows of raw materials and finished products.

When laying out the equipment the conditions shall be observed which ensure free access to workers operating it to it; sanitary control of production processes, quality of raw materials, intermediate and finished products, as well as a possibility to wash, clean and disinfect the premises and equipment .

Machinery, equipment, and the milk pipes shall be mounted in such a manner that a complete discharge of milk, detergent and disinfectant solutions is arranged. All the parts which contact with milk and milk products shall be accessible for cleaning, washing and disinfection. Metal milk pipes shall be dismountable. Glass thermometers without a protective case must not be used.

Tanks for the manufacture and storage of milk, cream, sour cream and other milk products (except those used to produce cottage cheese and cheese) shall be equipped with tight-fitting lids.

Machines, tanks and other equipment that are used to manufacture milk products shall be connected to the sewerage system with a jet rupture through the siphoned cones (see Section 7 hereof). The direct connection of the equipment with the sewerage system and discharge of water from them onto the floor are not allowed.

Internal factory transport and intrashop tare shall be assigned to certain types of raw materials and finished products and marked accordingly.

- Topic 2: Cleaning products for machines

Effective cleaning of milking equipment begins with analysis of the water supply for mineral content or hardness and choosing a cleaning compound that is compatible with the water.

When the water hardness exceeds 10 grains per gallon, it may be necessary to increase detergent concentration. In very hard water (30 grains per gallon or more), a water softener should be used.

The bicarbonates, sulfates, and chlorides of calcium or magnesium present in hard water can neutralize detergents, decrease rinsability, create films on machines and cause problems with water heaters.

The compatible cleaners would then be used according to manufacturer's directions in relation to amount and concentration of cleaner, temperature of the cleaning solution, and contact time of the cleaning solution and the surface to be cleaned.

Measure the correct amount of water to be used in the cleaning cycle.

Usually an alkaline or chlorinated cleaner (alkaline cleaner with added chlorine) followed by an acid cleaner is used. Alkaline cleaners usually contain basic alkalies, phosphates, wetting agents, and chelating agents.

They dissolve milk fats, proteins, and carbohydrates and loosen and suspend other soil particles so that they can be removed by mechanical action, i.e., by brushing or by circulation cleaning.

The chlorine aids the removal of protein deposits and prevents the formation of film.

They are not sanitizing agents! Acid cleaners remove or prevent accumulated mineral deposits or milkstone buildup.

Rinse the pipeline with an acid rinse (e.g., 1 oz acid per 5 gallons of water) immediately after the detergent solution is rinsed from the system.

Bulk tanks can be rinsed with acidified water after the detergent solution is rinsed off by installing a spray unit to the water line that automatically adds the proper concentration of milkstone remover.

Cleaning Procedures

- ✓ Equipment and bulk tank cleaning procedures should be posted on the milk-house wall and rigidly followed.
- ✓ The precise course of action, compounds used, and water temperatures will vary. In general, equipment should be rinsed with lukewarm (100° to 110°F) water immediately after milking to prevent drying of milk solids on surfaces.
- ✓ Water that is too hot can cause denaturation of proteins and a protein film on surfaces, while water that is too cold can cause fat crystallization and the formation of a greasy film on surfaces.
- ✓ Washing and rinsing should follow. Wash water should remain above 120°F.
- ✓ Start with water at 170°F.

- ✓ In clean-in-place (CIP) systems, velocity and air in the system are also essential. A minimum velocity of 5 ft/sec is necessary to ensure effective cleaning action.
- ✓ Introducing air into the system provides slugging or turbulence and increases scouring action. The wash cycle should take 6 to 10 minutes.
- ✓ With longer times, the water becomes too cold. The concentration depends upon water hardness and iron content.
- ✓ **Acid rinse**:Rinse the line with acidified water (pH 3.0 to 4.0) to remove all traces of cleaning solution (2 to 3 minutes minimum contact time). This should be done after every milking. It helps prevent mineral deposits, and the lower pH is bacteriostatic.
- ✓ All equipment and utensils should be stored in a manner that permits water to drain and equipment to air dry. In CIP systems, a drain should be located at the lowest point in the system.
- ✓ Teat cup liners and other rubber parts that come into contact with milk must also be thoroughly cleaned after each milking and sanitized before the next milking.
- ✓ Liners and other rubber parts should be replaced when they have been used for the recommended number of milkings (e.g., 1,200) or when they become soft, cracked, or rough or when they have holes. Pores and cracks in rubber parts protect soil and microorganisms from the effects of cleaning and sanitizing.

Bulk Milk Tanks

- ✓ Bulk tanks also must be properly cleaned and sanitized, or psychrophilic bacteria (microorganisms capable of rapid growth at temperatures of 35° to 50°F) multiply rapidly.
- ✓ Tanks are cleaned by using essentially the same procedures as recommended for milking equipment. The milk hauler is normally responsible for rinsing the tank immediately after the milk is removed. Rinse water temperature should be 90° to 120°F.
- ✓ Following this, the tank must be washed, rinsed, and sanitized. Allow the mechanical cleaning device to operate until clean (6 to 10 min)

- ✓ Cleaning solution temperature should remain above 120°F during the wash cycle, and that means starting with hot water (170°F).
- ✓ Rinse the tank completely with tepid water, finishing the rinse with acidified water as it neutralizes and removes detergent residues and removes inorganic soils.
- ✓ Tank covers and gaskets should be disassembled and the calibration rod removed for manual cleaning. The outlet connection and outlet valve must be cleaned manually.
- ✓ The tank exterior should be washed.
- ✓ Sanitizing should occur just before the next milking. Allow the sanitizer to drain from the outlet to prevent sanitizer residues in milk.
- ✓ Tanks may be cleaned manually or with CIP or mechanical systems.

- Topic 3: Cleaning techniques (CIP (cleaning-in-place, COP (Cleaning-out of-place)

CIP Equipment

The development of automatic CIP milking and bulk tank systems has been a great time-saver for dairy farmers. However, these systems must be properly maintained. Many problems will occur if these systems are not checked regularly, at least twice a year.

Improper or careless cleaning and sanitizing of equipment and tanks is a major cause of inferior milk quality. It need not be if cleaning water and cleaning compounds are compatible and a precise procedure is formulated and followed.

Steps of CIP

1. Rinsing with warm water for about 10 minutes.
2. Circulation of an alkaline detergent solution (0.5 – 1.5%) for about 30 minutes at 75°C.
3. Rinsing out alkaline detergent with warm water for about 5 minutes.
4. Circulation of (nitric) acid solution (0.5 – 1.0 %) for about 20 minutes at 70°C.
5. Post-rinsing with cold water.
6. Gradual cooling with cold water for about 8 minutes

- Topic4: Calibration (pH-meters)

The pH meter is an electrical oe/and digital device that determines the acidity or basicity of milk. To use a pH meter, the pH electrode is first calibrated with standard buffer solutions with known pH values that span the range being measured.

Calibration is an important step in ensuring accurate. results we recommend calibrating before each use to calibrate your Ph- meter press and hold the button for 3 seconds until Cal appears on the screen rinse according types of pH -meter. The electrode in deionized water and place the tester in your pH 7.01 buffer and wait for stable.

To make a pH measurement, the electrode is immersed into the milk sample until a steady reading is reached. The electrode is then rinsed after each sample and stored in a storage solution after all the measurements have been completed.

The measurement of pH in milk is important in testing for impurities, spoilage, and signs of mastitis infection. While there are a number of factors that affect the composition of milk, pH measurements can help producers understand what might be causing certain compositional changes.

Procedure of pH-meter calibration

- ✓ Standard Buffers 4,7,10
- ✓ Rinse small beaker with buffer or distled water
- ✓ Pour 40 ml of buffer in beaker
- ✓ Each individual Ph meter has its own set of step by step calibration instructions
- ✓ Discard after calibration,never pour used buffer back into original bottle

N.B: DO's

- ✓ Do strore electrode in electrode storage solution
- ✓ Do calibrate pH meter daily
- ✓ Do keep electrode moist

DON'Ts

- ✓ Do not strore electrode in distlled water
- ✓ Do not leave exposed to air

✓ Do not wipe electrode but blot with lint free tissue

- Topic5: Adjustment of machines

Adjustment and Calibration are two similar processes that are often confused and wrongly used interchangeably. **Calibration** is the process of comparing measurements taken by a test instrument against those taken by a standard device (with known accuracy). It plays an important role in quality assurance and compliance for many **industries**, but it is especially important for **companies** in the **food**, beverage and pharma sectors

Adjustment is defined as the operation of bringing a measuring instrument into a state of performance suitable for its use. This is not calibration.

Learning Unit 2 – Prepare raw milk

LO 2.1 – Control milk quality

Milk quality control is the use of approved tests to ensure the application of approved practices, standards and regulations concerning the milk and milk products. The tests are designed to ensure that milk products meet accepted standards for chemical composition and purity as well as levels of different micro-organisms.

- Topic 1: Milk acidity

Allowed milk acidity in term of pH should be 6.4–6.8. Lower values generally mean an acidification process due to bacterial growth, while higher values can indicate the presence of mastitis.

Allowed milk acidity in term of Titratable acidity should be in ranges from 0.10 to 0.20% and this ranges indicate concentration of lactic acid in milk. Any value in excess of 0.20 % can safely be reckoned as developed lactic acid. Due to the opacity of milk, the end-point of titration is not sharp, so care has to be taken to adjust the conditions to reach the same end-point.

Chemical used: Phenolphthalein indicator solution & sodium hydroxide solution.

Percentage of Lactic acid is calculated by this formula: ***Lactic - acid (%) = (A*0.OO9*100)/V***

Where A=ml of 0.1NaOH required for titration,

V=ml of milk sample taken for the test

Procedures used to control milk in terms of titratable acidity and pH.

Apparatus:

- ✓ A porcelain dish or small conical flask
- ✓ 10 ml pipette, graduated
- ✓ 1 ml pipette
- ✓ A Burette, 0.1 ml graduations
- ✓ A glass rod for stirring the milk in the dish
- ✓ A Phenophtalein indicator solution, 0.5%in 50% Alcohol
- ✓ Sodium hydroxide solution.

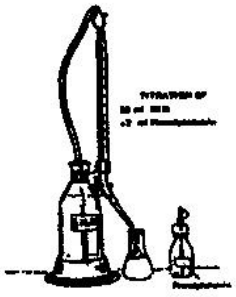


Fig4:**Acidity tester apparatus**

Procedure:

- ✓ 9 ml of the milk measured into the porcelain dish/conical flask,1 ml Phenopthalein is added and then slowly from the burret, 0.1 N Sodium hydroxide under continuous mixing, until a faint pink colour appears.
- ✓ The number of mls of Sodium hydroxide solution divided by 10 expresses the percentage of lactic acid.

- Topic 2 :Milk composition

Milk is a white opaque liquid produced /secreted by the mammary glands of mammals for feeding infants and used for processing others dairy products for human consumption . Milk contains proteins, carbohydrates, fat, vitamins, minerals and water as mains milk compositions.

- ✓ An important milk protein is casein about 80% and whey protein or serum about 20%.

✓ Milk fat is present in the form of small fat globules which are lighter than the other constituents of milk. When cow milk is allowed to stand, these globules gather on top of milk and form a layer of cream.

✓ Milk sugar gives milk its sweet taste. The lactose ferments by the influence of microorganism (sour milk).lactose is complex carbohydrate composed by fructose and galactose

✓ Milk is also a valuable source of vitamins: A; B1; B2; B3; B9; B12; D; E; vitamin C is little in milk.

✓ The composition of milk is not consistent and shows a wide variation. In the first place, the composition depends on the species of the cow.

✓ In the species, there is a significant difference between the breeds and individual animals within a breed

✓ The composition might even change from day to day, depending on feeding and climate changes etc. Also, during milking the first milk differs from the last milk drops. Below are average figures of the composition of milk from cows, sheep and goats.

Figure 1: Nutritional Value of Milk

	Cow's milk (%)	Goats milk (%)	Sheep milk (%)
Water	87.2	85.8	81.6
Total Solids	12.8	14.2	18.4
Fat	4.0	4.9	6.5
Protein	3.4	4.3	6.7
Lactose	4.5	4.1	4.3
Ash (minerals)	0.9	0.9	0.9

Source: IDF Doc. No.9002

- Topic3: Milk control by Microbial state

Microorganisms are living organisms that are individually too small to see with the naked eye. Microorganisms are found everywhere and are essential to many of our planets life processes. With regards to the dairy industry, they can cause spoilage, prevent spoilage through fermentation, or can be the cause of human illness.

Microbial Standards for Raw milk

✓ Total bacteria is 30,000 CFU/ml

✓ Somatic cell count should Not exceed 750, 000 CFU/ml

The total bacteria count is the number of bacteria in a sample that can grow and form countable colonies on *Standard Methods Agar* after being held at 32°C (90°F) for 48 hours.

The coliform count is the number of colonies in a sample that grow and form distinctive countable colonies on *Violet Red Bile Agar* after being held at 32°C (90°F) for 24 hours. Coliforms are generally only present in food that have been fecally or environmentally contaminated.

Somatic cells are blood cells that fight infection and occur naturally in milk. The presence of mastitis (an infection of the mammary gland) in the cow will increase the somatic cell count. The somatic cell count can be determined by direct microscopic examination or by electronic instruments designed to count somatic cells.

- Topic4: Milk control by Physical state

It is a white opaque fluid in color in which fat is present as an emulsion, protein and some mineral matters in colloidal suspension and lactose together with some minerals and soluble proteins in true solution. The opacity of milk is due to its content of suspended particles of fat, proteins and certain minerals. The color varies from white to yellow depending on the carotene content of the fat. Milk has a pleasant, slightly sweet taste, and pleasant odor. It is an excellent source of calcium, phosphates and riboflavin. If during the organoleptic inspection the milk appears to be too thin and watery and its color is “blue thin”, it is suspected that the milk contains added water.

The following procedure is used to control physical state of milk:

✓ Open a can of milk

✓ Look at the can lid and can

✓ Immediately smell the milk

✓ Observe the appearance of the milk

✓ Taste the milk without swallow it ,if there is not a clear judgment

✓ Accept the milk if color, flavor, taste are normal according standards of normal milk

✓ Reject the milk if the organoleptic test is positive

Factors affecting physical state of milk:

✓ The feed consumed by animals may lead to some undesirable flavors and taste.

✓ Bacterial growth in milk causes fruity, barny, malty or acid flavors and an unclean taste or bitter taste.

✓ Enzyme activities also may lead to unnatural flavors, rancidity due to lipase action being a classic example.

✓ Oxidative reactions may cause a cardboard flavor in milk.

✓ Cooked flavor occurs during milk processing.

✓ Seasonal changes with milk flavors.

✓ Cleanliness or equipments use and maintenance cause milk flavors.

✓ Exposure to metals such as various light sources during storage affect milk taste and color.

✓ Farm environment contribute to the taste of milk leaving the udder.

✓ Seasonal changes with milk compositions, these changes can be reflected in the taste and color of the milk.

✓ Temperature and transportation way change milk taste.

✓ Cleanliness or equipments use and maintenance cause milk taste.

✓ Breed, stage of lactation, milking time, udder health status, pasture grazing and seasonal calving. Etc.

LO 2.2 –2.2: Milk grading (for processing)

- Topic 1: Grading by microbial state

✓ Raw milk as it leaves the udder of healthy cows normally contains very low numbers of microorganisms and generally will contain less than 1,000 total bacteria per ml.Acceptable range of bacteria in raw milk content:Total bacteria is 30,000/mL more than this number can not accepted for processing milkSomatic cell count should Not exceed 750, 000/mL more than this number can not accepted for processing milk

- Topic 2: Grading by fat content

Categories of milk based on fat content:

- ✓ Low fat milk
- ✓ Fat free milk
- ✓ High fat milk

Example of terms for mik fat content by some country

Fat content by weight	**American Terminology**
100%	Clarified butter or Ghee
69%	Butter
45%	Manufacturer's cream
36%	Heavy whipping cream
30%	Whipping cream or light whipping cream
25%	Medium cream
18–30%	Light cream, coffee cream, or table cream
10.5–18%	Half and half
3.25%	Whole milk or regular milk
2%	2% milk or reduced fat milk
1%	1% milk or low fat milk
0–0.5%	Skim milk or nonfat milk

Autralia

While regular or whole milk has an average of 3.5% fat, reduced-fat milks have at least 25% less fat than regular milk. Low-fat milk must contain less than 1.5% fat and skim or 'fat-free' milk has no more than 0.15% fat

Canada

Fat content by weight	**Canadian terminology**

3.25%	3.25% milk orWhole milk or Homogenized milk or Homo milk
2%	2% milk
1%	1% milk
0-0.1%	Skim milk
UK	
5%	Channel Island milk or breakfast milk
4%	Whole milk or full fat milk
2%	Semi-skimmed milk or 2% milk
1%	1% milk
Less than 0.3%	Skimmed milk

- Topic3: Grading by density

✓ If during the organoleptic inspection the milk appears to be too thin and watery and its color is “blue thin”.

✓ it is suspected that the milk contains added water.

✓ The lactometer test serves as a quick method to determine adulteration of milk by adding or removing water and other substances.

✓ Farmers, milk traders, transporters and milk shoppers often add water and other substances to milk, to increase their profits.

✓ Raw milk has a density (specific gravity) of 1.028 to 1.032 grams per ml. Addition of water or other substances changes the density of raw milk.

✓ Addition of water reduces the density, while addition of solids increases the density considerably.If density is outside the normal range, it means the milk has been adulterated.

✓ At 15 ºC the normal density of the milk ranges from 1.028 to 1.032 g/ml, whereas water has a density of 1.0 g/ml.

✓ So when the lactometer reads a value closer to 1.0, probably water has been added to the milk.

✓ If possible the lactometer reading can be combined with the fat test.

✓ The density of fat is lower than that of milk.

✓ So in case the results of the fat test are low and the found density is still high (e.g. 1.035), then the milk might have been skimmed.

✓ If the results of the fat test are low and the density is low (e.g. 1.025), then water might have been added to the milk.Always read the temperature of the milk first; the lactometer reading varies according to temperature.

Procedure:

✓ Mix the milk sample gently and pour it gently into a measuring cylinder (300-500). Let the Lactometer sink slowly into the milk.

✓ Read and record the last Lactometer degree (ºL) just above the surface of the milk. If the temperature of the milk is different from the calibration temperature (Calibration temperature may be=20^0C) of the lactometer, calculate the temperature correction.

Fig5: **Grading by density**

Example if the lactometer reading was 28 and the temperature was at 77°F at the time

Given data:

Lactometer reading(LR):28

Temperature:77^{o}F

Formular: SG or Density=$\frac{\boldsymbol{Corrected\ RL\ at\ 60\ ^\circ F}}{\mathbf{1000}} + \mathbf{1}$

Solution: Different= **77°F - 60°F = 17°F**

Conversion of the temperature difference :**17 x 0.1 = 1.7** Lactometer units

Correcting the lactometer reading: we have to add or subtract the lactometer units obtained from the reading (if the temperature was above, add; if the temperature was below, subtract): **28 + 1.7 = 29.7**

The density would then be: $\frac{29.7}{1000} + 1 = 1.029$

Conclusion :milk is accepted

N.B: To convert Celcius degrees into Fahrenheit, use the following formular:

°F = °C x 9/5 + 32

°C = (°F - 32) x 5/9

LO 2.3 – Cool the milk

Cooling milk immediately after milking keeps bacteria from multiplying rapidly. Holding milk at temperatures below 40°F (4°C) and above freezing maintains its excellent quality until it is processed for fluid milk or manufactured into dairy products.

- Topic 1 : Cooling system

Cooling systems are used to cool the milk by releasing the heat outside. Most cooling systems include a refrigeration compressor, a condenser unit (air-cooled), and a refrigerated bulk tank. Add-ons are often used to reduce the milk's temperature before it reaches the refrigeration tank.

Cooling to 10 °C within two hours of milking and to 4 °C within three to four hours is essential, but more rapid cooling is much preferred. In many temperate and tropical countries, refrigerated cooling systems may not be available at the producer. The methods for cooling to 10 °C and below are governed by local circumstances and simple smallscale methods can be employed the following:

a) Evaporative cooling using a charcoal cooler.

Evaporative cooling is of very limited use other than for small-scale and domestic applications. In this system, the heat from the milk is used to evaporate water contained in a charcoal structure, thus removing heat from the milk and eventually cooling it.

In very small-scale operations, evaporative cooling can reduce the temperature of warm milk, but this system has limitations because it depends on the difference between the wet- and dry-bulb temperatures of the surrounding air. As the relative humidity of the

air increases, the performance of an evaporative cooling system will decrease, limit ng its use in moist climates with high humidity. Evaporative cooling is most effective in climates where the relative humidity is less than 30 percent.

Source: Sonnet Malakaran George and Tek .B. Thapa, 2015.

Fig6: **charcoal cooler**

b) Cooling with natural water systems – mains, well or groundwater

Immersion cooling methods include placing the milk cans in a stream, river, lake or tank. This method is most effective when the water temperature is 10 °C or below. Cooling milk to below 10 °C slows bacterial growth.

Diverting the water source to a cooling tank in which milk cans are placed is another common method. When available, ice can be added to the water tank to facilitate the cooling, but ice should never be added directly to warm fresh milk to cool it. To

avoid any heating effect from the surrounding air, cooling tanks should be insulated.

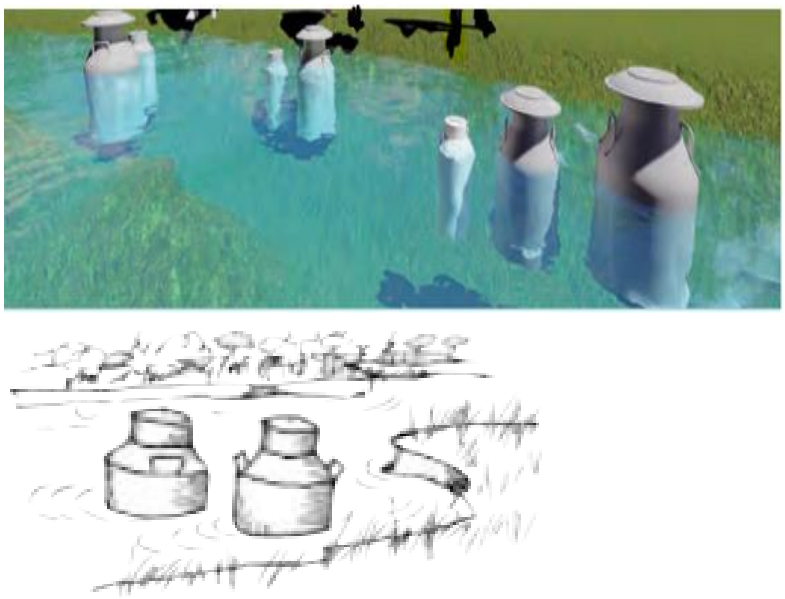


Fig7: **groundwater cooler**

c) **Surface milk coolers (open cooling systems):**

An open cooling system is based on surface coolers that use pressurized water from the mains or pumped from a natural source. Surface coolers can be constructed from horizontal stainless steel pipes attached to a vertical metal plate; the cooling water is passed through the pipes. Warm milk is fed on to the vertical plate from a small tank mounted at the top of the unit.

The milk cools as it passes over the plate and is collected into milk cans As they are open to the air, surface coolers are subject to contamination from dust and insects, and considerable care has to be exercised to ensure correct cleaning and sanitation.

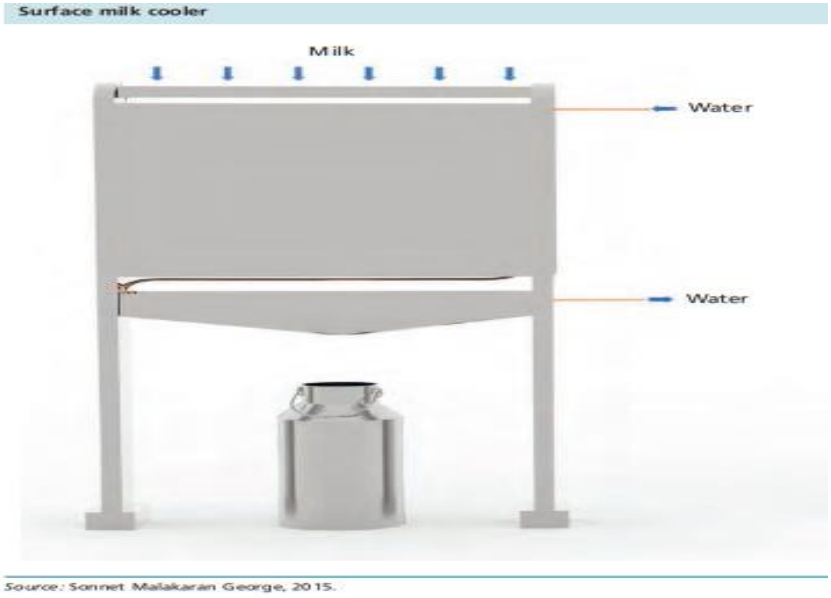


Fig 8: **Surface milk coolers**

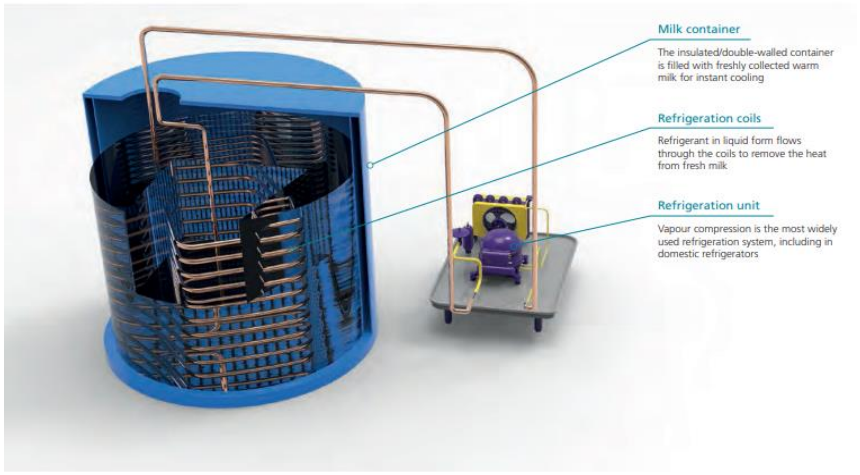
d) Refrigerated immersion cooler or cooling rings

Immersion cooling rings also use pressurized water from the mains or pumped from a natural source and can be used to cool milk in cans. In this system, a perforated tubular ring is placed over the neck of the milk can and cold (or iced) water is passed through the ring to run down the exterior of the can and cool its contents.

A small-scale refrigeration system can be used for immersion cooling where a single-phase power supply is available. The refrigeration system is attached to a cooling head, which is inserted into a can of warm milk or a specially designed insulated stainless steel container with capacity of 25–125 litres.

A refrigerant is passed through the immersion coil to reduce the milk temperature. The system often includes a trolley to allow easy transportation of the milk tank. Such systems may be of use in very small MCCs or privately owned milk cooling stations or milk shops.

Immersion cooler with refrigeration unit and insulated cooling and storage container



Source: Sonnet Malakaran George and Tek B. Thapa, 2015.

Fig10: **Cooling methods:**

1. keep the milk in the shade not in the sun
2. keep the milk in a well-ventilated place
3. use cold water to cool the milk (You can for example put the milk in a water bath, or in a stream)
4. use ice to cool the milk
5. use the following cooling equipment:

conventional refrigerator for small amounts of milkevaporative charcoal lined coolersurface coolersa bulk (direct expansion) milk cooling tank an in-can rotary cooler.

- Topic 2: cooling condition

Raw milk must be cooled within 4 h to 10°C or less from the start of milking, and then to 7°C or less within 2 h after the completion of milking. In addition, subsequent milk collections added to previously collected milk must not raise the temperature of the blended bulk milk above 10°C.

The batch of raw milk was split in 2 portions, and a plate heat exchanger was used to quickly cool one portion to <6°C within 1 min. The second portion was stored in a jacketed bulk tank and slowly cooled over 4 h to <10°C.

Learning Unit 3 – Make Ikivuguto

Fig11:**Full fermented kivuguto**

Traditional methods of fermenting milk involve the use of indigenous microorganisms, leading to the production of a variety of tastes in fermented milk products. Kivuguto is a fermented milk product, which is popular in Rwanda.

Kivuguto is produced by traditional spontaneous acidification of raw milk by a microflora present both on utensils and containers used for milk preservation and in the near environment of cattle. Thus, this method does not allow the shelf stability of the product. Faced to such a situation, modern dairies now produce fermented milk and other dairy products using exotic strains.

LO 2.1 – Pasteurize raw milk

Purpose:

- ✓ **Public Health Aspect** - to make milk and milk products safe for human consumption by destroying all bacteria that may be harmful to health (pathogens)
- ✓ **Keeping Quality Aspect** - to improve the keeping quality of milk and milk products. Pasteurization can destroy some undesirable enzymes and many spoilage bacteria.

- Topic 1: Pasteurization conditions for Ikivuguto(time and temperature)

A heat treatment of the milk base of most types of fermented milks after the homogenization is usually applied to remove any microbial contaminants acquired from the homogenizer, but an alternative method is to homogenize the milk base aseptically after the heat treatment stage, which is the recommended method during the manufacture of buttermilk.

Milk is heated to 85– 90ºC for 20-30 mins to inactivate and or kill both pathogenic and spoilage microorganisms

- Topic 2 : Homogenization (pressure and time)

Homogenization: is a mechanical treatment of the fat globules in milk which is achieved by passing milk under high pressure 10 MPa or/and 150 bars (optional)through a tiny orifice, which results in a decrease in the average diameter and an increase in number and surface area, of the fat globules. Homogenization serves to prevent the formation of a cream layer in the package during storage. Many users dislike such a layer. Therefore, the pasteurized milk is usually homogenized. As a rule, not all of the milk is homogenized but only its cream fraction (partial homogenization), to reduce cost. Homogenization clusters should be absent after the homogenization; therefore, the fat content of the cream should be rather low (10% to 12%) and the homogenizer temperature not too low (55°C). Usually the homogenization precedes the pasteurization, to minimize the risk of recontamination. Because milk lipase is still present, the milk should immediately be pasteurized.

Homogenization condition:

Pressure 150-200 bar Temperature: 58-60 ºC

- Topic3: Cooling to optimum

After heating the milk at 72 °C with a hot water circuit powered by, for example, steam. After this desired pasteurization temperature is reached, milk needs to be cooled down back to 20-35 °C as favourable condition for the growth of starter culture (Mesophlic). Used in fermentation of ikivuguto.

✓ **Purpose**

- To prevent growth of microorganisms resist on pasteurization process.
- To create favorable condition for mesophilic bacteria and multiplying rapidly.
- The protein in milk begins breaking down with heat. This can change the flavor, but also lower it's quality. The amount the protein breaks down with heat is dependent on temperature and time, so the quicker milk is cooled the better ,etc.

- Topic4: Ikivuguto fermentation temperature

✓ Fermentation of milk is a metabolic process that produces chemical changes in organic substrates through the action of lactic bactria.

- ✓ Ikivuguto is prepared by lactic acid fermentation and using mesophilic bactria.Let milk stand for 10-12 hours at 25-30^{0}C to allow for the fermentation process to be completed.

LO 2.2 – Ferment milk

- Topic 1: Principle of fermentation

The conversion of lactose into lactic acid has a preservative effect on milk. The low pH of cultured milk inhibits the growth of putrefactive bacteria and other detrimental organisms, thereby prolonging the shelf life of the product.

The digestive systems of some people lack the lactase enzyme. As a result, lactose is not broken down in the digestive process into simpler types of sugars. These people can consume only very small volumes of ordinary milk. They can, however, consume fermented milk, in which the lactose is already partly broken down by the bacterial enzymes.

If the fermentation time is too long or too short, the flavour will be impaired and the consistency wrong. In addition to flavour and aroma, correct appearance and consistency are important features.

- Topic 2: Selection of starter culture(Mesophilic cultures)

Mesphilic starters, consisting of lactococcus lactis SSP cremoris and lactococcus lactis SSP Lactis biovar diacetyl lactis

Starter cultures or starters are individual or mixed microbial cultures used in known concentrations to promote and conduct fermentation in milk products.

Bacteria, particularly lactic acid bacteria (LAB) and coagulase-negative staphylococci (CNS), as well as yeasts and molds, may be used as starters, thus contributing to increase the safety of fermented milk products.

Selection criteria for starter cultures should take into account the raw material, the properties of the strain(s), food safety requirements, and quality attributes.

LAB normally used as starters in fermented milk products are usually facultative anaerobes and belong mainly to the genera *Lactobacillus*, *Leuconostoc*, *Lactococcus*,etc.

One of the aims of the use of starter cultures is to accelerate the production of lactic acid from the fermentation of sugars. The antimicrobial properties of lactic acid result from the establishment of unfavorable conditions that reduce the growth rate of undesirable microorganisms.

2.1 Preparation of Mother Culture

- Boil the milk (for 10-20 minutes)
- Cool the milk to the inoculation temperature (45^0 C)
- Add powder starter culture (mix with little quantity of milk)
- Mix and incubate (6 – 12 hours) for Ikivuguto/Yoghurt and 12-24 hours for Cheese
- Cooling and storage (maximum 2 days in the refrigerator often in the deep freezer

2.2 Multiplication of Mesospheric Culture: (1st, 2nd and 3rd laboratory culture)

- Pasteurize the milk(85 - 95^0 C) during 20–30 minutes
- Cool the milk to the inoculation temperature (43-45^0 C)
- Add to prepare:

- 1st laboratory culture 2% of mother culture
- 2nd laboratory culture 3% of 1st lab culture
- 3rd laboratory culture 3% of 2nd lab Culture

- Mixing and incubation 3 – 6 hours at 43 45^0 C
- Cooling and storage

The culture can be kept in small sterilized pot/plastic containers. The activity of the culture is declining after time in that the culture may become less active, or its quality may decline because it may not have the desirable fresh, sour flavor.

- Topic3: Temperature monitoring (optimum temperature for mesophiles)

- ✓ Temperature affects the growth rate of organisms.
- ✓ Mesophilic organisms at 30°C will have twice the activity as the same organisms at 20°C.
- ✓ The optimum temperature for mesophilic starter used in Ikivuguto making is on the range of 20-30^o C.

- Topic4: Inoculation techniques and hygiene

After heat treatments, milk is cooled down to the inoculation temperature (20-30^{o} c)

Addition of mesomophilic start culture at 0.004%(Powder) or (3- 5% mother culture)

➢ **Techniques**

- Inoculation can be done continuously by dosigning a culture into the milk flow
- Adding culture to a fermentation tank and mix gengly
- Spread starter culture on surface of cold milk or bottom of fermented tanks/container.

- Topic5: Incubation conditions (Temperature and time)

Let milk stand for 10-12 hours or overnight at 20-30°C to allow for the fermentation process to complete.

Keep milk (20-30°C) until a pH 4.6 is reached as iso-electric point.

- Topic6: Incubation system (vat, packages)

The traditional method for manufacture was the cup-set ikivuguto in which the standardized and pasteurized milk was inoculated with the microbial strains, filled directly into the cups/wooden pot and then incubated in the cup in a warm room for 2 to 4 dayshours at 25-35 degree C and then removed from the warm room and placed in the cooling room.

The vat set method involved placing the standardized, pasteurized milk into a large process vessel and then inoculating and incubating within the process vessel for 3-6 hrs at 20-35 degree C.

LO 2.3 – Check the quality of Ikivuguto

- Topic 1: Checking the effectiveness(pH, taste)

✓ **pH for IKIVUGUTO:** iso-electric point must be range between 4.5-4.6

✓ **Organoleptic quality:**

- Texture: Gel like
- Color: white to slightly yellow
- Viscosity
- Taste; Clean, rich mouth fell, acidic, typical IKIVUGUTO Flavor.

- Topic2: Cooling (Slowing down fermentation)

✓ In final stage of incubation ,when the required pH (normally about 4.2-4.6) has been reached ,the ikivuguto must be cooled to 15-22 degree C.

✓ This temporarily stops further increase in acidity.

✓ Cooling can take place in a plate heat exchanger ,which is designed to give a gentle mechanical treatment of the ikivuguto.

✓ The capacities of pump and coller are often dimensioned to empty a tank in about 30 mins in order to maintain a unform ikivuguto quality.

✓ However,some cultures are specially adapted to stop when reaching pH e.g.4.3 by themselves.

✓ These cultures are fermenting very slow in this pH area and thus a longer cooling time to 15-22 degree C can be accepted.

LO 2.4 – Package and label ikivuguto

- Topic 1: Selection of packaging materials

a) Criteria for selection of milk packaging material for fermented milk (ikivuguto and yoghurt):

✓ It should be free from off-flavours

✓ It should not impart any taste or flavour to the product.

✓ It should act as barrier to bacterial contamination

✓ It should be resistant to UV light (max transmission: 8% at 500 nm & 2% at 400nm)

✓ It should have no physiological effects on the products

✓ It should possess good mechanical properties (sealing, tensile, structural strength etc.)

✓ It should be tamper proof.

✓ It should possess good oxygen barrier properties

✓ It should be economical

✓ It should fit in to processing- in-Line.

b) Types of Packaging used

The material used for packaging of fermented dairy products must be compatible with the special physical chemical and bacteriological properties of fermented milk. The packaging materials used are:

- ✓ Glass
- ✓ Coated paper board containers
- ✓ Plastics: (polyethylene, HDPE cups, Co extrusion plastic complexes, polystyrene, (polyvinyl alcohol and ethylene co polymer, Polystyrene –PETG (polyethylene glycol Terephthalate)

Present information in label is:

- ✓ **Product name:** the product should be named for its identification
- ✓ **Quantity of product / Net quantity:** the quantity of product to the label is very crucial as its even justifies its price
- ✓ List of ingredients in descending order
- ✓ **Company location/ producer location:** food processing company should be located such that anyone can know it. Its name should be in well-known to everybody
- ✓ **Shelf life information:** including production date, expiration date or best before date
- ✓ **Company/ produce address:** company address plays a critical functions as it is helpful in knowing company and getting different information about is that will attract many customers
- ✓ **Batch number:** it is a number given to food product by food processing company which helps in product traceability
- ✓ **Allergens content(if any):** the food manufacturer have to clearly identify and explain the allergens content if they are present for helping clients to whom they are allergic
- ✓ Nutritional information
- ✓ **Instruction of use:** instruction about the product utilization or usage is very important to achieve its effectiveness

✓ **Storage conditions:** identification of product storage conditions are very important to contribute to product quality and safety

Others :

✓ Lot number or batch number, Bar code

✓ Universal product card/barcode

✓ Advertising: sealed for freshness, aroma etc……..

✓ Direction for use

✓ Nutritional information

✓ Serving quantity

- Topic2 : Packaging material handling

✓ Handle the packing boxes and/or plastic (cardboard boxes) carefully.

✓ To avoid shock, do not throw the boxes down when unloading, and to avoid excess load, do not step on the boxes.

✓ Pay attention to the directional arrows on the boxes that indicate "this side up," and do not stack the boxes upside down or on their sides.

✓ Do not allow the boxes to come into contact with water

✓ Do not place the boxes in direct sunlight.

✓ In particular, do not under any circumstances leave the boxes in a closed vehicle with the air-conditioning off, where the temperature may exceed 30°C

✓ The use of vacuum (moistureproof) packaging and sealed containers is recommended when bad conditions are forecast for transport by ship, etc.

- Topic3 : Packaging conditions(hygiene, head space)

✓ All package must provide safe,convenient,attractive,functional,and cost – effective means for protecting the Ikivuguto throughout distribution and merchandising,for presenting it to the consumerand enable easy consumption.

✓ Packaging materials for Ikivuguto must be cleaned to avoid contaminants

✓ Head space must be considered

- Topic4 : Labeling techniques and specifications (Shelflife)

✓ **Labeling fermented milk**

Labeling is defined as the process of attaching a descriptive word or phrase to someone or something about a product on its container, packaging, or the product itself.

Labeling techniques

✓ **Applied labeling:** it is type of labeling at which all information is pointed on the paper which is applied on the bottle

✓ **Direct labeling:** it is type of labeling at which all information is printed on the package

- Topic5 : Random sampling for further analyses

Three sample or more will be taken for analysis (physical,biological and chemical)

Physical analysis:

✓ Syneresis value

✓ Texture: Gel like

✓ Color and flavor:depending to coloring and flavor agent or fruits used

✓ Viscosity

✓ Taste; clean, rich mouth fell, stweenest, typical Ikivuguto flavor accordingly.

Chemical analysis:

✓ Fat percentage is determined by centrifugation method.Acidity percentage is determined by titration and pH was measured by digital pH meter after calibration.

✓ Lactose percentage is determined by filtration.

✓ Total solids percentage is determined by hot air oven.

Biological analysis:

✓ Total viable count of mesophilic bacteria or others undesirable bacteria content is determined by standard plate count method.

✓ The selective media used for viable count of mesophilic sterter and Coliform were Neutral red chalk lactose agar,Acetate agar and Violate red bile agar respectively.

LO 2.5 – Store ikivuguto

- Topic1: Storage conditions (temperature)

Storage in refrigeration at 4-6°C for 5-7 days in refrigerator or at room temperature for 2-3 days .

Learning Unit 4 – Make Yoghurt

Fig12:**Srawberry yoghurt**

Yoghurt is cultured milk that contains the characteristic bacterial cultures (Lactobacillus bulgaricus and Streptococcus thermopiles). Yoghurt is easily digested and suitable for children and for old people. Milk for the production of yoghurt must be fresh and of good bacteriological quality. It must be free from residues of antibiotics and dairy sanitizers. Colostrum and mastitis milk must not be used for yoghurt processing as they will not withstand the heating required to render milk suitable for processing. Equipment used must be clean and free from bacteriophages.

There are two main types of yoghurt: set and stirred yoghurt.

- ✓ **Set yoghurt** is incubated in the retail container, usually a plastic or glass cup. It is the preferred method for production of natural yoghurt and yoghurt with fruit and/or nuts. The consumer breaks the curd with a spoon at the time of consumption.
- ✓ **Stirred yoghurt**, on the other hand, is incubated in bulk vats after which the curd is stirred, mixed with sugar and flavours, then packaged in retail cups and sealed.

Yoghurt is typically classified into the following groups:

Set Yoghurt:

- ✓ This type of yoghurt is incubated and cooled in the final package and is characterized by a firm jelly like texture.

Stirred Yoghurt

✓ This type of yoghurt is incubated in a tank and the final coagulum is "broken" by stirring before cooling and packing. The texture of stirred yoghurt will be less firm than a set yoghurt somewhat like a very thick cream. A little reformation of coagulum will occur after packaging.

Drinking Yoghurt

✓ It also has the coagulum "broken" prior to cooling. In drinking yoghurt the agitation used to "break" the coagulum is severe. Very little reformation of coagulum may occur.

Frozen Yoghurt

✓ Frozen yoghurt is inoculated and incubated in the same manner as stirred yoghurt. However cooling is achieved by pumping through a Whipper / chiller / freezer in a fashion similar to icecream. The texture of the finished product is mainly influenced by the whipper/ freezer and the size and distribution of the ice crystals produced.

Concentrated Yoghurt

✓ This type of yoghurt is inoculated and fermented in the same manner as stirred yoghurt. Following the "breaking" of the coagulum the yoghurt is concentrated by boiling off some of the water, this is often done under vacuum to reduce the temperature required.

✓ Heating of low pH yoghurt can often lead to protein being totally denatured and producing rough and gritty textures. This is often called strained yoghurt due to the fact that the liquid that is released from the coagulum upon heating used to be "strained" off in a manner similar to making soft cheese

Flavoured Yoghurt

✓ The flavours are usually added at or just prior to filling into pots. Common additives are fruit or berries, usually as a puree or as whole fruit in syrup. These additives often have as much as 50% sugar in them, however with the trend towards healthy eating gaining momentum; many manufacturers offer a low

sugar and low fat version of their products. Low or no sugar yoghurts are often sweetened with saccharin or more commonly aspartame.

Classification of Yoghurt

There are different types of yoghurt produced worldwide. However a Particular yoghurt may be subdivided into different groups based on the following aspect:

Basis of classification	Different groups of yoghurt
Chemical standards(Fat)	Full fat yoghurt,medim fat yoghurt and low fat yoghurt
Physical nature of product	Set yoghurt and stirred or fluid/drinking yoghurt
Flavors	Plain/natural yoghurt and frui or flavored yoghurt

L.O 4.1. Pasteurise raw Milk

✓ Yoghurt milk must be pasteurized according to an approved process. The normal short – time heat treatment does not result in a noticeable denaturation of whey protein (which is necessary for food yogurt temperatures and longer holding times.

✓ The pasteurization conditions at 90^0C-95^0C and 5-10 mins or 82-85 ^{0}C for 15-20 mins holding time are optimum and can be easily controlled.

- Topic 1 : Principle of pasteurization

✓ Kill any other bacteria that might be in the milk that would compete against the bacteria (Starter culture) that convert milk to yogurt.

✓ The normal short – time heat treatment does not result in a noticeable denaturation of whey protein (which is necessary for food yogurt temperatures and longer holding times.

✓ The pasteurization conditions at 90o C-95^0C and 5-10 min holding time are optimum and can be easily controlled.

✓ Some time heating temperature above 100^{o}C is encountered which heads to negative effects:

- Impair the casein
- Reduce the stability of the acid gel

✓ During pasteurization, denaturation of whey protein (B-laclogbunlin) plays role of:

- Limiting syneresis
- Prevent whey discharge from the gel

✓ An additional heating can:

- Inactivate recontamination germs, by increasing the product safety once more.

• Topic 2 : Addition of sugar (optional)

✓ Add sugar :15 cubes/1 litre of milk or 0.0625kg /liter of milk to increase yoghurt taste/sweetness

• Topic 3 :Pasteurization conditions for yoghurt (time and temperature)

✓ The pasteurization conditions at 90^0C-95^0C for holding time of 5-10 mins or 82-85 ^{0}C for holding time of 15-20 mins

• Topic 4: Homogenization (Pressure, time)

✓ Homogenization is another important factor for production of a high-quality fermented milk product.

The main objectives of homogenization of the milk base are:

✓ To decrease the size of the fat globules to avoid cream separation in the fermentation tank

✓ To improve the mouth-feel of the product, especially if any additives in powder forms have been used

✓ To improve the water-holding capacity of the milk proteins and reduce the tendency to syneresis.

✓ Another effect of homogenization is the increased stability of the drinking product; a secondary homogenization is normally carried out after the fermentation stage.

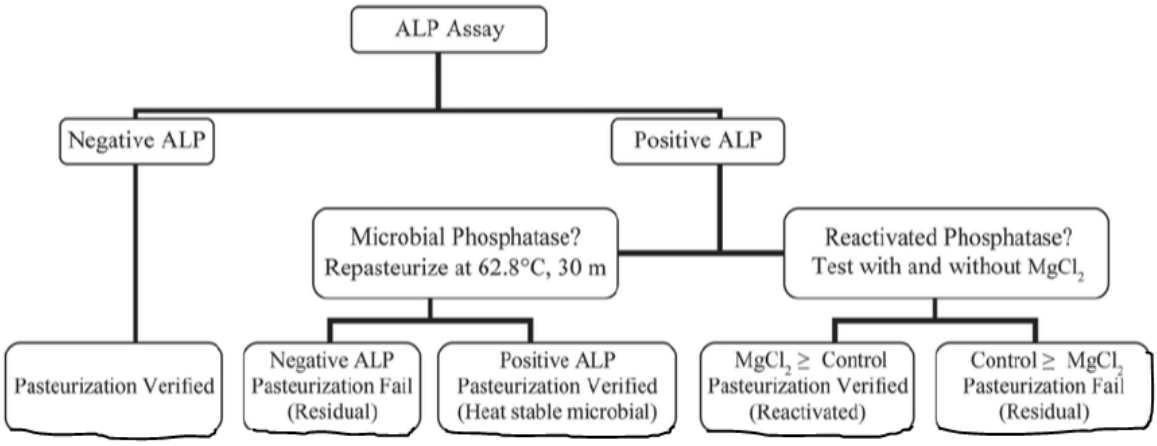
✓ For fermented milk products, full stream or total homogenization of the milk is the most commonly used form.

✓ The homogenization pressure and temperature are dependent on a number of factors, and one aspect is the formulation of the milk base.

- ✓ The most common homogenization pressure for milk intended for fermented milk products is ~20 MPa at a temperature range of 60–70°C Homogenization of yogurt milk prevents creaming of the fat and improves the tastes and consistency of the finished products.
- ✓ Complete homogenization results in a volume increase of casein particles. Homogenization is done at 150- 200 bar at 58-60^{0}C

- Topic 5: Effectiveness test (phosphatase test)

Milk pasteurisation efficacy is typically monitored by checking for the presence of alkaline phosphatase (ALP) an enzyme present in raw milk,thus ensuring a product is safe for consumption. ALP is inactivated under high temperature/short time pasteurisation processes and is used as a marker of pasteurisation.



- Topic 6: Cooling to optimum yoghurt fermentation temperature

- ✓ Cool milk at 42-45°C to take the yogurt to the ideal growth temperature for the starter culture.
- ✓ Cooling aims at creating an optimum temperature of yoghurt culture.

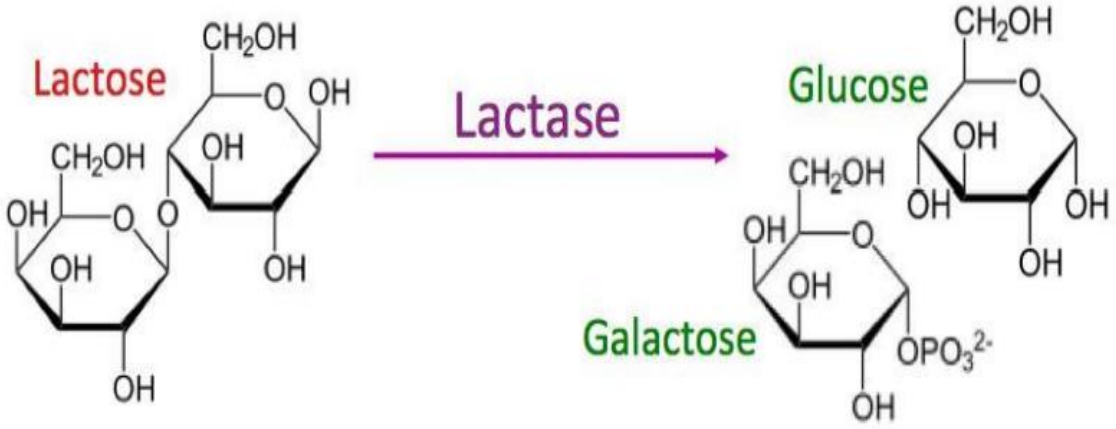
L.O 4.3: Ferment milk

- Topic 1 : Principle of fermentation

Starter cultures ferment lactose to produce lactic acid.The increase in lactic acid decreases pH and causes the milk to clot,or form the soft gel that is characteristic of yoghurt. The fermentation of lactose also produces the flavor compounds that are characteristic of yoghurt.

Chemical equations

1 st step: Enzymatic hydrolysis of lactose into Glucose and galactose



2step: Lactic acid fermentation

In Homolactic fermentation

One molecule of glucose is converted to two molecules of lactic acid

$C_6 H_{12}O_6 \rightarrow 2\ CH_3\ CHOHCOOH$

In Heterolactic fermentation

one molecule of glucose converted to one molecule of lactic acid, one molecule of ethanol, and one molecule of carbon dioxide: $C_6 H_{12}O_6 \rightarrow CH_3\ CHOHCOOH + C_2 H_5\ OH + CO_2$

- Topic 2 : Select ion of starter culture(Thermophilic)

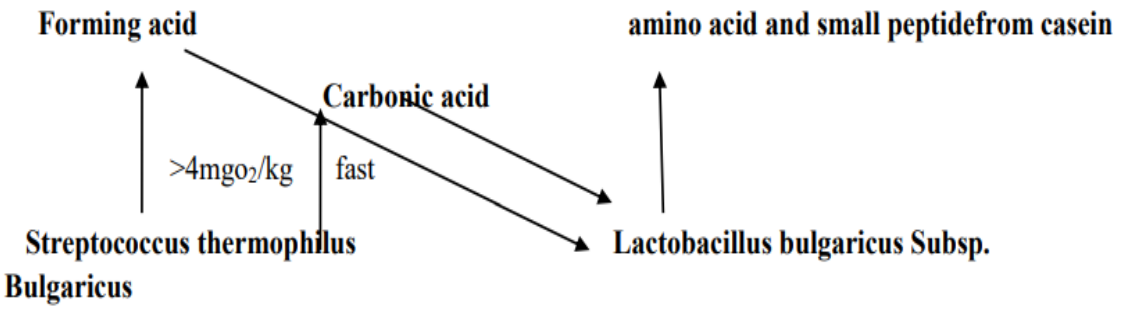
✓ Starter culture for yoghurt should consist of Thermophilic/ (heat-loving) Bacteria with a growth optimum average temperature of 42-45^{0}C.

✓ Typical yoghurt types are Streptococcus salivarivs Subsp. Thermophilus (S. Thermophilus) as acidifying agent ie it is responsible for producing lactic acid : The growth optimum is in range of 38-42^o c.

✓ Lactobacillus delbrueckii subsp.Burgaricus (LB. bulgaricus) responsible for production of aroma and flavor in yoghurt: The growth optimum is range at 42-45^{o}C.

✓ There is a symbiotic relationship between the two species of bacteria i.e. Lactobacillus bulgaricus and Streptococcus thermophilusthat‟s why there is more rapid acid development than in the single strain culture.

✓ Symbiosis between Streptococcus thermophilus and Lactobacillus delbrueckii Subsp. bulgaricus



Streptococcus thermophilus produces lactic acid and small quantities of formic acid, which promotes outgrowth of Lactobacillus delbrueckii Subsp. Bulgaricus. On the other hand Lactobacillus delbrueckii Subsp. Bulgaricuss produce aminoacids to stimulate the growth of Streptococcus thermophiles

- Topic 3 : Temperature adjustment (optimum temperature for thermophiles)

✓ The milk is held at 42-45°C until a pH 4.5-4.6 is reached.

✓ This allows the fermentation to progress to form a soft gel and the characteristic flavor of yogurt.

✓ This process can take several hours.

- Topic 4 : Inoculation techniques

✓ Mixed into the cooled milk the yoghurt starter culture to ferment the milk into yoghurt.

✓ Inoculation 3-5% of yoghurt starter culture

✓ Lactic bacteria(dry powder starter culture) can be sprinled over the surface of the milk or fermented cultures mix gently in heated milk.

- Topic 5 : Incubation conditions(Temperature and time)

✓ Keep milk (42-45°C) until a pH 4.5-4.6 is reached

✓ This allows for the fermentation to take place.

✓ Incubation (42 -45^0 C) for 3 – 6 hours

- Topic 6 : Checking the effectiveness(pH, taste)

✓ **pH for yoghurt:** iso-electric point must be range between 4.5-4.6

✓ **Organoleptic quality:**

- Texture: Gel like

- Color: white to slightly yellow
- Viscosity
- Taste; clean, rich mouth fell, stweenest, typical yoghurt flavor accordingly.

L. O. 4. 5. Add ingredients (optional)

✓ The main ingredient in yogurt is milk.

✓ **The type of milk used depends on the type of yogurt:**

- whole milk for full fat yogurt
- lowfat milk for lowfat yogurt
- skim milk for nonfat yogurt.

Other dairy ingredients are allowed in yogurt to adjust the composition, such as cream to adjust the fat content

- nonfat dry milk to adjust the solids content.
- The solids content of yogurt is often adjusted above the 8.25% minimum to provide a better body and texture to the finished yogurt.
- Milk composition may be adjusted to achieve the desired fat and solids content.
- Often dry milk is added to increase the amount of whey protein to provide a desirable texture.
- Ingredients such as stabilizers are added at this time.

• Topic 1 : Types of yoghurt flavours(natural/artificial)

Natural vs artificial flavor

✓ Natural flavors are created using ingredients from fruits,beans etc

✓ Artificial or synthetic flavorings are created from chemical sources rather than naturl sources

How are natural flavors created?

✓ Natural flavors are developed by isolating specific chemical ingredients from natural sources.

How are artificial flavors created?

✓ A flavorist will lookat the chemical composition of natural ingredients,like vanilla bean,then create flavor profiles using one or more synthetic ingredients that align with the known chemical composition. The completed flavor is then added to our yoghurt in allroved quantinties.

Are natural and artificial flavors used together?

- ✓ A yoghurt can even include both natural and artificial flavorings of the same flavor,for example could use both natural and artificial strawberry flavors to provide the flavor consumers expect.
- ✓ Natural fruit flavors increase taste and smell of yoghurt.
- ✓ Artificial flavor improve smell,odor of yoghurt accordingly.

Are natural and artificial flavors safe?

- ✓ Unless you have an allergy to a specific ingredient,natural and artificial flavors are safe for consumption at intended levels.

- Topic 2 : Ingredients (fruits, fruit concentrates, Vanilla)

- ✓ Fruits, fruit concentrates, Vanilla are added at different steps depending on the type of yogurt.
- ✓ For set style yogurt the fruit is added in the bottom of the cup and then the inoculated yogurt is poured on top and the yogurt is fermented in the cup.
- ✓ For swiss style yogurt the fruit is blended with the fermented, cooled yogurt prior to packaging.

- Topic 3 : Techniques of adding the ingredients

- ✓ Mix sugar with modifuied starch gently
- ✓ Add mixture in boiling milk at 50-60 degree C
- ✓ After heating milk,it must be cooled at 42-45 degree C and mixed with starter culture,coloring agent,flavors or fruit juice,natamycin(antifungal),etc
- ✓ Use a perforated spoon or a large whisk to stir them in gently.
- ✓ Lactic bacteria can be sprinled over the surface of the milk and Cover and let the cultures rehydrate on the surface of the milk

L. O 4.6 Package and label the yoghourt

- Topic 1 : Selection of packaging materials

Selection of packaging materials for yoghurt it is focused on:

- ✓ **Quality and functionality:**packaging is only effective if it protects the yoghurt against damage in tnasit.

- ✓ **Size,shape and design:** use standard it is always a good idea to use standard sizes and shapes for yoghurt packaging.
- ✓ Not only does this improve flexibility and convenience during storage,handling and transportation,but also reduces production costs for bespoke packaging.
- ✓ **Princing and cost savings:** the cost-effectiveness of packaging material depends on more than just its price. some packaging types are lighter than others,reducing transportation costs,while others are easier to handle and help boost production efficiency.
- ✓ **Distribution and storage:** understanding how your yoghurt makes it from a production unit to starage and distribution facility,retail outlet or customer the distance your shipments need totravel,modes of transportation used,as well as starage conditiona at each step,to ensure your product remains undamaged throughout the shipping and handling process.
- ✓ **Long-termsustainabilty:** yoghurt packaging scales help you improve production efficiency throu the development of an automated packaging process.focusing on sustainability and using recycled or recyclable packaging creates a greener,more eco-conscious image for your brand.
- ✓ **Brand packaging design is an effective marketing tools:**innovative and thoughtful packaging design says a lot about your business and values,especially when it is tailored to appeal to a specific target audience. Put in the time and effort to select packaging materials that reflect your brand identity and make sure these are used consistently across your bottom line tremendously.

- Topic 2 : Packaging conditions(hygiene, head space)

Fig13:**Yoghurt package**

- ✓ All package must provide safe,convenient,attractive,functional,and cost – effective means for protecting the yoghurt throughout distribution and merchandising,for presenting it to the consumerand enable easy consumption.
- ✓ Packaging materials for yoghurt must be cleaned to avoid contaminants
- ✓ Head space must be considered and contoled according standard.

• Topic 3 : Labeling (labeling elements)

- ✓ **Product name:** the product should be named for its identification
- ✓ **Quantity of product / Net quantity:** the quantity of product to the label is very crucial as its even justifies its price
- ✓ List of ingredients in descending order
- ✓ **Company location/ producer location:** food processing company should be located such that anyone can know it. Its name should be in well-known to everybody.
- ✓ **Shelf life information:** including production date, expiration date or best before date.
- ✓ **Company/ produce address:** company address plays a critical functions as it is helpful in knowing company and getting different information about is that will attract many customers.
- ✓ **Batch number:** it is a number given to food product by food processing company which helps in product traceability.
- ✓ **Allergens content(if any):** the food manufacturer have to clearly identify and explain the allergens content if they are present for helping clients to whom they are allergic.
- ✓ Nutritional information.
- ✓ **Instruction of use:** instruction about the product utilization or usage is very important to achieve its effectiveness.
- ✓ **Storage conditions:** identification of product storage conditions are very important to contribute to product quality and safety

Others :

- ✓ Lot number or batch number, Bar code.
- ✓ Universal product card/barcode.
- ✓ Advertising: sealed for freshness, aroma etc……..

- ✓ Direction for use.
- ✓ Nutritional information.
- ✓ Serving quantity

- Topic 4 : Random sampling for further analysis

Three sample or more will be taken for analysis (physical,biological and chemical)

Physical analysis:

- ✓ Syneresis value
- ✓ Texture: Gel like
- ✓ Color and flavor:depending to coloring and flavor agent or fruits used
- ✓ Viscosity
- ✓ Taste; clean, rich mouth fell, stweenest, typical yoghurt flavor accordingly.

Chemical analysis:

- ✓ Fat percentage is determined by centrifugation method.
- ✓ Acidity percentage is determined by titration and pH was measured by digital pH meter after calibration.
- ✓ Lactose percentage is determined by filtration.
- ✓ total solids percentage is determined by hot air oven.

Biological analysis:

- ✓ Total viable count of S.thermophilus, L. bulgaricus and Coliform is determined by standard plate count method.
- ✓ The selective media used for viable count of S. thermophilus, L. bulgaricus and Coliform were Neutral red chalk lactose agar,Acetate agar and Violate red bile agar respectively.

L. O 4.7 Store the yoghourt

- Topic 1 : Storage conditions (temperature,time,shelf life)

Shelf life of yoghurt depending on how it is processed and keeped.

- ✓ If yoghurt is stored good that already opened,then this yoghurt can last a maximum of about 2 hours,so it is recommend to consume it immediately after opening.
- ✓ Unopened or sealed yoghurt keep its quality for 1 to 2 weeks.

- ✓ Yoghurt can be keeped in freezer at 0 degree F for 6 to 8 weeks but it just might lose taste or texture.
- ✓ yogurt is stored in refrigerator at 4-7°C for 30 days to 90 days.
- ✓ Do not leave yoghurt at room temperature for longr than two hours or one hour if temperature is 90 degree F or above.

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