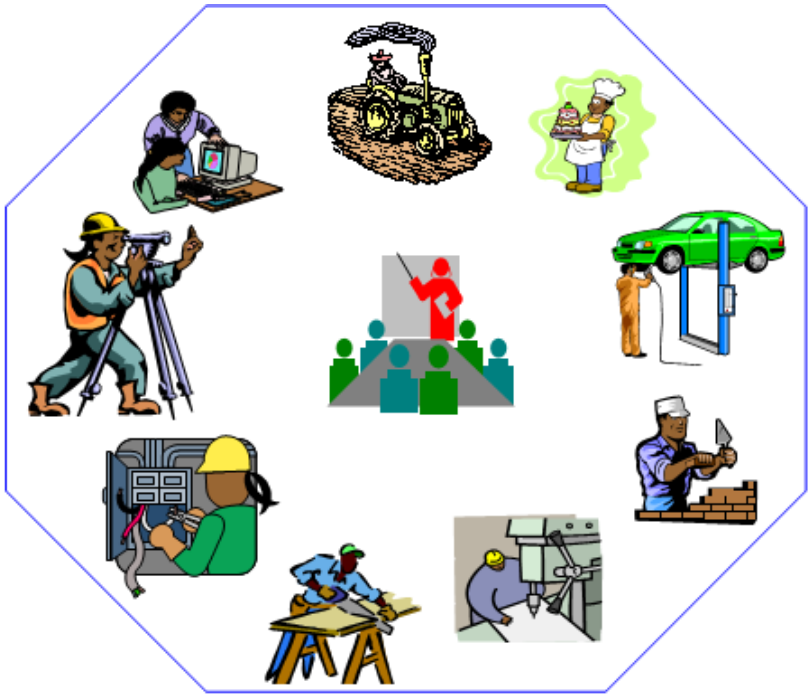
Dairy Product Processing Level III

Based on May 2019, Version 2 OS and Sept. 2021, V1 Curriculum



Module Title: Coordinating Dairy Products Making Operations

LG Code: IND DPP3 M08 LO (1-4) LG (25-28)

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L #25	LO #1 Monitor milk supply and quality

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Confirming milk supply for the batch
- Checking milk composition, homogeneity, somatic cell count and disk assay of sample data
- Maintaining required temperature for milk inoculation

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Confirm milk supply for the batch
- Check sample data on milk for composition, homogeneity, somatic cell count and disk assay
- Maintain milk at required temperature for inoculation with the required culture

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1 Confirming milk supply for batch

1.1 Introduction

Approximately 150 million households around the globe are engaged in milk production. In most developing countries, milk produced by smallholders and milk production contributes to household livelihoods, food security and nutrition

Milk provides relatively quick returns for small-scale producers and an important source of cash income.

In recent decades, developing countries have increased their share in global dairy production. This growth mostly the result of an increase in numbers of producing animals rather than a rise in productivity per head.

In many developing countries, dairy productivity is constrained by poor-quality feed resources, diseases, limited access to markets and services (e.g., health, credit and training) and dairy animals' low genetic potential for milk production. Unlike developed countries, many developing countries have hot and/or humid climates that are unfavorable for dairying.

Some countries in the developing world have a long tradition of milk production, and milk or its products have an important role in the diet. Other countries have established significant dairy production only recently. Most of the former countries are located in the Mediterranean and Near East, the Indian subcontinent, the savannah regions of West Africa, the highlands of East Africa and parts of South and Central America. Countries without a long tradition of dairy production are in Southeast Asia (including China) and tropical regions with high ambient temperatures and/or humidity

- In the last three decades, world milk production has increased by more than 59 percent, from 530 million tons in 1988 to 843 million tons in 2018.
- India is the world's **largest milk producer**, with 22 percent of global production, followed by the United States of America, China, Pakistan and Brazil.
- Since the 1970s, most of the expansion in milk production has been in South

Asia, which is the main driver of milk production growth in the developing world.

- Milk production in Africa is growing more slowly than in other developing regions, because of poverty and in some countries adverse climatic conditions.
- The countries with the **highest milk surpluses** are:
  - ✓ New Zealand
  - ✓ United States of America
  - ✓ Germany
  - ✓ France
  - ✓ Australia
  - ✓ Ireland.
- The countries with the **highest milk deficits** are:
  - ✓ China
  - ✓ Italy
  - ✓ Russian Federation
  - ✓ Mexico
  - ✓ Algeria
  - ✓ Indonesia.

The top 10 dairy producing countries in the world

1. USA)
2. India
3. China
4. Brazil
5. Germany
6. Russia
7. France
8. New Zealand
9. Turkey
10. UK

Milk processing is the procedure that includes various steps to start dairy farms like:

- Milk **collection** from cattle
- Pasteurization
- Clarification
- Homogenization
- **Packing** of the milk
- Finally transportation to processing

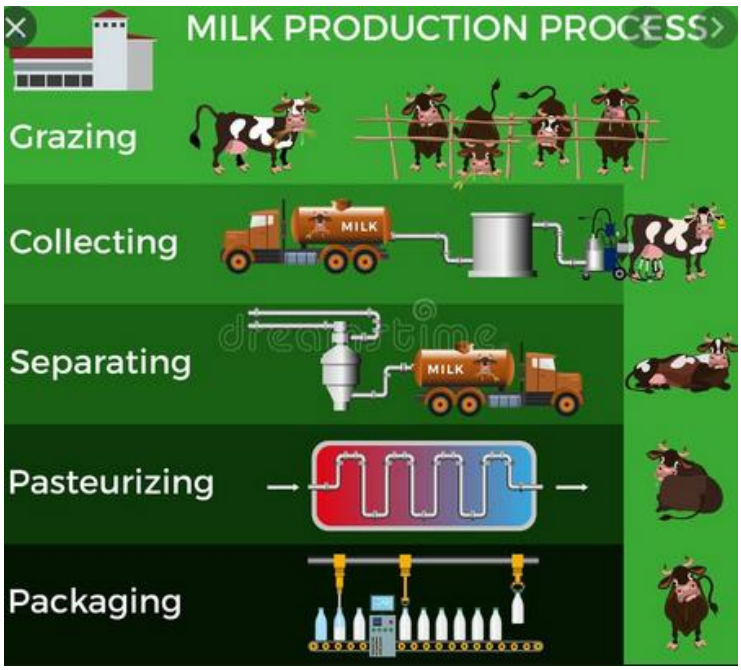


Figure 1: Milk production process

1.2 Confirming milk supply for batch

1.2 1. Milk collection

Milk collection is one of the first activities of milk producer or processer that include:

- Milk collection from several group members to a central location
- Milk transported to processing centers or markets

Raw milk supply has three possible sources

1. Dairy farm owner
2. Small scale farmers
3. Milk collectors.

The collected raw milk transported to the processing centre and used as main raw material to end up to pasteurized milk and other milk products through various technological processes

1.2.2 Establish milk collection center

Factors considered in establishment collection center are:

- Number of milk producers
- Milk volume of each producer
- Total volume of milk
- Time to transport the milk
- Distance from members to the collection center
- Distance from the collection center to the processing center or market
- Whether milk collection is once or twice per day.

1.2.3 Selecting a site for a collection center

In selecting the ideal site for a collection center, consider the following points:

- Reliable supply of clean water;
- Close to the road;
- Accessible for all milk transport vehicles;
- Close to other buildings/activities;
- Good drainage;
- Easy to construct a building or a shade;
- The area should not be dusty;
- Preferably, there should be electricity.

1.2.4 Constructing Milk collection center

Constructing a building or a shade depends on the capacity of milk collector and available of material.

The type of collection center house are:

A. An open shade sufficient for milk

- Collecting milk
- Simple testing

- Transporting to the processing center.

Figure 2: Open shade

B. Construct a building

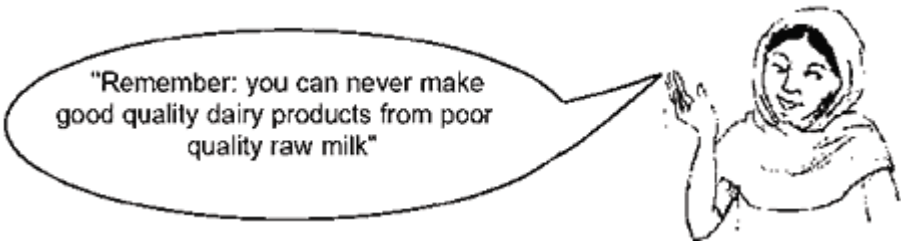
- Best if the floor is a hard washable surface.
- If the group plans to expand its activities in the future and wants to include milk processing

1.3 Hygienic milk collection

Hygiene at all stages of milk collection and processing important for the quality and shelf life of dairy products. The farmer could provide containers or the group may provide and clean standard milk churns to improve hygiene.

Important points for good hygiene are:

- Use clean containers and equipment;
- Use containers that are easy to clean with a wide opening;
- Keep the milk covered and in the shade;
- Transport the milk as quickly as possible after milking;
- Cool as quickly and whenever you can (4°C or below);
- Try to avoid any delays in milk collection.



1.3.1 Cleaning and Disinfection Milk collection equipment and Tools

A. **Cleaning** removes materials such as dirt and any residues of milk

Clean the containers as follows:

- Rinse with cold water first
- scrub with a brush and warm water containing detergent
- rinse again with cold water

B. **Disinfection** kills most harmful bacteria.

- Sterilize with boiling water (or use disinfecting solutions like hypochlorite)
- Dry the cans on a drying rack (preferably in the sun).

Figure 3: Disinfection of milking equipment

1.4 Milk Quality testing

Milk quality testing control carried out at all stages of the dairy product processing chain include:

- Quantity: measured in volume or weight;
- Organoleptic characteristics; appearance, taste and smell;

- Compositional characteristics: especially fat, solid and protein contents;
- Physical and chemical characteristics;
- Hygienic characteristics: hygienic conditions, cleanliness and quality;
- Adulteration: with water, preservatives, added solids, etc.
- Drug residues.

Good quality raw milk are:

- Free of debris and sediment
- Free of off-flavors
- Free of abnormal color and odor
- low in bacterial count
- Free of chemicals (e.g. antibiotics, detergents)
- Normal composition and acidity

The quality of raw milk is the primary factor determining the quality of milk products. Good-quality milk product produced only from good-quality raw milk.

The hygienic quality of milk is of crucial importance in producing milk and milk products that are safe and suitable for their intended uses. To achieve this quality, good hygiene practices applied throughout the dairy chain.

Among the causes of small-scale dairy producers' difficulties in producing hygienic products are

- informal and unregulated marketing
- handling and processing of dairy products
- lack of financial incentives for quality improvement
- Insufficient knowledge and skills in hygienic practices.

1.5 Milk collection record

Table 1: Weekly milk collection records sheet at processing center

Collector name	Day	Total milk kg	density reading	fat%	rate per kg	Date, months, year
	Sunday morning					
	Sunday evening					
	Monday morning					
	Monday evening					
	Tuesday morning					
	Tuesday evening					
	Wednesday morning					
	Wednesday evening					
	Thursday morning					
	Thursday evening					
	Friday morning					
	Friday evening					
	Saturday morning					
	Saturday evening					
	WEEK TOTAL:					
Payments made on:						
Remarks:						

1.6 Milk preservation

Milk cooled immediately after milking, and kept as cold as possible before processing. The best temperature to keep the milk is 4 degrees Celsius (or below), but in most developing countries this requires some kind of cooling equipment.

The most important preservation methods of milk are:

A. 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 milk;
    - Evaporative charcoal lined cooler;
    - surface coolers;
    - Bulk (direct expansion) milk cooling tank;
    - An in-can rotary cooler.

B. Lacto peroxidase System of milk preservation

The Lacto peroxidase System is a safe milk preservation method that used in situations where

- Milk transportation from farm to processing unit takes a long time
- No cooling facility is available or affordable.
- It intended for use by trained people at the level of collection points, not by individual farmers.
- An enzyme that exists naturally in milk and slows the growth of spoiling bacteria.
- The effect of Lacto peroxidase depends on the temperature, but even at 30-degrees Celsius
- Prevent souring of the milk for 7-8 hrs. (if the initial hygienic quality of the milk is reasonably good).

The Codex Alimentarius Commission has approved the use of the Lacto peroxidase system of milk preservation. Whether this system adopted is dependent upon country's regulations

The Lacto peroxidase system is not:

- An alternative for clean milk production but it delays bacterial growth
- Helps to maintain the milk in as healthy a condition as it was when drawn from udder.
- This system is only applicable if refrigeration is not available or practical.

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Mention at least five most Important points milk collector follow for good hygienic milk collection! (5%)

_____,_____

_____,_____

_____,_____

2. List down at least six the criteria of good raw milk quality! (5%)

_____,_____

_____,_____

_____,_____

_____,_____

3. Write down the method of milk preservation!(2)

_____,_____

Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 2. Checking sample data on milk composition, homogeneity, somatic cell count and disk assay

2.1 Milk sampling

Sampling of **milk** and **milk** products generally done for Chemical analysis, Bacteriological analysis, Sensory analysis etc.

It is expensive to analyses all milk supplies on a daily basis for all parameters.

- Taking sample of milk and place it in sample bottles with preservatives added.
- **Potassium dichromate** added to keep the samples (for fat testing) in a good condition
- Testing done on a mix of these samples
- Alternatively, milk sampled and tested on a random basis.
- keep milk samples cool (close to freezing point), but make sure the milk is heated to 40°C and then cooled to 20°C and mixed before testing
- Milk must thoroughly mixed before sampling to make sure that the fat dispersed throughout the container
- Make sure the samples labelled and carefully recorded to avoid confusion.
- Open the **sample** tube immediately before the **sample** taken
- Do not let hands or the teat end contact with the inside of the tube
- **Collect milk** until the **sample** tube is ⅓ to ½ full
- Holding the tube at an angle to prevent loose dirt or hair from falling into it.

Figure 4: Taking milk Sample

2. 2 milk composition

The major component of milk is water; the remainder consists of lipid (fat), lactose, and protein (casein and whey proteins) and Milk contains smaller quantities of minerals, specific blood proteins, enzymes, and small intermediates of mammary synthesis.

Approximate average composition of the milk of cows

Components	Cow (%)
Water	87.4
Total solids	12.6
Fat	3.6
Protein	3.4
Sugar	4.6
Ash	0.7

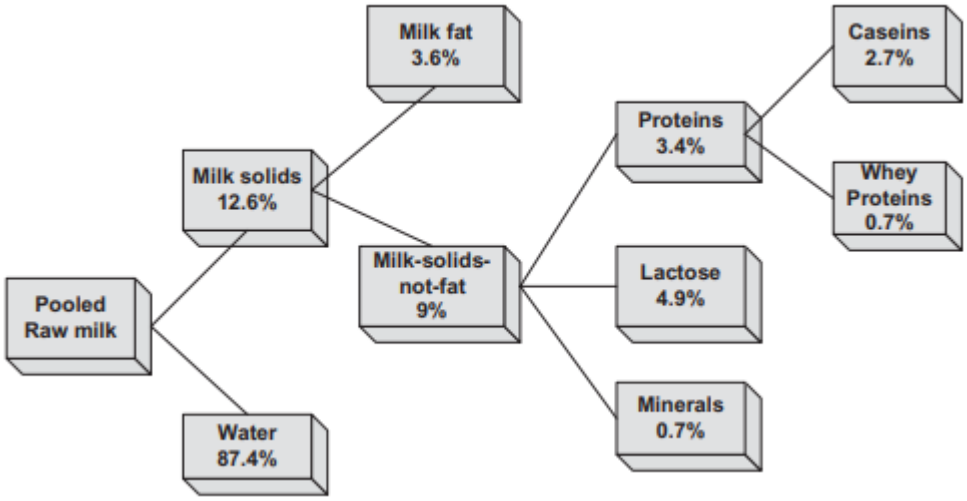


Figure 5: composition of raw milk

U.S. Product Standards of Identity

Milk Composition Minimum of 8.25% milk solids-not-fat (MSNF) and Minimum of 3.25% milk fat

2.2.1 Lipids

The major lipid component of cow's milk is **triglyceride**, which makes up about 98% of milk fat and the other 2% of milk lipids consists of glycerides, mono-glycerides, cholesterol, phospholipids, free fatty acids, cerobrosides, and gangliosides

2.2.2 Proteins

Normal bovine milk contains about 3.5% protein, which fractionated into two main groups. On acidification of milk to pH 4.6 at 20°C, about 80% of the total protein precipitates out of solution; these proteins called **casein**. Proteins that remain soluble under these conditions referred to as **whey proteins** or **serum proteins**. Both the casein and whey protein groups are heterogeneous.

2.2.3 Milk Salts

Milk salts consist mainly of chlorides, phosphates, citrates, sulfates, and bicarbonates of sodium, potassium, calcium, and magnesium

2.2.4 Lactose

Lactose, the major carbohydrate in milk found in cow's milk at levels of 4.8%. Lactose makes a major contribution to the colligative properties of milk (osmotic pressure, freezing point depression, boiling point elevation

The structures and properties of these components intensely influence the characteristics of milk and have important consequences for milk processing.

The composition of milk varies with the:

- Dairy breeds
- Environmental and physiological factors
- Progress of lactation.
- kind and quantity of feed
- factors, such as mastitis, extreme weather conditions, stress, and collapse

Table 2: Approximate milk composition of five major dairy breeds

No	Breeds	Fat	Protein	Solid not fat
1	Ayrshire	4	3.5	9
2	Brown Swiss	4	3.5	9
3	Guernsey	4.9	3.7	9.4
4	Holstein	3.6	3.2	8.7
5	Jersey	5.4	3.8	9.4

2.3 Milk Homogenization

Mechanical process used to reduce the size of the fat globules in the **milk**

Milk is a very complex food containing over 100,000 different molecular species. The main components of interest are protein and fat globules. The proteins, referred to as casein particles combine together with calcium and phosphate to form aggregates with a well-defined structure. Their typical size range of 100 nm. They are white, tasteless and odorless and used to make food, paint, and adhesives.

The **fat globules** in raw **un-homogenized** milk are between **1-10 µm**, while in **homogenized** milk the size range **0.2-2 µm**.

1.3.1 Reasons for homogenizing milk:

- An extended shelf life
- Easier to produce 2%, 1% and non-fat milk
- Consumer preference
- Easier to combine milk from many animals while still producing a uniform product

2.3.1 Homogenization Process

Milk is an oil-in-water emulsion, with the fat globules dispersed in a continuous phase of skim milk. If raw milk left to stand, the fat globules would form a cream layer and rise to the surface.

Homogenization is a mechanical process used to reduce the size of the fat globules in the milk. The net result of this process is a decreased creaming rate according to Stokes' Law, reduced clustering during creaming, and better density matching with the continuous phase.

The homogenization process reduces the globule size by passing milk under high pressure through a tiny orifice.

- Processing an emulsion such as milk at a flow rate of 20,000 l/hr.
- As it first enters the valve, liquid velocity is about 4 to 6 m/s.
- It then moves into the gap between the valve and the valve seat
- its velocity increases to 120 meters/sec in about 0.2 milliseconds
- The liquid moves across the face of the valve seat and exits in about 50 microseconds

- The homogenization phenomenon completed before the fluid leaves the area between the valve and the seat.

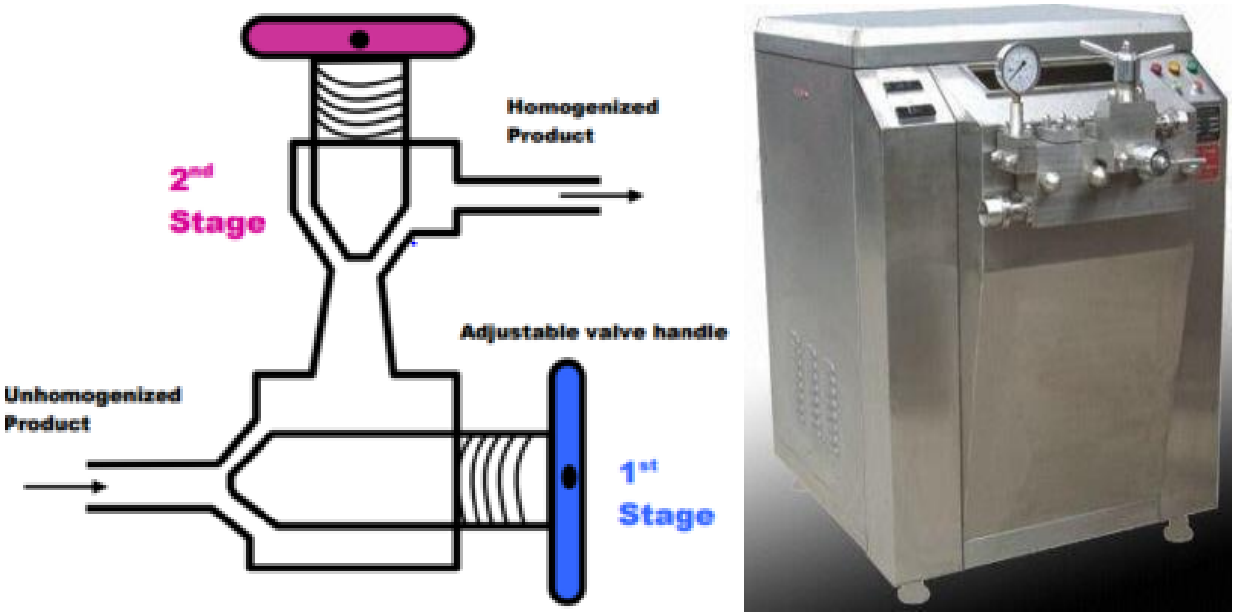


Figure 6: milk high-pressure homogenizer

While most of the fat globule reduction takes place in the first stage, there is a tendency for clumping or clustering of the reduced fat globules. The second stage valve shown in figure permits the separation of those clusters into individual fat globules, as seen in figure below. The second stage is similar to the first stage, as seen in the diagram above. The two-stage homogenizer permits precise control of the homogenization process. Different valve setting give different size emulsions, which in turn affect the final product s' stability, taste, and shelf life.

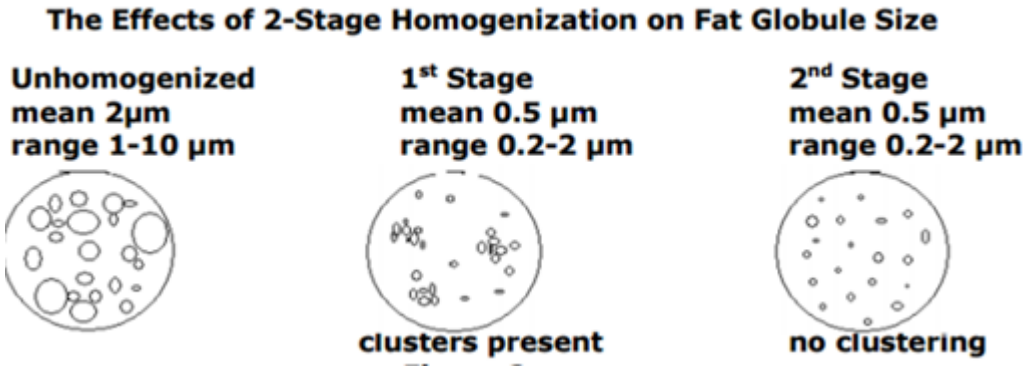


Figure 7: Stage of homogenization of milk fat

Intense turbulence during homogenization markedly reduces fat globule size, with a consequent four to six fold increase in surface area. Because the amount of available original membrane material is insufficient to cover this area, plasma proteins adsorb onto the fat globule surface.

Increase in number of fat globules; adsorption of casein on to fat globules; decrease in fat globule size; decrease in protein stability.

The new membranes in homogenized milk consist of:

- MFGM material
- Caseins
- casein micelles
- whey proteins

2.4 Milk somatic cell count and disk assay

The SCC quantified as the number of cells per ml of milk.

In general terms: an individual cow SCC of 100,000 or less indicates an 'uninfected' cow, where there are no significant production losses due to subclinical mastitis. A threshold SCC of 200,000 would determine whether a cow infected with mastitis.

For example, recommended achievable goals for raw milk premium programs **SCC < 350,000 cells/mL**

The somatic cell count (SCC) in raw milk used as an index of mastitis under the PMO and other regulations. An elevated SCC may serve as an indication of contamination, especially for the Streptococcus spp. (Fenlon et al., 1995). Additional concerning food safety perspective, high SCC also affects spoilage and quality of dairy products.

Mastitis pathogens do not generally survive pasteurization treatment. If present in pasteurized milk and milk products, it is most probably a result of post pasteurization contamination or inadequate pasteurization

2.5 Milk sample on disk assay

The disk-diffusion agar method tests the effectiveness of antibiotics on a specific microorganism by:

- First an agar plate spread with bacteria
- Paper disks of antibiotics placed atop of it
- This method used to determine the best antibiotic to use against a new or drug-resistant pathogen
- This method based on the principle that antibiotic impregnated disk placed on agar previously inoculated with the test bacterium
- pick-up moisture and the antibiotic diffuse radially outward through the agar medium producing an antibiotic concentration gradient

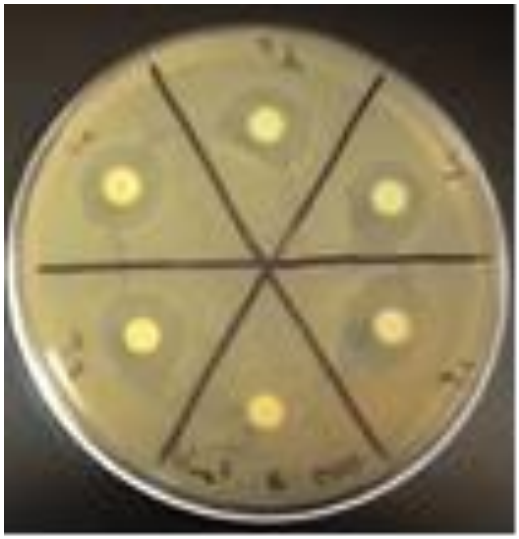


Figure 8: Milk sample on disk assay

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. What are the generally parameter of milk and milk products Sampling analysis for milk quality? (3%)

_____,_____

_____,_____

2. List down the major raw milk component! (4%)

_____,_____

_____,_____

_____,_____

3. Mention the **fat globules** size in **un-homogenized** and milk (3%)

_____,_____

Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 3. Maintaining milk at required temperature for inoculation

3.1 Introduction

The basis of cheese making relies on the fermentation of lactose by lactic acid bacteria (LAB). After inoculation with the starter culture, the **milk** held for 45 to 60 min at 25°C-30°C to ensure the bacteria are active, growing and developed acidity

LAB produce lactic acid which lowers the pH and in turn assists coagulation, promotes syneresis, helps prevent spoilage and pathogenic bacteria from growing, contributes to cheese texture, flavor and keeping quality.

LAB also produce growth factors, which encourages the growth of non-starter organisms, and provides lipases and proteases necessary for flavor development during curing

The first step to making cheese is inoculating milk with a culture and set the curd with rennet

Forms of Inoculation

General they are three formats of milk inoculation Cultures carried to prepare cheese

A. Traditional starters

Which need several scale up transfers

- This system requires some microbiological facilities and expertise
- Only feasible for **very large plants**
- For smaller plants which use mixed strain cultures.

B. Bulk set culture.

In this system

- The culture supplier does all the purification and transfer work
- delivers a bulk set culture
- Used to inoculate a bulk culture
- Turn used to inoculate the cheese milk.

- Bulk cultures are the norm in medium to large plants because the cost savings are significant.

C. Direct to the vat cultures

- Require no scale up at the cheese plant
- Concentrated cultures ready to inoculate the cheese milk supplied directly by the culture supplier.

3.2 Milk Heating

Milk needs to warm up to the right temperature to culture the bacteria.
The milk heated on the stove, whisking frequently to make sure the milk heats evenly (my usual method.)

The milk heated in a microwave or with a double boiler and **do not over heat the milk**, because it will cause the protein to denature and will not able to make cheese.

The general temperature guide for heating milk. Regardless, it is always best to follow recipe.

- Milk is heated to 88F (31 C) regardless of culture.
- Mesophilic cultures usually culture at 90 F (32 C)
- Thermophilic cultures usually culture 91.5F (33C).

Once the milk at the right temperature, stir in the bacterial culture and maintain the milk at that temperature. As long as the milk at the right temperature, the lactic acid bacteria will breakdown the lactose and acidify the milk. This is important because each type of cheese has its own level of acidification.

To achieve the right level of acidification:

- Start with a **recipe**
- Use the right type of culture
- Maintain the correct temperature for the right amount of time
- Maintain the temperature of milk using **Brød & Taylor Bread Proofer & Yogurt Maker** (affiliate link.)
- Milk kept warm by nesting the pot in a basin of warm water

- Maintaining the temperature by adding boiling water to the basin.

Figure 9: Brød & Taylor Bread Proofer & Yogurt Maker Equipment

3.3 Set the curd and condition the milk

3.3.1 Condition milk by calcium chloride

The producer of condition milk by Calcium Chloride include:

- Goat's milk, sheep milk or pasteurized cow milk need
- Mix 1/4 tsp of liquid calcium chloride into 1/4 cup of chlorine free water per gallon of milk
- Thoroughly stir the calcium chloride into the milk about 5 minutes before you add the rennet.

3.3.2 Mixing rennet to milk

The producer of mixing rennet to milk include:

- Mix the rennet (either liquid rennet or a rennet tablet) in a 1/4 cup of chlorine free water (or as directed on the package.)
- Fully mixed into the water
- Stir the rennet water into the milk
- Stir thoroughly for about 5 minutes
- Mixing the milk up from the bottom of the pot so that the rennet is well distributed.
- Continue to maintain the temperature of the milk, without stirring, while the rennet curds the milk
- This usually takes about 30 minutes.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Mention time and temperature required for milk inoculation! (3%)

_____

2. List down the three forms milk inoculation methods (4%)

_____,_____

_____

3. Write the producer of rennet mixing to milk for milk fermentation! (5%)

_____,_____

_____,_____

_____,_____

_____,_____

Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

LG #26	LO #2 Prepare cheese making equipment and add ingredients

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Applying and reviewing safe work practices
- Confirming and making available ingredients
- Adding ingredients at pre-determined levels
- Handling safely starter and optional adjuncts
- Checking equipment
- Setting and operating cheese making equipment
- Loading Ingredients into the plant at required stage
- Checking final mix against specifications

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Apply and review safe work practices
- Confirm and make available the ingredients
- Add ingredients at pre-determined levels
- Handle safely starter and optional adjuncts
- Check equipment
- Set and operate cheese making equipment
- Load Ingredients into the plant at the required stage
- Checking final mix against specifications

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Information1. Applying and reviewing safe work practices

1.1 Applying safe working practice during equipment and machine operation

- Shutdown the machinery and equipment after work completion
- Identify all energy sources and other hazards
- Identify all isolation points
- Isolate all energy sources
- De-energize all stored energies
- Lockout all isolation points
- Tag machinery controls, energy sources and other hazards
- Test by 'trying' to reactivate the plant without exposing the tester or others to risk (failure to reactivate ensures that isolation procedures are effective and all stored energies have been dissipated)

1.2 Reviewing safe work practices before operation

- Short term training is necessary for the operators
- Become familiar with the safe operation of the equipment
- The operator must know the machine working principle and operation
- All operators should trained. The owner of the machine is responsible for training the users.
- Check bolts and other loosen parts and tighten it before operation will start.
- When maintaining, inspecting, attaching and detaching parts, park the machine at flat and safe place.
- Use proper tools to maintain the machine and check working area is safe. During Operating
- Only allow responsible person, who are familiar with the instructions, to operate the machine

Self-Check.1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. List down Safety measure that an operator take before any machine operation**! (4%)**

_____

_____

_____

_____

_____

_____

2. List down tallest 6 point How the operator maintaining work areas with Equipment! (6%)

_____,_____

_____,_____

_____,_____

_____,_____

. Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 2 Confirming and making available ingredients

2.1 Ingredients needed for cheese making

They are around four ingredients required for cheese manufacturing

- Milk
- Rennet
- Salt
- Cultures

2.1.1 Milk

Fresh Milk is the most important ingredient in cheese making. If milk tastes sour or “off”, do not use to cheese making the taste of cheese not good.

2.1.2 Starter Cultures

Starter cultures are friendly bacteria that help “ripen” milk by increasing acidity levels. Since they are a key ingredient in most cheese making recipes, choosing the right one is an important step when gathering ingredients.

Cultures work by fermenting the lactose in milk and initiating the production of lactic acid, which enables a number of changes to take place.
This fermentation helps dictate the moisture and mineral content of curds, and has a big role in determining the

- Taste
- Texture
- Characteristics of finished cheese.

Following a recipe, cultures added when milk reaches a specific temperature. Each culture has an ideal temperature at which it thrives. In order to generate good culture There are two basic culture categories

- Mesophilic
- Thermophilic

Major difference between the two-starter cultures are **temperature tolerance**.

A. Mesophilic requires

Mesophilic cultures prefer medium range temperatures, rather than cold temperatures (psychrophilic) or hot temperatures (thermophilic).

- Low heat and dies off at higher temperatures
- Optimum growth range for mesophilic cultures is 30 - 35ºC
- Acid production is slow or absent at temperatures less than 20ºC
- Growth is inhibited at temperatures greater than 39ºC
- Cheese, which does not require high temperatures to dry the curd, will utilize mesophilic cultures. These include:
    - ✓ Cheddar
    - ✓ soft ripened cheese
    - ✓ most fresh cheese
    - ✓ Most washed cheese.
- Mesophilic cultures include both homo and hetero fermentative cultures

B. Thermophilic requires

Thermophilic cultures defined by their ability to grow at temperatures above 40ºC. With respect to cheese making, their important characteristics are:

- Optimum growth in the range of 39 – 50ºC
- Survive 55ºC or higher
- Minimum growth temperature is about 20ºC. Cell counts decrease rapidly at colder temperatures, so bulk thermophilic cultures should not stored at temperatures less than 20ºC.
- Thermophilic starters are normally mixtures of cocci and rod cultures, which at the time of inoculation are about equal in numbers. Rod/cocci blends grow together in a relationship referred to as “mutualism,” where the growth rate and acid
- Production of the mixed cultures are faster than for either culture on its own. The rods produce amino acids and peptides that stimulate the growth of cocci, and the cocci produce formic acid that is required by the rods.
- The balance between the rods and cocci controlled by temperature and pH

- ✓ The cocci prefer higher temperatures (optimum about 46ºC) than the rods (optimum about 39ºC).
- ✓ The rods are more acid tolerant than the cocci, so, initially, the cocci develop the initial acidity and outgrow the rods. But, as the acidity increases the rods begin to grow faster than the cocci.

- Some thermophilic rod cultures have the ability to ferment galactose as well as glucose, which is desirable in some cheese, especially Mozzarella.
- Although thermophilic cultures produce acetaldehyde, a principal component of yoghurt flavor, none of the thermophilic LAB are considered hetero fermentative

N.B Many times a combination of 2-4 cultures are used.

Figure 10: a) Mesophilic Starter Culture b) Thermophilic starter culture

2.1.3 Rennet activity

Rennet traditionally described in the industry as single, double, or triple strength. Single strength considered that concentration where:

- 200 ml is sufficient to set 1,000 Kg of milk in 30-40 min at 30-32ºC
- In terms of International Milk Clotting Units (IMCU), single strength rennet has about **250 IMCU per ml.**

Setting time the point where the curd will break cleanly and exude clear whey. Coagulation time is the point where flecks of curd first appear on a spatula or slide dipped into the milk.

Coagulation time is about half of setting time, so typically, coagulation using single strength rennet requires 15 – 20 minutes followed by setting at 30 – 40 minutes.

2.1.4 Cheese salt

Salt can enhance the flavor of cheese. Some recipes added to fresh curds, milled curds before pressing, used in a salt brine for after pressing, or even sprinkled or gently rubbed onto the surface of cheese.

Calcium Chloride

This is a salt solution used to restore balance to the calcium in milk, which heat-treated. Any milk that has been pasteurized and cold stored should have Calcium Chloride added. Since the calcium originally in milk can become soluble and will not able to form a firm curd, the result can be a weak curd formation in store bought milk. phase.

Cheese salt has many important functions

- It draws moisture from the curd
- helps drain whey by causing curds to shrink
- inhibits the growth of lactic bacteria toward the end of the cheese making process
- Acts as a preservative by suppressing the growth of undesirable bacteria.

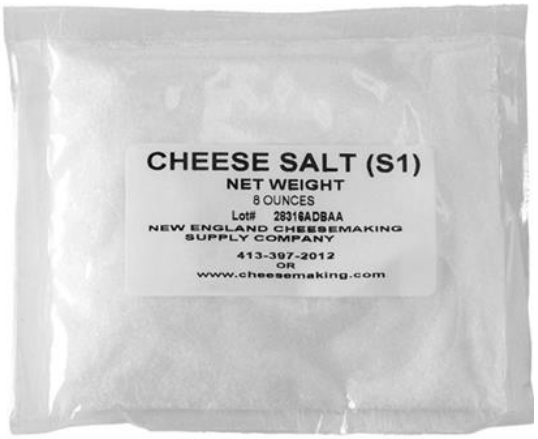


Figure 11: Cheese Salt

2.1.5 Herbs and Spices

Herbs and spices are a wonderful addition to many types of cheese. Variety of combinations that are both delicious and beautiful.

Fresh cheese by rolling the edges in herbs or mix the herbs throughout. Herbs made from Provence, chives, pepper, parsley, thyme, garlic, dill, oregano, basil, sage… with this the sky is the limit.

For a hard cheese, enjoy dried pepper blends, caraway seeds and cumin. With hard cheese, herbs typically added to the curds when filling molds with curd.

2.1.6 Acid

Two common acids when making soft cheese are

- Citric Acid
- Tartaric Acid

Both acids naturally derived and aid in the process of acid development in cheese making.

Citric Acid

Commonly used when making both Ricotta and thirty minute Mozzarella

Tartaric Acid

Used when making Mascarpone

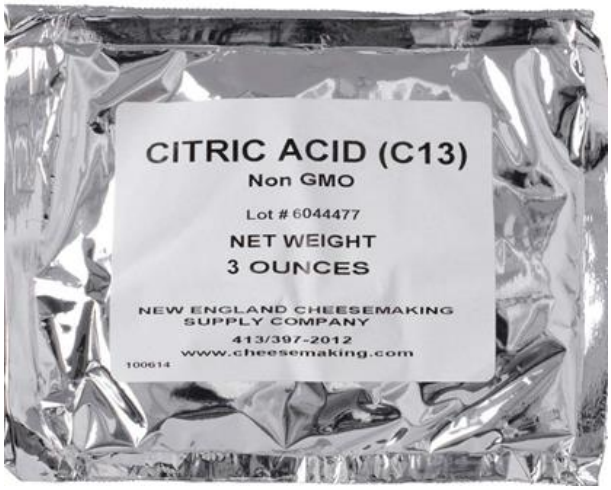


Figure 12: Citric Acid

2.1.7 Lipase

Lipase is a natural enzyme, and added to many types of Italian cheese to help elevate their flavor. Some cheese tends to be mild in taste and the addition of lipase will help give it more complexity.

Both a mild calf lipase to use in cheese such as

- Mozzarella
- Feta and Parmesan
- Sharp lamb lipase use in cheese such as
- Romano and Provolone

Lipase is a cold stored powder and keeps best in the freezer for up to 6 months.

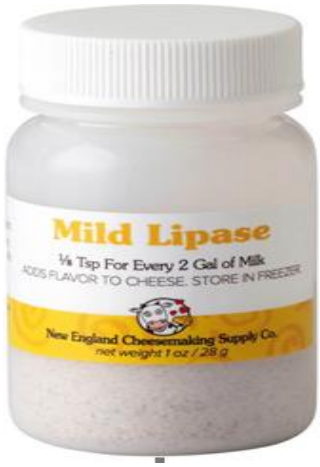


Figure 13: Mild Lipase Powder (Calf)

Self-Check.2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

Self-chech2

1. Write the four ingredient required for cheese making (4%)

_____,_____

_____,_____

2. Write the basic starter culture used for cheese manufacturing! (2%)

_____,_____

3. What are the role of starter culture in determining the quality of cheese (3%)

_____,_____

_____

4. Mention the two common types of acid used in soft cheese manufacturing! (2%)

_____,_____

5. _____Natural enzyme used to elevate the cheese flavor (2%)

. Answer the following question!

Note: Satisfactory rating 7 and 13 points Unsatisfactory below 7 and 13 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____ Date: _____ Score = _____

Information Sheet 3 Adding ingredients at pre-determined levels

3.1 Introduction

Production of maximum quantities of high quality milk is an important goal of every dairy operation. Poor quality milk affects all segments of the dairy industry. During cheese, making it is very important to determined quality levels of ingredients mixed.

The quality level of ingredients are:

A. Milk quality level for cheese making

- Composition
  - ✓ Fat average 3.90% (2% to 7%)
  - ✓ Protein (caseins and whey) average 3.20% (2.5% to 5.5%) (Caseins 2.6 % whey proteins 0.7%)

- Bulk tank Milk bacterial quality level
  - ✓ Somatic cell counts: good <100,000; concern >300,000
  - ✓ Total plate counts: good < 3,000/ml; maximum raw milk 100,000
  - ✓ Preliminary Incubation Count (PIC) <10,000 CFU /mL
  - ✓ Lab Pasteurized Count (LPC) <100 CFU /mL
  - ✓ Coliforms: good < 10/ml; concern > 25; max 100
  - ✓ Psychrotrophes (grow at T < 7C): good < 1,000

B. Select quality rennet

Calf rennet considered the best choice for longer aged cheese, because some of its residual components help to complete the breakdown of proteins. Some of the complex proteins in vegetable rennet can impart a slightly bitter taste after 6 months of aging.

Generally described in the industry as single, double or triple strength. Single strength is considered that concentration where

- 200 ml is sufficient to set 1,000 kg of milk in 30 - 40 min at 30 - 32C

- Setting time is the point where the curd will break cleanly and exude clear whey. Coagulation time is the point where flecks of curd first appear on a spatula or slide dipped into the milk.
- Coagulation time is about half of setting time, so typically, coagulation using single strength rennet requires 15-20 minutes followed by setting at 30-40 minutes.

C. Starter culture

Microorganisms used in the production of cultured dairy products such as **yogurt** and cheese. Provide particular characteristics in a more controlled and predictable fermentation.

Mesophilic is a non-heat loving **culture** and Used for making cheeses that not heated to more than 102^0F degrees. Used to make 90% of the variety of cheeses

Thermophilic is a heat loving **culture** and used to make cheeses that heated to 130 ^{0}Fdegrees.

Since the quality parameter of both starter culture relative, it is advisable to use Mesophilic starter for cold milk and theomorphic for hot milk fermentation.

D. Salt amount required for cheese making

Cheese salt merely a salt that **non-iodized**. Iodized salt harms and inhibits bacterial growth and well-being that is essential to any good cheese making. Iodized salt can also slow the aging process drastically

Salt is a natural preservative and helps to prepare cheese for aging. Salt is important in a number of cheese making steps

- Adds to the flavor of the cheese
- Helps to dry the curds during draining by controlling moisture and causing the curds to shrink
- Essential in the development of a good rind
- Help to kill bacteria and other harmful growth when used as a brine.

Self-Check.3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Mention the two basic milk chemical composition used in cheese manufacturing (3%)

_____

_____

2. List down the most bacteria type and quality level found in bulk Milk in the milk tank (5%)

_____

_____

_____

_____

_____

_____

3._____and_____are cultured dairy product produced from raw milk (2%)

. Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____ Date: _____

Score = _____

Information Sheet 4. Handling safely starter and optional adjuncts

4.1. Function and type of starter

Starter cultures are those microorganisms that used in the production of cultured dairy products such as

- Yogurt
- Cheese.

The natural microflora of the milk is either inefficient, uncontrollable or unpredictable, or destroyed altogether by the heat treatments given to the milk.

A starter culture provide particular characteristics in a more controlled and predictable fermentation.

The primary function of lactic starters is the production of lactic acid from lactose. Other functions of starter cultures may include the following:

- Flavor, aroma, and alcohol production
- Proteolytic and lipolysis activities
- Inhibition of undesirable organisms

There are two groups of lactic starter cultures:

1. simple or defined: single strain, or more than one in which the number is known
2. mixed or compound: more than one strain each providing its own specific characteristics

Starter culture categorized as **mesophilic**, for example:

- Lactococcus lactic sub.sp.cremoris
- L. delbrueckiisubsp.lactis
- L. lactissubsp.lactisbiovar diacetylactis
- Leuconostoc mesenteroides subsp.cremoris

Starter culture categorized as **thermophilic** example

- Streptococcus salivarius subsp. Thermophiles (S.thermophilus)

- Lactobacillus delbrueckii subsp. bulgaricus
- L. delbrueckii subsp lactis
- L. casei
- L. helveticus
- L. plantarum

Mixtures of mesophilic and thermophilic microorganisms used as in the production of some cheeses.

4.2 Origin and Supply of Cultures

The culture used should be suited to the technology employed in order to enable successful acidification. Do not use suspect cultures, those which are badly preserved or which have passed their expiry date.

When ordering commercial cultures, ask

- To avoid dispatch over weekend
- Check the condition of the culture upon arrival; especially when the delivery time exceeds 3 days
- For frozen cultures, ensure that they still frozen on arrival.

In lactic technology, whey used as a culture must come from good quality curd rated by

- Its appearance
- Odor
- Color
- Taste or Ph
- Acidity of the supernatant whey and its storage temperature

Where curd used as a culture, it must meet the same criteria. Indigenous cultures created directly from the milk of hand-milked animals. This technique used in an environment in which pathogens and spoilage flora are controlled - but which is not sterile. The milk taken from animals, which do not present signs of mastitis and must be performed using clean equipment and after hand washing.

The incubation takes up to 48 hours, preferably in a production room (~20°C) and a gel must form within that time.

It should be more or less firm with the characteristic odor, appearance and homogeneity of a well-made curd and sufficient acidity (>75°D, 32-34 °SH, or pH<4.5).

When preparing indigenous thermophilic cultures, producers must carefully follow the correct temperatures and ensure the development of sufficient acidity.

This can involve, for example, "thermisation" up to 60° C for 2-3 minutes, cooling to 45 °C and incubation at that temperature until the acidity reaches eg 54-63 °D, 24 - 28 ° SH or pH 4.7-4.5, depending on the technology employed.

4.3 Storage of starter culture

Commercial cultures should be stored in

- The temperature recommended by the manufacturer
- Stored at cold temperatures
- Away from humidity, light and within their expiry date (expiration date)
    - ✓ In the case of DVI (direct vat inoculation)cultures, check for signs of clumping
    - ✓ For liquid cultures check odor, appearance
    - ✓ the appearance of the curd obtained or the acidification curve of the inoculated milk

The quality of liquid starter evaluated by:

- Its acidity or pH before use
- Close part-used sachets containing cultures correctly
- store them in a container in a clean cold place
- Using them as soon as possible after opening.

Whey used as a culture (back slopping) must be stored in a clean place and in a clean container.

In order to avoid a loss of acidifying capacity

- It must not be stored for more than 3 days. Its use may be postponed by freezing but it should be using within 10 weeks following storage at -18°C.
- It recommend adding powdered milk or previously boiled milk before freezing. Whey should not refrozen after defrosting

4.4 Starter culture optional adjuncts (dose)

Ensure that inoculation dose respected, adjusting the quantity carefully according to the volume of milk. Pack-size is not always suited to the small volumes needed by small producers: where the volume of milk does not correspond to the dose in the **sachet, cultures diluted in 1 liter of UHT (ultra heat temperature)** milk and the required dose of the culture measured proportionally. Do not proceed to ripen the milk before cold storage.

The preparation preserved before use at 4°C and used within 2 days after dilution at the latest, stored in a sealed container.

Cultures weighed out using small sets of scales. Where DVI cultures packed by activity without standardized pack weight, the quantity worked out as a proportion of the total pack weight for each sachet opened.

Self-Check.4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. What is the primary function lactic starters in cheese making processes? (2%)

_____

2. Write the two groups of lactic starter cultures! 3%)

_____

_____

3 What are the required Commercial starter culture Storage requirement? (3%)

_____

_____

_____

4. What are the quality criteria evaluation of liquid starter? (4%)

_____

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score =

Information Sheet.5. Checking equipment

5.1 Equipment for Cheese Making

The equipment used to make cheese at home like:

- Cheese Pot/Vat
- Colander and measuring spoons
- Dairy thermometer
- Curd knife
- Cheese mold
- Drip Tray
- Cheese press
- Butter muslin

5.2 Cheese pot

A pot is one of the most used pieces of equipment in cheese making

Type of Material

Be sure the pot select is made of a non-reactive material

- Stainless-steel
- Heat safe glass
- Unchipped enamel are all great options
- Avoid any aluminum, or any other reactive metal, Teflon, and chipped enamel; these materials have an adverse chemical reaction when used in cheese making.

Stainless steel is favorite option since it easily sterilized and will not have to worry about cracks or chips.

Figure 14: a) Cheese pot (stainless steel) b) Cheese vat and cheese making asses

The size of pot will depend on recipe and how much milk use. Some recipes call for only a quart of milk; others will need at least 2 gallons, or perhaps looking to use 5 or more gallons to make a large batch or multiple cheeses at once

Additional things to look for in a good pot

- Get a pot that does not have rivets on the inside since they can be harder to sanitize.
- When working high temperatures a double boiler is the best way to prevent scorching.
- A pot with a lid helpful in the cheese making process to maintain heat when letting milk set

5.2. Thermometer

A good quality dairy thermometer is an important item to have on hand when making cheese.

Maintaining the correct temperature will help give the most consistent results and being able to rely on thermometer will make the process much easier. Most dairy thermometers even come with a clip that will attach to the side of pot.

There are many varieties **thermometer** including:

- Glass
- Digital or a dial head.

Figure 15: a) Tel-Tru Thermometer b) ChefAlarm c) Pocket Thermometer

5.3. Measuring Cup and Spoon

A. Measuring Cup

The best material for a measuring cup is glass, since it is non-corrosive and easily to see the measurement. Other materials that will work are stainless steel and plastic. If using plastic ensure there are no scratches since they can make it difficult to sanitize.

B. Measuring Spoons

Stainless steel measuring spoons are best for cheese making. Occasionally there will be particularly small measurements such as 1/16 tsp, 1/32 tsp or even 1/64 tsp; it can be helpful to have a set of spoons that include these measurements able to add ingredients more precisely.

Figure 16: Mini Measuring Spoon Set

5.4. Stainless Steel Skimmer

A stainless steel skimmer or slotted spoon is a great tool and will be helpful with many steps in the cheese making process use like:

- To add and properly mix rennet into milk, mix in cultures and some additives
- stir curds
- transfer curds into molds or a lined colander

A stainless steel ladle is preferable although a plastic one will work too. If using a plastic ladle take extra care when sanitizing and cleaning to help eliminate any bacteria that may try to hide in all those tiny holes.

Figure 17: Stainless Steel Skimmer

5.5. Crud Knife

A curd knife should have a thin stainless steel blade long enough to reach to the bottom of pot and usually has a rounded tip so as not to scratch the pot.

…

Figure 18: Curd Knife 14 Curd Knife 12

5.6. Colander

Colanders used quite often in cheese making; chances already have one on hand. Stainless steel, enamel and plastic are all fine to use, but avoid aluminum or any other reactive metal. The colander in conjunction with butter muslin or cheesecloth. The cloth used to line colander when curds placed inside to drain and expel whey.

7. Cheesecloth and butter muslin

Cheesecloth is a woven cotton gauze-like material, which used for lining molds when pressing cheese. Butter muslin has a tighter weave than cheesecloth and used for draining soft cheese and used for lining molds as well. These types of cloth are a staple in cheese making and a few should kept on hand. If taken care of properly the cloth will able to use repeatedly.

How to Clean

As soon as work done with cloth

- Rinse it thoroughly in cold water
- Wash in warm water
- If soap used, be sure it is unscented and rinsed out thoroughly
- Hang cloth to dry
- Store in a zip lock bag until need it again
- Occasionally boiling cloth with some baking soda will help keep it fresh
- Each time use cloth, sterilize it in a pot of boiling water to be sure it is ready for cheese making.

They are differ types of Cheesecloth such as:

Figure 19: a) Cheesecloth b) Butter Muslin c) Plyban Cheesecloth

5.8. Cheese Mold

Molds are forms used to shape cheese. They typically have holes or perforations to allow whey to drain properly. Some have open bottoms while others have perforated bottoms. Common materials are stainless steel or food grade plastic since they are both easy to clean and sanitize

Traditionally molds made out of reeds, wood or clay. On occasionally, still find these old style molds.

Note: If using a homemade mold ensure not made out of a plastic or metal that can leach into cheese. PVC molds not considered as food grade and leach toxins into cheese.

They are many different shapes and Sizes of molds come. In all different shapes and sizes, some cheese will call for a specific type of mold such as

- Camembert
- Ricotta Salata
- Basket Cheese

Figure 20: a) Hard Cheese Mold (Small b) Chevre Cheese Mold

Figure 21: Traditional Basket Cheese Mold

5.9. Drip Tray

A drip tray typically made out of stainless steel and used under cheese mold. When pressing cheese to help direct the whey into a pan or the kitchen sink.

Figure 22: Stainless Steel Drip Tray

5.10. Cheese Press

When making hard cheese will need to consolidate curds by applying weight once, they are in a mold. The easiest and most consistent option to use a cheese press. When selecting a press ensure it is both easy to assemble and clean. A good press will also have a gauge to tell how much weight applied to cheese.

Note: If do not have access to a cheese press. Use weights found around the house to add pressure to the curds. use a scale to check on the weight of a particular item

Figure 23: Cheese Press Dutch Style Cheese Press

Figure 24: Wall Cheese Press Plans

5.11. Cheese Draining Mats

Draining mats are typically made of food grade plastic or reeds. A mat will help the air to circulate on the underside of cheese while drying as well as aging. If a mat is not used moisture, can build up and interfere during the drying and aging process.

Figure 25: a) Reed Cheese Mat b) Fine Mesh Cheese Mat c) Medium Mesh Cheese Mat

5.12. Waxing pots

Melt wax before applying to cheese. A great way to do this is in a pot on the stove. Another good option is to use a heat safe glass or metal container submersed half way in a pot of water this will allow the wax to heat indirectly

Working with wax can be a bit messy one-way to make clean up easier to dedicate pot or container solely to cheese wax. Once done let the wax solidify and cool within pot or container then cover it and store until need to use it next. Using aluminium foil to line surfaces while waxing cheese will catch drips and help with clean up

5.13. Wax Bush

One of the easiest ways to apply wax to cheese is with a brush. When selecting a brush look for one with natural bristles since synthetic ones can melt right into wax. In addition, plan on designating brush solely to waxing cheese since it is nearly impossible to remove all the wax after use. Between uses keep brush in a zip lock bag or store it in with wax.

Figure 26: Cheese Wax Brush

5. 14. Cheese Wax

Wax applied to a hard cheese after pressing and drying for aging process and one of the most convenient ways to protect cheese during aging. Waxing cheese help in easily maintaining the desired moisture level within cheese.

5.15. Cheese Wax

The four different colors of cheese wax are

- Red
- Yellow
- Clear
- Black.

Choosing a color based mostly on personal preference although red is by far most popular. For new cheese maker yellow wax good since it will allow seeing what is going on under the surface without having to take the wax off

Cheese wax is a combination of **paraffin** and **microcrystalline,** which ideal for cheese making. This combination pliable tends not to crack during aging process and easily removed from cheese after aging.

A. Beeswax

Along with cheese wax

- Carry an all-natural bee-wax
- Choose to use beeswax please note that much more brittle and can crack when aging cheese
- Adding vegetable shortening to beeswax to help make it more pliable.

B. Reusing Wax

Cheese is done aging, and have taken off the wax there is no need to throw the wax away.

- Reused over again many times
- To prepare used wax for reapplication
    - ✓ Simply melt it down

- ✓ Strain it through cheesecloth. This will eliminate any particles from wax.
- ✓ High temperatures it takes to melt wax will sterilize it too.

C. Equipment for waxing

Waxing is a messy business. Using older equipment for waxing and dedicating it solely to waxing thereafter. Ideally, use the same container to

- Heat
- Melt
- Cool
- Solidify
- Store wax in

This can a heat safe glass container, a coffee can, an older pot with a lid. Using the same container for all of these steps will cut down drastically on clean up, along with preparation for the next time.

Applying wax with a brush be sure, it has natural bristles otherwise, and they can melt. To cut down on cleaning time even more keep brush in the same container as wax and let the wax melt off when heat things up next time.

D. Caution on Heating Wax

It may seem to take a long time for wax to go from solid to liquid, but once it has liquefied, the temperature will rise quickly. Make it a habit to constantly/ monitor the temperature of wax. If wax reaches flash point, vapors produced are extremely flammable.

The flash point of wax is typically above 300° F. Please do not let wax exceed 250° F. Note. Never leave wax on the unattended stove! The three types of

Figure 27: a) Red Cheese wax b) Yellow Cheese Wax c) Clear Cheese Wax

5.16. Cheese wrap

There are many different types of cheese wrap. Some wraps used when aging cheese while others used for storing a finished cheese.

A. Clear breathable wrap

This wrap is comprised of a single layer of clear cellophane. It breathable and will allow the proper exchange of moisture and gas for fresh air, which helps the ripening cheese surface. It is available in both a mold ripened and a washed rind version.

B. Two ply cheese wrap

This wrap comes in two varieties, one for soft and mold ripened cheese the other for washed rind cheese.

The wrap for soft and mold ripened cheese is comprised of a paraffin coated inner layer which lies against the cheese surface and a micro-perforated outer layer.

The inner layer helps pull moisture away from the cheese surface and the outer layer will allow gas to exchange while controlling moisture loss.

The wrap for washed rind cheese comprised of a sulphurized greaseproof inner layer with a micro-perforated polypropylene outer layer

The inner layer will help pull moisture away from the cheese, restrain surface mold growth and will prevent crystal formation, which can result in a grainy or sandy rind. The outer layer will allow gas to exchange while controlling moisture loss.

C. Foil wrap

This warp is a great option for a finished cheese. It makes a nice presentation and will help slow moisture loss. It used on a well-aged cheese.

Figure 28: a) Croute Fleurie Cheese Wrap (White) b) Two Ply Cheese Wrap (Washed Rind)

C) Ov-tene Cheese Wrap

5.17. PH and Acid test equipment

This equipment used to measure the pH and acidity level of milk, curds and whey.

Monitoring the pH and acidity is not necessary when first starting out in cheese making but once comfortable with the cheese making process and want to improve results and consistency from batch to batch monitoring the pH and acidity can help.

During cheese making the acid and pH, levels are constantly changing and can help let know if cheese is on track for the recipe are working with. Having levels that are too high or too low can affect both the consistency, and taste of finished cheese.

Figure 29: a) pH Indicator Strips 4.0-7.0 b) Acid Testing Kit

5.18. Yogurt Maker

A yogurt maker will help give the most consistent results. When making yogurt milk will need to ripen for at least 5 hours at a warm temperature, a yogurt maker will help with this

There are many different yogurt makers including

- Electric versions
- Non-electric ones. They typically do not take up much space on the counter and if making yogurt regularly it can be helpful to have one on hand.

Figure 30: a) Yogotherm Yogurt Maker b) Yogurt and Greek Yogurt Maker

c) Automatic Yogurt Maker

5.19. Note Book

Taking notes will help to remember some of the wonderful “mistakes” make along the whey. Sometimes that “mistake “made ends up producing a spectacular cheese and by golly want to make the same “mistake” again. Highly recommend keeping notes while making cheese, they will be invaluable to look back on from batch to batch and if using farm fresh milk from season to season as well.

A cheese maker’s notebook is a treasured item have quite a few tattered books lining shelves these days and can’t seem to part with a single one.

Self-Check.5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. List down equipment used for cheese making! (5%)

_____,_____

_____,_____

_____,_____

_____,_____

2._____ equipment used to shape cheese (2%)

3. Write the types of cheese wrap (3%)

_____,_____

_____,_____

4._____ the equipment used for milk fermentation for cheese making (2%)

. Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Information Sheet 6. Setting and operating cheese-making equipment

6.1 Setting and operating Commercial Cheese Making Equipment

6.1. Cheese Making Vats

cylindrical coagulators and hydraulic setting vats has been developed to offer flexible processing for a range of pasta filata cheeses from the small scale right up to industrial scale manufacturing

Coagulator units from configured to process curd with enzymes, and/or citric acid.

Offering precise temperature control and the reliability of servomotor drives.

The technology ensures homogeneous and gentle mixing for top quality texture and flavor of curds.

Hydraulic setting vats overturn able cradles configured process up to 5,000 liters of milk per cycle and allow curd coagulation either in or out of whey

Both cylindrical and hydraulic setting vats ensures precise operating parameters and allows fast recall and switching between processes**.**

6.1.1 Cylindrical coagulators for curd processing

Developed its state of the art CF series of reliable, hygienic milk coagulators to offer cheese producers capacities of 6,000–15,000 liters of milk per cycle

The systems are ideal for processing the highest quality curds from

- Sheep
- Cow or buffalo milk

For the manufacture of a wide variety of Pasta filata, fresh and seasoned cheeses, including

- ✓ Mozzarella
- ✓ Provolone
- ✓ Pecorino
- ✓ caciotta.

The CF coagulator units from GEA carry out the process of milk coagulation, curd cutting, and curd/whey shaking, cooling or heating, to generate maximum yield.

The systems offer the flexibility to process curd with enzymes, citric acid or using a combination process with both enzymes and citric acid.

The cylindrical coagulation vat is equipped with a steam-heated jacket for heating or maintaining the curd temperature.

A sprinkler distributes the rennet homogeneously throughout the milk. At the end of the cycle, the curd/whey discharged through a pneumatic valve at the bottom of the tank, and this valve removes cleaning solutions

The curd churner driven and controlled by a reliable and robust servomotor with mechanical reducer and inverter

The production process manage programmable set and control all working parameters of the production cycle. A memory function allows for up to five presets.

The churner contains a series of sloping blades and balanced stirrers to guarantee homogenous curd mixing and cutting to the required size.

The overall design facilitates maximum curd coagulation and maturation:

- A two-dimensional churning motion ensures that the whole mass of curd turned at each revolution. The balanced stirrers turn the curd axially, while the vat rotation provides radial movement of the curd mass.
- During mixing of the cut curd, radial motion ensures that the grains at the bottom of the churner brought up to the surface repeatedly, which helps to ensure that all the curds discharged.

Coagulation cylinders designed to comply with the most stringent hygiene and sanitization requirements.

The framework is made of AISI 304 stainless steel, and the interior of the vat features rotary cleaning sprinklers for rinsing at the end of the cycle or for sanitization. Cleaning pipes and rotary sprinklers connected to an external CIP plant

Figure 31: Cylindrical coagulators for curd processing

6.1.2 Hydraulic setting vats

Overturn able cradle cheese making vats with capacities of 3,000-5,000 liters

Flexible, reliable overturn able cradle cheese making vats (hydraulic setting vats) for the production of a wide range of pasta filata cheeses, including

- Mozzarella
- Mozzarella balls and braids
- pizza cheese
- Provolone or scamorza.

Configure systems with capacities of 3,000–5,000 liters of milk per cycle, to meet all the requirements of small, medium and large-scale manufacturers.

Versatile cheese making vats enable curd coagulation and maturation either in whey or out of whey, at precisely controlled temperatures.

The machines constructed with a curd churner that incorporates electro polished blades and stirrers, to ensure that the complete mass of curd cut and mixed at each turn. At the end of the churning and maturation cycle, the curd tipped out into drainage trolleys, and any remaining whey removed.

The complete cradle surface is equipped with a steam or water heated jacket, to cook the curd or to maintain a steady temperature.

Cheese making vats constructed to comply with the highest hygiene and sanitization requirements.

Internal rotary sprinklers connected to a cleaning in place plant. The framework of the machines constructed from AISI 304 stainless steel, and all seals are made from food-grade materials.

Features of cheese making vat systems include:

- Vat emptying by means of oleo hydraulic system with pistons.
- Curd churner operated by electronic motor with inverter.
- PLC-control of mechanical parts, churning cycles, timing and speed, with up to five presets.

Figure 32: Hydraulic setting vats

6.2. Molding Machines

Offers drum molding equipment, curd draining, molding and pre-hardening units, and all in one-combination systems.

Dedicated molding machines for provolone and caciocavallo cheeses ensure that customers have options for every cheese type.

Interchangeable molds cater for any cheese size or form, and the capacity to fill molds with or without whey ensures that a wide variety of cheese types handled and processed according to any recipe.

6.2.1 Drum molding machines

Drum molding machines for produce cheese like:

- Traditional shapes of soft pasta filata cheeses
- Soft mozzarella cheese
- Mozzarella balls as well as drier pasta filata types, such as
  - ✓ Scamorza
  - ✓ provola.

- Optional carousels offer the ability to form plaits and knots.
- Units are available with capacities of 180 kg per hour up to 1,400 kg per hour
- Even provide remote assistance for PLC-controlled machines
- Supplied with proprietary non-stick treatment, Vulcan, which offers many advantages over traditional Teflon coating
- Configured with 2, 4 or 6 auger feeders, to meet any process or production requirement and capacity.

Constructed in AISI 304 stainless steel, units designed for

- Automated spherical molding
- Semi-automatic cylindrical molding with carousels, for continuous braids and knot molding
- Electromechanical drives for the augers and molding drum allow for the precise adjustment of both feeder auger and drum speeds
- To ensure a constant pressure in the forming chamber and so consistent product weight.
- Feature thermos regulated hot water jackets to ensure maintenance of the required product temperature. A feeler unit in the auger chamber monitors the cheese temperature.

The solid aluminum drum molds easily interchangeable, and guarantee a perfect seal for minimal loss of whey. Drum rotation effected through a simple, efficient grooved coupling mechanism.

Figure 33: Drum molding machines

6.2.2 Molding and pre-hardening units

Used for the mass production of dry pasta filata type pizza cheeses and kashkaval. Comprehensive range of hygienic, precise and user-friendly units and fully automated production lines tailored to process the highest quality cylindrical and parallelepiped shapes, at capacities of 500-8,000 kg per hour.

As the carousel rotates, the product undergoes pre-hardening by means of cold-water sprays and at the end of rotation; the molds turned out into a hardening vat.

The cooling water passed through an exchanger and recirculated by centrifugal pump. The system operated via a PLC, and configured with pipework and sprinklers connected to an external cleaning in place plant for efficient cleaning.

The feeding unit and carousel completely separated when not in operation, which also aids faster and easier cleaning. All product contact parts are:

- Teflon coated

- The augers and carousel are driven by servomotors for precise control
- Robust operation.

Separately offers both bath (indirect cooling) and shower (direct cooling) machines for cheese molding and pre-hardening, which configured for production capacities of up to 3,500 kg per hour.

The direct cooling system comprises a cheese-feeding unit with auger conveyors, which transfers the cheese from the stretching unit to the molding carousel. As the carousel turns intermittently, the products in the molds cooled to 12-14° C using showers of cold water

After a complete revolution, a pneumatic system then turns the products out from the molds onto a short belt for transfer to the next stage of processing. An electronic size regulator means that cheeses of different heights produced using the same molds.

All the working parameters of the machine are PLC controlled. A centrifugal pump ensures the efficient recovery and circulation of the cooling water and the recovery of cleaning solutions following.

Supply molding and pre-hardening systems in which pre-hardening of the product is carried out by surrounding the molding carousel with a bath of cold water

Available for production capacities of up to 2,000 kg per hour, the systems configured with carousels for molding cylindrical or rectangular blocks of cheese at weights of 300 g to 5 kg each.

All units designed for user-friendly operation to minimize water usage. Water for hardening and pre-hardening recirculated through an exchanger and reused.

A number of machines configured with pipework and sprinklers for connecting to an external cleaning in place.

Figure 34: Molding and pre-hardening units

6.2.3 Molding machines for provolone and caciocavallo

Pasta filata cheese molding machines designed specifically for producing the highest quality provolone and caciocavallo cheeses.

Automated machines for molding

- Provolone cheeses at capacities of up to 1,200 kg per hour
- Caciocavallo cheeses at throughputs of 600 kg per hour

Available with multiple molding sections, all systems feature PLC control. Servomotor drives with mechanical speed variation enable precise control of the augers feeding the molding units.

Molded products then gently turned out from the molding cups using a pneumatic unit.

Electrically controlled water heated jackets ensure that the optimum product temperature maintained, and pneumatic systems operate cutting blades.
Configure 2 ad 4 molding section machines for automated caciocavallo forming.

A water recycling system allows the jacket heating water to recirculated and reused

All surfaces that contact with the product are Teflon coated. Augers easily dismantled, and all edges and corners rounded so that cleaning fluids can easily reach into every ingress.

Figure 35: Molding machines for provolone and caciocavallo

6.3. Stretching Machines - Water

an extensive range of hot water stretching machines with augers, dipping arms and rotary paddles, together with curd cutting equipment for highly versatile batch or continuous processing of curd cheeses.

Developed hot water stretching machines that allow customers to process a wide range of curd cheeses.

Stretching machines guarantee gentle curd handling to retain optimum cheese texture, structure and flavour

Systems feature precise control of water delivery and temperature, cheese residence time and whey recovery.

Stretching machines combined with the range of dry and liquid salt dosage equipment and mold machines including high-capacity carousel (container) systems. Options

include pipework for external cleaning in place, Teflon or Vulcan non-stick treatment, and PLC automation and control with remote assistance

6.3.1 Curd Cutters

Used for :

- Ideal for both batch and continuous curd processing
- With holding capacities of up to 500 kg curd
- The technologies developed to guarantee robust, reliable and safe operation.

Curd cutter units constructed around an accumulation vat with a sloping chamber. A rotary auger at the end of the accumulation vat transfers the curd to an adjustable rotary cutter. This cuts the curd into small pieces, the thickness of cuts changed by adjusting the position of the cutting knives.

The auger speed adjustable to vary the amount of curd passing through the cutter. Whey removed and collected in a recovery vat equipped with grilled strainer. A pipe then connects this vat to the downstream stretching machine. Curd cutter models designed to the highest specifications and hygiene standards.

Options include the provision of sprinkler valves throughout the chamber and associated pipework for connecting to an external cleaning in place plant. It is also possible to configure some models units with safety sensors that automatically stop operation if inspection panels to the cutter opened.

Figure 36: Curd Cutters

6.3.2 Hot water stretching & Mold unit with dipping arms

Hot water stretching and molding unit with dipping arms mini-compact for production capacities up to 100kg/h.

MINICOMPACT system is a completely self-contained hot water stretching and molding machine that can produce a wide range of stretch curd cheeses.

The unit features a rotary disk cutter with adjustable knives, and supplied with automated spherical or cylindrical molding units to produce individual cheeses from 5 g up to 1 kg

A version of the mini-compact system available with a steam inlet to enable steam stretching.

Hot water delivery to the mini-compact system through the inlet controlled precisely using manual micrometer valve

The ability for fine control of hot water at the required temperature allows producers to process a range of stretched curd products, from very soft mozzarella to drier, pizza-type cheeses.

The mixing vat and molding head are also fitted with hot water jackets, so that the correct working temperature maintained throughout the stretching and molding processes.

Prior to mold the stretched cheese passed through a pressing tool to ensure the correct amount of water retained.

Stretching machines built to offer robust, reliable operation. The mini-compact unit constructed with servomotor drives and mechanical speed aviators to guarantee accurate control of the variable speed feeding augers and molding drum.

Machines constructed using stainless steel AISI 304, and feature Teflon coating on augers, mixing arms and the machine body

Mechanical and electromechanical protection built in to dangerous areas to ensure operator safety

The mini-compact system’s hygienic design includes wide curvature in corners, and multiple inspection points, to facilitate cleaning and ensure compliance with the strictest requirements.

Figure 37: Hot water stretching & Mold unit with dipping arms

6.3.3 Stretching machines with dipping arms

Hot water stretching machines with dipping arms for production capacities of 100 - 3,000kg/h.

Hot water stretching machines with dipping arms create elongated, overlapping cheese fibers that are particularly suited to producing soft, fresh mozzarella cheeses, including balls and braids.

Batch and continuous systems to meet any industry requirement, and production capacities of 100-3,000 kg/h.

Developed its hot water stretching machines in partnership with the industry. For smaller producers and pilot-scale operation of up to 200 kg/h

Designed a range of all in one, compact hot water stretching machines with dipping arms that carry out stretching and molding in a single unit

Continuous production systems developed for medium to industrial-scale capacities, and guarantee optimum processing and reliability. These larger-scale systems connected to any of molding units.

Continuous production machines feature double walled feeding tunnels in which two counter rotating carry out pre-stretching before the curd reaches the mixing chamber with dipping arms. Servomotor drives with mechanical inverters guarantee accurate speed control and reliable operation, while delivery of hot water to the feeding tunnel and to the mixing vat controlled precisely using manual micrometer valves

Adjustable piping configuration enables very fine control of the liquid level in the vat, while waste whey (and cleaning solutions) recovered in a separate vat with strainer and centrifugal pump.

Machines are constructed using stainless steel AISI 304, and feature Teflon coating on augers, mixing arms and the machine body

Stretching machines include mechanical and electromechanical protection on dangerous areas to ensure operator safety.

Hygienic design complies with the most stringent regulations, and facilitates efficient, effective cleaning to minimize water usage and machine down time. Remote assistance.

Figure 38: Stretching machines with dipping arms

3.4 Stretching machines with rotary paddle

Hot water stretching machines with rotary paddles for production requirements of 500 – 6,000 kg/h

Hot water stretching machines with rotary paddles are ideally suited to producing dry and hard cheeses that have an elastic and fibrous texture, including dry mozzarella for pizza, scamorza and provolone

Worked with industry to develop a series of seven versatile machines with rotary paddles, which meet production requirements of 500-6,000 kg/h.

Hot water stretching machines with rotary paddles offer the industry reliable and robust continuous systems for medium to high industrial scale throughput.

The machines used with dry salt dosing systems, and connected to any range of molding units, including carousel machines for high capacity.

Hot water stretching machines with rotary paddles ensure optimum stretching, water content and temperature control.

Two counter rotating augers in the feeding tunnel pre-stretch the curd pieces as they transported from the cutting unit into the mixing vat. Manual micrometric valves control the amount of hot water delivered to both the feeding tunnel and to the mixing vat. The hot water also pasteurizes the cheese stretched by the rotary paddles.
After the required residence, time in the mixing vat the stretched cheese conveyed to the molding unit by two augers.

Waste liquid passed through a grilled filter into a feeler-controlled vat, from where it pumped away

Hot water stretching systems designed for optimum reliability. Servomotor drives with mechanical inverters guarantee robust operation and enable highly precise control of auger and paddle speeds.

The augers, paddles and machine body are Teflon-coated, and specific models supplied with innovative non-stick Vulcan treatment, which offers a near-permanent alternative to Teflon coating.

Mechanical and electromechanical protection incorporated in dangerous areas of all systems to ensure operator safety, and hygienic design means that hot water stretching technology complies with the most stringent of regulations.

Solutions supplied with all the required pipework and sprinklers for connection to a cleaning in place plant, to ensure the most efficient cleaning, reduced water consumption, and cleaning solution recovery.

Curd Drainage, Maturation & Feeding

Worked alongside industry to develop complete systems for curd feeding, drainage and maturation, which give our customers versatile options for processing a wide range of pasta filata cheeses. Batch and continuous solutions will let produce the highest quality curd cheeses, whatever process.

Fully automated batch maturation and drainage systems that can process up to 1,250 kg of curd cheese. Our continuous drainage and maturation solutions are ideal for processing for higher throughputs.

Systems allow maturation both in and out of the whey designed to highly configurable, cost effective and sustainable.

Technologies guarantee gentle curd handling and programmable, controlled curd heating, cooling and retention times. Teflon coated augers with electronic control, finely adjustable cylinder rotation and guillotine cutters and precisely heated cylinder jackets guarantee reproducible and reliable processing.

Figure 39: GEA Stretching machines with rotary paddle

4. Batch drainage and maturation DMC systems with auger

Automated curd drainage and maturation systems used in the production of various types of pasta filata cheese. Batch type DMC systems are available with capacities up to 2,000 kg.

The DMC batch systems integrated with adjustable-speed rotating coagulation cylinders that produce the curd, and with conveyors to pass the matured curd directly to stretching machines.

Comprising an external and internal vat with integrated auger, the DMC systems allow whey to drain through a perforate metal sheet. For recovery in lower part of external vat, from where it sent to a recovery line

The curd retained in the vat for a predetermined time to mature. During maturation the auger rotated both forwards and backwards to gently, agitate the curd. At the end of maturation, the auger moves the curd towards the rotary disc curd cutter, for cutting and passing on to the stretching machines

Features and options:

Features and options of the DMC systems include

- 600 mm auger capable of continuous and intermittent running
- electronically controlled auger speed with inverter and sensor
- auger support with mechanical gaskets
- rotary disk curd cutter

Continuous system

Continuous drainage and maturation system that is ideal for the production of large quantities of a single type of curd

The continuous system comprises a curd maturation and transport tunnel with drainage baskets, the allow curd maturation both in and out of whey is possible. A centrifugal pump sends drained whey to the recovery line using a centrifugal pump.
After maturation, the curd tipped out of the baskets to the lower part of the tunnel, where the 500 mm rotary auger transports it is to the guillotine the curd cutter unit to cut into predetermined sizes, before transportation along a conveyor system to the stretching machines.

Teflon-coated augers supplied for both the batch and continuous curd drainage and maturation systems. Precise control of the auger movement, curd transit and retention time guarantees optimum maturation and curd attributes.

Figure 40: Batch drainage and maturation DMC systems with auger

4.1 Continuous curd drainage and maturation tunnel systems

Automated curd drainage and maturation systems to produce various types of pasta filata cheese. Continuous tunnel systems are available with capacities of up to 6,000-8,000 kg/h.

The continuous drainage and maturation tunnel system from GEA designed to produce large quantities of a single type of curd.

The system comprises the following elements:

- A **rotating drainage drum** for faster drainage. The hygienic design makes cleaning easy.
- A **curd maturation and transport inclined tunnel**, through which the rotary auger transports the curd. The inclination of the tunnel allows a partial maturation of the curd with the whey. The electronically controlled auger speed, with inverter and sensor, allows for flexible production and maturation time.
- A **final guillotine** to cut the curd precisely into customized sizes, followed by a conveyor to the stretching machines.
- A **centrifugal pump** for the recovery of the drained whey.

Improved curd drainage and maturation system for pasta filata cheese

Drainage improved because of the curd pressure created through the accumulation of curd during tunnel filling. Precise control of the auger movement, curd transit and

retention time allows optimum maturation and the development of the desired curd characteristics.

Continuous tunnels are constructed using AISI 304 stainless steel and supplied with automatic cleaning-in-place to comply with the most stringent sanitization regime and hygiene regulations. Automated cleaning reduces water usage and the need for manual cleaning and minimizes stoppage time thereby reducing production costs.

PLC control optimizes automation and working parameters to reduce manual intervention. The sensors allow for the precise control of the curd temperature. Maturation times precisely controlled with double-walled jackets for hot water heating along the complete length, and a piping system for product cooling.

Safety first for curd processing

GEA builds the highest standards of safety into all its systems. The curd maturation and drainage technologies feature mechanical barriers or proximity switches to protect operators close to the danger zones, and safety switches ensure that no operation continued if the requisite protection features have not engaged.

GEA can configure continuous curd drainage and maturation systems to fit plant layout, footprint and utility supply.

Benefits of GEA curd tunnel systems at a glance

- Systems available with capacities up to 6,000-8,000 kg/h
- Rotating drainage drum for faster drainage
- Inclination of the tunnel enables a partial maturation of the curd with whey
- Improved drainage is achieved through the accumulation of a high curd layer during tunnel filling
- Electronically-controlled auger speed with inverter and sensor for flexible production and maturation time
- Auger support with mechanical gaskets for easy cleaning and maintenance
- Guillotine cutting into customized sizes
- Hygienic design for easy cleaning

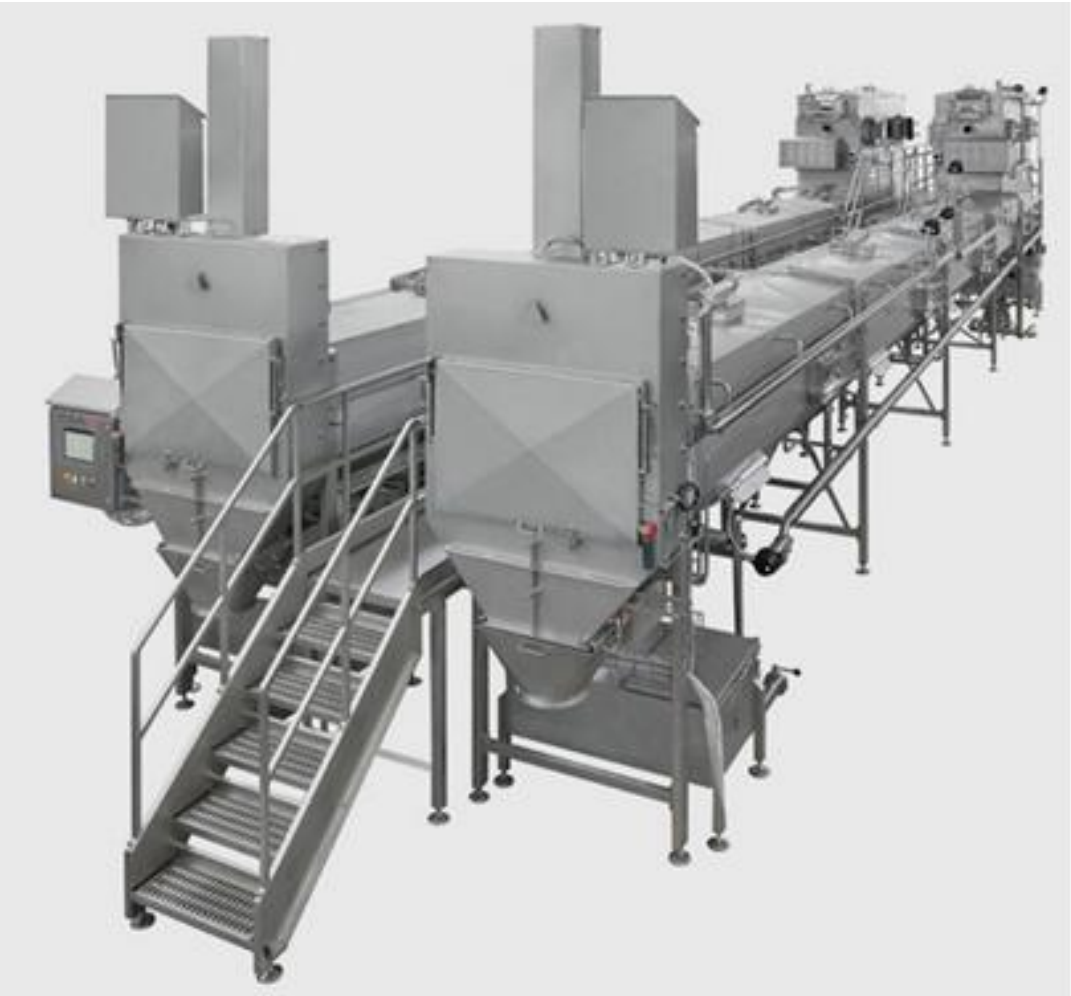


Figure 41: Continuous curd drainage and maturation tunnel systems

5. Feeding units

The feeder cutter unit from GEA offers customers flexibility and versatile processing, combined with gentle curd handling to retain top quality.

Offering low operating and maintenance costs, our feeder cutter machines are also energy efficient, and designed with the highest level of safety features, including mechanical and electro-mechanical protection of all danger zones.

Feeder units from GEA comprise an accumulation vat into which the curd transferred, either by hand or automatically, and which contains a 500 mm auger to transfer the curd to a pneumatically controlled curd cutter unit. Vats with capacity 1000-2,000 kg product supplied, and both the vat and strainer for whey recovery incorporate level feelers.

The auger programmed precisely to rotate either continuously or intermittently. This rotation feeds the curd to the curd cutter unit, which attached to the distal part of the vat.

The cutter comprises guides that move the curd to a blade with knives that cut the curd in parallel pipedal strips.

The blade driven by a pneumatic system that programmed to regulate the frequency of the down stroke.

The timing of the auger rotation and the blade down strokes are set independently to each other, so that the thickness of the cut curd slices adjusted precisely. The cut cur conveyed by means of an auger loader at the end of the accumulation vat, to the stretching lines.

GEA can supply a bi-directional chute with pneumatic control and two sonar feelers, to feed two stretching machines simultaneously.

The GEA feeder unit constructed from AISI 304 stainless steel, and features electro-mechanical drives and a waterproof control panel.

Figure 42: GEA feeding units

6. Salt Dosage System & Hot Water Heaters

Salt dosing is a key stage in producing many types of curd cheeses. GEA offers a comprehensive range of equipment for the precise dosing and homogeneous mixing of either liquid or dry salt. Also direct and indirect steam water heaters for cheese processing, which configured to heat up to 2,000 liters of water to 90°C, every hour.

6.1 Dry Salt Dosage Systems

GEA can configure dry salt dosage systems with tank capacities of 150-300 kg dry salt. Each unit in our portfolio designed to be energy efficient, and promise low operating and maintenance costs.

GEA offers a versatile portfolio of reliable and robust dry salt dosage systems for dispensing precisely measured quantities of salt to stretched curd cheese. Addition of salt after stretching and before molding prevents issues with curd structure, elasticity and shelf life that can otherwise occur due to poor water absorption.

Dry salt dosage systems constructed around a double truncated cone-shaped dry salt vat, which kept in constant rotation to help stop the salt clumping, and heated via an external jacket.

The tank contains spoons that scoop the salt into a hopper, from where it transferred to a conveyor pipe. At the end of this pipe, a variable-speed auger system transfers the salt to the curd coming out of the stretching machine.

The curd cheese transferred to a Teflon-coated chute in which it flattened by an adjustable paddle.

The cheese transported along this chute to a rotating drum. A sensor system automatically detects the thickness and speed of the stretched pasta filata as it moves along the chute, and this data sent to a PLC that adjusts the speed of the salt distribution auger, to ensure that the precise amount of salt dosed then dosed.

The cheese and salt combined in a rotating drum and transferred to a kneading unit that contains counter-rotating augers. From the salted pasta filata cheese is transferred to the molding station.

The cheese and salt mixing tunnel configured with pipework for connection to a cleaning-in-place (CIP) plant.

Whey and cleaning solutions from CIP collected in a vat that is connected to a centrifugal pump. Servomotor drives operating the salt distribution and mixing augers guarantee precise, reliable operation.

Offering automated adjustment and fine control, GEA salt dosage systems are accurate to within 0.1% salt dosing. The units are constructed using stainless steel AISI 316 to withstand the corrosive activity of salt.

Figure 43: Dry Salt Dosage Systems

6.2 Hot water heaters for cheese

GEA offers a versatile range of energy-efficient water heaters for supplying hot water for pasta filata cheese processing. The technologies offer fast, accurately controlled heating, with options including stretching water recirculation

Water heaters to meet any production requirement and capacity for pasta filata cheese processing.

- 200 liters direct steam hot water vat can heat 350 liters of water from 10°C to 85°C, every hour
- operating at 3 bar steam pressure
- The thermos-regulated system features a silencer injector in the steam inlet pipe, and solenoid valve.

Direct steam water heater for jackets, which can heat 120 liters of water from 20°C to 90°C in eight minutes, operating at 3 bar steam pressure. Water temperature monitored and regulated via a control system that features a highly accurate temperature gauge, thermoregulatory and electronically controlled on-off steam inlet valve. Water circulated continually via a centrifugal pump.

Indirect steam water heaters from heat 2,000 liters of water to 90°C, per hour. The stainless steel rectangular tank contains a stainless steel double pipe coil for heat exchange. An automatic water level gauge and solenoid valve control the amount of water in the tank.

The water temperature adjusted using a thermoregulatory feeler system connected to a modulating valve steam inlet.
Sprinklers connected to an external cleaning in place plant allow for optimum cleaning and reduced operator intervention. Safety features include protection grills to prevent accidental contact with steam. The system configured to enable recirculation of the stretching liquid.

Figure 44: Hot water heaters for cheese

6.3 Liquid salt dosage systems

Salt addition is a key stage in the processing of a range of pasta filata-type cheeses.

Technologies for the dosing of precise quantities of liquid salt solutions, and accurate temperature regulation. User-friendly technologies demonstrate low maintenance and operating costs, coupled with optimized energy efficiency.

Configures both stainless steel and fibreglass-reinforced plastic tank systems for liquid salt dosing, with capacities of up to 800 litters. All systems have developed to meet the highest hygienic requirements, and promise robust and reliable operation.

Thermos-regulated system for salt dosage constructed around a cylindrical stainless steel tank with capacity of about 800 liters, in which the salt solution is prepared.

The cold salt solution then passed from the tank by centrifugal pump to the heating station, which comprises a heat exchanger with titanium plates. Heated saline solution then piped to the stretching machines.

The desired temperature of salt solution easily set by the operator. The actual temperature monitored by a feeler unit in the delivery pipe. This temperature data then sent to the modulating valve, which automatically adjusts the flow of steam. Dosage of solution at correct temperature adjusted by the operator at a valve in the delivery line.

Two-tank system for liquid salt dosing.

- In the first fiberglass reinforced plastic tank, up to 1800 liters of saturated salt solution prepared
- The saturated solution then pumped to the second fiberglass-reinforced tank, where it mixed with fresh water to reach the exact salinity required.
- The amount of saturated saline taken into the second tank automatically adjusted to ensure the precise final salt concentration.

The Final saline solution is heated using direct steam injection, with temperature control maintained via a thermoregulatory feeler system, which adjusts the steam inlet valve. Vats with level feelers then feed the saline solution to the stretching machines.

Figure 45: Liquid salt dosage systems

7. Hardening and Brining Vats

Brining and hardening the final, worked with the industry to develop a modular, configurable series of brining vats and hardening vats that configured to fit any plant layout and capacity.

Brining and hardening vats tailored to meet the processing requirements of a wide range of cheese types and sizes, and any production capacity. Configure systems on two or more levels to reduce footprint when space at a premium. Brining and hardening vats constructed with centrifugal pumps and plate heat exchangers to recycle brining and cooling water, and to recover cleaning solutions after the cleaning cycle.

7.1 Brining vats

Brining vats used to add salt to pasta filata cheeses during the final cooling stage. Offers a modular system of brining vats that configured on either one or multiple levels and different shapes, to match production rate and plant layout. Additional units easily added when extra capacity needed, or removed if production capacity reduced.

Brining vats are constructed using AISI 316 stainless steel, and offer a modular solution that customized according to the cheese type, size of individual product and hourly throughput

The cheeses transferred into the vat by a conveyor, and moved through the brine solution to the distal end by means of adjustable water sprayers that positioned at intervals above the surface of the vats.

Product advancement regulated using an electrical motor-driven cruising system. Products removed from the end of the vat by means of a motorized belt comprising modular plastic elements.

Brining vat set-ups constructed on two levels configured with a pneumatic lifting system to move the products between levels.

The systems designed for optimum hygiene and easy cleaning. Brining vats feature pipework and rotary washing turbines for connection to external cleaning-in-place plants.

Each system configured with a centrifugal pump that has the dual roles of recycling the cooling brine water to a plate heat exchanger for recirculation, and recovering cleaning solutions after a cleaning cycle. Mechanical and electromechanical protection on dangerous areas ensure optimum safety for operators.

Figure 46: Brining vats

7.2 Hardening vats

The hardening vat is the last component in the processing line for pasta filata cheeses, which contains cold water to cool the products prior to packaging

Offers a range of robust, hygienic, modular hardening vats that configured to meet any cheese type or production throughput.
Hardening vats constructed in AISI 304 stainless steel. A complete system comprises an initial module that houses the motorization for conveying products through the vat, a number of central, cold water-filled 4 m vats through which the cheeses transported, and a final module that includes the extraction belt for removal of the cooled cheeses.

The total length and capacity of the vat configure to meet the required production throughput, and can be easily expanded or reduced by adding or removing modules. The cheeses arriving from the molding machine transferred into the vat via a loading hopper.

The products conveyed along the vat from one end to the other by a system that combines a crank-operated series of oscillating stainless steel beds at the base of the vat, and a series of adjustable water jets above the vat.

The oscillating beds set at different cycles that either keep advancing the products through the vat, or retain them in one position for a required length of time. At the end of the unit, the cheeses extracted automatically using a motorized belt.

Hardening vats include pipework and centrifugal pump for recycling of cooling water by recirculation through a heat exchanger

The pump also recovers cleaning solutions after a cleaning cycle. Electrical controls housed in a waterproof panel.

Figure 47: Hardening vats

8. Stretching Machines Steam

Steam stretching offer a number of advantages over traditional hot water stretching, for producing a wide range of curd cheeses

Batch and continuous steam stretching units and combination steam and hot water stretching systems, which can enable energy savings of up to 30%, result in significant increases in yield, and reduce water usage and waste.

Batch and continuous steam stretching units configured with dipping arms or with rotary paddles. The systems that operate just with steam, or with a combination of steam and hot water. Available with capacities of up to 6,000 kg/h, all our units connected to GEA molding systems for seamless processing.

8.1 Steam Stretching Machines Batch type

Offers a range of steam stretching machines for batch production that can improve yields by up to 1% when compared with hot water systems.

Steam stretching offers an alternative to hot water stretching for the production of many different types of pasta filata cheese, including fresh mozzarella, braids, loaves for pizzerias, scamorza or caciocavallo. Offers a range of steam stretching machines for batch production that can improve yields by up to 1% when compared with hot water systems.

Worked with the industry to develop a range of batch steam stretching machines available either with dipping arms, or with rotary shafts.

The systems process very soft mozzarellas and drier, pizza-type cheeses, at production capacities ranging from 200 kg/h to 1,000 kg/h.

All stretching machines connected to any of range of **drum molding, molding units** or special molding machines.

The curd cheese heated using steam that is injected directly into the lower half of the cylindrical mixing vat through multiple automatic pneumatic needle valves. The chamber features a hot water jacket to facilitate precise temperature control of the curd, and a feeler gauge continually monitors and displays the cheese temperature.

Machines built for reliable, robust performance. Steam stretching solutions constructed with servomotor drives to guarantee accurate speed control of the dipping arms or rotary shafts, and electrical motor-reducers to ensure constant speed of the cylindrical chamber.

machines are constructed using stainless steel AISI 304, with Teflon coating on augers, mixing arms and the machine body. Supply units treated using innovative Vulcan technology, which offers a near-permanent alternative to Teflon.

All steam stretching technology developed to offer optimum hygienic design that complies with the most stringent regulations. Certain units supplied with cleaning pipes and sprinklers for connection to an external cleaning-in-place plant, which reduces water usage, and minimizes down time

Mechanical and electromechanical protection on dangerous areas ensures operator safety, and remote assistance

Figure 48: Steam Stretching Machines Batch type

8.2 Steam Stretching machines Continuous Type

Continuous steam stretching machines are ideal for medium and large-scale production with capacities of 500 kg/h to 6,000 kg/h.

Steam stretching offers an alternative to hot water stretching for the production of many different types of pasta filata cheese, including fresh mozzarella, braids, loaves for pizzerias, scamorza or caciocavallo.

Using this technique the steam incorporated into the product, so no stretching water or whey generated as by-products. This minimizes the need for liquid recovery, skimming

or cooling, and enable energy savings of 30%. Steam stretching also increase production yields by up to 1% when compared with hot water stretching.

GEA has used its industry, technology and engineering expertise to develop a range of continuous steam stretching machines with dipping arms or with rotary paddles, which can operate either with steam alone, or using a combination of steam and hot water

stretching machines are ideal for medium and large scale production, with capacities of 500kg/h to 6,000 kg/h. systems can also be connected to any of our range of drum molding, molding units or special molding machines.

Continuous steam stretching solutions feature double walled feeding tunnels, through which the curd cheese transported by two counter rotating augers from the cutting units with adjustable knives, to the main mixing vat with dipping arms or with rotary paddles.

The augers carry out pre-stretching of the cheeses transported to the mixing vat. Multiple steam injection points add the required amount of steam directly to the feeding tunnel and to the mixing vat, for incorporation into the cheese pieces
The temperature monitored using multiple feeler units, and steam delivery to the mixing vat controlled precisely using automatic pneumatic valves.

Combination systems have additional hot water inlet points in both the feeding tunnel and mixing vat, which controlled using a flow meter and manual micrometric valves. Systems designed to be robust and reliable, and feature servomotor drives with mechanical inverters that guarantee the most reliable operation at all speeds

PLC softwareensures the precise control of temperature at every stage, as well as controlling residence times, valve opening and cleaning cycles. The PLC software can also store multiple recipes.

Machines are constructed using stainless steel AISI 304. Surfaces in contact with the product are Teflon coated, but we can also supply systems treated using patented non-stick Vulcan technology. Vulcan is an innovative, mechanical-chemical treatment that offers a highly effective, near-permanent alternative to Teflon.

Vulcan represents an innovative mechanical-chemical technology that involves multiple rounds of mechanically polishing the metal surface at different pressures and angles. The process generates a non-stick surface that has a virtually limitless lifespan. This is a major benefit compared with traditional Teflon-coating, which may wear or even chip off and require periodic reapplication. Vulcan is also highly resistant to cleaning-in-place cycles

Continuous steam stretching systems also feature mechanical and electromechanical protection built in to all dangerous areas, as well as electromagnetic sensors to ensure operator safety. Complying with the most stringent requirements for hygienic design, our systems provided with pipework and sprinklers for connection to a cleaning-in-place plant. Remote assistance

Figure 49: Steam stretching machines continuous type

Self-Check.6	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Write the two types of commercial cheese making vat! (2%)

_____

_____

2. Write the three types of commercial cheese making molding machine! (3%)

_____

_____

_____

3. Write the three types of commercial cheese making molding machine! (3%)

_____

_____

4. Mention the two types of Hardening and Brining Vats (2%)

_____

_____

. Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score =

Information Sheet 7. Loading Ingredients into the plant at required stage

7. Loading Ingredients into the plant at required stage

Most types of cheese only need two or three ingredients, milk, cultures and rennet. These simple ingredients will ripen the milk, form curds and whey and add flavor to the finished cheese. Milk is the most important ingredient in cheese

Cheese making described as the process of removing water, lactose and some minerals from milk to produce a concentrate of milk fat and protein

The essential ingredients of cheese are

- Milk
- coagulating enzyme (rennet)
- bacterial cultures
- Salt
- Rennet causes
  - ✓ The milk proteins to aggregate and ultimately transform fluid milk to a semi-firm gel gel cut into small pieces (curds)
  - ✓ The whey (mostly water and lactose) begins to separate from the curds.
  - ✓ Acid production by bacterial cultures is essential to aid expulsion of whey from the curd and largely determines the final cheese moisture, flavor and texture.

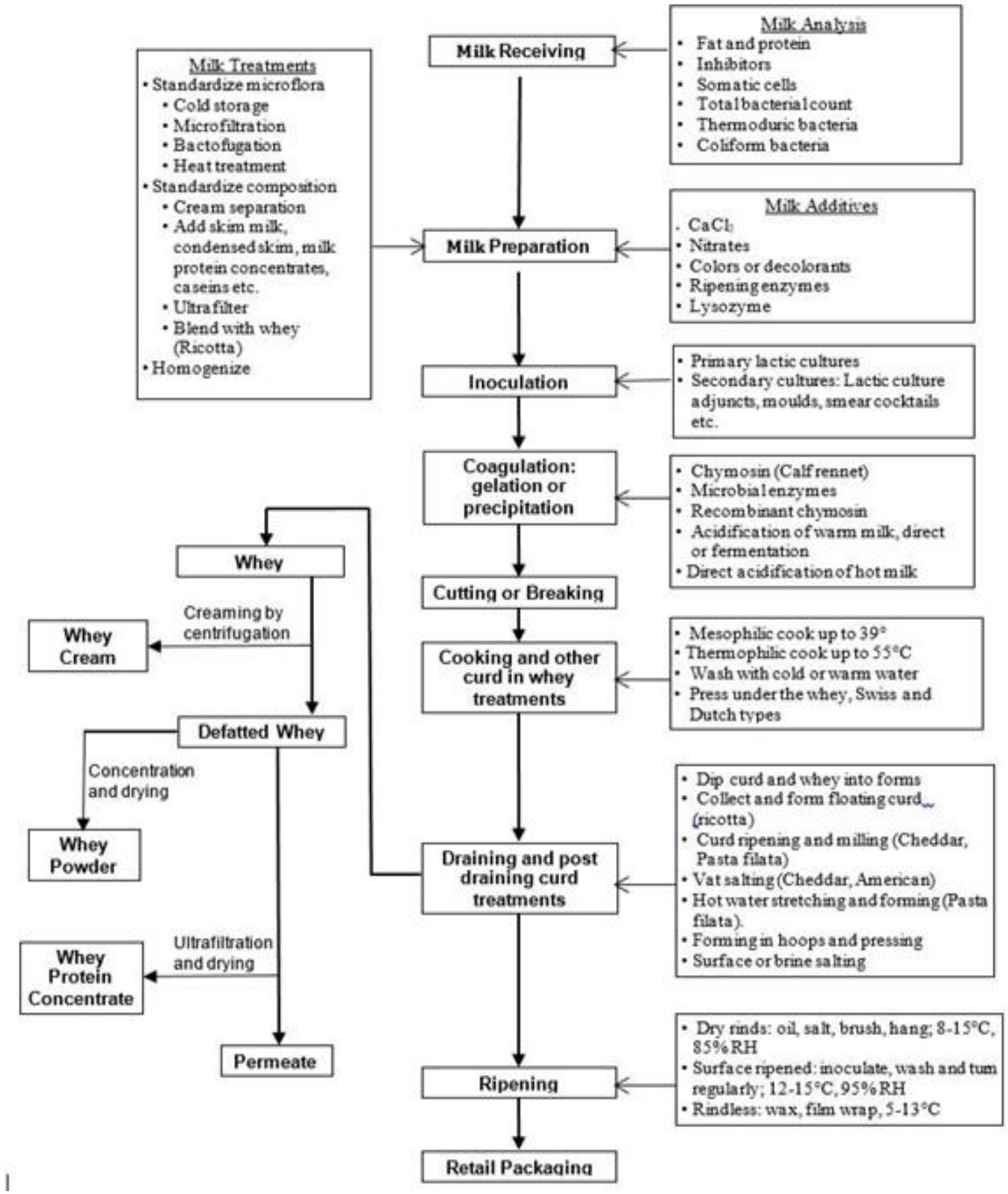


Figure 50: General operations of cheese making

1. Cheese coloring

Usage: 20-50+ drops per gallon of milk.

Using cheese coloring now is the time to add it. Be sure to mix it into milk thoroughly.

- It is best to add a little bit at a time and mix in after each addition until desired color occurred
- Coloring needs to add prior to
  - ✓ Calcium chloride
  - ✓ Cultures
  - ✓ Rennet. Coloring should be mixed in thoroughly, if not it can leave dark spots
  - ✓ Streaks in finished cheese.

Before adding to milk dilute cheese coloring in ¼-cup cool potable non-chlorinated water then add mixture to milk and stir in thoroughly. This will ensure even dispersion when added to milk.

Figure 51: Cheese Coloring

2. Calcium Chloride

Usage: ¼ tsp per gallon of milk.

This will help produce a nice thick curd.

- Recommend using it when making cheese with store bought milk as well as goat's milk
- Calcium chloride will need to add prior to cultures and rennet.

Note. Calcium chloride should not used with any cheese that needs to stretch such as mozzarella and provolone.

Before adding to milk, dilute calcium chloride in ¼-cup cool potable non-chlorinated water then add mixture to milk and stir in thoroughly. This will ensure even dispersion when added to milk.

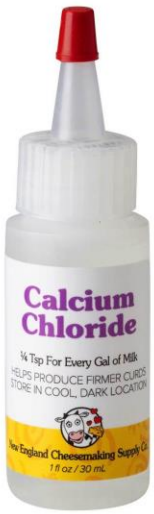


Figure 52: Calcium Chloride

3. Lipase

Usage: 1/16-1/8 tsp per gallon of milk.

Lipase help add a more pronounced flavor to cheese. It needs to add prior to rennet.

- Using a culture packet that has rennet in it, add lipase ahead of time.
- Using a separate starter and rennet, add lipase just prior to adding rennet.

Before adding to milk

- Dissolve Lipase in ¼-cup cool potable non-chlorinated water
- let sit for 20 minutes then add mixture to milk
- stir in thoroughly
- This will ensure even dispersion when added to milk

Figure 53: Mild Lipase Powder (Calf)

4. Citric Acid

Citric acid used to increase the acidity in milk and called for in recipes such as mozzarella and ricotta.

Before adding to milk

- First dissolve citric acid in ¼-cup cool potable non-chlorinated water
- Add mixture to milk
- Stir in thoroughly
- Ensure even dispersion when added to milk

Figure 54: Citric Acid

5. Adding mold powder

Mold powders added when making certain types of cheese such as

- Camembert
- Brie
- Blue and Triple Cream

Using a mold powder simply add it in at the same time as cultures unless otherwise stated in recipe.

Different types of mold powders:

- White Mold Powder
- Blue Mold Powder
- Red Bacteria Linens

A. Penicillium Candidum (SAM3)

White mold powder used to ripen and flavor cheese. This mold powder provides moderate proteolytic activity moderate lipolysis (aroma), medium surface density and height, and used to achieve a moderate fast ripening time. Best known to deter the growth of mucor, but it can give a slight ammoniated taste.

Combined with other penicillium candidum to reduce the chances of contamination. It is highly recommended to use this mold powder in combination with **Geotrichum Candidum, to help prevent the skin from slipping off finished cheese.**

Figure 55: Penicillium Candidum (SAM3)

B. Bacteria Linens (Red)

Brevibacterium Linens (red mold) used in making surface-ripened or interior mold-ripened cheeses such as

- Brick
- Limburger
- Muenster

It develops rapidly, ensures a good ripening, and produces flavor.

Added to the milk at the beginning of the process as well as used in the wash (needs re-hydrating for 8-12 hrs in light salt wash) during the ripening process for washed rind cheeses. The characteristic yellow to orange color may take 15-20 days to develop

Figure 56: Bacteria Linens (Red)

C. Penicillium Roqueforti (PV)

Used to ripen and give flavour to a variety of blue cheese including Gorgonzola, and Stilton the blue mold powder creates an intense blue-green marbled interior, piquant aroma and creamy consistency.

6. Adding Culture

Culture added to ripen milk. Follow recipes recommendation for which culture to use, and add it at the specified time and temperature in recipe.

When adding cultures sprinkle them onto the surface:

- Heated milk and wait 1-2 minutes before mixing them in thoroughly
- Letting the culture rest on the milks surface helps prevent clumping
- Rehydrates culture so it will mix in properly.

A. Mesophilic Starter Culture

used in making a variety of hard, moderate temperature cheese including Cheddar, Monterey Jack, Stilton, Edam, Gouda, Muenster, Blue, and Colby.

Five individual packets are included, for easy use. Simply add one packet directly to heated milk to begin the cheese making process.

This culture great for beginner and advanced cheese makers alike.

Figure 57: Mesophilic Starter Culture

B. Thermophilic Starter Culture

Used in making a variety of cheese, including Mozzarella, Parmesan, Provolone, Romano, Swiss, Gruyere, and other Italian style cheeses, which require higher temperature ranges.

Five individual packets are included, for easy use. Simply add one packet directly to heated milk to begin the cheese making process. This culture is great for beginner and advanced cheese makers alike.

Figure 58: Thermophilic Starter Culture

C. Yogurt Starter Culture (Sweet)

Sweet and creamy yogurt that simple to make and wonderful to eat. Works very well with store-bought milk and goat's milk.

For a Greek Style yogurt, simply drain homemade yogurt, in two layers of Butter Muslin, for 1-2hours

Figure 59: Yogurt Starter Culture (Sweet)

D. Butter Muslin

Butter muslin used to drain soft cheese, yogurt and other dairy products. This durable cloth is 100% cotton, reused and is machine washable. This is a staple for all cheese makers

Figure 60: Butter Muslin

7. Adding rennet

When added to milk rennet will form a thick custard like curd. Follow recipes recommendation for amount of rennet to use and add it at the specified time and temperature in recipe.

Note: Recipe measurements based on single strength rennet, if using double or triple strength please adjust accordingly.

Before adding to milk

- Dissolve rennet in ¼-cup cool potable non-chlorinated water
- Add mixture to milk and stir in thoroughly.
- Ensure even dispersion when added to milk
- After adding rennet to milk let it sit for the time called for in recipe
- Disturbing or moving the pot or milk during this time can interfere with the coagulation process.

To add rennet it is recommend using a perforated ladle.

- Hold the ladle over milk
- pour the diluted rennet solution through the ladle to help disperse

- Mix in gently by submerging ladle to the bottom of pot and bringing it back up to the surface
- Continue to mix in your rennet in this gentle up and down manor for about 1 minute.

A. Liquid Animal Rennet

This single strength liquid animal rennet is the highest quality form of rennet available on the U.S. market today and is NON-GMO. Liquid rennet is easy to measure and add to milk, which makes it a favourite for both beginner and advanced cheese makers alike.

Figure 61: Liquid Animal Rennet

B. Organic Liquid Vegetable Rennet

This organic liquid vegetable rennet is a double strength plus microbial "vegetable" rennet. All ingredients conform to organic standards, are gluten free and NON-GMO. Liquid rennet is easy to measure and add to milk, which makes it a favourite for both beginner and advanced cheese makers alike

Figure 62: Organic Liquid Vegetable Rennet

C. Tablet Vegetable Rennet

These vegetable rennet tablets contain no animal products, are gluten free and NON-GMO. Each tablet is scored into 4 segments, making it easy to break into smaller amounts for home cheese making.

Figure 63: Tablet Vegetable Rennet

Figure 64: adding Rennet to the milk

Self-Check.7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. List down the essential ingredients for cheese making! (5%)

_____,_____

_____,_____

_____,_____

2. Write the types of mold powder! (3%)

_____,_____

_____,_____

3. List down the types of cheese manufactured by mold powder (3%)

_____,_____

_____,_____

4. List down the types of rennet! (3%)

_____,_____

_____,_____

. Answer the following question!

Note: Satisfactory rating 8 and 14 points Unsatisfactory below 8 and 14 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Information Sheet 8 Checking final mix against specifications

Cheese making described as the process of removing water, lactose and some minerals from milk to produce a concentrate of **milk fat** and **protein.**

The objectives of cheese making are:
(1) To obtain the optimum cheese composition with respect to moisture, acidity (pH), fat, protein and minerals (especially calcium)
(2) Establish the correct structure of the cheese at the microscopic level
(3) Ripen to perfection
The quality of cheese determined by moisture content, pH level and mineral added during cheese making that controlled by mixture of cheese making ingredients and heating temperature used like:

- Milk
- coagulating enzyme (rennet)
- bacterial cultures
- Salt.

Effects of particular processing conditions, assuming other factors do not change, on pH at draining, minimum pH occurring in the cheese during early stages of curing, calcium retained in the cheese, the rate of syneresis, the moisture in the non-fat substance (MNFS) and the amount of calf rennet activity retained in the cheese.

Developments shown here apply to most rennet-coagulated cheese within normal ranges of moisture content and percent fat in the dry matter function at:

- Time between adding culture and adding rennet
- Total time between cutting and draining
- Total time between draining and salting; applicable to vat salted varieties

After maxing all ingredients, check the final mixture of cheese made against specification of Cheese component.

Table 3: Types of cheese based heat used for manufacturing, moisture content, and pH level

Type of cheese	Moisture in nonfat-substance	pH at 4 – 7 days
Acid Coagulated	72-80%, aw 0.980 - 0.995	4.3-4.8
Heat-acid Coagulated	75-84%	5.0-5.8;
Un-ripened rennet coagulated	60-80%	5.8-6.6;
Soft Ripened High Acid	60-70%, aw 0.96-0.99	4.5-4.8.
Semi-hard Cheese Washed	55-65%, aw 0.95-0.97	5.0-5.2
Hard Cheese Low Temperature	52-60%, aw 0.94-0.96	acid and moisture control determines residual lactose draining pH is critical
Hard Cheese High Temperature	39-52%Controlle: d mainly by high temperature cooking (52-55ºC)	Acidity and moisture determine residual lactose; draining pH is critical

Extent of acid development

- Low acid (minimum pH > 5.8), Latin American fresh cheese
- Medium acid (minimum pH 4.9 - 5.5), most European varieties
- High acid (minimum pH < 4.9), Fresh cheese, soft ripened cheese

Table 4Fat and water content

Type of cheese	**% fat**	**% water**
Hard	**25 - 30**	**35 - 40**
Semi hard	**20 - 35**	**40 - 50**
Soft	**20 - 30**	**40 - 60**
Very soft	**0 - 35**	**50 - 85**

Example Calculating expected cheese yield
Assumptions:
Approx. 90 % of the fat goes into the cheese.
Approx. 75 % of the protein goes into the cheese.
Approx. 0.5 kg of sugar + ash per 100 kg of milk goes into the cheese.
Calculate the yield from 100 kg of cheese milk with the following composition.
Fat content = 4.2 %
Protein content = 3.4 %
Assumed water percent in cheese = 40 %
Fat yields: $\frac{100 \times 4.2}{100} \times 90\%$ = 3.78 kg ~ 33%
Protein yields: $\frac{100 \times 3.4}{100} \times 75\%$ = 2.55 kg ~ 22 %
Sugar + ash yields: = 0.50 kg ~ 4 %
Total dry matter = 6.83 kg
Water yields: $\frac{6.83 \times 40}{60}$ = 4.55 kg ~ 40 %

=11.38 kg ~ 60 %

Kg of milk per kg of cheese $\frac{100}{11.38}$ = 8.8 kg/kg

Fat in dry matter $\frac{3.78 \times 100}{6.83}$ = 55 % = 55+

Self-Check.8	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1 mention the objective of making in dairy product processing plant (3%)

_____

_____

_____

2. Write the types of based on the content of fat and water (4%)

_____,_____

_____,_____

. Answer the following question!

Note: Satisfactory rating 4 and 7 points Unsatisfactory below 4 and 7 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

L #27	LO #3 Carry out process control and make adjustments according to operating procedures

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Following Correct start-up and shutdown procedures
- Identifying and reporting equipment faults
- Monitoring cheese making processes and taking required samples
- Carrying out routine testing and maintaining records
- Monitoring timings as cheese moves through processing stages.
- Monitoring and adjusting Salt, moisture and pH levels
- Checking cheese for food safety and quality.
- Identifying, rectifying and reporting unacceptable cheese
- Packaging cheese for curing and distribution with correct batch number
- Cleaning equipment in each batch
- Implementing and reviewing safety procedures

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Follow Correct start-up and shutdown procedures
- Identify and report equipment faults
- Monitor cheese making processes and taking required samples
- Carry out routine testing and maintaining records
- Monitor timings as cheese moves through processing stages.
- Monitor and adjust Salt, moisture and pH levels
- Checking cheese for food safety and quality.
- Identify, rectify and report unacceptable cheese
- Package cheese for curing and distribution with correct batch number
- Clean equipment in each batch
- Implement and review safety procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1. Following Correct start-up and shutdown procedures

1.1 **The correct pre-start up procedures of dairy equipment/machine**

The purpose of pre-start inspection to ensure that as equipment safe to use

The properly shutting down dairy product processing equipment/ machine procedures are:

- Reading, interpreting and following information on written job instructions, specifications and other applicable reference documents.
- checking and clarifying task-related information
- Entering information onto preforms and standard workplace forms.
- Shutting down machine/equipment.
- Purging/de-energizing equipment.
- Installing safety/security lock-off devices and signage

A. There are three key objectives of pre-start inspection

- . First that the equipment inspected.
- Second, that identified faults or hazards reported and rectified.
- Third, that unsafe equipment taken out of service until it is safe to use.

Pre-start checking (inspecting) for dairy machine

- Check bolts and other loosen parts and tighten it before operation will start.
- When maintaining, inspecting, attaching and detaching parts, park the machine at flat and safe place
- Use proper tools to maintain the machine and check working area is safe during Operating
- Only allow responsible person, who are familiar with the instructions, to operate the machine
- Use only the machine for recommended work in the manual
- Take care when loading or unloading the machine
- Maintain the proper working speed.

1.2 Check the Installation before operation/start up equipment or machine

- Poor machinery and equipment layout can face:
  - ✓ Blamed of many operating
  - ✓ Health and Safety problem
  - ✓ quality assurance problems in processing units
- Set the Churner on milk processing station
- Park the machine at flat and safe place to adjust operator's safety.
- When attaching components, take care of the components will in appropriate position and place.

To start up the machine, first inspect the machine sensitive parts such as

- Bolts
- Drain
- Cap tightness
- Pins.

1.3 The correct cheese making equipment shutdown procedure

- Pull plug or throw switch to off position before cleaning or adjusting any machine.
- Keep fingers, hands, spoons
- Away from moving parts.
- Wait until machine stops before moving cream or butter (any milk product).
- Check all switches to see that they are off before plugging into the outlet.

Particular care must take when, **cleaning** the slicing machine.

- **First, pull the plug.**
- Turn the gauge to zero in order to cover the edge of the blade
- Do not touch the edge of the circulated/ revolving body of machine
- Clean the internal from the center out.
- Clean the inside edge of the machine with a stick that has a cloth wrapped around one end.
- Do not start machine until the locked in place and the attachments are securely fixed

When using electric cheese making machine

- Turn off motor before you scrape down the sides of the bowl.

- Use a wooden or plastic plunger rather than your hands or spoons to push Cream or Butter into cream or Butter collection center (material)
- Keep your hands to the front of the revolving bowl when operating electric cream separator or churner. This is one of the most **dangerous** place of equipment in the commercial milk processing.
- Never start a machine until you are sure all parts are in their proper places. If a machine that operates with gears, check the gear position.
- You must be aware of the lockout procedures that are to be followed before repairing or cleaning any machine
- Lock-out procedures must be clearly posted by management near each machine
- When using electrical power equipment, always follow the manufacturer's instructions and recommendations.
- Do not wear **rings**, a **wristwatch**, or a **tie** when operating electrical power equipment.
- Never talk while operating any machine

Self-Check.1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Mention the three key of objective of pre-start inspection! (3%)

_____

_____

_____

2. What are sensitive parts of cheese equipment/ machine first inspect to start (4%) the operation?

_____,_____

_____,_____

3. Write down appropriate shutdown procedure for Dairy equipment/machine (5%)

_____

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Information Sheet .2 Identifying and reporting equipment faults

2.1 Identifying equipment faults

Unsafe or faulty tools and equipment means those that are already breakdown or have defect and requires repair or replacement in order to make safe and free risk in working environment for operators.

The main causes of fault/problem of equipment in working areas

- Poor design,
- Variations in raw water quality
- Lack of maintenance
- Inadequately trained operators,
- Inadequate process monitoring,
- Poor record-keeping and poor management

Record and/or report faults and any identified causes to the supervisor according to workplace procedures.

The technic of identifying equipment/ machine fault include

Continuously check the

- Components and parts of equipment/ machine
- Production materials
- Information and service
- Final products against workplace standards and specification
- The current operation and how they contribute to the final quality of the product or service Identify and isolate faulty

Generally Safe work practices written as:

- Define how tasks performed while minimizing risks to
  - ✓ People
  - ✓ Equipment
  - ✓ Materials
  - ✓ Environment

- ✓ Processes. Safe Work Procedures are documented procedures for performing tasks

Before using any tools, equipment and machines in the working area it is important to identify equipment faults like:

- Deformations (for steel-based tools)
- Visual Damage
- Loose components
- Pre-production irregularities

Mechanical equipment/machine requires regular attention to ensure problem free operation. Regular scheduled inspection must be strictly carried out and conduct to identify equipment/machine faults.

Table 5: .equipment faults report format

No.	Equipment name	Problems/ faults part	solution
1			
2			
3			

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part II Fill the black space

1. Write down main causes of fault/problem of equipment occur in working areas (5%)

_____,_____

_____,_____

_____,_____

2. List down procedure that identifying equipment/ machine fault technical! (5%)

_____

_____

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____

Information Sheet 3 Monitoring cheese making processes and taking required samples

3.1 Introduction

The cheese manufacture process require monitoring at each processing steps

Standardization

To assure the consumer a product of constant fat content and to meet standards, the fat content for milk products should standardized. Usually the fat content of raw milk is higher than the required standards. Manufacturing products with an excess fat content will lead to financial losses. In small-scale operations the cost of standardization (i.e. purchase and maintenance of separator, fat testing equipment etc.) may be higher than the profits especially if the cream cannot sold.

Standardization undertaken by:

1. Mixing whole milk with partly or totally skimmed milk
2. Mixing skimmed milk with cream.
3. Separating whole milk to get the required fat content.

Method 3 requires very sophisticated and expensive equipment so under small scale only methods 1 and 2 are of interest.

Example 1

Suppose 200 kg of raw milk is available. The fat test has shown a fat content of 4.5 % fat. Milk with 3 % fat is required for cheese production. How much raw milk is it necessary to skim (separate). In the calculation it will be assumed that all the fat is removed from the skim milk by separation.

If X = litres of cream with 32 % fat

and Y = litres of milk with 3 % fat

In the calculation the expression fat unit (fu) means 1 % fat in 1 litre of milk.

Total fat units = 200 1 x 4.5 % fat = 900 fu

I X + Y = 200

II 32X + 3Y = 900

Equation I should be multiplied by 32 so that X will be eliminated by subtraction.

I2 32X + 32Y = 6,400

II2 32X + 3Y = 900

Equation II should then be subtracted from Equation I and the following is obtained.

III 29Y = 5,500

III2 Y = 189.7 l with 3 % fat

The Value Y should be inserted in I:

IV X + 189.7 = 200

IV2 X = 10.3 l cream 32 % fat

Now it only remains to calculate how many litres to skim to get 10.3 l of cream with 32 % fat.

10.3 l x 32 % = 329.6 fu

329.6 fu = 73 litres to be skimmed

4.5 fu/l

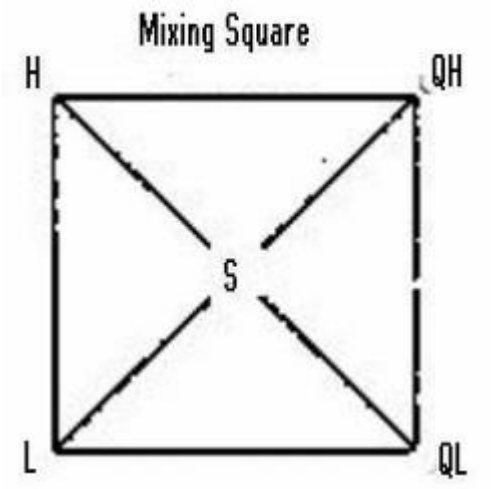
Control of calculation:

189.7 l x 3 % fat = 569.1 fu

10.3 l x 32 % fat = 329.6 fu

898.7 ~ 900 fu

If skim milk is available for mixing with whole milk to obtain standardized milk with a certain fat content the following mixing square may be used.



The square shows:

H = fat content of the milk with the highest fat content (e.g. whole milk with 5 % fat)

L = fat content of the milk with the lowest fat content (e.g. skimmed milk with 0.05 % fat)

S = fat content of the standardized milk to be produced (e.g. 3 % fat)

QH = quantity of milk available with highest fat content, that is milk to be standardized

QL = quantity of milk with lowest fat content; to be mixed with milk with highest fat content

In the example, H - S = QL = 5 - 3 = 2, and S - L = QH = 3 - 0.05 = 2.95, which means that for every 2.95 kg of whole milk 2 kg of skimmed milk has to be added to obtain standardized milk with 3 % of fat; in this case that is 4.95 kg of standardized milk

1. Ripening the Milk

Ripening refers to the practice of giving the culture time to begin acid production before the rennet added.

This done for two reasons:

1. To ensure the culture is active before the rennet added to milk

- Impossible to inoculate after the milk is set.
- Normally 45 – 60 min is sufficient to increase TA (titratable acidity) by 0.005-0.01%.

2. Development of acidity aids the coagulation process, especially the secondary stage.

In many varieties of cheese such as Brine Brick and Swiss require:

- Low amounts of culture are used
- Rennet proceeds with little or no prior production of lactic acid.

Figure 65: Ripening the Milk

Acidity test

The titratable acidity test employed to ascertain if milk contains a large amount of lactic acid, which might reduce its heat stability, and thereby its suitability for milk products manufacture.

Titratable acidity generally has been presented as the acidity measured by titration with 0.1 N sodium hydroxide, due solely to lactic acid. This is not really so because what is actually measured is the quantity of alkali necessary to bring the pH of the milk to approximately 8.3 at which point phenolphthalein shows the characteristic pink color.

Generally, freshly drawn milk does not contain lactic acid. Some bacteria, which contaminate milk, can attack the milk sugar (lactose) and form acids of which the principal is lactic acid.

The indicator substance phenolphthalein is colorless in an acid solution but red in an alkaline solution. On adding phenolphthalein to milk it remains colorless because the milk is acidic, its inherent acidity being due to its natural constituents particularly the protein and phosphates.

The addition of a solution of an alkali like sodium hydroxide neutralizes the acid and, when a slight excess added, the phenolphthalein turns red.

Method

1. Pipette 9 ml of the well-mixed sample of milk into a 100 ml Erlenmeyer flask.
2. Add 10 drops of 1 percent phenolphthalein solution (prepared by dissolving 1 gm phenolphthalein in 75 ml of 95 % Ethyl alcohol and adding enough distilled water to make total volume 100 ml).
3. Fill the burette with the 0.1 N sodium hydroxide solution, run out a portion to ensure that there are no air bubbles in the column, and then adjust to a convenient graduation mark, preferably zero.
4. While agitating the sample continuously, run the sodium hydroxide solution in slowly from the burette until the first permanent pink color obtained. A permanent very pale pink is the correct endpoint.

5. Read off the quantity of alkali used and calculate the amount of titratable acidity as percent lactic acid.

Titratable acidity = $\frac{\text{ml 0.1 M NaOH x 0.009 x 100}}{\text{Volume of sample}}$ = % lactic acid

Example: V**olume of sample 20 ml**

ml 0.1 M NaOH = 29 ml

Titratable acidity = $\frac{\text{29 ml x 0.009 x 100}}{\text{20 ml}}$ = 1.3 % lactic acid

2. Setting the Vat

A. Handling Rennet

- Repeatable performance depends on accurate measurement. For most varieties
  - ✓ The quantity of rennet selected to set the milk to a firm coagulum in 30-40min, corresponding to about 50 IMCU per liter.
  - ✓ Measure the rennet accurately and monitor to ensure that coagulation rate is uniform from day to day.
- Rennet must be diluted (about 20 times) in water and well mixed when added to ensure uniform distribution.
- Watch out for chlorine. It is imperative that the dilution water contains no chlorine.
  - ✓ Two ppm of chlorine will destroy 40% of rennet activity in 3 minutes
  - ✓ Similarly, do not sanitize the container used for the rennet with chlorine.
- Another water quality issue ph. typically, if the water is hard, it also has pH greater than 7.0, which also decreases rennet activity.
- Finally, dilute the rennet not more than 30 minutes before adding to the vat. After the brined rennet diluted in water, its activity declines.

B. Optimizing Setting Parameters

I. Pasteurization temperature

Higher temperatures increase yield by increased recovery of whey proteins, but a suggested maximum with respect to curd quality is **75ºC, 16 s.**

II. Temperature history

If the milk is pasteurized and immediately sent to the setting vat, it will be necessary to adjust the mineral balance by adding **calcium chloride**.

The jury on selection of coagulant always seems to be out. If microbial coagulants used for high temperature varieties, ensure that the supplier certifies that the heat treatment in the cheese making process sufficient to substantially reduce the activity of the enzyme.

For other varieties, the caution is to ensure that yield and flavor development not compromised. Given the decreasing availability of calf rennet, (the technical name for calf rennet is chymosin), recombinant rennet is the preferred enzyme provided. Customers not spooked by the genetic technology.

The amount of rennet must be carefully determined. Because rennet is costly, it is desirable to minimize its use, but this can be false economy if curd properties or cheese quality are compromised. Poor setting means increased losses of both fat and protein as fines. In addition, do not forget that the coagulant is also a ripening agent.

Temperature control must be accurate and uniform throughout the vat because both the enzyme activity and the subsequent process of micelle aggregation are extremely temperature sensitive

Inaccurate or non-uniform temperature during setting will result in local areas of under or over set curd, which in turn cause loss of fines during cutting.
Soft curd results from:

- Over heat treatment
- Low setting temperature
- Colostrum or mastitis milk

Firm curd results from:

- High calcium
- Low pH
- Standardization to high protein content

Figure 66: Pasteurilazetion of milk

3. Cutting the Curd

Proper cutting is important to both quality and yield. Improper cutting and handling the curd results in the

- Loss of fines; that is, small curd particles which are not recovered in the cheese. Unlike
- Whey fat, fat trapped in fines not recovered by whey cream separation
- Both fat and protein losses occur when shattered curd results in fines too small to recover in the cheese.

3.1 Determination of Curd Cutting Time

Both early cutting when the curd is fragile and late cutting when the curd is brittle cause losses of fines. Several means used to determine cutting time.

A. Manual testing.

The curd is ready to cut if it breaks cleanly when a flat blade inserted at a 45º angle to the surface and then raised slowly.

- Several mechanical devices based on oscillating viscometers, thermal conductance, or sonication tested experimentally and some used in commercial practice.

B. Some plants cut by the clock

This may be OK as long as all conditions are uniform from day to day (is that ever true?) and adjustments made for any change in milk composition or properties.

- If setting temperature is high, as for some Swiss recipes, the curd firms rapidly and cutting must begin early when curd is still somewhat soft to prevent over setting. Agitation should begin immediately to prevent.

C. Curd Size

Curd size has a great influence on moisture retention.

Figure 67: Cheese cut into large-sized curds.

- High temperature and low moisture varieties such as Italian hard cheese require the smallest curd. Cutting continues until the curd is the size of rice grains.
- Medium moisture cheeses like most washed varieties and Cheddar cut to ½ cm cubes.
- High moisture varieties like soft ripened cheese cut with 2 cm knives or the curd is simply broken sufficiently dipped into forms.

Small curd size will result in greater fat and NFS recovery because large curds tend to crushed, resulting in the loss of “fines.” Smaller curds will also dry out faster and,

therefore, other factors such as cooking temperature and stirring out may have to adjust according to curd size.

D. Types of cheese cutting

1. Manual Cutting

Manual cutting done with cutting harps, made by stretching stainless steel or nylon wire over a stainless steel frame

Total cutting time should not exceed 10 minutes (preferably less than 5 minutes) because the curd is continually changing (becoming overset) during cutting

The knives pulled quickly through the curd so they cut the curd cleanly, rather than push it around the vat.

Figure 68: Manual cutting of the curd.

2. Automated Cutting

With mechanical knives, the curd size determined by the design of the vat and agitators, the speed of cutting (rpm) and the duration of cutting.

In Double ‘O’ vats for Cheddar and American varieties, cutting is normally

- speed of about 4 rpm for 7 – 13 minutes
- Corresponding to a total of 30 – 50 revolutions
- It is important that the knives are sharp
- Cut the curd cleanly rather than partially mashing the curd or missing some pieces altogether.

Curd particle size at draining in mechanized Cheddar cheese influenced by cutting time, cutting speed, and subsequent agitation such that:

- Short cutting times and low rpm result in small particle size at draining and more loss of fines.
- With increasing cutting time (more total revolutions), curd particle size at draining reaches a maximum which corresponds to a maximum in fat recovery.
- Further increased cutting time causes decreased curd size at draining with little effect on fat recovery.

Figure 69: Automated cheese knives in a double ‘o’ vat.

E. Healing

The exterior of the freshly cut curd is fragile, so some time is needed for the surfaces to close up (heal) and prevent the loss of fat and protein in the whey. Fresh cut curd also has a tendency to aggregate, which is undesirable. Therefore, agitation after cutting should be minimal to give the curd some time to heal, but sufficient to prevent the curd from matting.

Figure 70: Curd healing.

F. An index of cutting quality

The loss of fines monitored by accurate analysis of whey fat content. Whey fat for cheese with 50% FDM should be < 0.3%. Efficient operations may achieve levels near 0.2%.

4. Cooking

The combination of heat and the developing acidity (decreasing pH) causes syneresis with resulting expulsion of moisture, lactose, acid, soluble minerals and salts, and whey proteins. It is important to follow

- The cooking schedule
- Cooking too quickly forms a tough exterior on the curd particles, which prevents moisture release
- Hinders development of a smooth texture during pressing.

5. Draining

The whey pH at draining or dipping is less than 5.0 for predominantly acid coagulated varieties and 6.1-6.4 for many predominantly rennet coagulated varieties.

The exceptions are varieties with no or little culture. Draining time should be uniform at about 20 min to prevent variation from vat to vat. Cheddar types stirred out 1 – 3 times as required to obtain required curd moisture.

6. Washing

Lactose content can be adjusted by moisture removal (syneresis), fermentation, or leaching with water (washing). Washing to remove lactose makes it possible to make a high moisture cheese and still achieve a final pH of about 5.0 – 5.2

Most cultured varieties with final moisture higher than 40% and minimum pH greater than 5.0 washed.

Temperature of the wash water will determine the moisture content of the curd. Sometimes relatively, hot water (e.g., Gouda) used to dry the curd and develop its texture.

Traditionally, washing accomplished by removing 50 to 65% of the whey, replacing it with water, and agitating for about 15 min. This process results in the dilution of large amounts of whey that must be concentrated or dumped. It also creates problems where curd tables have less capacity than setting vats. The solution is to remove more whey before washing and reduce the amount of wash water. In American style varieties such as Colby and Monterey Jack, the whey removed almost completely and washing accomplished by spraying water on the curd while agitating the curd with forking agitators.

7. Curd handling

Procedures applied during and after draining, are many and varied. However, most post draining procedures are similar to one of the following.

Figure 71: Cheese curds scooped into hoops.

8. Dipping

Used as another term for draining, but it applies in particular to cheese varieties for which curd and whey are “dipped” into forms. There may be a “pre-draw” to drain some whey from the curd before the remaining whey is dipped with the curd into the forms.

Whey drainage takes place in the forms, which turned frequently to enhance drainage and ensure uniform shape and smooth surfaces. Soft ripened varieties and most smear (washed rind) varieties dipped. In modern practice, the curd partially drained and then pumped into the forms with positive lobed pumps, which do not crush or otherwise damage the curds.

The process of dipping encourages formation of mechanical openings. Mechanical openings result when whey trapped inside the curd is absorbed into the cheese and leaving irregularly shaped holes behind. Much of the open structure in Havarti, for example, is due to mechanical openings.

9. Pressing

Pressing varies from little or none for soft cheese up to 170 kPa for firm or hard cheeses, such as Cheddar. Warmer curd requires less pressure. Mechanical openings may reduce by vacuum treatment before, during, or after pressing.

Figure 72: Cheese press

10. Salting

Almost all cheese is salted by one of three methods: before pressing as in Cheddar and American varieties, surface salting after pressing or brine salting.

Purposes of Salting

- Promote further syneresis
- Slow acid development
- Check spoilage bacteria. LAB are more salt tolerant than many pathogenic and spoilage bacteria.
- Promote controlled ripening and flavor development.
- Salty flavor

Brine Salting

Salt concentration in cheese brines range of 16 – 25% NaCl, but typically 20 – 23%. At brining temperatures (less than 10°C), the saturation point for salt in water is about 26%.

New brine should treated with about 0.1% of $CaCl_2$ to prevent conversion of calcium and hydrogen casein-ate to sodium casein-ate.

The latter has high water holding capacity, so the cheese takes up water from the brine and the cheese surface becomes soft and slimy. In addition, brine pH should adjusted to the pH of the cheese. Normally a pH of 5.2 – 5.6 is adequate. If the pH is too high, ion exchange causing sodium caseinate is encouraged.

If the pH is too low, there is insufficient Ca/Na exchange and the cheese surface becomes hard.

A suggested recipe for 100 Kg of brine is:

- 30 Kg salt
- 80 Kg water
- 170 mL of 30% Calcium chloride solution.
- 50 mL of vinegar (5% acetic acid) or 10 mL of lactic acid.

Brining time is dependent on the shape and weight of the cheese. A rule of thumb suggested by Kindstedt (2005) is:

1 h per 0.9 Kg per cm OR 1 h per pound per inch.

For example, a 1 Kg cheese made in a Kadova mold such as we have in the Guelph pilot plant is about 7.5 cm thick. Therefore, the estimated brining time is 0.9 x 7.5 = 6.7 h. It is important to monitor the brine with a salometer and adjust as necessary to maintain the target brine concentration. Also, monitor salt concentration in the cheese to ensure that it is consistent and close to the target level.

Brine must be continuously agitated to prevent density fractionation (lower concentration brine on top) and dilution of the brine around the cheese. Brine must also cleaned regularly by micro- or Nano filtration. Nano filtration has the advantage that in addition to removing bacteria and proteins, it also removes smaller molecules such as residual sugars, but it does not remove salt. Sometimes UV sterilization combined with filtration further reduce the chance of contamination.If cheese floated rather than immersed in the brine, the exposed surface of the cheese should be dry salted.

Vat Salting

- For vat salted cheese, uniform salt content depends on accurate estimate of the weight of unsalted curd, accurate weighing of salt, and consistent processing conditions
- Salt uptake is:
    - ✓ Increased by increased acidity (lower pH) at salting
    - ✓ Decreased by increased time between milling and salting due to healing of the cut surfaces on the curd particle
    - ✓ Increased by increased curd moisture content
    - ✓ Decreased for larger curds
    - ✓ For Cheddar and American varieties, the salt content as a percent of moisture (SM) should be greater than 3.6%

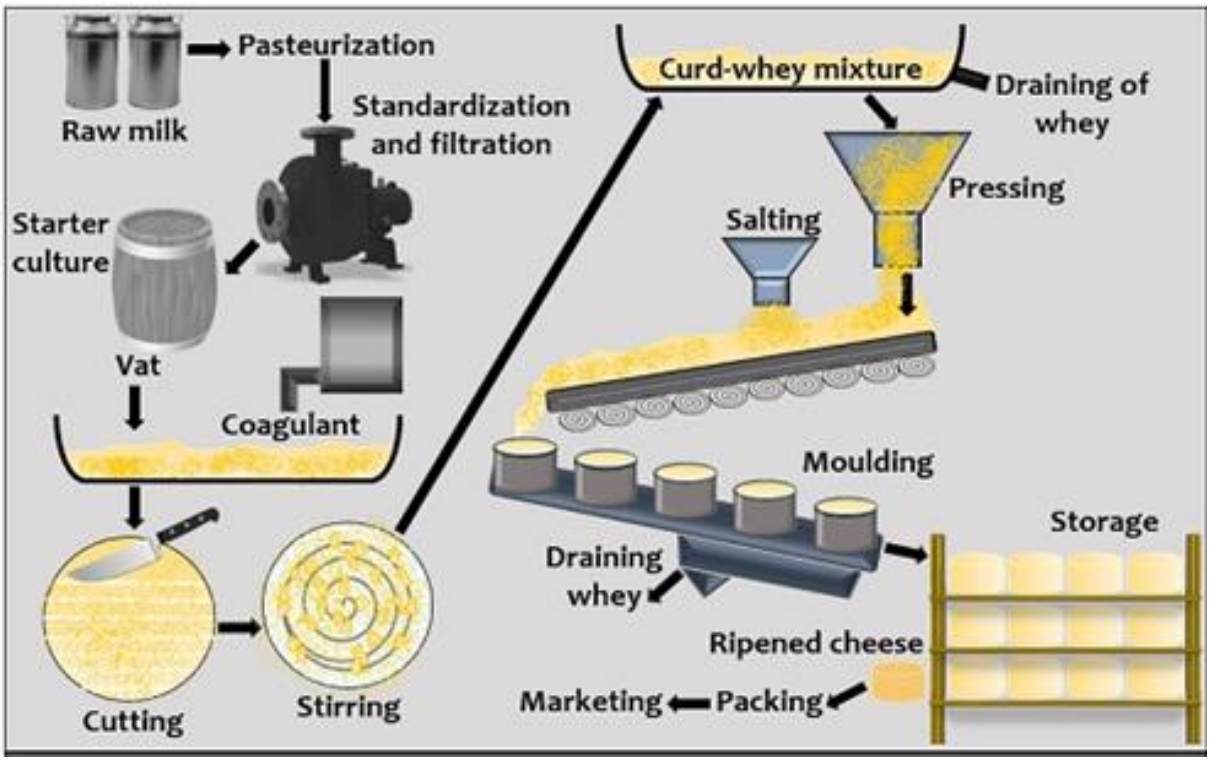


Figure 73: Flowchart of cheese production

MAKER	CHEESE	VAT #	DATE

Milk Kg _____ Skim Kg _____ Powder Kg _____ Starter Kg _____ TOTAL Kg _____	FRESH MILK Fat _____ Protein _____ STANDARDIZED Fat _____ Protein _____	STARTER TA _____ pH _____ Age _____ Media _____ Phage _____

OPERATION	TIME	TEMP	TA	pH	CURD pH	COMMENTS
Standardization						P/F=
Heat treat						
Pasteurization						
Add Primary Starters						Type Amount
Add Secondary Starters						Type Amount
Additives						Type Amount
Added Rennet						Type Amount
Coagulation						Coagulation Time
Start Cutting						Time From Inoculation to Cutting
Finish Cutting						
Steam On						
Steam Off						
Draining						Time From Cutting to Draining
Washing						Temperature Amount
Draining						
Milling						Time From Draining to Milling
Working						
Salting						Curd Weight Amount of Salt
Hooping						Hooped Yield
Pressing						Pressed Yield
Packaging						

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1._____the method of assuring consumer product of constant fat content and meeting standards! (2%)

2. Mention the milk standardization procedure before manufacturing! (3(%)

_____

_____

_____

3._____refers to the practice of giving the culture time to begin acid production before the rennet added!(2%)

4. Write the Couse of soft curd formation during heating milk for cheese making! (3%)

_____,_____,_____

5. Write the type of curd cutting during cheese making! (2%)

_____,_____

6. Mention the important procedure must cheese maker follow at cooking time! (3%)

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 7 and 13 points Unsatisfactory below 7 and 13 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____

Information Sheet 4 Carrying out routine testing and maintaining records

4.1 Milk and Cheese tests

4.1.1 Lacto fermentation (early gas) Test[1]

The majority of gas that produced within 10 days of making cheese originates from problems with hygiene and sanitation prior to cheese making.

Coliform bacteria and yeasts are the cause of early gas in cheese. It is often difficult to figure out if the cause of gassy cheese related to the quality of the milk.

The lacto fermentation test is a simple, definite, inexpensive way to determine the quality of the milk at any moment in the process from milking up to adding starter culture.

When the results known backtrack to find out if the milk was at fault Materials needed:

- Ladle for taking the sample
- Test tubes
- Test tube brush
- Sterile cotton
- Water bath or incubator set at 86-98 °F

Methods:

- Clean and rinse the test tubes and ladle
- Boil the test tubes and ladle to sterilize them
- Deposit the milk sample into a test tube
- Put on a sterile stopper
- Incubate the samples at 86-98 °F
- Wait for a curd to form in 24 hours for cow and goat milk and 48 hours for sheep milk

Using the Results:

During milking, storage and up to the beginning of cheese making the milk contaminated from

- Improperly sanitized milking equipment
- transferring milk

- storing the milk for too long or at too high a temperature

To get the right information take samples at the following points

- when milk is coming by hand or from the machine into the bucket or pipeline
- when the milk is poured or pumped into the bulk tank
- when the milk is emptied from the bulk tank
- When the milk is poured or pumped into the cheese vat.

Results

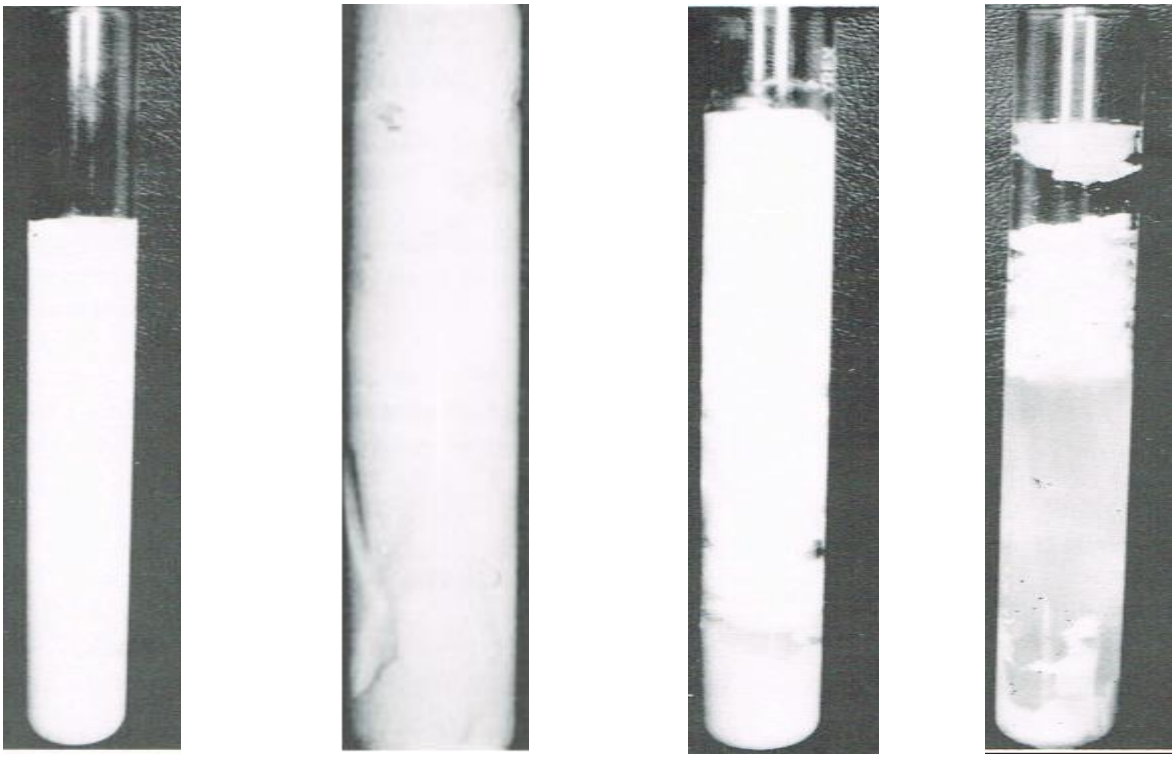


Figure 74: A. Very good milk B. Good milk C. Bad milk D. Bad milk

A. Very good milk

The curd is very homogenous, only few bubbles and cracks at the top of the curd, like yogurts. Not a source of gassy cheese

B. Good milk curd

Relatively homogeneous, some cracks in the body of the curd and rising babble and line of separation. Very low of risk of gassy cheese

C. Bad milk

The curd has rotten smell and scattered of babbles varioes size. Significant sources of gassy cheese. Sanitation problem.

D. Bad milk

Curd has a rotten smell with a large amount of gas , whey separation and floating curds. Maximum risk of. Sanitation problem

Principle:

The appearance of gas in cheese is indicates a problem with the equilibrium between two categories of bacteria:

- good lactic acid producing bacteria (some of which produce small amounts of carbon dioxide gas)
- contaminating gas producing bacteria

The contaminating bacteria and the lactic bacteria are in competition for their nourishment.

The contaminating bacteria have a better ability to adapt to the milk environment. If large numbers get into the milk then the lactic bacteria are at a disadvantage and their growth suppressed. This disequilibrium accentuated by poor techniques during cheese making, which leads to gassy cheese.

The lacto fermentation test is a powerful test that gives the cheesemaker an idea about the potential success of the cheese making operation

The test takes into account:

- The bacteria that are capable of growing at temperatures used in the setting step of cheese making
- The physical and chemical qualities of milk,
- The capacity of the bacteria to adapt to the milk environment.

The water bath or incubator is maintained at 86-98 °F, which is the general range for making cheese using mesophilic starter cultures but thermophilic bacteria are also active in this range.

The three more results that may provide helpful information:

- If the curd takes a longer time to form, say closer to 48 hours then the milk has a low population of lactic bacteria.
- If the curd has a flaky (fleecy) appearance then psychrotroph bacteria are present. The texture is a result of proteolysis.
- The curd may smell yeasty or fruity, which indicates yeast is present.

Since the lacto fermentation test if affordable and easy to do

- Highly recommend using
- Surprised at how it help to figure out where the gas is coming from
- It is always nice to have that sample with a good curd to give confidence about the potential for good quality
- If bad result occur then anticipate some problems with gas during aging
- Quickly adopted the test and taught all of the cheesemakers

Clostridia Tyrobutyricum (late gas) Test

This test identifies *Clostridia tyrobutricum,* which is the bacteria responsible for gas production later on, e.g. after two months, in cheese ripening.

- Large amounts of gas produced by the “butyric” creating large cracks and fissures in the interior of the cheese
- The source of this contaminant is improperly fermented silage and wrapped bales, manure, and the animals
- The butyric come from and spread from the soil. They multiply in certain conditions like:
  - ✓ when the ensiled feed is poorly prepared (there should be less than 100 spores of butyric bacteria per gram of feed)
  - ✓ after the animals eat the feed the spores are concentrated in their manure
  - ✓ Udders contaminated from bedding and other environmental sites.

The butyric can survive heat treatment and pasteurization by forming spores.

Later on when conditions are appropriate

- PH > 5.4
- low salt
- Higher temperatures, e.g., > 50 °F) they will grow very well and cause major problems

These conditions are normal for the affinage of certain cheeses like Grana and hard Alpine types. Silage and wrapped bales forbidden for feed to animals making milk for cheeses like Gruyere, Emmenthaler, and Parmigiano-Reggiano because of the inherent risk of butyric contamination

Wrapped bales much more commonly used as feed now. Several cheesemakers that use advice to monitor the quality of the feed closely. Some bales tested for spores. If the feed is, too wet or in any way compromised then do not feed it to the millers. Away from it altogether if making hard Alpine cheeses.

Materials:

- The test uses the same materials as the lacto fermentation test.

Methods:

- The milk is pasteurized in the test tube, which means it is heated to 145 °F and held for 30 minutes or heated to 161 °F and held for 15 seconds
- Seal the top of the test tube with a paraffin plug (heat some wax and push it into the top
- Incubate the sample at 100 °F for 12-24 hours
- Watch for the plug to move up in the test tube.

Laboratory Milk Tests

There are two tests that extremely helpful in locating sources of contamination in raw milk.

These done by a laboratory, which does routine milk testing of raw milk sample at least every other week and have them to done **Coliform Count and a Lab Pasteurized**

Count (LPC) While they are to test the fat, protein, somatic cell count (SCC), and standard plate count (SPC).

- The Coliform count is an indicator of the quality of hygiene and sanitation; stay below 25 CFU per ml.
- The Lab Pasteurized count measures the thermoduric (spore forming) bacteria and indicates the cleanliness of the equipment; stay below 250 CFU per ml.
- The somatic cell count gives you an idea of the health of your herd; stay below 250,000 for cows and sheep and below 750,000 for goats.
- The standard plate count also known as the “raw count” and measures all of the bacteria in the milk; stay below 10,000 CFU (colony forming units) per ml.

The following charts help to pinpoint sources of contamination

Bac. type in cheese	Bac. number in tested cheese	
Coliform	>100	<25
LPC	>2,500	<250

Troubleshooting High Bacteria Counts in Raw Milk[2]

Lpc	High	Low	High	Low
Coliform	Low	High	High	Low
Source	Equipment	Animal hygiene and environment	All Areas and incubation	O.K.

Testing for Residual Lactose in Cheese

Thermophilic starter cultures used to make higher pH cheeses such as hard Alpine types and soft-ripened washed rind varieties.

When the starter bacteria metabolize lactose, they split it into glucose and galactose. The *Streptococcus thermophilus and Lactobacillus bulgaricus* bacteria do not ferment galactose. Therefore, it is possible to have cheeses with some residual sugar in them after the cheese made.

During the early stages of ripening the galactose used by other bacteria and yeasts to make acid and carbon dioxide. This “post acidification” create problems in the ripening process. .Cheeses can become harder, gassy, and poorly knit together

Using small amounts of mesophilic starter culture or *Lactobacillus helveticus* can solve the problem of post acidification. To find out if cheese has residual lactose heat the curd in a microwave until the water is gone. The browner the color of the dry cheese is the residual sugar is in the cheese.

Lacto fermentation (early gas) Test

The majority of gas that is produced within 10 days of making cheese originates from problems with hygiene and sanitation prior to cheesemaking. Coliform bacteria and yeasts are the cause of early gas in cheese. It is often difficult to figure out if the cause of gassy cheese is related to the quality of the milk. The lactofermentation test is a simple, definite, inexpensive way to determine the quality of the milk at any moment in the process from milking up to adding starter culture. When the results are known, you can backtrack to find out if the milk was at fault.

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. List down the procedures must cheese maker must follow to take right sample! 4%)

_____
_____
_____
_____

2. Write the most known bacteria that affect cheese quality! (3%)

_____

_____

. Answer the following question!

Note: Satisfactory rating 4 and 7 points Unsatisfactory below 4 and 7 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Information Sheet 5 Monitoring time as cheese moves through processing stage

5.1 Cheese Manufacturing

To maximize returns, the cheese maker must obtain the maximum yields that are consistent with good cheese quality. To achieve this objective it advised to monitor/ control the production process and cheese movement through processing stage

The objectives of the cheese maker are to:

- Develop the basic structure of the cheese.
- Obtain cheese composition required for optimum microbial and enzyme activity during curing. Optimum composition mainly means optimum levels of moisture, fat, pH (lactic acid), minerals, and salt.

The characteristic texture and cheese composition of different cheese verities largely monitored/determined when the curd and whey transferred to the press table. Additionally during heat treatment of milk before **cheese moves through processing stage**, the basic structure (the **casein micelles** and **fat globules** are arranged) and chemical composition (especially mineral content) are already determined to produce quality cheese

5.2 Factors must monitored/ condoled during cheese processing are:

5.2.1 Moisture Control

Cheese making is a process of removing moisture from a rennet coagulum or an acid coagulum consisting of fat globules (unless the milk skimmed) and water droplets (whey) trapped in a matrix of casein micelles.

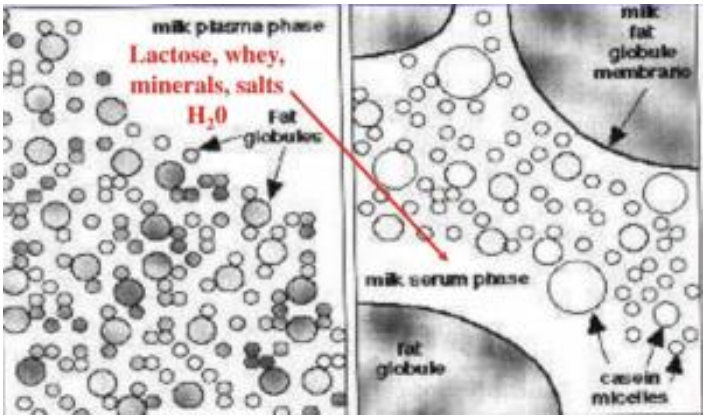


Figure 75: A microscopic view of the composition of milk in the milk plasma phase and milk serum phase.

- Cheese is, therefore, a concentrate of milk protein and fat.
- Most cheese making operations are related to this process of removing water from the milk gel by the process of
- This liquid (whey) contains water, sugar, whey proteins, lactic acid, and some of the milk minerals.
- The final moisture content, therefore, influences the final pH of the cheese because it determines the residual amount of fermentable lactose in the cheese.
- At the same time, other factors such as the amount and rate of acid development and the temperature and time of cooking, determine the amount and the rate of syneresis.

5.2.2 PH Control

- With respect to cheese quality and safety, the most important process control factor is the development of acidity.
- Increasing acidity causes:
  - ✓ Syneresis (due to reduced charge repulsion on casein micelles) and moisture expulsion
  - ✓ Solubility of calcium phosphates from the micelles.
  - ✓ Disruption of casein micelle structure with alterations in curd texture.
  - ✓ Reduced lactose content by fermentation to lactic acid
- Acid development occurs mainly within the curd because most bacteria trapped in the gel matrix during coagulation.

- The minimum pH value is dependent on the amount of acid developed during manufacture and the residual lactose that will ferment during early curing and cause further acid development.
- The residual lactose content mainly determined by the moisture content, washing which removes lactose by leaching, and the extent of fermentation.
- Ability of the culture to ferment galactose is also important. Cultures, which metabolize galactose slowly or not at all, will be able to produce less lactic acid.

For examples, galactose positive strains of *Streptococcus thermophiles* selected when limited lactic acid desired. Similarly, *Lactobacillus helveticus* used to reduce browning of pizza cheese because it depletes galactose and reduces Maillard browning on the pizza.

- Both the rate of acid development and the amount of acid development (as measured by final pH) are important. For example, the final pH of Swiss is the same as Cheddar, but Cheddar cheese reaches pH 5.2 after about 5 hours while Swiss cheese requires about 15 hours to reach this ph.
- It is important to maintain uniform rate of acid development. If acidity develops too slow or too fast, adjust the amount of culture rather than changing cooking time or temperature.
- PH at draining largely determines the mineral and residual sugar contents of the cheese and from the sugar, the final ph.
- Salting reduces the rate of acid development and therefore, the time and amount of salting is important to prevent the pH from dipping below 5.0 during the first several days after manufacture.

5.2.3 Mineral Control

- Loss of calcium phosphate determines extent of casein micelle disruption hence it determines basic cheese structure
- The important parameter ratio of Ca to casein or Ca to NFS (non-fat solids), which easier to measure Ca in mm/Kg SNF.
- In Swiss (high Ca, about 750 mM Ca/Kg NFS) the casein micelle structure intact while extensive dissociation and disruption of casein micelles is evident in Feta types (low Ca, about 400 mM Ca/Kg NFS).

- Retention of calcium phosphate also increases the buffer capacity of the cheese, protecting it from big changes in ph.
- PH at draining determines the solubility of calcium and phosphate when the curd separated from the whey.
- More Ca is retained at high draining pH as in Swiss cheese (pH 6.4 – 6.5) versus Cheddar at pH 6.1 – 6.3
- Calcium retention in soft ripened cheese is low relative to most predominantly rennet-coagulated cheese. This is partly due to higher amounts of culture and extended milk ripening and/or setting times, leading to more acid development before cutting.

This releases more calcium into the whey. Further, most syneresis occurs during continued acidification overnight in the forms to a final pH of 4.4 – 4.8. The acidic whey caries dissolved calcium salts with it.

When cheese graders refer to cheese texture, they often mean the amount and type of openness or holes in the cheese. Here, texture refers to the sensory properties of firmness, elasticity, brittleness, etc.

- Atypical texture in a young cheese is a strong indication of probable flavor defects later. Therefore, a primary objective of cheese making is to develop the ultra-structure that determines the proper texture.
- Conformation of the protein matrix also influenced by pH. At lower pH, micelles disrupted, but the proteins tightly packed because of reduced charge repulsion. Therefore, Feta is brittle while Camembert is soft and smooth due to alkalinity contributed by ammonia during ripening.
- Cheese drained at higher pH retains more Ca and firmer and more elastic.

An example Swiss types which inoculated with a small amount of culture to ensure slow acidification in the initial stages. Draining pH higher (6.3 – 6.4) then most varieties. This helps retain Ca, which helps form a curd that is well fused, stretchable and able to form eyes with production of CO_2 byPropionibacterium *shermanii.*

- Later curd handling treatments such as salting and pressing modify texture and body, but have minimal effects on the basic structure of the protein matrix.

5.2.4 Flavor Control

In the broadest terms, directed flavor development depends on retaining or adding ripening agents and controlling their activity over time

Important principles are:

- Milk heating and clarification treatments determine non-starter bacteria in the milk.
- A great deal of direction obtained through selection of cultures, coagulants and other additives. De-bittering cultures for example are an important tool to reduce bitterness and extend the shelf life of high moisture varieties such as Monterrey Jack and of low fat varieties.
- All cooking and curd handling procedures have specific effects on the types of ripening agents (bacteria and enzymes) that remain to ripen the cheese.
- Again, pH at draining is important because it determines the distribution between the curd and the whey.

Plasmin, an endogenous milk protease, prefers neutral to slightly alkaline pH and is more soluble at low ph. Therefore, varieties that dipped at high pH, such as Swiss types have higher retention and activity of plasmin

Plasmin activity also increased by higher cooking temperatures in traditional Swiss and Italian varieties.

Calf rennet is more soluble at higher pH, but more active at lower ph. Therefore, rennet retention is higher for varieties that drained at lower pH and in particular for varieties that cut at lower pH. Rennet activity also drastically reduced by the higher cooking temperatures in traditional Swiss and Italian types, so it is more active in mesophilic varieties.

Table 6: Types of cheese making based on operation

Operations	Swiss Type		Gouda		Cheddar MNFS 53%		Cheddar MNFS 57%		Feta		Short Set Cottage	
	Time	pH	Time	pH	Time	pH	Time	pH	Time	pH	Time	pH
Add starter	0	6.60	0	6.60	0	6.60	0	6.60	0	6.60	0	6.60
Add rennet	15	6.60	60	6.55	60	6.55	30	6.55	60	6.50	120[b]	6.45
Cut	45	6.55	90	6.45	90	6.50	75	6.50	120	6.30	[c]5 – 6 h	4.80
Drain or dip into forms	150	6.35	180[a]	6.35	210	6.10	180	6.3	140	6.25	[c] 7- 9 h	5.2
Milling	NA	NA	NA	NA	360	5.40	315	5.50	NA	NA	NA	NA
Pressing	165	6.3	210		420	5.35	390	5.45	NA	NA	NA	NA
Demolding	16 h	5.30	8 h	5.40	24 h	5.20	10 h	5.30	24 h	4.60	NA	NA
Minimum pH	1 wk	5.20	1 wk	5.20	1 wk	5.10	1 wk	5.20	1 wk	4.50	NA	NA
Retail	6 mo	5.6	6 mo	5.6	24 mo	5.50	4 mo	5.30	6 wk	4.55	7 d	5.2

5.3 Heat treatments

Many people assume that all dairy products made from pasteurized milk. Not so, several alternatives are possible as outlined below. Note, however, that the Food and Drugs Act and Regulations, recognizes only two types of cheese with respect to milk heat treatment, namely, fully pasteurized milk and raw milk. That is, if the milk is not fully pasteurized the resulting cheese considered raw milk cheese.

1. No heat treatment results in raw milk cheese which has more flavor. Raw milk cheese by law must be "held at 20C or more for a period of 60 days or more from the date of the beginning of the manufacturing process, " Food And Drugs Act And Regulations, Sections B.08.030 and B.08.043.

The question of raw milk cheese is an ongoing concern to consumer groups and to health authorities. With respect to regulations on cheese milk heat treatments, 'one size doesn't fit all'.

2. Termination (63-65C, short hold) results in phosphatase positive milk, which must fully pasteurized before cheese making. The purpose is to prevent raw milk spoilage (e.g. over a weekend) due to acid or protease producing bacteria.

3. Pasteurization (63C, 30 min. or 72C, 16 s)

Generally considered the safest alternative, but the full flavor of traditional ripened cheese cannot achieved.

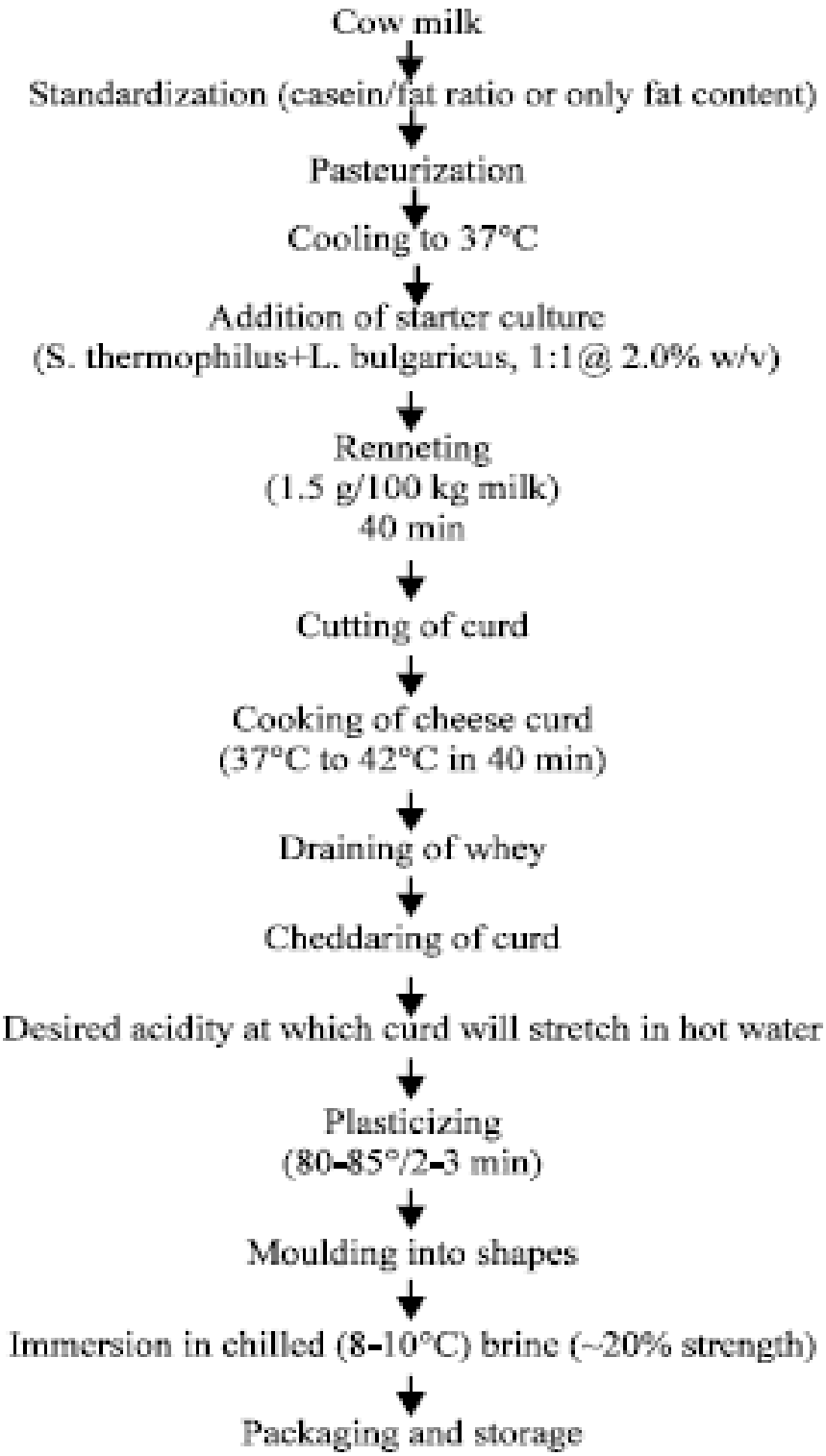
Note that over pasteurization causes denaturation of whey proteins, which subsequently adsorb to the casein particles.

The effects are:

- Longer flocculation times
- Weak or no curd formation
- Excessive loss of fines
- Poor syneresis (moisture release)
- Coarse textured curd with reduced ability to stretch, mat and melt.

4. Heat treat (55 - 65C, 16 s) trade lingo for sub-pasteurization treatment, which applied to destroy most pathogens but allow some bacteria to survive and contribute to cheese ripening.

This process permits fuller flavor of cheese with better control of culture growth (i.e., acid development) than with raw milk. For current regulatory purposes, heat treat is equivalent to raw. Most aged Canadian Cheddar safely made from heat-treated milk


Cow milk
Standardization (casein/fat ratio or only fat content)
Pasteurization
Cooling to 37°C
Addition of starter culture
(S. thermophilus+L. bulgaricus, 1:1@ 2.0% w/v)
Renneting
(1.5 g/100 kg milk)
40 min
Cutting of curd
Cooking of cheese curd
(37°C to 42°C in 40 min)
Draining of whey
Cheddaring of curd
Desired acidity at which curd will stretch in hot water
Plasticizing
(80-85°/2-3 min)
Moulding into shapes
Immersion in chilled (8-10°C) brine (~20% strength)
Packaging and storage

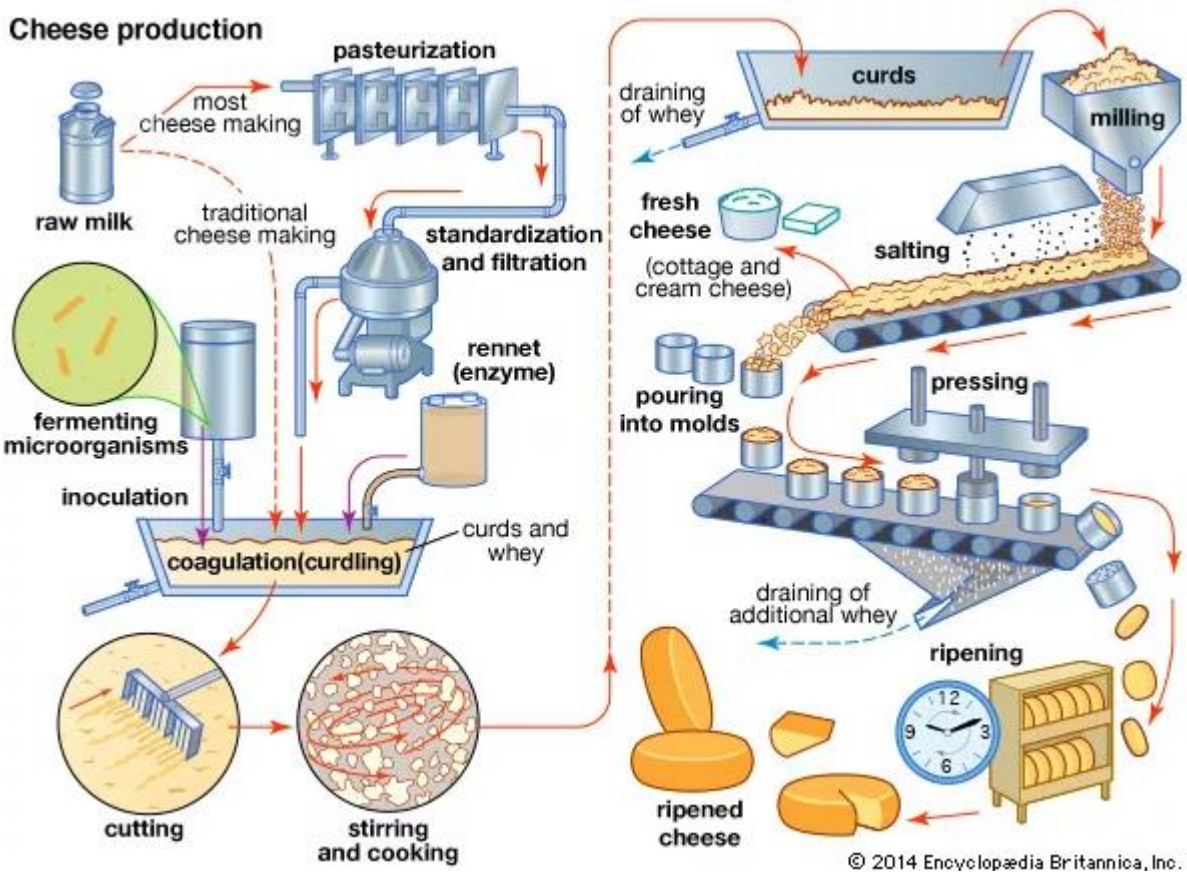


Figure 76: Cheese production flow procedures

Self-Check 5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. List down factor must controlled during processing

_____,_____

_____,_____

2. Write the methods of milk pasteurization

_____,_____

3. Write the different types heat treatment of milk during cheese making

_____,_____

_____,_____

. Answer the following question!

Note: Satisfactory rating 6 and 11 points Unsatisfactory below 6 and 11 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score =

Information Sheet 6 Monitoring and adjusting salt, moisture and pH levels

1.1 Monitoring Salting

A. Brining hard cheese

After pressing, hard cheese typically placed in salt brine to help slow down acid development and encourage rind formation on cheese.

To brine cheese fill none reactive pot with a brine solution and place cheese inside cheese will float within the brine so sprinkle the top of cheese with a small amount of salt. Half way through the brining time flip cheese for even absorption. Refer recipe for the type of brine required as well as how long to leave cheese in it.

Combine the following to make a saturated brine solution

- 1 gallon water
- 2.25 lbs salt
- 1 tbs calcium chloride
- 1 tsp white vinegar

B Salting soft cheese

Salt added directly to draining curds. Adding salt can help encourage whey to drain off. Refer to your recipe for the proper amount of salt to add.

C. Salting mold ripened cheese

Salt added directly to draining curds. Adding salt can help encourage whey to drain off. Refer to your recipe for the proper amount of salt to add.

Figure 77: Cheese Salt

This cheese salt absorbs easily and contains no iodine. Iodine will kill the lactic bacteria in the aging process. Lactic bacteria is important for proper aging of cheese. Cheese Salt does not dissolve too quickly or slowly.

- If a fine grain salt used in cheese making, it may dissolve too quickly, creating a high brine content near the curd surface, which will impede the movement of salt into the cheese.
- If a coarse grain used in cheese making, it will dissolve too slowly and not control culture bacteria activity.

Example Calcium Chloride will help with store bought milk; cold stored raw milk and goat's milk produce a firmer setting curd. A firmer curd is easier to cut and produces a larger yield.

Do not use Calcium Chloride when making Mozzarella, it can prevent the curds from stretching.

Figure 78 Calcium Chloride

1.2 Regulating humidity

To create the optimum relative humidity for place cheese inside of a clear plastic container with a lid. Moisture

Control moisture reduced by syneresis during cooking but remains high, 60 - 70%, in the finished cheese.

Curing: Fresh cheese as the name implies consumed fresh and has a shelf life of only 2 - 3 weeks.

The cheese should take up no more than 1/3 of the space in the container. It is best to place a cheese mat down first within the container to allow even airflow on the bottom of cheese. Sometimes the cheese alone will add enough humidity to the air within the container while other times we place a small bowl of water or even a damp cloth inside.

A hygrometer set up to check on the humidity levels within the container. If there is not enough humidity, cheese can dry out and even crack, if there is too much humidity cheese mould excessively.

Recipe should indicate what humidity range would be best for cheese.

Figure 79: Hygrometer and Thermometer

This hygrometer and thermometer by Thermo-Works perfect for testing the humidity in a cheese cave. Each unit includes a wall bracket, remote sensor, and operating instructions. This hygrometer is a professional tool at an affordable price. It records Min and Max temperatures and can be set to display Fahrenheit or Centigrade.

With large 1-inch, digits have no trouble reading the current display.
Mount hygrometer right to a wall with a convenient wall mount or set it onto a solid surface with the foldout stand.

This unit can display two separate temperature readings using a sensor on a 10-foot cable (included) measure temperature in a remote location

The humidity sensor housed in the hygrometer body so it can only monitor moisture at the base location. It will not read humidity in the remote location.

Note. It is important to use a hygrometer that provides an accurate reading. Many digital hygrometers not intended for high moisture measurement. Tested and rejected multiple units before finding this accurate hygrometer and thermometer

1.4 Control pH:

After cutting the cheese at pH 4.6 - 4.8, the curd cooked to 52°C, which sufficient to inactivate the culture and prevent further acid development. Acidity also reduced by washing the curd before salting.

Coagulation: The distinguishing characteristic of these varieties is that coagulation achieved by acidification to pH 4.6 - 4.8, with little or no coagulating enzyme. Acidification is normally by lactic acid producing cultures. Most other American and European cheese varieties also use lactic acid producing cultures, but gelation induced by a coagulating enzyme at pH 6.5 - 6.7, before much acid development has taken place.

Self-Check 6	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Write the procedure of saturate bribe salt solution during cheese making! (4%)

_____,_____

_____,_____

2. What is the uses of salt in hard cheese making? (2%)

_____,_____

3. _____equipment used to test the humidity of cheese. (2%)

4. What is the average PH cheese after cutting and curd cooked at 52^0c?

_____

. Answer the following question!

Note: Satisfactory rating 4 and 7 points Unsatisfactory below 4 and 7 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Information Sheet 7 Checking cheese for food safety and quality.

7.1 Introduction

Food safety includes free from contamination like:

- Chemicals
- Foreign material
- Bacteria (any microorganism)

Note. No one who makes cheese would forget to ensure that food safety protocols are in place for every aspect of their operation.

7.2 Food safety management system

Set out self-monitoring measures appropriate to each stage of the production process

A. Good hygiene practices (GHP)

Foundation upon which the health control plans are based so their actual contribution to product safety considerable. Often they cover routine measures such as checking the maintenance of machinery, which are easy to carry out and highly effective.

B. Good manufacturing practice (GMP)

Covers all aspects of manufacture including

- Raw material
- Transportation
- Processing
- Storage
- Delivery
- Sale of the finished product.

GMP ensures that products consistently produced and controlled to the quality standards appropriate to their intended use and as required by the product specification.

C. HACCP-based plans detail the preventive actions specific to the product or operations at a particular stage in its production.

7.3 Accomplishing Food safety management

Food safety management during production/ processing will achieved by.

1. Staff training

Essential to guarantee the correct application of food safety measures; mistakes may result from by poor communication (especially regarding changes in procedure), lack of training or lack of comprehension.

2. Analysis during the production process can provide useful information to producers and identify issues before products reach the market.

3. Analysis of products

Used to verify the correct functioning of their food safety management system based on HACCP principles and good hygiene practice.

4. Non-Conformity Management plans

Provide information on procedures for dealing with non-conformities where they identified.

5. Traceability

Enables the rapid identification and segregation of Non-Conforming Products

7.4 Milk and Cheese Analysis for food safety management

7.4.1. General Analysis

Chemical and microbiological analyses of cheese milk, finished cheese, and cheese whey are required to maintain efficient operations and to ensure food safety and quality.

The analytical procedures relevant to cheese making operations, but it not intended to be a comprehensive process and quality control manual.

The following overview of methods intended to orient the reader to the general types of analyses required in cheese operations.

Milk composition analyses should include both fat and protein, determined by infrared milk analyzers.

Note that casein content rather than total protein content is the critical parameter with respect to cheese yield. Many milk analyzers able to measure crude protein, true protein, and casein

Quality measurements of cheese milk should include

- Total counts Milk microorganism (and / or counts)
- Tests for inhibitors
- somatic cell counts

Depending on the types of controls in place at the producer level, cheese makers may need to monitor bacteria counts, inhibitors and somatic cell counts of individual producer milks.

Cheese composition analyses should include

- Fat (by Babcock, Mojonnier, or infrared instruments)
- Moisture
- Salt
- PH
- if possible, protein

Cheese pH should measure at critical stages during cheese manufacture at:

- 7 days after manufacture
- periodically during curing
- Other composition parameters should determine several days after manufacture to permit time for equilibration of soluble components.

Salt in particular requires time to become distribute throughout the cheese in brine or surface ripened cheese; uniform salt distribution may never achieved.

For Cheddar cheese and other vat-salted cheese, representative samples for accurate determination of salt content. Usually obtained as early as seven days after manufacture.

With respect to process and quality control, the ‘pH profile’ during manufacture and curing vital. “pH profile” is a term use to describe the set of pH values at critical process control points in the cheese making process.

Other important process control parameters are:

- Ratio of salt to moisture (SM)
- The moisture in the non-fat substance (MNFS)
- The fat in the dry matter (FDM). These ratios are normally reported as percentages and calculated as follow

Note: that percent total solids is 100 minus percent cheese moisture

7.4. 2. Analytical Quality Control

Effective control of quality and plant efficiency requires effective quality control of analytical procedures.

Smaller cheese manufacturers generally find it is more economical and reliable to have most analyses performed by an outside laboratory.

Some testing done in house, even for the smallest cheesemakers like:

- pH
- TA
- brine concentration are all test accessible

7.4 3. Sampling for Chemical Analysis

Depending on the size and shape, firm to hard cheese should be sampled using a cheese trier (at least 100 g sample) or by taking a sector sample. Soft cheese blended for sampling or sector sampled depending on its texture.

Sector sampling means taking a sample of uniform thickness across the entire cheese or from the center to the exterior of the cheese.

Cheese samples are stored in opaque airtight containers and fragmented using a grater or another device before analysis. It is important to grind and mix the sample well before sub-sampling for analysis.

Figure 80: Samples of cheese obtained with a cheese trier.

If the analytical procedure requires less than a 1 g sample, it is desirable to prepare a liquid cheese homogenate and take a sub-sample from the homogenate.

A homogenate suitable for most purposes can be prepared as follows:

- Weigh 40 g cheese into a blender container.
- Add about 100 g of 7% sodium citrate solution.
- Blend until homogenous using a high-speed blender.
- Rinse blender shaft into container and make up to final weight of about 200 g.

Note that cheese is notorious for inhomogeneous composition. Brine salted cheese have pronounced salt and moisture gradients, namely, higher salt and lower moisture near the surface

Large blocks or wheels of pressed cheese will have moisture and pH gradients, namely, increasing moisture and decreasing pH towards the interior.

In addition to moisture and salt gradients, surface ripened cheese also has pH gradients because pH increases at the surface during curing. These inconsistencies make it difficult to obtain accurate composition and mass balance (yield) data. A useful approach to improve yield and composition control of large blocks is to set aside small blocks (e.g., 20 Kg blocks of Cheddar) for early composition and quality testing, and subsequently conduct representative sampling of the large blocks (e.g., 240 Kg blocks of Cheddar) during the cut/wrap process.

7.4 4. Sampling for Microbial Analysis

Obtain samples as described above for chemical analysis. Triers or knives used for sampling must be flame or alcohol sterilized. Samples should be stored in sterile bags such as Whirl Pack bags at 2-4°C and analyzed within 24 hours.

Self-Check 7	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

Write the food safety contaminants! (3%)

_____,_____

_____

2. Write down the ways of food safety management! (3%)

_____

_____,_____

3. Mention the food safety management accomplishing procedures! (5%)

_____,_____

_____,_____

_____,_____

4. List down the procedure for Milk and Cheese food safety management Analysis! (4%)

_____,_____

_____,_____

. Answer the following question!

Note: Satisfactory rating 8 and 15 points Unsatisfactory below 8 and 15 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Information Sheet.8 Identifying, rectifying and reporting unacceptable cheese

1.1 Common Cheese Defects

Body: in the context of modern sensory analysis, body refers to texture, which is confusing because cheese graders use the term “texture” to refer to cheese openness use the traditional cheese grading terms.

Some descriptors for body defects are:

- Crumbly/short: often due to excess salt or acid.
- Corky: due to overcooking, low fat, low moisture, or excess salt.
- Mealy: this defect detected on the palate or by massaging the cheese between the thumb and forefinger. It is usually associated with excess acidity.
- Pasty: sticks to the palate and fingers due to excess moisture.
- Weak: breaks down too quickly when worked by hand due to excess **fat** or **moisture**.

Texture: relates to openness in the cheese, which may or may not be desirable depending on the type of cheese and the cause of openness.

Openness due to:

- Mechanical openings, which are holes of irregular shape caused by **trapped whey** that makes the impression in the cheese during pressing, but during ripening, the moisture dispersed throughout the cheese leaving the hole behind
- Mechanical openings lead to discoloration around the opening due to local acid development
- Undesired mechanical openings reduced or closed by vacuum packaging.
- Gas holes, which are desirable in many types of cheese.

Gas-hole defects include:

- Early gas defects due to coliforms. These appear as small, spherical, shiny holes.
- The defect is often associated with unclean flavor
- Late gas due to
  - ✓ *Clostridium tyrobutryricum* or *perfringens*, especially in some European made cheese.

- ✓ *Clostridia* spores are often present in American cheese as well but do not normally cause problems. However, they may be activated by heat treatment and therefore, sometimes cause gas defect in processed cheese.

- A third gas defect occurs in Cheddar and American types
  - ✓ The defect is distinctive in that the gas (mainly CO_2 with some hydrogen sulphide) blows the package but not the cheese
  - ✓ The defect occurs at 6-9 months in Cheddar, but a similar defect sometimes observed earlier in American Mozzarella and Colby
  - ✓ The causative anaerobic organism not fully identified; however, experiments have demonstrated that the defect does not occur in cheese aged at < 10°C.
- Yeast slits due to yeast growth.

Figure 81: Cheese with a late gas defect.

Flavor: most grading systems assign the greatest weight to flavor defects. A few common descriptors are:

Acid flavor associated with acid body defects noted above. The common causes all relate to process control:

- Too much moisture (i.e., too much lactose).
- Too much starter (i.e., too much acid development before draining)
- Salting too late or too little.
- Too warm during or immediately after pressing.

- Bitter flavors are common defects in American but also other cheese, including fresh cheese. Some causes include:
  - ✓ High moisture.
  - ✓ Excess rennet.
  - ✓ Bitter cultures
  - ✓ High ripening temperatures.

- Fruity/Yeasty flavors usually associated with high pH and bitterness and sometimes with yeast slits.
- Unclean flavors are reminiscent of the barnyard, and may be associated with coliforms.
- Whey taint is due to high moisture and is usually associated with acid defects including bitterness.

Color: other than traditional color preferences, such as orange Cheddar and white goat cheese, the most important color parameter uniformity. Even for cheese such as Colby, which colored with annatto, graders do not evaluate color intensity. Rather, they look for non-uniformity, which may signal a manufacturing defect. Some common descriptors are:

- Acid cut (pink or bleached) low pH, oxidation of annatto

Figure 82: Bocconcini cheese with blue discoloration.

- Mottled: may be an acid defect or caused by mixing cheese from different vats.
- Seamy: this is a Cheddar defect where the curd particles fail to knit properly. Causes Include:
  - ✓ Greasy curd from too much fat or high temperature during pressing
  - ✓ Improper salting, too soon after milling or pH at salting is too high or too low.
  - ✓ Hooped too soon after salting.

Finish: a lot of art and patience are required to produce cheese with a good finish. Common defects are:

- Checked/Cracked: too dry on surface.
- Greasy: temperature too high during pressing or curing.
- Huffed: gassy.
- Mineral Deposits due to calcium lactate.
  - ✓ Common on Cheddar cheese and sometimes on American varieties
  - ✓ Encouraged by certain non-starter *Lactobacilli* and *Pediococci* which favour formation of D-lactate which in turn encourages crystallization of DL-calcium lactate
  - ✓ Control measures are:
  - ✓ Decrease numbers of non-starter bacteria (e.g., pasteurize versus heat treat and/or bactofuge the milk).
  - ✓ Use tight packaging. Calcium lactate crystals tends to form in areas where the package is loose or in depressions on the cheese surface
  - ✓ Avoid temperature fluctuations. Calcium lactate crystals often form in the dairy case where temperatures are not constant.
  - ✓ Encourage rapid turnover in the dairy case.
- Rind rot caused by mites or mold.
- Surface mold is definitely one of the most common defects. A frequent consumer question is about the safety of moldy cheese.
- Unsymmetrical/Rough: poor workmanship.

Table 7: unacceptable, Identifying and Rectifying cheese product

unacceptable cheese	Identifying	Rectifying
Milk Coagulants contaminate milk with pathogenic bacteria or chemical residues.	Visual and organoleptic inspection	Reject coagulants of suspect odor, color or appearance. Amend handling and storage procedures. Change of supplier.
M, C, P: Contamination during dehydration caused by poor quality of salt, insufficient quantity of salt or unsafe handling.	Organoleptic inspection (visual and olfactory)	Reject abomasa with do not have the expected color and smell or where a gas is produced.
M, C, P: Contamination caused by poor quality salt and or insufficient quantity of salt(1)	Visual inspection	Reject salt which is visibly contaminated or not suitable for food use
M: Microbiological contamination through the water used, unhygienic handling or inappropriate salt concentration	See “water control” sheet	A producer should reject any coagulant they consider to be of doubtful hygienic quality.
M: Proliferation of possible bacteria present in the rennet or by contamination	Organoleptic inspection: Acid smell. light gold colour (liquid extract) or light brown colour (rennet pastes)	Reject coagulants, which do not have the expected color and odor.

Self-Check 8	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Fill the black space

1. List down the body defects of cheese! (5%)

_____
_____
_____
_____
_____

2. Write the gas-hole defects occur on the produced cheese! (3%)

_____
_____
_____

3. Write body defect of cheese associated acid flavor related with process control! (4%)

_____
_____
_____
_____

4. What are the cause's common bitter flavors defect of cheese (4%)

_____,_____
_____

. Answer the following question!

Note: Satisfactory rating 9 and 16 points Unsatisfactory below 9 and 16 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Information Sheet 9 Packaging cheese for curing and distribution with correct batch number

9.1 Packaging

Packaging refers to putting a commodity into a protective wrapper or container for shipment or storage.

Material used for packaging natural cheeses must:

- Afford general protection
- Prevent moisture loss
- Improve appearance
- Protect against micro-organisms and
- Prevent oxygen transmission

Packaging of cheese done to protect the cheese at the time of storage and transportation. Traditionally, cloth used with wood to give support and protection, but the invention of polymers or plastics has revolutionized cheese packaging.

Cheese manufacturing now a days highly mechanized and at the same time, many developments are taking place in the area of cheese packaging

9.2 Type of packaging

Cheese packaged mainly in two forms:

a) Packaging cheese for storage and ripening (bulk packaging)

b) Packaging for consumers (retail packaging)

9.2.1 Bulk Packaging of Cheese

For bulk packaging of cheese, it is either paraffinic or vacuum packed in flexible film.

- For waxing, the cheese lifted by means of suction and half immersed in wax then other half can be immersed
- For vacuum packaging, there are now available vacuum packaging machines, gas-flushing machines, over wrapping machines and vacuum skin packaging machines.

- Paraffinic now completely replaced by film packaging as it causes considerable loss of cheese while removing paraffin. Many cheap and easy to apply films are now available.

A. Modern Packaging Materials and Form

a) Basic modern packing Materials are:

- paper (usually coated or lined)
- Parchment
- Foil (usually aluminum)
- Polythene
- Propylene
- treated cellulose
- cellulose acetate (e.g. cellophane)
- Polystyrene
- Polyester
- polyamide (nylon)
- Rubber hydrochloride (e.g. cryovac) and Saran (a mixed polymer). Laminates are now more common

B. Basic modern packing Forms

- Wrappers
- Cartons
- Bags
- Tubes
- Tubs
- Jars
- Cans, etc**.**

C. Film packaging

This has become synonymous with ‘rind less cheese’. In the latter, green cheeses of uniform size and shape ripened in bags made of plastic films. The wrapped cheese placed in a wooden box or jig to preserve its shape. If the cheese made and ripened in

the conventional way, it cut into retail portions and wrapped by such method as the cryovac.

Desirable properties of films for packaging

- The film must be strong so that it does not tear or change its property when rubbed against a sharp point
- It should easily applied and sealed.
- It must be impervious to water vapor and oxygen.
- When the film is in contact with cheese, it should not change its inherent properties.
- The material must be chemically inert and non-toxic for humans.

Plastic film packaging of cheese applicable to varieties except such extreme types as cottage (which has very high moisture content) and as Parmesan (which is very low in moisture).

There are many advantages and few disadvantages of film packaging, which summarized as follows:

A) Merits (advantage of packaging)

- It affords a considerable saving in labor.
- It protects the cheese from attacks by molds, insects, rodents and fault-inducing microorganisms
- It is easily applied and the method can be readily mechanize
- Practically no loss of moisture and weight in the cured cheese (In traditional ripening the loss may 3 to 7%, even up to 12 %)
- The method permits and is suitable for packaging small quantities, which make handling and retail trade easier.
- The method most easily used for rectangular blocks.
- It is cheap and convenient.
- Humidity control is unnecessary during ripening and storage.
- More cheese can be stored in a given volume
- Turning is unnecessary during ripening.

- It permits ‘rind less curing’ so that whole of the cheese eaten. (When rind formed as in traditional method, the loss can be as high as 10%).

B) Demerits (dis advantage of packaging)

- Not all technical problems in film packaging have solved. (For example, failure to obtain a perfect seal and to remove all air may result in mold growth).
- The moisture content of the cheese at packaging must be less than for traditional packaging and carefully standardized. Failure to do so may lead to the growth of taint-producing organisms.
- The ripening process in some cheeses (such as Camembert) may be affected.
- The film does not always give the same mechanical protection to cheese as traditional methods.
- The most careful attention to detail is necessary in film packaging.

9.2 2 Retail Packaging of Cheese

Retail packaging pis an important aspect, which affects not only the shelf life of cheese but also its marketability

Cheese is available in the form of

- Slices
- Cubes
- Tubs
- Paperboard cartons with foil overwraps, etc.

These are available in different retail sizes like 100 g, 200 g etc.

The developments taking place in packaging technology, cheese packaging revolutionized. Active packaging and modified atmosphere packaging used for retail cheese packaging.

Figure 83: a) Slice b) Dairy cheese cubes c) Aluminium tube

9.3 Special packaging requirements

The packaging material requirements for soft cheeses differ considerably depending on whether the cheese concerned a soft cheese with a mold formation (surface mold, Camembert), blue-veined cheese (Roquefort), or a so-called smeared cheese (Munster). Different bacteria and mold flora require packaging material to have specific properties

1.3.1 Fresh Cheese

a) Protection against light

Metals are impervious to light. With regard to fresh cheese packaging, this concerns first and fore most aluminum, whether in the form of lids to seal plastic containers or as deep-drawn containers. A high degree of imperviousness to light achieved through the addition of carbon black or brown pigments (total transmission approaching 0%).

As black cheese, packaging would not be acceptable to the consumer, such light-preventing layers usually produced as the inner sheet of multilayer films by co-extrusion. This has not done in dairy industry because of cost.

The outstanding barrier property of aluminums also found with vacuum metalized plastic films (e.g. polyethylene terephthalate polyester (PETP), oriented polypropylene (OPP), cellophane or paper).

b) Protection against the effects of oxygen

In order to avoid the diffusion of oxygen, especially in packed fresh cheese with a long shelf life, the impervious packaging material possible must selected. This is achieved

using Al (foil or strips), metalized plastics or by means of O_2 resistant layers in plastic combinations such as polyvinylidene chloride (PVDC), ethylene vinyl alcohol (EVAL) or polyvinyl alcohol (PVAL)

When selecting mono or multilayer combinations (bags or thermoformed containers) it should borne in mind that the data concerning gas permeability always refers to flat (unfolded) material, measured at +23^{o}C. When a pack formed, the permeability may change significantly due to capillarity in the sealed seam, thinning of the material at the base of deep-drawn containers or fractures caused by bending in bags.

c) Protection against loss of moisture

The absorption of moisture is not of any significance for packaged fresh cheese. On the other hand, however, fresh cheese with a long shelf life must protected against loss of moisture. In addition to the specific properties of water vapor permeability of the various packaging materials, the way they processed into finished packs is also important.

d). Protection against contamination

Quite apart from contamination through leaks in the packs or lids, the packaging material itself contaminated to a greater or lesser extent. Paper, which used as wrappers affected as a raw material or during production by bacteria and/or mold conidia

Due to high temperatures involved in processing, plastics considered virtually bacteria-free. However, the possibility of contamination from the environment cannot ruled out during further converting into film and containers.

9.3.2 Hard cheese

Emmental cheese

A pressed, ‘block’-shaped Emmental Cheese (84 kg) is wrapped in cling film and stacked on a specially designed pallet, which mechanically turned during the ripening/storage period. The smaller ‘block’-shaped Emmental could package mechanically in a Cryovac-BKIL bag. This type of packaging material is a laminate of different layers of plastics

9.4 Coding Batch number for cheese

Designation that printed on the drug label that allows

- The history of its production to found
- Includes not only identification of the specific **batch** produced, but all relevant issues of control
- Manufacturing particulars should traceable from the **batch number**.

A. **batch number** or lot **number**

- Mark of identification, usually generated by the manufacturer, which allows a small sample of product uniquely identify
- Include/ relate to the
  - ✓ date of production
  - ✓ the source of raw materials
  - ✓ the machines used to process the food

The **batch code**

- Between 3 and 11 **numbers** (sometimes letters)
- usually either located near the barcode, near the company information
- On the bottom
- stamped on after the packaging was made

Figure 84: Mozzarella cheese with code number ten digit

In industrial terms batch number is designation in **numbers** and/or letters, to identify and trace a set of identical products that share certain characteristics of production (production time, production date, identification **code**

9.5 Cheese storage and distribution

After completion of the post-processing treatments like bandaging and dressing, the cheeses kept in the ripening room. This starts the process of ripening.For some varieties of cheese like Cheddar and Parmesan, ripening and storage are the same while for others like Camembert and Roquefort, ripening and storage are two different processes, as they need altered temperature and humidity in both the processes.

Storage is inevitably, a continuation of the ripening process (except changing temperature and humidity for some varieties) so that all the considerations, which apply to the ripening period, apply equally to the storage period.

9.5.1 Shelves for Ripening/Storage of Cheese

In traditional practice, wood used as the material for construction of shelves. However, it has many disadvantages as if it gives shelter to pests and is an excellent medium for the growth of molds and other microorganisms, once it is wet. Therefore, wooden shelves need lot of care and maintenance. The easiest materials to clean are glass and stainless steel.

9.5.2 Factors Affecting Ripening and Storage

The two most important factors controlling ripening and storage are

A. Temperature

B. Humidity.

A. Temperature

It is necessary to control the temperature during storage and maintain uniform temperature, as almost all biochemical reactions are temperature-dependent. Higher temperature accelerates ripening but jeopardizes the quality of cheese as it results in the growth of undesirable microorganisms. For cheeses of Cheddar and related varieties, temperature of 5-7°C is ideal but 8-12°C considered economically best. Temperature higher than 18°C should strictly avoided

B. Humidity

The relative humidity of a gas is the amount of water vapor present expressed as percentage of that required to saturate the gas

Higher humidity leads to:

- Mold growth
- Accelerated ripening and surface bacterial taints.

Lower humidity results in

- Cracking
- Shrinking
- Distortion
- Retardation of ripening in addition to excessive loss of weight.

The correct humidity for ripening depends on the type of cheese Soft cheese requires a higher humidity (95%) than open-textured hard cheese (85%) and these again require greater humidity than close-textured hard cheese (80%). Further, mold ripened cheese require higher humidity than other varieties of cheese

9.5.3 Storage Conditions for some of the Cheese Varieties

Cheeses of the Cheddar family (Cheddar, Cheshire, etc.) ripened at lower temperatures of about 4-8°C, and a relative humidity (RH) lower than 80%. The ripening time may vary from a few months up to 8–10 months or even 12 months.

Other types of cheese like Emmental are first stored in a ‘green’ cheese room at 8–12°C for some 3–4 weeks followed by storage in a ‘fermenting’ room at 22–25°C for some 6–7 weeks. After that, the cheese is stored for several months in a ripening store at 8–12°C. The relative humidity in all rooms is normally 85–90%.

Smear-treated types of cheese Tilsiter, Havarti and others – are typically stored in a fermenting room for some 2 weeks at 14–16°C and a RH of about 90%, during which time the surface smeared with a special cultured smear mixed with a salt solution.

Once the desired layer of smear has developed, the cheese normally transferred to the ripening room at a temperature of 10–12°C and a RH of 90% for a further 2–3 weeks. Eventually, after the smear washed off and cheese wrapped in aluminum foil, it

transferred to a cold store, 6–10°C and about 70–75% RH, where it remains until distributed.

Other hard and semi-hard types of cheese, Gouda, Edam, may first be stored for a couple of weeks in a ‘green’ cheese room at 10–12°C and a RH of some 75%. After that, a ripening period of about 3–4 weeks may follow at 12–18°C and 75–80% RH.

Finally, the cheese transferred to a storage room at about 10–12°C and a relative humidity of about 75%, where the final characteristics are developed.

9.3.4 Factors Controlling the Loss of Moisture in Cheese

The primary factors, which control the loss of moisture in cheese, are

- Temperature
- moisture content
- size and shape of the cheese
- RH of air

The rate of loss of moisture rises sharply with temperature. With storage at 5, 10 and 15°C, the losses in 6 months were found to be 4.4, 6.4 and 8.7%, respectively. Higher the moisture content, higher will be the rate of loss and more is the free moisture. The smaller the cheese, the more rapid the losses of moisture as a proportion of that initially present. The higher the RH of the air in the cheese storage room, slower will be the rate of moisture lossOther factors that influence the loss of moisture during storage are type and quality of the wax or film applied to the outside of the cheese and type of cheese

9.4 Distribution of Cheese

Distribution of cheese from manufacturer to distributor/retailer should done under strict conditions of appropriate temperature. For cheese varieties, which continue to ripen in the storage period, it is important to maintain the temperature for ripening during distribution also. For example, Cheddar cheese should distributed at the temperature of 5-8°C. Refrigerated and insulated vehicles used for this purpose.

Self-Check 9	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Fill the black space

1. What are the must material used packaging cheese? (5%)

_____,_____

_____,_____

_____,_____

2. Write the types of cheese packaging! (2%)

_____

_____

3. List down the basic modern cheese packing form! (5%)

_____,_____

_____,_____

_____,_____

4. Write the special function of packaging fresh cheese! (4%)

_____,_____

_____,_____

. Answer the following question!

Note: Satisfactory rating 9 and 16 points Unsatisfactory below 9 and 16 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score =

Information Sheet 10 Cleaning equipment in each batch

1.1 Cleaning equipment

Cleanliness is a top priority in cheese making. All equipment needs clean and sterilized before use and cleaned directly after use as well.

Keeping everything as clean as possible will help cut down on the chance of rogue bacteria in cheese.

The process of cheese making largely influenced by growth of friendly bacteria and the want to create the ideal environment for them to flourish and also a wonderful place for rouge bacteria to flourish too.

The process of cheese making will provide an ideal environment for friendly bacteria to ripen milk. Cleaning environment help the cultures to stay

- Strong
- Happy
- Healthy without having to compete against unwanted bacteria**.**

1.2 Sanitation and Food Safety for Cheesemakers

Proper sanitation, food safety, and personal hygiene practices are important for dairy farms since they can protect consumers from becoming ill and protect the cheesemakers' business.

1.3 Before Cleaning

In any food processing facility, there are multiple food contact surfaces. A food contact surface is any surface that may enter into direct contact with the food.

Examples

- Tables
- shelves,
- Scales
- Cutting boards
- Utensils such as shovels, knives, etc.

Before begin cleaning and sanitizing remove any

- Solids
- Dry or wet
- Present on the food contact surface.

For example, after a cheesemaking production run, all remaining curd pieces scraped off the vat, or otherwise removed, before start the cleaning steps.

Remember: it is easier to remove solids before they dry out.

1.4 Cleaning and Sanitizing Steps

Cleaning involves the use of soap or detergent and warm water to remove all invisible soul form the service.

Sanitizing involves the use of a sanitizer to reduce microbes to a safe level on an already cleaned surface. Cleaning and sanitizing compounds should not use interchangeably and should be used in the correct order: clean first and then sanitize. Steps needed to clean and sanitize a food contact surface properly are:

1. Pre-rinse
2. Wash
3. Rinse
4. Sanitize

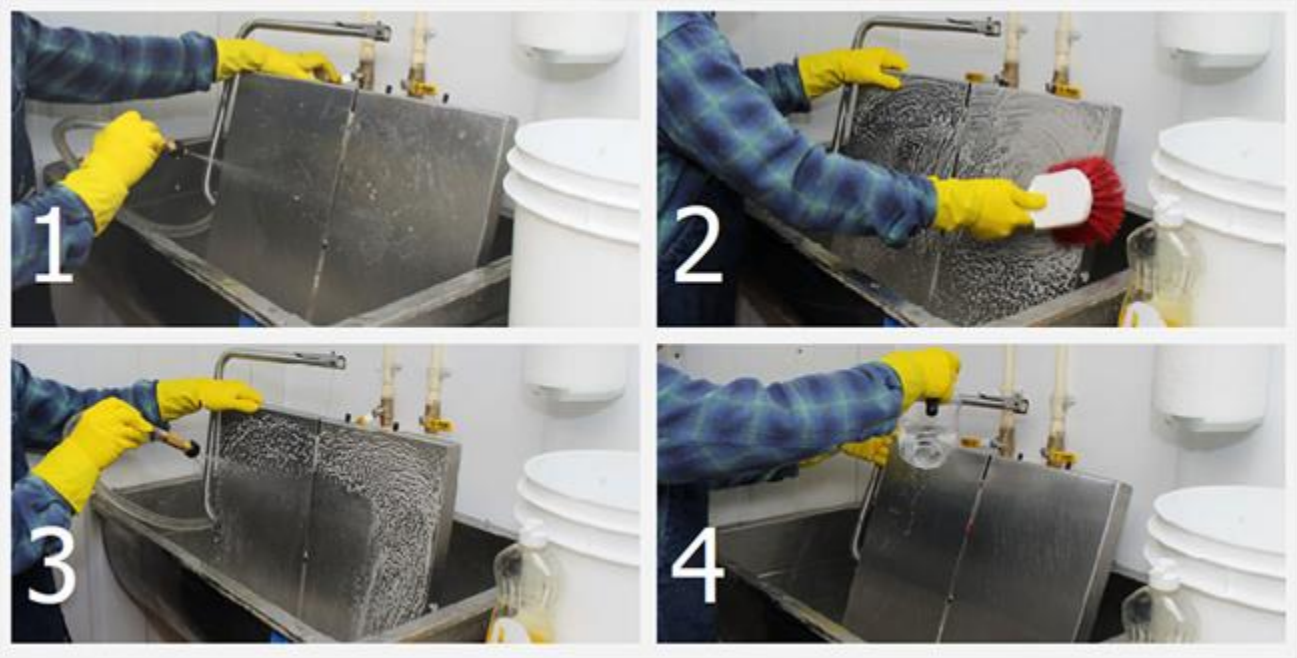


Figure 85: Cleaning and sanitation steps of cheese making

Step One: Pre-rinse

The first step is **pre-rinse**.

Wet the surface that cleaned to help loosen any soil or milk residue that present on the surface that left after the initial step of removing the residual solids.

Step Two: Washing

This step performed with

- Soap or detergent
- warm water
- Some form of mechanical action provided by brush to remove food or soil that is on the surface.

Figure 86: how a food contact surface is properly pre-rinsed.

Step Three: Rinse

This step washes off all the soap, as well as any remaining food particles, from the surface. After rinsing, the food contact surface should appear completely clean to the naked eye.

Figure 87: Cheesemaker properly washing a food contact surface.

Step Four: Sanitize

The final step is to **sanitize** the cleaned food contact surface. This step reduces the number of microbes to safe levels. It is important that all the soil and soap or detergent rinsed away. A sanitizer may not work as well if applied to a dirty or soapy surface. Some common chlorine based sanitizers like bleach inactivated by organic compounds like proteins and fats that present in milk and curds

Remember: first clean and then sanitize.

Figure 88: Sanitizing equipment

1.5 Cleaning and sanitation process.

Remember it is not possible properly sanitize if the surface is not cleaned first. It is also important to rinse the soap off the surface because soap or detergent can interfere with the efficacy of the sanitizer.

There are four elements considered in cleaning and sanitation process. These elements summarized by the acronym “TACT”

- **Frist T** stands for “**T**emperature,”
- **A** for “**A**ction,”
- **C** for “**C**oncentration
- Second **T** for “**T**ime.”

Figure 89: TACT”

T = Temperature

T is for temperature. Temperature is an important factor in the efficiency of cleaning and sanitizing. For example, cold water in the pre-rinsing step, it might be harder to clean because some components will solidify. If the water is too hot, other compounds might “cook” and attach to the surface cleaned also becoming harder to clean.

Temperature also affects sanitizer efficacy. Bleach works well in the temperature range of 75°F to 120°F.

Mix or use bleach at high temperatures, the bleach will leave the solution as a gas, making the solution less effective against microbes. So, mixing bleach with cold or warm tap water recommended.

To use another sanitizer, always read the label for proper instructions.

A = Action

A is for action. Action is the **mechanical force** apply to clean the surfaces. One example of action is scrubbing. The action applied during the cleaning helps to remove physically food and bacteria that might attached to the surfaces.

C = Concentration

C is for concentration. Using an accurate concentration of soap or detergent and sanitizer is extremely important. If the concentration is too low, then it is not effective. However, if the concentration is too high, it violates federal regulations can be wasteful and expensive and can harm people.

Some soaps and detergents applied directly to the surface to clean.

Note.

- To prepare soap or detergent, always read the label for instructions and follow them.

- The proper concentration of bleach for sanitizing surfaces is one tablespoon of bleach to one gallon of water to obtain a final concentration of 200 ppm.
- Remember to mix thoroughly before using.
- To use another sanitizer, always read the label for instructions and follow them.

Another option is to use a **sanitizing solution** recommended for dairy equipment like BTF Iodophor Sanitizer and Star San Sanitizer

A. BTF Iodophor sanitizer

BTF Iodophor sanitizer is an odorless, tasteless iodine sanitizer that is safe to use on all cheese making equipment. This low-foaming, no-rinse concentrate requires only 1 tsp per 1.5 gallons, and 2 minutes of contact time, to be effective.

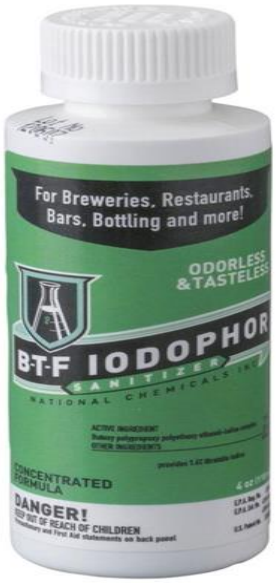


Figure 90: BTF Iodophor Sanitizer

B. Star San Sanitizer

Star San sanitizer is a broad spectrum, non-rinse, food grade acid sanitizer that is effective against **E. Coli** and **Staphylococcus Aureus**. Using this can help cut down on the possibility of contamination when making cheese. Starsan will keep equipment; surfaces and tools sanitized for daily use and not affected by organic materials.

Figure 91: Star San Sanitizer

T = Time

T is for time. The amount of time that a surface exposed to the sanitizing solution is very important for effective sanitation. Most sanitizers for food contact surfaces need a minimum for one-minute contact time to kill the remaining microbes. In addition, sanitizer's solutions lose their efficacy over time. It is important to make a fresh solution of bleach, at the correct concentration, at least once per day.

Precautions

When working with sanitizers, remember that they are chemicals and can be dangerous if not handled properly.

Be careful when mixing bleach or any other chemical at establishment. For instance, when chlorine accidentally mixed with acid solutions, chlorine gas generated, which is not only corrosive but also can cause respiratory irritation workers. Also, do not mix ammonia solutions with bleach.

ALWAYS use proper concentration of chemicals since “more” is not necessarily better, and “less” is almost certainly less effective!

Finally, be sure to label all chemicals clearly and properly, and do not store them in food containers

1.6 Cross-contamination

Cross-contamination is the transfer of harmful substances or microbes (also known as contaminates) from something dirty to something. Clean on a dairy farm concerned with the transfer of bacteria from unclean surfaces to food or food contact surfaces. One of the biggest concerns with cross contamination occurs when contaminants from a source outside the cheesemaking room transferred, via the cheesemaker or employees, to the cheese or the food contact surfaces

A. Cross-contamination ready to eat food.

Ready to eat foods are usually products that are prepared (cooked, fermented, and acidified) in advance and eaten as sold. In other words, they do not require any additional heating or preparation step and eaten

Examples of ready to eat food include

- Salads
- Deli meats
- Canned food and of course, cheese.

Examples of cross contamination include

- Handling
- Touching animals followed by handling cheese with the same unclean hands.
-

Figure 92: Cross contamination with animal

B. Cross-contamination: Shoes or Boots

The barn and other parts of a dairy farm are natural reservoirs of microbes. Try to minimize the transfer of microbes from those areas to the cheesemaking room.

One way for microbes to enter to cheesemaking room on shoes. Just by walking into the barn or outside gather billions of microbes on the sole of shoes. Measure in place to minimize the carriage of those microbes inside the cheesemaking room.

Figure 93: Cross-contamination: Shoes or Boots

Here are some options:

1. Use a boot bath with a sanitizer.

2. Wear shoes that are used exclusively inside the cheesemaking room.
3. Wash and sanitize boots every time re-enter the cheesemaking room.

A practical solution is to add a boot bath by placing a tray with sanitizer at the entrance door. Sanitizer in the tray should made fresh every cheesemaking session and changed when visually dirty.

Having these boot baths in place when visitors tour the cheese making room is a good idea since they might bring microbes from other places.

Prefer to wash boots when entering; the same principle applies, as with cleaning equipment: remove gross contamination, use mechanical action. Then use sanitizer.

Figure 94: Cross-contamination Shoes or Boots disinfection steps

C. Cross-contamination from Clothes

Just like with shoes clothes can carry microbes from the barn, the milking parlor, or the outside to the cheesemaking room.

To minimize the cross-contamination from “street or barn” clothes

- Wear designated clothing
- Overalls
- Aprons that are used exclusively inside the cheesemaking room

- The best practice is **always** change into clean clothes before entering the cheesemaking room to cheesemaking and use an apron.

Note. Avoid making cheese using the same clothes used in the milking parlor. That is because animal's excrement and microbes from other sources carried unnoticed on clothes.

Figure 95: Cross-contamination from Clothes

D. Cross-contamination for cutting and packing

When cutting cheese for packaging, taken special care to avoid cross-contamination. The inner portions of the cheese that are isolated from the environment by the rind exposed when cut. At this point dealing with final product, which is a ready to eat product.

Any contamination transferred to the cheese at this step will likely reach consumers. Proper cleaning and sanitizing all food contact surfaces and utensils will reduce the risk of cross contamination

Food contact surfaces include but are not limited are:

- Knives
- cutting boards
- cutting wires
- vacuum packaging machine; etc

Note. Remember it is important to use the four steps of cleaning and sanitizing for this food contact surfaces

1. Pre-rinse
2. Wash
3. Rinse
4. Sanitize) must wearing clean, untorn gloves at this step to minimize contamination of the cheese.

Figure 96: Cross-contamination for cutting and packing

E. Cross-contamination from transporting

Transporting the cheese to sale locations offers another opportunity for cross contamination. Containers used for transportation, if not clean, can contaminate cheese

Another chance for contamination occurs when the same container used for both cheese and raw products such as meats or produce. Even frozen meat can still be a source of contamination. Therefore, fresh or frozen meat **not** placed in the same cooler as cheese. The ice used in the coolers should made from potable water and frozen meat or other foods should not used in places of ice.

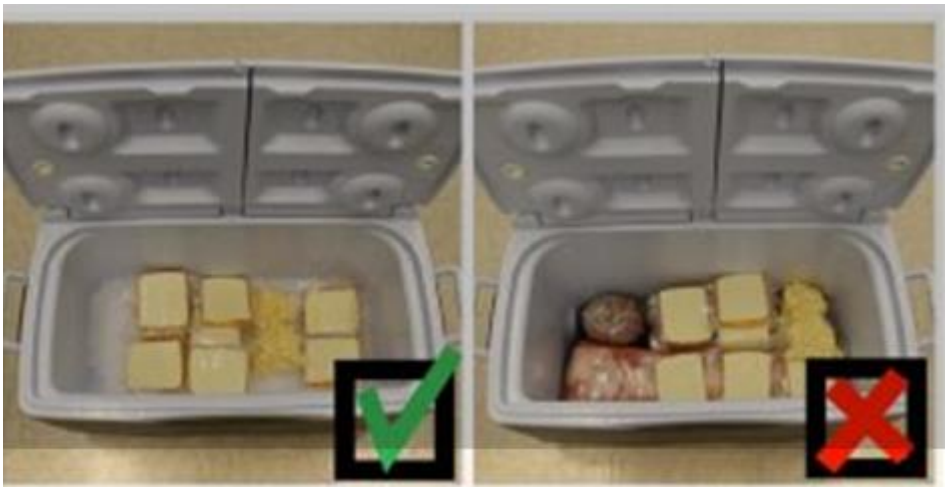


Figure 97: Cross-contamination from transporting

F. Cleaning and Sanitizing the Cheese Vat

The correct way to clean and sanitize the vat is to follow the four steps for cleaning and sanitizing

Disassemble any fittings, screens, etc. that are on the vat and take them to a sink to be cleaned later. Remove any solids that may be present and then follow the same cleaning and sanitizing steps

1. Rinse the interior and the outside walls with warm water.
2. Thoroughly brush all the inner walls, bottom, ridges, and exterior walls with soap and warm water, being careful not to let the brush touch the floor.
3. Rinse everything to remove the soap.
4. Sanitize all areas that brushed with a fresh, 200-ppm solution of bleach.
    - This solution is prepared by adding one tablespoon of bleach to a gallon of water, if another sanitizer used please follow the preparation instructions listed on the container.

Follow the same steps for the fittings, screens, etc

- Using appropriately sized brushed to clean all interiors and exterior surfaces prior to sanitizing them
- Reassemble as necessary
- Vat is now clean, sanitized and ready for use.

Figure 98: Cleaning and Sanitizing the Cheese Vat

G. Frequency

All equipment, utensils, and food contact surfaces must cleaned regularly. Some items require cleaning and sanitizing more frequently than others do

Below items that need to cleaned and sanitized every time to make cheese:

- The vat,
- Any utensils that used,
- Knives and wire knives,
- Hoops and hoops' lids or covers
- Other equipment that has direct contact with the milk or curds, like
  - ✓ Pasteurizers
  - ✓ milk cans
  - ✓ Agitation blades, etc.

If utensils cannot be stored in a way that avoids cross contamination from nonfood contact surfaces. They need to cleaned and sanitized before they contact with the milk or curds **every time**.

Some examples are:

- Thermometers
- Knives or another utensil to check coagulation

Nonfood contact surfaces should receive regular cleaning, depending on use. Develop a schedule for cleaning each of the following items:

- Floors
- Walls
- Shelves
- Sinks
- Other non-food-contact surfaces you might have

DO NOT use the same brush to clean the floors, walls, etc. for cleaning the food contact surfaces.

Figure 99: Frequency of cleaning and sanitization

Self-Check 10	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Fill the black space

1. _____ remove all invisible and visible soul form the equipment by soap or detergent and warm water (2%)

2. _____reduce microbes to a safe level on an already cleaned surface (2%)

3. Write the procedure/ steps of cleaning and sanitizing (4%)

_____,_____

_____,_____

4. Write down the types of contamination occurred during cheese making/ food preparation (4%)

_____

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score = _____

Information Sheet 11 Implementing and reviewing safety procedures

1.1 Personal Hygiene

Important to practice proper personal hygiene when working with food.

Personal hygiene refers to habits of cleanliness of

- Clothes
- Hair
- Hands
- Everything!

Figure 100: Personal Hygiene for cheese making procedures

1.2 Handwashing

One of the most important personal hygiene practices is hand washing

The basic steps for handwashing are:

1. Wet hands and arms with water
2. Apply soap
3. Lather and scrub your hands and arms for about 10-15 seconds. Do not forget the areas under your nails and between your fingers, and use a small brush as necessary.
4. Rinse thoroughly with warm water
5. Dry hands using clean paper towel or an approved drying method.

When handling any ready to eat food, include packing of cheese, ensure to wearing gloves.

Figure 101: Handwashing steps

Hand washing practice and time during cheese making

- After smoking
- Before packing cheese
- After using the restroom
- After sneezing or blowing nose
- Every time you return to the cheesemaking room, even if you were only talking on the phone or talking to a customer
- Before cutting cheese to serve at a farmer's market
- After handling money
- After picking something off the floor

Figure 102: Hand washing practice and time during cheese making

1.3 Hands and arms sanitizing

Sanitizing hands and arms, after washing them, is as important as sanitizing any other food contact surface or utensils

To sanitize hands and arms dip them up to elbows in the same sanitizing solution use to sanitize food contact surfaces and utensils.

For this reason sink or other container with enough sanitizer to dip hands and arms during the cheesemaking session.

Sanitize hands and arms every time, before touching milk, the curds or any food contact surfaces, like the hoops. The same care taken when flipping or otherwise handling pressed cheese.

Figure 103: Hands and arms sanitizing steps

1.3 Optional Handwashing Activity

Now it is turn to wash hands following the guidelines that were just provided.

1. Wet hands and arms with water.
2. Apply soap.
3. Lather and scrub your hands and arms for about 10-15 seconds. Do not forget the areas under your nails and between your fingers, and use a small brush as necessary.
4. Rinse thoroughly with warm water.
5. Dry your hands using clean paper towel or an approved drying method.
6. When handling any ready to eat food, include the packing of cheese ensure to wear gloves.

Figure 104: Optional Handwashing Activity

1.5 Hairnet and Beard Net: Incorrect/Correct

It is important to wear a hair net or clean hat, and beard net, when working with food to prevent cross contamination with hair, sweat, or dandruff.

The left photo demonstrates a correct practice. The right photo demonstrates an incorrect practice.

Eating

Always remember to eat in areas away from the food preparation area. Again transmit bacteria from saliva to hands or fingers, and ultimately, to the food handling.

Note. Always remember to wash hands before returning to work.

Avoid eating curds in the cheesemaking room, but if do eat away from the food preparation (cheesemaking room) area and wash hands afterward.

When chew might spit, and do not want to contaminate the curds with saliva. That's why, in the photos, the cheesemaker is tasting the curds **away** from the vat and then washes hands before returning to work.

Figure 105: Hairnet and Beard Net: Incorrect/Correct

1.6 Leaving the Cheese making Room

Each time enter the cheesemaking room, there is a chance to carry contamination from the outside

Minimize the risk of cross contamination by:

1. Not leaving the cheesemaking room during a cheesemaking session; if must leave, minimize the number of times.
2. Sanitizing boots before reentering the cheesemaking room; or changing to a pair of shoes or boots designed for the preparation area.
3. Washing hands before returning to work, and sanitizing hands and arms when necessary.
4. Leaving apron in the work area. If going to re-use apron, ensure that it does not become contaminate by falling on the floor, or by touching “dirty” surfaces, etc.

Figure 106: Leaving the Cheese making Room

1.8 Use of Gloves

The Food and Drug Administration's (FDA) Food Code recommends wearing gloves, in addition to hand washing, to protect the food are handling.

However, it is important to realize that gloves do not replace proper hand washing. It is also important to wash hands properly before putting on gloves.

Make sure that the gloves fit well. Gloves that too big tear easily or caught in equipment.

Hands must be clean in the case a glove rips, and bare hands accidently contact with the food or food contact surfaces to reduce the risk in contamination. So, wash hands before putting on gloves.

This step also will prevent contamination of the gloves from hands, when putting on the gloves.

Figure 107: Use of Gloves

1.9 Gloves: Correct/Incorrect

Glove use is beneficial to protecting the safety of food if used correctly.

First, it is important to know that gloves used to protect food from contamination and not for protecting hands.

Wear gloves on both hands as demonstrated in the left photo. Do not wear only one glove, as demonstrated in the right photo.

Use gloves when cutting and packing cheese and when cutting samples at a farmers' market or another retail setting

Figure 108: Gloves: Correct/Incorrect

1.10 When to Change Gloves

Remember, gloves only remain clean until touch a contaminated surface, including hair or face. If touch hair or face with gloves on, the gloves need to changed, especially before handling food Also, if sneeze or cough into glove, it is important to change gloves before continuing to work.

Gloves are not to be worn when handling cash or shaking hands.

Figure 109: When to Change Gloves

Self-Check 11	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Fill the black space

1. List down the Personal hygiene must habits during cheese making! (4%)

_____,_____

_____,_____

2. List down the proper handwashing steps during cheese making! (4%)

_____

_____

_____

_____

_____

3. Write down the practice and time must cheesemaker hand washing during cheese making (4%)

_____

_____

_____

_____

_____

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____

Score =

L #28	LO #4 Record and reach view cheese making process

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Monitoring and comparing cheese yields
- Reviewing environmental practices and safety standards
- Maintaining workplace records

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Monitor and compare cheese yields
- Review environmental practices and safety standards
- Maintain workplace records

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1 Monitoring and comparing cheese yields

Factors affecting Cheese Yield

1. Distribution of milk Components during Cheese Making

Cheese yield efficiency is about optimizing the value derived from all the dairy components passing through the plant.

Milk, Cheese and Whey chemical composition

	Milk and cheese chemical composition				
	Fat	**Protein**	**CHO**	**Ash**	**Solids**
Milk Composition %	3.3	3.2	5.0	0.7	12.4
Cheese Composition %	31	25	2.0	2.1	60
Whey Composition %	0.22	0.61	5.3	0.58	7.0
% Transfer	93	78	4	30	49

Cheese weight expected yield is about 10% of milk weight

The typical distribution of milk solids during cheese making. In practice the mass balance of cheese making is more complicated and is becoming more complex with an increasing collection of dairy ingredients

Inputs may include any of a wide variety of milk fat sources, milk protein and whey protein concentrates and isolates.

Outputs may include:

- Cream removed during standardization of milk
- Whey removed at draining
- Whey removed after draining, sometimes after salting, and during pressing
- Whey cream
- Defatted whey

Accurate determination of mass balance is, therefore, complex.

If possible, it is important to measure and maximize yield efficiency. This means maximizing the return (or minimizing the loss in the case of lactose) from all milk components entering the plant.

This includes obtaining maximum returns for whey non-fat-solids, whey cream and cream skimmed during standardization. Usually the highest return for all milk components obtained by keeping them in the cheese.

Accordingly, with respect to yield the cheese makers' objectives are:

1. Standardize milk to obtain maximum value for milk components consistent with good quality. Historically this usually meant to adjust the protein/fat ratio to maximize cost efficiency. In current practice, it may mean substituting one source of nonfat solids for a less expensive alternative.
2. Obtain highest MNFS (moisture in non-fat substance) and SM (salt as a percentage of moisture) consistent with good quality to maximize moisture and the recovery of whey solids (within permitted standards).
3. Minimize losses of fat and casein in the whey.

To achieve these objectives the cheese maker needs to understand what factors affect cheese yield and how they can controlled.

These factors grouped in two categories

- Influenced at the farm
- Influenced during processing.

2. Factors controlled at the farm

Milk quality factors that may cause altered milk composition or encourage release of proteolytic or lipolysis enzymes that break down proteins and fats. These may include high somatic cell counts, psychotropic bacteria, spore forming bacteria, temperature damage, excessive agitation etc.

Milk composition influenced by

- Genetics (species, breed, and particular protein phenotypes)
- Feed
- Season
- animal health
- stage of lactation

- Other production factors.
- Particularly important to cheese yield are proteins and fat.

In rennet coagulated cheese and cheese made by acid coagulation of warm milk, casein is the principal structure forming and water holding component. It therefore contributes much more than its own weight to the cheese.

In heat-acid precipitated varieties, whey protein play a greater role along with caseins to incorporate fat and water into the protein matrix

Fat interferes with syneresis and contributes more than its own weight to cheese yield, , but if other conditions are adjusted to maintain constant MNFS, then fat contribution to yield is dependent only on the conversion factor of fat from milk to cheese (i.e., fraction of milk fat recovered in the cheese).

3. Factors controlled during processing

Cheese moisture. A 1% increase in Cheddar cheese moisture causes about 1.8% increase in cheese yield, partly because the higher moisture is obtained by retaining more whey in the cheese, which results in retention of more whey solids.

For example, suppose a cheese yield value of 90 Kg cheese / 1000 Kg milk with a moisture 35%. Everything else being equal

If the cheese maker increased the moisture to 35% the cheese yield would increase by 1.7 Kg for a total of 91.7 Kg cheese / 1000 Kg milk.

Cheese salt. An extra 0.1% salt means an extra 0.14% yield of Cheddar cheese if the moisture content increased accordingly.

Time and Temperature

Increasing time and temperature of milk pasteurization increases cheese moisture retention and the recovery of whey proteins and soluble solids. This strategy is limited because excess pasteurization hinders renneting of milk. The safe amount of denaturation of whey proteins depends on casein level in the milk, extent of acid development, and the type of cheese.

Process control parameters

- Careless cutting results in increased fines and loss of both fat and protein in the whey
- Heating too fast at early stages of cooking may cause brittle curd with more tendency to break up and release fat and protein into the whey
- Salting too soon after milling of Cheddar allows rapid salt uptake, which in turn causes rapid syneresis and increased solubility of casein. Yield is, therefore, reduced by losses of protein, fat and soluble solids.
- High temperatures during pressing cause loss of fat.
- Proteolytic cultures or coagulating enzymes cause protein losses before and after cutting.
- Washing removes soluble solids.
- Working, as in Mozzarella, removes fat and soluble solids. Loss of soluble solids minimized by equilibration of the wash water with the cheese moisture.

Total Solids

Oven Method

1. Pre-dry aluminum dishes (105C, 1 h) and weigh to the nearest 0.1 mg on an analytical balance.
2. Weigh quickly 3-5 g of fragmented cheese into the aluminum dish. The weight of sample is the total weight minus the weight of the dish from Step 1.
3. Dry to constant weight (about 16 h) at 105C. To check for constant weight: weigh at least two samples, return both samples to the oven for an additional 20 minutes, and re-weigh. The difference between the weights before and after the additional drying period should be less than 1 mg.
4. Cool in desiccator and determine total dry weight. Sample dry weight is the total dry weight less the weight of the dish determined in Step 1.
5. Report total solids and moisture contents on weight percent basis as follows:

$$(a)\ \%\ Total\ Solids = \frac{Dryweight}{Wetweight}$$

$$(b)\ \%\ Moisture = 100 - \%\ Total\ Solids$$

Note: Several rapid moisture tests based on infrared or microwave drying are available. Check with your laboratory equipment supplier

Record of cheese manufacture.

MAKER	CHEESE	VAT #	DATE

CHEESE COMPOSITION %

Fat _____
Moisture _____
Protein _____
Salt _____
Calcium _____
FDM _____
MNFS _____
S/M _____

YIELD

Expected Yield %
Actual Yield %
Yield Efficiency %

Fat Recovery

Milk fat Kg
Cheese fat Kg
Recovery %
Whey Fat %

pH PROFILE

Cutting _____
Draining _____
Milling _____
Salting _____
1 day _____
7-14 days _____
3 months _____
6 months _____
1 year _____

MILK QUALITY

Protein/fat _____
Casein/protein _____
Somatic cells _____
Total counts _____
Antiobitics _____
Flavour _____

CHEESE QUALITY **Date** _____

Presumptive coliforms _____
E. coli _____
Presumptive staphylococci _____
S. aureus _____
Yeast and molds _____
Salmonella _____

GRADING **Grader** _____

Date/Cheese Age	Texture Score	Flavour Score	Total Score	Comments

Comments:

Self-Check.1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Mention factor affecting cheese yield! (3%)

_____

_____

_____

2. List down factor that affect milk composition. (5%)

_____,_____

_____,_____

_____,_____

_____,_____

3. Write down factor must controlled during cheese making (3%)

_____,_____,_____

4. Write the product out during cheese manufacturing (5%)

_____

_____

_____

_____

. Answer the following question!

Note: Satisfactory rating 9 and 16 points Unsatisfactory below 9 and 16 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Information Sheet 2 Reviewing environmental practices and safety standards

2.1 Introduction

Water used in domestic and industrial applications polluted to varying degrees. Water used as a transport medium to carry away waste products. As awareness of the importance of improved standards of water treatment grows, process requirements become increasingly exacting.

The food industry contributes significantly to pollution, particularly as the pollutants are of organic origin. Organic pollutants normally consist of 1/3 dissolved, 1/3 colloidal and 1/3 suspended substances, while inorganic materials are usually present mainly in solution.

2.2 Organic pollutants

The normal way to express the concentration of a pollutant is to specify the total quantity per unit volume of sewage. Another, more modern way of analyzing the presence and quantities of organic substances in sewage effluent is the use of chromatography, such as High-Performance Liquid Chromatography (HPLC).

However, the quantity of organic substances is normally determined in the form of.

- Biological oxygen demand (BOD)
- Chemical oxygen demand (COD)
- Calcining loss
- Total organic carbon (TOC)

A. Biological oxygen demand (BOD)

BOD is a measure of the content of biologically degradable substances in sewage. The substances are broken down by microorganisms in the presence of (and therefore with consumption of) oxygen. Oxygen demand measured in terms of the quantity of oxygen consumed by microorganisms over a period of five days (BOD_5) or seven days (BOD_7), in decomposing the organic pollutants in wastewater at a temperature of 20 °C. BOD measured in mg oxygen/l or g oxygen/m^3.

The following relationship assumed for municipal sewage

$BOD_7 = 1.15 \times BOD_5$

BOD is a measure of the content of biologically degradable substances in sewage.

B. Chemical oxygen demand (COD)

COD indicates the quantity of the pollutants wastewater that oxidized by a chemical oxidant. The normal reagents used for this purpose are strongly acid solutions (to ensure complete oxidation) of potassium dichromate or potassium permanganate at high temperature.

Consumption of oxidant provides measure of content in organic substance and converted to a corresponding quantity of oxygen, expressing the result as mg oxygen/l or g oxygen/m^3

The COD/BOD ratio indicates how biologically degradable the effluent.

Low values, *i.e.* < 2, indicate relatively easily degradable substances, while high values indicate the contrary. However, this relationship cannot used generally, but a typical value of COD/BOD for municipal sewage effluent is often < 2.

In the FIL-IDF Bulletin about Dairy Effluents, Document 138, 1981, reported (Doedens) that the COD/BOD5 ratio for effluent generated in different groups of dairies producing liquid milk, butter or cheese ranged from 1.16 to 1.57, at an average of 1.45.

In other groups of dairy plants producing milk powder, whey powder, lactose and casein, the ratio varied from 1.67 to 2.34, with an average of 2.14.

However, the general conclusion of the FIL-IDF Bulletin was that a COD: BOD ratio established in one dairy plant could not transferred with sufficient reliability to another plant.

COD indicates the quantity of the pollutants in wastewater that oxidized by a chemical oxidant.

C. Calcining loss

Calcining loss obtained by first determining the dry solids content in a sample, and then calcining it so that the organic substance is burnt.

The difference in weight before and after calcining represents the quantity of organic substance. The value expressed as a percentage.

D. Total organic carbon (TOC)

TOC is another measure of the quantity of organic materials, determined by measuring the quantity of carbon dioxide produced from combustion of a sample. The unit is mg/l.

Drinking water

The table below extracted from *Guidelines for drinking-water quality*, 2nd ed. Vol. 2 Health criteria and other supporting information, 1996 Geneva, and World Health Organization (WHO).

In WHO's Guidelines for drinking-water quality, also a large number of microbiological and other chemical parameters affecting the water quality can be found.

Drinking water

The table below extracted from Guidelines for drinking-water quality, 2nd ed. Vol. 2 Health criteria and other supporting information, 1996 Geneva, and World Health Organization (WHO).

In WHO is Guidelines for drinking-water quality, also a large number of microbiological and other chemical parameters affecting the water quality found.

Guideline values for drinking-water quality

Element value	Abbr.	Guideline mg/l
Cadmium	Cd	< 0.003
Arsenic	As	< 0.01
Chromium	Cr	< 0.05
Lead	Pb	< 0.01
Mercury	Hg	<0,006*

The current guideline value applies to inorganic mercury, which the form found in drinking water, whereas the previous guide

2.3 Inorganic pollutants

The inorganic components of sewage consist almost entirely of salts, and determined largely by the ionic composition and salt concentration in the mains water. The presence of these salts in sewage is normally unimportant. Present-day effluent treatment processes concentrate on the reduction of nitrogen, phosphorus salts and heavy metals. Nitrogen and phosphorus compounds are important, as they are nutrients for organisms, e.g. algae, in recipients. Because of the growth of algae, secondary processes can proceed in the recipient, forming further organic substances, which, when they decompose, can result in considerably higher oxygen demand than is caused by primary organic pollutants in the sewage effluent.

Heavy metals may be toxic in high concentrations and may disturb the ecosystems in low concentrations.

2.4 Dairy product processing wastewater

Dairy product processing wastewater divided into three categories:

1. Cooling water
2. Sanitary waste water
3. Industrial waste water

2.4.1. Cooling water

As cooling water is normally free from pollutants, it discharge into storm water by piping system, the system for run-off water from rain and melting snow, etc.

2.4.2. Sanitary wastewater

The sanitary wastewater normally piped direct to the sewage treatment plant with or without first having mixed with industrial wastewater.

2.4.3. Industrial wastewater

Industrial wastewater emanates from spillage of milk and products thereof, and from cleaning of equipment that has been in contact with milk products.

The concentration and composition of the waste depends on the production programmed, operating methods and the design of the processing plant.

Sewage treatment plants dimensioned to treat a certain quantity of organic substances and to be able to deal with certain peak loads. However, one organic substance fat presents particularly difficult problems.

Besides having a high BOD (cream with 40 % fat has a BOD_5 of about 400,000 mg oxygen/l while skim milk has 70,000 mg/l), fat sticks to the walls of the mains system, as well as causing sedimentation problems in the sedimentation tank as it rises to the surface.

Dairy wastewater should therefore pass a flotation plant where it aerated with "dispersion water" (the method of supplying finely dispersed air bubbles to the water at a pressure of 400 – 600 KPa called dissolved air flotation).

The air bubbles attach themselves to the fat, carrying it rapidly to the surface where it strained off, manually or mechanically depending on the size of the plant. The flotation plant is often located close to the dairy building and the waste passes through it in a continuous flow.

The defatted effluent mixed with the sanitary wastewater going to the sewage treatment plant.

BOD of some milk products

Product		**BOD_5 mg/ l**	**BOD^7 mg/ l**
Cream	40% fat	400 000	450 000
Whole milk	4% fat	120 000	135 000
Skim milk	0.05% fat	70 000	80 000
Whey	0.05% fat	40 000	45 000
Whey conc.	60% DM	400 000	450 000

2.5 pH of dairy effluent

The pH of dairy effluent varies between 2 and 12, because of the use of acid and alkaline detergents for plant cleaning.

Both low and high pH values interfere with the activity of the microorganisms that break down organic pollutants in the biological treatment stage of the sewage treatment plant, transforming them into biological sludge (cell detritus).

As a rule, wastewater with a pH of over 10 or below 6.5 must not discharged to the sewage system, as it is liable to corrode the pipes.

Used detergents are therefore normally collected in a mixing tank, often located close to the cleaning plant, and the pH measured and regulated to about pH 7.0 before discharged to the drain.

Wastewater with a pH of over 10 or below 6.5 must not discharged to the sewage system.

Guideline values for advanced treated sewage water

	Outlet in river/lake	Outlet in sea	Outlet in municipal WWTP
	Outlet in river/lake	Outlet in sea	Outlet in municipal WWTP
Ammonia-nitrogen, mg/l	1 – 5	< 10	< 100
Total-nitrogen, mg/l	< 25	10 – 15	80 – 100
Total-phosphorus, mg/l	0.3 – 0.5	0.5 – 1.5	10 – 30
BOD_7, mg/l O_2	10 – 15	15 – 20	500 – 2000
pH	6 – 9	6 – 10	> 6.5
Grease, mg/l	< 1	< 1	< 100

Specific regulations adopted to the recipient has defined in discussions with local and national environmental authorities.

As a fundamental rule, the water quality of receiving water must not adversely affected by the treated sewage water.

WWTP stands for Waste Water Treatment Plant.

2.6 Reducing the quantity of pollutants in waste water

There are many solutions for minimizing the amount of pollutants in dairy wastewater. Closed systems, reuse of water, recirculation of product/water mixture over membrane filters are just a few examples to reduce pollutants in wastewater.

Ultrafiltration and microfiltration are in many dairy plants used for purifying and reuse of CIP solutions. Condensation water from evaporators can preferably reused for other purposes in the plant.

It is constantly necessary to control and prevent wastage of water and product in the processing plant.

Hidden losses of water in subfloor and underground piping can detected by reading the water meter and recording the quantity used at the end of the day.

Daily records of water consumption compared with the daily quantity of milk processed. The water consumption, expressed as cubic meters per ton of treated milk plotted on a graph kept in an easily accessible place. A typical water: milk ratio is 2.0:1, but with intense saving of water, it is possible to come down to a ratio of less than 1:1.

The following general recommendations can serve as a guide to reducing wastage of water and product:

2.7 General milk treatment

- In reception of milk, particularly when tankers emptied, it is important that the outlet from the tankers is at least 0.5 m above the receiving container or tank, and that the connecting hose is well stretched, to ensure that the tankers completely drained.
- All pipelines must identified and marked, to avoid wrong connections that would result in unwanted mixing of products, as well as leakage of milk.
- When pipes are installed, they should be laid with a slight and correctly calculated gradient to make them self-draining. In addition, the pipes must well supported to prevent vibration, which could cause the couplings to work loose and thus cause leakage.
- All tanks should be equipped with level controls to prevent overflow

Self-Check.2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Fill the black space

1. Mention the types of organic substance (4%)

_____

_____

_____

2**. Mention the categories of wastewater produced in dairy product processing plant! (3%)**

_____,_____

_____,_____

3. **Write down the element that affect quality of drinking water (5%)**

_____,_____,_____

_____,_____,_____

. Answer the following question!

Note: Satisfactory rating 7 and 12 points Unsatisfactory below 7 and 12 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Information Sheet 3. Maintaining workplace records

3.1 Maintaining workplace records

Records are observations, measurements, and other data recorded manually or by means of monitoring equipment, to document the devotion to critical limits or other processes requires

Records are the collected information produced by the industry in the process of performing and reporting industry operation.

Characteristics of records are that they:

- Need to be easily retrieved or accessed;
- Contain information that is permanent, and does not require updating.

All Records should be

i. Legible and clear
ii. Dated
iii. Readily identifiable and retrievable;
iv. Carry authorization status;
v. Retained for a designated period;
vi. Protected from damage and deterioration while storage.
vii. All calculations should be duly recorded

3.2 Recording information

Records are observations, measurements, and other data recorded manually or by means of monitoring equipment, to document the devotion to critical limits or other processes requires.

Records are a tool used to confirm that things are working effectively. Records can:

- Provide a means to track/path and review deviations
- Identify the root cause of an issue
- Help improve a process
- Identify trends/tendencies indicating that a process is moving towards deviation
-

3.3 Production Batch Records

Documentation is the electronic or written record of all information regarding methods, conduct, and/or results of industry work; the factors affecting results of industry work; and the regular or corrective actions taken

Batch records should include documentation that each significant step in the production of the batch was accomplished including;

- Specific identification of each batch, including
- materials used during manufacturing
- Reagent record.
- Identity of major equipment used;
    - ✓ COA records
    - ✓ Equipment log.

Good records enable one to track all activities performed during batch manufacture, from the receipt of raw materials to the final product release; they provide:

- History of the batch
- Distribution
- Essential part of GMP to keep accurate records,

3.4 Signing all records

The initials or signature of the person who performs each test and date of tests performed

The initial or signature of a second person verifying the:

- Accuracy
- Completeness
- Compliance with established standards

The initials or signature of a person (supervisor/QA) reviewing the document.

3.7 Communicating recorded information

Communication is the transfer of facts, ideas, opinions, feelings and information from one person or group to another. It is how come to know and understand everything around us.

3.8 Operator communicate and seeking advice from supervisor to fulfil the jobs like:

- How to collect samples and conduct tests
- How to take corrective action.
- operational health and safety (OHS) hazards and controls
- common causes of variation and corrective action required
- Good Manufacturing Practice (GMP
- Inspection or test points (control points) in the water purification process
- Basic operating principles of process control
- Basic operating principles of equipment and main equipment components
- Workplace information such as;
    - ✓ Standard Operating Procedures (SOPs)
    - ✓ Specifications
    - ✓ Production schedules and instructions
    - ✓ Manufacturers' advice
    - ✓ Standard forms and reports
    - ✓ Critical control points

Self-Check 3	Written Test

Name……ID…… Date_____

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Choose the best answer (10 point)

1. Which one of the following is workplace information?

A. Standard Operating Procedures (SOPs) C. critical control points E. All

B. manufacturers' advice **D.** standard forms and reports.

2. All Records should be

A. legible and clear. C. readily identifiable and retrievable

B. Dated D. Carry authorization status

E. Retained for a designated period. F. All

3. Batch records should include.

A. COA records B. Equipment log F. All.

C. Labeling log D. Packaging log

4. Records are a tool used to confirm and can

A. Provide a means to track/path and review deviations

B. Identify the root cause of an issue

C. Help improve a process

D. Identify trends/tendencies indicating that a process is moving towards deviation.

E. All

. Answer the following question!

Note: Satisfactory rating 6 and 10 points Unsatisfactory below 6 and 10 points

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Name: _____ **Date:** _____

Score = _____

Rating:

Reference

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Goff, H.D., This is an educational area focused on milk, dairy products, and dairy technology, and is one book in our Dairy Education Series. This site was developed and is continually maintained by.

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The trainers who developed this learning guide

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Answer Key

Module Title: Coordinating Dairy Products Level III

LO #1 Monitor milk supply and quality
Self-check sheet 1.

2. Mention at least five most Important points milk collector follow for good hygienic milk collection!:

- Use clean containers and equipment;
- Use containers that are easy to clean with a wide opening;
- Keep the milk covered and in the shade;
- Transport the milk as quickly as possible after milking;
- Cool as quickly and whenever you can (4°C or below);
- Try to avoid any delays in milk collection.

2. List down at least six the criteria of good raw milk quality Free of debris and sediment

- Free of off-flavors
- Free of abnormal color and odor
- low in bacterial count
- Free of chemicals (e.g. antibiotics, detergents)
- Normal composition and acidity

3. Write down the method of milk preservation!

- cooling methods
- Lacto peroxidase System of milk preservation

Self-Check2

1. What are the generally parameter of milk and milk products Sampling analysis for milk quality?

- Chemical analysis
- Bacteriological analysis
- Sensory analysis etc.

2. List down the major raw milk component!

- Water

- lipid (fat)
- Lactose
- protein (casein and whey proteins)
- Milk contains smaller quantities of minerals, specific blood proteins, enzymes,

3. Mention the **fat globules** size in **un-homogenized** and milk.

- Un-homogenized milk1-10 µm
- Homogenized 0.2-2 µm.

Self-check. 3

1. Mention time and temperature required for milk inoculation.

- Time and Temperate 45 to 60 min at 25°C-30°C

2. List down the three forms **milk inoculation methods**

A. Traditional starters

B. Bulk set culture

C. Direct to the vat cultures

3. Write the producer of rennet mixing to milk for milk fermentation!

- Mix the rennet (either liquid rennet or a rennet tablet) in a 1/4 cup of chlorine free water (or as directed on the package.)
- Fully mixed into the water
- Stir the rennet water into the milk
- Stir thoroughly for about 5 minutes
- Mixing the milk up from the bottom of the pot so that the rennet is well distributed.
- Continue to maintain the temperature of the milk, without stirring, while the rennet curds the milk

LO, #2 Prepare cheese-making equipment and add ingredients

Self-check. 1

1. List down Safety measure that an operator take before any machine operation! (4%)

- Shutdown the machinery and equipment after work completion
- Identify all energy sources and other hazards
- Identify all isolation points

- Isolate all energy sources
- De-energize all stored energies
- Lockout all isolation points
- Tag machinery controls, energy sources and other hazards
- Test by 'trying' to reactivate the plant without exposing the tester or others to risk (failure to reactivate ensures that isolation procedures are effective and all stored energies have been dissipated)

2. List down tallest 6 point How the operator maintaining work areas with Equipment! (6%)

- Short term training is necessary for the operators
- Become familiar with the safe operation of the equipment
- The operator must know the machine working principle and operation
- All operators should trained. The owner of the machine is responsible for training the users.
- Check bolts and other loosen parts and tighten it before operation will start.
- When maintaining, inspecting, attaching and detaching parts, park the machine at flat and safe place.
- Use proper tools to maintain the machine and check working area is safe. During Operating
- Only allow responsible person, who are familiar with the instructions, to operate the machine

Self-chech2

1. Write the four ingredient required for cheese making (4%)

- Milk
- Rennet
- Salt
- Cultures

2. Write the basic starter culture used for cheese manufacturing! (2%)

- Mesophilic
- Thermophilic

3. What are the role of starter culture in determining the quality of cheese (3%)
    - Taste
    - Texture
    - Characteristics of finished cheese.
4. Mention the two common types of acid used in soft cheese manufacturing! (2%)

- Citric Acid
- Tartaric Acid

5. _____Natural enzyme used to elevate the cheese flavor (2%)
    - Lipase

Self-check.3

2. Mention the two basic milk chemical composition used in cheese manufacturing (3%)
    - Fat average 3.90% (2% to 7%)
    - Protein (caseins and whey) average 3.20% (2.5% to 5.5%) (Caseins 2.6 % whey proteins 0.7%)

2. List down the most bacteria type and quality level found in bulk Milk tank (5%)

- Somatic cell counts: good <100,000; concern >300,000
- Total plate counts: good < 3,000/ml; maximum raw milk 100,000
- Preliminary Incubation Count (PIC) <10,000 CFU /mL
- Lab Pasteurized Count (LPC) <100 CFU /mL
- Coliforms: good < 10/ml; concern > 25; max 100
- Psychrotrophes (grow at T < 7C): good < 1,000

3._____and_____are cultured dairy product produced from raw milk (2%)

Yogurt and Cheese

Self-check4

1. What is the primary function lactic starters in cheese making processes? (2%)

- Used for production of lactic acid from lactose

2. Write the two groups of lactic starter cultures! 3%)

3. simple or defined: single strain, or more than one in which the number is known

4. mixed or compound: more than one strain each providing its own specific characteristics

3 What are the required Commercial starter culture Storage requirement? (3%)

- The temperature recommended by the manufacturer
- Stored at cold temperatures
- Away from humidity, light and within their expiry date (expiration date)

4. What are the quality criteria evaluation of liquid starter? (4%)

- Its acidity or pH before use
- Close part-used sachets containing cultures correctly
- store them in a container in a clean cold place
- Using them as soon as possible after opening.

Self-check.5

1. List down equipment used for cheese making! (5%)

- Cheese Pot/Vat
- Colander and measuring spoons
- Dairy thermometer
- Curd knife
- Cheese mold
- Drip Tray
- Cheese press
- Butter muslin

2._____ equipment used to shape cheese (2%)

- Cheese molds

3. Write the types of cheese wrap (3%)

- Clear breathable wrap
- Two ply cheese wrap
- Foil wrap

4._____ the equipment used for milk fermentation for cheese making (2%)

- Cheese pot/vat

Sel-check.6

1. Write the two types of commercial cheese making vat! (2%)
    - Cylindrical coagulators for curd processing
    - Hydraulic setting vats
2. Write the three types of commercial cheese making molding machine! (3%)
    - Drum molding machines
    - Molding and pre-hardening units
    - Molding machines for provolone and caciocavallo
3. Write the three types of commercial cheese making molding machine! (3%)
    - Dry Salt Dosage Systems
    - Hot water heaters for cheese
    - Liquid salt dosage systems
4. Mention the two types of Hardening and Brining Vats (2%)
    - Brining vats
    - Hardening vats

Self-check.7

1. List down the essential ingredients of cheese making! (5%)
    - Milk
    - coagulating enzyme (rennet)
    - bacterial cultures
    - Salt
    - Rennet causes
2. Write the types of mold powder!(3%)
    - White Mold Powder
    - Blue Mold Powder
    - Red Bacteria Linens
3. List down the types of cheese manufactured by mold powder (3%)
    - Camembert
    - Brie
    - Blue and Triple Cream
4. List down the types of rennet! (3%)

- Liquid Animal Rennet Organic
- Liquid Vegetable Rennet
- Tablet Vegetable Rennet

Self-check.8

1 mention the objective of making in dairy product processing plant (3%)

- To obtain the optimum cheese composition with respect to moisture, acidity (pH), fat, protein and minerals (especially calcium)
- Establish the correct structure of the cheese at the microscopic level
- Ripen to perfection

2. Write the types of based on the content of fat and water (4%)

- Hard
- Semi hard
- Soft
- Very soft

LO, #3 Carry out process control and make adjustments according to operating procedures

Self-check.1

1. Mention the three key of objective of pre-start inspection! (3%)

- . First that the equipment inspected.
- Second, that identified faults or hazards reported and rectified.
- Third, that unsafe equipment taken out of service until it is safe to use

2. What are sensitive parts of cheese equipment/ machine first inspect to start (4%) the operation?

- Bolts
- Drain
- Cap tightness
- Pins.

3. Write down appropriate shutdown procedure for Dairy equipment/machine (5%)

- Reading, interpreting and following information on written job instructions, specifications and other applicable reference documents.
- checking and clarifying task-related information
- Entering information onto preforms and standard workplace forms.
- Shutting down machine/equipment.
- Purging/de-energizing equipment.
- Installing safety/security lock-off devices and signage

Self-check.2

1. Write down main causes of fault/problem of equipment occur in working areas (5%)
   - Poor design,
   - Variations in raw water quality
   - Lack of maintenance
   - Inadequately trained operators,
   - Inadequate process monitoring,
   - Poor record-keeping and poor management
2. List down procedure that identifying equipment/ machine fault technical!(5%)
   - Components and parts of equipment/ machine
   - Production materials
   - Information and service
   - Final products against workplace standards and specification
   - The current operation and how they contribute to the final quality of the product or service Identify and isolate faulty

Self-check.3

1._____the method of assuring consumer product of constant fat content and meeting standards. (2%)

- **Standardization**

2. Mention the milk standardization procedure before manufacturing! (3(%)
   - . Mixing whole milk with partly or totally skimmed milk
   - Mixing skimmed milk with cream.
   - Separating whole milk to get the required fat content

3._____ refers to the practice of giving the culture time to begin acid production before the rennet added.(2%)

- Ripening

4. Write the Couse of soft curd formation during heating milk for cheese making! (3%)
   - Over heat treatment
   - Low setting temperature
   - Colostrum or mastitis milk
5. Write the type of curd cutting during cheese making!(2%)
   - Manual cutting
   - Automated Cutting
6. Mention the important procedure must cheese maker follow at cooking time! (3%)
   - The cooking schedule
   - Cooking too quickly forms a tough exterior on the curd particles, which prevents moisture release
   - Hinders development of a smooth texture during pressing.

Self-check.4.

1. List down the procedures must cheese maker must follow to take right sample! 4%)
   - when milk is coming by hand or from the machine into the bucket or pipeline
   - when the milk is poured or pumped into the bulk tank
   - when the milk is emptied from the bulk tank
   - When the milk is poured or pumped into the cheese vat.
2. Write the most known bacteria that affect cheese quality!(3%)
   - Coliform Count
   - Lab Pasteurized Count (LPC)

Self-check.5

1. List down factor must controlled during processing (5%)

- Moisture Control
- PH Control
- Mineral Control
- Flavor Control

- Heat treatments

2. Write the methods of milk pasteurization (2%)
   - Pasteurization (63C, 30 min. or 72C, 16 seconds)
3. Write the different types of milk heat treatment of milk during cheese making (4%)
   - No heat treatment results
   - Termination (63-65C, short hold
   - Pasteurization (63C, 30 min. or 72C, 16 s) 4.
   - Heat treat (55 - 65C, 16 s

Self-chec.6

1. Write the procedure of saturate bribe salt solution during cheese making! (4%)
   - 1 gallon water
   - 2.25 lbs salt
   - 1 tbs calcium chloride
   - 1 tsp white vinegar
2. What is the uses of salt in hard cheese making? (2%)
   - Slow down acid development
   - Encourage rind formation on cheese (2%)
3. _____ equipment used to test the humidity of cheese. (2%)
   - **Hygrometer**
4. What is the average PH cheese after cutting and curd cooked at 52^0c?
   - pH 4.6 - 4.

Self-check.7

1. Write the food safety contaminants! (3%)
   - Chemicals
   - Foreign material
   - Bacteria (any microorganism)
2. Write down the ways of food safety management! (3%)
   - Good hygiene practices (GHP)
   - Transportation
   - HACCP

3. Mention the food safety management accomplishing procedures!(5%)

- Staff training
- Analysis during the production process
- Analysis of products
- Non-Conformity Management plans
- Traceability

4. List down the procedure for Milk and Cheese food safety management Analysis! (4%)

- General Analysis
- Analytical Quality Control
- Sampling for Chemical Analysis
- Sampling for Microbial Analysis

Self-check.8

1. List down the body defects of cheese! (5%)

- Crumbly/short: often due to excess salt or acid.
- Corky: due to overcooking, low fat, low moisture, or excess salt.
- Mealy: this defect detected on the palate or by massaging the cheese between the thumb and forefinger. It is usually associated with excess acidity.
- Pasty: sticks to the palate and fingers due to excess moisture
- Weak: breaks down too quickly when worked by hand due to excess **fat** or moisture.

2. Write the gas-hole defects occur on the produced cheese! (3%)

- Early gas defects due to coliforms. These appear as small, spherical, shiny holes.
- The defect is often associated with unclean flavor
- Late gas due to

3. Write body defect of cheese associated acid flavor related with process control!

- Too much moisture (i.e., too much lactose).
- Too much starter (i.e., too much acid development before draining)
- Salting too late or too little.
- Too warm during or immediately after pressing.

4. What are the cause's common bitter flavors defect of cheese.

- High moisture.

- Excess rennet.
- Bitter cultures
- High ripening temperatures.

Self-check.9

1. What are the must material used packaging cheese? (5%)
   - Afford general protection
   - Prevent moisture loss
   - Improve appearance
   - Protect against micro-organisms and
   - Prevent oxygen transmission
2. Write the types of cheese packaging! (2%)
   - Packaging cheese for storage and ripening (bulk packaging)
   - Packaging for consumers (retail packaging)
3. List down the basic modern cheese packing form!(5%)
   - Wrappers
   - Cartons
   - Bags
   - Tubes
   - Tubs
   - Jars
   - Cans, etc**.**
4. Write the special function of packaging fresh cheese! (4%)
   - Protection against light
   - Protection against the effects of oxygen
   - Protection against loss of moisture
   - Protection against contamination

Self-check.10

1. _____ remove all invisible and visible soul form the equipment by soap or detergent and warm water (2%)
   - Cleaning

2. _____reduce microbes to a safe level on an already cleaned surface

- Sanitizing (2%)

3. Write the procedure/ steps of cleaning and sanitizing (4%)

- Pre-rinse
- Wash
- Rinse
- Sanitize

4. Write down the types of contamination occurred during cheese making/ food preparation (4%)

- Cross-contamination ready to eat foods
- Cross-contamination: Shoes or Boots
- Cross-contamination from Clothes
- Cross-contamination for cutting and packing
- Cross-contamination from transporting

Self-check.11

1. List down the Personal hygiene must habits during cheese making! (4%)

- Clothes
- Hair
- Hands
- Everything!

2. List down the proper handwashing steps during cheese making! (5%)

- Wet hands and arms with water
- Apply soap
- Lather and scrub your hands and arms for about 10-15 seconds. Do not forget the areas under your nails and between your fingers, and use a small brush as necessary.
- Rinse thoroughly with warm water
- Dry hands using clean paper towel or an approved drying method.

3. Write down the practice and time must cheesemaker hand washing during cheese making

- After smoking

- Before packing cheese
- After using the restroom
- After sneezing or blowing nose
- Every time you return to the cheese making room, even if you were only talking on the phone or talking to a customer
- Before cutting cheese to serve at a farmer's market
- After handling money
- After picking something off the floor

LO, #4 Record and reach view cheese-making process

Self-check.1

1. Mention factor affecting cheese yield! (3%)
   - Distribution of milk Components during Cheese Making
   - Factors controlled at the farm
   - Factors controlled during processing
2. List down factor that affect milk composition. (5%)
   - Genetics (species, breed, and particular protein phenotypes)
   - Feed
   - Season
   - animal health
   - stage of lactation
   - Other production factors.
   - Particularly important to cheese yield are proteins and fat.
3. Write down factor must controlled during cheese making (3%)
   - Cheese moisture
   - Cheese salt
   - Cheese salt
4. Write the product out during cheese manufacturing (5%)
   - Cream removed during standardization of milk
   - Whey removed at draining
   - Whey removed after draining, sometimes after salting, and during pressing
   - Whey cream

- Defatted whey

Self-check.2

1. Mention the types of organic substance(4%)
   - Biological oxygen demand (BOD)
   - Chemical oxygen demand (COD)
   - Calcining loss
   - Total organic carbon (TOC)

2. Mention the categories of wastewater produced in dairy product processing plant!(3%)
   - Cooling water
   - Sanitary waste water
   - Industrial waste water

3. Write down the element that affect quality of drinking water (5%)

Cadmium

Arsenic

Chromium

Lead

Mercury

Self-check.3

1. Which one of the following is workplace information?

- **D. all**

2. All Records should be

- **F. All**

3. Batch records should include.

- **F. All**

4. Records are a tool used to confirm and can

- **E. All**