

VETERINARY PUBLIC HEALTH I

(VPH I)

Objectives of this class

- You will be able to define veterinary public health
- List the duties and responsibilities of Public health veterinarians
- Define food from two sense
- Define and differentiate different types of food contamination

INTRODUCTION

- Veterinary Public Health (VPH): stems from veterinary medicine which is considered as the broadest and the most comprehensive of health professions because it involves large number of species.
- VPH provides the linkage between agriculture and public health.
- It is a discipline which deals with **contribution** of veterinary medicine to public health.
- The ultimate objective of veterinary public health is to promote the **quality** and **well being** of human life. Human health is linked to animal health and production particularly in the developing countries of the world. This is because people live with animals in close contact.

Health, as defined by the **World Health Organization** (WHO), is "a state of complete physical, mental and social well-being of human and not merely the absence of disease or infirmity.

Public Health is defined as “the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society.

- It comprises of all **analytical** and **organizational** efforts that are aimed to **promote and improve the health of the community**.

Public health: Protection and improvement of

- The term VPH describes the concept and responsibility of veterinary medicine for the health of the public.
- In its widest sense, **it is defined as** a component of public health activities devoted to the **application of veterinary profession knowledge, skill and resource** to the **protection and improvement of human health and nutrition** by controlling and preventing zoonoses, decreasing malnutrition and improving hygiene and sanitation.

■ A new definition for VPH was suggested by WHO

Duties and Responsibilities of Veterinarian

- The activities of veterinarians can be described as follows:

1. In animal production and health

- Φ Diagnosing and treating diseased animals; and prevention, control and eradication of diseases of animals.
- Φ Prevention of **occupational hazards** and **diseases** associated with live animals and their products
- Φ Control of **quarantine** stations used to reduce

2. In food hygiene and zoonoses

- **Food hygiene** is a branch of VPH which includes all measures necessary to insure safety, soundness, wholesomeness of food at all stages from its growth, production or manufacture to its final consumption. From farm/Production, Processing to Consumption
- a. Prevention and control of zoonoses and other diseases which are transmitted through food of animal origin
- b. Advising on the construction of premises where foods of animal origin and by-products of animals are processed and inspection of food premises and products including processing, storage and distribution.

- d. Prevention of chemical or drug residues in food animals
- e. Supervision of the hygienic aspect of foods those are imported and exported
- f. Cooperation with epidemiological services in disease surveillance and dissemination of data with medical professionals for the control of communicable diseases between man and animals.

3. VPH activities related with the environment

- Supervise the proper collection and disposal of dead animals, condemned meat and meat products and other animal wastes thereby controlling zoonotic diseases of environmental origin like anthrax, leptospirosis, etc
- Control of vertebrate and invertebrate vectors of zoonoses like mosquito in rift valley fever and snails in fasciolosis and schistosomiasis, and fly in leishmaniasis

4. In biomedical research

- a. Development of improved diagnostic procedure on the production of vaccines or biological products
- b. Ecological and epidemiological research on the resources of infections
- c. Comparative medicine and biology between animals and humans
- d. Laboratory animal production and medicine for the safety and efficacy of medicines including vaccines, diagnostic sera and antigens

5. In disaster medicine: This includes intervention and preventive measures in case of:

- Outbreaks of exotic disease
- Natural and man made disasters including safeguarding of food and water supplies

6. In mental health:

- ♣ The use of companion animals in helping persons with mental problem and it develops man-pets relationships

Contamination of food with microorganisms

- Food is any substance, composed of carbohydrates, water, fats and/or proteins, that is either eaten or drunk by humans, for nutrition or pleasure (**in general sense**) but
- From veterinary sense it means meat and meat products, milk and milk products, fish and fish products, egg and egg products and game (wild animals).
 - ⌘ It can be processed or semi processed, raw or cooked. All these products contain protein, fat, carbohydrate, etc
- **Food Safety:** Assurance that food will not cause harm/ injury to the consumer when it is eaten.
- **Wholesome food:** is a food that is **sound, clean**

Criteria of food

The food should be:

- Healthy and palatable
- Attractive and pleasant
- It should not show decomposition and adulteration
- It should not contain other non food substances
- Should have high quality standards: i.e. nutritious, hygienic and psychologically acceptable by the consumer

Contamination of food

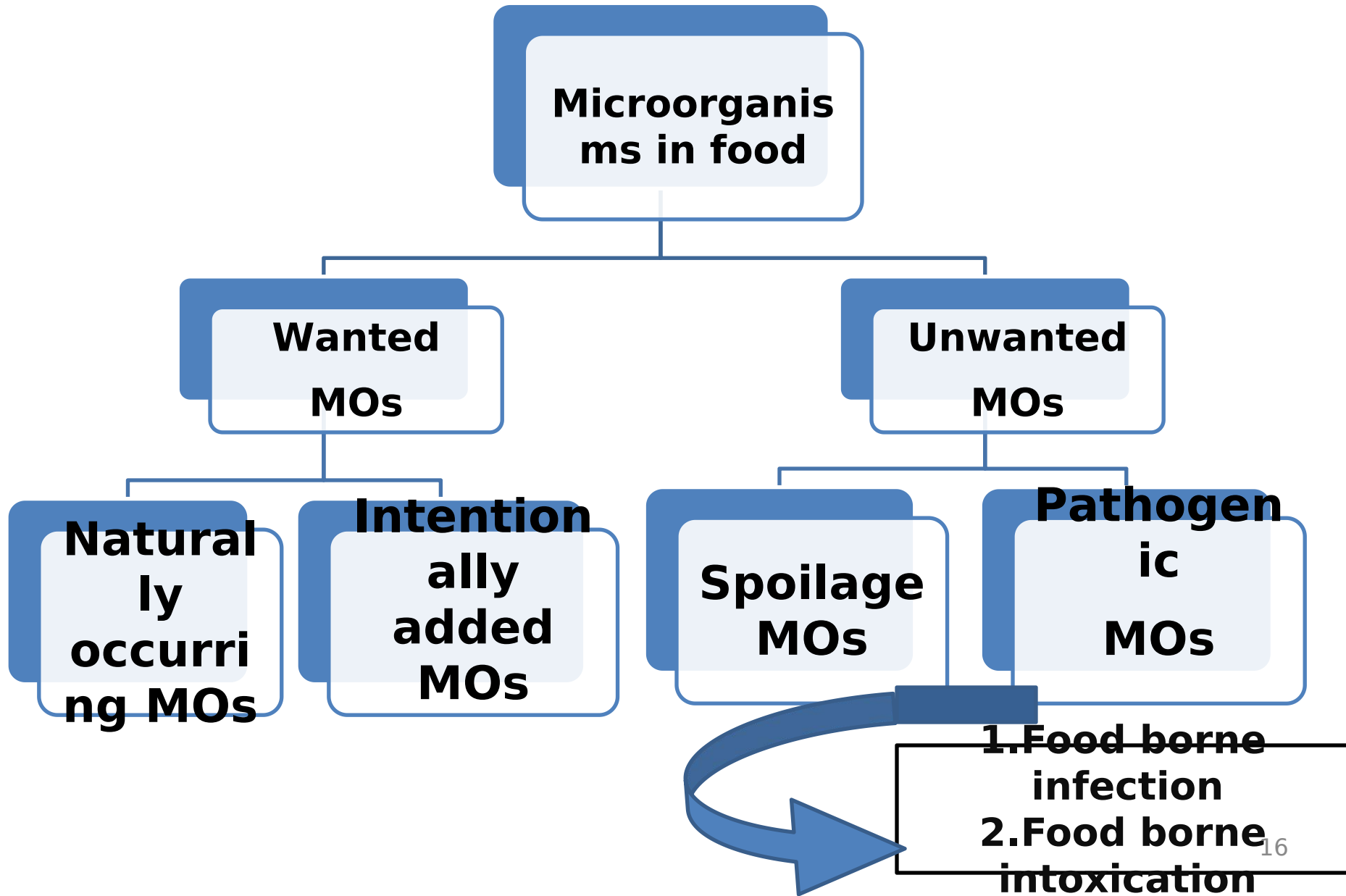
Food contamination: The presence of objectionable levels of **organisms, chemicals, foreign bodies, taints, or unwanted, diseased or decomposed material.**

- Food can be contaminated either by a **primary source** (when contaminant is obtained from the animal) or a **secondary source** (when contamination occurs after a healthy animal is slaughtered).
- **Primary contamination** can be by microbial agents, chemical residues or the discharges from infected animals.
- **Secondary contamination** can be obtained from infected human, other animals

Objectives : At the end of this class you will be able to:

1. Differentiate b/n food borne infection and intoxication
2. List food borne infection and intoxication causing pathogens
3. List the different factors influencing bacterial growth in food and explain how they affect
4. Define food spoilage
5. Discuss the causes and signs of signs of food spoilage
6. Discus methods of detection of food spoilage

Microorganisms in food



Unwanted Microorganisms

A. Food Borne Intoxication

Food borne infection occurs when a person or animal ingests the food together with viable pathogenic microorganism. But food borne intoxication occurs when one ingests preformed toxin produced by pathogenic microorganisms.

Food intoxication is important than food infection, because:

1. Even though the food is cooked and the microorganisms are killed, the preformed toxins may remain in the food resisting the heat inactivation
2. Incubation period is very short in case of

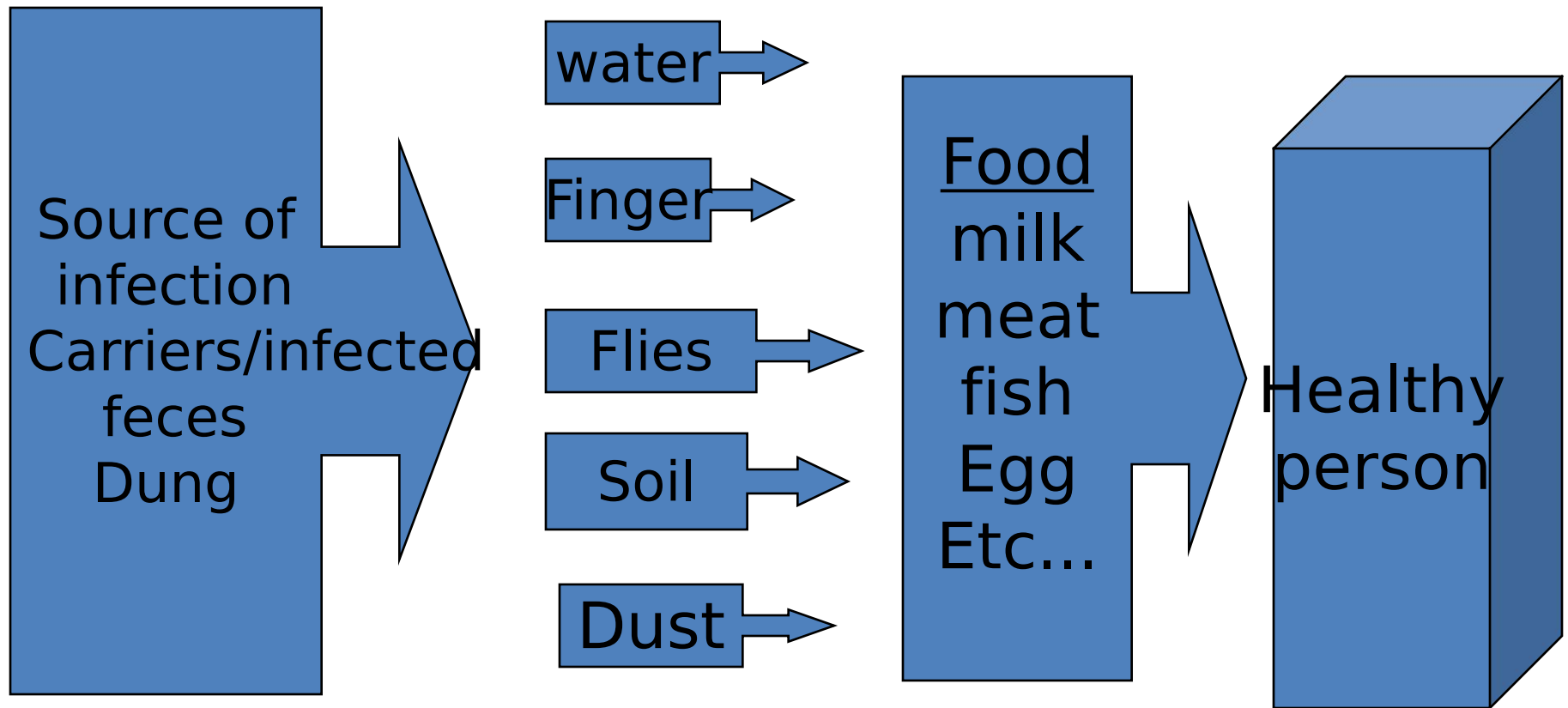
- Examples of MOs that can cause food borne intoxications are:

Clostridium botulinum, S. aureus, Bacillus cereus, Clostridium perfringens etc.

- Examples of microorganisms /organisms/ which cause food borne infection are:

Bacteria	Virus	Fungus
<ul style="list-style-type: none"> • Salmonella Spp • <i>Vibrio parahuemolyticus</i> • Campylobacter Streptococcus • Mycobacterium • Listeria • Brucella spp. • Anthrax • Other 	<ul style="list-style-type: none"> • Infectious hepatitis virus • poliovirus • others 	<ul style="list-style-type: none"> • Ergot fungus • Aspergillus spp (aflatoxicosis) • poisonous mushrooms • Others
Parasites		
<ul style="list-style-type: none"> • Taenia spp. <i>T. saginata</i> and <i>T. solium</i>, hydatid disease • <i>Trichinella</i>, • <i>Diphyllobothrium latum</i> and Others 		

Indirect Transmission of food -borne infection



Factors Promoting Food Borne Infections and Intoxication

1. Inadequate cooking of food
2. Inadequate cold or hot holding
3. Inadequate reheating of food
4. Poor personal hygiene
5. Use of left over
6. Inadequate cleaning and disinfection
7. Cross contamination
8. Contaminated raw materials and ingredients

Types of contamination

A. Classification from the **agent point of view**

- ø **Microbial contamination:** due to living agents (bacteria, fungus, virus, parasite etc.)
- ø **Non microbial contamination:** due to residues or chemicals or foreign bodies

B. Classification with regard to temporal (time)

- **Primary contamination:** begins directly from the food animals
Ex. Animal infected with anthrax or due to antibiotic treatment
- **Secondary contamination:** results from the environment, other animals, man or water or contaminated materials (fomites) and plants (toxic plants e.g. wild onion)

C. Types of **bacteria** contained in food

- ***Psychrophilics***: grow at low temperature (around 10°C)
- ***Mesophilics***: propagate at room temperature (30–40°C)
- ***Thermophilics***: grow and multiplies at very high temperature (> 40°C)

D. Classification with regards to the type of fermentation into two groups

- **Homofermentative**: which produce only one product e.g. **Lactic acid**
- **Hetrofermentative**: which produce more than one products.

e.g. Contamination with **yeast** results in CO₂ and

Effect of microorganism on food

- **Food spoilage** means the original **nutritional value, texture** and **flavor of the food** are changed, the food becomes **harmful** to people and **unsuitable** to eat.
- **Food spoilage** is a **metabolic process** that causes foods to be undesirable and unacceptable for human consumption due to changes in **sensory characteristics**.
- Food Spoilage can be **microbial, enzymatic, physical** or **chemical** changes.
- Microorganisms attack on proteins, fats and carbohydrates in foods.



Spoilage of food by microorganisms could be:-

1. Proteolytic Spoilage
2. Lipolytic Spoilage
3. Glycolytic Spoilage

1. Proteolytic Spoilage: Proteolytic MOs degrade proteins into Amino acids.

- Protein $\xrightarrow{\text{Bacterial enzyme}}$ polypeptides peptide amino acids $\text{H}_2\text{S} + \text{NH}_3$ (**foul smelling**)
- The production of H_2S , CO_2 & NH_3 are signs of food spoilage.
- Examples of microorganisms which cause proteolytic spoilage are *Pseudomonas*, *Proteus spp.*, *Bacillus spp.*, *Clostridium spp.* etc.

- 2. Lipolytic Spoilage:** Lipolytic MOs degrade fats into Fatty acids and Glycerol and cause food Rancidity
- Fat $\xrightarrow{\text{Bacterial enzyme}}$ Fatty acids + Glycerol **Rancidity**
 +(unpleasant smell)
 e.g. of lipolytic bacteria includes *Pseudomonas*, *Aeromonas*, *Micrococci*, *E. coli*, etc.

3. Glycolytic Spoilage:

Carbohydrates (Glycogen in meat/lactose in milk) $\xrightarrow{\text{Sachrolytics}}$ Glucose Lactic acid, Acetic acid, Propionic acid, alcohol, CO₂, H₂O

- These products are indicators of food spoilage.
Lactococci and *Pediococci* bacteria can cause glycolytic spoilage.
- **Production of lactic acid is seen as positive effect**, because lactic acid retards bacterial multiplication and prolongs the shelf life of food improving the keeping quality. It is also used in the production of yoghurt

Factors Influencing Bacterial Growth in food

- The parameters which affect growth of microorganisms in food can be grouped into two as **Intrinsic** and **Extrinsic** factors/parameters

1. Intrinsic Parameters:

They are ***inherent property or nature of the food.***

These includes:

1. Ph of the food: This is the parameter which indicate whether the media is acidic or alkaline or neutral.

- Most Microorganisms grow best at pH values around 7 (**neutral**). Bacterial growth or multiplication rate decrease more at lower pH of the food.

2. Oxidation reduction potential of the food:

- The oxygen tension or partial pressure of oxygen and the reducing and oxidizing power of the food (O-R potential) influences the growth of organisms.
- In relation to oxygen, **bacteria** can be aerobic, anaerobic or facultative, while fungi are mostly aerobic.
- Yeasts are aerobic or facultative anaerobic.
- A high O-R potential favors the growth of aerobic and facultative organisms. Most fresh animal foods have **low O-R potential** in their interior but have higher O-R outside.
- Thus, a fresh piece of meat could support the growth of aerobic organisms in the exterior and the growth of anaerobic organisms inside.

3. Moisture Content/ water activity of the food:

- Most microorganisms grow in food with higher moisture content.
- The water requirement of microorganisms is described in terms of water activity. Water activity is the amount of water found in the food which is available and essential for all living microorganisms.
- Water in food, which is **not bound to food molecules**, supports the growth of bacteria, yeasts and moulds.

The term “**water activity = a_w** ” refers to this unbound water.

- The water activity of food is not the same thing as its moisture content. Although moist foods are likely to

- A variety of foods may have exactly the same moisture content and yet have quite different water activity.

→ addition of Salt.

- Moisture Content= unbound free water (water activity) + bounded waters in a food
- The water activity is expressed as a_w and it is **1** for pure water.

4. Nutrient Content of the food:

- In order to grow in/on foods, microorganisms require water, source of energy, source of Nitrogen (Nucleotides, Peptides and other proteins), vitamins and related growth factors and minerals

5. Antimicrobial Constituents in the food:

Some foods may stay for a long time resisting attack by microorganisms due to the presence of naturally occurring substances that have anti microbial activity.

e.g.

- Cow's milk has **Lactoferin**, **Coaglutinin** but they will be destroyed during pasteurization.
- Egg contains **Lysosomes**, **Ovotransferrin** which inhibits the growth of Salmonella in egg.
- Spices have **oil** that possesses antimicrobial activity.
- Garlic contains **Allicin**.

6. Biological Structures of the food:

The natural covering of some foods provide excellent protection against the entry and subsequent damage by spoilage MOs.

B. Extrinsic Parameters:

- Extrinsic Parameters of food are those ***properties of storage environment*** and the presence of substances that affects both the food and Microorganisms. These are:

1. Storage temperature: Based on the optimum temperature requirement for growth and multiplication, MOs are grouped as:

1. Psychrophilics: grow best at low Temperature

2. Mesophilics: grow best at optimum temperature

3. Thermophilics: grow best at high temperature than the normal

“Temperature danger zone”

2. Relative humidity of the environment

3. Presence and concentration of gasses in the environment: such as CO₂ and O₃

4. Presence and Activity of other MOs in the environment of food that produce inhibiting factors like:

» Antibiotics,

- Bacteriocides or
- Bacteriostats

» H₂O₂

» Organic acids

N.B: Food spoilage can be controlled by controlling the intrinsic and extrinsic factors that influence microbial growth in foods.

Signs of food spoilage: Spoiled food can be recognized by: change in **appearance**, change in **consistency**, change in **colour** or change in **flavour**, **presence of visible growth** and **gas production**.

N.B. Bacterial spoilage is marked by **foul smelling** of food where as spoilage due to moulds & yeasts is mostly characterized by **whisker**.

- Intrinsic enzymes cause **autolysis** and spoil food after the death

Detection of Food Spoilage/contamination/

1. **Organoleptic methods** (using sense organs i.e. smell, taste, sight, touch ...)

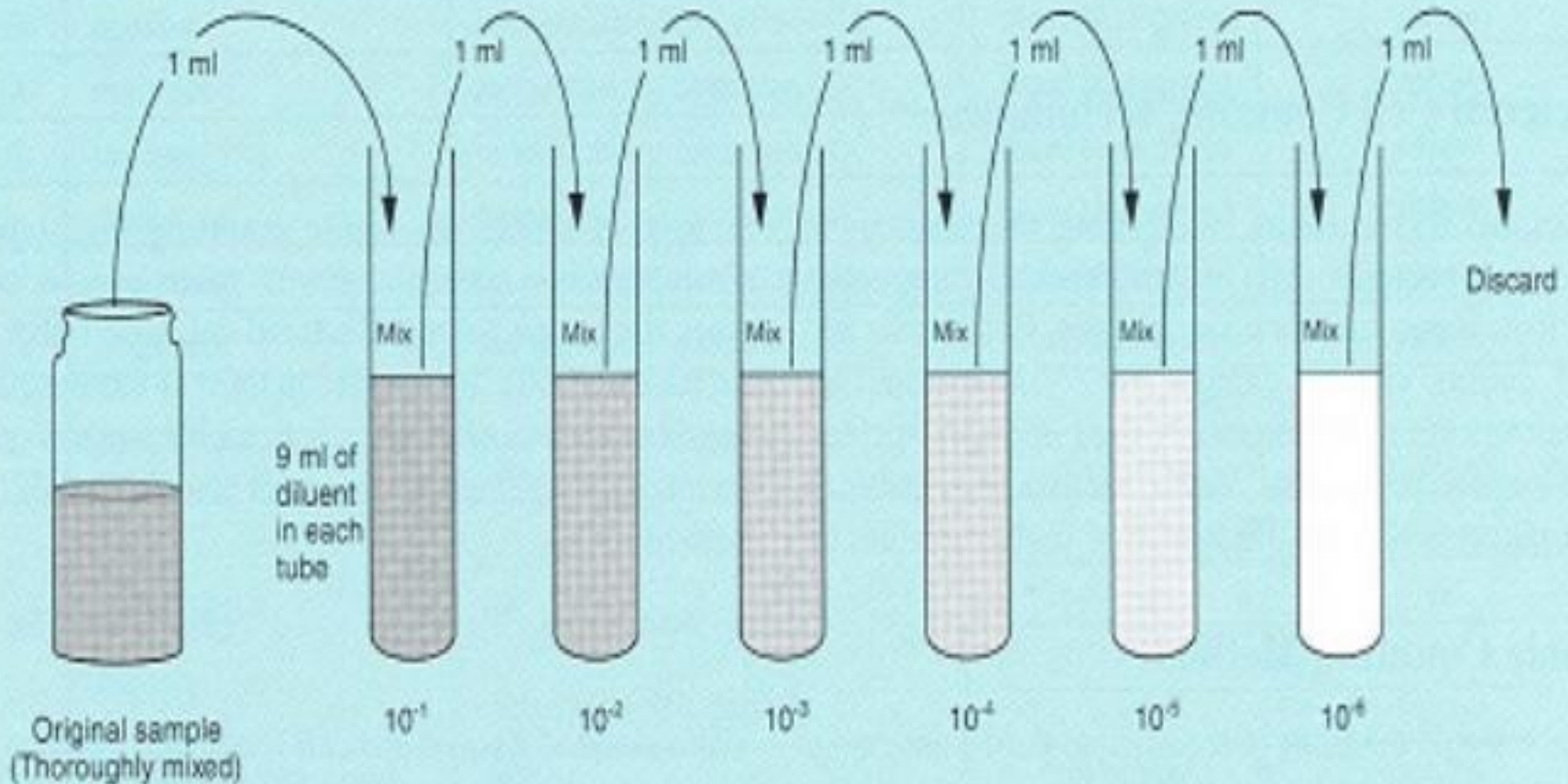
- Microorganisms Spoil Food by **metabolizing** and by producing bacterial end products/metabolites/ such as **Ammonia** (NH_3), **H₂S**, lactic acid or other alcoholic end products which result/bring/ change in **consistency, appearance, colour, flavour** (taste and smell) of the food. We can detect food spoilage by examining the food for the presence of the above changes using our sense organs.

2. **Supportive tests (laboratory tests):** Since it is not possible to sense **minute spoilage**, supportive tests are important to detect the hidden spoilage.

- **Measuring pH:** The normal Ph of fresh milk lies between **6.3-6.75** and that of fresh meat is about **5.5**. $\text{pH} < 6.3$ in milk suggests Microbial contamination, excessive lactic acid production, but $\text{PH} > 7.5$ indicate the milk is from **mastitic cow**
- **Determination of electrical conductivity:-** For example milk has Cl^- and other electrolytes and during mastitis the electrolyte increases.

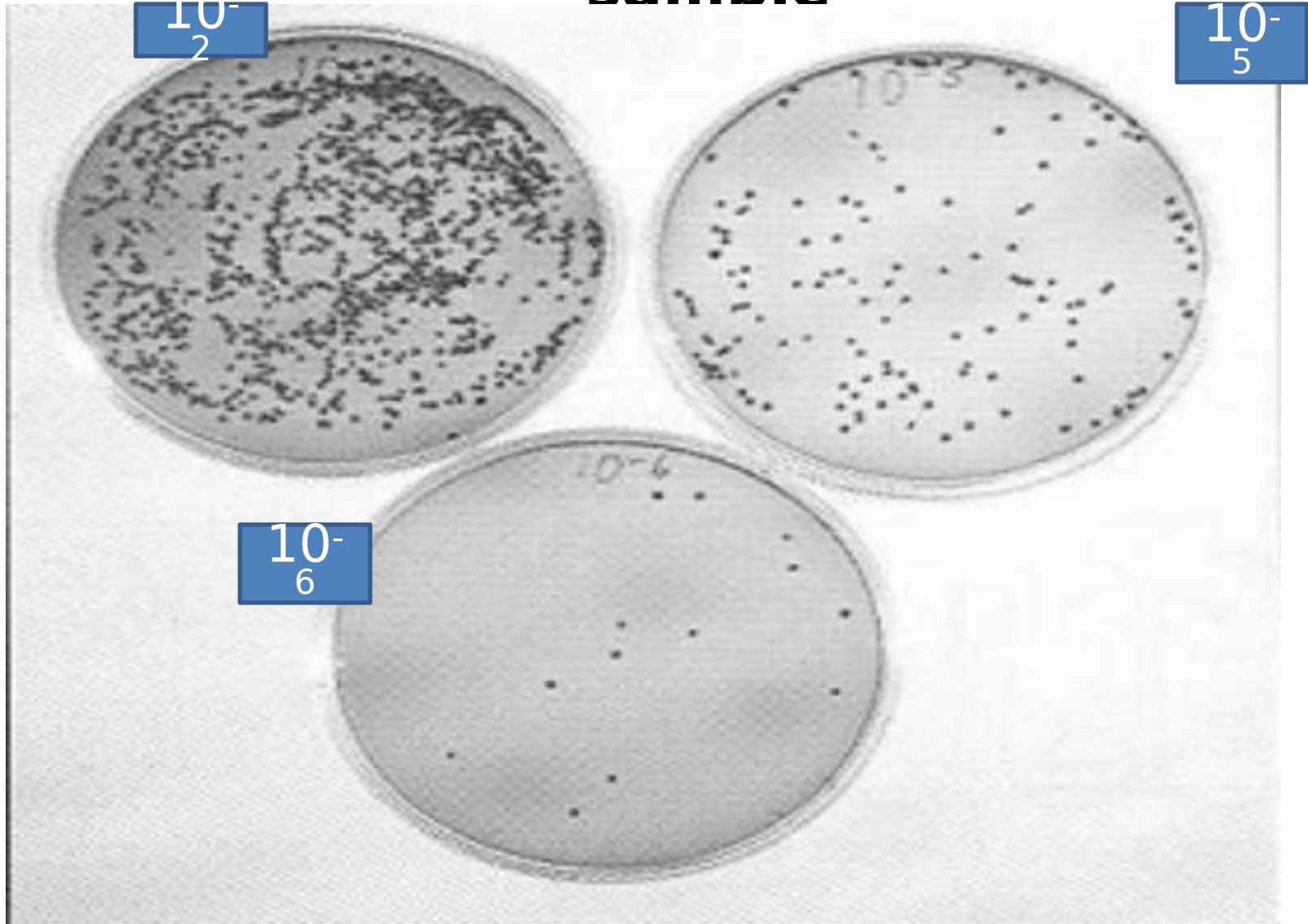
3. Culturing and bacterial load determination: By counting colony forming units (**CFU**) / Total aerobic Plate count (APC)

Serial dilution for colony forming unit (CFU) APC method



The importance of this **Serial dilution** is in order to make the counting of colonies very easy

Number of colonies per Petri dish at different dilution rates of the original food sample



4. Using rapid methods PCR: This could be applied at commercial level

Public health importance of food Spoilage

1. Spoilage results in food-borne infections and intoxications

Eg. Contamination of food by staphylococcus bacteria

2. Economic losses can lead to food scarcity

Milk hygiene



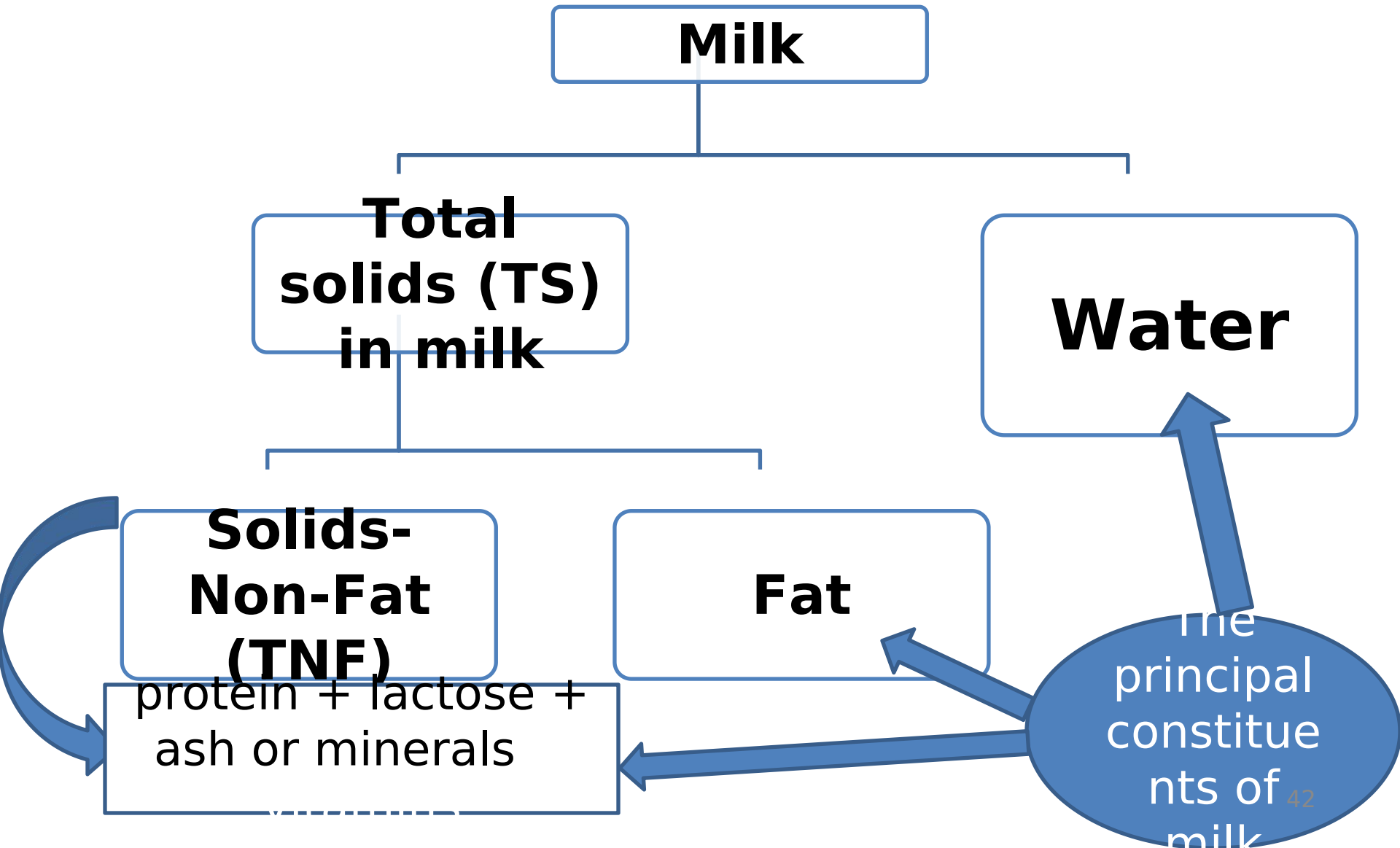
- Milk is secreted by the mammary gland of mammals to feed their offspring
- Well balanced diet
- **“nature's single most complete food” or “the most nearly perfect food”.**

Milk hygiene: All conditions and measures necessary to ensure the **safety** and **suitability** of milk at all stages of milk production chain.

Objectives of milk hygiene: -

1. To provide consumers with wholesome milk and thus, **safeguard the public from milk borne zoonotic diseases and residues.**
2. **To advise dairymen, creameries and consumers** on the proper handling of milk and milk products.
3. **To reduce economic losses** resulting from milk spoilage and other problems associated with poor milk hygiene.

Composition of Milk



The total solids (TS) in milk (i.e. fat + protein + lactose + ash or minerals + vitamins) minus the fat content are generally referred to as **Total Solids-Non-Fat (TNF) or milk Solids Not Fat (TS- fat = SNF)**.

On average, normal milk must contain **SNF** amount **9%** and TS **12.5%**.

SNF = protein **3.5%**
= Lactose **4.8%**
= Ash (mineral) **0.7%**

Total = 9%

TS = Fat + SNF
3.5% + 9% = 12.5%

Summary of average composition of milk from different species of animals and human is given in Table 1					
Mammals	Water (%)	Fat (%)	Lactose (%)	Protein (%)	Ash (%)
Cow	87.25	3.8	4.8	3.5	0.65
Water Buffalo	76.89	12.46	3.74	6.03	0.89
Goat	87.88	3.82	4.54	3.21	0.55
Camel	87.61	5.38	3.26	2.98	0.7
Sheep	80.82	6.86	4.91	6.52	0.89
Bitch	78.88	8.56	4.09	6.82	1.08
Cat	81.63	3.33	4.91	9.08	0.51
Human	88.3	3.11	7.18	1.19	0.21

Table 2. Composition of milk from the main breeds of dairy cattle

Breed	Fat %	Protein %	Lactose %
Ayrshire	4.1	3.6	4.7
Brown	4.0	3.6	5.0
Swiss	5.0	3.8	4.9
Guernsey	3.5	3.1	4.9
Holstein	5.5	3.9	4.9
Jersey			

There are **two types of milk** depending on the **lactation stage**, namely:

1. Colostrum and
2. Non-colostral milk

Colostrum is the milk, which is secreted during **first week of lactation** and such milks are usually slightly varying in their **color, consistency, flavor** and **composition** from Non-colostral milk.

- 1. Milk fat (Butter):** - is the second largest component of milk and **is of major commercial value.**
- It plays important role in human nutrition being a good source of **energy** and **essential fatty acids.**
 - It supplies an energy value of **9.3 calories /** gram of fat. This is higher when compared with energy value derived from **protein** and **lactose.**
 - Moreover milk fat plays an important role in the

- Milk Fat is composed of glycerol and fatty acids, which can be **saturated** or **unsaturated fatty acid**
- Fats present in the milk in the form of **fat globulins** and these fat globulins play important role in some operations such as **milk separation, churning of cream** and **cheese production**.
- Milk fat is responsible for yellow coloration of normal colostrum and this is made by the **carotene** of the milk fat.
- Milk fat is soluble in **ether** and **ethyl alcohol** and it **absorbs odor from surrounding** and its specific gravity may vary from **0.936-0.946** at 15°C and melting points at **20-29° C**.

- **Hydrolysis** (Fat $\xrightarrow{\text{lipase}}$ fatty acid + glycerol) and oxidation of fat that gives rancidity are some of the possibly mentioned chemical changes in milk fat. These changes are usually characterized by **offensive smell** and **unpleasant odor**.
- **Hydrolysis** is influenced by **lactation stage, type of feed, degree of homogenization of milk** and **microbial contamination**.

2. Proteins: - Milk protein is valuable to human since it contains all essential amino acids which are important for normal functioning of human body. (about **20 amino acids** among which **8** of them are essential) and a wide variety of these A. acids are found in each of the proteins of milk.

- Milk proteins are further subdivided into **casein**, comprising approximately **76-80%** of the total milk proteins, and the **whey proteins** such as **albumin** (e.g. lacto albumin), **globulin** (e.g. Lacto globulin, **immunoglobulin** and other globulins) and **enzymes**, comprising roughly **20-24%**.
- **Casein is** considered as the specific predominant protein of milk and it is **white** in color and thus, enables milk to have its **normal whitish color**.
- Addition of **acids** (e.g. citric acid, lactic acid), **enzymes** (e.g. rennin, pepsin) and **alcohols** and application of **heat** coagulates casein and hence

3.Milk sugar (Lactose): - Is the principal carbohydrate of milk.

- It is almost found only in milk in nature and the amount present in milk depends up on **the health of the udder, nutritional status** and **breed of the milk-producing animal**.
- The lactose content of the milk is increased by **over feeding of carbohydrates**, especially soluble carbohydrate and decreased by **mastitis infection of udder**.

- When bacterial enzymes act on milk sugar, it leads to lactic acids production (Glucose bacterial enzymes lactic acid).

Decomposition of lactose that could result from the action of microorganisms acts as a precursor of lactic acid that is used for fermentation in yoghurt preparation.

- Lactic acid **affects milk constituent** such as **casein** and when lactic acid acts on casein milk is **coagulated (precipitated)**.
- Even though, lactose doesn't taste as sweet as an equal amount of sucrose, it **imparts** or **gives fresh milk its normal sweet flavor** and **taste** and constitutes as one of the major solid constituents of milk.

4. Enzymes: - enzymes are **proteins** or combination of protein and other materials called **coenzymes**.

- Enzymes are usually very specific in their action and in most cases their power to act is destroyed by **heat** and as a result, each enzyme has a different **critical temperature**. The **pH** also may limit their activity.
- Milk contains different types of enzymes such as **peroxidase, phosphatase, lipase** and **amylase**.

a. Peroxidase: - is most abundant enzyme found in milk. **The test of milk for the presence of peroxidase are sometimes made to ascertain whether hydrogen peroxide has been added (used usually as preservative) or whether the milk has been subjected to sever heat treatment.**

Heat treatment of milk such as at a temperature of

- 80°C for 3 ½ minutes
- 73.5 °C for 28 minutes or
- 70°C for 150 minutes **will destroy this enzyme.**

The test for peroxidase is not useful for proving pasteurization.

b. Phosphatase two functions of this enzyme are found in milk,

1. Alkaline phosphatase which is most active at **pH ≥ 9.6** and

2. Acid phosphatase (is largely found in **non-fat fraction** of the milk) which shows its greatest activities around **pH 4.0.**

Alkaline phosphatase is destroyed in milk by pasteurization and thus a test for the absence of alkaline phosphatase is widely used to ascertain whether milk has been properly pasteurized or not.

⌘ The test can detect **0.2% raw milk** in

c.Lipase: - The enzyme lipase seems to be present in all normal milk, but its quantity varies greatly.

- Late lactation milk has higher lipase content than normal fresh milk and thus hydrolytic rancidity is common in it.
- The major lipase in milk is lipoprotein lipase
- Agitation during processing may bring the lipase into contact with the milk fat resulting in fat degradation and **off-flavors**. **Pasteurization** will inactivate the lipase in milk and increase shelf life
- If not pasteurized before or immediately after homogenization, raw homogenized milk will rapidly become rancid because of activity of lipase on the greater fat surface.

5. Ash: - Incineration of milk leaves the ash, a residue which equals about **0.7-0.8%** of the weight of the milk.

- The ash includes all of the mineral elements of the milk, and these include the ff .

1.Large amounts (relatively): **Potassium, Sodium, Calcium, Magnesium, Chlorine, Phosphorus** and **Sulfur**

2.Small amounts: **Iron, Copper, Zinc, Aluminum, Manganese, Cobalt** and **Iodine**

3.Trace amount: **Silicon, Boron, Titanium, Vanadium, Rubidium, Lithium** and **Strontium** have been reported to be present.

6. Vitamins: - Milk is good source of vitamin **A**, **B₁** (thiamine) **B₂** (riboflavin), small amount of vitamin **C** (ascorbic acid), vitamin **D** and **B₃** (niacin) etc.

- Vitamin **A**, **D**, **E** and **K** (**ADEK**) are fat-soluble, so they tend to be present in milk products in proportion to the fat content.
 - Vitamin **C** and several vitamins of the **B-complex** are water-soluble. Heat is detrimental to vitamin **B** and **C**.
- ∞ Pasteurization destroys \geq **10%** of the **B** and up to **50%** of the **C**.

7. Trace components of milk

a. Somatic or body cells:- Body cells or leucocytes, originating from the udder, are always found in fresh milk_____

- **California Milk Test:** is used to estimate number of leucocytes and thus, evaluate the quality of milk. The number of somatic cells may vary considerably, but it is generally lower than **100,000** per ml [10^5 cells/ ml of milk].
- Counts of **500,000** and more are an evidence of abnormalities, usually being an indication of mastitis.
- Milk from seriously diseased udder (e.g. severe mastitis) may contain **millions** of cells ($>10^6$).
- If milk from large number of animals is mixed, the infected milk of one or more animals will be diluted with milk of healthy animals and it becomes more

b. Microorganism: - Even aseptically drawn milk may contain some bacteria.

- They may be originated from the **teat cannal of the udder** (theses are usually the slowly multiplying and almost none pathogenic MOs).

Generally, the microorganisms could be of two types: -

- **Unfavorable microbes (pathogenic microorganisms or microbes that cause food spoilage** and such MOs should be controlled or destroyed to make food/milk/ and milk products safe for human consumption)

- **Favorable micro organisms** (microbes which **bring favorable changes in flavor** and **appearance** of milk and such microbes are beneficiary and thus, are usually carefully handled and propagated).
- **Starter cultures** (microorganisms which develop **acidity** and **desired aromatic milk**) are an example of beneficiary MOs.

The 3 main functions of starter culture are to:

1. Produce acid
2. Produce desired characteristics of flavor or aroma and
3. Prevent or inhibit the growth of unwanted microorganisms.

- Such Microorganisms are genus **streptococcus** and include;
- ***Str. lactis*, *Str. cremoris* and *Str. lactis* sub spp *diacetylactis*.**
- Generally, these are bacteria, which **naturally invade** or which are **intentionally added** to milk to produce different types of products such as **yoghurt, cheese** and **butter**.
- Used at home and dairy industry to improve **keeping quality** and **flavor of milk**.
- Such microorganisms usually referred to as **true milk bacteria** because they produce **lactic acid** from lactose then **reduce pH** of milk and this induce milk **coagulation** to produce yoghurt.

1. *Str. lactis*: - commonest bacteria found in milk and it causes sourness and coagulation of casein and it is used as starter culture in **cheese production**. Optimum temperature **6-41°C** but it can grow also under 0°C. At 25°C it sinks pH of milk at **4.5** and it will produce **1% lactic acid**.

2. *Str. cremoris*: - optimum temperature is 20-30°C and at 25°C it sinks pH of milk to **5**.

3. *Str. lactis sub spp. diacetylactis*: - This microorganism has similar characteristics to *Str. lactis* however it differs from it in that it produces an **aromatic substance** known as **diacetyl** which produced from **citric acid** and for this reason it is used as starter culture in butter production.

4. *Str. thermophilus* withstand high temperature of **65°C for 30 minutes**. Commonly found in **milking**

Table 2: Summary of starter culture and their use in milk production

Starter culture species	Role in milk production
<i>Str. lactis</i>	Souring, casein precipitation
<i>Str. cremoris</i>	Souring and yoghurt production
<i>Str. lactis</i> ssp <i>diacetylactis</i>	Souring, aroma production from citric acid
<i>Str. thermophilus</i>	Cheese production, souring and yoghurt production
<i>Leuconostoc dextranicum</i> <i>L. citrovolum</i>	Production of butter aroma –diacetyl
<i>Lactobacillus bulgaricus</i>	Souring and aroma production

Factors affecting milk composition

- **Milk** composition is affected by **genetic** and **environmental factors**.
- The potential fat content of milk from an individual cow is determined **genetically**, as are protein and lactose levels. Thus, **selective breeding** can be used to upgrade milk quality. Heredity also determines the potential **milk production** of the animal.
- However, **environment** and **various physiological factors** greatly influence the **amount** and **composition** of milk that is **actually produced**.
Herd recording of total milk yields and fat and SNF percentages will indicate the most productive cows

In general factors affecting milk composition include the ff:

1. Breed

- Milk composition varies considerably among breeds of dairy cattle: **Jersey** and **Guernsey** breeds give milk of higher fat and protein content than **Shorthorns** and **Friesians**. **Zebu** cows can give milk containing up to **7%** fat.
- **Shorthorns**: Breed of beef or dairy cattle: a reddish brown or white cow with short curved horns

2. Age

- As cows grow older, the fat content of their milk decreases by about **0.02** percentage units per lactation. The fall in **SNF** content is much greater.

3. Stage of lactation

- The fat, lactose and protein contents of milk vary according to **stage of lactation**. Solids-not-fat content is usually highest during the first **2 to 3** weeks, after which it decreases slightly.
- Fat content is high **immediately after calving** but soon begins to fall, and continues to do so for **10 to 12 weeks**, after which it tends to rise again until the end of the lactation.

4. Feeding regime (type and amount of feed):

- Underfeeding reduces both the **fat** and the **SNF** content of milk produced, although **SNF** content is more sensitive to feeding level than **fat content**. Fat content and fat composition are influenced more by **roughage** (fibre) intake

4.Disease: Both fat and SNF contents can be reduced by disease, particularly mastitis.

5.Interval between milking

- The **fat** content of milk varies considerably between the morning and evening milking because there is usually a much shorter interval between the **morning** and **evening** milking than between the **evening** and **morning** milking.
- If cows were milked at exactly **12-hour intervals** the variation in fat content between milking would be negligible, but this is not practicable on most farms. Normally, **SNF** content varies little even if the intervals between milking vary.

6. Completeness of milking:

- The first milk drawn from the udder is **low** in fat while the last milk (or strippings) is always quite high in fat.
- Thus it is essential to mix thoroughly all the milk removed, before taking a sample for analysis. The fat left in the udder at the end of a milking is usually picked up during subsequent milking, so there is no net loss of fat.

7. Season: Season influences **vegetation** (pasture) and consequently influences milk constituent and **color** of the fat.

Physicochemical properties of milk

- Knowledge of **physicochemical** properties of the milk is very important for the following reasons: -
 1. Enables milk technology to determine **sound** and **unsound** milk and thus, to **safeguard the public**.
 2. To determine the **quality** and **price** of milk.

A. Physical properties of milk:

- The **major** and possibly **dependable** physical properties of milk include the following:
 1. **Color**: - Ranges from bluish-white to golden yellow. Yellow color is influenced by **breed**, **feed** and **fat percentage**.
 2. **Taste**: - sweet due to presence of lactose.

3.Flavor (perceived with the combined senses of taste and smell) **Aroma (Smell): - Pleasant** due to **unsaturated fatty acid** in the milk

→ Milk may **absorb** odors from **utensils, equipment** and **atmosphere**. The odors are foreign to good milk and their presence considered as a defect.

4. Specific gravity of milk: - Specific gravity is the ratio of the weight of a volume of a material compared to the weight of the same volume of pure water.

Specific gravity of milk is ranges between **1.0295-1.0350** which usually determined at **20 °C**.

- This is important to determine **adulteration of milk** or removal of fat butter from milk.
- Milk with a lower fat content has higher specific gravity than milk with higher fat content.

5. Freezing points: - freezing point of milk is almost a constant value and freezes at **-0.55 to -0.53 °C** and is a ***suitable indicator for detection of dilution of milk with water.***

6. Boiling point: - freshly drawn milk boils at about **100.17 °C**.

An **increase in osmotic pressure** raises the boiling point of the liquid.

Decrease of osmotic pressure lower the boiling point. Osmotic pressure affects both the **freezing point** and the **boiling point** of a solution.

∞ ***As the strength or concentration of a solution increase, its freezing points diminish and its***

Chemical properties of milk (PH and titratable acidity)

- There are two basically different methods of expressing acidity:
 - a. Titratable acidity: expressed as percent of lactic acid
 - b. Hydrogen ion concentration or PH. The former measures **the total acidity** but does not measure the strength of the acids.
- 1. PH:** - indicates the strength of the acid condition.
 - One pH unit means a tenfold difference in strength; for example, a pH 5.5 indicates an acidity that is ten times as great as pH 6.5.
- When milk is freshly drawn from cow it shows an

2.Titratable acidity: - it measures the total acidity, but not the strength. Titratable acidity of milk is demonstrated by titrating a given amount of milk with an alkaline such as **NaOH**.

The acidity in milk is measured, for example by titration with a 0.1mol/L sodium hydroxide solution, and indicates the consumption of NaOH necessary to shift the pH-value from the average normal PH value (6.6 ± 0.1 which is corresponding to fresh milk) to a pH-value of **8.2 - 8.4** (phenolphthalein).

sodium hydroxide will be added till the solution is turned to pink using phenolphthalein as indicator.

The titratable acidity is calculated according to the volume of 0.1mol/L sodium hydroxide solution that has been used to bring the color change.

Titratable acidity of normal fresh milk ranges from **0.13-0.14%**

Presence of low lactic acid indicate good/high **hygienic standard** of milk.

Criteria of normal (fresh) milk

• **Good quality milk** is essential for production of **dairy products that are of good quality, free from pathogens** and have **long keeping quality**. Therefore, milk intended for **human consumption** and **further processing** shall meet the following criteria: -

1. Free from debris and sediment.
2. The Organoleptic qualities (appearance, flavor...) should not be affected.
3. Its constituents should be natural.
 - ↳ Shall not be highly deviated from normal and shall not be foreign.

5. The temperature shall not be greater than 10°C.

This is to hinder bacterial multiplication. If the temperature is greater than 10°C, there will be bacterial multiplication and lactic acid production which leads to milk coagulation.

6. The specific gravity shall range from **1.0295 to 1.0350**.

7. The pH shall range from **6.5 to 6.8**.

8. Bacterial load shall not exceed the acceptable load.

The bacterial load in fresh raw milk should be less than 50,000 per ml when it reaches the collection point or processing plant.

9. Somatic cell count shall not exceed the acceptable load

Contamination of raw milk

1. As long as the milk is still in the udder of a healthy animal the bacterial count will be low. After the milk leaves the udder, contamination will take place during **milking, milk handling, transport** and **storage** and
2. The microorganisms will begin to grow rapidly particularly at high ambient temperature and cause **marked deterioration/spoilage/** and thus badly affect the **keeping quality** of the raw milk/ spoil milk for liquid consumption/ and the **quality of the products** manufactured from such milk.
3. Milk contaminated with pathogenic bacteria is harmful to human health.

4. **Dirt such as dung/** so does bacteria in the intestinal

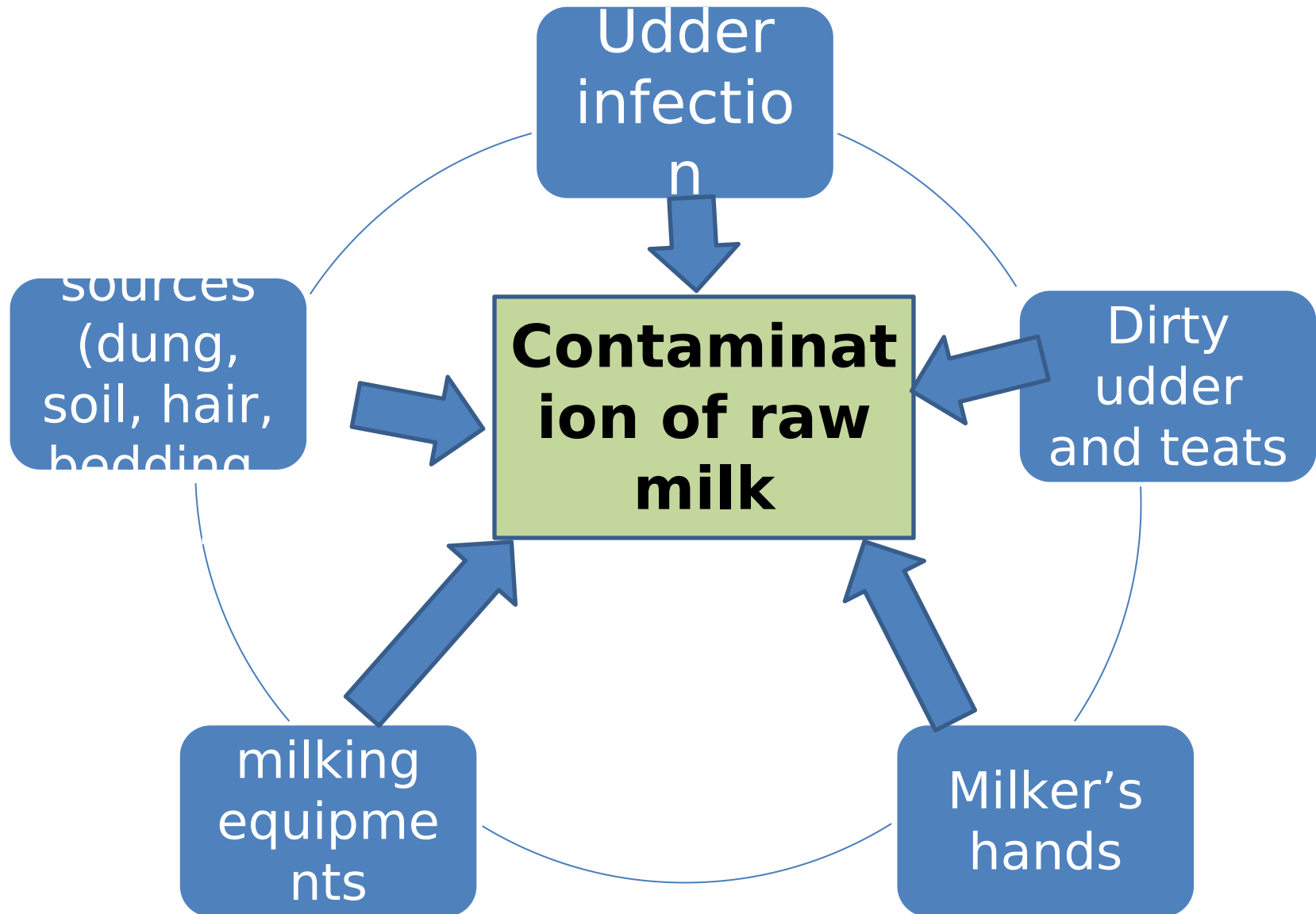
4. Milking in the rain may badly affect the quality of the milk if the rain water is allowed to flow from the animals' body into the milk.

5. Milk may be contaminated by the **hands of the milkers** as dirt could fall from his/her hand in to container/pail/.

6. The milker may be a source of pathogenic bacteria of human origin. Moreover, a disease can easily be carried from one animal to another on the milker's hands.

7. Generally, the source of bacterial contamination of milk may be within the udder or on the

The following diagram illustrates major sources of bacterial contamination of milk.



Hygienic milk production (essential steps in hygienic milk production)

1. Animals must be clean and healthy.
2. **Milking** should be done away from the herd.
3. Immediately before milking the **udder** and **teats** of the cow must be washed with clean lukewarm water and dried with clean cloths
 - ▶ a separate one for each cow.
4. The **milk handler** should also be clean and healthy. She/he should wear clean outer garments during milking or processing the milk.
5. The **milking room** should be clean, ventilated and dustless.
6. **Utensils** and **equipment** for milking and milk handling must be cleaned well.
7. **Immediately** after milking the milk must be

Recommended cooling temperatures:

Table 3: Recommended milk cooling temperatures to prevent deterioration.

Delivery time in hours	Cooling temperature
Within 4 hrs	15°C
Within 4-24hrs	6-10°C
After 24hrs	4°C

Defects encountered in raw milk

- The following Organoleptic changes may be detected in milk:-

1. Changes in color

- a. Exaggerated **yellow** color: contamination with **yeast** or **Flavobacteria**. It may also be due to **lipolytic** and **proteolytic** enzymes.
- b. **Blue** milk: ***Pseudomonas eynacase***.
- c. **Brown** milk: ***Pseudomonas puterfaciens***.
- d. **Red** milk: ***Serratia marzens***, inflammation of the udder.

2. Change in consistency

- a. Roppiness or stickiness contamination with *B. lactis*
- b. Frothiness: fungal contamination.

3. Flavor changes

- a. **Rancid taste:** increased lipase activity.
- b. **Cooked taste:** excessive heating
- c. **Bitter taste:** increased catalase activity
- d. **Fishy taste:** fish meal
- e. **Soapy taste:** contamination with *B. lactosaponasi*
- f. **Sour/acid:** acid production due to bacterial contamination
- g. **Barney taste** poor ventilation

Heat treatment of milk:

Objectives: -

- **To safeguard the public** i.e. to prevent milk borne diseases (e.g. bovine tuberculosis, brucellosis, salmonellosis etc) and render milk safe for human consumption.
- To improve the **keeping quality** of milk and milk products and **prolong shelf life**.
- To minimize **economic losses** resulting from milk spoilage.

- Heat treatment to temperatures **below 100°C** is designated as **pasteurization**, and that to temperatures above 100°C is **sterilization**.
- **Pasteurization:** The process of pasteurization was named after **Louis Pasteur**
- **Pasteurization of milk** is defined as heating milk in order to **reduce the number** of any pathogenic microorganism to a level at which they do not constitute **a significant health hazard**.
- **Pasteurization** is used to kill harmful microorganisms by heating the milk for **a short time** and then cooling it for **storage** and **transportation**.

- Pasteurization of milk has successfully eliminated the spread of diseases such as **tuberculosis** and **brucellosis** through contaminated milk.
- In raw milk, the naturally-occurring **lactic acid bacteria**, under suitable conditions, ferment the **lactose** present to **lactic acid**.
- The increasing acidity in turn prevents the growth of other organisms, or slows their growth significantly. During pasteurization however, these lactic acid bacteria are mostly destroyed.
- **Pasteurized milk** is still perishable and must be stored cold by both suppliers and consumers. (Cold chain should be there after pasteurization)

Methods of pasteurization:

Pasteurization can be carried out in **2 major** methods: -

1. As a **batch operation** ("***batch pasteurization***" or "**Low Temperature, Long Time *pasteurization***" (***LTLT***)), with the product heated and held in an enclosed tank. This is a process of heating milk and milk products at a temperature of about **63°C** and holding at this temperature for **30 minutes** and immediately cooled to **5°C**.
2. As a **continuous operation** ("**High Temperature, Short Time *pasteurization***" (***HTST***)) with the product heated in a **heat exchanger** and then held in a holding tube for the required time. This is heating milk and milk products at **72°C** for **15 seconds** and cooling it immediately to 5°C.

- Generally, several Time-Temperature combinations have been approved as equivalent:

3.89°C (191°F) for 1 s

4.90°C (194°F) for 0.5 s

5.94°C (201°F) for 0.1 s

6.68°C (204°F) for 0.05 s

These precise heat treatments are based on the destruction of the ***Coxiella burnetii***, which is considered the most heat-resistant non-spore forming pathogen found in milk.

Absolute control of the thermal treatment⁸⁷ is essential for the safety of milk.

Sterilization of the milk

- **Sterilization** is a **microbiocidal** control measure that can be obtained by various heat treatments, the most common and validated methods being **UHT (Ultra High Temperature)** processing in combination with **aseptic packaging** or **container Sterilization**.

- Thermal processes necessary to obtain **commercially sterile products** are designed to result in the **absence of viable microorganisms** and **their spores capable of growing in the treated product**

when kept in a closed container at normal non

- **UHT** treatment is normally in the range of **135** to **150°C** in combination with appropriate holding times necessary to achieve commercial sterility.
- **UHT** allows the milk to be stored **unrefrigerated** or an even **longer lasting sterilization** process until opened but also loses **more nutrients** and **assume a different taste** (e.g. **Condensed milk** which can be stored in cans for many years, unrefrigerated).
- Commercial sterilized products **must be microbiologically stable at room temperature.**
- Either measured after storage until end of shelf life or incubated at **30 °C for 15 days** in accordance with appropriate standards.

Milk preservation

- Milk is perishable product particularly in tropical countries due to **high humidity, high temperature** and **poor hygiene**.
- Therefore, spoilage occurs **during transportation, collection** and **storage**. Solution for these problems is **refrigeration** however; it is not realistic in developing countries.

The Lactoperoxidase System

- The Lactoperoxidase System of Raw Milk Preservation is currently the only approved method of raw milk preservation, apart from refrigeration (as an alternative solution) by **Codex Alimentarius commission**.

- The Lactoperoxidase System (**LP-system**) operates by the reactivation of the enzyme lactoperoxidase, which is naturally present in raw milk.
- **Hydrogen peroxide (H_2O_2)** and Thiocyanate (**SCN⁻**) are also present in milk but in negligible quantity.
- The lactoperoxidase - thiocynate - hydrogen peroxide system (**LPS**) inhibits bacterial **respiration**, reduces the enzymatic activity (Eg. **Hexokinase**) of glycolysis of the bacteria and **induces the leakage of potassium through the cell wall**.

- LP itself has no antibacterial effect but in combination with certain co-factors, thiocyanate (SCN^-) and hydrogen peroxide (H_2O_2), forms a potent antimicrobial system
- The antibacterial mechanism is caused by oxidation of vital SH-groups by OSCN^- / O_2SCN^- in vital metabolic enzymes, e.g. hexokinase.
- A wide variety of bacteria are influenced by the LP-system.
- Many **Gram-positive** bacteria such as **lactococci** and **lactobacilli** are inhibited (**Bacteriostatic**) while many **gram-negative** bacteria such as ***Escherichia***

- Activation of the LP-s by addition of hydrogen peroxide and SCN⁻, both at concentration of 0.25 mM, extended the shelf life of raw milk at 10°C for at least three days
- Other dairy uses have included control of post-culturing acidification of yogurt

Milk processing

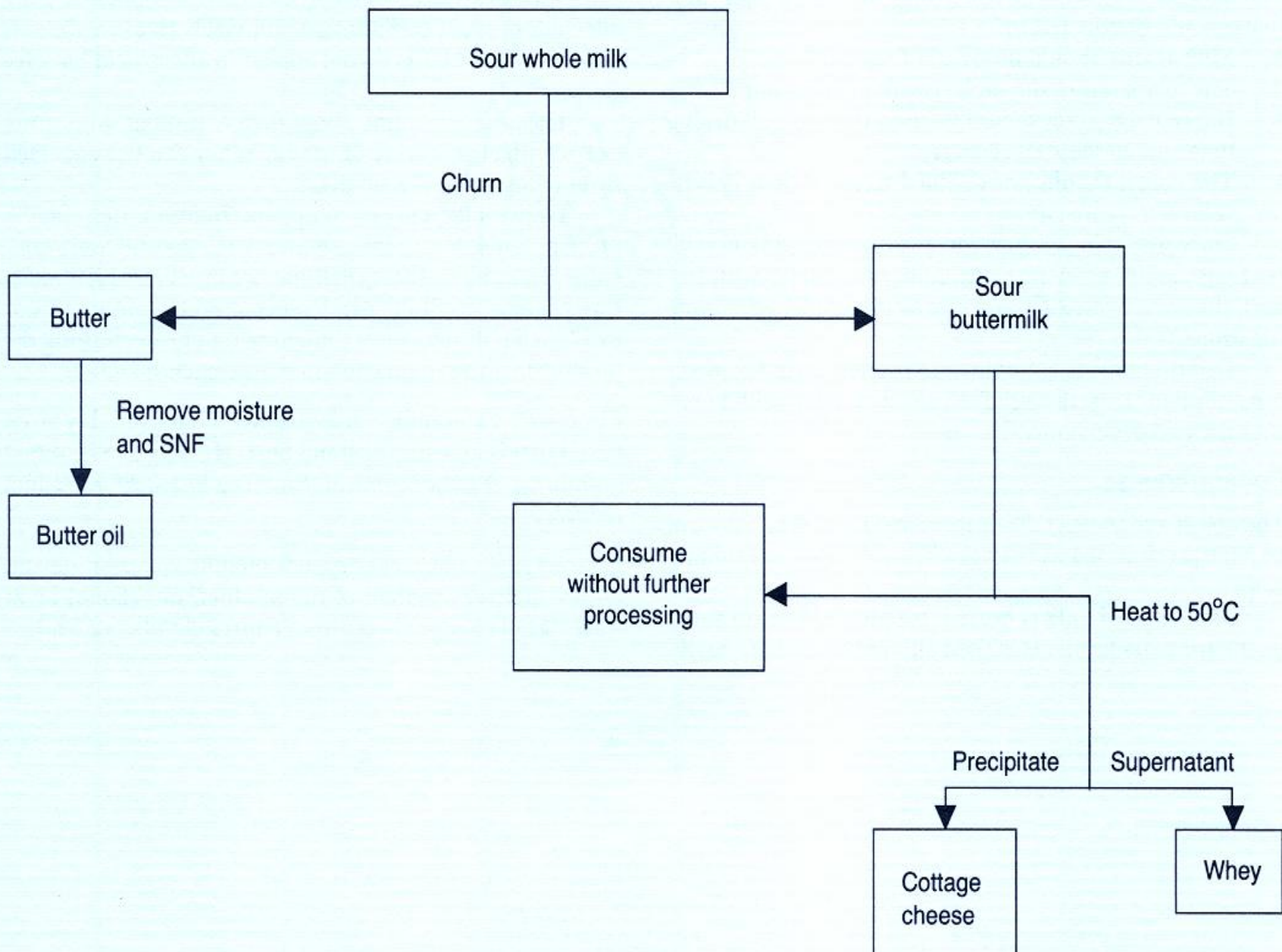
- Milk has been processed specially in countries where milk is not scarce.
- Basically, milk is processed to increase palatability of milk products and shelf life.
- Milk is processed in different ways; traditional or ⁹³

Traditional milk possessing in Ethiopia

(e.g. butter production)

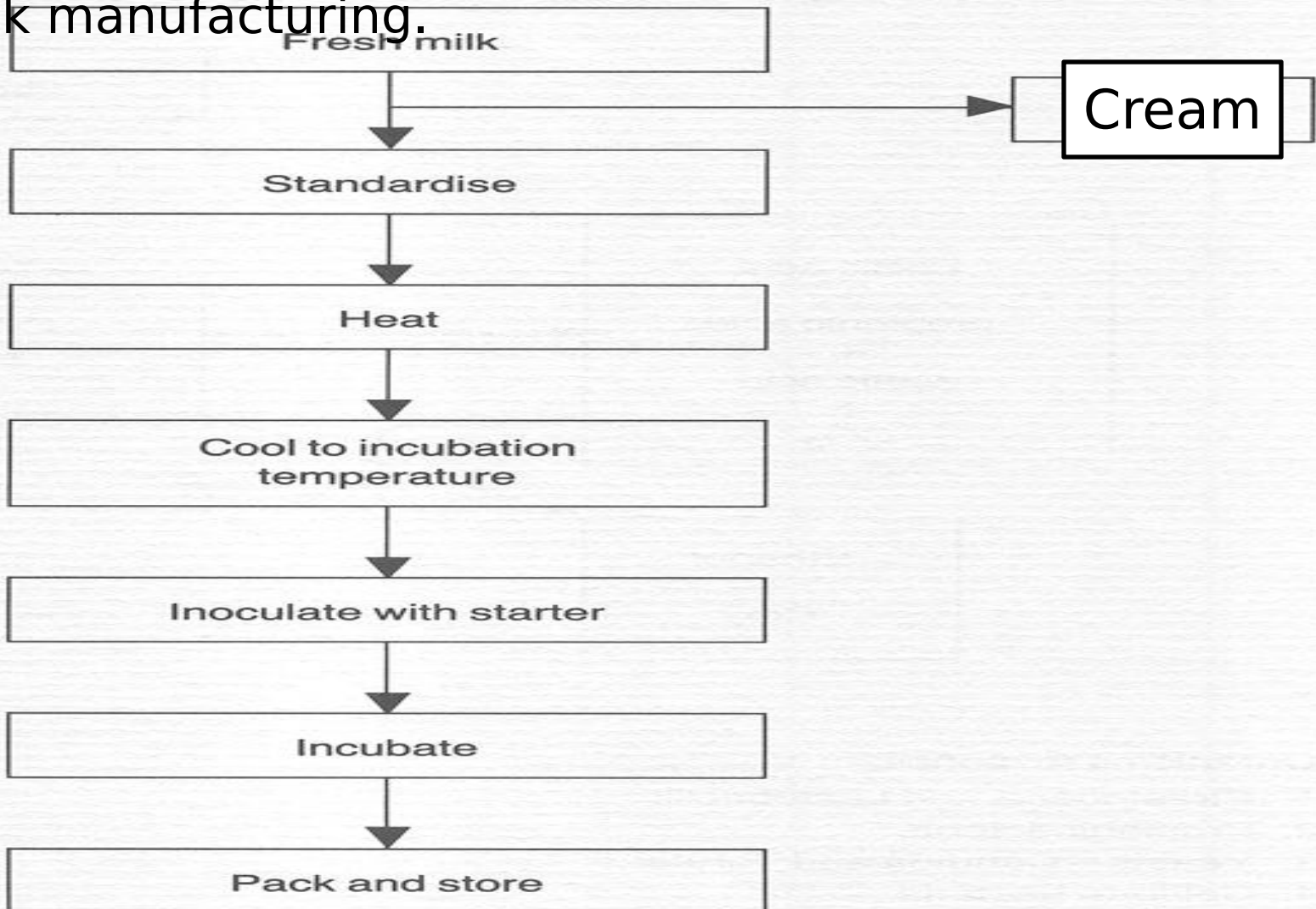
1. Milk is collected in the morning and evening in a container, which may differ according to different area and communities (clay pot, *chicho*, *sorora*, *gorfa* etc).
2. This is set aside until it gets fermented. In some areas they set a side fire to facilitate the fermentation process.
3. After a few days milk coagulate is formed (Ergoi/ yoghurt)

4. Usually they cover clay pot with pieces of leather in the area where the clay pot is used as container.
5. Churning is done by rocking a pot/calabash/ forth and back until granules of fat is formed.
6. A pieces of straw is inserted through a small hole at the neck of the container and formation of fat granules is noticed.
7. When the granules coalesce the churning will be stopped and the butter will be taken out from the top.
8. The buttermilk will be heated to a temperature of 40

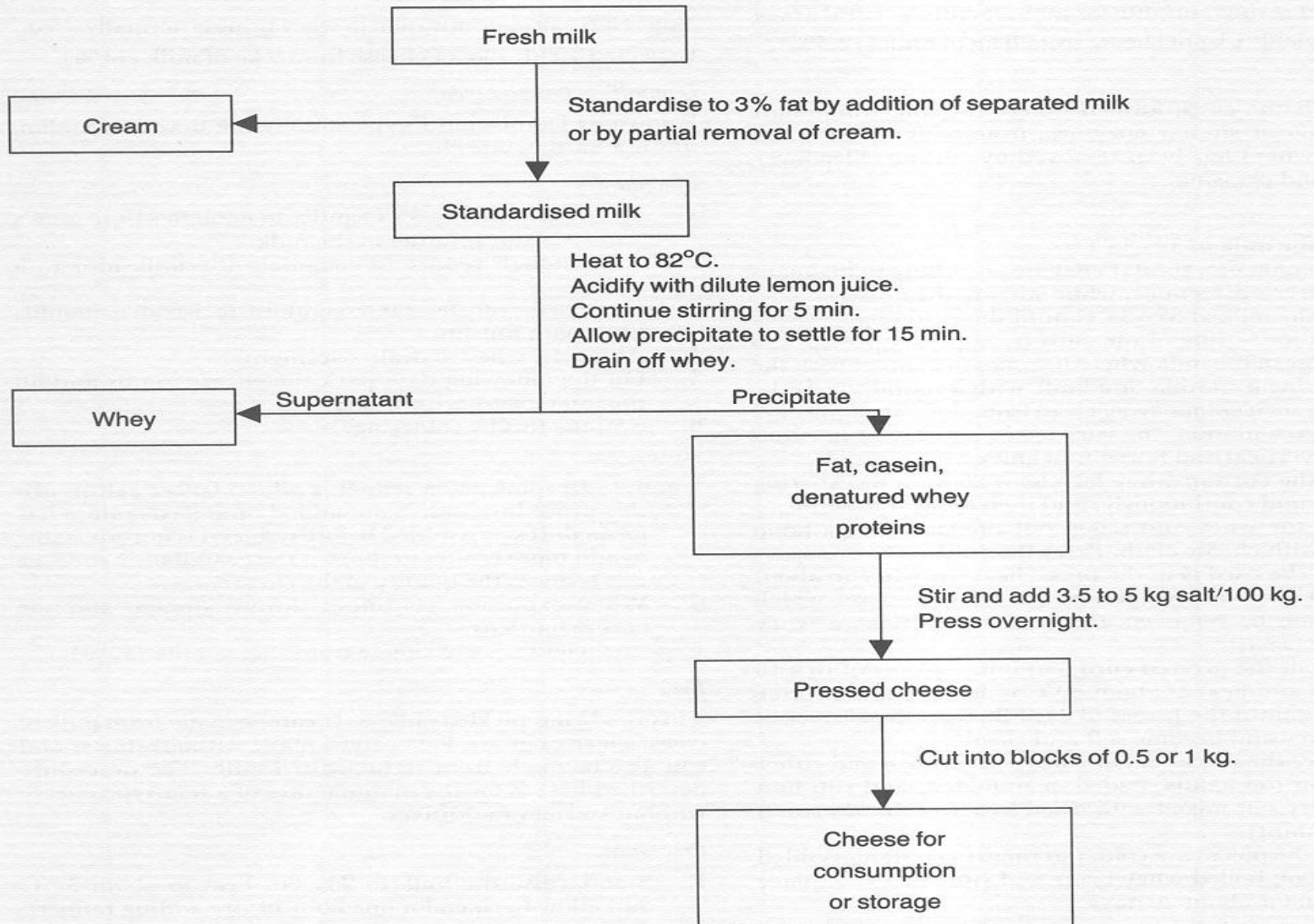


Industrially (yogurt)

a number of steps are common to each manufacturing process, and these are outlined. Flow diagram of fermented milk manufacturing.



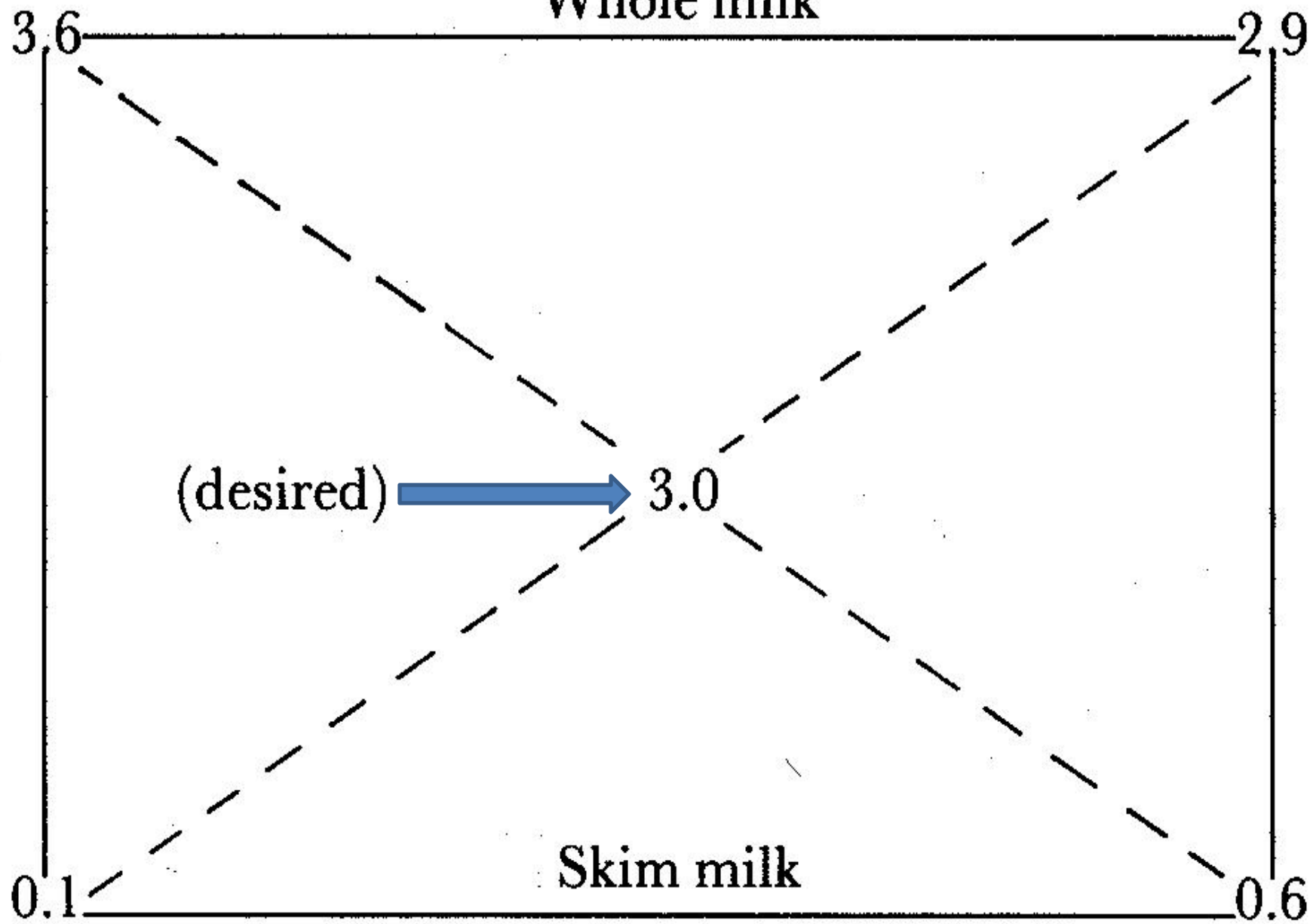
Cheese



Standardization:

- If fine adjustment of the fat content of cream is required, or if the fat content of whole milk must be reduced to a given level, skim milk must be added. This process is known as standardization.
- To make this calculation, draw a square and write the desired fat percentage of the standardized product at its centre and write the fat percentage of the materials to be mixed on the upper and lower left-hand corners.
- Subtract diagonally across the square the smaller from the larger figure and place the remainders on the diagonally opposite corners.
- The figures on the right-hand corners indicate the ratio in which the materials should be mixed to obtain the desired fat percentage. This is decided by

Whole milk



Determining milk quality

(organoleptic and laboratory tests including test on heated milk)

- Milk testing and quality control is an essential component of any milk processing industry.
- Milk being made up of **87% water** is prone to adulteration by unscrupulous middlemen and unfaithful farm workers.
- Moreover, its **high nutritive** value makes it an ideal medium for the rapid multiplication of bacteria, particularly under unhygienic production and storage at ambient temperatures.
- For any processor to make good dairy products, good quality raw materials are essential.

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

Techniques used in milk testing and quality control

Accurate sampling is the first pre-requisite for **fair** quality control system

Liquid milk in cans and bulk tanks should be **thoroughly mixed** to disperse the milk fat before a milk sample is taken for any **chemical control tests**.

Representative samples of packed products must be

1.Organoleptic tests

- The organoleptic test permits rapid segregation of poor quality milk at the milk receiving platform.
- **No equipment** is required, but the milk grader must have **good sense of sight, smell** and **taste**. The result of the test is obtained instantly and the **cost** of the test is **low**.
- Milk which cannot be adequately judged organoleptically must be subjected to other more **sensitive** and **objective** tests.

Procedure:

Open a can of milk

Immediately smell the milk

Observe the appearance of the milk

If still unable to make a clear judgment, **taste** the milk, but do not swallow it. Spit the milk sample into a bucket provided for that purpose or into a drain basin, flush with water.

Look at the **can lid** and the milk can to check **cleanliness**.

2.Clot on Boiling Test

- The test is quick and simple. It is one of the old tests for too acidic milk ($\text{pH} < 5.8$) or abnormal milk (e.g. colostrum or mastitis milk).
- If a milk sample fails in the test, the milk must contain much acid or rennet producing microorganisms or the milk has an abnormal high percentage of proteins like colostrum milk.
- Such milk cannot withstand the heat treatment in milk processing and must therefore be rejected.

Procedure: Boil a small amount of milk in a spoon, test tube or other suitable container. If there is clotting, coagulation or precipitation, the milk has failed the

3.The Alcohol Test

- The test is quick and simple. It is based on instability of the proteins when the levels of acid and/or rennet are increased and acted upon by the alcohol. Also increased levels of albumen (**colostrum milk**) and salt concentrates (**mastitis**) results in a positive test.

Procedure:

- The test is done by mixing equal amounts of milk and 68% of ethanol solution in a small bottle or test tube.
- If the tested milk is of good quality, there will be no **coagulation, clotting** or **precipitation**, but it is necessary to look for small **lumps**.

4. Milk cleanliness test: -

In milk there can be dirt substances especially if the cows are milked in a cow shade which is not clean enough. The dirt substances include **hair, thread, bedding** and **pieces of fodder**. The presence(s) of these foreign materials indicate that the milk in question is not clean. There are two methods to check milk cleanliness:

a. Sedimentation test:

Materials: Milk sample and transparent glass or cylinder

Test procedure:

Milk is put in a glass and kept for about **15-30** minutes

The foreign materials as sediment are observed in the

5. Catalase test: -

The catalase content of milk primarily depends up on the number of cells in milk.

Hence, the increased activity of this enzyme could indicate mastitis. It is necessary to take in to account the **lactation period** and If milk is kept for a longer period, catalase test is not employed because there could be microorganisms in the milk which also produce catalase enzyme.

Test procedures: -

2 ml of 9% H_2O_2 is put in a test tube containing 20 ml milk sample

Results: - Positive result i.e. in milk containing large no of cells, a strong bubbles of foam are formed giving spanking sound, while there is no foam formation in negative result.

- **N.B** if there is **5ml** or more foam layer, after exclusion of milk at the **beginning of lactation period** and **milk around end of lactation period** or **bloody milk**, it could be suspected of **mastitis**.
- Apparently the final result could be given after microbiological examination is performed in order to confirm the test.

6. Acidity test

- Bacteria that normally develop in raw milk produce more or less of lactic acid.
- In the acidity test the acid is neutralized with **0.1 N sodium hydroxide** and the amount of alkaline need for complete neutralization is measured.
- From this, the percentage of lactic acid can be calculated. Fresh milk contains in this test also "**natural acidity**" which is due to the natural ability to resist pH changes. The natural acidity of milk is **0.13 - 0.14%**. Figures higher than this signify developed acidity due to the action of bacteria on milk sugar.

Procedure:

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

7. The Lactometer test

- Addition of water to milk can be a big problem
- Any buyer of milk should therefore assure himself/herself/ that the milk he/she purchases is wholesome and has not been adulterated. Milk has its own specific gravity which is fixed.
- When it is adulterated with water or other materials are added or both misdeeds are committed, the density of milk changes from its normal value to abnormal.
- The lactometer test is designed to detect the change in density of such adulterated milk.

Procedure:

- Mix the milk sample gently and pour it gently into a measuring cylinder (300-500ml).
- Let the Lactometer sink slowly into the milk.
- Read and record the last Lactometer degree (**reading**) ($^{\circ}\text{L}$) just above the surface of the milk.
- If the temperature of the milk is different from the calibration temperature (Calibration temperature may be 20°C) of the lactometer, calculate the temperature correction.
- For each $^{\circ}\text{C}$ above the calibration temperature add 0.2°L ; for each $^{\circ}\text{C}$ below calibration temperature subtract 0.2°L from the recorded lactometer reading.

8. Freezing Point Determination

- The freezing point of milk (-0.55 – -0.53°C) is regarded to be the most constant of all measurable properties of milk.
- A small adulteration of milk with water will cause a detectable elevation of the freezing point of milk from its normal value of -0.54°C .
- Since the test is accurate and sensitive to added water in milk, it is used to detect whether milk is of normal composition and adulterated.

9. Inhibitor test

- Milk collected from producers may contain drugs and/or pesticides residues.
- These when present in significant amounts in milk may inhibit the growth of **lactic acid bacteria** used in the manufacture of fermented milk such as **cheese** and **Yoghurt**, besides being a **health hazard to the consumers**.

Principle of the method: The suspected milk sample is subjected to a fermentation test with starter culture and the acidity checked after 3 hours.

- The value of the titratable acidity obtained is compared with titratable acidity of a similarly treated sample which is free from any inhibitory substances.

Procedure:

- Three test tubes are filled with 10 ml of sample to be tested and three test tubes filled with normal milk.
- All tubes are heated to 90°C by putting them in boiling water for 3 - 5 minutes.
- After cooling to optimum temperature of the starter culture (30, 37, or 42°C), 1 ml of starter culture is added to each test tube, mixed and incubated for 3 hours.
- After each hour, one test tube from the test sample and the control sample is checked for development of acid.

Assessment of results:

- If acid production in suspected sample is the same as the normal sample, then the suspect sample does not contain any inhibitory substances;
- If acid production in suspect sample is less than in the normal milk sample, then, the suspect sample contains antibiotics or other inhibitory substances.

Public health significance of milk consumption

As it is well balanced food type, Consuming of milk has many advantages. but

1. Consumption of milk by some individuals results in **allergy to cow milk protein** and **lactose intolerance**. Allergy is denoted by GIT syndrome and asthma. The difficulty in digesting milk could be due to one of the following reasons:
 - I) An individual may be allergic to milk proteins
 - II) Milk having a hard curd forms a comparatively hard, small and compact curd mass in the acid environment of the stomach and this reduces the area of contact between the curd and digestive fluids.

III) In areas of the world where animal milk is not a common human food, the digestive system of indigenous people inherently produces **very little** lactase. As a result, many people find their digestive systems reject milk. **Lactose intolerance**

- By taking only small quantities of milk over a period of time an individual's digestive system may develop the capacity to produce the necessary lactase so that milk can then be ingested in larger quantities without adverse effects.
- People of the more developed dairy areas of the

Reaction due to the condition is mainly characterized by

- a. GIT disturbances** such as vomiting, **diarrhoea**, stomach ach, constipation, inappetance and bloating
- b. Respiratory syndrome** includes **rhinitis**, **bronchitis**, **asthma** and **pneumonia**
- c. Skin allergic reactions** are **urticaria**, **edema**, **exanthema** and **vesicle formation**.

As a solution:

- Sensitive person should **refrain** from consuming cow milk.
- Lactose intolerant individual advised to drink milk only up to **250ml** of milk per day.

2. Effects of cleansing and disinfecting agents

- cleansing and disinfecting agents may cause problem if the containers are not well rinsed.

3. Ingestion of antibiotic residues along with milk results in allergic reactions, hypersensitivity and development of antibiotic resistance in humans.

4. Milk can also serve as a vehicle for transmission of **zoonotic diseases** such as **tuberculosis**, *E. coli*, salmonellosis, cholera, mycotoxicosis, *S. aureus* etc if not kept hygienically. Diseases transmitted to human through milk (due to milk consumption) are summarized and presented in Table below

Disease	Main sources of infection		
	Human	Lactating cow	Environme nt
FMD	X	X	
I n f e c t i o u s hepatitis	X		
Q fever		X	
Anthrax			X
Botulism		X	
Brucellosis		X	
Cholera	X		
<i>E. Colli</i>	X	X	

Disease	Main sources of infection		
	Human	Lactating cow	Environment
Leptospirosis		X	
Salmonellosis	X	X	
Shigellosis	X		
Staph	X	X	
Tuberculosis	X	X	
Amebiasis	X		
Giardiasis	X		
Toxoplasmosis		X	