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**Fifth YEAR-Class of Milk Hygiene**

## **Microbiology of milk**

Milk consists of a variety of excellent good nutrition (including all the vitamins) which serve as sufficient raw material and essential factors for the growth of different microorganisms under ambient conditions. For example, bacteria require for growth commonly lactose, milk fat, milk proteins etc. As milk is a source of optimum environment for the bacteria, it can grow very fast causing harmful systematic consequences to animals. Some of these bacteria prefer lactose or may be other bacteria initially transform nutrition to another form to provide other bacteria like amino acids as nitrogen sources.

However, milk will be completely changed in colour and taste as a result of growth of the bacteria. High moisture percentage in milk is a significant factor that provides an ideal environment for microbial growth and for nutrients to be in solution in order to be taken into the microbial cell through wall by osmosis. An ideal osmotic pressure and neutral pH in milk are optimum potential factors for the multiplication of most bacteria.

### **1. Microbiological quality of milk**

Milk when secreted in udder is free from microorganism (sterile). The bacteria pass into the udder by passing from the teat canal. A variety of sources of infected udder with bacteria is from production, handling, transportation, contamination of tools for milking. The microorganisms entering milk may be pathogenic or non-pathogenic to humans. The growth of the microorganisms in milk affect the quality of milk by bring about milk spoilage. The rate at which this spoilage occurs depends upon not only the initial contamination loads but also on conditions under which milk is held and length of time is going to be kept. Certain metabolic (like lactic and other organic acids, gases, enzymes, and toxins) are produced during growth of the bacteria in milk. These metabolites lead to various kinds of spoilage in the products and sometime make it a potential health hazard.

## 2. Microorganisms in raw milk

The number and types of microorganism present in raw milk depend on the nature and extent of contamination. For example, if milk stored at a low degree of temperature (less than 4<sup>0</sup> C), less chance to contamination and growth of the bacteria might be occurred.

## 3. Number of microbial in raw milk

The microbial counts in raw milk may usually vary from less than one thousand per/ml to more than one million (10<sup>6</sup>) per/ml. The total microbial in raw milk may be estimated by standard plate count (SPC) by plating milk on tryptone dextrose agar or plate count agar and incubating at 37<sup>0</sup>C for 48 hours. Another better test to count the number is to use psychrotrophs, thermodurics, Coliforms, lactic acid, gram-negative rods, lipolytic and proteolytic types. Besides enumerating by plating, the microbiological quality can be predicted by performing other routine tests like methylene blue reduction and resazurin reduction test.

## 4. Types of Microflora in raw milk

A heterogenous population of mesophilic, thermoduric, thermophilic, psychrotrophic and pathogenic organisms constitute the microflora of raw milk.

- a. **Mesophilic microflora:** the microorganisms growing optimally at 30<sup>0</sup>C to 32<sup>0</sup>C are designated as mesophilic. The different microorganism forming the mesophilic microflora of raw milk including Staphylococcus, Streptococci, Mycobacterium, lactobacillus, and pseudomonas.
- b. **Thermoduric microflora:** thermoduric microorganisms are those which survive pasteurization condition but cannot grow at pasteurization temperatures. The genera of thermoduric bacteria in fresh raw milk are the following:
  - 1- *Microbacterium lacticum*.
  - 2- *Bacillus spores*.
  - 3- *Clostridium spores*
  - 4- *Micrococcus*
- c. **Thermophilic microflora:** the term thermophilic to the type of bacteria that can readily grow at 55<sup>0</sup>C and most of them have an upper limit of growth at about 70<sup>0</sup>C. A small number of thermophilic bacteria may gain access in to raw milk mainly from soil, bedding, feeds and rarely from water supplies. The common member of thermophilic microflora of raw milk belong to aerobic or facultative anaerobic sporeforming rods e.g. *B. stearothermophilus*, *B. circulans*, and *Lactobacillus thermophilus*.

- d. **Psychotrophic microflora:** this type of microorganism is famously that are able to grow at commercial refrigeration temperatures (2-7<sup>0</sup>C). Improperly cleaned/sanitized milk equipment is the major source of this type of bacteria although these may be derived from animal teat surface. The Psychrotrophic bacteria belong to two broad categories, gram negative and gram-positive rods.
- 1- Gram negative rods: these types of bacteria include:
- a- *Pseudomonas fluorescens*
  - b- *Pseudomonas putida*
  - C- *Pseudomonas fragi*
  - d- *Pseudomonas aeruginosa*
- o Other genera of gram-negative rods include Acinetobacter, Flavobacterium, Achromobacter, Alcaligenes and Enterobacter.
- 2- Gram positive bacteria: some strains of the following genera of Psychrotrophic gram positive rods and cocci are also encounter in raw milk:
- a- *bacillus* spp.
  - b-*Arthrobacter* spp.
  - c- *Streptococcus* spp.
- e. **Coliforms:** the term “Coliforms” bacteria in milk denote to aerobic and facultative anaerobic negative, non-spore forming rod shaped bacteria which ferment lactose to the acid and gas at 32<sup>0</sup>C within 48 hours. The typical genera included under this group are *Escherichia*, *Enterobacter*, and *Klebsiella*. The source of infection with these bacteria come from uncleaned equipment handling milking.
- f. **Pathogenic microorganism in raw milk:** this type of bacteria causes serious disease to the udder of animals due to contamination of milk from infected human handlers, faecal and non-faecal sources. A list of various pathogens reported to occur in raw milk along with their principle sources of entry is presented in the following table:

| <b>Pathogens</b>  | <b>Principle causes/sources</b>   |
|---|-----------------------------------|
| <i>Brucella abortus</i><br><i>Brucella melitensis</i><br><i>Brucella suis</i> | Brucellosis in lactating animal   |
| <i>Mycobacterium tuberculosis</i><br><i>Mycobacterium bovis</i>               | Tuberculosis in lactating animals |

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|---|--|
| <i>Streptococcus agalactiae</i><br><i>Staphylococcus aureus</i><br><i>Escherichia coli</i>  | Bovine mastitis<br>(udder disease)                                   |
| <i>Listeria monocytogenes</i><br><i>Bacillus cereus</i><br><i>Clostridium perfringens</i><br><i>Pasteurella multocida</i><br><i>Actinomyces species</i><br><i>Coxiella burnetii</i> | Bovine mastitis  |
| <i>Salmonella typhi</i><br><i>Salmonella paratyphi</i><br><i>Escherichia coli</i><br><i>Vibrio cholera</i><br><i>Shigella flexneri</i><br><i>Shigella dysenteriae</i>               | Faecal contamination of milk or human handlers (infected or carries) |
| <i>Streptococcus pyogenes</i>   | Human handlers   |
| <i>Cryptococcus neoformans</i>  | Bovine mastitis (infrequent causative)                               |
| Adenoviruses (20 different species)   | Human handlers (infected or carries)                                 |
| Enterovirus, hepatitis virus.   | Human handlers (infected or carries)                                 |
| Tick borne encephalitis virus.  | Acquired via tick bites  |
| Foot and mouth disease (FMD) virus  | Animal with FMD  |