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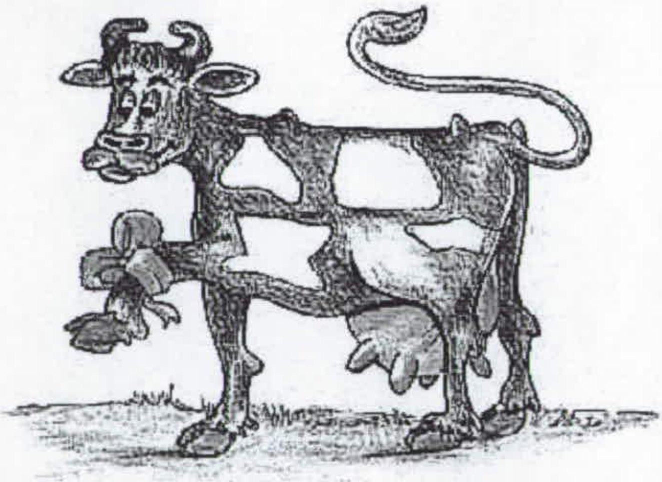
# GUIDELINES FOR THE PRODUCTION OF HIGH QUALITY MILK



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## Introduction

With numerous milk by-products appearing on the consumers' table, the products should be attractive to the senses: smell, taste, sight, texture and also shape. Failure to appeal to the consumers' senses could result in the reduction of consumption of these by-products. Therefore we mustn't gamble with the quality of milk. We should also not forget that milk has a high nutritional food value for human beings.

The term "milk quality" means different things, but for our purposes it can be defined and measured by the following characteristics: milk constituents, bacteria count, aesthetics, mastitis control, as measured by somatic cell count, and adulteration.
The quality of milk begins on the farm. Therefore it is important that the primary quality of the milk should be kept at as high a level as possible until it arrives at the dairy gate.

**It is important to remember that high quality milk products cannot be produced from low quality raw milk!**

## Milk Constituents

Milk is composed of 87.3% water, 3.8% butterfat, and 8.6% solids-not-fat (SNF). The exact amount of each constituent varies slightly with the different breeds and blood lines of dairy cattle.

Basically people drink milk for two reasons - it tastes good and it is highly nutritious. This assumes, of course, that it is produced, processed, and handled in the correct manner. The natural flavor of milk and its nutritional value are due to the butterfat and SNF.
Raw milk includes sugar (lactose), protein (casein), and minerals (particularly calcium and phosphorus).
Both genetics and environment affect milk composition. Approximately 60% of the variation in milk composition among cows is inherited, which means that the breeding program, especially the selection of herd sires, can have a significant long-term impact on the composition of milk produced by a dairy herd.
The remaining 40% of variation in milk composition is due to environmental factors. Butterfat is decreased and protein increased when a high grain ration is fed.

The feeding of a low energy ration will reduce SNF and protein in milk slightly, and will reduce milk yield significantly. Butterfat and SNF are also lower during hot weather. Milk components are adversely affected by sub-clinical mastitis, which is defined and discussed latter. For example, butterfat, protein, sugar, calcium, phosphorus, and potassium decrease when undesirable milk components such as lipase (which causes rancidity), sodium, and chloride are increased. Remember, regular tests will not always show the impaired quality of the milk whereas specific tests will. For instance, the percentage of crude protein in milk will not be altered in mastitic milk, but specific tests will show a decrease in the most important protein-casein, while increasing albumin.

The decrease in SNF, resulting from sub-clinical mastitis, makes milk more susceptible to "off" flavors and reduces the quality of manufactured products. In cheese manufacturing, for example, the curd strength, fat, moisture, protein, and yield are decreased, while coagulation time and the percentage of protein lost in whey are increased.

## Somatic Cell Count

The somatic cell count of raw milk, in addition to a bacteria count, is a common method used to assess milk quality in all milk producing countries. It is used as a payment criterion for the milk producer but also as a parameter to measure the udder health status of his cows.

The main factor which has an impact on the somatic cell count (SCC), is udder infections in the past and in the present, as well as the current presence of infection. Other factors, such as: lactation stage, age, and season, are defined as minor factors.

SCC, measured in bulk tanks several times a month and monthly per cow, represents mainly the milk leukocytes (white blood cells) and a small percentage of epithelial cells; collectively termed "somatic cells." The term somatic means body. **Leukocytes**, which comprise 98% of the total cells in milk, are present in **response** to injury or infection. **Epithelial cells** from milk-secreting tissues, which comprise the remaining 2%, are present as a **result** of injury or infection. Milk from an uninfected cow will usually contain between 50,000 to 200,000 cells per milliliter, while levels above 200,000 indicate an abnormal condition in the udder and a probability of infection, namely, **mastitis**.

When leukocytes enter the udder, they engulf and destroy microorganisms and release substances that permit blood fluids to enter and dilute irritating bacterial toxins or poisons. Leukocytes also assist in the removal of damaged milk secreting cells.

**Mastitis** is an inflammation of the udder and is formed as a consequence of udder irritation caused mainly by the entrance of bacteria. Mastitis changes milk composition and decreases its quality.

Mastitis has many modes but there are basically two types:

- Clinical mastitis – is a type with visible signs, such as: udder swelling, high temperature, redness, sensitivity to touch, milk yield reduction and appearance of flakes, clots or watery color in milk.
- Sub-clinical mastitis- is not visible and cannot be detected without special tests. Although infected quarters are visibly normal and milk appearance is normal as well, milk production and quality are reduced.

Approximately 130 different microorganisms are known to cause mastitis, but only 20 are well known. They can be classified into two categories: contagious pathogens and environmental pathogens.

- ***Contagious pathogens:***

Existing within infected quarters; they are transmitted from cow to cow, or quarter to quarter within a cow, during milkings via cloths used for wiping hand milkers and milking machines;

The most common contagious pathogens are: *Staphylococcus aureus, Streptococcus agalactia, Streptococcus disgalactia, Corynebacterium bovis.*

- ***Environmental pathogens:***

Bacteria are present in the environment of the cow, particularly in the bedding.

Invasion to udders occurs between milkings; cows are exposed to these bacteria especially at the beginning of their dry period when the teat canal tends to be open.

Cows are also sensitive to new infections during the 10 days before and 10 days after calving, due to the reduction of antibiotic concentration, the tendency of the teat canal to be open, longer lying of the cow, and due to changes in the immunological mechanisms.

The most common environmental pathogens are *Esherichia coli, Streptococcus uberis.*

**The key word in mastitis control is PREVENTION.**

Mastitis can be eliminated if all aspects concerning the cow's environment and milking procedures are carefully managed. The aim is to reduce the number of bacteria populations on the udders and teats' skin, particularly at teat end.

Usually there is a high correlation between SCC and milk yield in a particular cow. However, the variability between milk yield and SCC is large between herds and between cows within a herd. A research project carried out in the USA has shown a higher milk production loss in mature cows having a higher SCC: 100 liters loss to heifers whereas 200 liters for mature cows to every multiplication of SCC between 50,000 to 800,000 cells/ml.

Interrelationships also exist for milk production loss between bulk tank SCC and percentage of infected quarters in a herd. (see table 1). In herds where the SCC is between 200,000 to 500,000 cells/ml, an 8% reduction in milk yield was observed.

**Table 1**. **The Interrelationship between bulk tank SCC and infected quarters (%) in a herd on milk production loss (%)**

| SCC in bulk tank | % Infected quarters | Loss in milk yield (%) |
|---|---|---|
| 200,000 | 6 | 0 |
| 500,000 | 16 | 6 |
| 1,000,000 | 32 | 18 |
| 1,500,000 | 48 | 29 |

Research has also shown a high correlation between SCC and shelf life, quality and yielding of by-products.

**Environmental mastitis is caused mainly due to poor, muddy and unclean bedding.**

**Measures to take to ensure high milk quality in case of suspicion of mastitis:**

- Identification of mastitis-by squirting a few drops of milk into a cup with net surface or by examining the electrical conductivity on-line during milking;

- Palpation of the udder (swollen, rash, pain);
- CMT reaction or by hand monitor of electrical conductivity to identify the infected quarter.
- Mark the infected cow properly (on leg, tail, udder, etc.) and record it. Treatment of mastitic milk – milk it and transfer it to separate line or a special bucket;
- Milk the infected cows, or those with high SCC, at the end of the milking.
- Disinfect the milking equipment after milking infected cows.

**How to control mastitis and lower SCC?**

- Breed your cows with the semen of bulls with genes for teats with strong sphincter muscles, to prevent milk leakage between milkings, teats well adopted to mechanical milking, and proportional and attached udders;
- Use dry and clean bedding;
- Use a hygienic milking routine: attach the milking machine to teats only after cleaning, disinfecting and drying them, dipping immediately after milking;
- Milk the heifers first, and infected and high SCC cows at the end of the milking. If possible milk the calving cows first;
- Treat all clinical cases after consulting your veterinarian;
- Use dry cow treatment for all cows and quarters within a cow according to your veterinarian's instructions;
- Cull all chronic cows that do not respond to antibiotic treatment;
- Proper handling of the milking equipment.

**Remember!!!**

**Mastitis is the main factor which contributes to the elevation of SCC; Contagious mastitis transferred from cow to cow during milking; Environmental mastitis is caused mainly due to poor, muddy and dirty bedding.**

- **Milking Routine**

Predipping- before dipping, ensure that teats are clean and dry. After dipping wait 30 – 60 seconds, then dry and wipe the teats with individual paper towels or cloths to prevent residues in milk;

Stripping-for detection of abnormal milk, milk stimulation and removal of plugs from teat end orifice.

**When you strip: close the passage between udder cistern and teat cistern, squeeze the teat gradually- finger by finger, let milk drop onto a net plate positioned on top of a cup; use gloves and disinfect them between cows. Don't strip with your hands nor on the floor. Clean and disinfect cup between milkings.**

Milking cluster attachment – attach clusters on clean and dry teats with special care to prevent air leakage through liners. During milking, prevent air leakage and squawking- this phenomena might be the most crucial factor for establishing mastitis by a milking machine. Prevent dropping of clusters and if this occurs, repair immediately. Use claws with automatic shut off valves, or supply more vacuum capacity by the vacuum pumps. Prevent shell attachment to a dead teat or one with exceptional secretion. These teats are a reservoir for high bacteria and SCC. Mark the cow that has such teats appropriately (the best way is by a stripe on the near leg).

**Clean and dry the teat well before attachment. Prevent excessive air leaks during attachment and during milking. Use liners which fit your cows' teats. Use claws with shut off valves.**

End of milking – the threshold flow to end of milking is usually 200 – 400 ml/min. With high yielding cows milking 3 times a day, this threshold can be 500 ml/min. If removal is performed manually or automatically, ensure that the vacuum is closed prior to detachment. Don't detach one shell during milking under high velocity, as it can cause penetration of milk particles with bacteria into the udder.

**Ensure vacuum shut off prior to detachment. Avoid detachment of individual shell during milking.**

**Teat dipping after milking**

Teat dipping after milking is recommended to prevent the establishment of bacteria populations on teats and the penetration of bacteria through the teat canal. This procedure is the most important feature in reducing contamination and is a more useful application than spraying.

Idophors are the most commonly used disinfectants but others can also be used according to approval by authorities. Dip the teats as soon as possible after cluster removal. Ensure coverage of all teats and use the recommended dosage, following the instructions. Never keep prepared solutions from one milking to another. Use emollients (such as glycerin) if necessary, according to instructions. Remember, the higher the emollient concentration, the lower the disinfectants' efficiency.

- Backflushing – Backflushing the cluster attachments between cows reduces the bacteria populations. It might also reduce the infection rate.

## Bacterial Count

The most important indicator of milk quality is the bacterial count. Such counts are conducted frequently (2-3 times a month) on herd milk from each dairy farm. To comply with the Israeli Standards, bacterial counts must be less than 100,000 per milliliter. Dairy farmers who practice excellent milking management often maintain the bacterial count in the range of 1,000 to 10,000.

Microorganisms found in milk include bacteria, yeast, molds, protozoan, algae, and viruses. They utilize the protein and sugar present in milk and under ideal growth conditions are capable of doubling in number every 20 minutes. Their waste products accumulate and impart off flavors, which make the milk less desirable for human consumption.

Major causes of high bacterial counts will be discussed separately under the following subheadings: (i) improper udder preparation, (ii) improper cleaning of milking equipment, (iii) poor cooling of milk, and (iv) infected cows.

### (i) Improper Udder Preparation

Soil and manure on cows are prime sources of bacteria in milk. Efforts should be made to maintain the cows in an environment that minimizes the amount of soil and manure that sticks to the udders and flanks at milking time. Udders should be cleaned and dried thoroughly prior to attachment of teat cups (as aforementioned), the goal being to attach teat cups to clean, dry teats. Moreover, care should be taken to insure that water does not run down flanks or udders and accumulate at the top of teat cups. This water could be defined as "magic water" because - now you see it - and now you don't! Such water contains large numbers of microorganisms that are drawn into the teat cups as the udder milks out and the teats shrink in size. These microorganisms end up in the milk supply where they reduce milk quality. They may also cause mastitis.

The main factors that contribute to a high bacteria count are:

- **Improper cleaning of milking installation;**
- **Improper cooling;**
- **Poor environment for cows, resulting in dirty udders and teats;**
- **Non-hygienic milking routine;**
- **Udder infection.**

Clipping hair from the udders and flanks makes udder preparation easier. Individual paper towels or cloths are preferred to wash and dry udders. Sponges should never be used because they become a reservoir for microorganisms that are spread from cow to cow. If a bucket of udder wash solution is used, care must be taken to insure that it is changed regularly to avoid heavy contamination, which results in the spread of microorganisms.

### (ii) Improper Cleaning of Milking Equipment

Improperly cleaned milking equipment is the most significant single cause of high bacterial counts in raw milk. Milk is an emulsion composed of water, butterfat, protein, sugar, and minerals. Residues left by milk components on milk contact surfaces are known as "soils," which, if not removed on a regular basis, provide a place for bacteria to multiply. The result is low quality milk.

Soils on milking equipment surfaces can be identified as organic or inorganic. Organic soils are comprised of fat, protein, and sugar. These residues should be removed as soon as possible because they harden as they dry. Inorganic soils result from the precipitation of mineral salts such as calcium, magnesium, and iron from both milk and water.

Because soils on milking equipment may be caused by several different constituents of milk and water, no simple chemical or cleaning compound is capable of removing all soils. Each group of soils will be discussed separately, followed by a discussion of the different types of cleaners and recommended cleaning procedures.

- *Butterfat.* The temperature and alkalinity (pH) of the cleaning solution is critically important for removing butterfat. Because butterfat begins to solidify at 35°C, the temperature of the wash solution should be maintained above 38°C throughout the entire cleaning cycle. If the temperature is permitted to drop much below 38°C, fats removed during the initial phases of the cleaning cycle will be redeposited on surfaces that have already been cleaned. Detergent products must contain a sufficient concentration of alkaline compounds to break fat globules into tiny droplets that can be removed from equipment during rinsing. This is known as emulsification. If the butterfat is not removed during cleaning procedures, an oily buildup will occur that can trap and bind other soils to equipment surfaces.
- *Protein.* Protein films are colorless and difficult to see until they accumulate and turn yellow. Such films are very adhesive and difficult to remove, particularly if permitted to age and dry on equipment surfaces. A chlorinated alkaline cleaner is required to break up proteins and render them more soluble. Use of hot water during the initial rinse cycle should be avoided because high temperatures cause protein to break down and be redeposited on milk contact surfaces.
- *Minerals.* The buildup of minerals on equipment surfaces causes serious cleaning problems because they collect organic milk constituents and form a milkstone deposit. Milk contains a high content of calcium and magnesium that are easily deposited on surfaces and are difficult to clean. The natural phosphates in milk keep calcium, magnesium, and iron from precipitating out by holding them in suspension. Unfortunately, when milk residue on equipment surfaces is rinsed, soluble phosphates are removed and the remaining milk minerals begin to redeposit on the surfaces. This is why a complete washing procedure should immediately follow the rinse cycle. It is important to emphasize that milk and water minerals may also react with improper, or improperly used, cleaning chemicals to cause residues.
- *Sugar.* Milk sugars are water soluble and do not pose a problem unless the cleaning procedures are grossly inadequate.

- *Milkstone.* Milkstone is a white chalky film that is removed with an acid cleaner. Prevention is the key to control of milkstone because once a buildup begins, it results in deposits of additional milk constituents, which further compound the film removal process. Such films are invisible on wet stainless steel surfaces, but appear white when surfaces dry.
- Cleaning of milk contact surfaces is both simple and easy if done immediately after proper rinsing with lukewarm, mineral-free water, which removes 70% of milk residue. Remaining residue can be removed with a simple alkaline cleaner in hot, soft water.

The drying of milk residues on equipment surfaces and inadequate or improper rinsing causes changes in the physical and chemical nature of films that make effective cleaning more difficult. Thus, all milk contact surfaces should be cleaned immediately after milking (or immediately after a bulk milk tank is emptied) and not after breakfast, or just prior to the next milking, as is occasionally done on some farms.

**Wash the system with lukewarm water immediately after milking is completed and the bulk tank after being emptied. Don't delay washing!!! Dried milk residues will make cleaning more difficult.**

**Circulation must be carried out in sequence.**

*Water Quality.* The chemical quality of water varies from one farm to another and is an important consideration in the cleaning and sanitizing processes. Water hardness results from dissolved calcium and magnesium compounds, which can be precipitated with alkaline cleaners. Precipitated salts are difficult to rinse from equipment surfaces and may result in unsatisfactory cleaning.

Water hardness affects the ability of cleaners to perform adequately. This problem can be overcome with vigorous hand cleaning. However, with clean-in-place (CIP) wash systems, scrubbing action must be accomplished by vigorous recycling of cleaning solution and by keeping water hardness low. It is often necessary to soften hard water by using a water conditioner. An alternative is to use a cleaner that contains sequestering or chelating compounds to modify calcium and magnesium salts and prevent precipitation.

Otherwise, hard water will neutralize detergents, decrease rinsing action, create films on equipment surfaces, and cause problems with water heaters.

*Dairy Cleaners* The purpose of dairy cleaners is to remove milk solids and other soils from equipment surfaces. Such soils, if not removed by dairy cleaners, will protect bacteria from dairy sanitizing compounds that are used to sanitize milking equipment just prior to milking. Thus, cleaners are not sanitizing agents, but proper sanitation does require proper cleaning first.

Three classes of compounds are used to clean milk contact surfaces. These include alkaline cleaners, chlorinated cleaners, and acid cleaners. Regardless of the compound or product used, it is essential that the manufacturer's directions be followed exactly.

Alkaline cleaners are intended principally for the removal of butterfat. Such products contain basic alkalies, phosphates, wetting agents, and chelating agents - each of which serves a specific purpose and contributes to the cleaning process.

Chlorinated cleaners are alkaline cleaners with chlorine added to aid in protein removal. All alkaline cleaners, whether chlorinated or not, should be designed to have a low foaming action if used in CIP systems, because the presence of foam is detrimental to effective cleaning.

Acid cleaners are designed to remove or prevent accumulation of mineral deposits on all milk contact surfaces. Acids react with mineral deposits and convert the deposit into a chemical mixture that can be rinsed away easily. There are two alternatives to using acid: one to two times per week to eliminate milkstone formation; acid rinses after each milking. The latter practice prolongs the life of rubber gaskets and inflations, and protects stainless steel from corrosive chlorine. It also prevents mineral deposits and water spotting, inhibits bacterial growth, and improves the effectiveness of chlorine sanitizers.

As noted above, dairy cleaners perform many functions and no single cleaner performs all the necessary cleaning operations. A high degree of professional competency is required to properly formulate cleaning products for the dairy industry. Moreover, effectiveness of a cleaning compound depends upon several interacting factors as discussed below:

The cleaner must be used at concentrations recommended by the manufacturer for a specific job. The temperature of the cleaning solution is especially important. Solutions must remain above 43° C throughout the entire wash cycle, therefore, temperatures should be 71 to 77° C at the beginning of the wash cycle. Adequate time is also required for the cleaner to remove all soil, normally 8 to 10 minutes.

Every milking system has it's own characteristics to determine the cleaning program that will clean the system appropriately. Modern milking systems include large diameter pipelines, long pipelines, milk meters, automatic drains, wash tees, etc. Effective cleaning involves giving attention to many details such as types of cleaning products, size of washing sinks, water quality, water temperature, and in addition, air injection. Air injection is critically important in milking systems with large diameter pipelines. Air injectors must be located properly and be adjusted to provide turbulence for scrubbing action, control water distribution, and minimize cooling of cleaning solutions. Air injectors intermittently admit air, which forms a slug of liquid and induces a violent cleaning action as it moves toward the receiver. For effective cleaning and sanitizing, the solutions should hit the receiver with considerable force. This is necessary to form a splash to reach the top of the receiver. Some splash should be drawn into the sanitary trap, which insures cleaning of the connecting line. Failure to give adequate attention to air injection is a frequent cause of milking equipment not being cleaned properly, resulting in high bacterial counts and lowered milk quality.

*Dairy Sanitizers*. The purpose of dairy sanitizers is to sanitize milking equipment immediately prior to milking. Chlorine compounds are widely used. These compounds are economical and are highly effective germicides against a wide range of microorganisms, relatively unaffected by hard water, and nontoxic to man in recommended concentrations. Disadvantages include corrosive and irritating properties (hypochlorites are worse than others), loss of strength during storage (especially liquid hypochlorites unless stored in a cool, dark area), and loss of germicidal activity in presence of organic matter.

Usually sanitizing prior to milking is not necessary, if the cleaning system functions properly.

**Cleaning Procedures for Milking Equipment**

Effective cleaning of all milking equipment is critically important for the production of high quality milk. Otherwise, a high bacterial count and off flavors in milk will result.

**CIP Cleaning of Pipelines**

Pre-rinse all milk contact surfaces immediately after milking with lukewarm (38 to 43° C) water to remove and prevent the drying of milk solids. (Hot water will denature protein and cause protein films, while cold water will cause fat deposition on equipment surfaces). Be aware of the proper action of the air injector. Velocity of cleaning solutions should be at least 1.5 meters per second to assure effective scrubbing action.

Wash equipment in a solution containing the recommended amount of alkaline cleaner in the required volume of hot water, 71° C. (Circulate for 10 minutes, but do not permit water temperature to fall below 43° C). Drain thoroughly.

Rinse with lukewarm (38 to 43°C) acidified water. Circulate for 2 to 3 minutes and drain.

Inspect all milk contact surfaces for cleanliness. All parts not designed for CIP cleaning must be cleaned manually.

Rinse with lukewarm (38 to 43° C) prior to milking. Circulate at least 2 minutes and drain.

**Washing of Bulk Milk Tanks**

Rinse tank with lukewarm water, 38 to 43° C immediately after it is emptied. Drain all water and milk residues.

Prepare chlorinated alkaline cleaning solution or add the chemicals to the container in the washing machine. Pay attention that the temperature of hot water should be between 60 to 80° C (or 43° C if a heating body exists). Circulate the solution not more than 10 minutes, but don't let the temperature fall below 43° C.

- *Note*: there are places which need manual cleaning (such as: blades, outlet valve, three-way valves, calibration rod, etc.).

- Brush the outside of tank thoroughly.
- Rinse all inside surfaces with an acid solution (1%) once a week or as needed.

**(iii) Cooling Milk**

A third important cause of a high bacterial count is the improper cooling of raw milk on the farm. Standard requirements in most areas are that milk should be cooled to 10° C within the first hour after milking and to at least 5° C within 2 hours. Milk that is added to the bulk tank at subsequent milkings should not elevate the temperature of total milk above 10° C. One hour after milking the temperature should be 2° C.

Warm milk is an excellent growth medium for microorganisms. Many bacteria will double in number every 20 minutes under ideal growth conditions. This means that one bacterial cell can potentially multiply to more than 68 billion cells in just 12 hours. The increase in bacterial numbers in raw milk over a 12-hour period has been determined to be as follows:

| Storage Temperature | Bacterial Growth |
|---|---|
| 5° C | Slight |
| 10° C | 5-fold |
| 16° C | 15-fold |
| 21° C | 700-fold |
| 27° C | 3,000-fold |

If the milk temperature is below 4° C, the multiplication rate of bacteria is very slow.

The shelf life of pasteurized milk is also affected by its storage temperature as shown below:

| | Shelf Life |
|---|---|
| • 0° C | • 20 days |
| • 2° C | • 15 days |
| • 5° C | • 10 days |
| • 7° C | • 5 days |
| • 10° C | • 2 days |
| • 16° C | • 1 days |
| • 21° C | • 1/2 days |

Milk should be delivered every day, thus avoiding delivering or taking milk during milking.

Some research has shown that the shelf life of pasteurized milk decreases by approximately 1 day with each increase of 5,000 in the bacterial count of raw milk. The problem is that bacteria multiply at a rapid rate and leave their waste products in the milk. It is imperative that every effort be made to minimize the number of bacteria in the milk and to store it at low temperatures from the time it enters the bulk tank until it is ultimately consumed.

**(iv) Infected Cows**

It is rare that milk produced by infected cows will contain a enough bacteria to affect the total bacterial count of herd milk. It does happen, however, and the possibility of infected cows being the cause of a high bacterial count should not be overlooked. This subject will be discussed in detail in the following section.

## Troubleshooting High Bacterial-Count Problems.

The first step toward resolving a bacterial count problem in herd milk is to culture a bulk sample in a laboratory. This procedure enables the determination of the origin of most microorganisms and to make appropriate recommendations.

Several examples of high bacterial count problems, that can be identified by analyzing a sample of herd milk, are discussed below.

If the bacterial count is more than 10,000, and if most of the colonies are of streptococcal organisms (more than 75%), the source is probably infected udders. In the case of *Streptococcus agalactia*, a single infected quarter was shedding such large numbers of organisms that the bacterial count in herd milk increased from less than 10,000 to more than 100,000. Because this type of bacteria is contagious, it is likely to have high SCC. However, it depends on the number of infected cows.

If the streptococcal count is less than 25% of the total, the cause is likely to be due to improperly cleaned milking equipment, poor udder preparation (wet milking), poor cooling of milk, etc. rather than infected cows.

Samples with large numbers of streptococcal bacteria, plus large numbers of staphylococci (5,000 to 15,000), coliforms, micrococci, spore formers and other organisms, often indicate a dual problem of infected cows and poor udder preparation (wet milking).

A sample with more than 15,000 staphylococci often indicates poor cooling of milk. Staphylococcal counts greater than 15,000 in herd milk are rarely, if ever, caused by infected udders alone. If there are large numbers of coliforms, and nonagalactiae streptococci in addition to staphylococci, this indicates faulty milk cooling.

Coliform counts of over 100,000 often indicate dirty vacuum pipes and tubes (like in the case of broken teat cup liners), improper cleaning of the milking system (as a consequence of low water temperature or incorrect use of chemicals) which might result from the presence of milkstone.

A typical bulk milk sample with a bacteria count of less than 10,000 will usually contain a few colonies each of Streptococcus agalactiae, Staphylococcus aureus, Micrococcus spp., coliforms, corynebacteria, and other miscellaneous organisms. Each group of microorganisms adversely affects milk quality.

In working with bacterial count problems that have been difficult to diagnose, it may be desirable to take several milk samples to try and isolate the source of the contaminating microorganisms.

In the case of frequent high bacterial counts, it is recommended to take samples for bacteria counts from several locations during milk flow and several times during milking from the bulk tank.
Sometimes the source of contamination is the water supply. Therefore, it is also recommended to take water samples from several locations (i.e. entrance to CIP system, entrance to bulk tank, etc.).

***You can avoid a high bacterial count by:***

- Cleaning the milking system as soon as milking ceases and the bulk tank has been emptied.
- Check that the water is hot during the entire process.
- Use appropriate cleaners and concentrations;
- Confirm the proper functioning of air injector;
- Avoid circulation time with alkaline more than 10 min., ensure that solution temperature is not below 43° C;
- Don't mix alkaline with acid materials;
- Sanitize your system prior to milking or wash with plain water if last step of CIP is with acid;
- Attach milking clusters to dry and clean teats;
- Replace rubber parts as recommended. Don't over use;
- Check the functioning of the cooling system frequently;
- Don't leave milk in bulk tank more than 48 hours. It is recommended to empty it every 24 hours;
- Pump milk from milk outlet and not by inserting external pipe;
- Keep the cow surroundings clean;
- Apply hygienic milking routine;
- Milk cows in the following order: cows after calving, heifers, adults, infected or high SCC cows;

**The Milking Routine**

As aforementioned, the milking routine may cause not only a high SCC but also a high bacterial count. Follow the recommendations mentioned above.

**Cow environment**

Dirty legs and udders are one of the main sources of bacteria in milk (see the examples above). Therefore, any milking management regimen should include clean and dry bedding for the cows all year round. Bad conditions will develop if more cows than originally planned are crowded into the cowshed, bad drainage of cowshed, or poor maintenance.

**Aesthetics**

Taste and appearance of milk are the two most important aspects of milk quality from the consumer's point of view. Most consumers judge the products which they see on their table by its texture, appearance, odor and flavor. Thus, it is important that every effort be made to insure that milk, and dairy products manufactured from milk, are aesthetically pleasing to consumers. The aesthetics of milk are subjectively tested far away from it's extraction (i.e. the milking parlor) but they are initially affected by milking conditions.

Under ideal conditions milk should not have an exceptional flavor or odor. On the contrary, it should stimulate a pleasant feeling during drinking. Unfortunately, milk can absorb odors from the air, transferred by food consumed by the cows, or absorbed through breathing. Bacteria, existing in milking installations and bulk tanks can also cause other exceptional odors as mentioned below.

**Rancid Flavors**

Rancid milk has an objectionable taste that is often characterized as sharp, astringent, bitter, and/or soapy. In extreme cases, the milk may also have an objectionable odor.

Problems with rancidity develop when fat globules are broken down and subjected to the enzyme, lipase, which attacks free fatty acids. It is frequently caused by the incorporation of excessive air into the milk, which may result in foaming. The causes of excessive air may be leaks around gaskets, loose connections, or improper agitation of the milk. Other causes include freezing and thawing of milk, and the feeding of low quality rations.

**Feed Flavors**

An objectionable flavor will result if cows are fed feed containing strong flavors such as, wild onion or other weeds. Silage sometimes develops strong odors that are transferred to the milk. Such feeds should not be fed. It is also important to remove old silage from feed bunks.

**Environmental Flavors**

Numerous strong flavors may be transferred to milk via the lungs and bloodstream of the livestock, if the cows breathe odors prior to milking. These may be caused by improper ventilation, especially in barns that are not adequately cleaned. Other reasons include dirty or unclipped udders, or the use of a common rag or sponge for washing udders.

**Malty Flavor**

This flavor results from unsanitary equipment and poor cooling of milk.

**Chemical Flavors**

These off flavors generally result from incomplete draining of cleaning and sanitizing solutions from equipment prior to milking.

**Colostrum**

While colostrum may not impart an off flavor to milk, it is technically and legally considered to be abnormal milk and should be withheld from the market for aesthetic reasons. Such secretion is yellowish in color and is sometimes bloody. Milk should not be marketed until at least the fourth day after calving.

**Unintentional Adulteration of Milk By Water**

The quantity of water added to milk is determined by the freezing point. Extra water will impart a watery taste to milk, decreasing the SNF content. Added water will also negatively affect cheese production and might add bacteria to the milk. Water can find its way into milk due to:

Improper drainage of clusters when backflushing between cows, from receivers and milk lines before milking, from bulk tank after cleaning, and from plate cooling; Pushing milk *residues* to bulk tank by water.

**By Drugs**

The most dangerous adulterants are of drug residues. Drugs can enter the milk from several routes, but the most common route is through antibiotic administration for mastitis through the teat canal.

Every antibiotic has it's own withdrawal time. A producer should follow the instructions of the manufacturers. However, there is a considerable variability between cows concerning withdrawal time. Therefore, it is recommended to send a milk sample for residual residues prior to delivering the milk to the bulk tank. Sometimes there are producers that use a higher dosage than recommended. In such cases, withdrawal time must be determined individually.

Drugs that are used for other purposes and are administered by injection to the muscles or into the bloodstream, given orally or directly to the estrus might also find their way into the milk. Therefore, attention should also be paid to the withdrawal time of these products.

Cows that were treated with antibiotics at the beginning of the dry period, are susceptible to drug residues in their milk after calving. Care must also be imparted to this group of cows.

Residues of drugs in milk must be eliminated, since even small concentrations of certain drugs might be hazardous to human beings; some people can develop anaphylactic shock or even die. In dairies, small quantities of antibiotics inhibit bacteria cultures. This is the main reason why dairies use very sensitive tests that can detect very small concentrations of drug residues.

There are also other adultrants in milk, which originate from other sources, such as: teat dips, contaminated food, cleaners and sanitizers, etc. Since pre-dipping has become widely used, consequently there is a higher risk of contamination. Strict wiping must follow pre-dipping to eliminate the entrance of disinfectants, iodine in particular, to the milk.

**Avoid Adulterants:**

1. Don't feed cows with feed having strong flavors.
2. Take away old food before feeding fresh feed.
3. Avoid contact between cows and containers which might contain paints and other chemicals.
4. Don't use paints which might contain lead.
5. Ensure that milking installations and bulk tank are free of deposits.
6. Drain milking installation and bulk tank after cleaning.
7. Don't deliver colostrum to bulk tank until four days after calving.
8. Eliminate excessive air from entering the milking system.
9. Avoid unnecessary agitation of the agitator.

**Summary**

High milk quality should be the aim of every producer. It assures him more money for the same quantity of milk. On the other hand, bad milk quality will affect him in different ways: High SCC, meaning the presence of a high rate of infected cows with mastitis, which means less additional income due to lower milk production than expected.

Opposite him stands the consumer, observing the taste of fresh milk and its by-products (such as: cheese, yogurt, ice cream), their appearance and color, and examines the shelf life. An unsatisfactory response from the consumers will reduce the over all consumption of milk and other dairy products. If taken collectively, it is the target of the producer to produce and supply high quality milk.