The Veterinarian's Role in the Production of Quality Milk

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Modern milk sanitation regulations and milk quality evaluations in the dairy laboratory had their origin nearly one hundred years ago. Regulatory concepts and procedures have changed very little since the turn of the century. The role of milk in the spread of human disease has been suggested around 1860. Detection of milk pathogens awaited the later studies of Pasteur, Koch, and others.

Milk-borne disease had become a national disgrace by 1900. Mothers and their new-borne infants were frequent victims. Rapid spoilage of foods and epidemics that decimated whole neighborhoods were accepted facts of life.

A New Jersey pediatrician, Dr. Henry L. Coit is credited with formulating the first plan to obtain "safe, clean, pure nutritious milk" for infants and new mothers. He recognized that spread of disease resulting from consumption of raw milk could be controlled if dairymen would adopt proper herd health practices and maintain suitable sanitary practices for milking personnel and equipment.

A dairyman willing to produce milk according to Dr. Coit's specifications was approved by a newly formed Medical Milk Commission to produce this "Certified Milk." Conceived in 1893, Certified Milk was a recognized leader in milk quality and safety throughout the first half of the twentieth century. The demand for Certified Milk dropped off sharply after World War II as less expensive pasteurized milk became more firmly established.

Coit and his Medical Milk Commission established the important relationship between human health and cleanliness in milk production. Doctors inspected cows and handlers routinely to assure they were free from disease. For the first time, physical conditions at the farmland, milking area, water supply—were examined. Milking and milk handling practices from the cow to the ultimate milk consumer came under their scrutiny. Coit showed that dairymen meeting his sanitary standards could produce milk with only a few thousand bacteria. For others, counts in the millions were common.

Regulatory supervision to assure the purity and safety of the American milk supply has been mandated since the turn of the century. Standards related closely to concept put forth by Coit and The Medical Milk Commissions. Research confirmed the close relationship between total bacteria count of a farm milk supply and its sanitary care during and after milking.

In the following years, low bacteria counts became the primary goal of quality control efforts in the dairy industry. Mechanical cooling of farm milk supplies was introduced in the 1930's as an additional safeguard. Cities of any size adopted compulsory pasteurization of market milk supplies. Milk-borne epidemics dropped dramatically as Americans insisted their milk be pasteurized.

The dairy industry introduced quality control programs and worked with local, state, and federal regulatory agencies to control milk-borne disease and insure the purity of the American milk supply. But as World War II ended, milk collection and marketing areas expanded across state boundaries. The 40-quart can gave way to bulk milk cooling and handling. Dairymen became responsible to a multiplicity of inspection agencies, often with conflicting requirements. Through the National Conference of Interstate Milk Shipments (NCIMS), a cooperative program of uniform sanitary standards for the dairy industry was developed by the state regulatory agencies and the USPHS/FDA. These agreements are updated at a joint NCIMS meeting every two years and form the basic sanitary code for fluid milk in the United States today.

Rarely does anyone question the **safety** of commercial milk supplies today. But few consumers visit dairy farms or understand the relation between milking facilities and bacteria counts. The typical consumer judges milk on its taste and keeping quality, depending on some regulatory authority to insure its safety.

Regulatory standards to protect the consumer differ little in concept from those introduced at the turn of the century. Farm inspections assure milk comes from health cows maintained under strict sanitary conditions. Good sanitary practices must be observed during milking, milk contact surfaces must be clean, and the milk must be cooled promptly to 40°F to limit multiplication of microorganisms.

Regulations were developed to protect public health and prevent fraud or deception in the marketplace. They have little to do with consumer concepts of quality. Quality control measures are the responsibility of the dairy cooperatives and the milk processing plants which process and market the fluid milk supply. They vary widely from processor to processor.

Many regulatory groups and advisory bodies remain to control the many facets of the modern industry. Inspections and testing continue with a frequency that is extremely expensive to the dairy industry and regulatory authority

alike. However, nationwide acceptance of the NCIMS Program and the FDA/USPHS Recommended Grade A Pasteurized Milk Ordinance (PMO) has meant we could develop uniform standards for regulating our milk supply.

Qualified inspectors look at milk production facilities to assure they are adequate and clean. Major attention is given to herd health, leucocyte and bacteria counts. Construction and cleanliness of the barn, milkhouse, and milking equipment are examined. Clean animals, clean cowyards, clean personnel and absence of flies or rodents are essential. Adequate wash and toilet facilities for workers and utensils and a potable water source for the milkhouse must be provided. Milk must be protected from contamination by water, medicines, and other foreign materials after collection and it must be cooled promptly to safe temperatures. Bulk milk collection practices are inspected according to established standards of dairy sanitation also.

Adulterations, preservatives, and other deleterious substances in milk are prohibited by the Food, Drug, and Cosmetic Act. Under the PMO, farm milk supplies must meet the following legal standards:

1. It must be cooled to 45°F within two hours after milking and blend temperatures must not exceed 50° after the first milking.
2. There must be no more than 100,000 total bacteria (SPC) per ml.
3. Antibiotics residue tests should not show 16 mm clear zone by B. stearothermophilus disc assay method using ½ inch discs.
4. Somatic cell counts on individual producer samples must not exceed 1,500,000/ml.

The quality control laboratory runs these tests routinely, at least four times in any consecutive six month period. Most milk companies make these and other quality evaluations much more frequently. Other quality tests on incoming raw milk to assure the pasteurized products will meet consumer expectations would include some or all of the following:

1. Laboratory-pasteurized counts ("Heat Resistant" or "Thermoduric" Counts)
2. Presumptive Coliform Counts
3. Psychrotrophic Counts
4. Preliminary Incubated (PI) Counts
5. Freezing Point
6. Sediment
7. Odor and Flavor
8. Direct Microscopic Count

Temperature control is very important to prevent multiplication of bacteria, also to prevent freezing or churning of the milk in the bulk tank. Either would ruin the milk emulsion, lower the fat test, and cause the milk to develop a rancid flavor. Rapid milking which exceeds the cooling capacity of the tank, insufficient coolant, and faulty thermostats are frequent causes of cooling problems. Some of these tanks have been installed for 25-30 years now. They may need repair. Many were not designed to handle modern milking rates. Improper cooling remains one of our major quality problems today.

Laboratories test incoming milk to assure compliance with Federal regulations prohibiting antibiotic residues in milk. Minute amounts of antibiotics interfere with normal acid development in cheesemaking to cause severe economic loss also. Dairymen still do not understand the additive effects of multiple dosages when treating mastitis or other cattle disorders. Veterinarians must do their part to instruct dairymen about disposal of milk from cows they treat.

The Somatic Cell Count (leucocyte count, DMSCC) is the standard laboratory test to measure inflammation of the udder. The maximum permissable DMSCC has been 1,500,000/ml for years. If higher, the milk was considered abnormal.

Until recently, leucocyte levels of half million were considered normal. Now it has been shown that they need not exceed 200,000/ml when the dairymen follow a good udder health program. Lower milk yields are recorded as DMSCC increase. Cheese yields decrease also. The 1983 NCIMS delegates voted to lower the maximum permissible DMSCC standard to 1,000,000/ml by July 1, 1986. We anticipate a lot of cows will be treated and residues could be a problem if all sectors do not work together to keep treated cows out of the milking string.

The total bacteria count, or Standard Plate Count, has been the major legal test for dairy sanitation since its introduction in the early days of milk regulation. Contamination from improperly cleaned milking equipment, transport lines, or bulk tanks are common causes of high bacterial counts. Higher counts are expected when dust, bedding, or untreated farm water contaminate the milk. Inadequate cooling causes tremendous increases in microbial numbers. Unfortunately, milk psychrotrophs, the predominant microbial contaminant in the modern milk supply, are missed frequently in this laboratory procedure. While legal standards permit up to 100,000/ml., counts under 10,000/ml are common and should never exceed 25,000/ml.

Laboratory-pasteurized counts are made by holding raw milk samples at 145°F for 30 minutes, cooling the samples, and then running a SPC on the heat treated sample. Counts should be under 1000/ml and can be down to 100-200/ml if good production practices are followed.

A high laboratory-pasteurized, or thermoduric, count indicates some environmental stress has destroyed sensitive microorganisms but the more resistant ones remain. Inadequate sanitation of milking machines, inflations, and lines are common causes of high thermoduric counts. Milkstone residues are a problem. Dusty conditions during milking and dirty filter pads suggest the likelihood of high laboratory pasteurized counts.

Presumptive coliform counts should be very low and many believe such counts have little meaning regardless of numbers. Such counts are made to indicate milk contamination from unclean udders or bedding materials. Some soil and water organisms form colonies on the presumptive medium. For this reason, many sanitarians

believe a fecal coliform count would be more useful.

A psychrotrophyic count is made to determine the number of bacteria present that can multiply at milk storage temperatures. These organisms, as noted above, seldom form colonies at 32°C/48 hours, the incubation procedures used for the Standard Plate Count procedures. Thus, they escape detection.

The psychrotrophs multiply rapidly once reproduction starts, many producing undesirable flavor changes in the milk as they break down milk fats and proteins. Some produce slimes and/or "ropy" defects from long-chains or capsule formations. Their rapid multiplication rate causes rapid spoilage in contaminated milk.

The psychrotrophs were believed to be quite sensitive to heat until recent years. If so, they would be destroyed by pasteurization. It is believed quite generally that psychrotrophs from raw milk are not a problem in bottled milk. More recent evidence demonstrates that some psychrotrophs form spores, thus survive pasteurization. Some psychrotrophs produce fat-splitting or protein-splitting enzymes that survive heat treatment even if the vegetative cell is destroyed.

Psychrotrophic counts over 100/ml suggest inadequate cleaning and/or sanitizing of milk contact surfaces. Contamination with untreated farm water supplies may cause high psychrotrophic counts in the milk, even if the water came from a potable source.

The late Dr. C. K. Johns modified the total count many years ago as a better method of estimating microbial populations in bulk cooled milk. This test, called the Preliminary Incubated or PI method, permits colony formation by milk psychrotrophs. Psychrotrophic plate counts have never been popular because the laboratory must incubate plates for 7-10 days for colonies to form.

In the PI test, the sample is held at 55°F for 18 hours, then the Standard Plate Count is made on the incubated sample. The PI procedure give a much better estimate of sanitary care during milking and is a better indicator of potential milk shelf life than any of the other methods. Soft milk residues on any milk contact surface can cause elevated PI counts. Inadequate udder washing and drying cause trouble also. PI counts will differ little from the SPC when good sanitation practices are observed.

Usually we do not check raw milk for thermophilic ("heat loving") bacteria. These are a milk plant problem. There are few conditions on the farm that provide the higher temperatures (120°-135°F) needed by the thermophiles. Occasionally a culture of thermophiles will start in a water heater if the temperature is in the problem range and there is organic matter in the water supply. We may hear more about thermophiles in raw milk if recent efforts to "blanch" raw milk to control psychrotrophs become more popular.

The Freezing Point of milk should be about -0.540°C. Water adulteration can be expected when it is above -0.525°C. Improperly drained milk transport lines or careless use of water around the bulk tank are common causes of elevated freezing points. The dairyman may lose his milk market if water adulteration is repeated.

A sediment test is required in some markets and in earlier years was a common quality check for a farm supply. The test measures the amount of visible particulate matter in the milk. Sand, sawdust, straw, hairs, etc. are foreign to milk. entry to milk may occur through carelessness, improper udder and teat preparation, or faulty milking practices. A poor sediment test indicates bacterial contamination is a problem also. This type of contamination commonly results in higher thermoduric and psychrotrophic populations. Garget or evidence of other visible particles on the milk filters have similar inplication. Either dirty filters or sediment tests lower the quality of the raw milk and the products made from it.

The Direct Microscopic Count (DMC) is used to determine the number of leucocytes (DMSCC) in milk. It is a good laboratory test to get an idea of the type of microbial contamination causing a problem. Poor cooling, dirty utensils, or mastitis show rather distinctive cell formations when viewed with the oil-immersion lens. The DMC is of little value in low count milk so it is used infrequently to estimate microbial counts as such. Often a milk plant technician will use the microscope and DMC to verify that milk has a low count before it is unloaded from the transport vehicle.

Few consumers understand these laboratory criteria of milk quality nor do they know which dairies produce their milk. They assume *someone* is protecting the public from unsafe or unwholesome milk supplies but they have little ideaa who that someone might be. The flavor and odor test is the only real quality determination that can be made in the home.

Off-flavor may get in milk by faulty milk production practices. Products of microbial activity may ruin milk flavor. Any action that causes milk to churn or freeze lowers milk quality.

Poor flavored milk is usually detected by smelling the air on top of the milk in the bulk tank. Some non-volatile flavors such as rancid, oxidized, and some microbial flavors must be tasted to be detected. Young children usually are more sensitive to milk off-flavor than adults are.

Many odors in the cows' environment will go through the respiratory system and the blood stream to the milk. Thus poor ventilation, dirty stables or manger residues will cause consumer complaints. Poor sanitary care of milking equipment and unwashed udders and teats give trouble. Inadequate cooling may cause milk to taste malty or sour.

Milk quality standards are intended to assure the consumer of a safe wholesome product. While we hear a lot about controlling tuberculosis and brucellosis in dairy herds, an inspector can direct the disposal of any cow or cows found by a qualified veterinarian to suffer from any disease the agency deems a danger to human health. Some pathogens associated with mastitis (Group A Streptococci, staphylococci, etc.) have caused human disease when

cooling problems occurred.

Today, few question the safety of the American milk supply in usual market channels. We must maintain high quality standards if we are to compete with the alternative beverages available to the consuming public today. All elements of the industry must work together if we hope to help our dairy farmers produce a product the consumers desire over competitive offerings.

Our veterinarian friends have done a good job in controlling diseases in our dairy herds. You can be a tremendous influence in promoting milk quality if you insist your dairymen develop a strong appreciation for dairy sanitation throughout the dairy operation, prompt and adequate cooling of the milk, and freedom from contamination by sediments and chemical agents used in the dairy industry.

Just as you promote a clean environment for calving stalls and proper care of medicines, syringes, and needles used in treating animals, as you promote proper milking practices to minimize the incidence of mastitis and other diseases, so we must all subscribe to the motto of the National Sanitation Foundation which says "Sanitation is a Way of Life." Sanitary care is not a part-time idea. We must make it our goal in all our efforts to be sure our dairymen have healthy animals and produce a pure wholesome milk supply for our people.