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Dairy Foods Science Notes

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Milk Quality Improvement Program – Voluntary Shelf-Life Program

The Milk Quality Improvement Program (MQIP) is an extension-based program funded by the New York State Dairy Promotion Order, dairy farmers dedicated to the production, manufacture and distribution of quality dairy products. As dairy farmers strive to produce high quality raw milk, they feel it is equally important that the pasteurized milk and other dairy products made from their milk retain this high quality from farm, through processing, and ultimately to the consumer. A primary focus of the MQIP is the Voluntary Shelf-Life (VSL) Program, which is designed to monitor the quality and shelf-life of fluid milk products through microbiological, chemical and sensory analyses. Dairy processors are provided with feedback on the quality of their products and, when requested, assistance in improving and maintaining quality. A summary of the program, including a description of the analyses used, the regulatory standards and the quality goals follows.

Sample Collection, Storage Temperature and Testing Schedule:

Samples are collected at each dairy plant involved in the program two times a year. These generally represent the freshest products available and include the major types of milk (e.g., whole, 2%, 1% and skim). A minimum of one half-gallon is collected for each of the representative “core” samples that are tested for bacteria and flavor throughout shelf-life. Four half-pints each of representative “school-milks” are also collected. Samples representing other product lines/fillers may be collected on request. Milks are transported back to the MQIP laboratory at less than 40°F, with initial testing occurring within 48 hours of collection. Samples are tested for Initial Day results and subsequently **stored at 43°F** for testing over shelf-life at 7, 10, and 14 days from packaging. In some cases, where extended shelf-life analyses are warranted, 17 day testing is included. A raw milk sample may also be tested on initial day for microbiological and chemical quality.

Standard Plate Count (SPC) - Initial Day:

Standard $\leq 20,000$ /ml; Goal $< 1,000$ /ml.

The Standard Plate Count (SPC) procedure is used to determine the number of bacteria in a sample. In most cases the initial day SPC represents those bacteria that survive pasteurization (*thermoduric bacteria*), although gross contamination after pasteurization can cause high counts. The regulatory standard of $\leq 20,000$ /ml is generally easily achieved. Most initial day bacteria counts are < 500 /ml, while counts higher than 1000/ml suggest a potential contamination problem, either in the raw supply or within the processing equipment.

Standard Plate Count (SPC) - Shelf-Life:

Standard $\leq 20,000$ /ml; Goal $\leq 20,000$ /ml.

The ideal milk shows little or no increase in bacteria counts when held under refrigeration; most bacteria that survive pasteurization do not grow at low temperatures. For refrigerated milks that do show an increase, the bacteria that multiply are only those capable of growth under these conditions. While most bacteria prefer warmer temperatures, some bacteria, referred to as *psychrotrophs* (“cold-loving”) or *psychro-tolerant*, are capable of growth at 45°F or less. The types of psychrotrophic bacteria most often responsible for rapid milk spoilage and shelf-life failures do not survive pasteurization; thus their presence in milk results from **post-pasteurization contamination (PPC)** due to less than adequate sanitation practices. Although most bacteria that survive pasteurization are not psychrotrophic, a few strains (e.g., thermophilic psychrotrophic spore-formers) will grow slowly and can eventually spoil milk. These organisms can become the limiting factor for shelf-life when PPC is prevented or minimized. The initial day SPC of fresh pasteurized milk is not a good indicator of the numbers of psychrotrophs present. A significant increase in the SPC after 7 days of cold storage is evidence of psychrotrophic growth and suggests that PPC has occurred and that shelf-life will be shortened. Generally, when the SPC exceeds 10 million, milk will become unacceptable due to microbial spoilage. ***Preventing rapid spoilage and extending the shelf-life of a product requires that post-pasteurization contamination be prevented through a well-designed quality assurance program. It only takes one psychrotroph per container of milk to eventually cause spoilage.***

Coliform Bacteria Count - Initial & Shelf-Life:**Standard $\leq 10/\text{ml}$; Goal - no coliforms, ever**

The coliform bacteria (“coli”) count is used as an index of sanitation during the handling and processing of milk products. Coliforms are killed by pasteurization, thus when present in milk, they are regarded as **post-pasteurization contaminants** resulting from poor sanitation. While coliforms are “indicators” of PPC, the absence of these organisms does not guarantee that PPC has been prevented. Although the standard is “not to exceed 10/ml,” detection of any coliform bacteria, at any time, suggests that there is some point in processing that has been neglected in regard to effective cleaning and sanitation procedures. As a rule, the detection of coliforms in milk will indicate the potential for a shortened shelf-life due to concurrent contamination with psychrotrophic bacteria. Milks with coliform counts exceeding the legal limit of 10/ml are not tasted on subsequent test days in this program.

Coliform Stress Test - Initial:**Standard – none; Goal - no coliforms, ever**

Low levels of coliforms in milk (fresh counts $<1/\text{ml}$) may not be detected due to the limited sensitivity of the standard coliform plating procedure. The coliform stress test used in this program involves pre-incubating milk samples for 6 hrs at 37°C (98.6°F) before plating for coliform bacteria. This allows low levels of coliform bacteria to grow to numbers where they become detectable with the standard coliform test (e.g., from $<1/\text{ml}$ to $>1/\text{ml}$). This method often picks up coliform contamination that would not normally be detected in a fresh sample. A positive coliform stress test ($\geq 1/\text{ml}$) indicates post-pasteurization contamination and the potential for reduced shelf-life.

Sensory Analysis – Over Shelf-Life:**Standard & Goal – “acceptable” all test days**

Milks are judged by a trained panel according to the guidelines of the *American Dairy Science Association*. Flavor scores are on a 10 point scale with ≥ 9.0 = excellent; < 9.0 to 8.0 = good; < 8.0 to 7.0 = fair; < 7.0 to 6.0 poor; and < 6.0 = unacceptable, a probable consumer complaint. Fresh pasteurized milk should score ≥ 9.0 . Common flavor defects in milk may be classified as:

Absorbed -- feedy, barny, cowy, unclean, lacks freshness, stale, refrigerator/cooler odors.

Bacterial -- acid, bitter, malty, lacks freshness, unclean, fruity/fermented, putrid, rancid.

Chemical -- rancid, oxidized, light-induced, foreign, astringent, medicinal, flat, salty.

For more information, see the Dairy Foods Science Note titled *Sensory Evaluation of Milk and Dairy Products*.

Freezing Point ($^{\circ}\text{H}$ - Degrees Hortvet) Initial:**Standard: \leq minus 0.530°H , Goal \leq minus 0.540°H**

To screen for added water, a cryoscope is used to determine milk freezing point (FP). Pure water freezes at 32°F . Milk, due to dissolved solutes, freezes at a temperature slightly below that of water, about 31°F . When water is added to milk (e.g., from poor drainage), the milk FP will become closer to that of water. Most milk cryoscopes are calibrated in degrees Hortvet ($^{\circ}\text{H}$), a modification of degrees Celsius ($^{\circ}\text{C}$). The FP of milk has a relatively constant, narrow freezing range of about minus 0.530°H to minus 0.566°H ; the FP of most milk is less than minus 0.540°H . The cryoscope can detect as little as 1.0% added water, which would raise the freezing point about 0.0055°H (e.g., milk FP at -0.540°H increases to about -0.535°H when 1% water is added).

Butterfat: Butterfat % is determined by the Gerber method.

**Standards: Milk (whole) ≥ 3.25 % Fat
2% (1.8 - 2.2%); 1% (0.8 - 1.2%)
Skim Milk < 0.2 %****Molecular Microbiology:**

In addition to routine shelf-life testing, on approved request, MQIP offers molecular microbiology services to target, identify and resolve quality issues related to specific microorganisms (e.g., *Paenibacillus*, *Bacillus*, Gram-negative rods) that limit or degrade the shelf life of dairy products. Such testing may be coupled with specific sampling plans and testing parameters designed to investigate and resolve the related quality concern.

FOR MORE INFORMATION:

For a more complete description of the goals, procedures and interpretations of the MQIP Voluntary Shelf-Life Program or for information or assistance relative to dairy product quality & shelf-life, call 607-255-2893 or visit:

<http://foodscience.cornell.edu/cals/foodsci/extension/milk-quality-improvement-program.cfm>