



## THE DAIRY PRACTICES COUNCIL PERSPECTIVES E-NEWSLETTER

2021 Fall Edition



Featured Topic: Proper Cooling of Milk-Critical from Cow to Cup!

The Dairy Practices Council is a nonprofit 501(c)3 dedicated to developing and disseminating uniform educational guidelines for proper and improved procedures in the production and processing of milk and milk products under a cooperative effort of industry, educational, and regulatory members. Interested in joining this network of food safety professionals and subject matter experts? Visit [www.dairyipc.org](http://www.dairyipc.org) for additional information.

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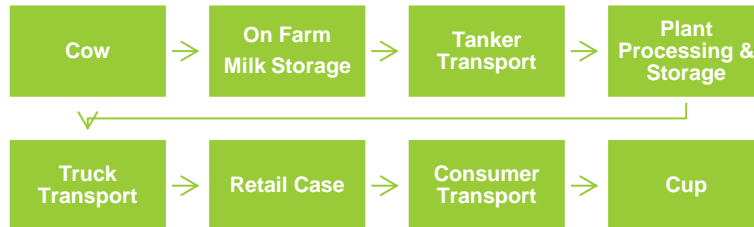
Regulatory Perspective

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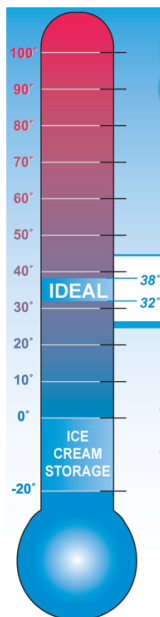
Proper cooling of milk from the cow to the consumer is a critical parameter in maintaining optimum product quality. Dairy farmers, milk haulers, dairy processors, product distributors and retail outlets must also meet regulatory requirements for the handling and processing of fluid milk under the Pasteurized Milk Ordinance (PMO). Milk quality is critical for all dairy products; however, this newsletter focuses only on the importance of maintaining proper temperatures for all steps in the fluid milk process.



Per the PMO, raw milk must be cooled and stored on the farm at 45°F (7°C) or less. The raw milk hauler must measure and record the milk temperature prior to pumping milk from the farm bulk tank for transport, and raw milk must be received at the processing facility and stored at ≤45°F (7°C). Milk buyers may require even colder temperatures upon receipt to enhance product quality.

Keeping raw milk cold, and minimizing the time between harvest and processing, limits the growth of many spoilage microorganisms that are present. Growth of these organisms can result in defects and off flavors that cannot be eliminated by subsequent processing.

Pasteurization of milk is designed to eliminate pathogenic bacteria, thus ensuring the safety of the product. This thermal processing does not eliminate all spoilage bacteria, nor does it denature



**Storing Milk at 32-38°F (0-3°C) is best for protecting the shelf-life of your product.**

all enzymes produced by those spoilage bacteria that might result in off flavors or other defects. Immediately after pasteurization, fluid milk must be cooled back down to ≤45°F (7°C) per the PMO, and preferably to 32-38°F (0-3°C). The colder the temperature (above freezing!) during bulk pasteurized storage, container filling, packaged product storage, distribution, and retail sale, the better the finished product quality at the time of purchase by the consumer.

The final challenge is to convince consumers to purchase milk last during their grocery store visits and to promptly transport and refrigerate the product at home, again at 32-38°F (0-3°C). Milk should be served directly from and promptly returned to the refrigerator to maintain shelf-life.

The entire supply chain, from cow to cup, must be dedicated to keeping milk cold to maintain optimum product quality! Please enjoy the rest of this newsletter that provides additional details on the journey that milk takes and all the considerations for producing safe, nutritious, and high quality fluid milk. *Contributor: Rebecca Piston, Director of Food Safety, HP Hood LLC*

## On-Farm/Educational Perspectives

*Neil Bendixen, Manager Milk Hauling Relations, Dairy Farmers of America and Dr. Joseph Zulovich, University of Missouri*

Basic standards of sanitation are required for interstate milk shipments and are governed by the PMO. At a minimum the federal standards are followed, but individual states may choose to require more stringent standards. Dairy farms are of many different sizes, which require customized equipment to ensure the proper cooling of milk. All equipment must conform to 3-A Standards and Practices. Refer to **DPC Guideline #108** for more detailed information on these systems and how to avoid common mistakes in the sizing and operation of milk storage tanks and milk pre-coolers.

As milk leaves the cow at 98°F (37°C), it must be cooled quickly to stop the growth of bacteria and preserve the quality of the milk for consumption. Bulk tanks are used to cool the milk to 35-38°F (2-3°C) during storage. They are designed with a fixed amount of cooling and are optimized for 48-hour storage. If the volume of milk produced exceeds the size and cooling capabilities of the bulk tank, additional milk pre-cooling is required. Many times, in-line tube or plate coolers will use cold well water to partially cool the milk to 65°F (18°C) so the bulk tank can cool it the rest of the way. This type of pre-cooling reduces the refrigeration load and conserves electricity. A second use of the coolant water should be determined ahead of time. Often this coolant water will be used for watering the dairy cows.



Given the increasing size of some dairy farm operations, silo tanks and direct-load tankers may be used to collect and store milk. These type of storage units act as a thermos bottle to store the milk. They do not have agitation or cooling capability. The use of a propylene glycol chiller is required to cool the milk immediately to 35-38°F (2-3°C) to preserve milk quality. Important to note is complete cooling of milk to at least 38°F (3°C) with in-line coolers, requires a coolant temperature close to 32°F (0°C) from a process chiller. The final milk temperature depends upon the flow of milk, its initial temperature, coolant temperature, coolant flow, contact area, and properties of the heat exchanger.

Although the PMO requires the milk be  $\leq 45^{\circ}\text{F}$  (7°C) to be shipped legally from a farm, the actual temperatures need to be lower than 40°F (4.5°C) to ensure the quality of the product is maintained and in case of weather delays, traffic concerns, truck breakdowns, etc. which might inadvertently delay the shipment from arriving quickly to the plant for application of additional cooling. For example, when ambient conditions outside are hot, tankers may absorb heat from the air resulting in milk warming more as compared to cooler weather. So extra cooling of on-farm milk may be required prior to shipment of the milk from the farm to the processor. Additionally, friction generated during milk transfer may raise temperatures a degree or two and will need to be considered as part of the milk temperature rise when shipping milk from the farm to the processor.

Prior to shipment milk haulers are required to sample the milk, take the temperature of the milk on a calibrated thermometer, and keep the sample cold for the chain of custody to the receiving

facility. Milk haulers must be appropriately licensed, permitted, or certified by the local regulatory agency. A useful management tool for both farmer and processor is to chart (record) time and temperature in any milk tank with recording thermometers. This records the cooling operation, the time of rinsing by the hauler, washing operations, and may help indicate if refrigeration problems have occurred. Sensing a high temperature limit for milk can be coupled to automatic light, sound, phone, or other output signal. Bulk tanks manufactured after January 1, 2000 are required to have a recording thermometer.

## Processing/Plant Perspective

*Melinda Davis, Quality Assurance Manager, HP Hood LLC*

According to the PMO, milk and milk samples must be stored within the appropriate temperature range of 32-40°F (0°-4.5°C) and handled in a manner to preserve integrity. Individuals who sample milk, physically handle official milk samples or test milk in the laboratory need to be appropriately licensed, permitted and/or certified to perform these activities by the local regulatory agency.



Samples are routinely transferred from the milk sampler's insulated sample case into sample storage refrigerators. Refrigerators used to store milk samples must be of sufficient size to prevent overcrowding. Ideally, units should be equipped with self-closing doors to ensure better control of cooling. Detailed records are required for all milk sample storage refrigerators. Thermometers on both the top and bottom shelves should be used to monitor each unit. These thermometers must be examined twice daily and documented

with written records. Sanitized, accurate, and unbreakable thermometers should be used to check the temperature of the milk throughout storage and processing. The accuracy of thermometers must be checked monthly against one of known accuracy and at least once every six months against a certified thermometer and a record of the results maintained. Refer to **DPC Guideline #032** for more detailed information.

Milk must be agitated to remain homogeneous. It is common practice to agitate continually with air using minimal pressures and volumes to prevent rancid flavor development. The air should be from an oil-free filtered air supply. Churning as defined as the presence of butter particles, either large pea-shaped or small flake-shaped, can be an indication of excessive agitation at temperatures above 50°F (10°C) and cream products are more susceptible. Storage silos must maintain temperatures at or below 45°F (7°C). The ideal temperature for the bulk tank is 36°F (2°C). Cooling plates and glycol jacketed tanks can help maintain the temperature as milk is transferred into silos. Excessive agitation can also cause excessive foaming, which will in turn cause differences in the component tests of the milk. Temperature and physical abuse of the milk during processing may cause product defects and/or reduction in shelf-life that can be problematic as milk travels through the supply chain to the consumer. Quality of milk matters. Special care and frequent, documented and verified temperature checks are a must throughout receiving, storage, processing, and packaging of milk products.

## Laboratory Testing/Quality Control Perspective

*Steven Murphy, Cornell Food Science Extension, Mostly Retired*

As reflected in prior perspectives, milk and milk products are considered highly perishable, thus proper refrigeration is critical to maintaining quality and safety from the farm to the consumer. See **DPC Guideline #016**. While controlling microbial growth is our primary concern, the effect of natural milk enzymes (e.g., proteases, lipases) on product quality, and in some cases yield (e.g., cheese), must also be considered. Keep in mind that there are a number of microbes that grow (i.e., psychrotrophic, more recently referred to as psychrotolerant) and enzymes that maintain activity under proper refrigeration, although the rates will be much slower than at elevated temperatures. From a quality assurance testing perspective, there are a number of tests that should be considered depending on the product and its shelf-life potential; the microbes or enzymes of concern; and the goals and testing capabilities of the facility. As mentioned in the processing perspective above, proper sample collection and handling are critical.

### Raw Milk

It goes without saying, that you can't make quality products from poor quality ingredients. Poor (i.e., > 45°F (7°C) )and even marginal cooling of raw milk on the farm, during transit, or during plant storage will promote microbial growth and potential enzyme degradation. For example, storage temperatures above 50°F (10°C) often selects for Lactic Acid Bacteria (LAB) that normally do not grow under proper refrigeration, while marginal refrigeration of 40-43°F (4.5-6°C) may select for gram-negative psychrotrophs. Typically, microbial defects do not become apparent until total bacteria counts are high (e.g., > PMO commingled limit of 300,000 cfu) although many processors aim for incoming loads to be less than 50,000 cfu to maintain quality. Regarding natural milk enzymes, increased activity is most often associated with increases in Somatic Cell Counts (SCC) and/or warm temperatures. Examples of recommended testing of raw milk as outlined in **DPC Guideline #021** and **DPC Guideline #024**.

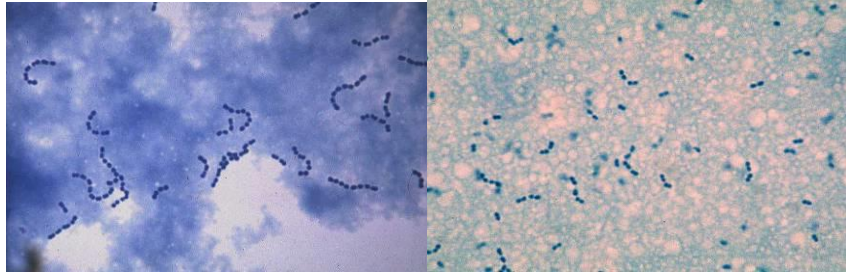
*Temperature:* Determined with accurate thermometers (See Regulatory Perspective), the milk hauler at farm pick-up (farm bulk tank); by the receiver at the milk plant (transport tanker); and by processors at the plant (milk storage tanks). Less than 38°F (2°C) is ideal.

*Smell and Appearance:* Performed by trained milk haulers at farm pick-up and trained receivers at the milk plant. A sour or malty odor is often a sign of high numbers of LAB as the result of poor cooling. Other odor defects may be evident including enzyme induced rancidity. The Acid Degree Value (ADV) test can provide an indication of rancidity, but few labs are set up for this method.

*Direct Microscopic Counts (DMC):* Determined on incoming loads and milk storage tanks before processing. This is a rapid test used to estimate both bacteria numbers and SCC. High numbers of LAB (typically seen as cocci in pairs and chains,(See Image Below) or other bacterial types may reflect poor cooling. Plate count methods can provide historical data.

*Rapid Bacterial / SCC Methods:* Rapid automated bench-top instruments utilizing flow cytometry are available that provide more accurate bacteria and cell count compared to the DMC. These instruments are costly compared to the DMC set-up, but may be worth the investment for larger dairy plants with many loads of milk.





\*Lactic Acid Bacteria (LAB) observed in the DMC procedures commonly associated with poor cooling.

### Processed Products

Proper refrigeration is critical to the shelf-life of most dairy products. For pasteurized dairy foods, post pasteurization contamination (PPC) with psychrotrophic organisms (gram-negative bacteria, yeast, and molds) needs to be prevented. There are a few organisms that can survive pasteurization and grow under refrigeration (i.e., psychrotrophic spore formers) that may cause concern, especially with pasteurized milk products at marginal refrigeration. Poor and even marginal cooling will reduce product shelf-life dramatically. Testing depends on the product. Examples of recommended procedures include:

*Temperature:* Determined on the product at packaging and monitored at all storage steps including plant cooler, transport systems, warehouses, and retail. Less than 38°F (2°C) is ideal from plant to consumer.

*Taste, Smell and Appearance:* Performed by trained personnel on fresh product and periodically and/or up to anticipated shelf-life. Shelf life storage temperatures should reflect those anticipated for the product; often marginal refrigeration temperature is used (i.e., 43-45°F (6-7°C) used for milk shelf-life evaluation).

*Microbial Counts:* Performed by trained personnel on fresh and stored product along with sensory evaluation as able (i.e., plant testing capabilities). Detecting contaminants that reduce shelf life on fresh product is often unlikely due to low levels. Methods used depend on the product.

*Total Bacteria Counts:* Pasteurized milk products - increases over time indicate psychrotrophic growth or perhaps growth under poor refrigeration. Fresh counts typically do not give an indication of shelf-life but may reflect gross contamination or high numbers of thermotolerant bacteria in the raw milk.

*Coliform Bacteria Counts:* Performed on all pasteurized products as indicators of PPC. The absence of coliforms does not confirm that PPC did not occur.

*Gram-negative Bacteria Counts:* Pasteurized milk products; cottage cheese - indicators of PPC and potential for reduced shelf-life. May be useful with stress tests.

*Yeasts & Mold:* Cultured products, cheese – primarily occur as PPC.

Details of methods and interpretation can be found in **DPC Guideline #038** and **DPC Guideline #060**. Your testing program should be tailored to your products and your plant. If you have limited lab capacity, at minimum temperature should be monitored and sensory evaluations should be conducted as outlined above. Keep it cold!

## Regulatory Perspective

*Joe MacPhee, Michigan Department of Agriculture and Rural Development*

Dairy is one of the more highly regulated industries. Considering the vast number of laws, rules, regulations, policies, and procedures, consulting your local dairy inspector is always a best practice. Cooling of milk and milk products is an essential part of the consumer safety portion of the regulatory process. When milk and milk products are not properly cooled within a reasonable time, the bacterial content will be materially increased. Therefore, it is necessary to cool the milk rapidly and keep it cold.

One important regulatory area of concern when it comes to the cooling of milk is the recording and verification of milk temperatures. This means having accurate thermometers and recording devices. It also means proper maintenance of those thermometers and recording devices. Chart recording devices are valuable tools that are becoming a common occurrence at dairy farms. When using these devices, there are a few things operators need to keep in mind. Chart recording devices need to be calibrated, the charts need to be changed at a regular interval, and an inventory of used charts must be maintained. Be sure to check with your dairy inspector on exactly how many months' worth of charts you should be keeping.

Milk sampling, hauling and transportation are key areas where the temperature of milk is important. The milk hauler has the responsibility to ensure the temperature of the milk at pickup time meets the legal temperature requirements. A common issue found by inspectors is that during the milk pick up at the farm the haulers do not have a calibrated thermometer, or if a calibrated thermometer is available, it is not being used. Referring to **DPC Guideline #050** can help address some of these issues, as it outlines the best practices for checking the temperature of the milk.



At the processing plant the temperature of milk and the milk products produced is monitored and recorded at several different steps. Although detailing each requirement for each process can be tedious, the big picture from a regulatory standpoint is that thermometers are calibrated and used where required, recording thermometers are maintained properly, and temperatures are clearly recorded on the appropriate paperwork.

As always, if you have a regulatory question, please contact your dairy inspector directly as regulations may differ by state.

## Industry Perspective

*Amanda Rife, Member Relations East Regional Manager, Land O'Lakes Inc.*

As a perishable product, milk has a limited shelf life. Long shipping distances and/or exposure to extreme ambient temperatures can greatly impact quality. The speed and temperature at which milk gets to the processing facility matters to milk quality. Milk should be kept cool at or below 45°F (7°C). Rancid flavors, identified as sharp, unclean, soapy, or sour-like taste that lingers, is caused by lipolysis of glycerides in milk fat. Lipase enzymes which can cause this breakdown are naturally present in raw milk. However, these enzymes are heat sensitive and inactivated by pasteurization. Legal pasteurization of milk is defined as holding every particle of milk at equal to or greater than the following temperatures for the specified times, 145°F (63°C) for 30 minutes or, 161°F (73°C) for 15 seconds utilizing properly designed and operating equipment. Having adequate and fast cooling after pasteurization helps maintain the quality of milk. Post-pasteurization contamination with certain species of bacteria and/or heat abuse can also result in the development of off-flavors and rancidity, so proper handling, packaging, and temperature control from the farm, throughout storage, processing, packaging, and distribution is important. Refer to **DPC Guideline #038** for additional information.

Keeping milk cold, helps maintain the quality and extends its shelf-life. The need for proper cooling and handling includes the display case at the retail store and during transportation home to your refrigerator. It is important that milk be kept at or below 40°F (4.5°C) and carefully protected from light, particularly sunlight, to avoid the development of light-induced oxidized flavor. This is why milk is generally packaged in opaque and/or colored packages.



Dairy products should be put in your shopping cart last to minimize the exposure time to ambient temperatures. If ambient weather conditions are hot or the time it will take you to arrive home will be extended, use of an ice chest or cooler bag can help maintain cooler temperatures until it arrives safely in your refrigerator. For example, for every 5°F (3°C) rise above 40°F (4.5°C), the shelf-life of milk drops 50 percent. Bottom-line: Controlling what can be controlled throughout the supply chain and moving milk cold and quickly helps ensure the most tasteful and safe product experience for your customers.

## Final Thoughts

*Christopher Hylkema, President of The Dairy Practices Council*

As you've been reading, keeping milk cold from cow to cup is the key to keeping consumers happy and safe. For over 51 years, The Dairy Practices Council, a 501(c)3 nonprofit, has been dedicated to developing and disseminating uniform educational guidelines for proper and improved procedures for the production and processing of milk and milk products.





The Dairy Practices Council is comprised of a broad network of food safety experts with different perspectives (on-farm, processing, lab/QC, regulatory, industry and education). Our **52nd Annual DPC Conference is coming up November 3-5th** at the Doubletree by Hilton in Pittsburgh, PA. This is great opportunity for you to meet with us in-person to learn dairy food safety best practices and expand your network of dairy industry expertise through participation in technical sessions, task force sessions, vendor visits, pre-conference educational tour, and workshops.

Pre-meeting educational workshops on Automated Milking Systems facilitated by DPC experts and on Supply Chain Food Safety Management facilitated with experts from the Innovation Center for U.S. Dairy will be held November 2nd. November 3rd an educational tour of Pleasant Lane Farms will be held in the morning followed by the official opening of the conference at 1:00 p.m. EST on November 3<sup>rd</sup>. This year's Keynote speaker, Matthew Gould, The Dairy Market Analyst will share Global Perspectives on Dairy: Where Does the U.S. Industry Fit-In Post Pandemic? Mark Your Calendars and Join Us! [Click Here To Register](#). Be sure to register before **September 10<sup>th</sup>** to take advantage of **Early Bird Registration Discounts** and [Click Here For Hotel Reservation](#) by **October 8<sup>th</sup>** to take advantage of our **Discounted Hotel Room Rate at the Doubletree**. Contact [evp@dairypc.org](mailto:evp@dairypc.org) or call 419-890-5147 if you have questions about the conference.

Visit [www.dairypc.org](http://www.dairypc.org) for additional information about the organization, membership, or to purchase the Guidelines recommended in this article.

## What Does DPC Membership Mean To You

*Miles Beard, Dairy Specialist, IBA, Inc.*



I work on the production side of the dairy industry supplying monthly consumables from sanitation and testing supplies to animal hygiene and more to dairy producers. I joined The Dairy Practices Council over 30 years ago. As a company, we have participated as a vendor sponsor during the Annual Conference. During the conference, we have a display table in the general session space where we have the opportunity to hear the invited speakers. During breaks and at the networking reception, attendees stop by to visit our table to hear more about product offerings. It is a great way to connect with people and expand our business network.

My favorite part of belonging to DPC is working on the Guidelines in the Task Force sessions. By getting involved in these working sessions and participating in the discussions, I have learned a lot about the Pasteurized Milk Ordinance and other government rules. More specifically, how they apply and translate into everyday practices on-farm, in-transit, during processing, into package and during distribution to keep milk safe. Having practical, peer-reviewed, best practice Guidelines to share with my clients helps me, help them in keeping milk safe. My advice for anyone new in the dairy industry is Drink Your Milk and Get Involved in DPC! You will not only educate yourself, but you will meet and work with lots of great people.

## Upcoming Events



**52<sup>nd</sup> Annual DPC Conference-Doubletree by Hilton**  
**1 Bigelow Square, Pittsburgh, PA , November 2-5, 2021**



**Join Us! [Click Here To Register](#) before September 10<sup>th</sup> to take advantage of Early Bird Registration Discounts and [Click Here For Hotel Reservation](#) by October 8<sup>th</sup> to take advantage of our Discounted Hotel Rate at the Doubletree.**

Contact [evp@dairypc.org](mailto:evp@dairypc.org) or call 419-890-5147 if you have questions about the conference.