

**United States Department of Agriculture
Agricultural Marketing Service
Dairy Programs
Dairy Standardization Branch**

**Report to the
National Association of
State Departments of Agriculture**

**Re-evaluation of the
USDA Recommended Requirement
For the Cooling of Can Milk**

**With Particular Consideration for its Effect on
Non-Electric Dairy Farms**

July 15, 1999

TABLE OF CONTENTS

1.	INTRODUCTION.....	1
2.	BACKGROUND	1
3.	FEDERAL COOLING REQUIREMENTS	3
4.	CONSIDERATIONS AND CONCLUSIONS	
	Consideration 1	4
	The Effect of Cooling and Storage on the Number of Bacteria Present in Milk.	
	Consideration 2	5
	The Effect of Cooling and Storage on the Number of Pathogenic Bacteria Present in Milk.	
	Consideration 3	6
	The Effect that Cooling and Storage has on the Marketability of U.S. Manufactured Dairy Products.	
	Consideration 4	8
	Non-Electric Options to Cool and Store Milk in Cans.	
5.	SUMMARY	10
Appendix I	Non-Electric Can Milk Producer Numbers and Temperature Requirements by State	
Appendix II	Influence of Time and Temperature on the Growth of Selected Pathogens (Predicted Growth)	

INTRODUCTION

During the 1996 annual meeting of the Dairy Division of the National Association of State Departments of Agriculture (NASDA), the Delegates discussed the long-standing manufacturing grade milk cooling requirement of the United States Department of Agriculture (USDA). As a result of this discussion, the Dairy Division of NASDA passed the following resolution:

The Dairy Division of NASDA requests USDA, Dairy Standardization Branch to conduct a study, based on food safety criteria, to determine appropriate cooling temperature requirements for can milk recommended for adoption by state regulatory agencies.

This resolution was later considered by NASDA at its 1996 meeting. At that time, NASDA passed the following resolution that significantly modified the scope of the Dairy Division's request:

NASDA requests the United States Department of Agriculture (USDA) to work in concert with NASDA and the Dairy Division of NASDA and re-evaluate the cooling temperature requirements for can milk recommended for adoption by state regulatory agencies.

The scope of these two resolutions differs in that the Dairy Division of NASDA requested a study, based on food safety criteria, be conducted to determine the appropriate cooling temperature requirements for can milk. The NASDA resolution modified the scope by requesting USDA to work cooperatively with States in re-evaluating the USDA cooling recommendation. It did not request a study, based on food safety criteria, be conducted to determine the appropriate cooling temperature requirement for can milk. The NASDA resolution also did not incorporate the Dairy Division of NASDA desire for USDA to conduct a study to determine the safety of can milk stored at elevated temperatures. However, much information is available concerning the potential food safety impact that pathogens have in raw milk and raw milk products and selected information on this subject is provided in this report.

The NASDA resolution broadened the scope to consider not only food safety issues, but also issues such as milk quality, marketing, and possible alternatives available to non-electric dairy farms.

BACKGROUND

The USDA *Milk for Manufacturing Purposes and Its Production and Processing, Recommended Requirements* (Recommended Requirements) were developed in close cooperation with the Dairy Division of NASDA. The intent of the Recommended Requirements is to promote, through State adoption and enforcement, uniformity in State dairy laws and regulations as well as national uniformity in the sanitary manner in which manufacturing grade milk is produced and processed. The Recommended

Requirements establish minimum provisions for the production of manufacturing grade milk and the processing of manufactured dairy products (butter, cheese, dry milks, etc.) for consideration and adoption by State regulatory agencies.

The USDA does not have authority to enforce these Recommended Requirements. Laws enacted by State legislature form the basis for regulating the production and processing of manufactured dairy products. In many instances, these laws reflect the recommendations of USDA, and the desire of NASDA to promote national uniformity in State dairy legislation. It is the responsibility of the State regulatory agency to enact and enforce their State dairy laws and regulations.

As provided in the Agricultural Marketing Act of 1946, USDA offers assistance to States in an advisory and interpretive capacity in order to promote the purpose and intent of the Recommended Requirements. In addition, USDA periodically reviews State progress in the adoption of these recommendations and assesses the ability of the State regulatory agency to enforce their laws and regulations in a manner that promotes national uniformity.

The current USDA can milk cooling recommendation became effective in 1972 when USDA revised the Recommended Requirements. The Recommended Requirements were subsequently amended in 1985, 1993 and most recently in 1996 without changes to the milk cooling recommendations established in 1972.

In 1972, much of the can milk was cooled and stored in can milk coolers that used electricity to refrigerate insulated cabinets. This method of collecting, cooling, and storing milk in cans has decreased substantially since then. Many of the producers that cooled and stored their milk in cans no longer use this method. Today, most producers use electrically cooled bulk milk tanks to cool and store their milk.

Currently, the majority of can milk produced on non-electric dairy farms occurs in States that have not established cooling requirements consistent with the USDA Recommended *Requirements (Appendix I)*. USDA polled State regulatory agencies that have manufacturing grade milk programs concerning the producer information and statistics. This information indicates there are 15,827 manufacturing grade milk producers in the United States. Of these, approximately 4,264 (27 percent) producers use cans to collect and store milk. Of the 4,264 producers, 2,581 (61 percent) are located on non-electric dairy farms whose ability to cool milk to the USDA recommendation is limited. These 2,581 producers represent 16 percent of the total number of manufacturing grade milk producers nationwide.

Currently, four States have can milk cooling requirements less stringent than the temperature recommended by USDA. In three instances, the State permits can milk to be cooled and stored at temperatures up to 60E F. In the fourth instance, the State permits can milk to be cooled and stored at temperatures up to 55E F.

The information in this report considers increasing the USDA recommended can milk cooling temperature from 50E F to 60EF. This temperature was selected because 93 percent of the can milk produced under State regulation exceeding the USDA recommendation is done so in States permitting a cooling and storage temperature of 60°F.

FEDERAL MILK COOLING REQUIREMENTS

The USDA Recommended Requirements provide the following milk cooling recommendation:

“Section D4. Cooling.

(a) Milk in cans shall be cooled immediately after milking (to 50EF or lower)² unless delivered to the plant within 2 hours after milking. The cooler, tank, or refrigerated unit shall be kept clean.

(b) Milk in farm bulk tanks shall be cooled to 40EF or lower within 2 hours of milking and maintained at 50EF or lower until transferred to the transport tank.

² Until 3 years after adoption, the temperature for milk placed in cans will be 60E F.”

The Food and Drug Administration (FDA) also has a model program to promote nationally uniform requirements for the production and processing of Grade A milk. The FDA developed and implemented this program cooperatively with State regulatory agencies and the dairy industry to encourage greater uniformity and a high level of milk sanitation practices in the United States. A stated purpose of this recommend standard is to “... facilitate the shipment and acceptance of milk and milk products of high sanitary quality in interstate and intrastate commerce.” The FDA Pasteurized Milk Ordinance (PMO) establishes the following milk cooling requirement:

“ Item 18r. Cooling:

Raw milk for pasteurization shall be cooled to 7EC (45EF) or less within 2 hours after milking. Provided, that the blend temperature after the first milking and subsequent milkings does not exceed 10EC (50EF).”

NOTE: The PMO does not provide different temperatures for milk marketed in cans. The same cooling requirements apply to both can and bulk tank milk.

To justify their cooling requirements, both USDA and FDA provided similar information. The following justification appears in the PMO.

Milk produced by disease-free cows under clean conditions usually contains relatively few bacteria immediately after milking. These can multiply to enormous numbers in a few hours unless the milk is cooled. However when the milk is cooled quickly to 7EC (45EF) or less, there is only a slow increase in the numbers of bacteria. In order to understand this, it is necessary to recall merely that bacteria are actually infinitesimal plants, and that most plants do not grow in cold weather.

Usually, the bacteria in milk are harmless, and if this were always true, there would be no reason to cool milk, except to delay souring. There is however, no way for the dairyman or regulating officer to be absolutely sure that no disease bacteria have entered the milk, even though the observance of the other item of this ordinance will greatly reduce this likelihood. The likelihood of transmitting disease is much increased when the milk contains large numbers of disease bacteria. Therefore, it is extremely important for milk to be cooled quickly, so that small numbers of bacteria, which may have entered, will not multiply.

CONSIDERATIONS AND CONCLUSIONS

Consideration 1 The Effect of Cooling and Storage on the Number of Bacteria Present in Milk.

The Recommended Requirements establish a maximum of 500,000 bacteria per milliliter in manufacturing grade milk. This level has been in effect since 1996 when the Dairy Division of NASDA requested USDA to lower the level from the then existing maximum of 1,000,000 bacteria per milliliter. It is important to note that individual shipments of milk exceeding the 500,000 bacteria level may occur provided the history of the dairy farm operation meets the protocol detailed in the Recommended Requirements. Bacterial estimates in milk that are consistently above 500,000 bacteria per milliliter do not meet this protocol. Milk shipments from that dairy farm would be excluded from the market until the circumstances creating the high bacteria count are corrected and the milk once again meets the requirement.

The effect that temperature has on the number of bacteria present in milk is well documented and must be considered when assessing whether an increase in the storage temperature of milk on the dairy farm is appropriate. Hammer and Babel in the 4th Edition of Dairy Microbiology reported a USDA study concerning the influence that time and temperature has on the bacterial growth in milk (Table 1). Findings from this study revealed that even when bacteria are present at relatively low numbers (4295 cfu) in freshly drawn milk, storage of this milk at a temperature of 60EF for 24 hours resulted in a bacterial estimate of 1,587,333. This estimated count greatly exceeds the maximum bacteria allowed in the USDA Recommended Requirements. Conversely, milk stored at 50EF with the same initial number of bacteria resulted in a bacterial estimate of 13,961 after 24 hours and 127,727 after 48 hours of

storage. At that level, the estimated bacterial count is well within the maximum allowed in the USDA Recommended Requirements after 48 hours of storage.

Table 1. THE INFLUENCE OF TIME AND TEMPERATURE ON BACTERIAL GROWTH (cfu/ml)

Storage Temperature	Freshly Drawn Milk – 0 Hours	Milk Stored for 24 Hours	Milk Stored for 48 Hours	Milk Stored for 72 Hours
40EF	4,295	4,139	4,566	8,247
50EF	4,295	13,961	127,727	5,725,277
60EF	4,295	1,587,333	33,011,111	326,500,000

It can be readily concluded that milk cooled to 60EF can only be stored at this temperature for a very short period of time without exceeding the bacterial level provided in the Recommended Requirements.

In some instances, manufacturing grade milk is picked up daily, however, it is common practice to pick up milk from the dairy farm every second or third day. In order to meet the bacterial requirement, milk cooled to 60EF would need to be delivered within a short time period (considerably less than 24 hours) following milking. This allowance already exists in Section D4 of the Recommended Requirements where Milk in cans shall be cooled immediately after milking (to 50EF or lower) unless delivered to the plant within 2 hours after milking.

Conclusion 1

It is widely accepted that sanitary milking practices and rapid cooling and storage controls the bacterial population found in raw milk. When improper sanitation or inadequate cooling exists, extremely large numbers of bacteria would be present in the milk in a relatively short period of time. It is concluded that milk must be obtained in a sanitary manner then cooled quickly and stored cold until delivered to the processing facility in order to comply with the bacterial limit contained in the Recommended Requirements.

Consideration 2 The Effect of Cooling and Storage on the Number of Pathogenic Bacteria Present in Milk.

Usually, the bacteria present in fresh milk are harmless. If this were always true, cooling the milk to temperatures that limit bacterial growth would only be necessary to prevent excessive numbers of

bacteria from developing in the milk. However, there is no way to ensure that disease-causing bacteria have not entered the milk even though the milk is obtained in a sanitary manner.

A modeling program that predicts the growth of certain pathogenic organisms was developed by USDA and can be used to predict the growth of pathogenic organisms encountered in milk. *Appendix II* provides information predicting the growth of the following pathogenic organisms at 50EF and 60EF for 24 and 48 hours:

- *Staphylococcus aureus*
- *Salmonella*
- *Escherichia Coli 0157:H7*
- *Listeria monocytogenes*
- *Yersinia enterocolitica*

Before the introduction of pasteurization, raw milk and raw milk products were a major vehicle in the transmission of disease. The extensive use of pasteurization in the United States has dramatically reduced disease transmission through milk and milk products. The U.S. dairy industry relies on pasteurization to help ensure the safety of milk and milk products.

Pasteurization is extremely effective in destroying pathogens. It can be argued that the pathogen content in raw milk is not important because subsequent pasteurization will destroy the pathogenic organisms present. It can be further argued that if pasteurization is required for all dairy products produced from raw milk the number of pathogenic organisms present in the raw milk is not important. However, pathogens produce heat stable toxins that are not destroyed by pasteurization and their presence in raw milk at elevated levels is a food safety concern. The best method to control the number of toxin producing organisms in the raw milk is to follow sanitary milking procedures and promptly cool and store milk at temperatures that inhibit the growth of these organisms.

Conclusion 2

While pasteurization has been proven effective in destroying pathogenic organisms, it does not inactivate toxin produced by bacteria prior to pasteurization. Therefore, it is necessary to control the population of pathogenic organisms that produce toxins. The information provided in the modeling program clearly indicates that elevating the cooling and storage temperature of raw milk from 50EF to 60EF greatly increases the possibility that heat stable toxins may be present in pasteurized milk products.

Consideration 3 **The Effect that Cooling and Storage has on the Marketability of U.S. Manufactured Dairy Products.**

Domestic Considerations:

To promote the orderly marketing of dairy products in the United States, the USDA in consultation and cooperation with NASDA developed the Recommended Requirements. These Recommended Requirements provide national uniformity that facilitates the marketing of dairy products nationally. Both USDA and NASDA have consistently supported the uniform adoption of these requirements. A benefit of the Recommended Requirements is to provide State regulatory agencies certain assurances that milk produced in another State meets comparable standards to milk produced in their State. As a result, State regulatory agencies are more likely to unconditionally accept the sale of milk products produced in another State if that State meets similar requirements, and thereby, facilitate the orderly marketing of dairy products.

Certain States have adopted and are enforcing requirements that meet or exceed the USDA recommendations. If the cooling requirement for milk produced on non-electric dairy farms is relaxed to 60° F, greater differences in milk cooling provisions may result and impede the marketing of dairy products between States. We are concerned that States with more stringent requirements may restrict the marketing of dairy products produced in States that allow the elevated cooling and storage temperatures.

A relaxation of the temperature requirements for can milk will broaden the differences between can milk and milk cooled and stored in bulk milk tanks. We are not aware of any interest in relaxing the cooling requirement for milk cooled and stored in bulk milk tanks or can milk that is cooled in refrigerated storage units. If an increase in the cooling and storage temperature for milk stored in cans is provided, similar relaxation in bulk milk cooling allowance would seem appropriate.

International Considerations:

International trade agreements are effecting the manner in which dairy products are marketed globally. The U.S. dairy industry realizes the important role that international markets play in its future. Currently, many U.S. dairy companies are effectively exporting dairy products throughout the world.

As international trade develops, importing country governments have the responsibility to ensure that imported dairy products meet certain safety standards. The U.S. Government is frequently asked to certify that U.S. manufactured dairy product meet the requirements of the importing country or are produced in a system that is equally effective.

The U.S. has been actively involved in equivalency discussions with countries that import U.S. manufactured dairy products. During these equivalency discussions, milk production and processing requirements are compared. If the milk is produced and processed under similar requirements, or if adequate safeguards are in place to provide similar results, an equivalency determination can be made. If they are not, the differences need to be considered and provisions made to ensure that food safety requirements are met.

One of the issues considered during equivalency discussions is the milk-cooling requirement. We have utilized the USDA Recommended Requirements as the model program that establishes the minimum requirements for manufacturing grade milk and have been successful in satisfying the cooling requirements of importing countries. If this temperature is relaxed, the effect that this change would have on international trade is not known. However, we can be certain that raising the can milk cooling allowance would make it more difficult for an importing country to accept the U.S. requirements as equivalent.

Also, the U.S. must compete with other dairy exporting countries. We have reviewed the cooling standards of several of these countries, none of which allow cooling and storing milk at 60°F. If the can milk cooling allowance in the U.S. is raised, our ability to market dairy products in the global market could be negatively impacted.

Conclusion 3

The impact that increasing the can milk cooling requirement would have on the ability to market dairy products cannot be accurately predicted. It is dependent upon the reaction of State regulatory officials and governments from countries that import U.S. manufactured dairy products. However, we can be certain that any impact resulting from this change would negatively effect the marketing of U.S. dairy products.

Consideration 4 Non-Electric Options to Cool and Store Milk in Cans.

Since the early 1970s, USDA has assisted State regulatory agencies by assessing the ability of manufacturing grade milk farms to comply with the Recommended Requirements. In conducting these assessments, USDA:

- randomly selects a group of manufacturing grade milk producers,
- evaluates the construction and sanitary conditions of the selected dairy farms,
- reviews their observations with State dairy officials,
- provides a report detailing State program effectiveness, and

- annually reports findings to the Dairy Division of NASDA.

In conducting these assessments, USDA has observed several methods of cooling can milk on non-electric dairy farms. Some of the methods that are successful in cooling milk to meet the USDA Recommended Requirements are as follows:

1. Several non-electric dairy farms use diesel generators to cool and store milk in bulk milk storage tanks or refrigerated can milk storage cabinets. While the use of diesel generators is not universally acceptable, this option is available and is successfully used in many areas of the country.

2. Some non-electric dairy farmers collect their milk in cans and then transport the milk to milk houses where bulk milk cooling tank(s) are located to collect, cool, and store milk from a number of dairy farms. While this method does provide an acceptable alternative, it requires dairy farmers to transport their milk off their farm soon after each milking. This method is used extensively in at least one State.
3. Some non-electric dairy farmers use ice to supplement cooling during warm weather. The ice is either purchased or gathered during winter months and stored on their dairy farms for future use. While this method can be used to cool milk to meet the Recommended Requirements, it can be quite expensive and labor intensive. To successfully cool milk using this method, the dairy farmer must agitate the milk to ensure uniform and thorough cooling.
4. Several non-electric dairy farmers use water to cool milk. If their water source is cold enough, auxiliary cooling apparatuses can be used to adequately cool milk during warm months. Auxiliary equipment circulates cold water in sanitary tubes inserted into the milk can or sprays cold water on the exterior of the milk can. The effectiveness of this option is contingent on the temperature of the water supply. To successfully cool milk using this method, the dairy farmer must agitate the milk to ensure uniform and thorough cooling.

In addition to the methods that are currently available, other energy sources that could be used to cool milk exist and could be explored. These include solar and wind generated power. The technology exists to gather energy from these sources and cool milk, however, the cost of installing the necessary equipment could prove prohibitive.

Conclusion 4

Alternatives exist that can be used to cool and store milk from non-electric dairy farms. While these options may be more expensive and/or more labor intensive, options exist for non-electric dairy farms to meet the USDA Recommended Requirements.

SUMMARY

The resolution passed by NASDA requested USDA to reconsider its long-standing milk-cooling recommendations for manufacturing grade milk. This reconsideration was requested because the majority of the can milk produced in the U.S. is from non-electric dairy operations in States whose can milk cooling requirements exceed the USDA Recommended Requirements.

The Dairy Standardization Branch, Dairy Programs, Agricultural Marketing Service, identified and considered four issues to determine whether to support an increase in the USDA recommended can milk-cooling requirement:

1. Whether it is possible to cool and store milk at temperatures exceeding the USDA Recommended Requirements and still comply with the 500,000 bacteria per milliliter requirement;
2. Whether the potential for increased pathogen and toxin production in raw milk exists if the milk cooling and storage temperature is raised;
3. Whether elevated can milk cooling and storage temperatures would negatively impact the marketability of U.S. manufactured dairy products; and
4. Whether alternatives exist that permit dairy farmers the option of producing and marketing milk from non-electric dairy farms.

After careful consideration, it is our opinion that the temperature recommendations for can milk produced and stored on non-electric dairy farms should not be increased and that USDA should maintain its existing recommendation of 50EF.

**Appendix I Non-Electric Can Milk Producer Numbers and
Temperature Requirements by State**

STATE	NUMBER OF NON-ELECTRIC CAN MILK PRODUCERS	CAN MILK TEMPERATURE REQUIREMENT
INDIANA	900	60EF
IOWA	200	50EF
MICHIGAN	321	60EF
MINNESOTA	73	50EF
MISSOURI	375	45EF
NEW YORK	173	55EF
OHIO	1187	60EF
PENNSYLVANIA	448	50EF
WISCONSIN	400	50EF

Appendix II Influence of Time and Temperature on the Growth of Selected Pathogens (Predicted Growth)

Staphylococcus aureus

	50EF Storage	60EF Storage	50EF Storage	60EF Storage	50EF Storage	60EF Storage
Initial Number of Bacteria	10	10	100	100	500	500
Number of Bacteria after 24 Hours of Storage	13	1000	160	8,000	631	39,000
Number of Bacteria after 48 Hours of Storage	100	199,500	1260	2,512,000	5,000	12,600,000

Salmonella

	50EF Storage	60EF Storage	50EF Storage	60EF Storage	50EF Storage	60EF Storage
Initial Number of Bacteria	10	10	100	100	500	500
Number of Bacteria after 24 Hours of Storage	11	80	108	685	523	3,150
Number of Bacteria after 48 Hours of Storage	14	40,000	131	380,000	615	1,800,000

Appendix II Influence of Time and Temperature on the Growth of Selected Pathogens (Predicted Growth) - Continued

Escherichia Coli 0157:H7

	50EF Storage	60EF Storage	50EF Storage	60EF Storage	50EF Storage	60EF Storage
Initial Number of Bacteria	10	10	100	100	500	500
Number of Bacteria after 24 Hours of Storage	18	240	157	2200	720	10,500
Number of Bacteria after 48 Hours of Storage	98	1,015,000	865	7,850,000	3,900	30,000,000

Listeria monocytogenes

	50EF Storage	60EF Storage	50EF Storage	60EF Storage	50EF Storage	60EF Storage
Initial Number of Bacteria	10	10	100	100	500	500
Number of Bacteria after 24 Hours of Storage	33	1,450	283	14,000	1,275	70,00
Number of Bacteria after 48 Hours of Storage	400	8,000,000	3,750	50,000,000	18,000	145,000,000

**Appendix II Influence of Time and Temperature on the Growth of
Selected Pathogens (Predicted Growth) - Continued**

Yersinia enterocolitica

	50EF Storage	60EF Storage	50EF Storage	60EF Storage	50EF Storage	60EF Storage
Initial Number of Bacteria	10	10	100	100	500	500
Number of Bacteria after 24 Hours of Storage	49	73	430	685	1,980	3,325
Number of Bacteria after 48 Hours of Storage	76	203	707	2,300	3,500	13,650