

# Dairy Pipeline



Volume 27 Number 3, 2015

A Technical Resource for Dairy Manufacturers

## Around the World of Cheese: Springside Cheese Continues the Wisconsin Specialty Cheese Tradition through the Revival of Polish Style Cheese

Nearly twenty years ago, Keith Hintz, a cheesemaker from Northeastern Wisconsin, attended the Wisconsin Center for Dairy Research artisan short course on Polish cheese. One of the first artisan courses of its kind, the ultimate goal was to help Wisconsin cheesemakers transition to more value-added cheese varieties.

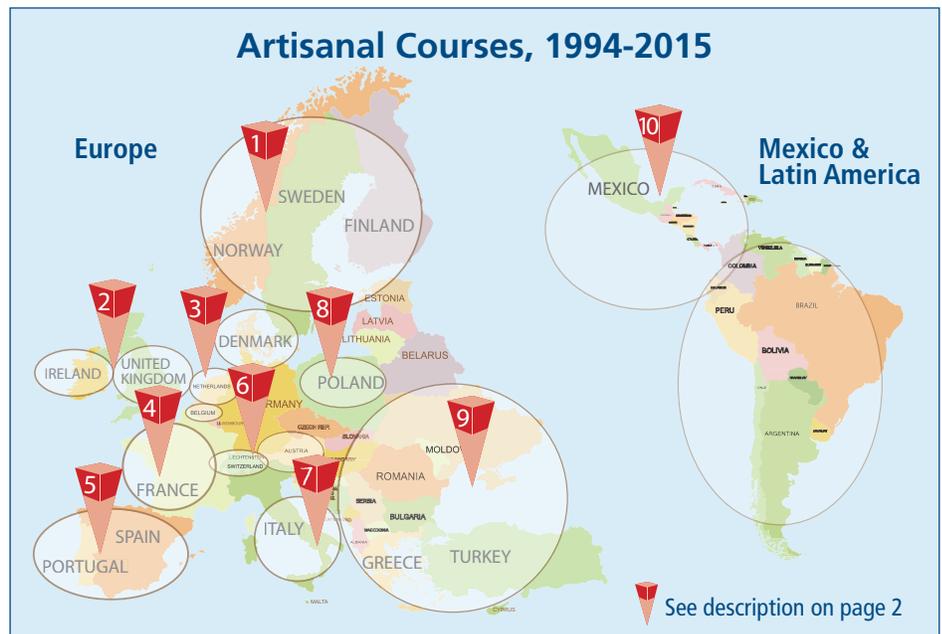
The course on Polish cheeses had been a long time in the making. Dairy manufacturing short course pioneer and CDR staff member Jim Path had been traveling the world looking for cheese recipes and ideas to bring back to Wisconsin. For this particular course, Path focused on Poland due to the large Polish population in and around the Midwest. Path thought that with such a large market for Polish cheese, Wisconsin cheesemakers needed to be making these styles.

The two-day course, The Pride of Poland, introduced Hintz and his classmates to Polish styles of cheese. Students spent time in the plant making cheeses such as Podlaski and Polish cheese experts were flown in to give lectures on various topics. After the course, Keith took the recipes home and tried them out again, this time with the help of his father Wayne. They had some luck in developing the cheese but decided to shelve it until the time was right. As it turns out, 2015 was the right time.

“Springside Cheese has long been known for our Cheddar style and novelty flavors such as ghost jack and beer Cheddar, but historically we’ve always sold through wholesale,” said Nathan Hintz of Springside Cheese. “So, while we really enjoyed making the Polish style cheese back in 1997, we were focused on wholesale production and so it wasn’t a priority. Recently, however, my brother and I took over and we wanted to work on building a brand by adding specialty cheeses that are unique to us and complement our current products.”

The Hintz brothers decided to base their specialty cheese on the recipe for Podlaski cheese introduced at the CDR artisan short course. While the Hintz family is of German descent, Keith and Nathan’s father began his cheesemaking career in a Polish region of Northeast Wisconsin at Krakow Cheese factory in Krakow, WI and the brothers wanted to honor that experience. After tweaking the Podlaski recipe and creating a specialty cheese unique to Springside, the Hintz family launched Krakow, a soft, creamy, mild flavored cheese with a natural rind. Krakow is often compared to other continental cheeses and performs well as a table or melting cheese.

“The cheese has really been taking off since early spring when the first two batches were made,” said Hintz. “We ran out quickly and have been trying to keep up with sales ever since.” Now retired, Path couldn’t be happier to hear that twenty years later, the artisan courses he launched are still affecting the cheese industry. ➔



“The ultimate goal of these courses was to expand the varieties of cheese being manufactured and open up new areas for production,” said Path. “I think it did more than that though. It helped to turn the corner in the mind of the cheesemaker to think of cheesemaking as not only a scientific but also a creative venture. The success is proof that there really is a market for those creative products.”



*Krakow cheese*

At the time when the artisan cheese courses began, specialty cheese in Wisconsin represented about four percent of production. Today, specialty cheese represents 23 percent of Wisconsin cheese production.

“It’s really great to see this growth,” said Path. “It would take a set of books to list all of my favorite memories from those courses, but in general the warmth and openness I was greeted with during my travels and the friendships that developed between not only me and the instructors, but also between all of the attendees, is something I will carry with me. I truly believe that it was those relationships and all of the people involved in the classes that had a part in helping the Wisconsin specialty cheese industry to grow.”

For more on the CDR artisan short courses please visit [www.cdr.wisc.edu/shortcourses](http://www.cdr.wisc.edu/shortcourses)

To purchase Krakow, please contact Springside Cheese at 920.829.6395 or visit Schoolhouse Artisan Cheese, 7813 State Hwy 42, Egg Harbor, WI 54209 🍷

## GETTING BACK TO BASICS: PROPER HANDLING OF WHEY TO MAXIMIZE QUALITY

*Contributed by Dean Sommer, CDR*



The processing of whey has come a long way since my time as a young boy working on the family farm. I can remember the milk truck coming to unload warm whey into our oak stave barrel to be used for feeding the pigs. In those days, whey was mostly seen as a waste product. Careful and thoughtful handling of the whey was not something that was given any consideration. Today, whey is a valuable by-product of cheesemaking and in some cases people would say that whey is the primary product and cheese is the by-product. Given whey’s immense value, careful handling of the whey from the time it is generated in the cheesemaking process to the time it is converted into a saleable end product is critically important. Handling is the key to maximizing whey quality and reaping the economic returns from your whey stream.

Unfortunately, all too often, when I visit cheese plants I encounter some vestiges of old ways. As an industry we still haven’t mentally adopted the idea that whey is a valuable product that is subject to quality degradation if it isn’t handled properly.



*Stirring curds and whey in a cheese vat.*

Ultimately, you should handle your whey with the same care and thought that you handle your raw milk in order to preserve the best quality of your product. Some plants, at times, rely on practices such as pH neutralization or blending of the whey with other supplies, but at best these solutions merely try to cover up damage that has been already done to the product. Once the whey is damaged there is no going back to the original quality.

### The Enemy: Time and Temperature and Microbes, Oh My!

When processing fluid whey, there are a few things that you should watch very carefully. Your number one enemy is time. Generally speaking, the more time you take to process the whey, the more likely it is that the microorganism and enzyme →

## A Complete List of CDR Artisanal Courses, 1994-2015

### 1. Scandinavian

- 🍷 The Art of Making Scandinavian Cheese, 1994
- 🍷 Cheese Technology-A Northern European Approach, 1998

### 2. Ireland & UK

- 🍷 The Great Cheeses of Great Britain, 1995
- 🍷 Cheeses of Ireland and the UK, 2008

### 3. Netherlands

- 🍷 The Art of Making Dutch-Eyed Cheeses, 1994
- 🍷 Dutch Cheese Seminar, 2001

### 4. France

- 🍷 Cheeses of France With a Focus on Soft Cheeses, 1997
- 🍷 Cheeses of France-Part Two (Deux), 2004
- 🍷 Affinage-The Aging of Cheese, 2007

### 5. Spain & Portugal

- 🍷 Mixed Milk Cheeses-Focus on Cheeses of Spain & Portugal, 2000

### 6. France, Switzerland & Belgium

- 🍷 Small Country-Great Cheeses of Switzerland, 1996
- 🍷 Semi-Soft & Monastery Cheeses, 1998
- 🍷 Cheeses of the Alpine Region, 2014

### 7. Italy

- 🍷 Cheese Masterpieces from Italy, 1996
- 🍷 Cheese Masterpieces from Italy-Part 2, 2003

### 8. Poland

- 🍷 The Pride of Poland, 1997

### 9. Eastern Mediterranean

- 🍷 Cheeses & Fermented Milks from the Eastern Mediterranean, 2010

### 10. Mexico & Latin America

- 🍷 Making Mexican Cheeses, 1995
- 🍷 Exploring Cheeses of Mexico & Latin America, 1999
- 🍷 World of Hispanic Cheeses, 2006

### Other Topics

- 🍷 Cultures Seminar, 2000
- 🍷 A Fresh Look at Fresh Cheeses, 2002
- 🍷 Customizing Cheese Flavor, 2005
- 🍷 Natural Flavorings for Natural Cheeses, 2009
- 🍷 Identifying and Correcting Defects in Cheese, 2011
- 🍷 Starter Cultures and Adjuncts, 2012
- 🍷 A Comprehensive Review of Cheese Yield, 2015



activity in the whey will cause damage to occur. Additionally, temperature can cause a number of issues over time, adding to your frustrations. Generated whey is typically at the ideal culture growth temperature, often in the 95-105 °F range. Starter cultures from your cheesemaking process are dividing actively in the whey and rapidly ferment lactose to lactic acid, reducing the pH of your whey. These cultures can double in numbers about every half-hour at these temperatures. If you are using thermophilic cultures in your cheese process, these cultures generate galactose when they ferment lactose. Galactose makes whey difficult to dry, more hygroscopic and can lead to undesirable browning reactions in whey products.

Another enemy for whey processors is acid development. The more acid that is developed in your whey, and the lower the pH falls, the greater the damage to the whey solids. Also, the fermentation of lactose to lactic acid reduces the amount of lactose in the whey. More importantly, the generated lactic acid is difficult to dry. Additionally, acid development can make the product less palatable.

## THE ENEMIES

- ⊙ Time
- ⊙ Acid Development
- ⊙ Temperature
- ⊙ Unsanitary Conditions

Perhaps the greatest enemy for whey processing, however, is unsanitary microbial conditions. The more microbes you allow to grow or introduce into your whey stream, the more damage you'll see regarding solids in the whey. The majority of the microbes will be from the starter cultures used that day, however in unsanitary conditions other microbial contaminants, such as spore formers and thermophilic bacteria, are introduced into the whey leading to quality degradation. Frequent cleaning is important as the whey stream dynamic is not plug flow or first in first out. Instead, newer whey mixes with older whey as it moves through your system. Over time, this leads to poor quality whey. This is especially true towards the end of the day when increased time and temperature have led to an extensive increase in microbial populations in your tanks and equipment. You can break this cycle by having duplicate surge tanks at each step, and switching the tanks every four hours. This allows you to wash and sanitize the dirty tank before it is used again. If possible rinsing and sanitizing the separators every four hours will also reduce microbial growth problems.

Lastly, keep in mind that rapid cooling of your liquid whey streams before storage and shipment remains the most effective way to slow unwanted microbial growth and preserve maximum quality. Rapid cooling of your whey stream utilizing an appropriate heat exchanger before final storage, whether it is raw whey, liquid WPC, or liquid permeate, is imperative if the objective is to maximize whey quality. Alternatively, some people heat treat or pasteurize the whey in order to slow the growth.

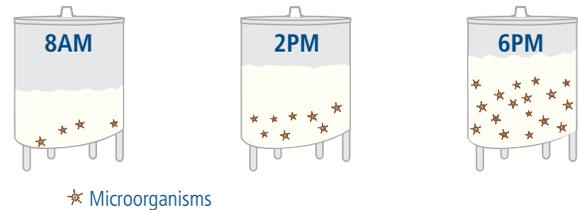
### Avoiding By-products in the Whey Stream

It should also be noted that other by-products of cheesemaking can cause problems when they are in your whey.

Cheese fines are detrimental to whey processing. For economic reasons plants want to keep as much of the fines in the cheese as they can, but fines that escape into the whey stream destined for further processing can wreak havoc on membranes. The

most effective way to capture virtually all the fines is to run your whey through a mechanical clarifier. Capturing the fines also makes capturing the residual fat in the whey more effective. Other methods of capturing fines, including mechanical rotary fine savers or filters, will not capture small fine dust in the whey stream, but can be helpful on a larger level.

### Seeding of equipment downstream



Fat is also unwanted in most whey streams, unless you are making whey products for animal feed, in which case fat is desirable due to nutritional and flavor attributes. This is especially true in whey protein concentrate products because the residual fat in the whey concentrates right along with the protein. Too much residual fat can lead to flavor problems, functionality problems and the inability to achieve the desired protein concentration in your WPC. Having properly sized and operated whey cream separators will go a long way in helping you achieve both economically important effective recovery of whey cream (separated whey fat contents of 0.05-0.06 percent are achievable) and the highest quality fluid whey for further processing.

In the end, if you want to maintain the quality and value of your whey, proper handling is the key. Whey must be treated like the valuable product it is in order to reap any economic benefits. That means maintaining a pure product free of fines, fat and unwanted microbes. With these key issues in mind and careful planning, however, the industry can continue to see new and exciting rewards from whey processing. 🍷

## WELCOME ALICIA WANG

Please join CDR in welcoming Alicia Wang to the CDR processing group. A senior in the UW-Madison biological systems engineering program, Alicia serves as the CDR processing pilot plant intern. In this role, Alicia works to create and update piping and instrumentation diagrams (P & ID's). By creating these drawings, Alicia is helping CDR to prepare for the move to an automated data capturing system.

“Alicia brings a unique set of skills to CDR,” said processing coordinator Dean Sommer. “Internally, CDR doesn’t have an engineer who is specialized in this area, so it’s a unique situation where Alicia’s really teaching us.”

Alicia previously interned with a pharmaceutical firm and Nestle. She will graduate in December and plans to find more hands-on experience before continuing her education. Eventually, she hopes to open her own engineering consulting firm that serves the food industry. 🍷



# EXPLORING THE CDR WEB

In an effort to better serve industry, the Wisconsin Center for Dairy Research (CDR) continues to expand its program areas and services. As such, CDR staff have been working to keep you informed and involved through our online presence [www.cdr.wisc.edu](http://www.cdr.wisc.edu). Our website is meant to serve as a user friendly resource for industry and we are continually adding materials, resources, pages and links that we hope you find useful. Given the many changes to the site, we wanted to highlight a few key resources available via the CDR website. If you have additional questions about these resources, or ideas for other articles or links, please contact [communications@cdr.wisc.edu](mailto:communications@cdr.wisc.edu).



## About CDR

Do you need to contact a CDR staff member directly? Perhaps you are looking for a job at CDR? Or, do you want to access information about other dairy industry resources? All of this and more can be found under the ABOUT CDR tab on the website. You can also find detailed descriptions of each CDR program area, as well as a copy of the CDR brochure.



**CDR STAFF**

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 <a href="#">Cultured Products Staff</a>	 <a href="#">TURBO Staff</a>
 <a href="#">Dairy Processing Staff</a>	

Additionally, the CDR store can be accessed via the ABOUT CDR tab. Our new store offers industry the opportunity to purchase CDR resources such as the Better Butter book or the Dust Fires and Explosions handbook online.

## Program Areas, Services and Videos

If you are interested in starting a project at CDR or you need assistance in a particular area such as cheese, dairy ingredients, cultured products, dairy beverages, dairy processing or safety/

quality, the CDR website offers extensive information on these areas. Each program area has its own page that contains contact information, services, FAQs, equipment, sensory services and more. Most areas also contain a link to a success story so you can see how CDR works with industry.

We are currently developing individual program area videos to highlight CDR services. The CDR overview and the safety/quality video are already available via the CDR VIDEO tab on the homepage.

## Media, News and Newsletters

CDR's flagship publication The Dairy Pipeline is published quarterly and is available online for free. It can be accessed via the NEWSLETTER link. The page also contains information about subscribing (email: [communications@cdr.wisc.edu](mailto:communications@cdr.wisc.edu)) and the Pipeline archives which is searchable, making it easy to find topic specific articles.

Additionally, the CDR homepage also contains links to a news page, as well as DIRECTOR'S CORNER which includes all of Dr. Lucey's latest columns and updates.

To find CDR press releases, visit the media page, also available via the CDR homepage.

## Short Courses

Our most popular page allows industry to quickly and easily register online for any public dairy short course held at Babcock Hall. Course enrollment generally opens approximately six months before the course is held and the courses fill up quickly so be sure to enroll as soon as possible. Each short course has its own page and includes information regarding scheduling, parking, lodging and more. →



**SHORT COURSES**  
Learn more about our upcoming short courses.

**REGISTER**

# SITE [WWW.CDR.WISC.EDU](http://WWW.CDR.WISC.EDU)

## Master Cheesemaker Map

The Master Cheesemaker page offers information for those interested in joining the program including program application and requirements. Want to locate a Master Cheesemaker? Check out the Master Map which provides a unique view of all the state's Master Cheesemakers.

**CENTER FOR DAIRY RESEARCH**  
COLLEGE OF AGRICULTURE AND LIFE SCIENCES, UNIVERSITY OF WISCONSIN-MADISON  
SUPPORTED BY DAIRY FARMER CHECK OFF DOLLARS

ABOUT CDR | CHEESE | INGREDIENTS & FUNCTIONALITY | CULTURED PRODUCTS | DAIRY PROCESSING | SAFETY & QUALITY | MASTER CHEESEMAKER

**WISCONSIN MASTER CHEESEMAKER**

**WISCONSIN MASTER CHEESEMAKERS MAP**

To view a Master profile click directly on a specific medal's point, clicking on the circle may not result in the correct link.

**Gary Grossen**  
Certified in: Brick, Muenster, Cheddar, Gouda and Harvarti  
Babcock Hall Dairy Plant  
Madison, Wisconsin  
County: Dane

Photos © WMMB

## The "Insider" is your source for the latest on CDR research, education and more.

CDR Industry Team (CIT) members and/or Wisconsin manufacturers can sign up to receive exclusive access to a multimedia publication, "The Insider Newsletter," which includes video interviews, demonstration videos as well as detailed articles on topics that affect the dairy industry. You will also receive exclusive access to research papers, Powerpoint presentations and more. To access this material please create a username and password or simply login if you have already done so. Please note that you must be a CIT member or a Wisconsin dairy foods manufacturer to access this information.

**CENTER FOR DAIRY RESEARCH**  
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**CDR INSIDER**  
Premium content for Wisconsin Manufacturers and the CDR Industry Team

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WELCOME TO THE CDR INSIDER!

As a full U.S. CIT member and/or WI manufacturer you will now receive exclusive access to the **CDR Insider**. This members-only section of the CDR website will host research papers, powerpoint presentations, exclusive industry resources and the new, multimedia publication, "The Insider Newsletter," which includes video interviews, demonstration videos as well as detailed articles on topics that affect the dairy industry. Use the left navigation bar to discover all the **CDR Insider** has to offer.

**CDR "INSIDER" Articles**

- THE CDR "INSIDER" LOOK AT ► THE STORY OF ACID WHEY
- THE CDR "INSIDER" LOOK AT ⇒ BLOCK GOUDA
- THE CDR "INSIDER" LOOK AT ⇒ CALCULATING A YIELD EQUATION
- THE CDR "INSIDER" LOOK AT ⇒ THE I6 CHALLENGE GRANT
- THE "INSIDER" LOOK AT ⇒ EXPORT OPPORTUNITIES

## TURBO

The CDR homepage contains a link to the TURBO website which extends CDR's services into the economic development realm. The TURBO site offers a list of CDR technologies available to companies as well as a BUSINESS RESOURCE page which includes economic services provided to businesses in Wisconsin and throughout the U.S. [www.turbo.cdr.wisc.edu](http://www.turbo.cdr.wisc.edu)

**TURBO**

About CDR TURBO | Available CDR Technologies | Developing Your Idea | Contact Us | Economic Development Portal

**About CDR TURBO**  
A comprehensive Business Accelerator designed to increase the speed of commercialization for new products and technologies specifically related to the dairy industry.

**Available CDR Technologies**  
Bring novel technologies and products to market. CDR is offering access to technologies that range from high grain snack cheese to beta casein manufacture.

**Developing Your Idea**  
The CDR TURBO program can help you to develop your idea through technical assistance, business planning, regulatory, and financial resources.

**Business Resources**  
From entrepreneurial assistance to patents and licensing, this unique portal provides a wide array of information and links that can assist companies with business development.

**TURBO**

Scaling Companies Interested in the Further Development of a Process to Modify Cheese Properties Post-Manufacture

Scaling Companies Interested in a Modified Dairy Protein with Improved Functionality

**Available CDR Technologies**

**Patented Low Fat, Reduced Sodium Cheese**  
The Center for Dairy Research (CDR) has developed a novel technology for the production of low fat, reduced sodium cheese. This technology is based on the use of a novel enzyme system that allows for the production of low fat, reduced sodium cheese with improved texture and flavor.

**Modified Dairy Protein with Improved Functionality**  
The Center for Dairy Research (CDR) has developed a novel technology for the production of modified dairy protein with improved functionality. This technology is based on the use of a novel enzyme system that allows for the production of modified dairy protein with improved texture and flavor.

**CDR Available Technologies**  
[www.turbo.cdr.wisc.edu/available-cdr-technologies](http://www.turbo.cdr.wisc.edu/available-cdr-technologies)

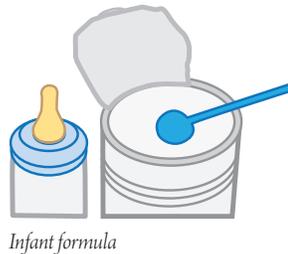
## PART 2: CONTROLLING SPORES

Technical Contributors: Dr. Karen Smith and Dr. Mark Johnson, CDR

This is part two of a two-part article discussing spores, biofilms and their effects on cheese and dried dairy ingredients. The first part was published in Volume 27 Number 1 of the Dairy Pipeline.

Maintaining low bacterial spore numbers in dried whey and milk products is key to manufacturing a high quality product. Spores should always be monitored very closely but for those looking to export their product, the spore count should be top priority. In general, countries importing dairy products demand much lower spore counts than might be required by the U.S. domestic market so keeping those levels down is necessary.

Some bacterial spores can be a serious health hazard and all spore levels should be low. There are a few species in particular that concern food scientists and regulators. In regards to infant formula, *Bacillus cereus* is a serious concern because it can cause food borne illness. It can double in number every hour at 30 C (86 F). Starting with 100 cells per ml of baby formula, the population of *B. cereus* could reach a population of over one million in less than 15 hours at 86 F, which is a level that can cause illness. Some *B. cereus* can grow in the gut and produce a toxin that can sometimes result in death of infants while other strains can produce a very heat resistant toxin in food that can result in severe vomiting when ingested.



*Clostridia perfringens* is another common spore former found in foods. It is the third leading cause of foodborne illness in the U.S. and under the right conditions can also grow rapidly in non-refrigerated foods. Even though the spores may not be growing in the foods that contain them (dried milks, cheese) because of the harsh environment, once these foods have been used as an ingredient in other food products the spores may germinate and produce toxin and illness can result if the conditions are right.

### Why is spore count important for dry dairy ingredient markets?

Exports of dried dairy ingredients continue to grow. In fact, in 2012, 3.3 billion pounds of milk solids were exported according to United States Dairy Export Council (USDEC). End users in other countries are particularly concerned with spores and the effects they can have on product quality, thus the strict limits in place regarding spores. Below are two tables based on USDEC data. Note that each region is different, but these are the general guidelines for export.

### The Stream of Spore Contamination

Spore count and dried dairy ingredients are often discussed together, but keeping spores out of milk and cheese is the only way to ensure that the spore count will be low by the time the whey makes it to the dairy ingredient processing stage.

**Table 1.** Typical example of Spore-Formers Specifications-Infant Formula for Export

Contaminant	Range of limit (CFU)
Mesophilic plate count	Max : <5,000 to 10,000/g
Thermophilic plate count	Max: <5,000/g
Aerobic spore, mesophilic	<500 to <1,000/g
Aerobic spore, thermophilic	<500 to <1,000/g
<i>Bacillus Cereus</i>	Max: <100/g
<i>Clostridium perfringens</i>	Max: negative /0.1g
Sulfite reducing <i>clostridia</i>	Max: <10 to <25/g

Source: USDEC

**Table 2.** Typical example of Spore-Formers-Recombined and UHT for Export

Contaminant	Limit (CFU/g)
Mesophilic plate count	<10,000
Thermophilic plate count	<5,000 to <10,000
Aerobic spore, thermophilic	<500 to 2,000
Thermoresistant spore count	<500

Source: USDEC

### Raw Milk

The first step in reducing spore contamination is to reduce their occurrence in the raw milk. Since spores are not found in milk inside the cow, it is once the milk leaves the cow that contamination with spores or vegetative cells of spore forming bacteria of the teats occurs. These spores can be found in high numbers in feces, dirt, vegetative matter and water that has come into contact with such substances. There are three main ways that milk becomes contaminated. First, the milk may be initially contaminated with high numbers because of unsanitary conditions. Secondly, the warm milk may be inoculating equipment and forming biofilms on the equipment which then contaminates subsequent milk. Thirdly, if the milk is not cooled properly bacteria will produce spores. Regardless, maintaining a clean environment during milking and only accepting high quality milk with low spore counts is key.

### Cheese & Whey

Clean milk is essential to the whey stream as poor quality milk for cheesemaking will result in poor quality whey. Manufacturers of eyed cheeses are especially concerned about raw milk containing spores of *Clostridia* species including *C. tyrobutyricum*, and *C. sporogenes*. Eyed cheeses are brine salted to a fairly low salt content and manufactured where most of the fermentation of lactose occurs during or after the curd has been pressed. In addition the pH of these cheeses are often >5.4 due either to lactic acid metabolism by *propionibacterium* or the low acid content of the cheese due to whey dilution during manufacture. An anaerobic environment within the cheese is conducive to the germination and growth of *Clostridia*. Metabolic activity of vegetative cells feeding on lactic acid can result in prolific gas formation, both carbon dioxide and hydrogen. *C. perfringens* in processed cheeses and sauces (high pH products) is also a potential health hazard, especially if the phosphate salts and sodium chloride are reduced and the cheeses are not refrigerated. ➔

While *Clostridia* contamination in eyed cheese is easily recognized, the presence of non-germinated spores of *Clostridia*, *Bacillus*, *Geobacillus*, *Anoxybacillus* and *Paenibacillus* in cheese may not be of direct concern in the cheese that contain them. There are reports of some species of *Bacillus* sp. causing gas in mozzarella cheese and if there are very high numbers of *Bacillus subtilis* in fresh cheeses, they could potentially cause bitterness. Of greater concern is the use of contaminated cheeses or dried cheese as ingredients in other foods where conditions in the prepared food are quite different than the cheese (such as elevated temperatures of storage, increased water activity, diluted antimicrobials and high pH of the food product) and could result in germination and subsequent spoilage or toxin production (by certain *Clostridia*). The potential for the foods to be stored at warm temperatures also makes it imperative to have a very low spore count in the cheese.

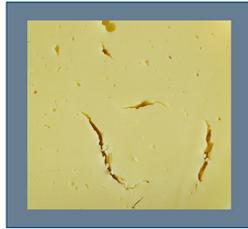
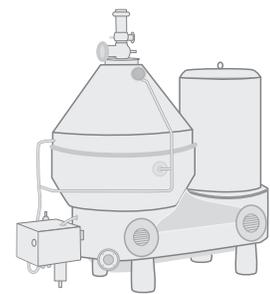


Figure 1. Gassy Provolone

If spores have entered the system in the raw milk the second line of defense to prevent excessive spore count in dairy products made from this milk is to physically remove the spores. The most common system used at the cheese plant is the centrifuge. At first, only Swiss and Parmesan cheese plants used them but now we are hearing about their use in Mozzarella and Cheddar plants especially in other countries. At least 90 percent of spores are

removed with the centrifuge. Some companies use two centrifuge in tandem to remove at least 99 percent of the spores. Vegetative cells are also removed but to a lesser extent because they are lighter than the spores. One potential negative to this method is that sludge generated during the process can be 0.1-0.3 percent of the milk volume as the portion of milk that contains the spores is typically discarded. An interesting sidelight is that the centrifuge also removes tiny dirt and



Dairy Separator

hay particles that have occluded air bubbles. These areas can serve as focal points around which gas will collect to form eyes in Swiss cheese. Some Swiss cheesemakers will sterilize a small portion of the sludge and return it back to the milk to assist with eye formation.



CDR Processing Group Ultrafiltration System.

Microfiltration of whey is also used to remove spores and other bacteria prior to processing. Microfiltration can remove up to 99.99 percent of all bacteria but generates a retentate that may make up to one percent of the volume of milk or whey. Recent investigations led by Dr. Sanjeev Anand at South Dakota State University demonstrated that a combination of ultrasonication and pasteurization can be very effective at killing some species of spores found in milk.

### Biofilms

If spores survive the hurdles in place to remove them, they may produce biofilms (as discussed in Part one of this article). These can proliferate and result in a tremendous increase in spore load, especially in dried dairy ingredients. The biofilm must be removed before it becomes entrenched on equipment resulting in conventional sanitation procedures being much less effective at removing them. It takes several days for a biofilm to become an issue but once established it can remain a permanent layer on equipment.

Once a biofilm is in place, a portion of the biofilm may remain even after using conventional cleaning/sanitation protocols and eventually the biofilm will cause elevated spore counts. On a freshly cleaned and sanitized piece of equipment with a biofilm layer, it takes only 6 to 10 hours before an increased spore load becomes apparent. This strongly suggests that a cleaning/sanitation cycle of between 6 and 10 hours could help to control the number of bacteria emanating from it. Many dairies have employed a mid-day wash to manage spores and other bacteria in a biofilm. This cleaning practice may not completely remove the biofilm, however, and it can build up again in another 6-10 hours. On a perfectly clean piece of equipment (no biofilms) it could take days for the biofilm to become reestablished. Mid-day washes mean that the factory has to stop production and this definitely interferes with productivity. The idea is to eliminated midday washes completely remove the biofilm that a dairy plant would start each day with totally biofilm free equipment. Conventional cleaning/sanitation chemicals and protocols may not be sufficient even if properly applied. Consequently, companies selling cleaning chemicals have worked on supplying a more appropriate cleaning regimen to remove existing biofilms and with continuous use should prevent redevelopment of a biofilm.

Another aspect of biofilms is finding where they exist so that those sites are properly cleaned. Any place where liquid product is in contact with equipment is a potential site of a biofilm. Some equipment is more prone to biofilm formation than others because the equipment may not be cleaned thoroughly or often enough. Membranes, clarifiers, fines savers and separators are notorious for being bacterial growth factories. Cold separation or processing is better than warm separation to prevent bacterial growth. Warm whey or milk running through or sitting in equipment will not only hasten proliferation of the bacteria but also biofilm development in them.

### Conclusion

It's quite clear that this issue is not going away. In fact, we are likely to see the requirements tighten and expand into the domestic market as well. Preparing for this shift in regulations by maintaining low spore counts may be necessary to be in the market place. 🍌

**Center for Dairy Research**  
University of Wisconsin-Madison  
1605 Linden Drive  
Madison, Wisconsin 53706-1565

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## Dairy Pipeline

Center for Dairy Research  
1605 Linden Drive  
Madison, WI 53706-1565



608-262-5970 fax: 608-262-1578

We welcome your questions and comments.

**Send to: Bekah McBride, Editor**

[rmcbride@cdr.wisc.edu](mailto:rmcbride@cdr.wisc.edu) 608-262-8015

### Technical Reviewers:

Debra Wendorf Boyke, John Jaeggi, Mark Johnson,  
Jim Path, Dean Sommer, Marianne Smukowski,  
Tom Szalkucki

### Newsletter Design

Tim Hogensen

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