Wisconsin Center for Dairy Research

Dairy Pipeline

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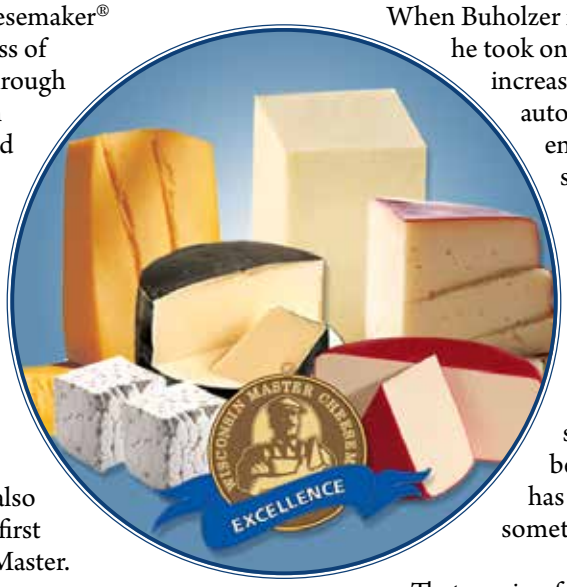
2015 WISCONSIN MASTER CHEESEMAKERS

This year, the Wisconsin Master Cheesemaker® program will be honoring its 19th class of cheesemakers. Established in 1994 through joint sponsorship with the Wisconsin Center for Dairy Research (CDR) and the Wisconsin Milk Marketing Board (WMMB), the Master program is the only one of its kind in the United States. The program takes three years to complete and this year, the program welcomes two first-time Master Cheesemakers and four returning Masters who have all proven that they have what it takes to be a Wisconsin Master Cheesemaker. The class of 2015 will also mark another milestone as this is the first class to include a second generation Master.



ADAM BUHOLZER ▸ KLONDIKE CHEESE

Certified Master: Feta & Havarti

Adam Buholzer grew up surrounded by his family and cheese. A fourth generation cheesemaker at his family's plant, Buholzer always knew deep down that he wanted to be a part of the Klondike Cheese Company tradition. This year, Buholzer will join in another family tradition as he becomes the fourth member of his family to become a Wisconsin Master Cheesemaker. His dad, Steve Buholzer, as well as his uncles Dave and Ron Buholzer all hold two Master certifications.

"Cheese is in our blood," said Buholzer. "My dad encouraged me to go to college and get a degree. I majored in chemical engineering at UW-Madison and worked at a paper company and computer engineering company getting work experience, but about that time our feta was going well and they were going to automate it so it felt like a good time to come back."

When Buholzer returned to the company in 2000 he took on many new roles, mainly working to increase efficiency and fine tuning the cheese automation processes. He also used his engineering degree and automation skills to help launch the company's successful Greek yogurt line in 2013 under the Odyssey® brand.

"Being in a family business I wear many different hats, but I really enjoy fine tuning the recipes and creating that perfect piece of cheese," said Buholzer. "Trying to make the best piece of cheese day in and day out has been the secret to our success and something I want to continue."

That passion for the perfect product has earned Klondike Cheese Company many awards and it's that pride and passion that led Buholzer to the Wisconsin Master Cheesemaker® program.

"I was aware of it from my dad and uncles and I knew it was a very prestigious program," said Buholzer. "I knew I wanted to take that next step, and for me, it was really the knowledge that I gained. It filled in the gaps and helped me to learn why we do certain things in cheesemaking."

Buholzer is receiving his Master certification in feta and havarti, two of the most popular cheeses manufactured by Klondike Cheese Company. His Master certification will make him the very first second generation Wisconsin Master Cheesemaker.

"I've learned a lot from my family, especially my dad, Steve," said Buholzer. "He taught me to be driven by quality and to make the best and most consistent product. He showed me the commitment it takes and that it is worth striving for the best."

CHRIS ROELLI ▸ ROELLI CHEESE
Certified Master: Cheddar

A fourth generation cheesemaker, Chris Roelli is proud to make cheese just as his great-grandfather did. A native of Switzerland, Roelli's great-grandfather studied cheesemaking before eventually moving to the Shullsburg area. Upon settling, he became a dairy farmer and worked at Hick's Cheese Co-op, which was located in the exact spot where the Roelli Cheese Haus now stands.

"My great-grandfather came to Wisconsin hoping to continue his cheesemaking career, so when the position of head cheesemaker opened at Hick's he was excited to take it," said Roelli. "My great-grandfather stayed on as the head cheesemaker for many years and when the time came for the original owners to move on, they asked my great-grandpa to run the plant, and really the rest is history."

Roelli's grandfather, Walter and his father, Dave continued the tradition, all making cheese in the very same plant in Shullsburg. Their focus for many years was producing commodity Cheddar, but in 1991 the situation for small Cheddar cheese plants became difficult and the plant closed.

"It was hard when the plant closed. I had always wanted to continue the family tradition and I remember hoping that somehow, someway I would be able to open the plant again," said Roelli, whose dream came true in 2006.

"I'm proud to be receiving my Wisconsin Master Cheesemaker certification in Cheddar, because that is the cheese that my family was built on, but today, we make several other varieties," said Roelli. "When we opened for the second time, I knew we needed to try making some artisan varieties, so we developed a blue type as well as some alpine style cheeses."

Roelli's artisan cheeses have been quite successful winning several awards. His Dunbarton Blue® and Little Mountain have both won an award at the American Cheese Society competition while his Red Rock cheese won an award at the United States Championship Cheese Contest. According to Roelli, however, it's his fresh Cheddar cheese curds that are still the most popular item purchased at his shop in Shullsburg.

"My personal goal is to be the best cheesemaker I can be while providing my customers with the best product possible," said Roelli. "I firmly believe in continuing education and to me, the Wisconsin Master Cheesemaker® program is the highest mark of my trade. The program has made me a better cheesemaker and introduced me to some great people."

Roelli is currently developing new varieties of cheese and experimenting with a new aged Cheddar recipe. He hopes that the Master Mark® will allow his business to grow and he is looking forward to continuing with the program and receiving other Master certifications.

"I'm just really proud to be a Wisconsin cheesemaker," said Roelli. "I like the artistry of cheesemaking and I like the business side and seeing the fruits of my labor, but there is really nothing better than those first few hours of the day when I am making cheese in my plant. It's my passion, it's in my blood and those are just the best moments of my day."

Returning Master Cheesemakers

KEN HEIMAN ▸ NASONVILLE DAIRY
Certified Master: Asiago & Cheddar

A Wisconsin licensed cheesemaker since the age of 16, Wisconsin Master Cheesemaker Ken Heiman's passion for the cheese industry and appreciation for the Wisconsin cheesemaking tradition is present in everything he does. Working at Nasonville, a plant with over 125 years of history, Heiman and his family manufacture nearly 40 different kinds of cheese, including six different varieties that bear the Master Mark®.

"It's very important to be diverse," said Heiman. "Wisconsin prides itself on its ability to produce quality specialty cheese. It's really about exemplifying Wisconsin's best. We have the best milk and the best university to aid us in making products. We are so steeped in tradition."

Cheesemaking is certainly a tradition at Nasonville where three generations of the Heiman family have been making cheese for nearly 50 years. Nasonville includes Heiman, his two sons, his two brothers and their four sons as well as Heiman's father, brother-in-law and several nieces and nephews.

"Cheesemaking isn't something that was forced on any of us," said Heiman. "We all went away to school and were given the option to come back and we all did."

Heiman passionately promotes the Wisconsin dairy industry as well as advanced education for cheesemakers. Serving on the first board of directors for the Wisconsin Master Cheesemaker® program, Heiman encouraged others to have an active interest in moving the industry forward.

"There's a lot expected of a Wisconsin cheesemaker," said Heiman. "We're the only state that has a Master program and we are also the only state that makes 600 different types of cheese."

Heiman has his Master certification in four cheeses including feta and monterey jack, which he earned in 2009 and 2010. This year he will add Cheddar and asiago.

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pH CONTROL IN CHEESE

Curd Clinic Doctor: Dr. Mark Johnson

Question: *I am getting complaints that my cheese is too acidic. What can I do about this?*

Answer: In almost every cheese contest the number one fault judges observe across all varieties is excessive acidity. While many cheese varieties such as Cheddar, feta, and cream cheese are, by their very nature, described as having an acidic character, there is a point at which the cheese begins to take on undesirable acidic attributes. Regardless of the cheese, when the level of acid taste is excessive for the variety, it will get marked down as being excessively acid. This concept often leaves many cheesemakers asking themselves, with a cheese that is supposed to be at least slight acid what is too much acidity?

I have challenged my colleagues many times on that one, often to no avail. If you have ever tried a variety of aged Cheddar cheeses from around the US you will find the range in acceptable acidity (at least to consumers) rather large, varying from the sweet, nutty notes to distinctively acidic. So, if you are getting complaints or comments that your cheese is acidic what can you do about it? The most obvious choice is to employ procedures such as whey dilution or curd rinsing to reduce the lactose content of the milk or cheese. Reducing the moisture content of the cheese, changing the starter, increasing the cook temperature and salting the curd at a higher pH are also viable options.

These methods work well because they inhibit the lactic acid production during the cheesemaking process. To give you a bit of background, the acid in cheese comes from lactic acid, which is produced when lactose is fermented by the starter bacteria. This fermentation process begins when you add starter culture and continues until either all the lactose is fermented, or the starter bacteria are inhibited by lack of sufficient available nutrients, high salt or low temperatures. So, in order to limit acid production, you must find a way to inhibit the fermentation process.

Cheddar cheese made from RO concentrated milk at 18% total solids, pH 4.75.

To control starter culture acid production consider salting at a higher pH. This method can be very effective if the salt is allowed to penetrate the curd before the starter can produce excessive acid. Slow acid producers tend to be more salt sensitive than fast or more aggressive starters which generally happen to be the starters of choice in the larger cheese factories. If a fast acid producing culture is used, curd is often salted at a higher pH (pH 5.7) than if a slow culture is used (pH 5.4). Using less of the fast culture does not always work as these cultures tend to be less salt sensitive and will still drive the pH down as long as the temperature is warm enough to allow them to ferment lactose. If direct salting is used it should also be done in increments i.e., salting in two or three applications with the first salting adding less salt than the other additions. This helps pull moisture out of the curd but at the same time will allow the salt to penetrate faster into the curd and slow the starter. If you are using the milled curd process do not stack the curd slabs as much as normal, keep the slabs thin.

CDR cheesemaker Emma Watry checking titratable acidity of whey.

Another culprit of acidity to consider is high moisture in the cheese. This is one of the biggest concerns in regards to acid development because it will produce higher levels of lactose fermentation and therefore higher levels of acid in the cheese. Increased moisture content will facilitate more acid development, so by decreasing the moisture in the cheese, the cheesemaker is able to better control the amount of acid produced. It is important to decrease the moisture before acid development to retain buffer capacity in the curd. This means that there should be little ripening time (if bulk culture is used) and that the curd must be cut at a slightly reduced firmness and smaller than normal. It also requires sufficient stir-out time after cutting to allow for syneresis to occur. Also, note that the use of milk concentrated by reverse osmosis or by evaporation will increase the lactose content of the milk and should be avoided if you want to prevent highly acidic cheeses.

Increasing the cook temperature will also result in a lower moisture cheese with less acid development. The larger the pH drop from cutting the coagulum to draining the whey, the larger the loss in moisture. Developing acid before cutting followed by less stir-out results in a higher moisture cheese and loss of buffering in the curd. Partial removal of whey during stir-out (pre-draw) helps reduce curd moisture and if it is done prior to much acid development (pH >6.3) it will result in lower moisture cheese and the retention of calcium phosphate (buffering capacity) of the curd.

I believe that one of the reasons we've seen an increase in acidic cheese defects is the increased desire to improve cheese yield. Outside of milk composition, the major contributor to cheese yield is moisture content but by increasing the moisture content of the cheese, many cheesemakers are inadvertently increasing their acid content. So, consider each step you are taking during the cheesemake process and how it might affect the acid development in your cheese. Weigh the pros and cons and then choose the method that most closely fits the acid level and yield you desire.

PART I: WHAT IS A SPORE?

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

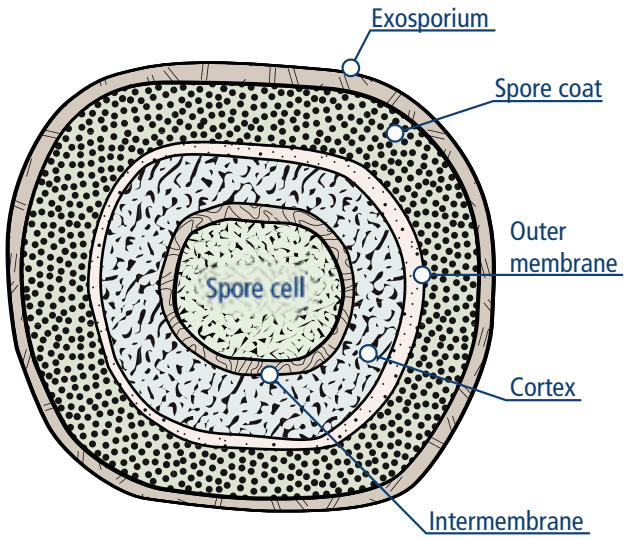
This is part one of a two-part article discussing spores, biofilms and their effect on cheese and dried dairy ingredients.

A spore is an ingenious survival tactic employed by some bacteria in times of stress. The spore, which is essentially layers of protective material that encapsulate the vegetative or mother cell's DNA, ensures that the bacteria's DNA continues in the event that the mother cell dies.

Put another way, spores are essentially a survival pod for the bacteria. Much like an astronaut in a science fiction movie enters a space pod and stays there in suspended animation until the danger has passed, the bacteria produces a spore and remains inactive until after the threat to the bacteria has gone. After the threat is gone, the spore uses the stored genetic material to produce a new vegetative bacterial cell.

The layers of a spore are quite complex and include an intermembrane layer, outer membrane layer, cortex layer, spore coat layer and exosporium layer, which are produced around a copy of the cell's DNA within the bacterial cell *(Figure 1)*. As you can see in the Figure 2, once the spore production is complete the mother cell releases it out into the world, ensuring the bacteria's survival beyond the threat.

Figure 1. Cross section of a spore.

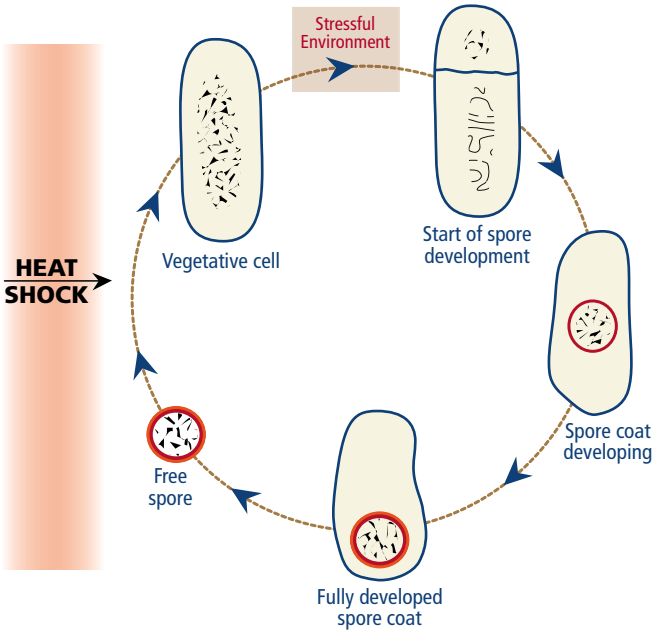


While such a survival unit is very beneficial to the bacteria, it poses problems for processors of dairy ingredients such as non-fat dry milk (NFDM) and whey protein concentrate (WPC). As designed, spores ensure survival of the bacteria despite exposure to adverse conditions such as extreme heat or cold, lack of nutrients and chemicals like sanitizers. Spores therefore are resistant to many of the processes such as pasteurization, evaporation, drying and cleaning that are designed to eliminate or inhibit the growth of bacteria.

Another disturbing challenge posed by spores is that exposure to heat, in a process known as heat shock, can result in their germination. So while you may think that the heat of pasteurization is killing the spores it is actually triggering the spore to germinate and begin its vegetative state as an actively growing bacteria once again. In fact, many bacteria that produce spores actually have an optimum growth temperature somewhere between 104°F and 149°F and although spores vary in their ability to tolerate heat and adverse condition some of the spores may be able to survive 212°F for 30 minutes.

All of this is summarized in Figure 2 which illustrates the life cycle of bacteria and spores. Depending on the situation, you may find bacteria in all stages of the life cycle in a product.

Figure 2. Life cycle of bacteria and spores.



So why should we care about spores?

Spores in dairy ingredients can cause problems when the product is used in another food application. The spores themselves are not a problem because they are inactive, but the bacterial or vegetative cell that results from germination of the spore is the issue. Whether or not the resulting bacteria is a problem depends on the type of sporeformer and the product application.

There are four basic categories of sporeformers based on optimum growth temperature and oxygen requirement. They are aerobic mesophilic, anaerobic mesophilic, aerobic thermophile and anaerobic thermophile. Aerobic bacteria require oxygen while oxygen is toxic to anaerobic bacteria. Mesophilic bacteria prefer temperatures around 95°F while thermophilic bacteria grow best at 131°F. Examples of each type along with some of the problems they can cause are given in Table 1.

Some examples of issues with sporeformers within the food chain include thermophilic aerobic and anaerobic sporeformers which can cause spoilage of canned foods especially when the products are stored above 95°F. This can happen when a dairy powder containing spores is blended with other ingredients and filled into a can for sale to the consumer. The spores are inactive until heat treatments used in processing the ingredients signal the spores to germinate and grow into vegetative bacteria. If the bacteria are thermophilic then storage at temperatures found in the tropics allow growth and results in spoilage of the product in the can.

The growth of *Clostridium tyrobutyricum* in cheese is another example of problems caused by spores. *C. tyrobutyricum* produces gas when it grows thereby causing a defect known as late blow in cheese. Late blow refers to the gas being produced farther along in the cheese aging process. The defect can have significant economic impact for the cheese manufacturer.

Where do spores come from?

Spores and spore forming bacteria are located throughout the environment so it is not possible to completely exclude them from dairy products. A key is to limit their populations from the very start and continually restrict their ability to grow and form biofilms throughout processing.

The process of exclusion starts on the dairy farm. The farm can play host to any number of bacteria and spores as soil, feed, bedding and silage are all good sources of microorganisms. It becomes critical that the farm and especially the milking environment be kept as clean as possible. A poorly cleaned udder or incomplete cleaning of milking equipment can rapidly lead to spores entering the milk supply and the processing plant. Once in the dairy plant setting, heat exchangers, storage tanks, evaporators and other processing equipment can become a perfect place for spores and spore producing bacteria to establish a biofilm and multiply with the resulting release of spores into the dairy product.

Table 1. Basic categories of sporeformers.

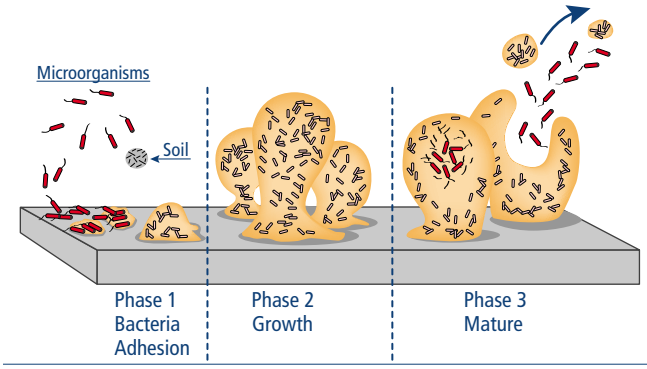
Type of Sporeformer	Example Organisims	Possibe Issues of Sporeformer
Mesophilic aerobic or Facultative anaerobic	Most important members belong to *Bacillus* family • *B. cereus* • *B. subtilus*	Present in food, water and soil. Spoilage in thermally processed, low acid foods.
Mesophilic anaerobic	All are members of the Clostridia family • *Clostridium tyrobutyricum* • *Clostridium botulinum* * • *Clostridium perfringens* *	Widely distributed in nature (soil, fish, vegetables, water, etc). Late gas in cheese. * Food spoilage. * Food poisoning/death
Thermophilic aerobic	Members of the *Bacillus* family • *B. coagulans* • *B. stearothermophilus*	Cause spoilage of canned foods, especially those stored above 95°F (tropics)
Thermophilic anaerobic	*Clostridium thermosaccharolyticum*	Cause spoilage of canned foods for hot vending machines. Spoilage of canned foods in tropics

What is a biofilm and how do they relate to spores?

Biofilms are collections of microorganisms that have attached to a surface and set up residence. Biofilms are common in corners or crevices within dairy processing equipment but they can occur anywhere that has inadequate cleaning. Bacteria within biofilms are generally resistant to heat, drying and cleaning and sanitizing compounds, making them difficult to deal with once they are established.

The steps in the formation of a biofilm are shown in Figure 3. During processing microorganisms come in contact with the surface of the processing equipment. Some microorganisms have the ability to form attachments which they use to adhere to the surface. Once the initial group of bacteria have attached to the surface, soil and other microorganisms can easily become entrapped thereby increasing the size and stability of the biofilm. If the growth of the biofilm continues then a firmly established colony of microorganisms can result. The biofilm is able to trap additional nutrients for the microorganisms and protect them from adverse conditions such as heat and sanitizing chemicals. As the population grows, some of the microorganisms in the biofilm will be released into the product.

Figure 3. Biofilm Development.



Based on 2003, Center for Biofilm Engineering at MSU-Bozeman
Marshall ASM News 58: 202, 1992

Conditions in the biofilm can result in the development of spores. As the population of microorganisms increase within the biofilm, nutrients can become in short supply leading to stressful conditions for bacteria. The use of heat during cleaning or processing (as in a pasteurizer) also can stress the bacteria thereby triggering the development of spores that are then released into the product. Biofilms and spore producing bacteria form a very effective partnership that results in the continual seeding of the product with spores. Once established this partnership can be very difficult to break.

Spore Part II: Summer 2015 Dairy Pipeline

- *Ways to control or remove spores/biofilms.*
- *Spore limits on dried dairy ingredient applications and cheeses.*

Continued from page 2

"I love to eat a good aged Cheddar, but I love making feta," said Heiman. "Feta is really fun to make and to tweak."

Heiman enjoys that "tweaking" process as it allows him to be creative and improve his product. Creativity is also one of the things he enjoys most about the Master program.

"It really gets your juices flowing," said Heiman. "You think outside of the box. It's always about new and improved products. Plus, the people make you want to come back to the program."

Heiman appreciates the comradery that exists within the industry, pointing out that there's always someone around the corner who is willing to help when you have trouble in the plant. He also appreciates the support the dairy industry receives in Wisconsin.

"It's good to see so many different cheese plants and people getting involved in the program," said Heiman. "The tradition here is unbelievable. If it hadn't been for CDR and WMMB we might be in a bad position; instead we've been given an opportunity and we need to take advantage of it. Right now, it's all about having fun and making a new or better product."

MIKE MATUCHESKI ▸ SARTORI

Certified Master: Fontina & Romano

Award-winning cheesemaker Mike Matucheski, of Sartori Cheese, attributes his love for dairy to the time he spent on his grandma's farm. Often helping her to make cheese from the excess milk, Matucheski grew to love the taste and was fascinated by the science.

"I often wondered, how can you take something as innocent as milk and make it into so many things?" said Matucheski. "I always liked science, but I wasn't much of a scientist. I actually have a bachelor's in history from UW-Madison."

While Matucheski didn't originally set out to become a cheesemaker, he always returned to that love of science and history, a combination that defines the Wisconsin cheese industry.

"I began working in a cheese plant in 1993. I had just gotten married and I was looking for a steady job that could supplement my farm income. I remember seeing an ad for a cheesemaker helper and I thought, why not. I received my official cheesemakers license just four years later."

As Matucheski began to learn the science of cheesemaking he also took the opportunity to travel to Europe where he was moved by the industry's history.

"I found that I couldn't pass a cheese plant without stopping in to see what was going on," said Matucheski of his trips to Europe. "They just really inspired me."

After nearly fourteen years of learning and traveling, Matucheski became motivated to take on a new challenge, enrolling in the Wisconsin Master Cheesemaker® program.

"The program forces you to look deeper at things. You might take a course and think you know everything but then you get a new idea," said Matucheski. "You just see that you can never learn enough."

Matucheski graduated from the program for the first time in 2011, earning a certification in asiago and parmesan. This year he is will add romano and fontina.

"I would encourage others to go through the program as you gain incredible knowledge from incredible people," said Matucheski. "It has helped me to better predict things; I've become the guy who can walk into the plant and know when something is wrong. It's also a great opportunity to think about what new and creative things you can do with cheese. You know, it's funny, my kids sometimes even call me the "Willy Wonka" of cheese."

DUANE PETERSEN ▸ ARLA FOODS

Certified Master: Havarti

Duane Petersen has been making cheese for more than forty years now, but he didn't always plan on becoming a world-class cheesemaker. Petersen actually began working in a cheese factory when he was 14 as a way to save money for college. He continued working at the plant while earning an associate's degree and had plans to work as a Civil Engineer after school, but cheesemaking kept calling him back.

"Cheesemaking was something I just decided to stick with," said Petersen. "I really enjoy making many different products and making sure everything turns out as it's supposed to. It provided me with work even in difficult economic times. The craft has been good to me for many years which helped in the support of my family."

Petersen's passion for his craft led him to pursue a Wisconsin Master Cheesemaker certification in 2002 in edam and gouda. This year, Petersen returned for a certification in havarti.

"The Wisconsin Master Cheesemaker® program offers so many different educational courses and opportunities," said Petersen. "The staff at the Center for Dairy Research are helpful and the program has really allowed me to better myself."

Petersen currently works for Arla Foods, making cheese, helping to keep equipment up-to-date, mentoring cheesemakers, monitoring the cheese recipes and helping to

make sure everything runs smoothly. He hopes that his years of experience will help his fellow cheesemakers and that his certifications will help his company to grow.

"The Wisconsin Master Cheesemaker® program is something I've always wanted to do. It gives you a better understanding of the cheesemaking process. It is about making a better product for your customers and it has helped me to accomplish that. I would like to thank the Wisconsin Center for Dairy Research and the Wisconsin Milk Marketing Board for this wonderful program that helps Wisconsin to be a leader in the dairy industry."

STEVE STETTLER ▸ DECATUR DAIRY

Certified Master: Cheddar

A third generation cheesemaker and four-time graduate of the Wisconsin Master Cheesemaker® program, Steve Stettler of Decatur Dairy is proud to carry on the Wisconsin cheesemaking tradition. His family ties to cheesemaking date back to his grandfather, a cheesemaker from Switzerland, who came to Monroe, Wisconsin and eventually passed down his cheesemaking knowledge to his son, Roy and his grandson, Steve.

"Wisconsin offers so much to cheesemakers and has a large source of knowledge a cheesemaker can use to better his product," said Stettler.

Having grown up in the dairy industry, Stettler found that it was only natural to join the family business after attending UW-Madison. Stettler joined his father at Decatur Swiss Cheese Co-op in the early 1980s, taking over as manager of the co-op in 1982. Soon after, Stettler and his wife Glennette started Decatur Dairy Inc. which markets and manufactures cheese for the co-op. For the past thirty plus years, Stettler has been making cheese and managing Decatur Dairy Inc., focusing on the manufacture of havarti, muenster, brick, farmers cheese, and specialty Swiss. Stettler has a Master certification in all of the cheeses listed here, and this year, he will add Cheddar to his repertoire.

"The Wisconsin Master Cheesemaker® program is just a unique program and the networking in that group presents a great source of cheesemaking expertise," said Stettler. "The people you meet are great and the cheesemaking and artisan classes are always a really good source that you can go back to. I've really enjoyed being involved and watching the program gain momentum."

Stettler has served on the Wisconsin Master Cheesemaker® program board several times over the years, has been President of the Foreign Type Cheesemakers Association, is President of the Wisconsin Cheesemakers Association, and recently became President of the National Historic Cheesemaking Center in Monroe, Wisconsin. Decatur Dairy has also won several awards in the U.S. Championship Cheese Contest, the World Championship Cheese Contest and in several fairs including the Wisconsin State Fair.

"Wisconsin supports the cheese industry and it is great to be part of an industry that gives back," said Stettler. "My favorite thing about making cheese here are the relationships I've built in the industry and trying to make it better. Plus, you can tell a few cheese jokes and wear a cheesehead."

ADAM BUHOLZER ▸ KLONDIKE CHEESE

CHRIS ROELLI ▸ ROELLI CHEESE

KEN HEIMAN ▸ NASONVILLE DAIRY

MIKE MATUCHESKI ▸ SARTORI

DUANE PETERSEN ▸ ARLA FOODS

STEVE STETTLER ▸ DECATUR DAIRY

IMPROVED SEPARATOR EFFICIENCY PART 1: THE BASICS

Contributed by Dr. Robert L. Bradley, Dept of Food Science and CDR, UW-Madison and David Johnson, dairy industry consultant, retired from Separators, Inc.

This is part one of a two-part article discussing separators, cream quality and maximum returns.

Most dairy plants today have a unique piece of equipment within their facility called a centrifuge. It may go by other titles such as separator or clarifier, but whatever the title, they all separate components of a mixture on the basis of gravity or component densities.

The concept of density separation is not entirely new. Early technology allowed milkfat to simply rise by gravity before it was scooped from the surface of the milk as cream, but in 1890 Gustaf de Laval invented the first mechanical milk separator in France. This device used the same conical shaped nested discs that are in most of today's units *(Figure 1)*. These units have been modernized but the principle of gravity/density separation has not changed. Whether it is simply the removal of milkfat from whole milk or whey, the removal of water from cultured Greek yogurt, the fractionation of partially crystallized milkfat, or the removal of sediment and debris, the principle of density (gravity) separation prevails. Your challenge as a dairy plant worker is to operate the equipment at maximum efficiency to gain effective separation of the components with minimal loses.

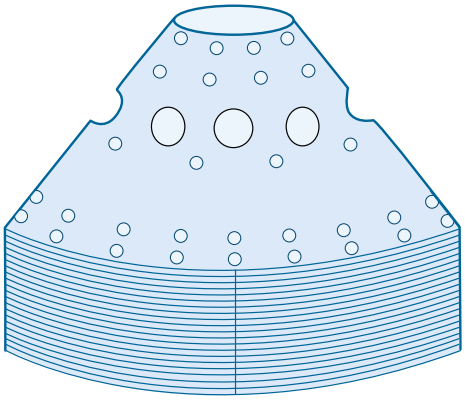


Figure 1. Conical shaped nested discs. Source Tetra Pak

The efficient separation of milkfat as cream from milk or whey is influenced by many variables including: the difference in density between the aqueous phase and the milkfat, the temperature of the product, the size of the fat globules, the diameter and speed of the bowl (centrifugal force), and the flow rate through the separator. Whether the separator is designed for cold milk or heated milk defines the spacing between the conical shaped discs and the efficiency of separation. The thinner the layer of milk, the more efficient the removal of milkfat. The greater the distance the layer of milk travels across the conical disc, i.e., bowl diameter, the greater the efficiency. Temperature also plays a huge role in efficiency of separation. The warmer the product the thinner the layer, meaning less viscosity which also affects the density of the components and in particular, the difference between milkfat and skim milk.

Table 1 shows the density changes at temperatures useful to users of separators. Note the minor change in skim milk density compared to milkfat. Whey would show similar differences.

Table 1: Approximate Densities of Milk Components

°C	°F	Skim Milk	Milkfat
5	41	1.0365	0.9612
10	50	1.0359	0.9512
15	59	1.0348	0.9421
20	68	1.0338	0.9304
25	77	1.0322	0.9208
60	140	1.0171	0.8913
65	149	1.0145	0.8881
70	158	1.0117	0.8848

H. H. Sommer, 1952, Market Milk and Related Products, Olson Publ. Co. Milwaukee, WI

In general, dairy separators have two capacity ratings:

1. Milk Standardizing Capacity: this capacity is sometimes referred to as the maximum hydraulic capacity of the separator. It is used when only a portion of the milkfat is removed to produce the desired level of milkfat in the finished cheese milk or beverage milk. This capacity can be as much as 50 percent higher than the original equipment manufacturer rated separating capacity. The resulting skim milk will have between 0.03 and 0.05 percent milkfat remaining.

2. Milk or Whey Separation Capacity: This is a rated capacity provided by the original equipment manufacturer (OEM) for the purposes of marketing the right size machine for the right application. These capacities were developed long ago and were set to provide a skim milk or skim whey that would result in an extra grade dried product. It does not represent the actual total amount of fat or the lowest fat skim a given separator can remove from a given product stream. This effect can usually be achieved when operating a separator at approximately +/- 80% of the full rated capacity. If the desired end product is the lowest fat content whey, milk protein concentrate (MPC) or whey protein concentrate (WPC) or even whey protein isolate (WPI), then this 80 percent rule should be followed. Monitor the milkfat content of the whey or skim stream to develop your process.

Efficiency

The efficiency of whole milk separation and whey separation is influenced negatively by abusing the base products before separation. The fat globules will be reduced in size by air entrainment, shearing by high speed centrifugal pumps, pressure drops across valves, or sudden exposure to vacuum. Also, as a result of abuse, active lipase can attack exposed milkfat in the sheared milkfat causing rancidity.

High levels of cheese fines in whey can also lead to reduced separator efficiency. Mozzarella and Queso Fresco fines are particularly sticky. Fines from such products lodge between the discs in the separator decreasing product residence time in the bowl which decreases efficiency of separation. To maintain peak efficiency in the separator, consider using 20 micron screens in your fine saver. Better yet, use a clarifier to obtain the clearest whey stream and improved function of ultrafiltration (UF) and reverse osmosis (RO) systems.

Depending on the brand and age of the separator, the spacers on the disc stacks will differ. Some of the older machines have spacers of 0.5 mm material. The newer machines have spacers of 0.32 mm and even 0.28mm. Because of this, the older units will be more 'forgiving' in handling a quantity of cheese fines.

Cream Concentration

In general, all milk and whey separators were designed to produce 40 percent fat cream (*Figure 2*). The location of the rising channels in the disc stack, the sizing of the skim and cream centripetal pumps in the machine, and the external product valving affect and control the process to deliver 40 percent cream. The separation process must begin where the rising channels are or the process will greatly suffer or may not function at all (*Figure 3*).

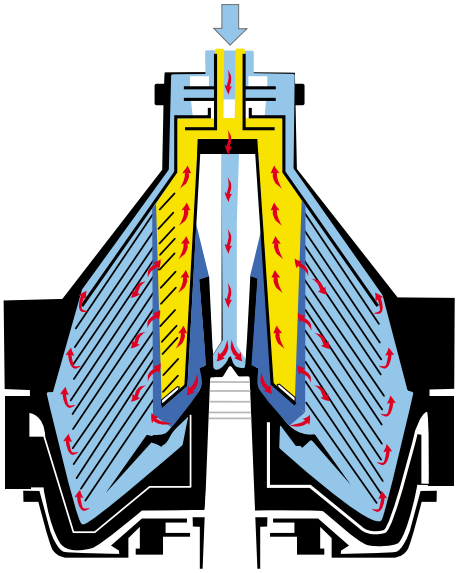


Figure 2: Semi-open self-cleaning separator. Source Tetra Pak

When separating milk, approximately 9 percent of the total feed volume will be discharged as 40 percent fat cream. When separating whey, approximately 0.5 percent or less of the total feed volume will be discharged as 40 percent cream. In whey separation, this low volume makes control somewhat challenging, but can now be achieved with up-to-date Programmable Logic Controller (PLC) controls, instrumentation and valves.

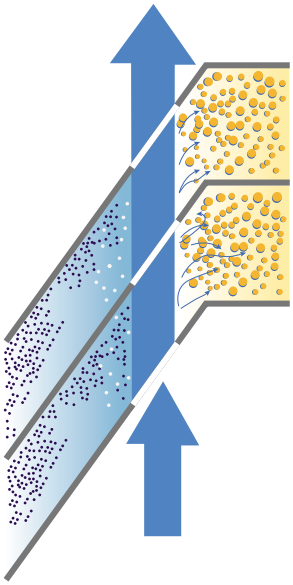


Figure 3: Milk or whey flow and separation in disc stack. Source Tetra Pak

Up-to-Date Proper Controls

With today's newer desludging centrifuges, PLC based control systems, magnetic and mass flowmeters, electronic positioner valves, etc., a much more advanced control of a separation process can be achieved. In general, small increases in overall efficiency are attainable by removing the cream from the bowl with the bypass valve prior to sediment ejections and allowing the cream to concentrate after this process is completed. Further, use a combination of partial and full sediment ejections along with water flushes to keep the machine better cleaned out and provide a more efficient operation over multiple hours of operation.

Newer models of separators will be more efficient than older models because the bowls are usually larger creating a longer path for the force of gravity to act on the fat globules and solids-not-fat. "Warm" milk separation (hot side of the regenerator) will be much more efficient than performing the same task with cold milk or cold whey. Consideration for potential lipase activity is needed with "heat treated" milk and cream. Rapid cooling to <45°F is required to minimize lipase activity and maintain cream quality.

Preventative maintenance and training

Separators are usually trouble free machines, especially if properly maintained, however do not expect to get peak performance unless they are properly maintained, cleaned, regasketed, etc. Further, operators or maintenance personnel must be correctly trained by qualified personnel to keep things running smoothly.

Part II: *Managing cream quality to maximize returns, Summer 2015 Dairy Pipeline.*

Wisconsin Cheese Industry Conference 2015

ALLIANT ENERGY CENTER, MADISON WISCONSIN, APRIL 22 & 23

JOIN US!

Join CDR at the nation's top seminar for the cheese, butter and whey industry – The Wisconsin Cheese Industry Conference (WCIC), April 22 – 23, 2015 at the Alliant Energy Center, Madison, Wisconsin.

Network with CEOs, marketers, plant managers and R&D staff; sample contest winners from the U.S. Championship Cheese contest; and best of all, challenge CDR staff at the Thursday morning technical session, "Finding Solutions with your Cheese Doctor on Call". See below for a full list of the CDR sponsored sessions and workshops.

To view the entire WCIC program and to register now: www.cheeseconference.org

CDR Technical Session, Thursday, April 23

9:30 – Noon ▸ Mendota Rooms 1-4

Finding Solutions with Your Cheese Doctors on Call

Center for Dairy Research staff will address common technical questions they receive from the cheese industry. From product safety to controlling bake performance in mozzarella and how to successfully increase moisture content in cheese. Don't miss these practical, solution-based talks and a wide-open panel discussion between CDR's world-class staff and cheese industry professionals like you.

Moderator

Dean Sommer
Cheese and Food Technologist, Center for Dairy Research

How to Successfully Increase Moisture Content in Your Cheese

Dr. Mark Johnson
Distinguished Scientist and Assistant Director
Center for Dairy Research

Controlling Bake Performance in Mozzarella Cheese

Dr. Rani Govindasamy-Lucey
Senior Scientist, Center for Dairy Research

Novel Approaches to Improved Safety of Natural Cheese

Adam Borger, Program Outreach Manager
Food Research Institute, UW - Madison

Panel Q&A

CDR Concurrent Workshops , Thursday, April 23

1:30 – 3:30 p.m.

Workshop I: Detecting Flavor and Texture Defects in Cheese ▸ *Upstairs Lounge, Limited to 40*

This hands-on workshop will focus on four common defects: acid, bitter, weak texture, and off flavors. You'll have an opportunity to learn how to use all of your senses in detecting these defects, and discuss with the cheese doctors solutions to avoid these defects in your cheese. This is your opportunity to interact with and challenge four of the best in the industry when it comes to cheese grading and defects: **Dr. Mark Johnson, Dean Sommer, John Jaeggi CDR; and Terry Lensmire, Agropur.**

Workshop II: Detecting Flavor Defects in Whey Ingredients ▸ *Monona, Wingra Rooms, Limited to 30*

Become the company expert on evaluating the sensory properties of whey ingredients. You'll learn from CDR's **KJ Burrington and Susan Larson** about typical flavor attributes for everything from sweet whey to whey protein isolates, as well as how to taste the attributes such as oxidized, cooked, or astringent, how to characterize your own ingredients and develop your own internal system of grading.

Visit Us at Booth #605

Stop by the CDR booth on Wednesday afternoon. We're located in booth #605 near the Ideas Showcase stages. Catch up with CDR staff to discuss any questions or projects in the works.

CDR Booth at 2014 International Cheese Technology Exposition (ICTE).

UNITED STATES CHAMPIONSHIP CHEESE CONTEST

MARCH 17-19, 2015

The United States Championship Cheese Contest, hosted by the Wisconsin Cheese Makers Association, was held March 17-19 in Milwaukee, Wisconsin. This competition, which occurs in the spring of odd years, brought in 1,885 entries from 28 states, setting a new record for entries. There were thirty-two expert judges in attendance including CDR cheese technologist Dean Sommer, CDR distinguished scientist Mark Johnson, Ph.D., CDR cheese applications coordinator John Jaeggi and CDR dairy ingredients, cultured products and beverages coordinator K.J. Burrington.

In addition to the cheese and butter classes, this year the Wisconsin Cheese Makers Association introduced six new classes including lowfat yogurt, high protein yogurt and drinkable, cultured products, making for a total of 90 dairy classes. Burrington assisted in judging the cultured products category, tasting 86 yogurts over the course of the competition. Meanwhile, Sommer, Johnson and Jaeggi were involved in judging the various cheese categories throughout each round of the competition. The winner in the cheese contest, a Swiss wheel from Team Guggisberg Sugarcreek, of Guggisberg Cheese, Millersburg, OH, was announced on Thursday evening March 19 during the Champion Cheese Charity Event-Benefit for the Hunger Task Force.

While Wisconsin didn't take home first prize, according to the Wisconsin Cheese Makers Association, cheesemakers from the Dairy State did take home 56 gold medals, the most of any state. Additionally, 82.7 percent winners attended a CDR Short Course prior to the competition. **Congratulations to all the winners.** A full list of results is available at www.uschampioncheese.org.

Dr. Mark Johnson, CDR judging cheese.

Dean Sommer, CDR judging cheese .

Sherrie Tussler, Executive Director of Hunger Task Force and John Umhoefer, Executive Director of the WCMA.

CDR NEWS

Welcome Pat Polowsky

As the sensory coordinator at CDR, Pat works closely with center staff and industry partners to tailor sensory analyses to meet the specific objectives of each project. He oversees the training of panelists, participates in the sensory components of several short courses and constantly endeavors to expand CDR sensory portfolios and capabilities. Pat graduated from Purdue with a degree in Food Science and he is excited to continue to follow his passion for food chemistry and education. Pat is particularly passionate about sensory as he feels it is the perfect combination of pure science and human interest.

Congratulations, Juan!

Please join us in congratulating CDR researcher, Juan Romero on receiving the International Dairy Federation (IDF) Prize of Excellence. The prize was awarded to Juan and four fellow scientists for their efforts to modernize and validate the Kjeldahl method.

According to IDF, the Prize of Excellence is a "mark of recognition and appreciation for outstanding work and involvement in the IDF Programme of Work in accordance with the following five concepts: speed, worldwide visibility, impact, focus and transparency."

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Short Course Calendar:

- World of Cheese, April 26-30
- Wisconsin Cleaning & Sanitation Workshop, May 5
- HACCP Workshop, May 6
- Applied Dairy Chemistry, May 12-13
- Cheese Grading Short Course, June 2-4

For detailed information on each CDR short course:
www.cdr.wisc.edu/shortcourses

Events:

Wisconsin Cheese Industry Conference
April 22-23, 2015 | Madison, WI

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