

# Dairy Pipeline

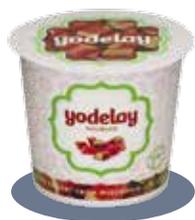
Volume 29 Number 2

A Technical Resource for Dairy Manufacturers

## CANDINAS' CULTURED CREATION

### HOW CDR HELPED LOCAL CONFECTIONER AND ENTREPRENEUR MARKUS CANDINAS CREATE A NEW ARTISAN YOGURT

In a Swiss town where the sweet smell of the local confectionery shop wafts through the air and summer afternoons are spent picking raspberries to place atop the local yogurt, Markus Candinas found his inspiration. A young child at the time, Candinas spent his summers in this town visiting his grandparents and taking in the local flavors. By the time he was six years old, Candinas had developed a love for gourmet food and his passion for experimentation in the kitchen was growing. At sixteen, he moved from the United States



to Interlaken, Switzerland to study at a confectionary school and today, those experiences have culminated in the opening of Candinas' two businesses, Candinas Chocolatier and, his latest entrepreneurial venture, Yodelay Yogurt.

An entrepreneur at heart, Candinas opened his first business, Candinas Chocolatier in 1994, shortly after returning from his time as an Apprentice Confiseur in Interlaken, Switzerland. The confectionary, which now has stores in Verona and Madison, Wisconsin is a celebrated artisan chocolate shop and has enjoyed success for more than 23 years, but in 2003, Candinas found himself thinking about those early memories of Swiss yogurt.

Eager to create a new, artisan yogurt reminiscent of the one he had enjoyed as a child, Candinas developed his business plan for a Swiss-style brand, Yodelay Yogurt. Although Swiss-style yogurt does not have a legal definition, Candinas describes it as a lighter, creamier



yogurt with a slightly tart flavor. "I wanted to create something different and I was deeply influenced by the European style," said Candinas. "I guess I would say my ideology is somewhere in the Mid-Atlantic."

In an effort to create this unique, but traditional, experience for consumers, Candinas decided to develop a Swiss-style yogurt that mimics what's found in Switzerland. He also made it a point to create a clean label product with milk sourced from a local family farm. Although there were many great options for his milk, Candinas eventually secured milk from Voegeli Farms, a family owned Brown Swiss dairy farm just 30 minutes from the Yodelay Yogurt plant. With authentic cultures and locally sourced Brown Swiss milk, Candinas didn't feel he needed to reinvent the wheel in terms of flavor, but he knew he had to create a delicious raspberry flavor that would pay homage to the sweet berries he used to pick from his grandmother's garden in Switzerland.

Deeply inspired and armed with a plan, Candinas set out to create this distinctively artisan yogurt. He found, however, that despite his previous success as an entrepreneur, entering the dairy foods industry had its own set of challenges. That is when he found the Dairy Business Innovation Center (DBIC), a not-for-profit organization launched in 2004 thanks to a federal earmark and support from the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). Developed to provide technical and business assistance →



to Wisconsin entrepreneurs in the dairy industry, DBIC served as a resource for the industry before it ended in 2012. Although the program is no longer around, Candinas is thankful for the help he received from the organization.

“DBIC did so much for me as I was working to get this business going,” Candinas said. “They helped me to cut through massive amounts of information and pinpoint what I really needed to consider.”

In fact, Candinas says that it is thanks to DBIC that he was introduced to Center for Dairy Research Dairy, Ingredients, Cultured Products and Beverages Coordinator KJ Burrington, who was able to help him realize his dream of creating an authentic Swiss-style yogurt.

Funded by the dairy farmer check off program through partners such as the Wisconsin Milk Marketing Board and the National Dairy Council,



CDR serves as a resource for dairy foods companies looking to bring innovative, nutritious and profitable products to the global marketplace. CDR offers clients, such as Candinas, access to a pilot plant and technical experts who are able to assist with product development and troubleshooting. Burrington serves as

the technical expert for cultured products, so she worked with Candinas to create his ideal product.

“Candinas came to CDR with a recipe in mind, but he needed a place to create his yogurt on a larger scale,” Burrington said. “The CDR pilot plant has conditions that are typical for a larger plant so it’s a great place to experiment.”

In addition to a few trials at CDR, Burrington also recommended that Candinas attend the CDR Cultured Products short course to learn more about yogurt production. The course, which is held bi-annually, covers the basics of manufacturing yogurt, sour cream, kefir and specialty products, incorporating lectures, demonstration labs and evaluations, which assist attendees in their production of high quality, fermented dairy products.

Although Candinas had experience in the food industry, he says he was able to gain a great deal from the Cultured Products short course, including information about milk that helped him to enhance his chocolate confections.

“KJ has been helpful in hooking me up with everything from culture companies to technical assistance,” Candinas said. “The ability to go to CDR and meet with people who have been living and breathing this industry and to be able to test out ideas in their facility is great.”

In addition to the product development and technical assistance, Candinas was also able to secure economic development and business assistance from the CDR Technology Transfer, University Resources and Business Opportunity (TURBO) program. A comprehensive business accelerator designed to increase the speed of commercialization for new products and technologies specifically related to the dairy industry, the TURBO program provides CDR clients with access to everything from a portfolio of technologies to grant assistance.



*Brown Swiss Cows*

In 2016, when Candinas was building the Yodelay yogurt plant, Burrington introduced him to TURBO Program manager, Vic Grassman, who was able to help Candinas secure a grant through the Wisconsin Economic Development Corporation (WEDC) to purchase a homogenizer. The grant program, which assisted eleven dairy foods companies from May 2013 to September 2016, helped to create or retain 29 jobs and leveraged a 10 to 1 return on WEDC funds.

After securing the necessary equipment and finalizing his product, Candinas’ dream, 14 years in the making, finally came true in April 2017 when Yodelay Yogurt launched in stores. Available in raspberry, peach-raspberry, pineapple, rhubarb, tart cherry, blueberry and strawberry, the yogurt has received positive feedback from consumers, including Burrington, who is proud of the product she had a hand in creating.

“I like the yogurt because of its bright, tart flavor and I enjoy the fact that all of the fruit flavors are very true to the fruit,” said Burrington. “My favorite is the rhubarb yogurt.”

Found in Madison area stores such as Metcalfe’s Market, Hy-Vee and Miller & Sons Supermarket, Candinas is proud to say that the Swiss yogurt he so loved as a child is quickly finding its niche in the United States.

“We’ve been doing in-store tastings and it’s so great to see that people like it,” Candinas said. “There’s always an element of self-doubt with something new like this. Yes, there’s an entire country that enjoys this style of yogurt, but I didn’t know if Americans would accept it. It’s not your usual yogurt, but the response has been amazingly great. I just can’t help but feel like we’re on to something here.” 🍌

## WHEY HANDLING IN WISCONSIN: UPDATE

Technical Reviewers: Karen Smith, Ph.D., CDR and Kathy Glass, Ph.D., UW, Food Research Institute

Ensuring a safe, nutritious product is the top priority for the dairy industry, which is why the Center for Dairy Research is collaborating with organizations around the state to investigate the safe handling of raw whey. A huge undertaking, CDR, the University of Wisconsin-Madison Food Research Institute (FRI) and the Wisconsin Cheese Makers Association (WCMA) have been working closely with the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) to investigate the current regulations surrounding the transportation of raw whey as well as alternative options for those who lack the ability to meet those regulations.

### The Current Situation

Originally outlined in Volume 28, Number 3 of the *Dairy Pipeline*, this team has been working together for more than a year to develop an overall approach to raw whey handling that takes into consideration the needs and resources of both large and small plants. As a part of this effort, the team has decided to focus their research on new prevention methods for *Staphylococcus aureus*, an organism that is present on the skin and in the nose and respiratory tracts of some humans. Although the organism itself is not always dangerous, it is capable of producing a heat-stable toxin that can cause food borne illness. Unfortunately, warm whey serves as the perfect catalyst for the production of this toxin since *S. aureus* is mesophilic, growing at the same temperature as many mesophilic cheese cultures. For this reason, current regulations focus on the prevention of *S. aureus* through temperature control.

A full list of regulations concerning whey handling and processing in Wisconsin are available through DATCP under ATCP 80 and ATCP 65, but essentially, whey

must either be cooled to less than 45 degrees Fahrenheit or heated to at least 140 degrees Fahrenheit within four hours of draw from the vat to prevent the growth of this toxin. Unfortunately, processing whey and storing it according to these regulations is a huge expense that cannot be taken on by many small plants. To remedy this issue, DATCP has created a short-term variance, which allows for the legal use of up to 100 ppm of hydrogen ( $H_2O_2$ ) peroxide in raw whey as an antimicrobial agent, however, some customers will not accept whey that has been processed utilizing this method. Additionally, DATCP rules state that there must be no detectable hydrogen peroxide in the whey products before final processing and the four-hour processing requirement remains in effect. While this variance serves as a viable short-term solution for some manufacturers, DATCP and other industry team members asked FRI and CDR to focus on a more permanent solution, particularly focusing research efforts on the study of *S. aureus* and its behavior in whey.

### Finding a Solution

In order to develop a permanent solution, the team sought to answer four questions about *S. aureus*. These questions include:

- ⊗ How does the presence of starter bacteria and acid production affect *S. aureus* growth?
- ⊗ What is the effect of temperature on *S. aureus*?
- ⊗ What is the effect of hydrogen peroxide on *S. aureus*?
- ⊗ What are the Z- and D- values for *S. aureus*?

Joining forces, the team decided that FRI would investigate the questions through research funded by WCMA. Once complete, CDR and DATCP would use the research data to develop alternatives to current requirements that would take into consideration the balancing act companies face. In other words, the need to create a high-quality and safe product at a reasonable cost.

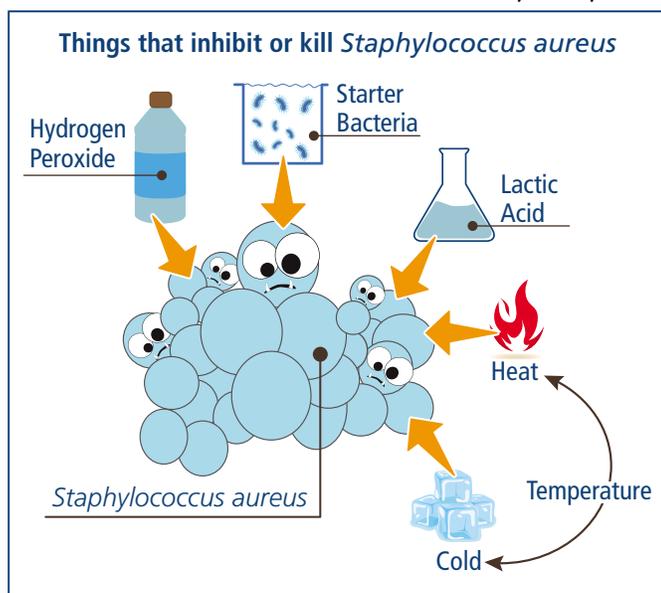
At this time, FRI has completed two studies, which are outlined below. The hope is that the findings can be utilized to develop pasteurization procedures to kill vegetative pathogens such as *S. aureus* while gaining a better understanding of the way *S. aureus* behaves in whey.

### Study 1

#### Inhibition of *Staphylococcus aureus* in Whey Treated with Hydrogen Peroxide during Extended Non-Refrigerated Storage

Brandon Wanless, Associate Researcher, FRI and Kathleen Glass, Ph.D., Associate Director & Distinguished Scientist, FRI

**The goal:** To assess the ability of whey treated with hydrogen peroxide to inhibit the growth of *S. aureus* when stored non-refrigerated for 24 hours. ➔



**Methods:** Two whey types (with and without starter culture; four lots each) were inoculated with 3-log *S. aureus* per ml. Whey was then treated with 0, 10, or 100 ppm H<sub>2</sub>O<sub>2</sub>, and samples incubated at either 21 or 32°C. Results: When stored at 21°C, the no-starter culture whey without H<sub>2</sub>O<sub>2</sub> supported >1 log increase of *S. aureus* at 8 hours, whereas none of the other treatments supported growth for the 24 hour holding period. When stored at 32°C, the no-starter whey with 0 or 10 ppm H<sub>2</sub>O<sub>2</sub> supported >1 log growth at 4 and 8 h, respectively. In contrast, no growth was observed in the 100-ppm treatment for no-starter whey or in any of the whey with starter culture. The pH of whey without H<sub>2</sub>O<sub>2</sub> decreased from 6.6 to <5.0, regardless of inclusion of starter culture whereas the pH of treatments with 100 ppm H<sub>2</sub>O<sub>2</sub> remained stable.

**Significance:** Data suggest that whey produced with a starter culture will inhibit *S. aureus* if stored at <32°C for up to 24 hours. Alternatively, *S. aureus* can be inhibited in whey through temperature-time control or addition of 100-ppm hydrogen peroxide.

## Study 2

### Thermal Inactivation of *Staphylococcus aureus* in Liquid Whey

Kori Scherer, undergraduate research assistant and Brandon Wanless, Associate Researcher, FRI and Kathleen Glass Ph.D., Associate Director & Distinguished Scientist, FRI

**The goal:** To determine the D- and Z-values of *Staphylococcus aureus* in whey.

**Methods:** Six lots of whey (three lots each from cheese made with or without mesophilic starter culture) were standardized to pH 6.5±0.1 with NaOH and inoculated with a 3-strain mixture of *S. aureus* to yield 9-log CFU/ml. Samples (1ml aliquots) were vacuum-sealed in

moisture-impermeable pouches and heated to 60.0, 62.8, 65.6, or 68.3°C (140, 145, 150, or 155°F) by submersion in a water bath. For each treatment, duplicate samples were removed from heating at appropriate time intervals and enumerated for surviving *S. aureus* by plating on Baird-Parker agar overlaid with Tryptic Soy agar to aid in the recovery of heat-injured cells.

**Results:** There was no statistical differences in thermal inactivation rates for whey regardless of whether it was produced with starter culture (P>0.05). Pooled data was used to calculate thermal inactivation rates. D-values were 1.32, 0.38, 0.12, and 0.07 minutes for samples heated at 60.0, 62.8, 65.6, or 68.3°C. Z-value was calculated to be 6.1°C (11.5°F) with best-fit reference temperature of 62.8°C.

**Significance:** These data can be used by the dairy industry to develop pasteurization procedures to kill vegetative pathogens such as *S. aureus*.

### Looking to the Future

Thanks to the efforts of FRI staff, these studies can be utilized to determine a more permanent solution for the safe handling and transportation of raw whey in Wisconsin. The next step will be for regulators to work with industry and CDR to create new solutions based on the studies that will preserve whey quality and safety while keeping processing costs low for manufacturers. A special thank you to industry, specifically WCMA, who helped to make this research possible. It is only through partnerships such as this that the industry will continue to increase dairy manufacturing innovation and provide consumers with safe, wholesome products.

For more on the studies and next steps please contact Dr. Kathy Glass | [kglass@wisc.edu](mailto:kglass@wisc.edu) 🍌

## CURD CLINIC: CRYSTALS IN CHEESE

Contributed by Mark Johnson, Ph.D., CDR

### Question

In Volume 26 Number 3 of the *Dairy Pipeline* you discussed crystal formation in cheese and the fact that there is a lot more to learn regarding the science behind crystal formation. Have you done any new research in this area?

### Answer

Crystals in cheese continue to be an area of study here at CDR. As you mentioned, in the Volume 26, Number 3 issue of the *Dairy Pipeline*, we discussed the formation of calcium lactate in Cheddar and Colby. We also mentioned the presence of leucine and tyrosine crystals in hard Italian and aged Gouda cheese, particularly

focusing on the role of *Lactobacillus helveticus* in the development of these crystals. Today, we are continuing to study those issues but we have also expanded our research into other types of crystals in other cheese varieties, such as those caused by calcium phosphate, also called brushite. In studying these crystals, we have found an excellent partner and friend in Franklin Hobbs of the UW-Madison Geology department who uses their x-ray diffraction equipment, a tool commonly used to identify the chemical make-up of crystalline structures in rocks, to help us identify each crystal. While our research is still ongoing, I want to share with you what we have discovered through our study of crystals in blue cheese and hard, aged, wash-rind cheeses such as Gruyere.

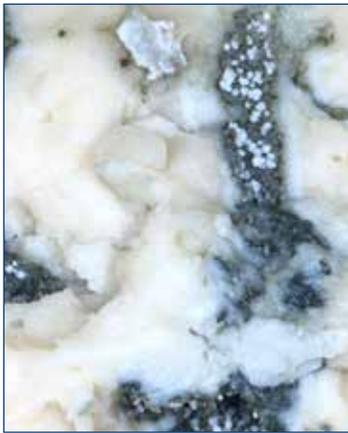
**Review: The Science Behind Crystal Formation**  
While Volume 26 Number 3 of the *Dairy Pipeline*

thoroughly explains the science behind tyrosine, leucine and calcium lactate crystal formation, it is helpful to revisit some of those facts before discussing our latest findings.

First, it's important to recall that most crystals are harmless and that in some cases, crystals are actually seen as a desirable trait in certain aged cheeses. Despite this, crystals often confuse consumers who mistake them for a defect, glass in the product or even mold growth. Therefore, studying crystals and their cause is essential, as this research will allow us to learn how to select for or against crystal formation.

### What We Know About Crystal Formation

At this point, studies show that the formation of a crystal requires two conditions for development; concentrations exceeding solubility and the expression of free serum. In other words, for a crystal to develop there must



Tyrosine and leucine crystals on blue cheese



Brushite deposits found on brine tank



Enlarged view of calcium phosphate crystals isolated from cheese

be enough crystal components present that there is physical contact between them (exceeding solubility) and conditions that allow serum to move to the crystal nucleation site (expression of free serum). Essentially, a crystal will develop when the concentration of calcium lactate, leucine or tyrosine increases to the point where molecules touch, thereby reacting with each other and developing a crystal nucleation site. Once this site forms, the availability of free serum will encourage more calcium lactate or tyrosine to move towards the site eventually making the nucleation site, or crystal, large enough to be seen by the naked eye.

Based on this information, it has become evident that a crystal is most likely to develop wherever water, or free serum, can easily collect on

the surface or inside the cheese. Therefore, cheesemakers need to keep an eye out for areas of incomplete curd particle fusion or a wrinkle in the packaging which are the perfect environment for free serum collection and the eventual formation of a crystal. It is also important to avoid temperature abuse as this can cause the cheese to sweat, a source of free serum buildup. Additionally, areas with high buildup of colloidal calcium phosphate are also points of water accumulation and serve as a source of free calcium as the cheese acidifies.

In addition to moisture issues, research has also shown that *L. helveticus*, a common starter bacteria used in cheesemaking, can cause tyrosine and leucine crystals to form. *L. helveticus* has a very robust peptidase activity, which develops flavor in the cheese but also releases tyrosine and leucine from the peptides. Consequently, after sufficient breakdown of peptides, substantial quantities of tyrosine or leucine are released, which exceeds the limit of solubility leading to the development of crystals.

### Blue Cheese and Tyrosine Crystals

In the case of blue cheese, we found that the tyrosine crystals were most common. Using x-ray diffraction mentioned above we determined that the crystals in the blue cheese were either tyrosine or leucine, or a combination of each with tyrosine being the dominant part. It is unclear what caused tyrosine to form, but the crystal makeup does suggest that proteolysis of casein by something like *Penicillium roqueforti* may have resulted in a concentration of amino acids sufficient to cause precipitation and, therefore, the development of crystals. We plan to investigate this further.

### Hard, Aged Wash-Rind Cheese and Brushite Crystals

In the hard, aged wash-rind cheeses we discovered a different problem all together. Instead of the tyrosine or calcium lactate crystals discussed above, we found that the crystals were tiny, did not dissolve and gave the cheese a distinctly gritty mouthfeel. Using x-ray diffraction, we were able to identify the crystals as brushite (calcium phosphate dihydrate).

Brushite is formed when calcium combines with phosphate. Initially as acid develops in the cheese both minerals dissolve. However, as the pH increases during aging, due to the formation of ammonia from protein breakdown, these minerals recrystallize eventually forming calcium phosphate or brushite in washed rind aged cheeses.

This issue may develop due to slow acidification during cheesemaking. With insufficient acidification of the milk and curd by whey separation the level of calcium phosphate remaining undissolved is high. If subsequent

*Continued on page 9*

# UNDERSTANDING AND PREVENTING BACTERIOPHAGE

Technical Reviewers: Mark Johnson Ph.D. & Dean Sommer, CDR

Cheese is often referred to as a living product thanks to the plethora of bacteria, yeast and mold that can occur within the product. Although cheese itself may not be truly alive, it does contain living starter bacteria, and like any living thing, these bacteria can get sick.

Bacterial viruses, known as bacteriophage or phage, have the ability to infect bacteria in cheese, including the starter culture, leading to bacterial lysis and consequently, the loss of necessary lactic acid production. While there are many types of phage, the specific strains that kill lactic acid bacteria are immensely problematic for cheesemakers who rely on lactose fermentation to acidify the milk and eventually produce the desired characteristics of cheese. Like most viruses, the bacteriophage is easily spread and is invisible to the naked eye. In fact, phage are 1/1000 the size of a bacterial cell and cannot be seen under a traditional microscope. Small, easily spread and strong enough to survive pasteurization, bacteriophage are difficult to eliminate. Luckily, the incidence of phage can be reduced when a cheesemaker takes preventative measures and gains a clear understanding of the bacteriophage lifecycle, symptoms and modes of transmission.

outnumber the starter bacteria, therefore inhibiting lactose fermentation within hours. The bacteriophage that infect starter cultures multiply quickly by employing the lytic cycle (Figure 2), one of two lifecycles utilized by viruses. During the lytic cycle the bacteriophage injects its DNA into a bacterial cell where the virus proceeds to take over the cell machinery, reproducing hundreds of phage particles which eventually cause the cell to burst or lyse. The newly released phage then go on to infect other susceptible cells. Once the spread has begun, a cheesemaker will notice slower than normal acid development taking place, an indication that a bacteriophage is present and actively destroying the lactic acid producing bacteria in the cheese.

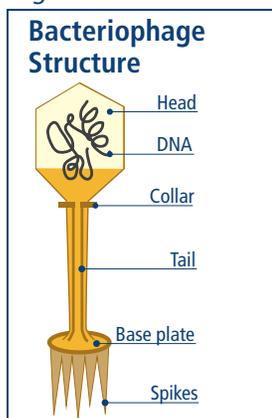
## There is a Bacteriophage in the Plant: Where they Come From and How to Prevent Them

In cheese plants, bacteriophage are primarily spread through whey movement, either aerosols of whey in air, spillage of whey on the floors or simply having whey processing located in the same room as cheesemaking. Once established in the plant, phages can find their way into the bulk starter or directly into the cheese vats. Preventing this entrance is key to avoiding costly and complicated elimination.

It should be assumed that phage are always present so prevention necessitates the use of good manufacturing practices (GMPs) that take into consideration all potential sources of contamination from floor to ceiling. Fully explained in *The Dairy Pipeline* Volume 26, Number 1 (Figure 3), a quality airflow program like the example outlined below is one of the first steps in keeping phage from entering sensitive areas of the plant and infecting the starter culture.

In addition to proper airflow, cleaning and sanitation of the plant throughout the day is also key. This includes cleaning each vat and all affected equipment utilizing a sanitizer effective against phage. Speaking with a cleaning →

Figure 1



## The Lifecycle of the Bacteriophage

Like all viruses, bacteriophage are not living and are simply made up of RNA or DNA and protein (Figure 1), but that is all they need to multiply quickly. Just one tiny virus can become 1.6 billion in less than two hours. In fact, bacteriophage multiply more quickly than lactic acid starter bacteria making it easy for a strain of bacteriophage to

Figure 2

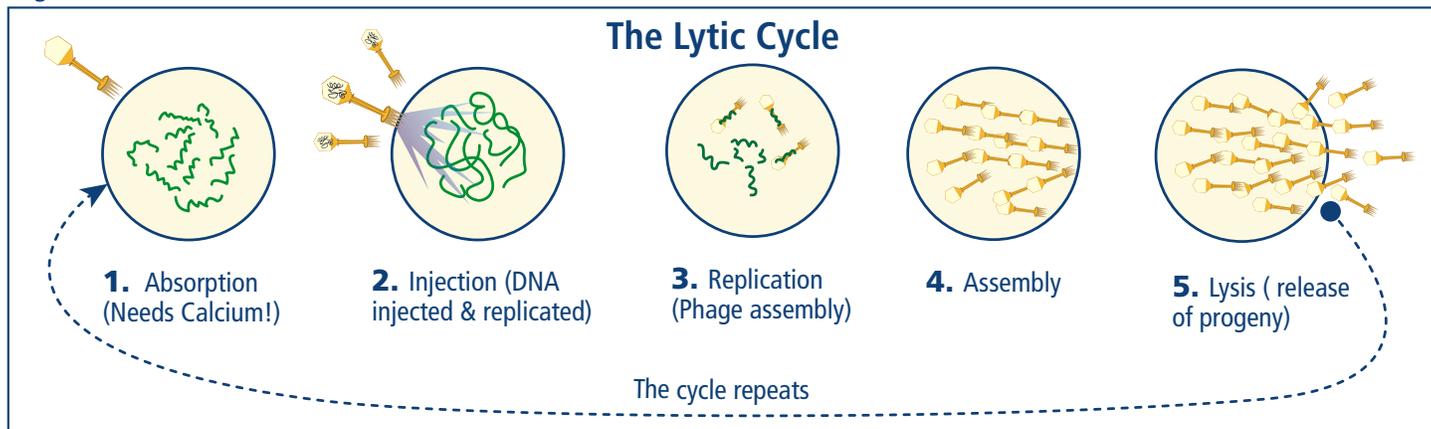
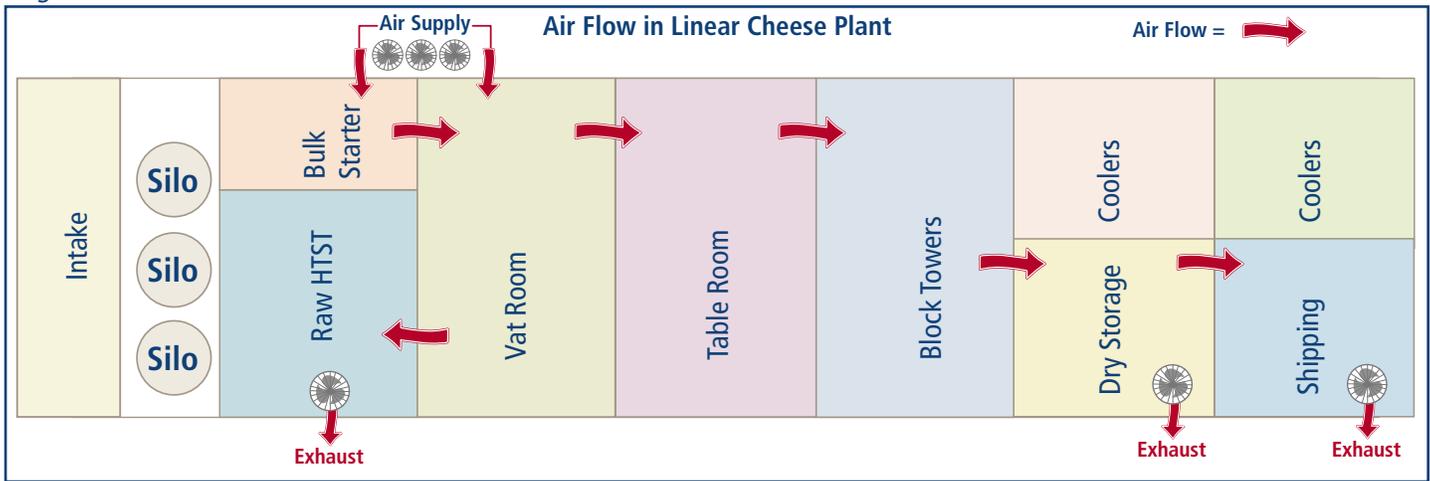


Figure 3



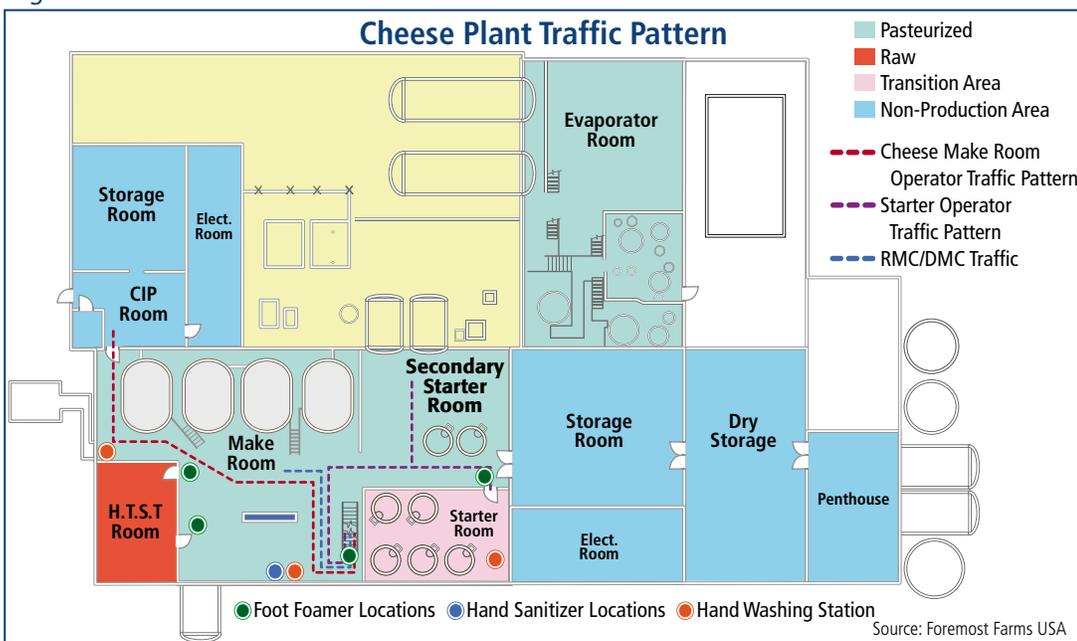
and sanitation representative about such solutions for phage control will provide the best outcome. Floors should also be thoroughly sanitized especially in areas where they can accumulate. It is advisable to sanitize the floors at least once every shift to keep the background levels of phage in the room as low as possible. Keeping the floors as dry as possible is also effective because phage need to infect living bacterial cells and bacteria cannot multiply without a source of water such as whey. Additionally, employees can carry the virus from room to room so utilizing a proper traffic flow pattern (Figure 4) and shoe sanitizer stations between rooms is essential.

Modifying the make procedure itself can also aid in preventing the development of bacteriophage. This may include transitioning to a direct vat set (DVS) procedure if a plant is struggling with a bulk starter propagation system. Adding DVS helps because it reduces the risk of contamination during propagation of a bulk starter.

A separate tactic is to shorten the time between starter inoculation and rennet addition, called ripening time, because it shortens the amount of time the phage can replicate in the cheese milk prior to coagulation. Phage infection of starter cells is most problematic before coagulation of the milk occurs, because coagulation traps the starter and the phage into the gel matrix prohibiting further movement of phage. In other words, trapping starter in the curd particles reduces the spread of phage if an infected cell bursts and releases phage.

Finally, employing culture rotation will help to avoid an outbreak. Culture rotation is using the same culture blend for a limited number of consecutive vats before switching to an entirely new blend of strains. This method works because, like all viruses, each strain of bacteriophage has a unique fingerprint that targets a specific type of bacterial cell. When multiple cultures are rotated, the bacteriophage cannot attack all of the strains (also called a narrow host range) and therefore, even if one culture is impacted, it lessens the risk of total devastation because the other strains in the starter culture mix can continue to produce acid. Contact your starter culture representative for a culture rotation plan. Keep in mind, however, that once a bacteriophage has attacked a certain strain of culture, that strain should not be reintroduced into the plant. Even a few years after an outbreak, plants have experienced a reoccurrence of bacteriophage when reintroducing a strain of lactic acid bacteria that has previously been attacked. ➔

Figure 4



Beyond the basic best practices listed above, it is essential that cheesemakers protect the lactic acid culture itself since bacteriophage target these cells. The best way to protect the lactic acid culture is to adhere to the following steps:

- ⊗ Keep DVS culture frozen until ready for use
- ⊗ Restrict access to the room where starter cultures are stored and propagated i.e. bulk culture room. In other words, bulk starter rooms, pasteurizer rooms and cheese vat rooms must be segregated from any whey processing operations.
- ⊗ Do not use a partial DVS container. This is important for two reasons. First, the culture packaging contains a number of different organisms that are not necessarily equally distributed so utilizing half of a container or less may compromise the effectiveness of the culture. Secondly, utilizing a culture that has been open for a few hours or a few days can lead to contamination issues including bacteriophage.
- ⊗ Avoid reintroducing cheese fines, whey or whey cream back into the vat as these can contain bacteriophage.
- ⊗ Avoid allowing plant personnel to move from the whey handling areas to the cheese processing areas.
- ⊗ Avoid long runs with the same starter as this increases the risk for a phage incident in the plant environment.

### **There is a Bacteriophage in the Plant: Eliminating the Virus**

Should a bacteriophage problem appear, cheesemakers will notice that the desired acid development is not taking place. If this occurs, that vat of cheese will not yield the expected pH level, and therefore, is no longer viable as a first rate commercial product.

Remember a clean environment coupled with proper culture care is the best defense against a bacteriophage issue. Don't forget to sanitize the vats and the floors, check for issues with airflow and foot traffic patterns and take additional time to ensure that employees are following GMPs. For example, ensure that worker clothing and boots have been cleaned and the plant has been sanitized. Also, remove the previous starter strain from the culture rotation before production begins again. Though culture houses are working on improving natural phage defense mechanisms, including starter strains that may be able to build immunity to certain bacteriophage, viruses mutate to survive and this can cause two unfortunate situations in the plant. First, if the previously infected strain remains in rotation the phage will likely infect the starter strain again. Secondly, several

new strains of phage can develop from one strain as it mutates, eventually leading several strains of starter to become infected. Keep in mind that phage mutation is more likely to be a problem if the same strain of starter is used exclusively, so it is best to use culture rotation.

Keeping track of phage numbers in the whey is the best way to know when to rotate cultures and to lessen the likelihood of developing new phage strains. It is imperative that all cheese plants regularly monitor and test the phage levels of the whey in their plant either through an in-house laboratory or by regularly sending whey samples to their culture supplier for testing. This is a service offered by the company that supplies your starter. Taking this step will allow a plant to detect and, ultimately, head off a potential problem with phage before it gets out of control.

### **Conclusion**

Although bacteriophage can be complex and costly, cheesemakers can make great strides in preventing an outbreak by following the prevention points outlined here. By utilizing best practices and working with your culture house, bacteriophage, and the costs and damage associated with them, will be kept at bay. 🍌

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## **RANI GOVINDASAMY-LUCEY WINS CAL S ACADEMIC STAFF AWARD FOR EXCELLENCE IN RESEARCH**

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On May 3, CDR Senior Scientist Rani Govindasamy-Lucey, Ph.D., received the 2017 College of Agricultural and Life Sciences (CAL S) Academic Staff Award for Excellence in Research. This award is given annually to a member of the CAL S academic staff who has contributed to the research mission of the college. Nominated by her colleagues, Govindasamy-Lucey is deserving of this award, having participated in countless research projects at CDR for nearly 20 years. Govindasamy-Lucey remains dedicated to quality research, currently serving as the coordinator for CDR research projects including company research and work with graduate students. She also helps to develop new projects, write grants, oversee project proposal development for company work and author project papers on cheese related topics. Please join CDR staff and CAL S in congratulating Govindasamy-Lucey on this award. 🍌



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acidification of the curd in the hoop occurs after most of the whey has been drained the calcium and phosphate that has dissolved with acidification will remain in the cheese but in a dissolved state and around the site of the original casein bound calcium phosphate.

Calcium and phosphate remain dissolved because the concentration of acid (H<sup>+</sup> ions) remains high in a cheese with a low pH. However, in certain cheeses such as wash-rind cheeses, the acidity decreases during aging. There are less H<sup>+</sup> ions to compete with calcium for sites on the phosphate molecule that now the calcium can reunite with the phosphate forming brushite, calcium phosphate crystals. Because the calcium phosphate forms near or around the original site where it was once bound to the casein many small crystals will form. Once a crystal begins to form more calcium phosphate will be attracted to it and a discernable crystal will be formed.

To prevent brushite crystals from forming in the cheese, the amount of calcium must be reduced during the make procedure. The lower the pH at cutting, the lower the amount of calcium remaining in the cheese.

Another contributing factor in the cheese that we studied was the release of ammonia due to the metabolism of the amino acid histidine by a contaminating species of bacteria. Eliminating the extensive ammonia production coupled with a lower pH at cut should eliminate brushite crystal formation.

As it turns out, brushite is not only a problem in the cheese, but also in some brine tanks. As a side project, we recently investigated the formation of an extremely hard crystalline material isolated from the walls of brine tanks. The material was brushite. The crystal material also had inclusions of a mineral called copiapite, which gave it a tan or brown color to parts of the material. The copiapite is a hydrated iron or magnesium sulfate that can complex with salts. Iron, magnesium, and sulfate originate from hard water used to make the brines. Therefore, we believe that the reason for this build up on the tank is hard water with traces of iron in it. If you are experiencing this issue, the best solution is to replace the brine or remove minerals from the water used to make the brine.

### Prevention

Though crystals are a complex topic, remember that they are not always bad. In many cases, crystals are a positive feature as they are an indication that the cheese is aged and that it may have more flavor. This phenomenon has given rise to the term flavor crystals. While the crystals themselves actually have very little flavor, the term assures the consumer that the cheese will have a lot of flavor. In other words, tyrosine and leucine crystals are the result of proteolysis that occurs during the aging of cheese and this proteolysis must occur for the cheese to have great

flavor, a point the industry can share with the consumer. In fact, as we learn more about crystal formation it will become important to share this information with retailers and consumers who may have misperceptions about the crystals in their cheese. 🍌

### Supporting References

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Tansman, G. F., P. S. Kindstedt, and J. M. Hughes. 2015. Crystal fingerprinting: elucidating the crystals of Cheddar, Parmigiano-Reggiano, Gouda, and soft washed-rind cheeses using powder x-ray diffractometry. *Dairy Sci. Technol.* 95:651-664.

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## WELCOME NEW CDR SENSORY COORDINATOR SARA JARMA ARROYO

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As the sensory coordinator at CDR, Sara works closely with center staff and industry partners to tailor sensory analyses to meet the specific objectives of each project. She oversees the training of panelists, participates in the sensory components of several short courses and constantly endeavors to expand the CDR sensory program portfolios and capabilities. With a B.S. in Food Engineering from the University of Córdoba in Colombia, a M.S. in Food Science from the University of Arkansas and previous experience investigating new methods for descriptive panels, Sara brings a deep understanding of sensory science and a passion for decoding the consumer mind to the CDR sensory lab.

Phone: (608) 262-3990 | [sarroyo@cdr.wisc.edu](mailto:sarroyo@cdr.wisc.edu) 🍌



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## NEW TECHNICAL REPORT ON MILKFAT AND RELATED INGREDIENTS AVAILABLE FROM [THINKUSADAIRY.COM](http://thinkusadairy.com)

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A new technical report on milkfat and related ingredients, co-authored by CDR Dairy Ingredients Coordinator KJ Burrington, is now available from the United States Dairy Export Council (USDEC). The technical report titled, *How Milkfat-based Ingredients Can Add to Your Next Product Launch*, highlights the changing consumer perception surrounding milkfat as well as the functional benefits of milkfat ingredients in an application. From butter to dairy powders, this report provides manufacturers with an overview of all that milkfat has to offer.

To download the report visit: [www.dairyspotlight.thinkusadairy.org/how-milkfat-based-ingredients-can-add-to-your-next-product-launch](http://www.dairyspotlight.thinkusadairy.org/how-milkfat-based-ingredients-can-add-to-your-next-product-launch) 🍌

## THE DAIRY TECHNICAL SUPPORT LINE, YOUR SOURCE FOR DAIRY FOODS INFORMATION

SUPPORT LINE

Finding the answer to your dairy foods related question is as easy as sending an email or picking up the phone thanks to the U.S. Dairy Export Council (USDEC) technical support line. Operated through a partnership between the Center for Dairy Research (CDR) and USDEC, this support line is a free resource for dairy manufacturers and consumers seeking answers to their dairy foods related questions.

Generally available Monday through Friday from 7:30 a.m. to 4:00 p.m. CT, CDR Associate Researcher Susan Larson, Ph.D., answers all dairy technical support line calls while also serving as a researcher for the CDR dairy ingredients group. A knowledgeable food scientist, Larson has over 20 years of experience in research and development as well as a M.S. and Ph.D. in dairy related fields. Utilizing her talents as well as the skills of the staff at CDR, USDEC and Dairy Management Inc. (DMI), Larson connects callers with answers and resources including links to monographs, regulatory information, supplier lists and more. In fact, the technical support line was developed to support the USDEC goals [ThinkUSAdairy.org](http://ThinkUSAdairy.org) website, which includes materials and



Susan Larson, Ph.D. CDR

content created specifically to aid the food & beverage industry. In addition to technical resources, Larson is also able to refer callers to one of CDR's coordinators to discuss potential fee-for-service formulation assistance or prototype development at CDR.



Therefore, whether you are looking for a dairy-based recipe, viscosity standards for cream or hands-on technical assistance, the USDEC technical support line is here to connect you with the resources you need to succeed.

For more information please visit [www.thinkusadairy.org/contact-us](http://www.thinkusadairy.org/contact-us) or contact the Dairy Technical Support Line at 1-800-248-8829 | [slarson@cdr.wisc.edu](mailto:slarson@cdr.wisc.edu) | [techsupport@thinkusadairy.org](mailto:techsupport@thinkusadairy.org).

## CDR AND INDUSTRY JOIN FORCES TO SUPPORT THE NEXT GENERATION OF FOOD SCIENCE PROFESSIONALS

At the Center for Dairy Research, it is our mission to provide the foremost scientific expertise in dairy research, technical support and education. In support of this mission, we continue to seek out new ways to grow the next generation of dairy food professionals. Last year, the CDR Industry Team (CIT) agreed to help with this effort by voting to support two new research projects as well as two new food science graduate students who will work to complete this research at the University of Wisconsin-Madison. The students, who are collaborating with CDR staff have just finished their first full year at UW-Madison and have already made huge strides in their research and education. We are thankful for this industry support and we welcome the opportunity to share a bit about the students and their research with our readers. If you have additional questions about CDR's mission, CIT membership or the student projects please contact [jlucey@cdr.wisc.edu](mailto:jlucey@cdr.wisc.edu).

### Liz Reale

**Q.** *What is your educational experience and what made you decide to pursue your graduate degree in Food Science?*

**A.** I hold a B.S. in Food Science and Human Nutrition from Clemson University and I am pursuing an M.S. in Food Science. Two summers ago, I was lucky enough to land a food science internship with Ingredion. At the



time, I still was not sure if I wanted to pursue food science, however, it was a good job and close to home so I couldn't refuse the offer. As I got used to the new job and learned more, I found myself excited to get up and go to work; a clear indication that food science was right for me. I was given

two research projects- one in dairy applications and one in bakery applications. I loved both and was passionate about the research, but I always cared a bit more about my dairy project. For whatever reason, I enjoyed the science behind dairy more and decided to further my education in that field.

**Q.** *What are you researching and what do you hope to discover?*

**A.** I am researching the effects of using microfiltered (MF) milks with different casein (true protein ratios) on the quality of Cheddar cheese. Right now, the FDA regulations surrounding the use of MF milk in cheese are unclear, but I hope to discover that cheese made from MF milk is comparable to standard Cheddar and is, therefore, a viable option. In the future, this research may provide FDA with the data needed to fully approve MF milk for cheesemaking.

**Q.** *How is your research project going so far? Do you have any progress you would like to share?*

**A.** I started making cheese and testing it in February →

so I only have data on young cheese. Cheddar is usually aged for at least a few months so I look forward to testing my cheese as it goes through the aging process. I am also starting to think about a second chapter for my thesis, although no decisions have been made yet.

**Q.** *What are your plans for the future?*

**A.** As of right now, I have not eliminated the idea of pursuing a Ph.D., however, I would like to get some work experience before taking that next step. After graduation, I plan to work in the dairy industry in R&D or product development. Although I love dairy, I would also still be open to working in other areas and expanding my knowledge outside of this field.

### Nelson Trusler

**Q.** *What is your educational experience and what made you decide to pursue your graduate degree in Food Science?*

**A.** I have a B.S. in Biology with Honors and Distinction, and a minor in Nutrition Science from Syracuse University (2016). I'm currently working towards my M.S. in Food Science. During my first half of college I planned on going to medical school. I always asked myself, "If I didn't want to be a doctor what would I want to do?" I could never answer that question, but the fact that I kept asking myself made me know that my heart wasn't in medicine. Finally, one day during sophomore year, the idea of food science popped into my head while I was doing some



work and it was like a slap to the face. It just made so much sense and I became really excited about pursuing this degree. I had always been into science and cooking, and am really interested in nutrition, so it was a no brainer to combine all of those interests.

**Q.** *What are you researching and what do you hope to discover?*

**A.** I'm researching the effects of microfiltration and calcium depletion/reduction on milk powder functionality. I'm hoping to find that these calcium reduced milk powders show similar or improved functionality and practical application compared to non-calcium reduced milk powders.

**Q.** *How is your research project going so far? Do you have any progress you would like to share?*

**A.** So far, I've made progress in investigating the application of calcium reduced milk powders to yogurt and gels. In the coming months and remainder of my time at UW I will be transitioning into application for beverages and emulsions.

**Q.** *What are your plans for the future?*

**A.** After receiving my Master's I plan to enter the industry, focusing on product development. I would also like to try to address nutritional and food systems issues if I can. The dairy field would be neat, but I'm also open to other fields like sports nutrition, beverages and cereals as well. 🍌

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## CDR IS YOUR RESOURCE FOR CULINARY SUPPORT

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Whether you are an established company looking for that creative boost to enhance your product line, or an entrepreneur looking to fine-tune the culinary appeal of your new product, the Center for Dairy Research (CDR) is your resource for culinary services.

Available to all U.S. manufacturers of dairy ingredients and cheese, end user companies, and foodservice operations including full service, fast food and institutional, CDR culinary services include menu ideation, flavor formulation, application assistance and much more. With the help of CDR staff, including Research Chef and Applications Kitchen Coordinator Sarah Minasian, CDR culinary services can help your company to create the ideal cheese, yogurt or dairy ingredient based product.

To learn more about these services visit the CDR program area service webpages. 🍌



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## Short Course Calendar:

- ☎ Milk Pasteurization, August 1–2
- ☎ Certificate in Dairy Processing, August 30–November 14
- ☎ Cultured Products September, 6–7
- ☎ Master Artisan Course, September 19–21

For detailed information on each CDR short course: [www.cdr.wisc.edu/shortcourses](http://www.cdr.wisc.edu/shortcourses)

## Events



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