

DAIRY PIPELINE

CDR AWARDED GRANTS TO LAUNCH BEVERAGE INNOVATION CENTER

Earlier this year, the Center for Dairy Research (CDR) TURBO Program received a \$750,000 grant from the Wisconsin Economic Development Corporation (WEDC) to help fund the creation of the Beverage Innovation Center.

Wisconsin Governor Tony Evers announced the award at the Cheese Industry Conference in April, “This new initiative will be a collaborative effort that will provide small businesses and entrepreneurs the resources they need to translate their great ideas and discoveries into commercial products.”

CDR Director John Lucey said, “This grant will allow us to purchase specialized equipment as well as provide technical assistance to dairy producers and entrepreneurs in Wisconsin. When the Beverage Innovation Center is up and running, there will be no other facility quite like it in the United States.”

In addition to the support from WEDC, Dairy Farmers of Wisconsin contributed a \$250,000 grant to support the center. The Beverage Innovation Center will be recognized as a WEDC Center of Excellence. WEDC-supported centers of excellence serve as “anchors” around which academic R&D, corporate R&D and commercialization, external investment and company attraction connections are made.

This new, one-of-a-kind Beverage Innovation Center will allow CDR to work with companies

and entrepreneurs to develop aseptic (shelf stable) beverages. Developing and producing aseptic beverages requires specialized equipment and the Beverage Innovation Center will have the necessary pilot plant equipment that entrepreneurs can use to run small batches of aseptic beverages in order to test and develop new formulations that are safe for consumer testing.

CDR has long had the expertise in developing aseptic beverages but it was lacking the equipment. CDR’s Dairy Ingredients, Beverages & Cultured Products Coordinator, KJ Burrington said, “It has been on my wish list to have aseptic processing capability at CDR for the last 10 years.”



From left: Chad Vincent, CEO of Dairy Farmers of Wisconsin; Vincent Rice, WEDC Vice President of Sector Strategy Development and John Lucey, CDR Director at the grant announcement for the Beverage Innovation Center.



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Specialized Equipment

The CDR is currently working on selecting and purchasing the specialized equipment that will be used in the Beverage Innovation Center. It is expected that the center will have modular components such as ultra high temperature (UHT) heat exchangers, an ➔

Examples of modular equipment for processing aseptic beverages. (There may be different equipment in CDR's Beverage Innovation Center).



**UHT heat exchanger
(direct heating)**



**UHT heat exchanger
(indirect heating)**



Aseptic homogenizer



Aseptic surge tank



Bag in box filler



Packaging/bottling

aseptic homogenizer, a surge tank, and an aseptic bottling/packaging system.

UHT heat exchangers are quite different than the pasteurizers found in most dairy plants. “Fluid milk uses pasteurization; that’s the process that’s used in cheese plants to process the milk,” Lucey said. “This technology is going to be different. It’s going to be much higher temperature, like 280°F for two or more seconds. That’s going to kill all bacteria that are in the product.”

In addition, the plan is to have a UHT unit that utilizes direct heating and one that uses indirect heating; this will allow for a larger range of temperatures and holding times. “Some products need a little higher temperature and a longer time and some need less time; there’s all kinds of variability,” Lucey said.

Once the product passes through the UHT heat exchanger, it will be sterile. The product will then go into an aseptic surge tank to ensure that the product stays sterile until it is ready to be packaged/bottled. As far as packaging, the initial goal is to have a small-scale, aseptic bottling system that is validated (approved for public consumption). Lucey said, “We have the goal of setting up a system that will be able to generate a couple hundred bottles from a single batch in an afternoon or over the course of a couple of hours.”

Having a small-scale aseptic system will provide a big opportunity to dairy beverage producers and start-ups. Most commercial aseptic packaging systems are multi-million dollar operations that produce thousands of bottles per minute. These large-scale systems are not conducive to running test trials. ➔

The focus will also be on acquiring equipment and building a system that is flexible and modular; this will allow CDR to switch out equipment to ensure that the system continues to be up to date. The system will also be scalable, which will allow companies or entrepreneurs to take the product they develop at CDR and scale it up at a larger plant.

Shelf Life and Sensory Testing

Once the product is bottled at the Beverage Innovation Center, the shelf life of the beverage will be tested. A number of attributes will be monitored, such as does the product retain its flavor, color, nutrients and physical stability. Does the product remain shelf stable after a certain amount of time? CDR's microbiology lab can ensure that the product is maintaining its shelf stable attributes (no microbiological growth).

CDR can also help test the product in-house. CDR's sensory panel can test attributes such as taste, color, etc. Physical attributes can also be tested using CDR equipment that can evaluate things such as viscosity.

The beverages can also be sent out for consumer testing, which will allow companies and entrepreneurs to get feedback as they develop and fine tune their formulations.

Tapping into CDR's Expertise

In short, companies and entrepreneurs will have the opportunity to utilize all of CDR's expertise as they work through the entire process of product development. "It's a great situation for us because we can leverage all aspects of CDR and help people produce some really great innovative beverages," Lucey said. This also includes helping with product formulation before it is aseptically processed. Clients will be able to use CDR's equipment and expertise in areas like membrane filtration and beverage formulation.

"There are lots of ways we can process the milk before we even get started in the Beverage Innovation Center," Lucey said. "We can filter milk in different ways, add in powders, other novel ingredients, do whatever processing or fractionation we want to do. The Beverage Innovation Center will access all of CDR's assets."

The Beverage Innovation Center can also offer business service support to companies and entrepreneurs through the Beverage Innovation Center's Client Development and Growth Program. This program, for qualified clients (small businesses) in Wisconsin, will partially reimburse companies for business services like hiring a consultant for technical advice in identifying new markets, ensuring regulatory compliance, evaluation of production costs and ROI analysis, packaging design and grant writing assistance.

Currently, CDR is in the process of setting up the Beverage Innovation Center. An industry advisory panel will be formed to help guide the purchasing of equipment and providing input on different details such as types of packaging. For instance, the initial plan is to set up a system that produces aseptic beverages in bottles but with the help of the industry advisory team, other packaging, like pouches, may become an option in the future. If you are interested in joining the Beverage Innovation Center Industry Advisory Team, contact KJ Burrington, CDR's Dairy Ingredient, Cultured Products and Beverages Coordinator, at burrington@cdr.wisc.edu or 608-265-9297 or Tom Guerin, CDR Research Program Manager, at tguerin@cdr.wisc.edu or 608-982-6548.

As for the physical location of the Beverage Innovation Center, there is 3,000 square feet of new space allocated in the CDR Babcock Hall building project. Until the building project is completed, the equipment can be placed in the existing Babcock Hall or offsite.

An Area of Growth and Innovation

The Beverage Innovation Center is an exciting step forward for CDR. Over the years, CDR's Beverage Applications program, led by KJ Burrington, has helped many companies develop and/or improve their dairy beverage formulations. However, CDR hasn't had the specialized equipment to produce aseptic beverages onsite. Now, in addition to having the formulation expertise, CDR will also have the equipment.

Burrington said, "The Beverage Innovation Center will give us more full service support for companies selling ingredients to beverage manufacturers and for beverage manufacturers developing new products."

Shelf stable dairy beverages are an area of growth and innovation for the dairy industry. These products offer high quality dairy proteins and can have other unique characteristics like being lactose free. In addition, since these products are stable and have a long shelf life, they could potentially be exported.

The end goal is to help companies and start-ups develop and launch their products, which in turn will help add value to dairy ingredients and fluid milk. Lucey said these aseptic products could be the next big value-added dairy product, "We've done similar things with specialty cheese, now we want to look at fluid milk. I think we can also help boost this sector. It's all about helping increase the demand for dairy." 🌻

CURD CLINIC: CHEESE SAFETY/STORAGE

Clinic Doctors: Mark Johnson Ph.D. and Marianne Smukowski

Question

How do I know if I can safely hold a cheese outside of temperature control/refrigeration?

Answer

First of all, you need to ensure that your cheese is being produced safely. The dairy plant must be following Good Manufacturing Practices (GMP) and have a food safety plan in place. Using high quality milk from a trusted source also goes a long way in producing safe, quality cheese. The Pasteurized Milk Ordinance (PMO) directs how milk is to be handled at all stages from the farm to the plant but, still, dairy plant operators need to be vigilant and practice good hygiene and ensure that the proper environmental controls are in place in order to produce a safe product.

FDA/USDA Risk Categories	
HIGH →	Soft unripened cheeses (>50% H ₂ O i.e. Cottage, Cream cheese, Ricotta)
MODERATE →	Fresh soft cheeses, Soft ripened cheeses, Semi-soft cheeses (>39-50% H ₂ O i.e. Brie, Camembert, Feta, Mozzarella)
VERY LOW →	Hard cheeses, Pasteurized process cheeses (<39% H ₂ O i.e. Cheddar, Colby, Parmesan)

That said, many cheeses are generally considered to be an inherently safe food: if they have reduced moisture, a significant salt content, a higher acidity and contain an active starter culture. These characteristics help keep pathogens from growing. The dairy industry is also highly regulated with strict food safety and environmental controls in place. Considering the high volume of cheese that is produced across the globe, there are not many outbreaks or food safety issues with cheese. Therefore, some cheeses, produced under good hygienic and manufacturing process, may be safely held outside of temperature control if they meet certain requirements. So, how do you determine if a cheese qualifies?

Two measurements help us determine if a cheese can be safely held outside of temperature control: water activity and pH.

Water activity (a_w) is the measurement of free or unbound water available in a food for microbial growth. It utilizes a scale of 0 to 1.0 where pure water equals 1.0.

A cheese with a high water activity (i.e. 0.99 a_w) has a lot of water available to be used by microorganisms and therefore is at a greater risk for growth of bacteria, yeast and molds. Conversely, a cheese with a low water activity (0.92 a_w or less) would preclude the growth of some types of microorganisms yet allow the growth of the more tolerant. In short, the higher the water activity, the more potential there is for biological growth to occur.

Different styles of cheese have different water activity values. For instance, Cottage cheese, which has a high moisture content, is typically around 0.99 a_w , while Parmesan, an aged cheese with a lower moisture content, can have a water activity as low as 0.67 a_w . Based on this data, we know that Cottage cheese has a much higher risk of microbiological growth than Parmesan because more water is available for microorganisms to grow.

The other important factor to consider when evaluating whether a cheese can be held out of temperature control is the pH of the cheese. Generally, the lower the pH (higher acidity) of the cheese, the more likely it will qualify to be held out of refrigeration. A high-acid environment is more hostile to pathogens. Cheese pH is achieved using an active starter culture that produces lactic acid and brings down the pH of the cheese. The use of an active starter culture is a requirement for cheese to be safely held out of temperature control.

Figure 1. Interaction Table From 2017 Food Code			
Interaction of pH and a_w for control of spores in food heat-treated to destroy vegetative cells and is subsequently packaged.			
a_w Values	pH Values		
	4.6 or less	> 4.6-5.6	>5.6
0.92 or less	Non-PHF/non-TCS	Non-PHF/non-TCS	Non-PHF/non-TCS
>0.92 – 0.95	Non-PHF/non-TCS	Non-PHF/non-TCS	PA
>0.92	Non-PHF/non-TCS	PA	PA

PHF – "Potentially Hazardous Food"
TCS – "Time/Temperature Control for Safety Food"
PA – "Product Assessment Required"
Source: FDA

Thus, the interaction of low pH and low water activity can be used to determine if a cheese can be safely held out of refrigeration. The Food and Drug Administration (FDA) includes a table (see Figure 1) in the Food Code that lays out the parameters of when a food product can be safely held out of refrigeration. Essentially, those cheeses with a lower water activity and a lower pH are more likely to be a non-potentially hazardous food (non-PHF) and thus don't require temperature control. →

A couple of important caveats should be mentioned before we go into determining what cheeses are safe to hold outside of refrigeration.

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| 1. As mentioned at the beginning of the article, these guidelines are for cheeses that are assumed to have been produced safely (GMP, food safety plan, heat treated milk). |
| 2. This applies only to cheese that has been uncut, has no cracks, breaks or punctures and/or retains the original, undisturbed wax or cloth packaging. |
| 3. The maximum storage/display temperature can't exceed 86°F (30°C). |
| 4. Finally, storing a cheese out of temperature control is not ideal for the quality of the cheese. |

With that said, let's use the Interaction Table (Figure 1) to determine if a cheese can be safely held out of refrigeration. Let's say that we have a Parmesan with a water activity in the range of 0.68 - 0.76 a_w and a pH of 6.5. The cheese milk was heat treated and the cheese was cured for 2-3 years and then packaged. Can this cheese be safely held out of refrigeration? First, we would locate the cheese's water activity (0.68 - 0.76 a_w) in the correct line and then locate the pH (6.5) in the correct column. You will see that they intersect at "Non-PHF/Non-TCS," which tells us that no temperature control is required.

Additionally, there is a list of cheeses that, when produced to the Code of Federal Regulations (CFR) standards, should be considered exempt from refrigeration requirements during aging, storing, shipping and display (maximum temperature of 86°F). The list includes:

Asiago (medium and old)
Aged Cheddar
Colby
Feta
Monterey Jack
Muenster
Parmesan
Pasteurized Process Cheese
Provolone
Romano
Swiss/Emmentaler

In Wisconsin there are also special considerations for cheese curds. With the popularity and prevalence of cheese curds in the state, a special dairy inspection policy was drafted. The policy states that cheese curds must be refrigerated at all times with one exception. Cheese curds

can be offered for sale outside of refrigeration only on the day they are manufactured. Any cheese curds that are not sold must be disposed of at the end of the day.

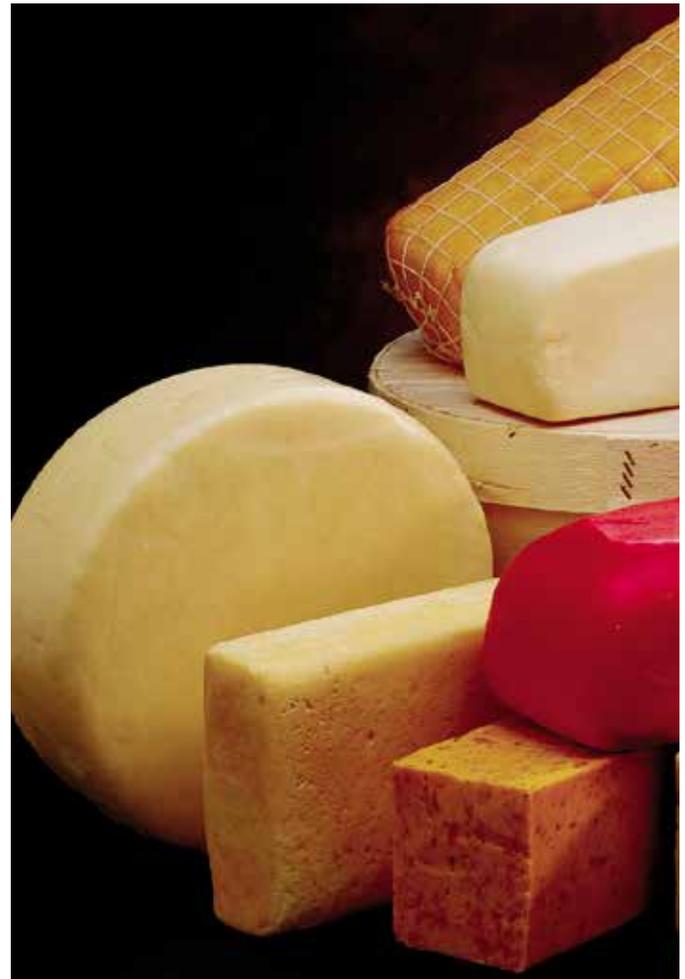
As mentioned at the beginning of the article, cheese is an inherently safe product. Cheese is a fermented product and fermentation is an age-old preservation method that is antagonistic to foodborne pathogens and will inhibit their growth or inactivate them. Research has also shown that active starter cultures are detrimental to pathogens. Given these characteristics of cheese, some cheeses can be safely held out of temperature control.

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CHALLENGES WITH CONTROLLING YEAST AND MOLD GROWTH IN CHEESE

Contributed by Dean Sommer, CDR

For some varieties of cheese, the growth of yeast and/or mold organisms is vital to produce that particular variety of cheese. Examples include blue mold (*Penicillium roqueforti*) for blue veined cheeses like Blue and Gorgonzola, white mold (*Penicillium camemberti*) for bloomy rinded cheeses like Brie and Camembert, or yeast organisms (*Debaryomyces hansenii* and *Geotrichum candidum*) for smeared cheeses like Limburger. However, for most other varieties of cheese the growth of yeast or mold organisms is unwanted and will contribute to the spoilage of the cheese resulting in consumer disappointment.

Unwanted molds create problems in cheese because they produce excessive amounts of enzymes, such as lipases, proteinases and carbohydrases, which lead to the breakdown and deterioration of cheese. The amount of dairy products spoiled by mold growth is unknown, but even if it is 1% or 0.5%, this spoilage represents a major loss for the industry.

Yeast and mold organisms are fungi, which are fundamentally different from bacteria. Many varieties of yeast and mold tend to be both acid and salt tolerant (molds can also grow under refrigeration). Molds need oxygen to grow, while many yeasts do not. Molds reproduce through spores, which become airborne and quickly spread throughout the plant. Yeasts reproduce by budding. These characteristics of yeast and mold have implications in how they spread and how we eliminate or control their growth both in the cheese plant environment as well as on the cheese itself.

Control of yeast and mold organisms from cheese manufacture to the consumer can be divided into three strategies:

1. Prevention of contamination of the cheese by yeast and mold organisms during cheese manufacture;
2. Managing the packaging systems for the bulk cheese to minimize yeast and mold contamination and potential for growth; and
3. Managing the packaging systems for retail packages of cheese to minimize yeast and mold contamination and growth.

Environmental Controls

Yeast and mold organisms are typically destroyed by pasteurization of milk. Thus, the trick is to prevent recontamination of the product after it has been pasteurized. (It should be noted that mold spores are not killed by pasteurization.)

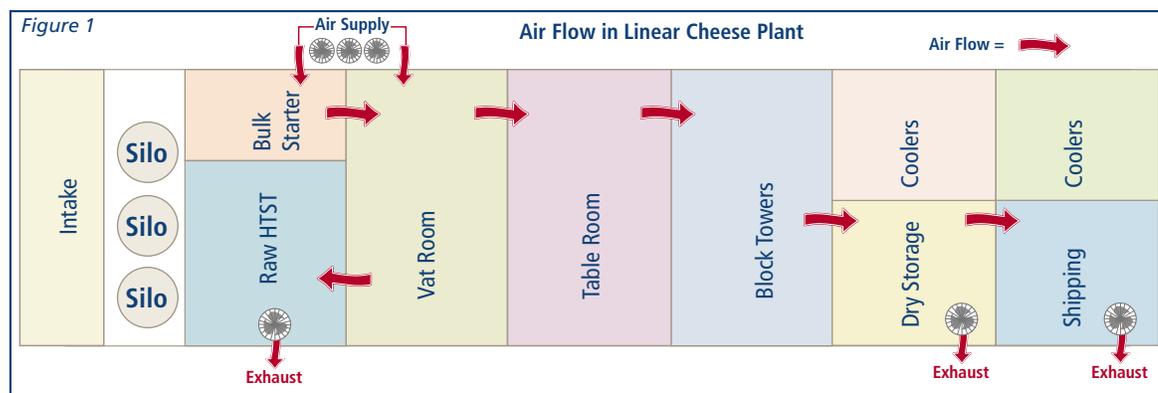
Keeping yeast and mold counts as low as practically possible in the plant environment is key. This starts with managing the air quality in the cheese plant. Having an HVAC system that delivers adequate quantities of clean, filtered air with reduced humidity is the first step. Having positive air pressures and proper air directional flows so that air moves from “clean” rooms (containing open product) to less sensitive rooms (product protected by packaging; storage rooms) is a must (see Figure 1). Remember, mold spores are readily airborne necessitating filtration and directional air flow.

Since yeast and mold typically grow in moist areas, managing water and humidity in the plant and maintaining a dry floor program will go a long way in keeping yeast and mold counts under control in your environment. Even condensate water on equipment like air-conditioning units and pipes, can contribute to yeast and mold growth.

Practicing Good Manufacturing Practices and maintaining strict sanitation in your cheese plant is a must. Yeast and mold organisms can enter the plant on wood pallets, corrugated boxes, and other supplies, as well as on the forklifts that deliver these supplies around the plant. It is critical to minimize the amount of

these materials in operations rooms that contain open cheese product.

As previously mentioned, yeast and mold organisms are salt and acid tolerant. Traditional acid sanitizers are ineffective in destroying yeast →





Yeast and mold organisms can enter a dairy plant on corrugated boxes.

and mold organisms, so, in areas where control of these organisms is a priority, it is recommended to choose other types of sanitizers that are effective in destroying yeast and mold.

Options for limiting mold and yeast contamination include:

- ▶ Quaternary ammonium sanitizers on non-product contact environmental surfaces,
- ▶ Natamycin in correct concentrations in brines or as a surface application on cheeses, and
- ▶ Chlorine-based sanitizers on product contact surfaces.

It is recommended to work closely with your cleaning chemical representative to choose an effective sanitizer against yeast and mold.

Controlling Yeast and Mold in Salt Brines

Salt brines are a harborage for yeast and mold organisms, since these microbes tend to be salt and acid tolerant. Maintaining clean, cold brines is critical in preventing yeast and mold contamination of brined cheeses. Having a properly sized and operated ultrafiltration brine cleaning system is the most effective control technique we currently have to maintain a clean brine with low yeast and mold counts.

While the practice of periodic pasteurization of brines will destroy yeast and mold, this practice doesn't remove the food (fats, proteins and lactose) from the brine, nor does it remove the destroyed microbes or mold spores. So, a pasteurized brine isn't clean in the true sense of the word, and microbes may rebound more rapidly with all the food left in the brine.

Some cheese plants have used antimicrobials such as natamycin in the brine to suppress the growth of yeast and mold organisms. While this can be effective, there are cost implications and it can be difficult to maintain the proper concentration of natamycin in the brine.

Packaging to Reduce Yeast and Mold

Since mold organisms are obligate aerobes, meaning they need some quantity of oxygen (about 1-2%) to grow and reproduce, removing oxygen from the package is one of the most common and effective ways to prevent mold growth in both bulk and retail packages of cheese.

Traditionally, cheeses like 40 pound block Cheddar, as well as many other cheese varieties in 40 pound blocks, rely on vacuum-sealed poly (flexible plastic) bags to remove the oxygen and prevent mold growth; as do cheeses like 20 pound slabs and 6 pound loaves of Mozzarella cheeses, or various size loaves of Brick, Muenster or Havarti. This is an extremely effective practice, however, the trick is to minimize the incidence of leakers in these bags. When leakers occur, whether from seal failure or inadvertent puncturing of the bag by a burr or rough handling, oxygen leaks back into the bag and mold growth inevitably occurs. This is especially problematic in aged, long-hold cheeses like aged Cheddar or Parmesan in 40 pound blocks because the mold has plenty of time to grow. The detection of leaking bags is further complicated by the traditional use of corrugated boxes and liners used around the vacuum-sealed blocks of cheese, which makes visual inspection and preemptive discovery of leakers problematic.

It is advisable to have proper functioning and well maintained vacuum-sealing systems and use high quality poly bags with the proper mil (1 mil = 0.001 inch) thickness and a low oxygen transmission rate. Additionally, especially for long hold cheeses, devise some sort of inspection system (i.e., looking for whey leakage on the boxes; opening some statistically valid frequency of boxes to visually look for loose bags) to verify seal and bag integrity of the blocks early on so that you don't encounter cheese blocks that are months or years old with high rates of mold growth.



These bags didn't seal properly or were punctured, which allowed oxygen to leak back into the bags, causing mold to grow on the cheese.

Handling and Monitoring 640 Pound Boxes

Bulk cheese packaged in 640 pound boxes presents a unique challenge when it comes to preventing mold and yeast growth.

Typically, the 640 pound box container, whether wood or plastic, is lined with a poly tube. The box is subsequently ➔

filled with cheese curds. Once the box is filled, a plastic sheet is put down on the cheese, the plastic tube is folded over and covered with the bottom piece of the box. The box is then inverted and the process is repeated on the top side of the box – a plastic sheet is put on the cheese, the ends of the plastic tube are folded over, and then a press plate, compression springs and top plate are put in place. The entire box is squeezed and banded tightly together to form the finished 640 pound block of cheese. As you can imagine, this is not a hermetically vacuum-sealed block of cheese, which means oxygen will be present at the surface of the cheese.



Sporendonema casei is a red-orange mold that grows on some natural-rind cheeses and adds a mushroomy flavor to the cheese. There's no known danger from this mold and many consider it desirable on cheese rinds. Photo Credit: Benjamin Wolfe, Tufts University.

In order to limit oxygen exposure in the 640 pound box container, the goal is to achieve as tight as possible contact between the plastic and the cheese surface and minimize any folds or areas where oxygen can contact the surface of the cheese. Thus, the amount of oxygen present, which can contribute to mold growth at the surface of the cheese, is minimized by good workmanship in lining the poly tube in the box (minimizing folds in the poly tube liner), correct placement of the top and bottom poly sheets, careful folding of the ends of the poly tubing and proper placement of the bottom plate, press plate, compression springs, and top plate, finished with a tight banding of the entire block.

A common practice today is to spray the top of the 640 pound block with a solution of the antimycotic natamycin to prevent yeast and mold growth. This can be an effective practice. However, it is imperative that the concentration of the natamycin applied to the cheese surface be correct. If the concentration is too low, it will be ineffective. If the concentration is too high, you may be in violation of maximum concentration standards promulgated by FDA. It would be advisable to work closely with your natamycin provider to make sure your application technique is correct and to have them periodically check the concentration of applied natamycin at the cheese surface.

Historically, manufacturers of 640 pound blocks used another practice to limit oxygen penetration and mold growth at the surface of the 640 pound block. Before the

press plate was put in place, a bead of hot paraffin wax was placed around the inside perimeter of the box to provide a better seal and help prevent oxygen from contacting the surface of the cheese. This practice, while very effective, has largely been discontinued, likely due to cost, labor, and the waxy mess it created for the conversion plants. However, plants making long hold cheese in 640 pound blocks may want to revisit this practice if they are currently encountering mold issues.

Strategies for Retail Cheese

Many of the practices used to control and limit yeast and mold growth in bulk cheese can also be applied to retail cheese. Control of the environment and air quality in the cheese conversion plant is essential. Using quality filtered air, positive air flow in rooms with open cheese product, limiting corrugated boxes and wood in rooms with open cheese product, practicing a dry floor program, and following Good Manufacturing Practices are all critical to success.

However, control of yeast and mold in conversion plants has some additional challenges. Many conversion plants, especially shred plants, use belt systems to convey product. Belts can be problematic for effective cleaning, as mold and especially yeast organisms can be difficult to remove from belts that have cracks or other niches where organisms can hide, making them hard to remove or destroy. This situation is made even more challenging by the move to extended runs between full cleanups.

Operators can face some tough choices when incoming bulk cheese has visible mold growth. If scraping and trimming off some of the mold growth is deemed to be possible, this should ideally be done in less sensitive areas and not in “clean” rooms containing open product as mold spores are readily released when the packaging is opened. The time between opening bulk product and converting it into chunks, shreds, etc. should be minimized to limit the time of exposure of the unwrapped bulk cheese to contamination by airborne yeast and mold organisms.

Similar to bulk cheese, limiting the exposure of retail cheese cuts to oxygen is a sound strategy to prevent mold growth. In cuts of cheese, this is routinely accomplished by vacuum packaging. Modified Atmosphere Packaging (MAP) is routinely used for shredded, diced or cubed cheese to flush virtually all the oxygen out of the bag and replace it with a mixture of nitrogen and carbon dioxide (i.e. for shreds of soft cheese 30-40% CO₂ and 60-70% N). It is advisable to routinely check these bags for oxygen levels to ensure that the gas flushing process was done correctly. It should be noted, however, that many yeast strains are facultative, which means ➔

they need little to no oxygen to grow, so in typical MAP packages, while mold growth is controlled, yeast growth can continue. Keeping the packages of cheese as cold as possible is one strategy of slowing down the growth of yeast.

In addition, natamycin is commonly added to cheese shreds to prevent mold and yeast growth in the package. It also helps retard growth of mold and yeast once the consumer has opened the package.

Monitoring Yeast and Mold Counts

Routine monitoring of yeast and mold counts in bulk cheese as well as finished cuts of retail cheese is advisable. More often than not, yeast and mold contamination is highest on the surfaces of the bulk cheese. Since yeast and mold contamination usually occurs on the surface of the cheese, traditional sampling for microbiological testing by plugging the cheese with a trier is a poor method for yeast and mold count determination and may give a false sense of security. Rather, for bulk cheese it is advisable to sample a relatively large area of the cheese surface to determine the levels of yeast and mold contamination.

In the case of mold, it is nearly impossible to keep all varieties off the surface of your cheese. The commonly allowed contaminant level for yeast and mold in a brined cheese such as Mozzarella is less than 100 CFU/g (colony-forming unit per gram) while vacuum-packed cheeses such as 40 pound blocks of Cheddar or Colby often have specifications of less than 10 CFU/g.

Controlling yeast and mold growth in cheese represents a continuing challenge to our industry but it is crucial in maintaining consumer satisfaction with our cheese products. Yeast and mold are opportunistic organisms that will grow and cause problems in cheese if we allow them the proper niche. At both the converter level and the consumer level, the tolerance for yeast and mold problems in cheese seems to be decreasing. Thus, cheese manufacturers must practice constant vigilance to keep these organisms at bay.

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UPCOMING MASTER SHORT COURSE WILL FOCUS ON CULTURES AND ENZYMES – “THE FLAVOR CREATORS”

The Center for Dairy Research will be holding a two-day short course, September 17 to 18 in Babcock Hall on the University of Wisconsin–Madison campus, that will take a deep dive into cheesemaking cultures and enzymes.



This Master short course, open to all cheesemakers, will cover cheese starter cultures, culture adjuncts, coagulants, lipases, surface ripening microflora and focus on their impacts on cheese flavor, texture and functional properties.

In addition, the course will also address bacteriophage, the proper handling and use of cultures and enzymes, and new and exciting product offerings.

Sessions will feature CDR staff as well as industry experts. A special session will feature a panel discussion with Wisconsin Master Cheesemakers. Other sessions include:

- ▶ Use and Impact of Mesophilic Acidifying Cultures on Cheese Attributes
- ▶ Use and Impact of Thermophilic Acidifying Cultures on Cheese Attributes
- ▶ Accelerating and Enhancing Flavors with Adjuncts (non-gas producing)
- ▶ Proper Manufacture, Handling and Use of Bulk Starter Cultures
- ▶ Controlling Mold and Yeast Using Antimicrobials
- ▶ Culture House Open Mic: Recommendations for Creating Flavor

Register now as the class is expected to sellout. For more information or to register, visit:

www.cdr.wisc.edu/shortcourses/master 19. 🌟

REGISTER NOW FOR THE CERTIFICATE IN DAIRY PROCESSING TRAINING PROGRAM

The Center for Dairy Research will be holding the Certificate in Dairy Processing program September 4 to November 27. This 10-week hybrid course (in-person and online) is designed to provide plant workers and operators with a clear understanding of dairy plant processes.

The program begins with an introductory, in-person course September 4 at Babcock Hall in Madison, Wisconsin. After the introductory session, a live-streamed lecture/discussion session will be held online each Wednesday afternoon from 3-5 pm (CT). The online course will be composed of 10 modules covering important aspects of dairy product manufacturing.

For more information or to register:

www.cdr.wisc.edu/shortcourses/cdp 9 19. 🌟

COLLABORATING WITH INDUSTRY TO IMPROVE PRODUCTION OF 640 POUND BLOCKS

The Center for Dairy Research (CDR), in partnership with Malisko Engineering and Rockwell Automation, recently wrapped up an exciting project to support research related to production of 640 pound blocks of Cheddar.

Staff at CDR, Malisko Engineering and Rockwell Automation worked together to design and build two temperature monitoring panels. Each panel is fitted with 36 temperature probes designed to be inserted into a 640 pound block. The probes monitor and record the temperature in different parts of the block. The data can be tracked in real time and/or downloaded onto a computer. The panels also have industrial IT switches that allow the data to be monitored remotely.

The panels are fitted with uninterrupted power supply units that enable them to operate without power for up to about one hour. This feature helps protect the data in the case of a power outage and also allows the panels to be moved around the plant. Additionally, the data is collected in a CSV format, which makes it compatible with any computer or device.

The two temperature monitoring panels are currently being used in a CDR research project led by Claire Collins, a food science graduate student at the University of Wisconsin-Madison. Claire's advisor is CDR Director John Lucey.



Temperature monitoring panel developed in partnership with CDR, Malisko Engineering and Rockwell Automation.

“We will monitor the temperature in different locations throughout 640 pound blocks to get a better idea of how they cool,” Collins said. “It can take up to 14 days to cool the inside of the blocks, so we want to have a better understanding of how exactly they cool during this time frame.”

“There currently aren't any technologies on the market that are robust

enough to continuously collect and store temperature cooling data for multiple weeks,” Collins added. “So, these temperature monitoring panels are a unique solution to monitoring the quality of 640 pound blocks.”

The temperature monitoring panels will help CDR develop a successful protocol for cooling 640 pound blocks, which is currently a challenge for the industry.

“During the 640 pound block cooling process, the outside cools faster than the inside,” Collins explained. “The differences in temperature drives moisture to migrate from the inside of the cheese block to the outside of the block, leading to texture differences in a single block. Monitoring the temperature of 640 blocks is important to the industry because operators can see how the blocks are cooling and if there are any large temperature difference during cooling.”



Temperature probes insert into blocks of cheese.

“Temperature in these 640 pound blocks is a huge thing affecting quality,” said CDR Director John Lucey. “There is a lot of moisture and texture variability in 640 pound blocks. We want to help industry produce consistent, high-quality blocks.”

When developing the temperature monitoring panels, Rockwell Automation donated the hardware for the panels and Malisko Engineering designed and created the panels in addition to programming the panels to CDR's specific needs. Dan Jacoby, an automation solutions consultant for Malisko Engineering, served as project lead.

Jacoby said the goal of the project was to help CDR and the dairy industry, “Malisko was happy to donate our services to help the dairy industry and CDR to solve some of the problems plaguing the cheese industry with the 640 pound block.” He added that another goal of the project was to provide an example of how technology can be used to improve processes in the dairy plant.

“This project is showing that you're not limited to the old school method of recording data. There is this entire industrial internet of things out there that you can use to collect this information to help you analyze data and monitor your processes. That's the biggest thing with this project – we want to show the art of the possible.”

This CDR research project is being funded by the CDR Industry Team and Dairy Management Inc. Results from the project should be available later this year. Watch future issues of the Dairy Pipeline for more details. 🌟

ADDING VALUE AND NUTRITION WITH DAIRY: CDR-DEVELOPED PROTOTYPE FEATURED AT IFT19

A flavorful, protein-fortified gelatin snack developed at CDR was featured at the Institute of Food Technologists (IFT) Annual Meeting & Food Expo, June 2-5, in New Orleans, LA. The event is the largest gathering of food scientists convening to learn the most current information on food science research, as well as its practical application to commercial food product development.

Sarah Minasian, CDR's research chef, developed a gelatin snack flavored with calamansi fruit and fortified with U.S. whey protein isolate (WPI). An acidified WPI was used to provide good clarity, low astringency and a tart flavor that complemented the calamansi juice in the formula. The Calamansi Protein Gel Snack was shared with attendees at the U.S. Dairy Export Council (USDEC) booth at IFT19.



CDR used calamansi, a citrus hybrid popular in the Philippines, to develop a flavorful protein-fortified gelatin snack.

Calamansi is a citrus hybrid cultivated primarily in the Philippines. It is similar in appearance to a lime with a more pronounced sour taste. Adult and child palates alike welcome its sweet-tart, lemon-lime-orange flavor. It is a ubiquitous flavor in Philippine cuisine and beverages. Although calamansi is not well known in the U.S., there have been sightings of it on upscale menus.

Minasian discovered calamansi at an oil and vinegar tasting, "I thought the flavor would be great for both children and adult tastes. I also thought the exotic and new nature of the fruit would be interesting to American consumers."

As mentioned above, the calamansi flavor is well-known to consumer tastes in Asia, which is a growing market

for dairy products. USDEC's current strategy is to target the Asian market with adult-oriented flavors, particularly keeping an aging demographic in mind. The Calamansi Protein Gel Snack fits those parameters. The product could also gain traction in the U.S. where Filipino flavors are emerging; driven by increasing ethnic diversity of younger generations and growing consumer demand for global flavors.

Additionally, the Calamansi Protein Gel Snack is an excellent example of how a dairy ingredient, in this case whey protein isolate, can be used to add value and nutrition to a flavorful food product. Gel snacks are trending across the globe but they typically don't have much, if any, added nutrition. A typical serving of a gelatin snack has about 2 grams of protein. One serving of the CDR-developed Calamansi Protein Gel Snack has an impressive 13 grams of U.S. WPI and only 100 calories per half cup serving. WPI is recognized as one of the highest quality sources of protein. It contains an abundance of essential amino acids like leucine, which has been shown to be the key amino acid in stimulating muscle protein synthesis. Whey protein isolate can be particularly beneficial to older consumers who require more protein in their diet.

"The nutritional aspect of this recipe was a major focus, but I also wanted to make sure it had a bold, interesting flavor," Minasian said. "I think this gelatin snack successfully fulfills the nutrition and taste requirements that a lot of us look for in a food product."

Consumers are also looking for products with "clean" food labels. This formulation has the potential to also check that box as the ingredient list consists of five "clean" label items: water, acidified whey protein isolate, sugar, calamansi juice, and gelatin mix.

The recipe for CDR's Calamansi Protein Gel Snack is available on the USDEC website, www.ThinkUSADairy.org.

In addition to sharing innovative CDR-developed products, CDR staff also presented at IFT19. KJ Burrington, CDR's Dairy Ingredient, Cultured Products and Beverages Coordinator, was part of a technical session that was organized by Rohit Kapoor, Ph.D. from the National Dairy Council. The title of the session was "Increasing Dairy Protein Hydration: A Fresh Look Using New Age Tools." Burrington presented on the "Importance of Protein Hydration on Functionality of High Protein Foods." Other speakers included Chenchaiah Marella, Ph.D., of Idaho Milk Products; Jayendra Amamcharia, Ph.D., Kansas State University; and Daiki Murayama, Ph.D., University of Wisconsin. For more information on the event, visit www.iftevent.org/. 🌟

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CDR FEATURED ON DISCOVER WISCONSIN

The Center for Dairy Research was included in a recent episode of Discover Wisconsin. The episode, titled “Wisconsin Cheese Renaissance,” showcased cheesemakers from around the state.



In the episode, CDR Associate Director and Distinguished Scientist Mark Johnson discussed cheese judging with Discover Wisconsin host Eric Paulsen. Interim Sensory Coordinator Luis A. Jimenez-Maroto talked about serving as a judge at the World Cheese Contest. Marianne Smukowski and Joanne Gauthier discussed the Wisconsin Master Cheesemaker Program.

View the “Wisconsin Cheese Renaissance” episode at www.discoverwisconsin.com.

DAIRY PIPELINE

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Short Course Calendar

- ▶ Milk Pasteurization, August 6-7
- ▶ Certificate in Dairy Processing, September 4-November 27
- ▶ Cultured Dairy Products, September 10-11
- ▶ Master Course, Cheesemaking Cultures and Enzymes - The Flavor Creators, September 17-18
- ▶ Cheese Technology, October 7-11
- ▶ Dairy Ingredient Applications, October 22-23
- ▶ Dairy Protein Beverages, October 24-25
- ▶ Cheese Grading, November 6-8
- ▶ Ice Cream, December 3-5*
- ▶ Making Consistent, Quality Cheese with Concentrated Milk, December 10-12

For detailed information on CDR short courses:

www.cdr.wisc.edu/shortcourses

Events



AMERICAN CHEESE SOCIETY ANNUAL CONFERENCE
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