CENTER FOR DAIRY RESEARCH

DAIRY PIPELINE

A TECHNICAL RESOURCE FOR DAIRY MANUFACTURERS | WINTER 2023 | VOL. 34, No. 4

EYE OF THE BEHOLDER: A LOOK AT SWISS CHEESE PRODUCTION AND DEFECTS

Swiss cheese is a challenging cheese to produce. It requires the hands-on expertise of an artisan cheesemaker as well as technical, scientific knowledge of the cheesemaking process.

"There are a lot of conditions that have to go right," said John Jaeggi, CDR Cheese Industry and Applications Coordinator. "You need to have cheese with the right pliability to get eyes to form, spacing of eyes, shine of eyes; it really takes a true master to make it correctly."

In recent years, CDR staff have seen producers struggle to consistently manufacture high-quality Swiss cheese. This article will take a look at the key manufacturing steps as well as some of the common defects seen in Swiss cheese.

Swiss Cheese History and Varieties

Traditional Swiss cheese originated in Emmen Valley in Switzerland and is known as Emmenthaler. In the later 1800s, Swiss immigrants came over to the U.S. and began making large, traditional 200 lbs. wheels of Swiss cheese. There used to be hundreds of small manufacturers scattered in Ohio, Wisconsin, and the upper Midwest making these large wheels of Swiss cheese.

Traditionally, Swiss cheese was made in copper kettles. Some copper will leach out during cheesemaking, which in many studies has shown to have a positive impact in overall Swiss flavor profile. Copper also has some antibacterial properties. For instance, some

studies have shown copper can slow the growth of propionic bacteria (the bacteria essential to creating the characteristic eyes of Swiss cheese). Copper's antibacterial properties are especially evident when using raw milk, like traditional Swiss cheesemakers.

Today, very few U.S. cheesemakers use copper cheese vats. Here in Wisconsin, the state requires that production facilities utilizing copper cheese vats document that their make procedures yield a pH of 6.0 or greater while cheese is held in the vat. (The lower the pH during cheesemaking, the more copper that will slough off.) At CDR, staff have noticed that different cleaners will also impact the amount of copper that sloughs off into the cheese. Jaeggi and other cheesemakers think copper has a positive impact on Alpine-Style cheeses, but, as mentioned above, there are certain factors that manufacturers need to be aware of when using copper to manufacture Swiss cheese.

Swiss cheese production changed in the 1950s when Darold Johnson of Kraft Foods developed what was called the rindless block Swiss procedure. This cheese was made in stainless steel vats, was vacuum packaged, and aged in block form making it easier for conversion with no rind waste.

Beginning in about the 1960s, Swiss cheese in the U.S. continued to evolve. Notably, Dr. George Reinbold at Iowa State University developed Baby Swiss cheese

What's Inside:

cheese. Development of Baby Swiss was in response to consumers preferring a more mild, buttery, smooth-bodied cheese in comparison to traditional Swiss, which tended to be firmer, a bit more grainy, with more grassy, acetic acid flavor, and "harsher" Swiss notes.

What is Swiss cheese?

When we think of Swiss cheese, typically the first characteristic that comes to mind are the eyes. Other cheeses, like Gouda, can have eyes but they are not the same. For instance, the eyes in Gouda are produced with different bacteria which utilizes a different substrate (citric acid) and results in smaller and less numerous eyes. It also results in a different flavor profile than Swiss cheese.

So, what makes Swiss cheese special? Swiss cheese gets its flavor and eyes from propionic bacteria. Propionic bacteria is added to the cheese vat where it ferments the lactic acid in the cheese into propionic acid and acetic acid. This fermentation process produces the flavor profiles of Swiss cheese and also produces CO_2, which causes the eyes to form (more on this later).

Typically, Swiss cheese is a lower fat cheese and a very low salt cheese. (Baby Swiss tends to be a bit higher in fat but otherwise is close to Swiss cheese in composition.)

Swiss Cheese composition	
Moisture: ~39-41%	Fat: ~ 29-32%
Salt: ~0.30-1.20%	Total Protein: ~21-23%
pH: range from ~5.10 at one day up to 6.00 (time point dependent) at 6 months	

Swiss Cheese Manufacturing

Here are the key steps in the manufacturing of traditional Swiss cheese.

Milk: Milk quality is extremely important; more so with Swiss cheese. The Swiss do not allow the use of milk from cows fed sileage due to the potential for spore formers to cause gas and spoilage issues in their Swiss cheese. This is not the case in the U.S. Swiss cheese industry. Good quality milk, low in somatic cells, lactobacilli, spores, standard plate count, and MUN is advantageous for making Swiss. Though Baby Swiss uses whole milk, traditional Swiss cheese will remove some fat from whole milk; usually ending anywhere from 3.0-3.3% fat. Milk for Swiss cheese is sometimes clarified or run through a bactofuge, which will remove spores that can cause ripening issues. A small "slip stream" from the bactofuge is added back to the milk prior to pasteurization which helps provide the "nuclei" that disrupts the cheese body just enough to allow for eye development. Use of concentrated, ultrafiltered milk is allowed in the U.S. to manufacture Swiss cheese. Standardized milk is then pasteurized at normal temperatures of ~162°F with a hold time of about 16 seconds.

Starter Cultures: For traditional Swiss cheese, the starter cultures used are typically thermophilic cultures (*Streptococcus thermophilus, Lactobacillus delbrueckii* subsp. *bulgaricus* or *lactis* or *Lactobacillus helveticus*). Every plant is different; some might prefer to use thermo-meso starter culture blends to get up front acidification with starter culture. For Baby Swiss, the starter culture used is typically a mesophilic culture (*Lactococcus lactis* subsp. *lactis* and/or subsp. *cremoris*) like what is used in Cheddar production.

Eye Former: To get proper eye development, propionic bacteria is added. The typical eye former used is *Propionibacterium freudenreichii* subsp. *shermanii*. Propionic bacteria are found in raw milk and can be a contamination issue in Cheddar and other cheeses. When making Swiss cheese, Jaeggi says, "You can never add too many props." Jaeggi has experimented with different amounts of props and has found that he can still get cheese with nice eyes even when he cuts the props back to 1 ml per 1,000 pounds of milk and even .001 mls per 1,000 pounds of milk. However, the flavor of the cheese will be bad. "I was still getting round, shiny eyes but the flavor was less and less 'Swiss-like' until I got to the point where the cheese had eyes but an unclean dirty sock, bitter flavor profile," Jaeggi said.

Propionic bacteria not only forms eyes in Swiss cheese it also gives Swiss cheese its characteristic sweet, acetic acid, and nutty flavor profile. Therefore, props should not be skimped if you want to produce Swiss cheese with good eyes and flavor.

Optional Ingredients: Some Swiss cheese manufacturers will use culture adjuncts for various flavor or quality reasons. Care should be taken as use of these cultures may interfere with eye development. It is best to consult with your culture house representative when using adjunct or bioprotective cultures.

Some manufacturers also add color (typically annatto or beta carotene) to replicate the nice gold color that is seen in traditional Swiss cheese that is produce with pasture-fed cows. Calcium chloride is also used by some cheesemakers to enhance clotting by the rennet and reduce the amount of rennet needed.

Rennet: Jaeggi said he has seen Swiss cheese made with all different rennets (Chymosin, microbial, calf). While

the type of rennet used can impact body development and flavor, the critical aspect to keep in mind is that pH control in the wet and dry phases are key.

"The reason the Swiss cheese industry sometimes struggles has to do with cultures and rates of acid development," Jaeggi said. "Because all of our cultures today are meant for speed, think Mozzarella and Cheddar cheeses, but Swiss cheese is different."

Jaeggi adds that Swiss cheese manufacture used to be much different. "In the in the old days, raw was milk brought in and held in non-refrigerated silos where the temperature of the milk maybe went to 50°F in the summer months." In that scenario, the milk would be held overnight where some natural fermentation would occur, and the pH of the milk could drop to about 6.4-6.5. Today, milk is more around 6.6- 6.7 pH.

In addition to starting with milk with a lower pH, the starter cultures were typically milk or whey-based. "So, what was happening the cheesemaker would get a larger pH drop up front but then cultures would slow it down on the backside in the dry phase when it was sitting in the press," Jaeggi said. "Today, cultures just keep on driving the pH right on through the entire cheesemaking process." This results in Swiss cheese texture that is gritty and grainy and lacking flavor because the Swiss cheese industry is backing off on starter culture because they need to be able to control acid development. More specifically, inoculation rates are cut back, so the cheesemaker does not miss the critical control points during renneting and pump over in the wet acid phase to better control pH in the dry acid phase where it becomes more difficult to slow up acid development.

Cutting: Cutting at the correct gel firmness is key. Jaeggi recommends pulling a whey sample to monitor total solids, total protein, and fat to optimize cutting at the right firmness. Knife size depends on desired moisture content in relation to cheesemaking equipment – the end goal is hit target cheese moisture while minimizing fat and solids losses in your whey.

Cooking: Traditional Swiss cheese cooks up to about 118°F while Baby Swiss cooks up to about 100°F. The curd is cooked to help control the starter culture (slow pH drop), develop the proper curd firmness, and slow acid development in the dry phase pressing and hooping step. The primary concern is the cook temperature shouldn't be higher than the starter culture can withstand, otherwise the starter culture will be slowed up.

Add Water (pH control): Another strategy to slow acid development and control end pH is to add water. Water can be added to the milk or the curds and whey. Whey dilution during cheesemaking removes some lactose from the curd, thereby keeping the pH in the desired range of 5.05 to 5.20, which results in a cheese with a more pliable body, which is essential for eye development.

"By adding water, the cheesemaker is controlling the rate of pH drop with the amount of lactose in the vat," Jaeggi said. For instance, at end of the cooking phase, the Swiss cheesemaker will drain some whey from the vat and add water back in. To do this properly, a lot of water is needed. Jaeggi added that water usage can be an issue in some plants. In the future, strategies like lactose standardization could be an option for Swiss cheese and help reduce water usage.

Pump Over/Pressing: "Air is your enemy in the manufacture of Swiss cheese," Jaeggi says. "If I see a lot of foaming in the milk, that is very bad." Air can also be incorporated into the whey/curd when it is pumped out of the vat and into the press. To minimize air incorporation, some Swiss cheese vats are designed with a valve located on the bottom of the vat to avoid air incorporation during pump over. This gives a constant output/pressure of whey/curd going through when pumping. Swiss cheese vats are also designed to tilt or lift at end of pumping over, again to try and keep air out. In the press, it is very important to use very little pressure and press the curd/cheese under whey initially, again to drive air out.

Brining: Swiss cheese can be brined using different systems like a static brine, pit brine, or a flowing channel brine system. Swiss cheese can even be dry salted. When Swiss cheese is brined, the salt level on the outside of the cheese is a little higher than the interior. The higher salt level on the outside of the cheese inhibits the growth of the propionic bacteria on the outside of the cheese. Therefore, Swiss cheese doesn't form eyes on the outside of the cheese.

Pre-Warm Room: It is critical the Swiss cheese body is ready to develop eyes. The cheese needs to undergo some proteolysis before going into the warm room. After brining, Swiss cheese should go into a room with a temperature ranging around 45°F for a period anywhere from 7-14 days before being placed into the warm room. This will allow the curd to properly knit with free water being bound to the protein during this time.

Warm Room: The warm room is where the characteristic eyes of Swiss cheese are developed. At this point, hopefully the cheesemaking process has produced a cheese with the right body and texture. If not, eyes will not develop correctly. In the warm room, the propionic bacteria in the cheese ferments lactic acid and converts it to CO_2, which produces the eyes. The temperature of the warm room can range anywhere from 66°-84°F depending on many factors such as flavor development, rate of eye formation, and control of potential contaminating organisms.

Cold Room Storage: After the cheese comes out of warm room, it goes into the cold room to slow down and stop gas formation. There are a couple of things to keep in mind in the cold room. Swiss cheese that is palletized out of the warm room will take longer to cool down to stop gas formation. If Swiss cheese is palletized when gas is still forming that can lead to cracks and splits in the cheese or continued eye development to the point that they become too large and a conversion issue. Under the current FDA Code of Federal Regulations (CFR) 133.195 for Swiss and Emmentaler cheese it states the cheese needs to be held for 60 days before it can be sold.

Conversion and Packaging: Swiss cheese is converted after 60 days of age due in part to the CFR standards. The cheese body must be pliable and free from cracks, splits, excessive streubel, and excessive nesting to prevent slices from breaking during high speed slicing. Eyes must be "dime sized" if used in these high-speed slicers. Too large of eyes can cause issues with exact weight packaging. Cheese with blowholes are also an issue when converting Swiss into slices.

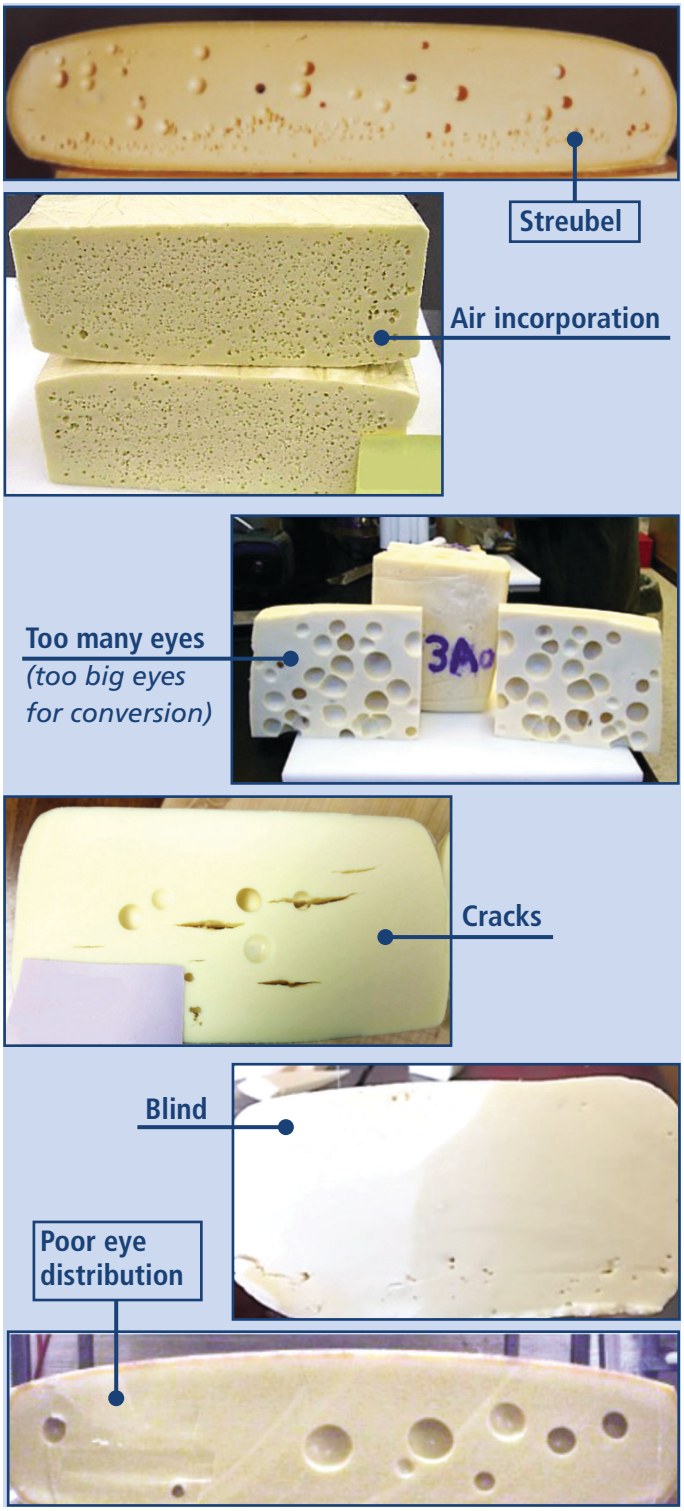
Any cheese that has eyes needs specific bags to allow for the transmission of CO_2 to escape the packaging at a certain rate. Barrier bags can still blow if transmission rate is so high doesn't allow gas to escape at the correct rate. This can result in package blowing in a retail case, which is a poor visual issue (not a food safety issue). Packaging suppliers can work with manufacturers to provide the right bags allowing for CO_2 transmission for the cheese.

Defects in Swiss Cheese

In Swiss cheese, there are two root causes that result in defects – either make issues or microbiological contaminants.

"The make issues are a little easier to solve," Jaeggi said. "We can walk into a plant and see the process and it usually straightforward to find the issue." It is the microbiological issues that tend to be more difficult to identify.

Swiss Cheese Defects



Blind Swiss: What do you call Swiss cheese with no eyes? Blind. Jokes asides, blind Swiss cheese can be the result of several make issues including, low pH, low salt, and/or low warm room temperature. Blind Swiss cheese can also be the result of making Swiss cheese using a bactofuge. This results in milk that is too clean. Another possible issue is that some heterofermentative starter cultures can

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YOGURT MONOGRAPH SERIES: PRODUCTION

Daniel Wilbanks, Technical Contributor

This is Part I of a new CDR Monograph Series focused on yogurt production. Watch for further installments of this series in the Dairy Pipeline.

Perhaps no other food contains as robust of a nutritional and probiotic profile as cultured milk. Due to its ancient origin, many varieties exist today but yogurt is the most popular cultured milk product in the US. The fermentation of milk using *Lactobacillus bulgaricus* and *Streptococcus thermophilus* cultures differentiate yogurt from other cultured milks, and in the US the FDA regulates the standard of identity for yogurt under 21 CFR 131.200. Notably, the FDA does not regulate many varieties, such as Greek or French styles. This monograph series will overview the production of yogurt and highlight tools to help manufacturers produce high quality yogurt. Subsequent parts will cover narrow topics, such as viscosity determination and sensory evaluation.

The transformation of milk into yogurt is biochemistry in action. Biologically, microorganisms metabolize lactose and convert it into lactic acid. Chemically, the high acidity lowers the pH $\leq$ 4.6 (titratable acidity $\geq$ 0.7%) which gives yogurt its distinct sour or tart flavor and causes proteins in the milk to coagulate and form a gel. Flavor compounds, such as diacetyl and acetaldehyde, are also produced during fermentation and additional cultures may be used to provide more flavors, modify texture, impart therapeutic effects, or protect against spoilage.

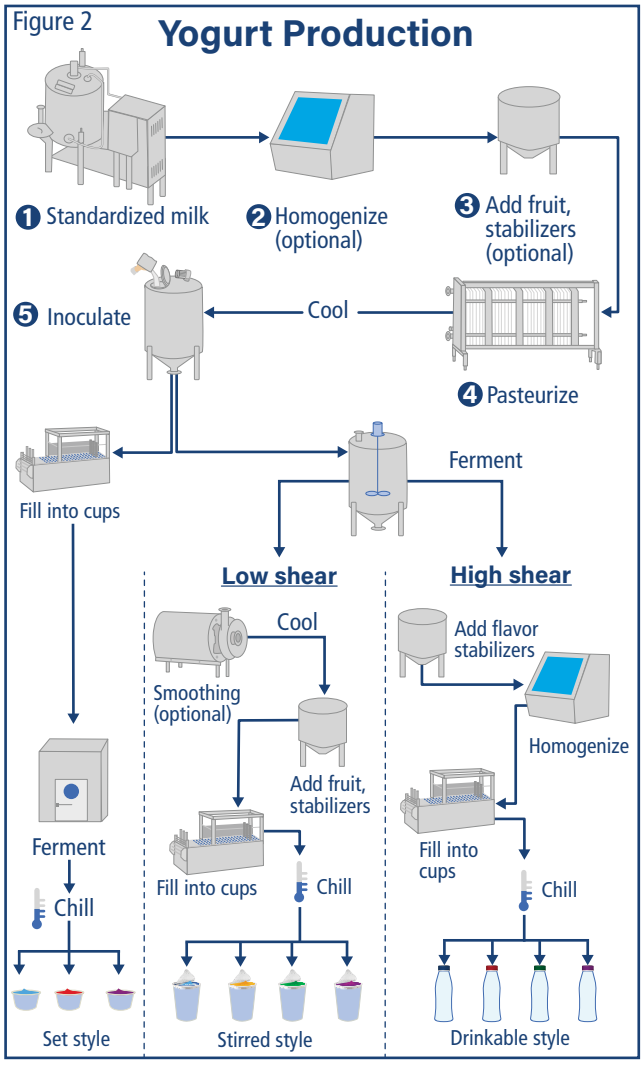
The gel, or white mass, that forms from the acidification of milk is a result of insoluble complexes aggregating. Caseins, which make up ~80% of the proteins in bovine milk, are naturally insoluble near pH 4.6. Other components in milk are soluble in acidic conditions, such as lactose, lactic acid and milk salts, and so are found in the water – or whey – phase. Water and soluble components do not coagulate and are loosely held within the gel, much like water in a sponge. Whey proteins are natively soluble – hence their name – but can be made insoluble by severely heating milk prior to fermentation. These insoluble denatured whey proteins will aggregate with caseins to form a stiffer white mass that more firmly traps water. This helps to reduce the amount of whey that sometimes separates from yogurt (Figure 1). If milk is homogenized before fermenting, milkfat globules acquire a coating of casein proteins and become insoluble – to a degree – and provide additional stiffness to the casein-based gel.

Figure 1

A process flow diagram for yogurt production is shown in Figure 2, though many more varieties exist. For instance, yogurt may be concentrated, such as with Greek or Icelandic styles. Concentration can be thought of as a water removal process, and the water (and water-soluble components) may be removed after fermentation by straining, which generates acid whey. Yogurt may also be concentrated prior to fermentation by evaporating milk or by a more modern approaches like membrane filtration, though these come with their own challenges that we will cover in a later issue. Additionally, yogurt may be heated < 150°F after fermentation to extend the shelf life or heated at high temperatures (>162°F) to inactivate microbes and allow storage without refrigeration.

In part II of the series we will explore rheology to demonstrate how yogurt viscosity decreases when disrupted by stirring, how the structure rebuilds over time, and how stabilizers can be used to modify texture.

Figure 2



SUSTAINABLE AND INNOVATIVE CHEESEMAKING: CRAVE BROTHERS FARMSTEAD CHEESE LOOKS BACK ON 20 YEARS

About 20 years ago, George and Debbie Crave stepped away from the dairy farm and tried their hand at cheesemaking. Today, they operate Crave Brothers Farmstead Cheese, which has received numerous awards for their cheeses and recognition for their focus on sustainability.

The Craves are probably best known for their Fresh Mozzarella. In fact, that was the cheese that started it all. Back in the late 1990s/early 2000s, George was dairy farming but was ready to do something else.

"I knew we had good cows and good milk production. I just didn't want to milk more cows," George said. "I started reading and I did a lot of research. Pretty soon I'm talking with some cheese marketers and they suggested making Blue cheese, soft cheese, aged cheese and then finally Fresh Mozzarella so we started with Fresh Mozzarella."

Working with CDR

In the late 90s, Fresh Mozzarella was still a relatively new product in the U.S. To help develop a make procedure for their Fresh Mozzarella, George turned to the Center for Dairy Research.

"I went in there 21 years ago with about 2 or 3 milk cans of raw milk from our bulk tank and we made Fresh Mozzarella," George remembers. "John Jaeggi was the first person to make our Fresh Mozzarella. We dialed in the pH, the cook temp, the molding process; everything."

Although Fresh Mozzarella was a newer cheese for Wisconsin cheesemakers, John Jaeggi, CDR Cheese Industry & Applications Coordinator, had focused on Fresh Mozzarella in the early 90s as part of the specialty cheese program that Jim Path started at CDR.

After the initial trials at CDR, John went out to the Crave's cheesemaking facility near Waterloo, Wisconsin and helped scale up.

"George was always very forward thinking and he always had a can-do attitude," Jaeggi said. "He had a unique perspective on how to look at cheesemaking. George's background is farming, so he didn't have preconceived ideas on how to make cheese. He'd have different tweaks and twists on how to do things."

George Crave at the Crave Brothers Farmstead Cheese plant.

That ability to think outside of the box and be innovative helped George and Debbie in those early years.

"The Fresh Mozzarella was a very young product in the U.S.," George said. "We learned along the way. We learned from John and John learned from us."

The Craves also visited Italy to learn more about making Fresh Mozzarella. When they came home, they bought the equipment and began production. "It wasn't automatic; we had plenty of mistakes," George remembers. "We had a lot to learn about cooling refrigeration and everything that goes along with it."

Growing the Business

In addition to George's background in dairy farming, Debbie worked at the Wisconsin Milk Marketing Board (now Dairy Farmers of Wisconsin) and had a strong background in dairy marketing. Still, George emphasizes that he was a novice when he started cheesemaking. One of their first employees was Kurt Premo, a licensed cheesemaker with a Food Science degree from the University of Wisconsin-Madison.

"He's been with us for 21 years," George said. "Our niece Beth joined us a few years later in 2005 for quality assurance and customer service. We built a team out from there and now have about 4-5 licensed cheesemakers in the building."

Today, Crave Brothers Farmstead Cheese has expanded well beyond Fresh Mozzarella. They also make pizza cheese, Queso Oaxaca, Mascarpone, Farmers Rope, and Cheese Curds. They have about 50-55 employees, depending on the time of year. They're also currently on their fourth addition to their cheesemaking facility.

They are truly a farmstead operation. The family's dairy farm sits across the road from the cheese factory. Fresh milk from the dairy farm is piped directly under the road straight to the cheese plant.

"The goal when we started in 2000 was to use 80 percent of the milk from our 400 cows on the farm," George said. "Now we're using about that same percentage from our 2,000 high-producing, modern Holsteins."

Focus on Sustainability

The Crave's dairy farm operation is modern and cutting-edge. Among other impressive aspects is the farm's biodigester, which produces energy for the farm and cheese plant and over 300 area homes. The biodigesters consist of two, large 750,000 gallon tanks. Byproducts from the farm and cheese plant as well as other byproducts like brewers grain from local food and beverage producers are added to the tanks.

"The rapid decomposition from the biomass from the farm and the cheese factory produces methane gas, a highly combustible natural gas that powers an internal combustion engine," George said. "It's like the engine in your car only the engine is the size of your car and it burns this methane gas, turns an electromagnetic generator that generates enough electricity to power the farm, the cheese factory and about 300 homes."

It's a big investment and a lot of expertise to get set up and maintained but it is the future of sustainable farming and cheesemaking. The Craves have developed a green logo on their cheese packaging that calls out the Craves' focus on sustainably. "It's amazing how it's become more important and relevant," Debbie said. "We're glad because it really helps us tell our story." Or, as George puts it, "We were green before green was groovy."

In addition to electricity, the biodigester's large engine produces a lot of heat and that warmth is captured and used to heat the buildings. Solids taken from the biodigester are run through a furnace where they are dried and produce a soft, odorless material used for bedding for the cows. Liquid nutrients are also taken from the biodigester and used in the farm's fertilizer for their crop fields.

The Craves are also focused on sustainability in their cheese plant. In 2020, they received a grant from the Dairy Business Innovation Alliance to help offset the cost of a cooling system for their Fresh Mozzarella line. The system allows water to be recycled, thus cutting down on water usage in the plant.

A worker moves Mozarrella curd into the cooker.

Always Looking Ahead

When the Crave's started making Fresh Mozzarella 20 years ago it wasn't as popular as it is now. It was more of a seasonal cheese – people mostly ate it in the summer in caprese salads. During the other months, business would slow.

"We'd stand by the fax machine and wait for an order and nothing happened," Debbie remembers. "Thankfully people changed their eating patterns and are excited about different foods. Now we want caprese salad and Fresh Mozzarella on pizza year-round."

George adds, "No doubt that the foodie movement has helped us tremendously and helped the Wisconsin dairy industry and the cheese that we make here in Wisconsin. You turn on the food channel and they're talking about using cheese on this or that. We're also fortunate we have the Italian market and the Hispanic market and that's been good for us."

Early on, it was also hard to get some retailers to put the Fresh Mozzarella on their shelves because of challenges of its shorter shelf life. The Craves also learned about the importance of meeting the needs or requests of their customers. To meet those needs, they began making Fresh Mozzarella in all the different sizes and shapes (logs, Ciliegine, Perline, Ovoline, etc.).

"When we started with our Fresh Mozzarella, we made three main sizes and we thought, 'Yay! We're done, we did it!'" Debbie said. "But then we heard from our buyers and they want it pearl size, medallions, logs, sliced logs… Consumers want the convenience and choice of all these different sizes. And we realized that's how you sell more

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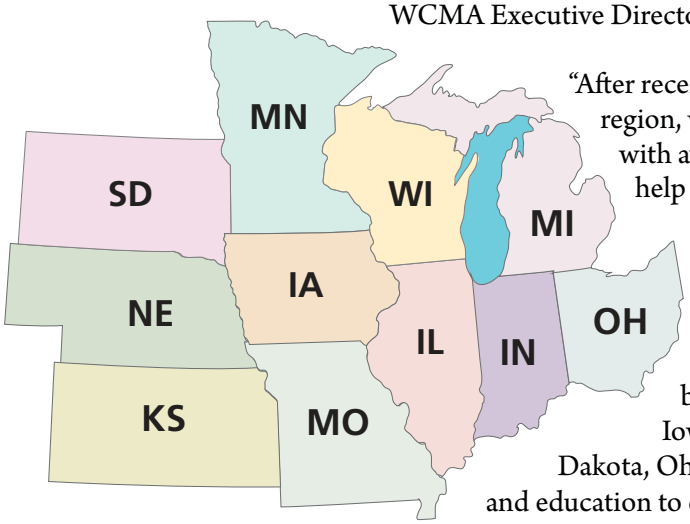
DBIA AWARDS INDUSTRY IMPACT GRANTS AND DAIRY BUSINESS BUILDER GRANTS

The Dairy Business Innovation Alliance (DBIA), a partnership between the Wisconsin Cheese Makers Association (WCMA) and the Center for Dairy Research (CDR) recently announced the 31 companies and cooperatives that have been selected to receive Dairy Business Builder grants totaling nearly $2.5 million.

The Dairy Business Builder grant program aims to encourage small- to medium-sized dairy farmers, entrepreneurs, and processors in the Midwest to pursue innovative projects such as dairy farm diversification, on-farm processing, value-added product creation, and efforts to market dairy products for export. Reimbursement grants of up to $100,000 each are awarded following a competitive review process.

"Amid robust competition from across the Midwest, these projects stood out for their ambitious, distinctive approaches to adding value from farm to vat. We're thrilled to support dairy innovation today and in the future," said John Umhoefer, WCMA Executive Director.



"After receiving more than 100 applications from across the 11-state DBIA region, we are delighted to be able to support 31 small dairy businesses with awards. Almost all are first time winners and these funds will help them grow and innovate," added CDR Director John Lucey.

The DBIA is supported by funding from the U.S. Department of Agriculture. Including the awards listed above, since its inception as part of the 2018 Farm Bill, the DBIA has administered approximately $7 million in grants to 88 dairy businesses within its 11-state service area of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, South Dakota, Ohio, and Wisconsin. The program also offers technical assistance and education to dairy farmers and processors in the region.

Companies and Cooperatives Receiving Dairy Business Builder Grants

Alpinage Cheese LLC - Oak Creek, Wisconsin	JB's Barnyard - Evansville, Indiana
Augment LLC - Madison, Wisconsin	Jisa Farmstead Cheese - Brainard, Nebraska
Black Radish Creamery - Alexandria, Ohio	Ozark Mountain Creamery, LLC - Mountain Grove, Missouri
Charlevoix Cheese Company - Charlevoix, Michigan	Pine River Pre-Pack, Inc. - Newton, Wisconsin
Comstock Cheese LLC - Comstock, Wisconsin	Rowdy Cow Creamery LLC - Burton, Ohio
Copper Crow Distillery - Bayfield, Wisconsin	Saltless Sea Creamery, LLC - Traverse City, Michigan
Freshly Dairy - Lizton, Indiana	Semifreddo LLC - Hart, Michigan
Furniture City Creamery - Grand Rapids, Michigan	Sirocco Ridge Farmstead Creamery, LLC - Henryville, Indiana
Gardner's Wisconsin Cheese, LLC - Marshfield, Wisconsin	Smith Brothers Creamery LLC - McConnelsville, Ohio
Goat Milk Stuff LLC - Scottsburg, Indiana	Specialty Cheese Co. Inc. - Reeseville, Wisconsin
GoodSport Nutrition, LLC - Evanston, Illinois	Thistle Dew Creamery - Vassar, Michigan
Green Dirt Farm, LLC - Weston, Missouri	Troyer Specialty Foods - Millersburg, Ohio
Grison Creamery, LLC - Ava, Missouri	Twin Springs Creamery - Bloomington, Indiana
Hemme Dairy, LLC - Sweet Springs, Missouri	VernDale Products, Inc. - Detroit, Michigan
Highfield Farm Creamery - Walworth, Wisconsin	Wisconsin Dairy State Cheese Company - Rudolph, Wisconsin
Hinterland Dairy - Donnellson, Iowa	

Industry Impact Grant Recipients

Through a competitive review process, DBIA is awarding a combined $1 million in Dairy Industry Impact grants. The grant program awards reimbursable grants of up to $250,000 for USDA-eligible expenses related to a company's proposed project. DBIA has selected six projects that can positively impact the dairy industry. As part of the Dairy Industry Impact program, grant recipients must be willing to share results of their project.

This is the second round of Dairy Industry Impact grants awarded by DBIA. In 2021, DBIA distributed reimbursable grants totaling $600,000 to four companies and cooperatives.

2022 Dairy Industry Impact Grant Recipients:

Cedar Grove Cheese – Plain, Wisconsin
Cedar Grove Cheese is working to connect a tracking system to a database of farmer stories, images, and any certification documents the farms use to document the conservation practices on their farms. This same system can be used to track and aggregate the farms' environmental impacts including carbon sequestration, water usage, animal welfare practices, and make that information available to consumers.

Crave Brothers Farmstead Cheese – Waterloo, Wisconsin
Continuing their commitment to sustainable leadership, Crave Brothers Farmstead Cheese is researching and implementing new Fresh Mozzarella packaging with the goal of increasing shelf life, reducing costs, and converting to new sustainable packaging. Crave Brothers Farmstead Cheese is currently investigating a range of technical and marketing issues as they consider bringing innovative packaging to market.

CROPP Cooperative – La Farge, Wisconsin
CROPP Cooperative is evaluating micro-fixing production processes, at scale, with a view toward improving product quality and inventory management. The technology has the potential to allow dairy plants to process milk to meet market demand without sacrificing operational efficiency.

Fromage Spa – Green Bay, Wisconsin
Reducing food waste is a key deliverable for this project submitted by Fromage Spa. The company is evaluating machinery to recycle packaged butter in an efficient and sanitary fashion, thereby allowing them to reclaim lost profit margins and reduce the amount of edible product going to waste. If tests prove satisfactory, the process would be of benefit to both large- and small-scale manufacturers.

Redhead Creamery – Brooten, Minnesota
The partners in Redhead Creamery, LLC seek to open up entry for artisan cheesemakers into the artisan alcohol market. Converting dairy streams, such as whey, into a value-added alcohol typically requires complex equipment normally found in larger plants. Redhead Creamery is evaluating a way to make the process accessible to smaller processors.

Specialty Cheese Co. – Reeseville, Wisconsin
Specialty Cheese has been developing a novel method of separating curd from whey that would be capable of high separation rates while maintaining the integrity of weak or flocculated cheese curds. Based on preliminary results, they are confident this method can be commercialized for Paneer cheese and will very likely work for ricotta and all cheeses with soft curd. This project will work to validate and commercialize this process.

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cheese. That was a little eye opener when we started."

George said, "We're always doing something different, whether is a different size, shape, pack size, we're just continuously looking at what's next. Or what's another product that we can make that's unique to us and that we have the capacity for."

Award-Winning Cheese

At the 2022 Wisconsin State Fair, the Craves were named the Grand Master Cheesemaker with their Chocolate Mascarpone, which scored 99.7 in the flavored soft cheese class. Debbie said they never expected a soft, spreadable cheese like their Chocolate Mascarpone to win the top honors.

"We couldn't be more surprised and humbled," Debbie said. "And lots of people were involved in that success from one end of our building to the other." To recognize everyone's role, the Craves had photos taken of each of their employees with the State Fair trophy.

The Crave's Fresh Mozzarella has also won numerous awards. Most recently, it took first place in the Fresh Mozzarella category at the American Cheese Society 2022 Judging and Competition. Their Chocolate Mascarpone, Marinated Fresh Mozzarella and Mascarpone also took top three in their respective categories.

Their success can be attributed to George, Debbie and their employees' hard work. They are also thankful for support available to dairy processors in Wisconsin.

"We have CDR and Madison just 40 minutes away – that's invaluable," George said. "I can call Dean Sommer, John Jaeggi, or Mark Johnson and leave a message and they'll get back to me on any technical question."

Debbie adds, "CDR has just been a myriad of programs for us from the consulting, the DBIA grant program, and everything else. We know we're lucky to have this program here and we feel the envy of other states who don't we have such good support like we do in Wisconsin. And it's not just the good support, it's the people."

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inhibit the eye-forming propionic bacteria (talk to starter culture representative).

Poor Size, Quantity and/or Distribution of Eyes: A number of make issues impact the size, quantity or distribution of eyes in Swiss cheese. Pressing time is one factor. For instance, if Swiss cheese is pressed for 3 hours, instead of overnight, this may result in a cheese with smaller eye size. The amount of time the cheese spends in the warm room can impact eye size (i.e. if the cheese is taken out of the warm room too soon, it may not have enough time to develop a desirable amount of eyes and the eyes that do develop may be small). Other factors that can impact eye size and quantity are related to a lack of predrawing whey into the press, pumping issues, cold curd from rinsing the vat, uneven curd depth, and salt levels. Finally, air incorporation is a big issue in eye quality. Jaeggi shared that the old CDR dairy plant had issues with air incorporation and eventually it was tracked down to a leaky seal in the pasteurizer. This resulted in "floaters," which are spongy curds that float to the top of the vat during cooking. Typically, if too much air is incorporated into the cheesemaking process, it results in Swiss cheese with many small eyes or nesting.

Nesting and Streubel: Nesting can be described as poor-quality eyes where eyes form very close together and/or appear to "nest" within each other. This can result from handling the curd once the cheese is pumped over from the vat. "Once you pump over, you don't want cheesemakers in there handling or stirring the curd. That's going to cause issues of nesting." Streubel is the appearance of many small, rough curdy eyes. This can be the result of dumping loose curd from the vat on top of the cheese or pumping over with no predraw whey, which causes air to incorporate into the cheese.

Splits/Cracks: This can be the result of storing the cheese at a cold storage temperature that is too warm, for example >39°F. Splits/cracks can also be the result of aggressively handling or slamming the cheese when turning it in cold storage. Microbiological contaminants like spores can cause splits and cracks to form.

Discoloration: Swiss cheese can develop discoloration on the outside. This is typically caused by Serratia bacteria.

ABOUT CDR VIDEO

CDR has produced a new overview video featuring staff and describing the services and opportunities that CDR provides. Learn how CDR helps the dairy industry through innovation, support and training. To view this video, visit https://www.cdr.wisc.edu/cdr-video

This discoloration only appears on the outside of the cheese and doesn't produce any abnormal flavors.

Blowholes or Blowing: In Swiss cheese, blowholes or blowing occurs either early or late in the ripening process. Early blowing can occur if the cheese body has not been conditioned properly through initial proteolysis, warm room temperature is too high, or if coliform bacteria are present (raw milk cheese are more prone to early blowing). Late blowing is typically seen around 2-3 months after manufacture. It can be caused by anaerobe spore formers such as *Clostridia tyrobutyricum*, which can be identified by analyzing butyric acid levels. It can also cause a rotten egg sulfide odor. It doesn't take many spores to produce late blowing – counts as low at 5 spores/ml can case late blowing. (see Dairy Pipeline Volume 27, Numbers 1 & 3 for articles on controlling spores).

As described in this article, Swiss cheese is one of (if not the) most difficult cheeses to produce. The industry is facing many challenges working against it. It is a unique cheese that appeals to consumers for its taste but also its nutritional profile (low salt and slightly lower fat). It's also versatile and works well in different food applications where it can add flavor to sauces, processed cheese, etc. Consumers in the U.S. have long enjoyed the many varieties of Swiss cheese and it should continue to have a strong presence in the U.S. dairy industry.

Technical Reviewer: John Jaeggi, CDR

CDR WELCOMES NEW EMPLOYEES

Stacy Kunesh, Culinary Technician

As CDR's culinary technician, Stacy supports all areas of the Center and develops new and innovative formulations utilizing dairy ingredients and products. She has nearly 30 years of experience in the restaurant industry. Some of Stacy's accomplishments include owning and operating a restaurant in Portland, Oregon, working on a movie set in Hollywood and teaching a Farm to Table cooking class at the University of Wisconsin College for Kids program. Stacy loves living in Wisconsin, supporting Wisconsin dairy farmers and is proud to be a part of the CDR team.

Mike Matucheski, Outreach Program Manager – Mentor

Mike is an award-winning Wisconsin Master Cheesemaker, with master certifications in Parmesan, Asiago, Romano, Fontina, BellaVitano and Pastorale blend (mixed milk). He is perhaps best known for developing Sartori's BellaVitano, which is a unique Wisconsin cheese with a creamy profile and flavor notes comparable to Parmesan. Mike started cheesemaking in 1993 when he joined the Kraft plant in Antigo, Wisconsin. As a CDR mentor, Mike shares his expansive knowledge of cheesemaking with cheesemakers across Wisconsin and beyond. Mike is passionate about passing on knowledge and helping the dairy industry produce high quality cheese.

Brian Riesterer, Outreach Program Manager – Mentor

Brian grew up on a dairy farm in Manitowoc County (Wisconsin) and worked in a cheese factory in high school. Since then, Brian has had a long career in the dairy industry. His work experience includes cheesemaker at Emmi Roth, buttermaker at Pine River Dairy, a member of the cheese ingredient division at Sargento and manager of dairy innovation at First Choice Ingredients. Brian was also one of the early CDR employees. He worked at CDR from 1985-90 and ran industry trials and assisted the researchers and graduate students. As a CDR mentor, Brian works closely with dairy processing plants and employees and provides support and guidance on a variety of issues.

Ben Smith, Cheesemaker

As a Cheesemaker, Ben supports all aspects of CDR's pilot plant including receiving milk, operating the pasteurizer, running CIP and assisting with research and client cheesemaking trials. Ben has diverse work experience in the food and dairy industry and has helped run his family's produce and poultry farm. He previously worked at Schoep's Ice Cream where he was a flavor operator and pasteurizer.

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Upcoming CDR Trainings

The Center for Dairy Research is here to help with dairy processing training. Below is a listing of upcoming CDR short courses and other training opportunities.

- Cheesemaking Fundamentals (in-person) – March 7-8
- Fundamentos de elaboración de queso (presencial) – March 14-15
- Cheese Grading & Evaluation (in-person) – March 21-23
- Cheese Judging (in-person) – March 24
- Buttermaking Fundamentals (self-study) – April 12
- Cheesemaking Fundamentals (self-study) – April 12
- Certificate in Dairy Processing (online, live) – April 20
- Advanced Cheesemaking: American-Style Varieties – May 2-4
- HACCP Certification (in-person) – May 11-12
- Process Cheese (in-person) – May 23-25
- Cheesemaking Fundamentals (in-person) – May 16-17
- Buttermaking Comprehensive (in-person) – June 6-8
- World of Cheese from Pasture to Plate (in-person) – June 13-16
- Cultured Dairy Products (in-person) – June 20-22

For the latest information or to register visit www.cdr.wisc.edu/short-courses.

Save the Date!

CHEESECON

April 4-6, 2023 | Alliant Energy Center, Madison, Wisconsin | CheeseCon.org

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The Dairy Pipeline is published by the Center for Dairy Research and funded by the Dairy Farmers of Wisconsin.