

# Dairy Pipeline

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## BLENDING THE POWER OF GIRL WITH THE POWER OF DAIRY

Jouzge represents confidence, self-love and serves as the inspirational name behind a new line of dairy-based snack bars developed to promote healthy eating and a healthy self-image among young women.

Created by UW-Madison alumnas and Oregon, Wisconsin resident Dana Wendt, with formulation assistance from the Center for Dairy Research (CDR), Jouzge bars were born out of Wendt's desire to create a dairy-based snack for young girls that would fuel their self-love, rather than disparage it.

"Years ago, I was eating a particular bar that had a weight management message attached to its name and marketing," Wendt said. "My daughter, Hadley, saw me eating this bar and asked if she could take it to school as a snack. While the nutrition was acceptable, I began to worry about the message the bar was trying to send to my daughter. It basically said, 'you're not the right size, but if you eat this, you'll be better.'"

Disillusioned by the messaging, Wendt worked with her daughter and her mother to develop the initial plans for a bar that would pair a positive message with an ingredient list and flavor profile young women and their caregivers could support. In terms of the messaging, Jouzge became a natural name for the bar, as it was the phrase Wendt's father used as a self-affirmation each day before he headed to work at his B2B dairy company.

"My Dad had to make a lot of sales calls as a part of his job, which required a lot of confidence," said Wendt. "Each day, after he was finished getting ready he would flip his hair back, look himself in the mirror and say, 'You've got so much Jouzge.'"

With a self-affirmation tied into the brand name and "to the power of girl" serving as the tagline, Wendt began to focus on the formula.



Growing up in the dairy industry, Wendt was aware of the health benefits of milk and milk product, so she was eager to create a dairy-based bar. A UW-Madison alumnus, Wendt was also looking for that campus connection, so she reached out to CDR, located on the UW-Madison campus, to see if they could help her to formulate a nutritious and flavorful bar.

The premier dairy research center, CDR offers dairy foods companies access to the foremost scientific expertise in dairy research, technical support and education. Funded by dairy farmers through the dairy check off program and partners such as the Wisconsin Milk Marketing Board and the National Dairy Council, it is the Center's goal to help companies such as Jouzge to bring innovative, nutritious and profitable products to the global marketplace.

Experts in the application of dairy ingredients, CDR Dairy Ingredients, Beverages & Cultured Products Coordinator KJ Burrington and CDR Associate Researcher Susan Larson, Ph.D., were happy to help Wendt develop her product. As a CDR client, Wendt →

received access to the many resources at CDR including the culinary services and the use of the CDR applications lab kitchen where formulation took place.

For several months, Wendt and the dairy ingredients team experimented with a variety of different formulas, bar shapes, sizes, coatings and drizzles.

“It was a collaborative effort when she came to CDR,” Larson said, “We would try product, play with flavor and tweak the formula to meet her directives, which included a clean label, shelf-stable product with a moderate amount of protein.”

Utilizing dairy proteins was an important part of the formulation process, which included the use of whey protein concentrate, whey protein isolate, milk protein isolate and whey protein crisps, which created a crunchy texture in some of the bars.

“Dairy proteins are high quality complete proteins that contain all the essential amino acids,” Larson said. “Essential amino acids are ones that must be

provided by your foods as your body cannot make them. Specifically, whey proteins have an especially high concentration of the branched chain amino acids: leucine, isoleucine and valine that are used for building and maintaining lean body muscle.”



The CDR dairy ingredients team helped Wendt to create three separate flavors of the bar including chocolate peanut butter, chocolate mint and chocolate chip cookie dough. Filled with dairy goodness, each clean-label bar contains no more than 130 calories and seven to eight grams of dairy-based protein and no more than seven grams of sugar.

“Susan and KJ really hit the flavor out of the park,” Wendt said. “The girls who tested the product ended up calling it a treat. It was really a huge effort on CDR’s part to come up with the great candy like flavor. The girls just light up when they talk about our bars.”

With successful flavor profiles in place, Wendt needed a co-packer to help bring her bars to market. Through the connections made at CDR, Wendt was able to secure co-packer Betty Lou’s out of McMinnville, OR.

“Betty Lou’s has been so supportive and always made us feel like we count even though we’re not their biggest customer,” Wendt said. “They are particularly supportive of women owned businesses and have really bent over backwards to help us.”

In addition to a co-packer, Burrington suggested that Wendt also consider collaborating with industry to help the Jounge business grow. In particular, Burrington shared the opportunities put forth by the Land O’Lakes, Inc. Dairy Accelerator program, which supports U.S. dairy entrepreneurs by providing access to business resources, financial support and more. Interested companies must apply and be accepted into the highly competitive program. A successful applicant, Wendt recently became a part of the program.

“The Land O’Lakes, Inc. Dairy Accelerator program will serve as a mini-MBA,” Wendt said. “We expect it will accelerate the launch of Jounge and advance dairy.”

All about positive messaging for girls and for dairy, Jounge has been growing quickly. Launched August 16, 2017, the bar is currently sold at HyVee in Fitchburg, WI as well as Amazon.com. Having sold several cases in the first few weeks, Jounge was recently accepted into the Amazon Launchpad program, which provides start-ups with the resources they need to succeed on Amazon.

Wendt is grateful for the early support and success, but is most thankful for the opportunity to provide young women with a dairy-based snack that promotes self-esteem.

“Jounge is all about self-love and knowing your self-worth,” Wendt said. “This snack is meant to serve as a daily self-affirmation for girls. A love note to yourself. My mom sent me a note every day in my lunch from elementary through high school and it helped me to know that someone loved me no matter what. I want girls to feel that same love when they eat this bar. We are rooting for them but more importantly we want to remind them to root for themselves and each other.”

To aid in promoting this message, Jounge has recruited influencers and brand ambassadors to share the Jounge story of self-love. Utilizing social media, Wendt’s daughter Hadley and her friend Galia serve as brand ambassadors, promoting the brand and encouraging girls to share empowerment stories on the various brand outlets. Soon to come, the ambassadors will be participating in a campaign promoting the benefits of dairy. ➔



Wendt and her daughter Hadley

For Wendt and her team, things are just getting started. She plans to continue to promote the brand and its self-love message to grocery store chains, school athletics and booster programs and retailers who sell other items to young women.

"I'm so thankful to all those who have helped along the way

and particularly CDR who helped us to secure partners and break this start-up process into meaningful steps," said Wendt. "It's also great to know that this is a product formulated for women, by women. I think a lot of our success is thanks to great women. It's been incredible to see that no one wants to say no to girl power."

For more on the Jouzge brand visit: [www.jouzge.com](http://www.jouzge.com)

For more on the Land O'Lakes, Inc. Dairy Accelerator program: [www.dairyaccelerator.landlakesinc.com/home](http://www.dairyaccelerator.landlakesinc.com/home)

## ARTISAN BUTTER: STEPS FOR A START-UP

Contributed by: Dr. Robert L. Bradley, Professor Emeritus, Dept. of Food Science, University of Wisconsin-Madison

While there is growing interest in the manufacture of butter by artisans, there are several factors to consider before getting started. For example, what do you need up front before the first lot of butter is churned? In the state of Wisconsin, you will be required to obtain several permits before producing butter, including:



Garlic & basil flavored butter

- |                                   |                            |
|-----------------------------------|----------------------------|
| 1. Dairy Plant Operator's License | 3. Buttermaker's License   |
| 2. Pasteurizer Operator's License | 4. Butter Grader's License |

Keep in mind that four licenses are required within the plant operation for food safety reasons. Once these requirements are fulfilled then butter can be manufactured in your approved facility. Other states may have similar regulations, so please check with your state regulatory agency before proceeding.

Once the regulatory requirements have been met, the buttermaking can begin. Among the first steps is the need to pasteurize the cream in order to inactivate the lipase enzyme and bacteria that are present. A high-temperature, short-time (HTST) system is a popular method that requires a minimum temperature of 185°F and a 15-second hold at that temperature. The estimated cost of HTST equipment to pasteurize small lots of cream is probably prohibitive for a small artisan buttermaker, however, a stainless steel vat may be within the budget. Vat pasteurization requires a minimum temperature of 165°F with a 30-minute hold. While artisan cheesemakers can use high quality raw milk successfully to prepare finished cheese, buttermakers must pasteurize to eliminate the influence of active lipase. Otherwise, the finished product will be rancid and an undergrade by taste. Pasteurized cream shipped from one plant to another must be re-pasteurized before use

according to the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). Again, those outside of Wisconsin should check their local regulations. The pasteurization step provides protection against most bacteria including pathogens and spoilage organisms, as well as development of rancidity. A review of the literature cites many articles that reveal problematic bacterial populations in raw milk as well as numerous court records showing illnesses and deaths. Be careful and retain properly filled out pasteurization charts for the required 90 days.

The next issue is churning. I would suggest a commercial mixer (beater types) with a three to five gallon bowl because small batch churn are difficult to find. For example, one gallon of 40 percent cream will yield 4.12 pounds of finished unsalted butter. Consider what batch size do you want and whether you want to sell salted (1.5% salt added) butter only or unsalted butter. With unsalted butter you may wish to add lactic acid and diacetyl (natural flavors) to lower the pH to 5.1-5.2 to control the growth of mold. Both components are food grade and are available commercially with directions for use.

While the regulations and equipment require a great deal of thought beforehand, the manufacture of butter is relatively easy. Start with pasteurized cream (35-40 percent milkfat) warmed to 50°F, held for one hour to adjust the fat globules to readiness, then churn. In a revolving churn or beater bowl, it will take about 45 minutes to generate a mixture of clumps of yellow butter floating in buttermilk. This is the inversion of the emulsion, i.e., fat-in-skim milk to skim milk-in-fat. Separate the butter from the buttermilk, and work the butter into a continuous mass by clean, gloved hands or in the churn or beater bowl. Your butter composition must be at least 80 percent milkfat to meet the minimum legal standard. Determine the moisture content by analytical analysis and adjust the composition by adding water or working the butter more to expel the buttermilk. When you reach the correct moisture, add →



salt and work the butter more to gain equal distribution throughout. To obtain salted butter, add 0.6 pounds of flake or fine ground salt per pound of finished butter and mix WELL. No crunchy salt should be detectable by



Bob Bradley inspecting butter at the 2017 CDR Buttermakers Short Course.

taste. Keep in mind that salt dissolves only in the moisture phase. If you are preparing flavored butters, these ingredients are added after or with the salt. If you add honey, this must be pasteurized because of the presence of active lipase enzyme.

Packaging is next. The typical parchment paper used in the butter industry is too porous for your use. Off odors can penetrate and severely alter flavor. I would suggest using a plastic one-pound or half-pound tub with a tight cover. In fact, it would be best to use a pigmented (white or yellow) tub to hold your butter. The pigment coloring of the container would control flavor altering, light induced oxidation. You will then need a large enough refrigerator to store the cream

and the packaged butter. Pressure sensitive labels can be used to identify what is inside and could be hand prepared to declare the ingredients used.

Clean up is the final step. Use chlorinated alkaline cleaner at the manufacture's recommended level in hot water following a hot water rinse (greater than 110°F to melt milkfat). The equipment should be clean and sanitary at this point, but sanitize immediately before the next use with at least 100 ppm chlorine-based sanitizer or a recommended sanitizer of your choice. Do not use iodine-based sanitizers because of the off-flavor possibility. Also, purchase a stainless steel table to store your stainless steel utensils. This is necessary for sanitation and makes clean up easier.

Before pursuing artisan buttermaking consider the expense, time and your total commitment. This on paper might appear quite simple, but you need a high quality source of cream, an understanding of regulatory requirements, including food safety and a plan for acquiring customers to purchase your finished product. This is not an easy undertaking! 🍌

## GETTING YOUR PROTEIN ON

Contributed by Sarah Minasian, CDR

Pease porridge hot, pease porridge cold ... pease porridge with protein? Yes! But we're not talking about the split pea soup that the nursery rhyme references, we're talking about porridges that are eaten around the world.

Upma, for example, is a very popular "porridge-like" dish commonly eaten for breakfast throughout India. Unlike America's counterpart—the oftentimes served sweet oatmeal, Upma is a savory dish made with a base of whole or refined ground wheat or rice. Vegetables are included as opposed to fruits, along with nuts, beans and savory spices and herbs like cumin, ginger, chile and cilantro.

Travel even further east to China and you'll likely find Congee, again similar to porridge, offered on breakfast menus. Congee is essentially what Americans would call a savory rice pudding. Prepared in varying degrees of thickness, Congee's base serves as a platform for fish, chicken, seafood, eggs and/or mushrooms, oftentimes seasoned with garlic, sesame, soy and ginger.

Here at the Center for Dairy Research, we've added Milk Protein Concentrate 80 (MPC80) to formulas we've developed for both Congee and Upma, yielding 10g of protein per serving of Congee, and 20g of protein per serving of Upma.

Here are two formulas for you to experiment with. We think you'll find Congee's flavor subtle yet satisfying, and Upma's interestingly exotic. Go ahead and spice up your breakfast while getting your protein on, and let us know what you think. 🍌



### Protein Enhanced Congee

Amount	Ingredient
236.00 grams	rice, white, dry, long grain, enriched
15.00 grams	oil, sesame, salad or cooking
1,892.00 grams	broth, vegetable, low sodium
20.00 grams	milk protein concentrate 80
15.00 grams	garlic ginger paste
10.00 grams	soy sauce, less sodium
115.00 grams	mushrooms, shiitake, cooked

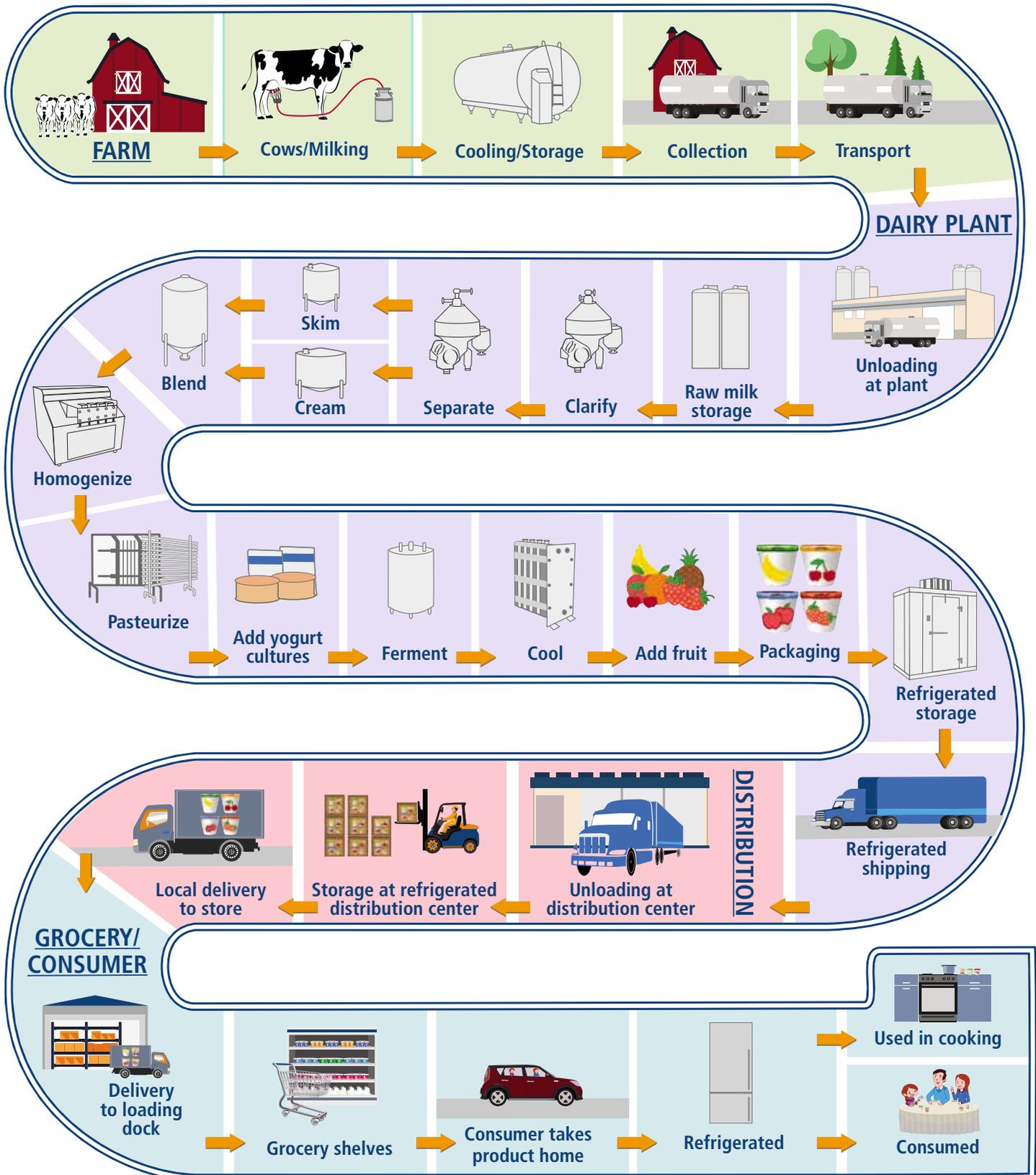
### Directions

1. Wash rice in cold water until it rinses clean; set aside.
2. Remove stems from cooked shiitake mushroom and slice; set aside.
3. Place sesame oil in heavy bottomed 4-quart pot.
4. Add rinsed rice and stir to evenly coat with oil.
5. Stir in broth and bring to boil for several minutes.
6. Reduce heat to simmer and cover 3/4's with lid.
6. Simmer, stirring occasionally for 30 minutes.
8. Whisk in sifted MPC80 until completely blended.
9. Add garlic ginger paste, soy sauce and sliced mushrooms.
10. Return lid and continue cooking on low heat for additional 30-45 minutes until creamy and porridge like.
11. Add more broth if the congee is too thick for your liking.
12. Garnish with chopped scallion if desired.

The upma recipe is available at [www.cdr.wisc.edu/Ingredients/cdr\\_recipes](http://www.cdr.wisc.edu/Ingredients/cdr_recipes)

# SUPPLY CHAIN FOR YOGURT "FROM FARM TO FORK"

In recent years, consumers have shown a greater interest in understanding where their food comes from and how it is manufactured. To aid in consumer education efforts, CDR has created a visual illustrating the path yogurt typically takes as it moves from Farm to Fork. CDR has also created a similar graphic that outlines the manufacture of whey products (Vol. 26, #4). If you have any questions regarding these visuals, please feel free to contact Karen Smith, Ph.D at [smith@cdr.wisc.edu](mailto:smith@cdr.wisc.edu).



## THE STING, CO<sub>2</sub>, AND FLAVOR: AMINE FORMATION IN CHEESE

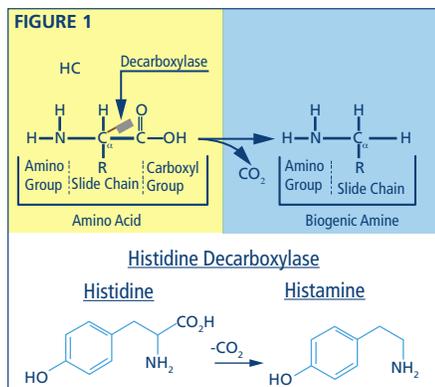
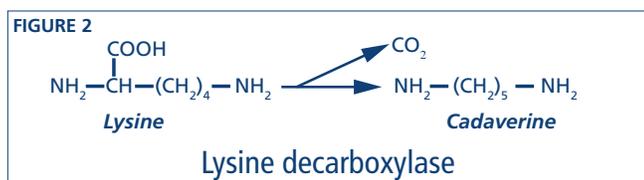
Contributed by Mark Johnson, Ph.D., CDR

There is a smorgasbord of events occurring in cheese as it ripens, but the most dominant of these events is the development of flavor. This occurs when the protein (casein) breaks down into peptides (small fragments of protein) and amino acids, which are subsequently metabolized by microorganisms. This metabolic reaction gives rise to different flavors, both desirable and undesirable. Additionally, the metabolic process serves as a catalyst for other reactions, including the development of histamine, a biogenic amine, which can cause a burning or stinging sensation in the mouth.

### What is a Histamine and Why is it Important?

Histamine is formed from histidine, a common amino acid found in the proteins of milk. In the event that certain bacteria, such as *Lactobacillus parabuchneri*, are present, histidine can be liberated from the protein by the bacteria's proteolytic enzymes, ultimately producing amines from the amino acids. To be clear, amines are formed by the decarboxylation or cleavage of CO<sub>2</sub> from amino acids (Figure 1). The enzyme responsible for this decarboxylation is called a decarboxylase. For example, the specific type of carboxylase found in *Lb. parabuchneri* resulting in the formation of histamine, is called histidine decarboxylase.

This enzyme cleaves off the carboxyl group (CO<sub>2</sub>) on histidine resulting in the formation of histamine. The formation of this amine can cause the pH of the cheese to increase (Fröhlich-Weber, et al. 2013) and can also lead to the formation of unclean flavor compounds. These compounds can include putricine (decarboxylation of ornithine originally derived from arginine), which has an odor like bad breath and cadaverine (decarboxylation of lysine), which has a urine like aroma (we call it catty in cheese) (Figure 2).



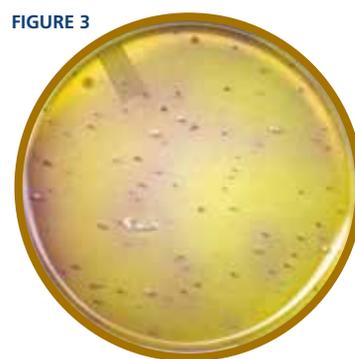
When these flavors or the stinging sensation are found in cheese, the cheese is almost always produced from raw milk. This aligns with a study by Patricia Ascone, from Agroscope Institute for Food Sciences in Bern, Switzerland, who reported a correlation between high levels of histamine in cheese, the growth of *Lactobacillus parabuchneri* and the unpleasant burning taste, ie. “The STING”.

Although I have referred to flavors such as cadaverine and putricine as off-flavors, as most cheese judges would in contests, especially if they are intense, there are some people who think quite differently. We introduced a cheese in our Cheese Grading and Cheese Technology Short Courses that always has a strong unclean flavor. While most do not like the cheese, some love it. It sells very well and provides the desired flavor to a clientele that appreciate it and so it is with cheese.

It's also important to note that not all stinging sensations in cheese are attributed to amines. Fatty acids or compounds derived from them have been implicated. I have not seen any actual supporting literature on this conjecture, nor do I consider the sting similar to what is observed in cheese with high histamine levels. In my opinion, it's likely that a compound, but not an amine, derived from fatty acids produces the sting.

### What Compound Causes Stinging, Where does it Come From and How do I Test for it?

The most common cause of the sting is brought about by *Lb. parabuchneri*, a milk contaminant that is often found in silage. Utilizing genomics and a technique developed to isolate amine-producing bacteria from milk and cheese (Bovar-Cid, and Holzapfel, 1999), scientists have been able to trace the path of this bacteria from the farm to the cheese.



Agar plate testing for amine production

First, in order to isolate and identify the culprit bacteria, a microbiologist utilizes a dye (bromocresol purple) in a special agar containing histidine or other amino acids such as tyrosine and lysine that can be converted to amines. The pH of the medium is acidified so the agar color is yellow. As the pH increases with sufficient amine formation, the dye color changes around the colonies to a blue/purple color (Figure 3). Then, using a newly developed genotyping method, researchers in Switzerland have been able to trace back the milk suppliers who were responsible for →

contamination of raw milk with *Lb. parabuchneri*. It was found that improperly cleaned and sanitized equipment harbored a biofilm and served to inoculate raw milk flowing through the pipes. However, the original source of the *Lb. parabuchneri* undoubtedly was contamination of the milk by residue on the cow that was not removed from the teats or teat canal before milking.

At CDR we have confirmed these findings, also identifying *Lactobacillus parabuchneri* in cheeses with very high levels of histamine. We have found that the level of histamine in the cheeses with intense sting was between 600-720 ppm, but a younger cheese without the sting had only 88 ppm of histamine. It is worth noting that previous research from Switzerland found that histamine levels at 500 ppm would cause the sting.

### Additional Findings

Kristen Houck, CDR microbiologist, has isolated *Enterococcus faecalis*, as an amine producer derived from raw milk samples and will use the technique on cheese later to verify its involvement in amine formation.

Additionally, carbon dioxide is released when amines are formed. Given this, one would expect some slits in the cheese if high levels of amines are found, but originally, we did not observe any slits in the cheeses we studied with high level of amines. Upon close examination, however, we observed numerous tiny gas bubbles in the cheese (Figure 4).

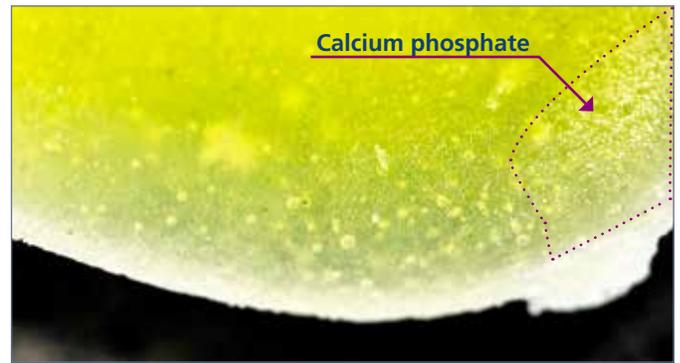
FIGURE 4



There also seems to be a correlation between histamine development and the development of calcium phosphate crystals. This may be due to the initial low pH of the cheese that dissolves calcium phosphate (See *Dairy Pipeline* Vol. 29 No. 2). An initial low pH in the cheese contributes to the formation of crystals, but it can also contribute to the formation of amines as the decarboxylase enzyme is formed by the bacteria under acidic conditions. Still, not all cheeses with gas holes and high histamine showed evidence of the calcium phosphate crystals, so the correlation still needs to be studied to determine the exact cause of this reaction (Figure 5).

Finally, we have heard from many cheese mongers that they are getting a rash or burn on their arms and hands

FIGURE 5



after handling some cheeses, particularly hard cheeses such as parmesan. At times, the reaction can be very severe to the point where employees must be kept from handling aged parmesan cheese. Because of the similarity of this condition to the sting, a great leap is often made to attribute this allergic type response to biogenic amines particularly histamine. This has not been proven and I do not think the response is due to histamine. While I am sensitive to the stinging sensation in my mouth brought on by histamine, I have never had the allergic type of response or stinging sensation with parmesan as others have, so it's difficult to make any scientific or anecdotal correlation.

### How can Amine Production in Cheese be Prevented?

Not all raw milk contains bacteria that will lead to excessive levels of amines such as *Lb. parabuchneri*, but if you do find yourself dealing with this bacteria the raw milk is the likely source of contamination. *Lactobacilli* are commonly found on plant matter such as silage while *Enterococcus* are commonly found in feces, so proper cleaning and sanitation of the teat, teat canal and related milking equipment are essential to reducing the level of contaminating bacteria.

Proper temperature control is also necessary to avoid bacteria growth and related issues, especially during the cooling of the milk and during ripening. Histamines are caused by bacteria and both microbial growth and metabolism are accelerated by warmer temperature. Consequently, ripening cheese at 50° F or more to enhance flavor development could inadvertently also enhance the development of amines. Thus, it is important to monitor temperature.

Quality milk without *Lactobacillus parabuchneri* and *Enterococcus faecalis* is key, but both can be killed by pasteurization. However, pasteurization of milk does not confer immunity to the development of amines in cheese, since it is possible for the cheese to become contaminated after pasteurization. Additionally, pasteurization of milk for cheesemaking may not be an acceptable means for some cheesemakers to use to prevent the development of amines. In that case, they must use milk that is not →

contaminated with these bacteria or use an alternative to pasteurization such as thermization or a heat-treatment sufficient to cause reduction or elimination of potential deleterious bacteria, but not destroy the beneficial bacteria. We are also currently exploring the impact of sub-pasteurization heat-treatment on amine producers. We will keep you informed.

## Conclusion

Overall, histamine development can be avoided if cheesemakers utilize quality milk and take steps to avoid contamination. We are continuing to learn more about this topic each day and look forward to sharing more with you soon. If you have questions or concerns about the information shared here, please contact CDR Distinguished Scientist, Mark Johnson, Ph.D. at [jumbo@cdr.wisc.edu](mailto:jumbo@cdr.wisc.edu)

## Sources

Ascone, P, H. Berthoud, S. Irrmler, M. Haueter, T. Bavan, J. Mauer, J. Haldermann, and D. Wechsler. 2016. Typing and tracing of *Lactobacillus parabuchneri* in raw milk and cheese. Abstract of paper presented at the International Parallel Symposia, Dublin, Ireland.

Bovar-Cid, S., W. H. Holzapfel. 1999. Improved screening procedure for biogenic amine production by lactic acid bacteria. *International Journal of Food Microbiology* 53:33-41.

Frölich-Weber, M-T, D. Guggisberg, R. Badertscher, D. Wechsler, A. Wittwer, and S. Irrmler. 2013. The effect of *Lactobacillus buchneri* and *Lactobacillus parabuchneri* on the eye formation of semi-hard cheese. *International Dairy Journal*: 33:120-128.

Joosten, H. M. L. J., and M. D. Northolt. 1989. Detection, growth, and amine-producing capacity of *Lactobacilli* in cheese. *Applied and Environmental Microbiology* 55:2356-2359. 🍌

## THE SUCCESSFUL USE OF UF MILK IN CHEESEMAKING

Technical Contributors: Mike Molitor & Dean Sommer, CDR

In a move that signals changes for the U.S. cheese industry, the Food and Drug Administration (FDA) recently announced that they would begin to “exercise enforcement discretion regarding the use and labeling of ultrafiltered (UF) milk and UF nonfat milk” in standard of identity cheeses. To be clear, this only applies to fluid concentrates. While variances have allowed U.S. cheese companies to utilize outside sourced UF in a few standard of identity cheeses (SOI), this marks the first time that the U.S. industry can widely utilize UF milk for SOI cheesemaking and not have to declare its use on any

cheese labels. This opens the door for SOI manufacturers to utilize UF milk made outside of the plant as desired. Cheese converters who source their product from a mix of manufacturers, will appreciate that UF milk does not require labeling for any cheese regardless of where the UF milk was made. The specific impact of the ruling is noted in the table below, but, overall, the changes provide a positive economic opportunity for many domestic cheesemakers and removes uncertainty about the regulations.

The benefits of utilizing UF milk in cheese are noteworthy, including increased yield and the means for manufacturing consistent standardized cheese milk composition throughout the year. With these benefits comes a new learning curve, however, as cheesemakers learn to account for the changes in make procedure caused by the utilization of concentrated milk. Center for Dairy Research (CDR) staff frequently receive questions about these changes and the resulting issues. As such, the CDR has developed a new short course to educate cheesemakers who currently use UF milk, or are considering using UF milk for cheesemaking. Titled, “Making Consistent, Quality Cheese with Concentrated Milk,” the course will be held December 5-6, 2017 at Babcock Hall, on the UW-Madison campus. Additionally, CDR has prepared the following information on the utilization of UF milk in cheesemaking in an effort to ensure that all interested cheesemakers are prepared to make quality products utilizing UF milk.

How the FDA Ruling Impacts the Use & Labeling Requirements for UF Milk in Cheesemaking			
	Standard of Identity Cheeses		Non-Standard of Identity Cheeses
Cheese Types	Cheddar, Mozzarella, Swiss	All Other Standard of Identity Cheeses	Non-Standard Varieties
Outside UF Milk Received by the Cheese Plant	* See below	Before: Not Allowable	Before: Allowable, but labeling required
	After: Mandatory labeling not required ■	After: Mandatory labeling not required ■	After: Mandatory labeling not required ■
UF Milk made within the Cheese Plant	Before: Allowable with no labeling requirement	Before: Allowable with no labeling requirement	Before: Allowable with no labeling requirement
	After: No changes	After: No changes	After: No changes

- \* • FDA clarified that it has previously not objected to the use of fluid milk as an ingredient for experimental use in Cheddar and mozzarella
- Enforcement regarding use of UF milk as an ingredient in Swiss cheese was not listed as a priority (Text courtesy of IDFA)
- "We encourage industry to identify the ingredients as "ultrafiltered milk" and "ultrafiltered nonfat milk" to the extent feasible and appropriate." (Text courtesy of FDA Guidance Document)

If you have additional questions regarding the use of UF milk in cheesemaking, we encourage you to attend the CDR course and/or contact CDR Cheese and Food Technologist, Dean Sommer at [dsommer@cdr.wisc.edu](mailto:dsommer@cdr.wisc.edu). You can also review the official FDA ruling at: [www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ucm571090.htm](http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ucm571090.htm). ➔

## Understanding the Basics of UF Milk

At the most basic level, UF milk is traditional milk that has undergone a filtration process. This filtration process efficiently concentrates both of the two critical cheesemaking components, the butterfat and casein. Serum proteins, or the whey proteins, are also concentrated and even the lactose is technically slightly concentrated, although minimally, simply because water passes through the membrane more easily than the lactose. Yes, much of the lactose and soluble minerals pass through, or permeate, the membrane to form the stream, also called permeate.

In any case, the concentrated product, or retentate (i.e. what the UF membrane retains), contains predictable concentrations of butterfat and casein, which is helpful for cheesemakers. For filtration, the phrase concentration factor (CF) is the UF feed volume divided by the retentate volume. Thus, simply multiply the initial butterfat or casein content by the CF to predict the butterfat, or casein concentration, of the retentate. The following two tables contain the theoretical concentrations of the key components in whole and skim milk UF retentates.

Note that the columns labeled “1X CF”, are the initial whole and skim milk compositions, respectively. Together the tables convey important points that the UF does not change the fat/casein ratio and both types of UF retentate still contain lots of lactose. In fact, UF milk contains a little more lactose (percentage by weight) than the initial milk, again because the UF slightly concentrates the lactose.

Whole Milk (WM) UF Retentate Composition  
Concentration Factor (CF) = Volumetric Ratio of Feed/Retentate

	1X CF	1.5 X CF	2X CF	3X CF
% Butterfat by wt.	3.8	5.7	7.6	11.4
% Casein by wt.	2.6	3.9	5.2	7.8
% True Protein by wt.	3.2	4.8	6.4	9.59
% Lactose by wt.	4.7	4.85	4.97	5.13
Volume Removed	0	1/3	1/2	2/3
% of Lactose Removed as UF Permeate	0	31.1	47.1	63.6
% Total Solids by wt.	12.74	16.48	20.35	27.78
Fat/Casein Ratio	1.46	1.46	1.46	1.46

Skim Milk UF Retentate Composition  
Concentration Factor (CF) = Volumetric Ratio of Feed/Retentate

	1X CF	1.5 X CF	2X CF	3X CF
% Butterfat by wt.	0.06	0.09	0.12	0.18
% Casein by wt.	2.6	3.9	5.2	7.8
% True Protein by wt.	3.2	4.8	6.4	9.59
% Lactose by wt.	4.7	4.85	4.97	5.13
Volume Removed	0	1/3	1/2	2/3
% of Lactose Removed as UF Permeate	0	31.1	47.1	63.6
% Total Solids by wt.	9.00	10.97	12.87	16.56

This basic understanding of the compositions and properties of UF milk is key as cheesemakers begin to experiment with its use, but beyond that, cheesemakers must also consider how the UF milk will affect coagulation, yield, texture and so much more. The impacts are dependent on so many factors, it is nearly impossible to describe in a short article. That is why CDR staff encourage cheesemakers to do a bit of research, ask questions and attend educational sessions, such as the CDR course in December, to gain a better understanding of the impact UF milk can have on the cheesemaking process and therefore the end product.

For more information on UF milk, see *Dairy Pipeline* Volume 25 #1 and Volume 27 # 4.

## New CDR Short Course to Focus on the Use of Concentrated Milks in Cheesemaking

Register now to secure your spot in the first Center for Dairy Research short course dedicated to the use of concentrated milk in cheesemaking. This inaugural course, titled, “Making Consistent, Quality Cheese with Concentrated Milk,” will be held at Babcock Hall December 5-6, 2017 and is ideal for cheese manufacturers that currently use ultra-filtered (UF) milk or are considering the use of UF milk for cheesemaking.

“Given the current regulatory changes in regards to concentrated milks, now is the ideal time to learn how to properly utilize these milks in cheesemaking,” said CDR Distinguished Scientist Mark Johnson, Ph.D. “Although there are many benefits to utilizing concentrated milk, there are also many challenges. A thorough knowledge of the risks and benefits is key to addressing such challenges and maintaining a high quality, consistent product during the transition.”

Through hands-on labs and applicable lectures, participants will learn how to handle the unique challenges presented by UF milk. Specifically, this course will address:

- The benefits of UF milk in cheesemaking.
- The economics and mass balances of using UF milk for cheesemaking.
- Basic design and operation of a UF system for milk used in cheesemaking.
- How to achieve the correct and consistent UF milk composition for cheesemaking.
- The changes that need to be made to make procedures when using UF milk to ensure a consistent, high quality product.
- Common cheese defects that can result from the use of UF milk for cheesemaking and what adjustments are key in avoiding these issues.

This course qualifies as an elective course for the Wisconsin Master Cheesemaker® Program. For additional details, visit [www.cdr.wisc.edu/shortcourses/uf\\_milk\\_17](http://www.cdr.wisc.edu/shortcourses/uf_milk_17) or contact course leader Dean Sommer, Cheese & Food Technologist, at [dsommer@cdr.wisc.edu](mailto:dsommer@cdr.wisc.edu)

## THE LATEST INNOVATIONS FROM THE CDR DAIRY INGREDIENT FUNCTIONALITY & APPLICATIONS PROGRAM

Technical Source: Hong Jiang, CDR

Since joining the CDR Dairy Ingredient Functionality & Applications Program in April 2016, I have been able to jump right into some hands-on projects related to the development of cultured products and beverages. I came to CDR as a new graduate in Food Science, having obtained my Master's degree from UW –Madison. Since then, I have been gaining knowledge and experience every day. Here are just some of the projects I have worked on so far.



Hong Jiang, CDR

Helping United States (U.S.) companies to create functional, nutritious and flavorful dairy-based products is one of the goals of the CDR Dairy Ingredient Functionality & Applications Program, which provides technical support and applications development assistance to all U.S. manufacturers of dairy ingredients. Through research, education and collaboration, the Dairy Ingredients group helps companies to bring innovative, nutritious and profitable products to the global marketplace.

While the CDR Dairy Ingredient's program can offer assistance in many ways, the creation of dairy-based prototypes is one way in which the program can help companies to optimize the functional and nutritional benefits of dairy. With the growing popularity of innovative beverages, CDR and the United States Dairy Export Council (USDEC) collaborated to highlight these benefits, creating a dairy-based beverage called whey protein cherry switchel for the Institute of Food Technologists (IFT) Annual Meeting, held in June. The switchel combines the muscle synthesis benefits of whey protein with the ancient tradition of vinegar-based, fermented beverages. The cherry juice and cane sugar provides sweetness, masking any astringency from the vinegar and adding additional beneficial minerals such as potassium. With a light pink color and a clean taste, the beverage contains 11 grams of protein per 8 fluid ounces, providing consumers with a protein-rich version of the popular vinegar-based beverages of today.

In addition to innovative prototypes created at CDR, dairy ingredient research is also ongoing, allowing the dairy ingredients group to use the latest research insights in their application projects. With the popularity of high-protein yogurts, our group has been studying the impact of protein fortification on traditional yogurt.

In the first round of the trial, the ingredient group fortified yogurt with whey protein

concentrate (WPC) 80 to increase the protein to six percent, eight percent and 10 percent of a 100-gram sample size. The group then measured the fermentation time and viscosity of each sample. In terms of the fermentation, there was a noticeable increase in the time required to meet pH 4.6 with each additional percentage of protein, which is due to the buffering capacity of proteins. In terms of viscosity, there was a noticeable increase from six percent protein to eight percent protein. Interestingly enough, the viscosity of the 10 percent protein yogurt decreased by as much as 80 percent leaving the yogurt ropy. Additionally, the color of the yogurt changed to a tan color, influencing the flavor and indicating that the Maillard reaction occurred during processing.



Switchel

In the second round of the trial, milk protein concentrate (MPC) 85 was used to increase the protein of the yogurt. While we attempted to use the same processing steps for both trials, we noticed that the MPC yogurts took longer to reach pH 4.6 during fermentation than the WPC 80 yogurt.

Despite this shift in fermentation time, there were very few changes noted between the viscosity of the six, eight and ten percent protein samples. The overall taste remained clean and the yogurt maintained a good appearance, but each sample did tend to be more viscous than those in the WPC 80 study. The biggest challenge presented by the utilization of MPC was the amount of time needed to rehydrate the MPC. It took more than 12 hours to fully hydrate the MPC in cold milk (39.2°F), compared to about one hour at 122°F for the WPC. Without this proper hydration, however, the product may provide a grainy mouthfeel.

Overall, WPC 80 or MPC 85 could both be viable ingredients methods for protein fortification, but it depends on the type of yogurt and the amount of protein used.

To learn more about this research project or the services offered by the CDR Dairy Ingredient Functionality & Applications Program, please contact Hong Jiang at [hjiang@cdr.wisc.edu](mailto:hjiang@cdr.wisc.edu) 🍌



Hong & KJ Burrington making switchel in the UW Dairy Plant

## JIMÉNEZ-MAROTO WINS NDC GRADUATE PRESENTATION CONTEST

Please join CDR in congratulating CDR Sensory Advisor and UW-Madison Food Science Graduate Student, Luis Jiménez-Maroto, who received first place in the National Dairy Council Graduate Student Paper Presentation Contest in Dairy Foods Research at the American Dairy



Bill Graves, DMI presenting ADSA award to Luis

Science Association (ADSA) annual meeting in June.

Now in his second year of the Food Science Ph.D. program, Jiménez-Maroto, received the award for his oral presentation on his research, which seeks to

extend the performance shelf-life of various cheeses using a combination of high pressure processing (87,000 psi) and reduced temperature storage (between refrigeration and freezing).

Titled, *Extending the shelf-life of low moisture part-skim mozzarella*, Jiménez-Maroto's abstract is available at: <http://m.adsa.org/2017/abs/t/71066>, but he also offers a brief explanation below.

The growth of overseas cheese markets has made it a strategic objective of U.S. dairy agencies to secure the position of the US as a global cheese supplier. Pizza is a popular food item and mozzarella is an important ingredient in pizza. Specifically, low-moisture, part-skim (LMPS), mozzarella which has ~90 days of shelf-life under refrigeration. Exporting overseas could require longer than that. LMPS mozzarella is a cheese that can be frozen, but freezing a cheese implies the need for later thawing and there are some countries where thawed products cannot be labeled as "fresh." We looked at another low temperature method: superchilling, in which a food product is stored at less than 0°C (32°F) but just above the freezing point of the product. This method has been used in the fishing industry for a few decades. A lower temperature reduces biological activity.

Now, the performance shelf-life of the cheese refers not to concerns about spoilage bacteria, but to how long a cheese maintains its functional properties, such as melting, stretching, shredding or slicing. These attributes are primarily driven by the enzymatic activity that affects the texture of the cheese. This enzymatic activity could be coming from the coagulant (rennet) used, the natural enzymes of the milk that survived the pasteurization process, or bacterial cells. Looking into ways to minimize the enzymatic activity, we did three things:

1. Use superchilling, storing cheeses at 0°C.
2. Using camel chymosin, which is a coagulant that has been shown to have less residual proteolytic activity than bovine chymosin.
3. Use high pressure processing (HPP), in which the use of very high hydrostatic pressures (87,000 psi for three minutes) reduces enzyme activity in cheese.

We found that the high-pressure treatment affects the cheese network by disrupting protein interactions and solubilizing the calcium phosphate, which slightly raises the pH of the cheese. The disruption to the proteins softens the cheese texture and lowers its melting point, but this has no effect on how the cheese stretches or the amount of blisters observed when used in a pizza application. Through the combination of the factors mentioned above, we successfully reduced cheese proteolysis by approximately 50 percent over 12 months of storage maintaining important pizza performance characteristics such as strand thickness and blister quantity for a longer period and also showed more desirable shred characteristics. Overall, the performance of the LMPS mozzarella could be extended up to at least seven-nine months.

Jiménez-Maroto would like to thank all these individuals in the project including all CDR staff, especially Rani Govindasamy-Lucey, John Jaeggi, Mark Johnson and John Lucey.

It is also worth noting that Jiménez-Maroto is the sixth student to win this award under the guidance of advisor and CDR Director, John Lucey, Ph.D.

**Congratulations to Jiménez-Maroto and all those involved in this research.** 🍌

## UW-MADISON FOOD SCIENCE TEAM WINS 3RD IN PRODUCT COMPETITION



Paige Palmieri & Lauren Sipple

During the American Dairy Science Association (ADSA) Annual Meeting held June 25-28, 2017 in Pittsburgh, the University of Wisconsin-Madison Food Science team placed 3rd in the National Dairy Council (NDC) sponsored New Product Competition. The team members worked with CDR and Food Science faculty

to develop the winning product: Lassigo, a mango and spice infused yogurt beverage that contains 13 grams of dairy-based protein per serving. Congratulations to the team members, Lauren Sipple, Paige Palmieri, Rachel Fehring, Natalie Mysak, Eric Williams, Darin Reid and Jay Alexandar on this exciting win! 🍌

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## Short Course Calendar:

- ☎ Cheese Technology, October 9–13
- ☎ Dairy Ingredient Applications, October 17–18
- ☎ Dairy Protein Beverage Applications, October 19
- ☎ Cheese Grading, November 8–10
- ☎ Ice Cream, November 29–December 1

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

## Events

**2017 Joint Annual Meeting**  
National Dairy Promotion and Research Board  
National Milk Producers Federation  
United Dairy Industry Association  
October 30–November 1, 2017  
Anaheim, California

**2017**  
making a difference with dairy

**Belfast**  
IDF WORLD DAIRY SUMMIT 2017  
29 October to 3 November  
[www.idfws2017.com](http://www.idfws2017.com)



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