

Dairy Pipeline

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A Technical Resource for Dairy Manufacturers

CDR & UW Alumni Innovating for **MAX**imum Performance

Entrepreneurial assistance has always been an important part of the Wisconsin Center for Dairy Research (CDR) and its mission to reach beyond the lab and bring new, novel products to the marketplace that help to grow Wisconsin's dairy industry. So, when UW-Madison graduates Andrew Berns and Brandon Duck approached CDR with the trademark for BadgerMax® and a plan to create a protein-rich, isotonic beverage with no artificial colors or flavors CDR's K.J. Burrington was ready to help.

After graduating from the UW-Madison Executive MBA program and becoming business partners in a sports drink venture, Berns and Duck began researching their options, meeting with several coaches, companies and R&D specialists to gain insight into the sports drink market. In the end, they determined that their line would need to consist of an isotonic beverage, high pH premium spring water and a protein-rich isotonic beverage that could be manufactured in powder form as well as a ready to drink (RTD) bottle.

"We spoke with several coaches at the high school and college level and they all mentioned that they had concerns regarding the nutritional content of certain drinks being consumed by students," said Duck. "That's when we began to explore the feasibility of making a great tasting all-natural protein-rich recovery drink." Once Duck and Berns had determined the products

they wanted to make they knew that they also wanted to create a product with Wisconsin sourced ingredients and Wisconsin manufacturing ties.

"We're UW-Madison alumni and we're proud of our alma mater and our state," said Berns. "It was important to us that we create a healthy product that could compete in the market place and help to support Wisconsin's economy."



Mike Unitan, UW Athletic Department

So Berns and Duck began working with several different Wisconsin companies in an effort to create their great tasting, all-natural, protein enhanced sports drink; but they found themselves struggling to get the taste just right. In 2011, the team was visiting the World Dairy Expo in Madison and spoke with several individuals who recommended contacting CDR

for formulation and development help.

"We contacted CDR in April of 2012 and we were put in touch with K.J. Burrington," said Duck. "K.J. was able to do what no one else could. She formulated a protein enhanced sport drink that athletes will enjoy drinking."

CDR Dairy Ingredients and Functionality Coordinator K.J. Burrington had been working on the development of protein-rich isotonic beverages since 2005, so she was prepared to help BadgerMax® develop both the powder and RTD protein products they needed for their



line. Whey Protein Isolate, a filtered by-product of the cheesemaking process, was chosen as the source of protein for the drink.

Whey is currently being used in many food products as it is known for its ability to aid in muscle recovery. In particular, whey is one of the most nutritionally complete proteins known to man. It contains the highest amount of essential amino acids found in food and it is especially high in Leucine, a branch chain amino acid directly linked to muscle protein synthesis. In fact, as little as 10 grams of whey can stimulate muscle protein synthesis (Tang et al., Appl Physiol Nutr Metab. 32:1132-1138, 2007).

“It was also important for the product to have a clean label, so we worked hard to limit the number and types of ingredients and also create a clear, heat-stable product,” said Burrington.

Being a clean label product, the beverage required the use of natural colors which generally come from fruits and vegetables and can behave much differently in a product than an artificial colorant. There were a few challenges with the heat sensitivity of the colorant and maintaining an ideal hue, but in the end, BadgerMax® and CDR were able to develop two isotonic, protein-rich beverages, a grape and fruit punch flavored BadgerMax® Protein Boost, each containing 12 fluid ounces and 12 grams of protein, a similar ratio to the protein available in milk (approximately 1 gram per 1 fluid ounce).

“Having had experience in developing isotonic beverages that contain whey, it really didn’t take us too long to come up with a finished product,” said Burrington. “By August 2012, BadgerMax® had a final product to show to the UW Athletic Department.”

In particular, Duck and Berns were interested in supplying their product to the UW Badgers. This required their protein beverage to meet the NCAA rules and regulations for nutritional compliance. Essentially, the beverage needed to have a maximum of 30 percent of the calories from protein which the BadgerMax® Protein Boost provides.

“Protein-rich recovery drinks are an excellent option for athletes as they generally contain a 4 to 1 or 3 to 1 ratio of carbohydrates and protein,” said Burrington. “The combination of carbohydrates and protein equals a better recovery for athletes than just carbohydrates alone and the isotonic elements provide electrolytes to the athletes.”

After securing Dr. Pepper Snapple Group as a distributor, BadgerMax® applied to get the bid for beverage services with UW-Madison Athletics. Prior to the start of the 2013 Badger Football season, BadgerMax® received the news that they would in fact be the new beverage supplier to the UW-Athletic Department.

“We’re very proud of BadgerMax® and its ability to not only provide athletes with an all-natural, protein-rich recovery drink, but also its ability to boost Wisconsin’s economy,” said Berns. “It’s really the triple bottom line here, a win, win, win.”



BadgerMax® is selling its isotonic beverage and water in all UW athletic facilities and the Protein Boost is available to the athletes. BadgerMax® plans to have statewide distribution for all of its products before next spring. For more on BadgerMax® or to inquire about obtaining their products visit their website at www.badgermax.com

Partnering for Innovation

Contributed by: Debra Wendorf Boyke

There were several times during the CDR/Babcock Hall Dairy plant fundraising campaign that industry donors asked, “Why doesn’t CDR build off campus since that would be quicker?” While it might seem like a simple question, the answer may be even simpler.

When Wisconsin’s dairy farmers, through the Wisconsin Milk Marketing Board, discussed how to invest dairy checkoff dollars, they recognized the need for product research and its positive impact on the dairy industry. Thus, they made a commitment to the University of Wisconsin-Madison (UW) to provide funding for the Wisconsin Center for Dairy Research (CDR). Today, dairy farmer checkoff dollars account for over 70 percent of the CDR budget.

Recently, the CEO of GE spoke to the University of Wisconsin System Board of Regents. His main take away: American universities like the UW are one of the most stunning advantages the country has for growth in the global economy. CDR, as part of the UW, fits that description as well. If you think about the resources that CDR currently provides to the dairy industry, many can be traced back to knowledge gained from the fundamental research that has been done at UW-Madison and CDR’s predecessor, the Walter V. Price Cheese Research Institute, over the past several decades. Today, CDR continues to build upon the benefit of being based on the UW campus by utilizing the wide network of resources within the UW College of Agriculture and Life Sciences (CALS) and the greater UW campus, providing an ongoing, broad-based resource for industry. Being able to collaborate on research projects with >>>

world-renown researchers from UW programs like Food Science, Nutritional Sciences, Dairy Science, Biological Systems Engineering, the Medical school and Food Research Institute, just to name a few, is a great asset for CDR as it is a part of a world-class research university like UW-Madison. Having easy access to this multidisciplinary approach to problem solving, combined with the broad industry experience of many CDR staff, provides the dairy industry with a unique resource of knowledge and passion for helping them succeed.

Established as a true research center, CDR is part of the college, but it doesn't report to a specific department. This autonomy allows it to more easily engage with a variety of programs across the campus, as well as work with many organizations across the State, e.g. i6 partnerships, the Wisconsin Whey Working Group, dairy waste water research, etc.



CDR will continue to draw on the learnings and science from research, conducted within CDR and on campus, as the basis for teaching more than 30 short courses and company trainings each year, reaching more than 1400 industry students per year. CALS recently started a comprehensive strategic planning process, and the CDR has had the opportunity to actively participate, allowing us to emphasize the importance of continuing education and outreach for the non-traditional student, and the role the UW can play in this effort. In addition, the activities of CDR closely support four of the six priority themes developed by CALS which address grand challenges for the future where CALS has the potential to make a significant impact, and lead in the production and dissemination of new knowledge. Here are some CDR examples:

▶ **Food systems:** a dedicated focus on milk and its components as a nutritious food (e.g. protein) for the

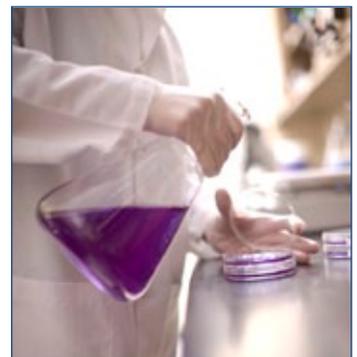
growing U.S. and global population. This includes programs such as new product development, short courses, Wisconsin Master Cheese Maker Program®, the Dairy Pipeline newsletter, safety/quality, technical support across the food chain, etc.

▶ **Bioenergy and Bioproducts:** new and more economical whey processing options.

▶ **Health and Wellness:** product development that focuses on reducing sodium and fat, increasing protein, supplementing with Omega 3 fatty acids, probiotics, etc.; research collaboration in the areas of protein allergenicity, spores, raw milk quality, products for patients with PKU; product development utilizing whey ingredients resulting in sports beverages that enhance protein consumption and muscle recovery; researching new uses for whey permeate, etc.

▶ **Economic and Community Development:** the recently awarded U.S. Department of Commerce i6 grant to support efforts to commercialize research ideas that will positively impact economic development. This partnership includes CALS, Wisconsin Alumni Research Foundation (WARF), UW Office of Corporate Relations (OCR), Wisconsin Milk Marketing Board (WMMB), Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP), Wisconsin Economic Development Corporation (WDEC), Wisconsin Cheese Makers Association (WCMA), United States Dairy Export Council (USDEC) and Dairy Research Institute (DRI); CDR also serves as an incubator where cheese and dairy manufacturers utilize the pilot plant to develop new product prototypes which leads to new jobs and/or expansions positively impacting rural Wisconsin.

From these many examples, it's easy to see the tremendous synergies that develop by having a world-class dairy research center located within a world-class research university. Both benefit from the interdisciplinary collaboration and the industry partnerships in supporting the Wisconsin idea which states: **Research conducted at the University should be applied to solve problems and improve health, quality of life, the environment and agriculture for all citizens of the state. CDR is The Wisconsin Idea.**



Importance Of Acid Development In Cheese Milk Prior To Renneting

Technical Experts: Mark Johnson Ph.D and Dean Sommer

Cheesemaking is as much about the journey as it is about the finish. So, maintaining a desirable pH and monitoring levels during the entire cheesemaking process is important to a successful end product.

Many of the undesirable body or textural attributes seen in cheeses can be traced back to inadequate pH development prior to rennet addition or excessive proteolysis due to prolonged aging. Cheese plants often monitor the acid development in their cheesemaking process, paying close attention to the finish pH of their cheese. Little attention, however, is generally given to the pH during other parts of the make process and especially at renneting. This is a mistake because the finish pH of a cheese does supply important information about the acid development journey, and this journey has a major impact on textural and performance attributes of the finished cheese.



Ray Michaels, CDR Cheesemaker measuring pH level.

When considering acid development and its effect on the quality of cheese, cheesemakers often overemphasize the importance of proteolysis and underemphasize or even ignore the importance of calcium solubilization from the protein matrix. There's no doubt that proteolysis is important in determining the texture of the cheeses, but it's important to realize that proteolysis, especially by enzymes from cultures, adjuncts and contaminants, is a long and slow process and doesn't significantly affect the texture of a young cheese. It's also important to understand that for a younger cheese the coagulant is the dominant proteolytic enzyme and increasing coagulant usage will increase the rate of breakdown of the cheese. Different coagulants have different intensities of proteolysis.

Calcium solubilization can also affect lactic acid developed during cheesemaking as it solubilizes calcium from the protein matrix. This effectively weakens the structure of the protein matrix and makes it less rigid. Calcium is more easily removed from the matrix when the milk is still liquid, as opposed to after the coagulum has been cut. Thus the milk pH at renneting is an important determinant in cheese textural development, machineability, and functional performance, such as melting and blister formation on a pizza.

For example, when making mozzarella cheese for food service pizza use most customers like their cheese to perform well at 10-20 days. Proteolysis as a result of cultures is relatively insignificant in regards to the age of cheese, but the impact of pH history of the cheese make and the solubilization of calcium during and immediately following manufacture has a dramatic effect on how this young mozzarella performs on pizza.



Testing the stretch of pizza cheese.

There is an everyday example of this effect. Those companies that make whole milk or low moisture part skim mozzarella using acidification by starter cultures know that for the cheese to stretch well in the cooker stretcher they typically need a curd pH of between 5.15 and 5.35. If the pH is above this range the cheese will often be tough, "green", rough looking and will not stretch well. On the other hand, makers of fresh mozzarella that utilize direct acidification of the milk without the addition of culture typically stretch their curd at a pH near 5.6-5.7, and it stretches beautifully. How can this be, when cultured whole milk or low moisture part skim mozzarella would not stretch at this pH? The answer is calcium solubilization. In fresh mozzarella, the cheese milk is typically acidified with acetic or lactic acid down to a pH of 5.6-5.7, and no culture is added. When liquid milk is acidified, calcium is readily solubilized from the protein matrix. Because more calcium is removed from the matrix the cheese will stretch well at a much higher pH, in this case pH 5.6. With whole milk or low moisture part skim mozzarella, the liquid milk is not acidified to any great



extent prior to rennet addition and more calcium is retained in the protein matrix. The cheesemaker will need to drop the curd pH after whey drainage to a much lower level (pH 5.15-5.35) to achieve the necessary calcium solubilization to allow the curd to be successfully stretched.

Newer cheesemaking practices have also had an effect on this phenomenon. Before the 1980's cheese plants utilized conventional (non-neutralized) bulk starter culture. This bulk culture was allowed to acidify to low levels, down to the area of pH 4.8, prior to breaking, cooling, and subsequent inoculation of the vats. When this culture was added to the vat it not only added the starter culture but also added a lot of acid, which helped solubilize calcium from the protein matrix. Furthermore plants commonly used longer ripening times which developed even more acid and solubilized more calcium. Shortly after the '80s plants, in an effort to save money by reducing the amount of bulk culture needed to be added to the vats, switched to pH neutralized bulk culture systems which are commonly neutralized with ammonium hydroxide to pH 5.5-6.0. Consequently the plants didn't have the free acid entering the vat when starter was added and less calcium was solubilized. To compound this, make times started to get significantly shorter, ripening times were cut to minimize phage development and to shorten make times, and as a result much less acid was formed prior to rennet addition. In recent years various types of direct vat set cultures have become commonly used to make cheese. There are some great benefits to this system in terms of ease of use, consistency of operations, control and flexibility, but virtually no acid is being developed by the culture before rennet is added and thus no calcium is being solubilized. Therefore, the finished cheese may be initially tough because it contains more calcium, and requires a longer time for the cheese to "break down" and become more machineable or melt well.

For example, if you are making a cheese where you don't want much breakdown, such as string cheese or cheese curds, you want to minimize the amount of pH drop prior to rennet addition in order to minimize calcium loss from the protein matrix. Also, you may want to use calcium chloride and a reduced amount of a coagulant with minimal proteolytic activity to minimize the amount of early proteolysis.

On the other hand, if you want to make a whole milk or low moisture part skim mozzarella that you want to melt well by 10 days of age, or a mild cheddar cheese that you want to shred at a young age you might consider dropping the pH in the cheese milk prior to rennet addition to decalcify the protein matrix. This will soften the curd and allow it to knit together well. You may also want to consider minimizing the use of calcium chloride and increasing the amount of a proteolytic rennet variety to smooth the body and texture of

the cheese at an earlier age. Not that this cheese will have a shorter shelf-life as it will soften much more rapidly as the cheese ages.

To increase the amount of acid in the cheese milk prior to rennet addition you can consider allowing the final pH of your bulk culture to drift lower, much like the days of a 3 step manual neutralization system. If you are growing thermophilic rods in a separate bulk system, you could consider growing them without neutralization. Rods generally like acid conditions and their activity will not be excessively slowed by growth and storage at low pH conditions. Adding these rods to your cheese milk will also add significant amounts of acid to decalcify the proteins in a very traditional and natural way.



Cheesemaker adding rennet. © WMMB

The other option is preacidification or acid addition directly to milk prior to rennet addition. Acetic and lactic acids are commonly used. Diluted acid is added cold to the cheese milk in the vat or on the way to the vat to lower the pH prior to rennet addition. Today many cheesemakers have opted to add carbon dioxide to lower the pH and "protect" their whey for further processing.

Fortification of milk with ultrafiltered milk is a common practice today. The levels of protein and insoluble calcium are raised and thus more acid is needed to solubilize sufficient calcium to obtain the desired cheese characteristics. This may require that the pH at rennet addition will have to be even lower than with non-fortified milk. Preacidification or the use of non-neutralized starter or addition of carbon dioxide has become routine practice when milk is fortified.

It's important to understand some of the main tools that a cheesemaker has at their disposal that influence cheese texture and performance requirements such as melt and machinability. Understanding the role that acidification prior to rennet addition plays in solubilizing calcium and the impact that it has on the finished cheese will greatly aid the cheesemaker in achieving satisfactory performance for their customers in a wide variety of applications.

Basic Techniques To Gain More Moisture In Cheese

Technical Contributors: Mark Johnson, Ph.D and Dean Sommer

The manufacture of Monterey Jack, Colby or other such cheeses, requires a specific level of moisture to avoid loss of yield and product defects. A low moisture Colby, for example, will be crumbly, have slow flavor development and will not slice or shred well. On the other hand, excessive moisture will lead to a shortened shelf-life, excessive acidity (low pH) and the cheese may become pasty as it ages.

Maintaining that ideal level of moisture can be challenging and many cheesemakers have voiced concerns over a potential loss of yield and the subsequent negative economic impacts that can be brought on by either low or excessively high moisture levels. In practice, cheese manufacturers often focus solely on increasing moisture through manufacturing adjustments late in the cheesemaking process, while totally ignoring adjustments early in the process. This oversight can lead to a number of issues, so CDR experts have compiled a list of techniques that can help to increase the moisture content of the cheese. Keep in mind that any one step may increase moisture only a small amount, but when each step is considered as a part of the larger process, these tips can help cheesemakers in their efforts to gain a higher yield and a better quality cheese.



1 Lower the cook temperature. This is the most commonly used technique to raise the moisture of the cheese. Do not be afraid to drop the cook temperature by several degrees. Be aware that the rate of acidification may be slower with thermophiles and in some cheeses preacidification may be necessary as well. Acidification may be slightly faster with some strains of mesophiles if you are currently cooking at 100-102°F.

2 Another very effective means to increase moisture in cheese and improve the texture of cheese made from fortified milks is to allow more acidification of the milk prior to the addition of rennet. The larger the drop in curd pH from when the coagulum is cut to when the whey is drained, the greater the loss in moisture. More acidification of the milk prior to cutting the coagulum reduces the need to drop the pH during cooking and stir-out. This technique is often used with direct acid addition to eliminate long ripening times.

Expert Note:

In my early days in this industry many cheese plants were still using traditional bulk culture that was allowed to grow and stay at a very low pH. Adding acidic bulk culture to the cheese milk effectively preacidified the milk. Traditionally some plants had relatively long ripening times in order to develop sufficient acid prior to renneting. Today with the advent of pH controlled bulk starters and increased use of direct vat set cultures, both of which have a lot of positive merits, renneting pH's are typically much higher than in the past. This has made maintaining optimal moisture content in some cheeses more difficult. The solution is to lower the pH of the milk prior to renneting from pH 6.65 of typical milk down to perhaps around pH 6.5. This also means that the starter is active and the pH when the coagulum is cut is also much lower than would be with current practices of using direct vat set cultures. Other forms of preacidification such as addition of carbon dioxide or direct addition of lactic acid have been successfully applied in the manufacture of several varieties of cheese.

When the casein content of milk is increased there is a general tendency for the cheese to be lower in moisture. When milk is fortified with ultrafiltered or microfiltered milks, the pH at rennet addition may have to be lowered to pH 6.2-6.3 to substantially increase moisture retention. Lowering the pH of high casein milks at rennet addition also has a positive impact on increasing curd fusion and melt of the finished cheese.

3 Reduce the time and speed of stirring once the curd and whey has reached the desired temperature. This technique may also have to be used with preacidification to attain the desired pH in the curd before whey drainage. Constant pressure exerted on the curd as it moves through the whey and curd collisions causes the curds to lose moisture. The greater the pressure (fast stirring) and the longer the time the curd and whey is stirred, the greater the loss in moisture. In addition, the faster you can get the whey and curd transferred out of the processing vat and onto a drain table or tower the less variation in moisture between blocks from the same vat.

When the casein content of the milk is increased there will be more curd which increases collisions of curd and there is a tendency by cheesemakers to increase stir speed to keep the curd from settling. Consequently a reduction in the time of stirring is warranted when milks of high casein content are used.

4 Cut the coagulum firmer. Much of the industry cuts their coagulum very soft. The industry has drifted in this direction for a couple of reasons. One is that cutting soft typically results in less fat losses in the whey. Also, with the increasing use of enclosed vats it has been found that

cutting on the soft side does increase milk solids retention in the curd. The time it takes to cut a vat and the tendency for the coagulum to be firmer at the bottom of the vat than at the top of the vat where the set is typically tested causes this retention. Cutting the coagulum soft results in a weaker initial protein structure which forms more easily and collapses in on itself with greater loss of whey. When the coagulum is cut soft the reactions between proteins that allow the coagulum to occur in the first place are still occurring rapidly. As soon as the coagulum is cut these reactions result in a skin around the outside of the curd particle. This is called healing. Moisture is lost as the skin forms but the fat inside the curd particle is sealed in and the curd is more resilient to the subsequent stirring procedures.

For example, look at really high moisture cheeses such as Feta or fresh Mozzarella. Traditionally, these varieties were cut at an extremely firm coagulum. Why is this so? Well, cutting at a firm coagulum results in a more rigid protein structure in the curd which will not expel much moisture. A cheese plant has to perform an economic evaluation to see if they are better off with a firmer set which will lose a little more fat into the whey but retain more moisture in the finished cheese. CDR calculations have shown that typically it is economically advantageous to “give up” a little fat retention to “gain” moisture in your finished cheese, especially if you recover lost fat in a whey cream separator. Milks that have been fortified with protein clot faster and there is a tendency to cut too soon when making higher moisture cheeses. The milks appear firm because there is so much protein in the milk. In reality, it is similar to cutting a non-fortified milk soft. Unless changes are made to the acidification of these milks prior to cutting the coagulum, cheeses made from these milks will be lower

.06 - .07	% yield increase for every 1 percentage point increase in fat recovery
.08 - .09	% yield increase for every 0.5 percentage point increase in moisture
.14 - .16	% yield increase with a combination of 1 percentage point increase in fat recovery + 0.5 increase in moisture

Table 1. Impact on cheddar yield with increase in fat recovery and moisture.

% yield increase	Increases in yield per 100K milk	Value per pound cheese	per 100,000 pounds milk per day
.07	70 lb	x 1.50	= \$105
.09	90 lb	x 1.50	= \$135
.16	160 lb	x 1.50	= \$240

Table 2. Economic impact of increasing cheese yield.

in moisture and may be tough and curdy. To remedy all of these negatives, cheese makers must lower the pH at rennet addition, even as low as 6.2 depending upon the protein content and desired characteristics of the cheese.

Keep in mind there is the potential that making changes to the cutting regimen may cause an increase in fat and fines lost into the whey. For example, by cutting the coagulum firmer fat losses and fines may be higher but moisture is also increased. While actual yield might be greater than the yield lost due to an increase in fat or fines, the cheesemaker may be reluctant to implement a firmer set at cut. A gentler stirring is a must even though the curd may sink and form globs of curd that cook unevenly and cause acid pockets in the finished cheese. In fortified milks this is a real possibility. Consequently the best solution would be to implement multiple strategies together i.e. preacidification and cutting the coagulum softer (sooner) but into larger pieces. This approach allows the curd to heal faster and thus the curd is more resilient to stirring resulting in less fines and fat lost. To reduce the chance that the soft cut will counter the potential increase in moisture due to the larger curd size, it would be prudent to reduce the cooking temperature and limit the stir-out time after the curd has reached the appropriate temperature.

5 Cut the curd in bigger pieces. This works best in combination with other methods but will require gentle stirring especially after cut. Typically the larger the cube the higher the moisture of the finished cheese. Again, with high moisture cheeses like Feta, the cube is often extremely large, up to a 1” cube. This can be tricky and must be done in a balanced and normally modest way. Everything depends on the ability to cook the curds properly if you are making a cheese that cooks the curds (feta and fresh mozzarella are typically not cooked), and the ability to handle, stir, and pump the curds and not induce shattering. Nevertheless, modest increases in curd size for cheeses like Colby and Monterey Jack will result in a finished cheese with higher moisture. If you see an increase in whey fat after cutting the curd to a larger size you are stirring too briskly or cutting the coagulum too firm.

6 Cool the curd and whey by adding cold water to the jacketed vat or by adding cold water directly to the curd/whey. The temperature of the curds should be dropped below 90 F. It is best to remove as much of the whey as possible before adding the water. This will slow or even stop water loss and water actually clings to the curd if you wash the dry curd with cold water. Note that this moisture is more readily lost upon salting and pressing. Adding cold water also removes some lactic acid and lactose so the final pH in the finished cheese may be higher. Also cold curd tends

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CDR Building Update

The Wisconsin Center for Dairy Research (CDR) and Babcock Hall building project continues to proceed thanks to support from building campaign donors, the State and the University of Wisconsin.

In August, Governor Scott Walker announced that the proposed building project involving a CDR addition and Babcock Hall renovation would move forward immediately with the start of the design stage. Since that time the State and the University have been moving quickly to select an architectural engineering (AE) team. The interview and selection process should be completed by early October, 2013.

In the meantime, CDR is putting together an advisory team of industry members to assist in the design process and provide input/advice to the AE group. If you are interested please contact John Lucey. Our goal is

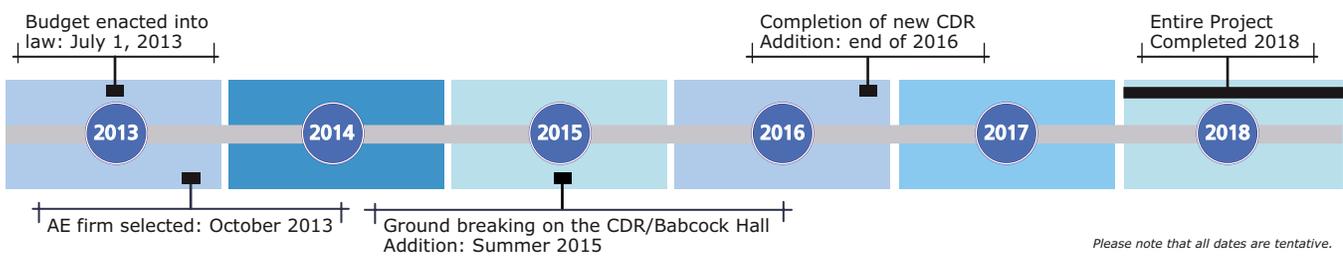
to create a world-class facility so your help and advice is very welcome. Industry members are encouraged to check the CDR website for regular updates regarding the building project.

Thanks again to all donors and supporters of the CDR/Babcock Hall building campaign including John Umhoefer of the Wisconsin Cheese Makers Association, Co-Chairs Lou Gentine and Dave Fuhrmann, as well as the ongoing CDR operational support from dairy farmers via the dairy checkoff program.

If you have additional questions regarding the campaign or would still like to donate, go to the CDR website www.cdr.wisc.edu/building or please contact: **CDR Director, John Lucey**, 608-265-1195, Email, jlucey@cdr.wisc.edu

Barb McCarthy, UW Foundation, 608-265-5891, Email, barb.mccarthy@supportuw.org

CDR/Babcock Hall Addition Milestone Timeline



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to knit together slower and the cheese may be more open textured. Alternatively, add some water during cooking of the curds. This has an additional benefit of reducing the acidity of the finished cheese.

7 Reduce or omit the addition of calcium chloride to the cheese milk. Calcium chloride is often added for a couple of reasons. These include obtaining more uniform set times, and also reducing the amount of expensive coagulant that must be added to obtain the optimal set in the desired length of time. Adding

calcium chloride increases the rate of moisture expulsion from the curd, thus resulting in a slightly drier cheese.

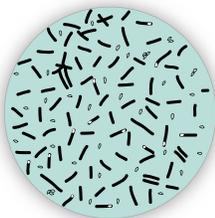
Although maintaining the ideal moisture level to ensure adequate yield and lack of defects can be challenging, it is important to remember that cheese moisture is developed and sustained throughout the cheesemaking process. As Grant Krueger, Kraft Cheese Procurement, taught Dean Sommer a long time ago, "Cheese is made in the vat."

Industry Update on *Clostridium botulinum* spores testing

Contributed by: Kathy Glass, UW Food Research Institute

A recent false-positive report of *Clostridium botulinum* spores in whey protein concentrate (WPC) generated many questions about spores in dried dairy products. On August 28, 2013, New Zealand's Ministry for Primary Industries confirmed that the isolate was a closely related species, non-toxigenic *Clostridium sporogenes*, and not pathogenic *Clostridium botulinum*. Regardless, the implicated lots were removed from the food supply out of an abundance of caution.

Detection, isolation and confirmation procedures of *Clostridium botulinum* are laborious, expensive, and results can be challenging to interpret. The original reports that the isolate was toxigenic were false positives. The presence of botulinum spores can be identified by first enriching the food sample to allow the dormant spore to germinate and grow. If rapid methods are used, specific DNA can be detected in the enrichment with PCR or toxin identified by a cell based assay, such as an ELISA. If results suggest a presumptive positive, the presence of toxin can be confirmed with specific antitoxin to neutralize and identify the toxin type. However, specific antitoxin is typically reserved for therapeutic applications and not available for research. Hence, heating the extract is used as an alternative to neutralize the sample. Interpretation of these results is difficult and can result in a false-positive report.



Spores and vegetative cells of *Clostridium botulinum*

There are lessons to be learned from this episode, particularly with regards to *C. botulinum* and testing. First, bacterial spores are ubiquitous in the environment and in foods. It is not uncommon to find botulinum spores in foods such as honey, vegetables that grow in or near the ground, or smoked fish. Whereas spores in honey or the environment have been associated with infant botulism, consuming the spores of *Clostridium botulinum* alone poses no health risk to children older than 1 year old or to adults with normal microflora.

Spores are known to survive milk pasteurization and other similar thermal processes. Therefore, populations

of spores in dried milk products should be minimized through use of good quality milk, temperature control, sanitation of equipment and processing plants, and potentially other processing techniques.

The International Commission on Microbiological Specifications for Foods does not recommend routine testing of milk products for *Clostridium botulinum* spores. However, testing for other microbes, such as sulfite-reducing clostridia (limit 100 cfu/g) may be useful as indicators of process control and sanitation. Products which exceed this limit should not be used for powdered infant formula. Source of contamination should be investigated and corrective actions taken.

Pulsenet Fingerprinting of Bacterial Pathogens in Dairy Plants & Products

Recalls are an unfortunate reality of the food industry and while most recalls are allergen related, occasionally, a product is recalled due to a pathogen which causes food related illness. When a pathogen related recall occurs there are generally a number of questions and concerns surrounding the recall. In particular, companies and individuals often question how the pathogen was traced by the Food and Drug Administration (FDA) and the Center for Disease Control (CDC) and how this information was obtained.

Greatly simplified, the FDA and CDC use a program called PULSENET to identify a pathogen source. This program is essentially a network of 87 laboratories around the United States which work to identify foodborne illness outbreaks through DNA "fingerprinting" of bacterial pathogens. Fingerprints of pathogens generated by regulatory and public health laboratories from previous outbreak investigations as well as in some cases from pathogens found during regulatory sampling and swabbing of plant environments are stored in an electronic database. When a food borne outbreak occurs and a pathogen is discovered PULSENET is used to "fingerprint" the pathogen and then that fingerprint is compared to other fingerprints in the database to see if there might be a match.

The term fingerprinting is used because just as each human has a unique fingerprint, each bacterial strain also has a unique sequence or "fingerprint." The

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important thing to note here is that the same strain (or clone) will have the same fingerprint. *Listeria* are prokaryotes, or single celled organisms, so to reproduce the bacteria make a clone of themselves. That means that progeny of that strain will have the same DNA fingerprint. This enables investigators to match food and processing plant isolates with patient isolates and trace the outbreak strain back to a particular product or plant. In some cases a pathogen fingerprint may be unique to one particular food or dairy plant. In other cases, pathogens with the same fingerprint may be found in multiple plants. This would likely depend on where the pathogen strain originated and how it originally entered the food or dairy processing facility.

In order to fingerprint or obtain the DNA profile of a strain, microbiologists use a method known as pulsed-field gel electrophoresis (PFGE). This technique uses restriction enzymes to cut up the bacterial chromosome into pieces, which are separated by PFGE. This method is highly discriminatory. That means, for example, that this technique can identify differences between strains that belong to the same genus, *Listeria*; species, *monocytogenes*, and serotype, 4b. This is important because the serotype and strain help investigators identify which cases are part of an outbreak and which plant or product carried the offending microbe. Fingerprinting is just one piece of the puzzle though. Identifying and halting an outbreak is a several step process that requires the cooperation of the public, medical staff, labs and plants. The full steps are outlined on the CDC website at www.cdc.gov/pulsenet/about/faq.html, but essentially the steps are as follows:

- 1 An individual with a suspected case of foodborne illness visits a doctor and is tested for harmful bacteria.
- 2 If the test is positive, the isolate is sent to the state public health lab where the species, serotype, and PFGE profile (fingerprint) can be determined.
- 3 The fingerprint is uploaded to PULSENET and epidemiologists interview patients if the patterns of illness seem suspect. The fingerprints are compared and if a “cluster” or group of ill individuals following the same pattern is found, then steps will be taken to identify the source of the outbreak and control the spread of disease.

Thanks to PULSENET and related technologies, food borne illnesses are generally now identified in a matter of days rather than a matter of weeks. Since its start in 1996 PULSENET’s database has grown significantly and as it continues to succeed in halting food borne outbreaks, this technology will pave the way for the future of food safety and quality.

CDR Welcomes three new staff members

Vic Grassman, CECD, Commercialization Manager (i6)

As the i6 Challenge program Commercialization Manager, Vic Grassman, CECD serves as the lead coordinator and partner contact for the i6 Challenge initiatives.

Grassman has more than twenty-five years of experience in economic development and previously served the Wisconsin Department of Workforce Development and the City of Janesville in economic development leadership positions. Grassman views this role as an important, pro-active step in bringing research and technology to the private sector. His goal is to engage partners and industry in the economic development process by building strong networks and assisting start-ups and businesses looking to further explore new technologies and research in the dairy sector.



Elise Lambert, Associate Research Specialist (i6)

As the research specialist for the CDR i6 Challenge program, Elise works with Vic Grassman, CDR i6 commercialization manager, to assist clients with the science and technology portion of the i6 program.

Elise also works directly with CDR research staff to commercialize CDR research projects. Elise is a graduate of Virginia Commonwealth University in Richmond, VA with dual degrees in Chemical & Life Science Engineering and Chemistry with a minor in Mathematics. While pursuing her degrees, she worked in the pharmaceutical field.



Joe Minor, Financial Specialist

As a financial specialist, Joe assists CDR in purchasing, accounting and other administrative duties. He has a Bachelors in Business Administration and previously worked in dairy sales and marketing. Joe is interested in the financial aspect of business and hopes that his work here at CDR will assist the dairy industry and CDR partners in reaching their goals.



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WHEYING THE OPTIONS: PROCESSING AND ECONOMICS OCTOBER 24, 29, 31

FOR WISCONSIN MANUFACTURERS ONLY



Wisconsin cheesemakers and whey processors are invited to attend one of three regional workshops focusing on the basics of whey processing and how to financially evaluate the various options available. These workshops, co-sponsored by the Wisconsin Center for Dairy Research (CDR) and the Wisconsin Milk Marketing Board (WMMB), are one of the outcomes of the Wisconsin Whey Working Group report. They will provide an excellent chance for dairy manufactures to learn more about whey processing and discuss this topic with industry experts. If you are interested in attending, but are not a Wisconsin manufacturer, please contact us regarding possible openings. Register online, www.cdr.wisc.edu/shortcourses/whey_workshops

Dates & Locations:

Thursday, October 24

Ludlow Mansion, 1425 Mansion Drive, Monroe

Tuesday, October 29

The Plaza Hotel, 1202 W. Clairemont Avenue, Eau Claire

Thursday, October 31

Hilton Garden Inn, 720 Eisenhower Drive, Kimberly

Cost: \$35.00 | Workshop 11:30 a.m. - 4:15 p.m.

Agenda

Registration and Buffet Lunch 11:30 - 12:10 p.m.

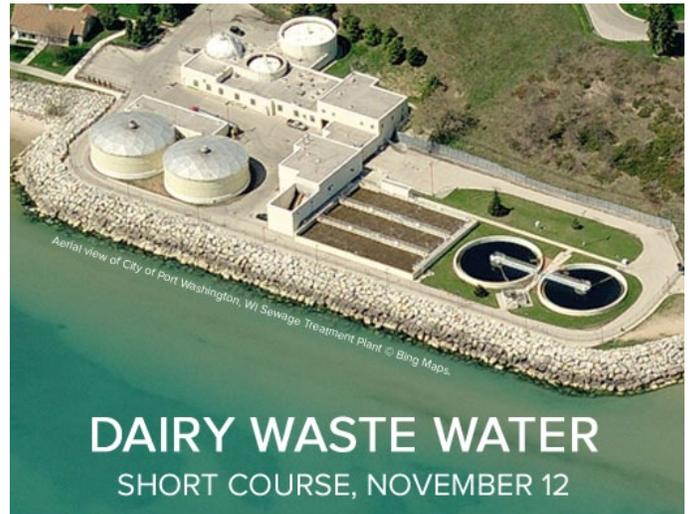
- * **Session 1** Whey Processing Basics and Options - Dr. Karen Smith, CDR
- * **Session 2** How to Financially Evaluate Whey Processing Options - Rich Scheuerman, RS Strategic Consulting
- * Q & A Session

Contact:

Karen Smith | (608) 265-9605 | smith@cdr.wisc.edu

Registration Contact:

CALS Conference Services | Phone: 608-263-1672



DAIRY WASTE WATER SHORT COURSE, NOVEMBER 12

This solution-based course will provide an in-depth look at the recent waste water regulatory changes and what those changes mean for your plant. Regulatory agency professionals, waste water treatment experts and dairy industry consultants will be presenting on topics ranging from best practices to financial opportunities. Speakers will include individuals from the WI Department of Natural Resources, the Tom Probst Group, Baker Tilly and CDR. Register online, www.cdr.wisc.edu/shortcourses/waste
Contact: dsommer@cdr.wisc.edu

Gluten Free

The Food and Drug Administration has finalized a definition for the voluntary claim “gluten-free” on foods and beverages. Note that, this will apply to foods that naturally contain no gluten such as dairy products. The compliance date for the final rule is August 5, 2014. www.federalregister.gov/articles/2013/08/05/2013-18813/food-labeling-gluten-free-labeling-of-foods



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www.cdr.wisc.edu

Short Course Calendar:

Cheese Technology, Oct. 7-11

Dairy Ingredient Applications, Oct. 15-16

WHEYING the Options: Processing and Economics, Oct. 24, 29, 31

Cheese Grading, Nov. 6-8

Waste Water, Nov. 12

Ice Cream Makers Short Course, Dec. 4-6

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

Events:

