RARE CHEESES REVIVED

The cheese industry is known for its ability to mix tradition with innovation. Thanks to these efforts, there are a number of fantastic traditional and not-so-traditional cheeses on the market today. Despite the more than 600 varieties, types and styles being produced in Wisconsin alone, there are still a few cheeses that have become extremely rare. CDR often receives questions about some of these cheeses as consumers often want to know where they can purchase these varieties and manufacturers want to know more about the cheese make procedure. In an effort to encourage tradition and continued innovation, CDR tracked down information on some of the most discussed “rare” cheeses to assist those manufacturers and consumers who would like to know a little more about these hidden gems. This information isn’t necessarily complete, so we would love to hear from all of you as to the history and current state of these cheeses. Additionally, CDR would be interested in hearing from you regarding what rare cheeses you would like to learn about in upcoming issues. All questions and comments can be sent to communications@cdr.wisc.edu.

Liederkranz
Similar in many ways to Limburger, Liederkranz is a smear-ripened cow’s milk cheese that is known for its strong flavor. Originally produced in New York during the late 1800s, Liederkranz became very popular among the local population who were already fans of Limburger style cheeses. After many years in New York, the Liederkranz operations moved to a Borden plant in Ohio. Liederkranz was available on the market for more than 80 years, but production eventually ceased in the mid-1980s due to a bacterial contamination issue.

In 2010, DCI (now part of Saputo) and Chalet Cheese Cooperative worked together to bring Liederkranz back to the market. Chalet Master Cheesemaker, Myron Olson, had already been producing Limburger for many years and had even worked with the Center for Dairy Research experimenting with Liederkranz-style cheese makes, so the partnership was ideal. Olson manufactured the new Liederkranz and it was unveiled at the 2010 World Champion Cheese Contest. Thanks to press from the cheese contest and an article in the Milwaukee Journal Sentinel, over 240 packages of Liederkranz were sold in the very first weekend of sales. The cheese continues to be sold under DCI/Saputo.

Bon Bree Brick
Prior to the 1980s this cheese, known for its firm texture and creamy taste, was produced by a company in Mapleton, WI. When the plant closed in the mid-1980s, Bon Bree brick was no longer available to the masses, but it did not leave the minds of many. In fact, Lloyd Williams, a dairy farmer in Delafield, loved the cheese so much he decided to bring it back to life with the help of Mapleton cheesemaker Terry Shaw and the Dairy Business Innovation Center (DBIC).

About three years ago, Williams met with Shaw, who manufactured Bon Bree at the original facility. Shaw provided Williams with a few Bon Bree recipes, some of which date back to 1625 in France. Additionally, Shaw
gave Williams some of the original mother cultures that once produced Bon Bree in Mapleton. After more than 16 batches and a few years, Williams Homestead Creamery began selling Bon Bree under its trademarked name.

Clock Shadow Creamery currently manufactures the cheese which is made solely from the milk produced on Williams’ farm. In just the last year, Bon Bree has grown into three new varieties, dill, chive and caraway. It is also now available in more than 30 grocery stores and it is on the menu at a number of restaurants throughout Wisconsin. For more on this cheese, please visit bonbree.com

Dariworld
According to Norm Olson, Walter V. Price Cheese Research Institute/Center for Dairy Research Director from 1986-1993, Dariworld was developed at the University of Wisconsin-Madison in the early 1950s thanks to experiments done by Prof. Stan Knight in Bacteriology. “The white *P. roqueforti* style cheese originated from experiments in which the blue mold was irradiated and lost its color,” said Dr. Olson. “Knight and Prof. Walter Price brainstormed its potential and decided to ask faculty members at the University of Minnesota to develop a cheese with this mold rather than the traditional blue mold.” Dariworld cheese eventually evolved out of research done by a graduate student, Don Irvine, and Price.

Dariworld is considered a soft-ripened or semi-soft ripened cheese, depending on the moisture content and make procedure. Generally known to have a smooth texture, and often used as a cold pack product, Dairworld calls for 5 to 5.5 percent salt in the milk during the make procedure and is generally cured at 45 degrees Fahrenheit for one to two months. A full make procedure can be found in *Practical Cheese Making* by G.H. Wilster (1980).

Later in its life, Dariworld was mixed with Nuworld cheese to produce a blue cheese flavored cheese spread which garnered attention from a few major companies. Ultimately, Dariworld was phased out of production due to the intense addition of a salt brine to the curd-whey mixture which created whey utilization problems. See page 12 for contributors to this story.

### CHEESE SHELF STABILITY STUDY

*Contributed by Barb Ingham, Ph.D, & Wan Mei, graduate student, UW Food Science*

Researchers in the Food Science department at the University of Wisconsin-Madison, have completed a study funded by the Wisconsin Milk Marketing Board which provides supporting documentation for extended room temperature storage of cheeses which meet certain compositional factors.

**Background** According to the FDA Food Code, cheeses are potentially hazardous foods, and a product assessment is required to evaluate safety of extended storage at room temperature (more than 6 hours at 70°F or higher). This study looked at sixty-seven market cheeses all of which were tested for their ability to support growth of *Listeria monocytogenes* (LM), *Salmonella* spp. (SALM), *Escherichia coli* O157:H7 (EC), and *Staphylococcus aureus* (SA) over 15-days at 77°F. Hard (Asiago and Cheddar), semi-hard (Colby and Havarti), soft cheeses (Mozzarella and Mexican-style) and reduced-sodium or reduced-fat types were tested. Single-pathogen cocktails were prepared and individually inoculated onto cheese slices. Inoculated slices were vacuum packaged and stored, and surviving bacteria were enumerated every three days. The pH and percent salt-in-the-moisture phase (%SMP), along with other variables, were periodically measured for each cheese.

**Results** Pathogens did not grow on 53 cheeses, while 14 cheeses supported growth of SA, six of SALM, four of LM, and three of EC. Of the cheeses supporting pathogen growth, all supported growth of SA, ranging from 0.57 to 3.08 log CFU/g (avg. 1.70 log CFU/g). Growth of other pathogens was supported to a similar, or lesser, degree. SA did not grow to a level that would support toxin formation. Pathogen growth varied within cheese type or lot. Pathogen growth/no growth data from laboratory research were pooled with data from published research for a total of 82 trials, and pathogen growth/no growth was found to be most influenced by the compositional variables pH and %SMP. Results will be published in the Journal of Food Protection this summer.

**Implications for the dairy industry** Compositional variables pH and %SMP can be used to predict the likelihood of pathogen growth on certain retail cheeses during extended room temperature storage. Cheese composition, not cheese type or standard of identity, is critical in decision making. Processors and retailers can use predictive results combined with laboratory data when handling, storing and retailing cheese at up to 77°F for up to 15 days with the following qualifiers:

- Study results are applicable to cheeses made with pasteurized bovine milk, and manufactured under a food safety plan and other regulatory standards for safety and sanitation.
- Study results do not apply to Swiss-style cheeses, mold- or bacterial surface-ripened cheeses, and cheeses made with non-bovine milk; insufficient data were gathered as part of the study to apply predictive modeling to these types of cheeses.

An online tool known as a Cheese Shelf Stability Predictor is currently in development. This tool will allow processors and retailers to anticipate the safety of extended room temperature storage of cheeses based on pH and %SMP. This research was presented to the Conference for Food Protection (Orlando, FL) in May 2014 with the goal of amending the FDA Food Code to allow extended room temperature storage of cheeses meeting compositional standards for pH and %SMP. For more information on this predictive tool and the results of this research, contact Barb Ingham at bhingham@wisc.edu.

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See page 12 for contributors to this story.
NEW FDA SAMPLING ASSIGNMENT

Under a new directive from the Food and Drug Administration’s (FDA) Center for Food Safety and Nutrition (CFSAN), a new sampling assignment has begun in plants manufacturing dried milk and milk ingredient powder. This assignment was put in place to better determine Salmonella and Cronobacter sakazakii levels in dairy plants. The FDA has not released any specific details regarding when, where or how these samples will be taken, but it has been noted that the FDA may be most interested in zones 1 and 2 which are essentially direct and indirect product contact surfaces. Enforcement methods and repercussions stemming from a positive test remain unclear.

What does this mean for your plant?
The new FDA sampling assignment has the potential to cause several challenges for companies that do not currently have a process in place for sampling product or product contact areas for pathogens. In general, companies will face two key problems; maintaining control of the product that is affected by the sampling results, and understanding where the clean breaks are in the process.

Maintaining control of the affected product is the most straightforward challenge. Typically, a positive result for a pathogen will result in a recall of the affected product. Therefore, when a product is sampled for testing it is recommended that all products that could be subject to a recall be placed on hold and isolated until the results are confirmed as negative and the product is released. The biggest challenge here is typically related to storage space and ensuring product is not accidentally shipped. The recommended course of action for a positive pathogen test for either direct or indirect product contact surfaces as opposed to the product itself is not as clear.

The second issue of clean breaks in the process is much more problematic. Regulatory agencies have not issued a statement as to what they consider a clean break in a powder drying operation. For example, is a clean break a specific batch of milk/whey, a dryer chamber wash, a washing of the bag house/bag replacement, etc.? Instead of a clean break, could the recall scope involve testing the final powder to determine if the specific pathogen is present? Without a specific answer to the question of “What is considered a clean break in a powder operation?” it is impossible to know the scope of the product that should be held under the plant’s control when regulatory agencies take swabs of product contact surfaces.

Answers to some of these questions are not currently available, however, it is important for companies to begin thinking about how they intend to handle the situation should they be selected as part of the new sampling assignment and the worst situation regarding results occurs.

As CDR learns more about this new assignment in the coming months we will be sure to share it with the industry. In the meantime, we welcome any questions you may have on how your plant can better be prepared for such testing.

Technical Contributors: Marianne Smukowski, msmuk@cdr.wisc.edu & Karen Smith, Ph.D, smith@cdrwisc.edu

25TH ANNIVERSARY OF THE PIPELINE

The Wisconsin Center for Dairy Research is proud to be your source for technical support and education. Thanks to your interest and support we’ve been able to provide the industry with a number of resources and celebrate a number of milestones including the 10,000th short course student and the 20th anniversary of the Wisconsin Master Cheesemaker® Program. This summer, we are honored to celebrate yet another milestone, the Dairy Pipeline’s 25th anniversary.

Developed in 1989 as a short fact sheet series containing research updates and technical development information, the Dairy Pipeline has grown into a twelve page technical magazine with nearly 3,000 subscribers.

“When we developed the UW Dairy Pipeline 25 years ago, the intent was to provide updates to the small and medium sized cheese plants in Wisconsin,” said Bill Wendorff, Ph.D, the mastermind behind the Dairy Pipeline. “Little did we realize at the time, that it would soon become the nation’s primary communication tool for the US cheese industry.”

The very first edition was published in August 1989 along with the help of then editor, Sarah Quinones. It contained three pages of text and one article on landspreading whey permeate. The publication grew quickly and soon items such as the Curd Clinic became a regular part of the quarterly magazine.

By 1996, CDR had its very own website and it didn’t take long for the Pipeline to become available online as well as in print. Karen Paulus, who worked as the Dairy Pipeline editor for more than 15 years, continued to help the Pipeline grow and assisted in publishing the first Curd Clinic Collection, which was based on requests from industry readers.

“The editors of the Dairy Pipeline have been outstanding in constantly updating the communication tools used to convey the information out to the industry,” said Wendorff. “We are especially grateful to the Wisconsin Milk Marketing Board (WMMB) for their willingness to fund this adventure for the past 25 years.”

The Wisconsin Center for Dairy Research thanks you for your support and interest in the Dairy Pipeline. We love to hear that so many of you use this publication and continue to routinely reference old issues. We hope you will take this time to celebrate with us, and as always, please contact us with any ideas you would like to see developed in future issues. We appreciate the chance to work with all of you to move the dairy industry forward. Thanks for 25 years!

Pipeline editor Bekah McBride & designer Tim Hogensen
MILK BASED OFF-FLAVORS

Contributed by: Robert L. Bradley, Professor Emeritus, Ph.D & Scott A Rankin, Ph.D Department of Food Science

Fluid milk is a delicate product that must be handled with great care to maintain quality. Dr. Valente Alvarez in the text, Sensory Evaluation of Dairy Products defines quality milk as “milk that has almost a neutral flavor profile that is pleasantly sweet, with no distinct aftertaste,” and this flavor characteristic must be maintained at and, in general, up to a week beyond the sell by date.

If the milk is not maintaining quality flavor then it will be important for staff to review the accompanying Milk Based Off-Flavors sheet to ascertain the problems. The foldout describes the principle off-flavors found in milk, their cause and source, the milk component affected and a comparative severity scale.

The scoring system used was developed by the American Dairy Science Association. This method of scoring is unique in that consideration is given to the off-flavor, intensity and severity. For example, a cooked defect is not penalized as much as rancid or oxidized flavors. Furthermore, flavors caused by bacterial contamination are marked down severely. Keep in mind that training and experience are necessary to become proficient in milk flavor assessment. You are encouraged to practice and use the fold-out to assist in correcting off-flavor problems whenever one occurs. Plants should always be in the practice of using sensory techniques to evaluate their finished products through shelf life.

Off-Flavor and Incoming Milk Quality

Once the staff has determined the off-flavor, the next step will be to control the off-flavor.

The first place to look for the source of the off-flavor is the incoming milk. Be sure to check that the Standard Plate Count (SPC) is below 5,000 Colony Forming Units (CFU’S) per milliliter and that the raw milk coliform count is below 25 CFU’s/ml. Psychrotrophs should also be limited to 10,000 CFU’s/ml. Remember that enzymes liberated by psychrotrophic bacteria will survive pasteurization and these active enzymes will later produce flavor defects.

The flavor should also be similar to that from day zero, the process day. The bacteriology must be within federal and state limits, i.e., no more than 20,000 CFU’s/ml for SPC and not greater than 10 coliforms/ml. These are the maximum bacteriological standards for the entire shelf-life of the fluid milk product. Obviously the lower the bacterial population the better the product quality.

With these basic requirements, pasteurization fulfilled and properly cleaned and sanitized equipment, your zero-time standard plate count should be less than 100 CFU’s/ml and less than 10 coliforms/ml and the library sample from this lot of milk at the shelf life date should now reflect the excellence that you strive for in relation to milk quality.

The following figure shows the many factors which need to be controlled to produce and maintain quality milk and cream:

Figure 1: Quality Milk Requirements
Milk Handling
A strong emphasis on quality milk is vital when any consideration is given to shelf life, yield or product quality. One major factor dramatically affecting finished milk quality that is commonly overlooked is GENTLE handling of the raw milk. Basically, gentle handling of the raw milk is key to keeping the fat globule membrane intact, which is most desirable for quality.

What is the result of two milkfat globules colliding during pumping?
At first the globules stick to each other, then break apart and the reactions start. A partial loss of membrane occurs, then the milkfat is exposed to lipase activity. Lipase activity yields free fatty acids, a lowering of pH and a reduction in rennet clotting. Butyric to lauric fatty acids (C4-C12) play major roles in imparting rancid flavor. Also, there may be free fat floating on the surface. Note the severity of the rancid defect on the accompanying fold-out.

In view of the possible negative characteristics of milkfat abused by mishandling, corrective actions must be taken to avoid such mishandling.

- Install frequency drives on centrifugal pumps used to move raw milk so as to not overwork raw product.
- Use PD pumps for raw milk handling.
- Gravity feed wherever possible and eliminate bottom feed on large, tall silos where pumping is against considerable head pressure using centrifugal pumps. Use top fill even though pumping is vertical.
- Do not allow milk to splash directly into holding or manufacturing equipment, instead, direct milk to the side wall of any vessel. Eliminate air leaks that will result in foaming and note that the seals on back plates of centrifugal pumps are particularly troublesome.
- Consider also if this leaking centrifugal pump is used as a stuffing pump to feed a separator. With air in the separator bowl a micro-foam will occur. This is particularly troublesome with a separator where the milk has only been heat-treated and most of the lipase is still highly active. In this case, a stable micro-foam will float on the surface of the cream in the storage vessel of the pasteurizer and resist cooling. Again, as a result, lipase activity will be measurable, leading to rancidity.
- Always use positive displacement (PD) pumps to move cream regardless of temperature. Do not operate the PD pump at maximum output since cream does not flow rapidly when cold thus milk fat globule membrane damage may occur. In fact, PD pumps are highly beneficial in minimizing globule membrane damage when operated correctly.
- Consideration is also needed at the farm level where fat globule membrane removal and lipase activity can easily start. In a milking parlor where milk is pumped up to an overhead pipeline, the probability of globule damage and increased lipase activity in the warm milk is considerable. If the centrifugal pump at the vacuum jar does not shut off immediately when the milk reaches the bottom of the electrode, no milk will be pushed to the bulk tank and there will be marked membrane damage, a cause of rancidity and milk fat destabilization.

“Beating up” milk and milkfat also has an effect on the processor of this milk. There are several comelingled factors involved:
- What products are manufactured at your plant?
- What is the pasteurization temperature and length of hold?
- What is the shelf-life of these products?
- Have you evaluated the yield?
- Do you have reputable standards for the lab evaluation of rancidity? (Check “Standards Methods for the Examination of Dairy Products” for the procedure titled “Acid Degree Value”. Note that a final titration value above 1.1 indicates detectable rancidity by taste or smell. Above 1.5 is clearly unsatisfactory and highly rancid.)

Cleaning
In addition to having quality incoming milk and handling milk properly, clean equipment will also be necessary to maintain that milk quality, flavor and functionality. In general, it will be extremely important to check the circulation of sanitizer in addition to cleaning the system on a regular basis. Research has shown that the shelf-life of fluid milk can be measurably extended by using peroxyacetic acid based sanitizer. Peroxyacetic acid appears stable and retains some activity in the presence of dairy-based residues.

Conclusion
With the accompanying information in hand and as a reference, take the time to evaluate how milk or cream is handled as it comes into your plant and be sure to consult pump manufacturers or suppliers for the least problematic system available for your needs. Also note that your quality assurance group should be able to collect samples throughout your plant to validate that your arrangement of equipment and tubing meets the requirements for excellent processed milk or cream with a shelf-life on all finished products that exceeds the sell by date. For fluid cream and milk products, shelf-life can be defined as the number of days for those products to reach 20,000 CFU’s/ml by Standard Plate Count. This number of days to reach 20,000 CFU’s/ml should always be greater than the number of days selected for shelf life. Checks on library samples will reveal the best of all possible storage and handling situations, however, a check of
# MILK BASED OFF-FLAVORS

<table>
<thead>
<tr>
<th>PRINCIPLES</th>
<th>ACID</th>
<th>BARNY/ COWY</th>
<th>BITTER</th>
<th>COOKED</th>
<th>FEED</th>
<th>FLAT</th>
<th>FOREIGN (CHEMICAL)</th>
<th>FERMENTED/ FRUITY</th>
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<tr>
<td>SEVERITY:</td>
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<td>SLIGHT (1)</td>
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<tr>
<td>Psychrotrophic &amp; mesophytic bacteria</td>
<td>Poor ventilation in barn or parlor</td>
<td>Psychrotrophic &amp; mesophytic bacteria</td>
<td>Thermal abuse</td>
<td>Thermal abuse</td>
<td>Poor sanitation</td>
<td>Very high processing time &amp; temperature</td>
<td>Flavorful feed: cabbage, turnip, onion, garlic</td>
<td>Added water</td>
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<td>Thermal abuse</td>
<td>Animal health</td>
<td>Poor sanitation</td>
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<td></td>
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<td>Sanitizer</td>
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<tr>
<td>Poor sanitation</td>
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<td>Residual flavor in surge vessel</td>
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<td>Some vitamin concentrates</td>
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<td>MILK COMPONENT AFFECTED</td>
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<tr>
<td>Lactose ➔ Lactic acid</td>
<td>Throughout milk</td>
<td>Protein ➔ Bitter peptides</td>
<td>Sulfur containing amino acids, methyl sulfide and others</td>
<td>Throughout milk; Absorbed through blood</td>
<td>None, Just dilution of milk components</td>
<td>Throughout milk</td>
<td>Milkfat and fermentation involved</td>
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<tr>
<td>PERSISTENCE</td>
<td>Fermentation continues once initiated</td>
<td>Odors adsorbed remain in milk unless vacuum treated</td>
<td>Fermentation continues once initiated</td>
<td>Temperature related. Some people are bitter blind.</td>
<td>Lessens with time</td>
<td>Intensity remains throughout shelf-life</td>
<td>Remains in milk</td>
<td>Remains in milk</td>
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<td>Temperature related</td>
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<td>Off-Flavor will continue to develop</td>
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<td>10</td>
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**Slight**

**Pronounced**

*Prepared by Department of Food Science University of Wisconsin-Madison & Center for Dairy Research*

*Authors: Robert L. Bradley, Emeritus Professor, Department of Food Science, UW-Madison & Scott A. Rankin, Chair, Department of Food Science, UW-Madison*
<table>
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<tr>
<th>D/</th>
<th>LACKS FRESHNESS</th>
<th>LIGHT OXIDIZED</th>
<th>MALTY</th>
<th>METAL OXIDIZED</th>
<th>RANCID</th>
<th>SALTY</th>
<th>STALE</th>
<th>UNELEAN</th>
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<td>6-10</td>
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<td>8-9</td>
<td>6-10</td>
<td>6-10</td>
<td></td>
</tr>
</tbody>
</table>

**Odor & Flavor**
- Psychrotroph & mesophylic bacteria
- Thermal abuse
- Poor sanitation

**Milk Component Affected**
- Lactose ➞ Lactic acid
- Throughout milk
- Amino acid: Methionine ➞ Methional
- Amino acid: Lactose ➞ Methyl butanal
- Initial flavor is metallic, then oxidized with time
- Unsaturated fatty acids.
- Free fatty acids. Short chain fatty acids have classic baby breath flavor and odor
- Any disruption of fat globule membrane in presence of active lipase
- Copper in dairy metal
- Exposed iron in old milk cans
- Indicates mastitic milk
- Elevation of sodium in milk from mammary infection
- Elevation of sodium in milk from mammary infection
- Old or mishandled skim milk powder (NDM)
- Stale NDM added to fluid milk or cheese milk to fortify
- Throughout milk

**Prelude to Advanced Spoilage**
- Diminishes somewhat with time. Flavor threshold is 50 parts per billion.
- Fermentation continues with time, temperature related
- Develops more with time: May develop a painty flavor
- Develops with time
- Chloride/lactose value remains constant once cow is milked
- Remains constant once mixed, About 10x increase in off-flavor in cheese made
- Develops with time and thermal abuse

**Persistence**
- Fermentation continues once initiated
- Temperature related. Some people are bitter blind.
- Lessens with time. Intensity remains throughout shelf-life
- Remains in milk
- Off-Flavor will continue to develop
- Prelude to advanced spoilage
That does not look like a big decrease in available water but to growing microorganisms it’s a significant decrease. A cheese with a high water activity, around .99, has a lot of water available to be used by microorganisms and therefore there is a great chance for growth of all types of bacteria, yeast and molds. Conversely, a cheese with a low water activity, around .91 would preclude the growth of some types of microorganisms yet allow the growth of the more tolerant. Basically, the higher the water activity, the more potential there is for biological reactions to occur and typically a cheese will “breakdown” and soften faster at higher water activities.

So why is this important?

Low Moisture Cheese
As you might expect, the combination of a low moisture cheese together with a high salt cheese results in the lowest water activity because of the high salt concentration dissolved in the relatively low amount of moisture in the cheese. A good example of this would be Parmesan cheese, which has a water activity of around 0.91-0.92. A cheese like a Pecorino Romano which has low moisture content and a salt content of up to 5 percent would likely have an even lower water activity. This is why these cheese varieties are so stable and resistant to microbial spoilage even at elevated temperatures. Dried Parmesan has a moisture content in the area of 18 percent and a high salt content due to the concentration effect of removing moisture via drying, thus it has such a low water activity that it is considered shelf stable and does not need refrigeration to prevent microbial growth and spoilage.

High Moisture Cheese
Conversely higher moisture cheeses with relatively low salt contents, such as cottage cheese or fresh mozzarella,
have high water activities and are very susceptible to microbial survival, growth and spoilage. For example, cottage cheese has a reported water activity of around 0.99 and is very susceptible to spoilage and has a short shelf life. Some of the higher volume cheeses, such as Cheddar, Colby or Gouda, have water activities in the area of 0.95 depending on their moisture and salt contents. One of the concerns with the interest in low salt cheeses is the increase in water activity of these cheeses vs. their normal salt counterparts. Remember, this lowering of salt increases the chances for undesirable microbial survival and growth, and also faster enzymatic breakdown of the protein structure of these cheeses often resulting in bitterness and undesirable flavors.

**Conclusion**

Water activity values for different cheese varieties are what they are; meaning if you want to make the standard version of the cheese variety at the typical salt and moisture contents expected for that variety the water activity will be what it typically is and there isn’t much you can do about lowering it. Knowing what the water activity is for a cheese variety, however, does give you some good information regarding the robustness of that variety with respect to how resistant the cheese might be to aging or display temperature fluctuations and the potential for microbiological growth, pathogen survival or growth, potential for spoilage, and expected shelf life of the product.

<table>
<thead>
<tr>
<th>$a_w$</th>
<th>Bacteria Growth Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>0.96</td>
</tr>
<tr>
<td>C. botulinum</td>
<td>0.93*</td>
</tr>
<tr>
<td>L. monocytogenes</td>
<td>0.91</td>
</tr>
<tr>
<td>S. aureus</td>
<td>0.86</td>
</tr>
<tr>
<td>Yeast and molds</td>
<td>0.65-0.7</td>
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Source: Food Research Institute, University Wisconsin
* If other conditions are met, such as pH

Continued from page 5

your product that reaches grocer’s shelves yields a measure of abuse tolerance. Make sure that these products are tasted to determine consumer acceptance.

In summary, take careful note of the milk and cream that you convert to consumer products. Examine the milk and cream with a microscope to check the fat globules. Have your laboratory run the test for free fatty acids and use Figure 1 and the fold-out to assist you in locating the source of the problem.

References:

**CDR NEWS**

**Ray Michels Honored by UW**

CDR cheesemaker and resident buttermaking expert Ray Michels recently received the 2014 UW-Madison Classified Employee Recognition Award as well as the College of Agriculture and Life Sciences (CALS) Classified Staff award for his work at the Center for Dairy Research.

Michels, who has worked at the Center for more than five years and at Babcock Hall dairy plant for more than 30, helps to run the cheese and buttermaking equipment for CDR and has obtained his Pasteurizer Operator Certification as well as a Wisconsin Cheesemaker’s license. Please join us in congratulating Ray Michaels on his excellent work!

**CDR Welcomes New Staff Member**

Emily Caruso is a research specialist who brings years of industry testing experience to the CDR lab. With knowledge of quality assurance programs and waste water analysis, Emily is able to continuously improve data processing and reporting. She has a B.S. in biochemistry from the University of Wisconsin-Madison, and enjoys the intellectual and physical challenges that come with her work in the lab. She is also proud to continue her family’s tradition of working in the dairy industry.
The Wisconsin Center for Dairy Research strives to be at the forefront of dairy innovation and discovery. To assist with these efforts, CDR recently launched the TURBO program, a comprehensive business accelerator designed to increase the speed of commercialization for new products and technologies specifically related to the dairy industry.

CDR and the TURBO program are excited to share a number of technologies with the industry, including those that can be found at www.turbo.cdr.wisc.edu/available-cdr-technologies, in addition to the technology highlighted below. We hope you will continue to check back often for more technologies and further developments.

A more efficient and cost effective method for concentrating dairy proteins
Inventors: Mark Etzel and Abhiram Arunkumar
Technical Contributor: Mike Molitor

UW-Madison researchers Mark Etzel, Ph.D and Abhiram Arunkumar along with the assistance of CDR Senior Instrumentation Technologist Mike Molitor and financial support from Dairy Management Inc. (DMI), recently developed a negatively charged ultrafiltration membrane that will provide improved concentration of milk protein, milk serum protein or cheese whey.

This patent pending technology, currently licensed with the Wisconsin Alumni Research Foundation (WARF), allows manufacturers to perform ultrafiltration with less water and chemical usage, at a higher flow rate, and at the same protein retention as uncharged membranes.

Technology Overview
One of the issues faced by whey protein concentrate (WPC) and milk protein concentrate (MPC) manufacturers is the permeability-selectivity tradeoff of membrane pores. If the pores are large then there is a high liquid flow rate through the membrane but few proteins are retained. On the other hand, if the pores are small then more proteins are retained, but flow rate is low.

Researchers at CDR and UW-Madison Food Science have discovered a way around this dilemma by adding a negative charge to the membrane system, which essentially allows for larger pores that still have a high protein retention.

Basically, the science behind this technology relies on the rules that surround the protein isoelectric point and electrostatic repulsion. Consider that when two like charges meet, they are repelled, but the same is not true for two opposite charges. This idea is the key to charged membrane technology.

In this case, when milk and cheese whey proteins are in a solution at a pH greater than about 5, the proteins are generally negatively charged. By putting these negatively charged proteins through a membrane that also contains negative charges, the proteins are repelled, thus preventing protein loss. All other material without a negative charge is allowed to pass through. So, by using this method, the pore sizes of the membrane can actually be larger, which allows for greater flow rates without the loss of proteins. Selectivity is not sacrificed to get high permeability.

Functional and Economic Benefits
To date, this method has been tested within the CDR pilot plant and at a bench top level. Both have proven to be quite successful. In general, when dealing with WPC 80, the flow rate through the membrane went up two to four times without losing protein. In regards to MPC, flow rate generally increased by five times or more. Additionally, thanks to the larger pore sizes, sugars were more easily eliminated with less water. Less fouling of the membranes also meant that researchers needed to use less chemicals in the cleaning process. Thanks to these many benefits, less membrane area is needed in general, which also contributes to the improved bottom line.

Pros and Cons
While this technology can offer less water use, less fouling, a need for less membrane area and essentially a more environmentally and financially friendly method of ultrafiltration, there are several challenges that a company adopting this technology may face.

In particular, this technology will need to be tested in a larger scale facility. Through the TURBO program, potential partners are able to come into the CDR pilot plant to test this technology on a larger scale. We do have industry scale
elements available for use within the pilot plant. Partners are also welcome to make an appointment to investigate the bench top prototype.

Additionally, a company wishing to adopt this technology would need to partner with a membrane manufacturer in order to produce the necessary membranes. The exact cost of this has not been analyzed and a price for the charged membrane has not been determined as CDR and the University do not actually manufacture the membranes. All partnering companies will need to license this technology through WARF and follow their procedures.

**How can I learn more?**

CDR is an internationally known dairy research center and the largest within the United States. Access to world class food scientists/technologists, and a licensed, operating dairy plant along with CDR's client confidentiality commitment provides applied research results at a minimal cost. This technology is currently available for licensing from Wisconsin Alumni Research Foundation (WARF). CDR will assist in this technology adoption for a nominal fee.

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**Master Artisan Short Course Series**

**Cheeses of the Alpine Region**

**September 23-24, 2014**

The Wisconsin Center for Dairy Research invites all cheesemakers to attend this year’s Master Cheesemaker short course, September 23-24, 2014, at Babcock Hall in Madison, Wisconsin.

This two-day, hands-on course will focus on the traditional methods of Alpine-style cheese manufacture and will include sensory sessions as well as lectures from CDR staff and European cheesemakers. Topics will range from the functional aspects of Alpine cheese in cooking to propionibacteria use and its impact on swiss cheese manufacture. This course qualifies as an Advanced Artisan Course for Wisconsin Master Cheesemakers and as an elective course for candidates in the Wisconsin Master Cheesemaker® Program.

To register, visit [www.cdr.wisc.edu/short-courses/master](http://www.cdr.wisc.edu/short-courses/master) or call CALS Conference Services at 608-263-1672.

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**IFT 2014, JUNE 22-24 IN NEW ORLEANS**

Dairy Ingredients staff at the Wisconsin Center for Dairy Research recently assisted the United States Dairy Export Council (USDEC) in the development of a poutine-inspired cheese dipper for the 2014 Institute of Food Technologists (IFT) annual meeting, June 22-24 in New Orleans, Louisiana.

Made with U.S. cheese, milk protein concentrate 80, nonfat dry milk, whey permeate, whey protein concentrate and butter, this poutine-inspired dish contains 30 percent of the daily value of calcium and 15 grams of protein, while also promoting U.S. dairy.

Traditionally, poutine is a French-Canadian dish that contains French fries, gravy and cheese curds, however, this new dish was developed as a snack item or appetizer. Similar to a cheese stick, this sweet-potato encrusted cheese snack contains Juustoleipa-style cheese complemented by a mushroom dipping sauce.

CDR dairy ingredients staff members, KJ Burrington, Sarah Minasian, Susan Larson and Becky Kalscheuer attended IFT and worked the USDEC booth, helping to promote dairy-based product ideas to food companies. For more information visit [www.am-fe.ift.org/cms](http://www.am-fe.ift.org/cms).

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[Sign up for the electronic version of the Pipeline at subscribe_pipeline@cdr.wisc.edu](mailto:subscribe_pipeline@cdr.wisc.edu)

For further information, please contact Vic Grassman, TURBO Manager, [vgrassman@cdr.wisc.edu](mailto:vgrassman@cdr.wisc.edu) or CDR Senior Instrumentation Technologist, Mike Molitor, [molitor@cdr.wisc.edu](mailto:molitor@cdr.wisc.edu).

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Short Course Calendar:
- Master Artisan Short Course Series, Cheeses of the Alpine Region, September 23-24
- Cheese Tech Short Course, October 6-10
- Dairy Ingredient Manufacturing, October 14-15
- Cheese Grading Short Course, November 5-7

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

Events:
- UW-Madison Day at WI State Fair, Aug. 6
- ADPI Technical Symposium, October 21 & 22, Madison, WI
- WMMB Expos Oct. 28 & 30 (28th in Green Bay; 30th in Madison)
- Annual meeting, Grapevine, TX, Oct. 27-29
- IDF World Dairy Summit, Tel Aviv, Israel, 2014

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