

# DAIRY PIPELINE

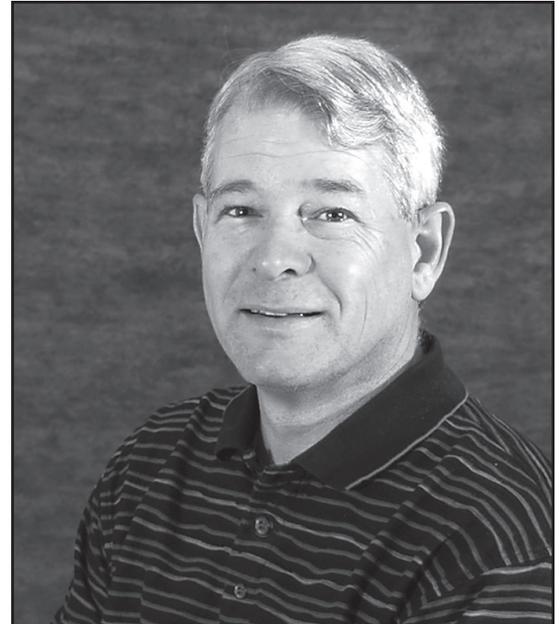
## Looking Back at 20 Years

By Rusty Bishop, Director, Wisconsin Center for Dairy Research

Where did we start? At what point in the journey do we find ourselves? As we look back on the past 20 years, I think the industry we serve, our primary investors (Wisconsin Milk Marketing Board and Dairy Management Inc.), the university and our staff are pleased with the development of the Center.

In the beginning, Norm Olson set his sights on building the pre-eminent dairy foods research center in the U.S., and one of the best in the world. To that end, he succeeded. The state of Wisconsin funded the Walter V. Price Cheese Research Institute in 1979, then CDR came on the scene in 1986 when the WMMB leadership and board set up a trust fund to provide additional money. The original goal was to provide technical research and support to accompany their marketing efforts, in order to enhance the value of Wisconsin cheese and other products. That goal has been realized. In 1992/1993, CDR decided to greatly expand the portfolio of services it would provide Wisconsin's industry, by partnering with manufacturers and marketers, and providing a balanced approach of fundamental research, applied research, applications/tech service, and outreach (short-courses, symposia, publications, tailored training, electronic access to information, etc.).

Over the 20-year history of CDR, we have grown from a staff of 2 and a budget of around \$200,000 to today's staff of 34 and an annual budget of \$3.7 million. We have seen significant changes in the dairy industry, not only in Wisconsin and the rest of the Midwest, but across the United States. Fewer dairy farms have bigger herds producing more milk.



Cheese plants have aligned themselves as large manufacturers of commodity cheese or medium-to-small sized specialty cheese manufacturers. Specialty cheese, as a percentage of total cheese production in the state, has grown from 2% to 14%. Per capita consumption of cheese has almost doubled, and most is eaten as an ingredient rather than direct consumption from retail. CDR conducts many more trials on the functionality and performance of the cheese when used in other foods, and less on developing new cheese varieties targeting retail markets. We formulate high protein/low carbohydrate foods and beverages with dairy proteins, mainly from whey. Ironically, this leads to a scenario that requires some manufacturers to make cheese to get whey proteins. Essentially, dairy has become part of the food business and not merely a dairy

*continued on page 2*

### What's Inside:

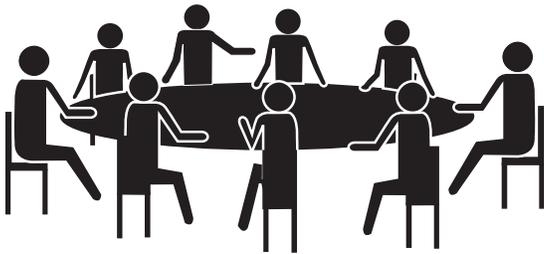
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business. The industry has shifted from a sell what you make to a make what you can sell mentality and “innovation” is the new business buzzword. What does that mean for the dairy industry?

**Innovation—the key to future growth**

In a recent article in The Economist (January 21, 2006), entitled, “The Search for Innovation,” the authors state that successful businesses separate ‘planning for profit’ from ‘planning for growth.’ This thinking shifts the focus from paring costs and improving margins to emphasizing new products, new markets and new customers. Paying less attention to bottom-line profits and more to top-line revenues leads to sustained and steady growth. Of course, paring costs/improving margins is a reality for the cheese industry due to federal pricing orders, co-op structures, and commodity markets. But we know this tactic is not sustainable.

There are two ways to achieve top-line growth. The first is to buy it through mergers and acquisitions. The second is to generate it internally. I believe we need to go with the second direction, and that means we need to innovate! The unavoidable reality is that long-term advantage requires skills that create internal growth, which is driving companies to search for ways to make their people more creative and more productive. At the heart of internal growth lies innovation: ideas to develop new products and new markets.



In the past, innovation sprung from the R&D laboratories of individual companies, which has been marginally successful. Industry has learned that it is not necessarily how many R&D dollars you spend, but how you spend them. Now, innovation in many industries is coming from small, new firms. So where can companies turn for innovation? Many are looking outside their own organizations, to university dairy research centers.

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“Innovation can blossom almost anywhere in an organization that is structured to encourage it, or has the foresight to seek it outside of it’s own walls.”

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Innovation can be a simple thing. It does not reside only in the minds of the brilliant but nutty scientists, or develop from creative people in marketing departments and advertising agencies. Innovation can blossom almost anywhere in an organization that is structured to encourage it, or has the foresight to seek it outside of it’s own walls. CDR is ready and willing to partner with you as you “innovate” toward a sustainable, profitable future. There is so much potential and opportunity for dairy products and components tailor-made for every consumer at every stage of life. In the next 20 years, let’s tackle the challenge together.

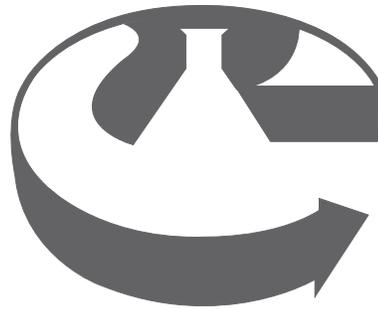


Join us at the—

**2006 International Cheese Technology Exposition**

Alliant Energy Center Meeting Rooms  
Alliant Energy Center, Madison, Wisconsin

Thursday, April 27, 2006  
Concurrent Session 3  
“Technology Innovations  
to Enhance Profitability”



- 9:00 Welcome - Jeff Kondo, DMI - Moderator
- 9:05 Current Issue Update: FDA/Cheese storage temperature  
Rusty Bishop, CDR
- 9:20 Repositioning the Midwest and US cheese industry / Impediments to profitability  
and innovation  
John Fridirici, Grande Cheese Co.
- 9:35 Thinking outside the box - new flavors in traditional cheeses  
Bob Lindsay, Dept. of Food Science, UW Madison
- 10:30 Thinking outside the box - cheeses for target applications  
John Jaeggi/Mark Johnson, CDR
- 10:55 Health positioned cheese (omega 3, probiotics, etc)  
Dean Sommer, CDR
- 11:20 Trends for truly novel cheese ideas/penetration  
Jerry Dryer, Dairy & Food Market Analyst



## Applications Update

# Whey ingredients can replace eggs in baked products

By Kathy Nelson, Food Scientist in CDR's Dairy Ingredients Applications Program

The bottom line for food formulators focuses on flavor, function and cost. For baked products, the high nutritional and functional value of eggs make them an important ingredient. Whole egg is chemically constant from egg to egg, although within the egg, the yolk and white differ markedly from one another. The yolk is a complex emulsion of proteins, lipids and water, while the white is an aqueous protein solution, and is virtually free of lipids. Consequently, the white and yolk each contribute unique functions in baking. The whites have binding ability derived from heat coagulation characteristics, and the ability to entrap air to form a stable foam, while the yolk has excellent emulsifying capacity, largely due to its phospholipid content. In baked products, eggs provide leavening, viscosity, tenderizing, textural properties (or crumb structure), and volume, as well as color, flavor and nutrition. Given the number and variety of roles eggs play in baked products, replacement becomes a daunting task. However, whey ingredients can be a cost-effective, functional replacement for eggs in many products—if you follow some guidelines.

### WPC—the ingredient of choice

Whey protein concentrates (WPC) are the ingredient of choice for most egg replacement in baked products, due to their high protein content. Whey protein isolates (WPI) are used less often, primarily because of cost. WPC's are readily available in protein concentrations of 34%, 60% and 80%, some with enhanced functional properties like high levels of phospholipids that improve emulsions. In addition, WPC's can be customized to meet specific requirements. The 60% and 70% protein concentrates are often called reduced lactose whey (RLW).

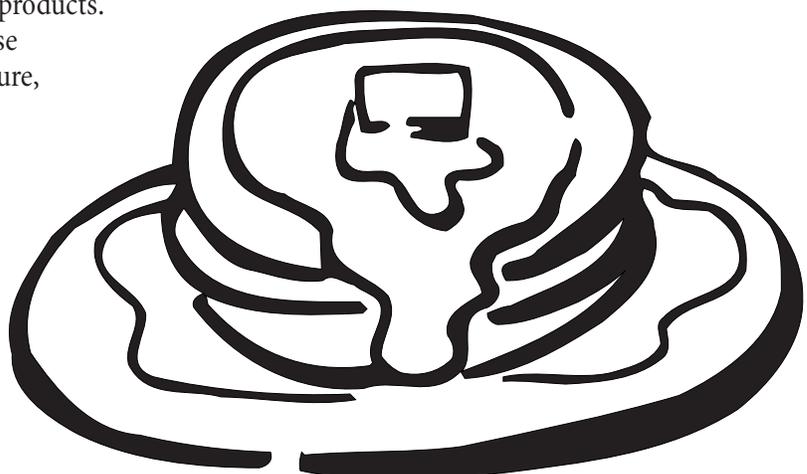
You may be surprised to know that total replacement of egg with whey ingredients can be accomplished quite successfully in many chemically-leavened baked products. For example, in cookies whey ingredients decrease moisture loss during baking, contribute to structure, enhance a crisp texture and act as emulsifiers. In biscuits and scones, whey ingredients help contribute a tender internal texture, and hold moisture over shelf-life. In quick bread, muffins or pancakes, whey ingredients increase batter viscosity, and give a tender, even crumb structure. Whey ingredients assist in surface browning in all of these baked products, although you may need to adjust times and temperatures to avoid excessive browning.

Cake systems are more complicated, thus partial replacement (50% or less) with whey ingredients is more successful than complete replacement of egg. Whey proteins act to enhance sweetness, extend shortening, and they are also useful in low sugar or low fat cakes. In high-ratio cakes (high ratio of sugar to flour), egg proteins form a complex network with the flour gluten, stabilizing the cake structure. Sugar increases the temperature to set flour gluten, thus requiring the presence of protein that sets at a lower temperature—like egg—to assist with forming structure at the right point in the baking process. For this reason, only partial replacement of egg is recommended in layer cakes. A higher protein whey concentrate is most effective, such as WPC-60, a unique WPC with a higher level of phospholipids, or WPC-80, especially one with high gelling capacity. Cakes containing whey protein often have a more even and tender crumb structure than an egg-based cake.

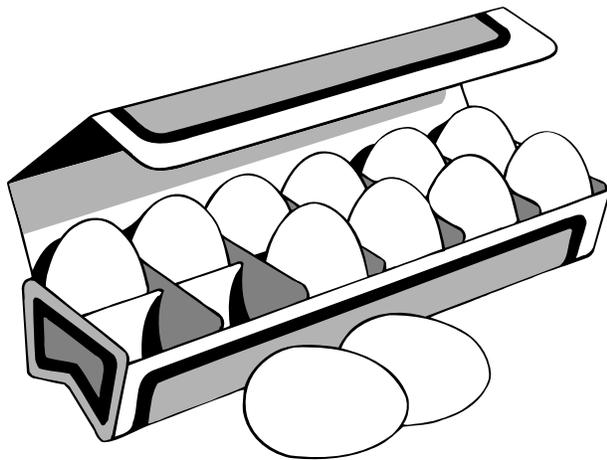
### Consider the following questions

Before you replace eggs with whey powders you should consider the following questions. First, are fresh or dried eggs being replaced? Next, what is the total amount of protein being replaced? And finally, what other effects will whey powders have on the finished product?

One large fresh egg weighs approximately 52-55 g, and 75% is water. If you use a dry whey powder to replace a whole fresh egg, the water must also be replaced. The functional properties of egg are associated with protein, thus replacing with whey ingredients should be done on an equal protein basis. Only 12% of a large fresh egg is protein, while 46% of dried whole egg is protein. Protein levels in whey powders vary from 13% in sweet whey to over 90% in whey protein isolate. For each product, choose the whey ingredient which gives the most function at the most reasonable cost.



Finally, especially when using a sweet whey or WPC-34, the largest component of either ingredient is the sugar, lactose. Adding either sweet whey or WPC-34 to your formula will enhance browning, increase tenderness and may affect sweetness level. It is important to consider these things and verify the performance in the product. You may need to adjust levels in a formula to get the results you want.



Typical formulas for replacing 100 g of whole egg suggest 15 g of WPC-80 plus 75 g of water. If you use WPC-34, you will need 35 g plus 75 g of water for the same 100 g replacement of fresh egg. However, to replace 100 g whole dried egg you need to add 57 g of WPC-80. For more information, or specific formulas, contact Kathy Nelson at (608) 265-3570. ☺

Below are suggested starting levels for replacement and the expected benefits:

Product of Choice	Whey Ingredient (% of total formula)	Suggested Use Level	Expected Benefit
Cookie or Brownies	WPC-34 to WPC-50	1-5%	Surface browning, Tender texture, Mild dairy flavor
	WPC-80	1-5%	Provide structure, Surface browning, Provide soft crumb
Muffins or Quick Bread	WPC-80	2 -4%	Surface browning Provide structure, Improve tender texture
Scones or Biscuits	WPC-80	2-4%	Provide structure, Surface browning
Layer Cakes	WPC-34 to WPC-50	1-6%	Improve crumb tenderness, Surface browning
	WPC-80	1-4%	Batter viscosity, Provide structure
Pancakes	WPC-34	4-6%	Surface browning, Mild dairy flavor
	RLW-60	3-5%	Increased batter viscosity
	WPC-80	1-2%	Provide structure
Lowfat Muffins or Pound Cake	WPC-34	2-10%	Surface browning, Partial fat or sugar replacement, Improved water binding, Finer crumb structure
	WPC-80	3-9%	Improved volume, Provide structure

# Only in Wisconsin



*Bob Aschebrock, chief judge, plugs a provolone during the 2006 WCMA contest.*

The 2006 World Championship Cheese Contest sponsored by the Wisconsin Cheese Makers Association (WCMA) was held from March 21 to 23<sup>rd</sup> at the Monona Terrace Convention Center in Madison, Wisconsin. WCMA notes that this is the world's largest contest, and in 2006 the contest set a record with 1,792 entries from 18 nations.

Judges converged on Madison from France, Canada, Denmark, Netherlands, Puerto Rico, New Zealand, Scotland, South Africa, Spain, Sweden, Switzerland, and the United States. Bob Baer, US judge from South Dakota State University, enjoyed his stint as a judge in Madison and noted "This contest is truly unique, and it could only happen in Wisconsin."

After all, where else can you find someone like chief judge, Bob Aschebrock, who has decades of experience grading cheese? The same is true of former chief judge, Bill Schlinsog.

Bob Aschebrock says that everyone benefits from a contest like this. Sales increase, in both directions. For example, this was the first time someone from South Africa came to judge at the contest. Sure enough, a cheese entry shows up from



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"This contest is truly unique, and it could only happen in Wisconsin."

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*Mark Johnson, CDR, is paired with French judge Jean-François Chambert to judge blue veined cheeses.*



South Africa, too. Visitors from Japan were very interested in the Black Diamond cold pack from Pine River Pre-Pack, Inc. winner of the Cold Pack class.

The contest is educational for judges and the cheesemakers who enter their cheese, and receive the scoring sheets after the contest. And, for the US judges, Aschebrock asserts “It is good for our judges to see product from other countries.”

Aschebrock offers these tips for future contests. First, pay attention to shipping directions and use high quality commercial ice packs to cool your cheese during shipping. Aschebrock has seen improvised ice packs, and even jam jars filled with water, that froze and broke during transport. Also, cheese that is loose in a box can get bumped around, cracking the rind of the cheese and allowing a potential winner to dry out.

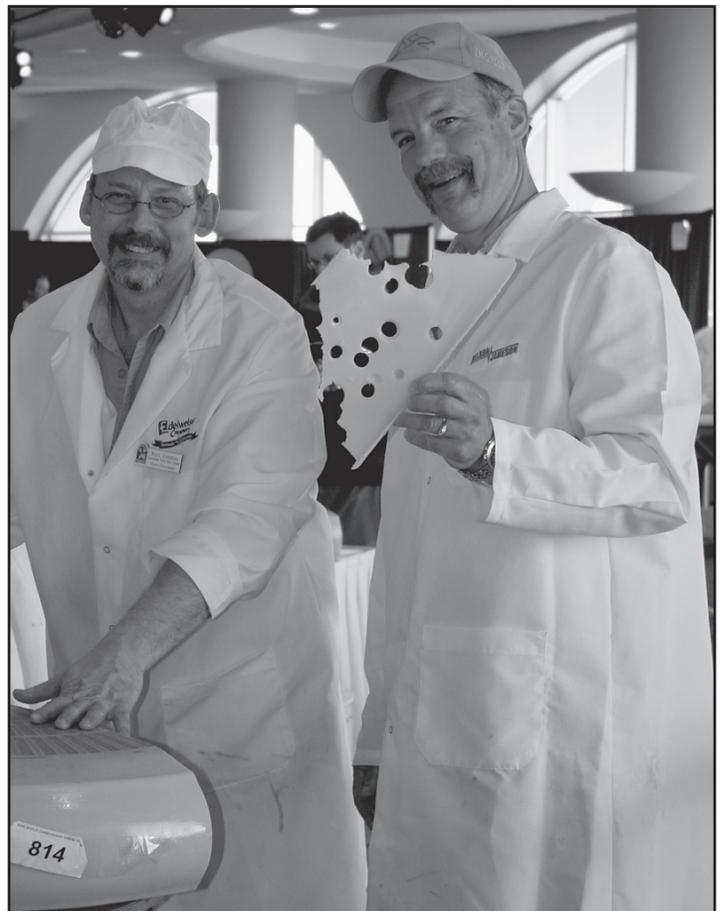
In addition, Aschebrock says, “We always encourage cheesemakers to pick their best product. Of course, they can’t sample or plug the entry but they can choose a cheese based on sampling on either side for quality.” It’s a good idea to use a panel to judge the samples, pull in your office people to get some varied opinions.



Photos from the top:  
*Black Diamond cold pack from Pine River Pre-Pack, Inc.*

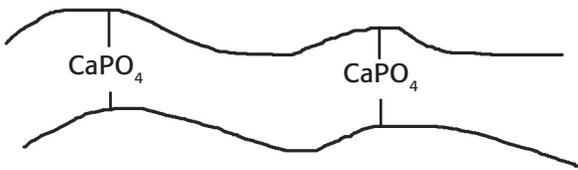
*Wisconsin Master Cheesemakers, Jamie Farney, Myron Olson and Gary Grossen*

*Contest volunteers as well as Wisconsin Master Cheesemakers, Bruce Workman and Steve Stettler*

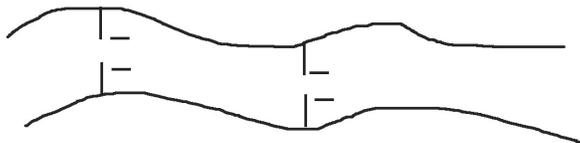


# Curd Clinic

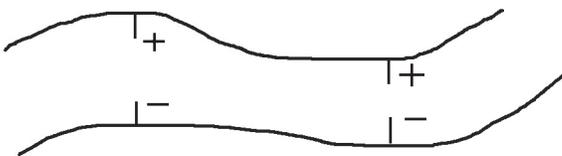
Curd Clinic doctor for this issue is Carol Chen, researcher at CDR



**Cheese pH 6.0**  
**Calcium phosphate bonding**  
**No Melt**



**Cheese pH 5.0 to 5.3**  
**Calcium phosphate dissolves**  
**Repulsive forces dominate**  
**Melt**



**Cheese pH 4.8**  
**Attractive forces dominate**  
**No melt**

**Q.** We are using the same mozzarella cheese in two different pizza applications. The first is a typical deli style pizza with the sauce spread on the crust first, followed by cheese and then the toppings. When the pizza is baked the cheese melts nicely, with all of the shreds completely fused. Our second pizza is a deep dish variety, the cheese is layered between the crust and the sauce on the top. However, after baking this pizza the cheese doesn't look melted, and you can even see individual cheese shreds. Why is this happening?

**A.** Your question is a wonderful illustration of protein chemistry and it offers a great opportunity to review the importance of casein composition and structure in cheese. (See Pipeline Vol. 11 #2 and Vol. 12 #1 for an in depth discussion of casein.) Essentially, the differences you observed are due to interactions between the cheese and sauce. Pizza sauce, a tomato based product, is quite acidic, ranging from pH 4.1 to 4.4. The pH range of mozzarella cheese is 5.1 to 5.3 and at this pH range the casein molecules interact less, allowing the cheese to flow when heated. By covering the cheese with sauce you have allowed the pH of the sauce to influence the pH of the cheese. The surface of the cheese shred becomes more acidic, (i.e. pH < 4.9) and it affects the strength of the chemical bonds.

Cheese softening and flow depend on a complex balance of attractive and repulsive forces between casein molecules. These forces are influenced by pH, temperature, the structure of casein itself and the breakdown of the casein complex, or proteolysis. The pH is the most important factor when considering this question since the cheese is the same and you verified that the cheese temperature is similar in both pizzas.

### As pH decreases melt and stretch increase

In milk, at a high pH (6.6 - 6.7) the main interactions between casein molecules involve calcium phosphate and hydrophobic interactions. Calcium phosphates are important because, like the cement in a brick wall, they act to stabilize the cheese. As the pH decreases, the calcium phosphate dissolves from the casein and is replaced by hydrogen, and you will see an increase in cheese melt and stretch as repulsive forces dominate. However, if the pH falls too low (pH < 4.9), the cheese won't flow. The attractive forces between casein dominate and the cheese can maintain its shape, no longer flowing. The strength of the interactions between the protein strands under acidic conditions is too great. (See the illustration to the left.)

### Solving your problem

Solving your problem involves raising the pH of the pizza sauce enough to affect the shreds. The cheese and sauce pH do not need to match. Once the pH of the sauce rises to about pH 4.9 the melted shreds begin to flow again. This is because raising the pH of the sauce above 4.9 affects the cheese pH and shifts the balance of power among the protein bonds to the repulsive forces. As the photos show, pizza sauce with a pH of 4.8 allows the cheese shreds to blend into the background and they are no longer visible.

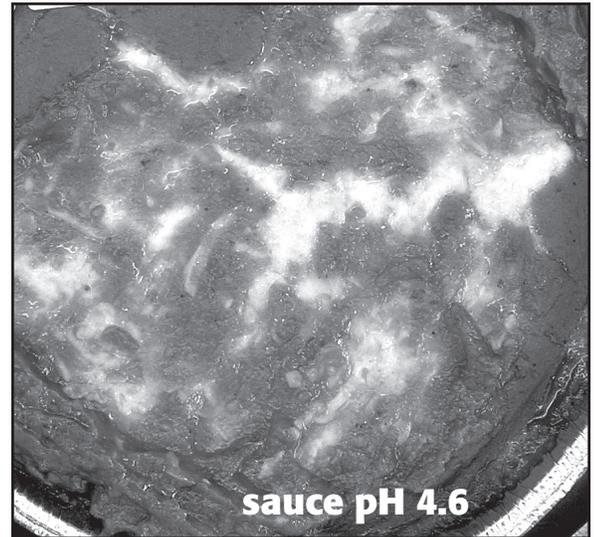


For an in depth technical review:  
Invited Review: Perspectives on the Basis of the Rheology and Texture Properties of Cheese  
J.A. Lucey, M.E. Johnson, D. S. Horne  
Journal of Dairy Science 86:2725-2743  
2003

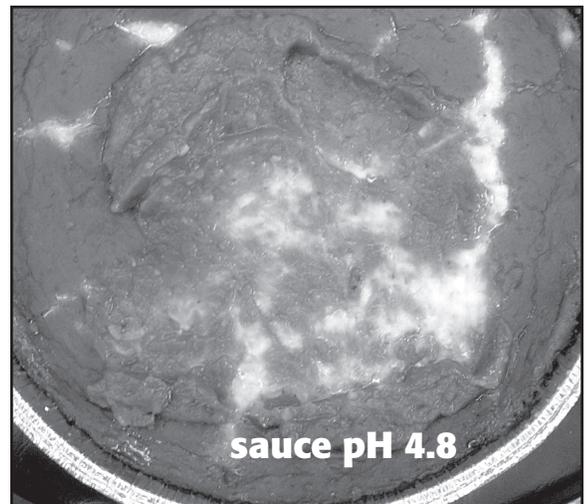
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### Deep dish pizzas

These deep dish pizzas are made of the same kind of crust, the same cheese and they were baked at the same temperature for the same length of time. The pH of the sauce varies. For these photos the sauce has been scraped aside to show the cheese.



“Solving your problem involves raising the pH of the pizza sauce enough to affect the shreds. The cheese and sauce pH do not need to match.”



# 2006 Wisconsin Master Cheesemakers

When Jim Demeter was 14 years old he was handwashing feta cheese at his parents cheese plant in Lena, Illinois. Now, decades later, he has earned a Wisconsin Master Cheesemaker title for feta cheese.

The cheesemaking roots run deep in Jim's family. His mother, Dorothy Demeter, was the first female to earn a degree in Dairy Science from Iowa State. While she was studying in Iowa she also met her husband, James C. Demeter, who was born and raised in Greece and came to the United States after the war to learn about agriculture. They both ended up working with Dorothy's parents at the Kolb Lena Cheese Company, eventually making Iowa style baby swiss, camembert, brie and feta.

Demeter says that his years of experience making cheese were invaluable, and so was the Master Cheesemaker endeavor. In particular, the classes he took help him teach others. "Now I can tell my operators why things need to be done in a certain way," admits Jim.



*Jim Demeter, Trega Foods*



*Bruce Willis, Burnett Dairy*

Like others in the program, Jim noted that one of the challenging parts of becoming a Master Cheesemaker is taking the test. "It really completes the process," he noted.

Bruce Willis of Burnett Dairy has been making cheese for over thirty years and he continues to learn. Earning his Master Cheesemaker title for cheddar and colby is his latest way of proving it. He finds cheesemaking challenging and would advise young cheesemakers, "Don't get discouraged by all there is to learn."

Willis enjoyed the classes he traveled to Madison for, particularly learning about cheese grading and trying new cheeses. His suggestion for improving the program involves the timing of test—do it before or after deer season!

*continued on next page*



*Dave Buholzer, Klondike Cheese*

# Masters 2006

The third Master Cheesemaker graduating in 2006 is Dave Buholzer who makes cheese with his brothers at Klondike Cheese, in the plant his grandfather started 80 years ago. Dave, a third generation cheesemaker, has earned Master status for feta and muenster cheese. He enjoys the challenge of marketing and making Klondike cheese products stand out from the rest.

Like other Master Cheesemakers, Buholzer enjoyed the classes he took along the way and he also found that interacting with other cheesemakers was particularly useful and enjoyable.

In addition to the first-timers, 3 more Master Cheesemakers will be earning certification for additional cheeses. Carrie Wagner, earned certification in monterey jack and cheddar, Steve Stettler is now a Master making brick and farmers cheese, and Randy LaGrander is a cheddar Master. 



## Calendar, continued

May 23, 2006 Energy Management in Your Dairy Plant, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

June 6-7 Wisconsin Cheese Grading Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

June 24-28 IFT Annual Meeting, Orlando, FL. For information see [www.ift.org/amfe](http://www.ift.org/amfe).

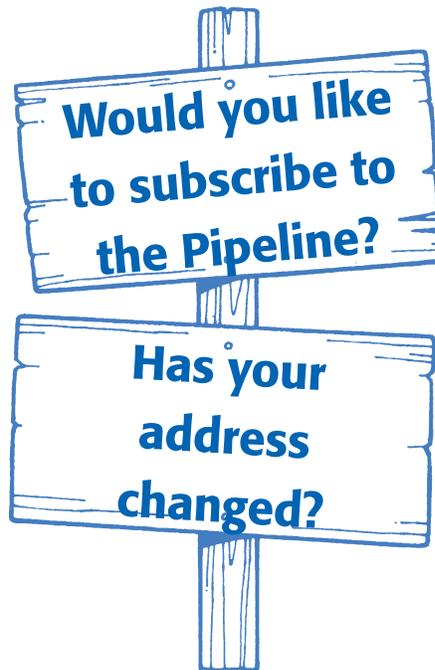
June 25-27 WDPA Dairy Symposium, Eagle Ridge Resort, Galena, IL. Sponsored by WI Dairy Products Assn. For further information, contact WDPA at (608) 836-3336.

July 9-12 American Dairy Science Association Annual Meeting, sponsored by American Dairy Science Assn. Minneapolis, MN. For more information call ADSA, (217) 356-5146.

July 20-23 American Cheese Society Annual Meeting. Portland, OR. For info, call (502) 583-3783.

## News from CDR

Madison will be well represented at the 2006 Dairy Science World Series Conference in Sydney, Australia. Mark Johnson, Rusty Bishop and Jim Steele (Dept. of Food Science) are all part of the program, they are traveling to Australia to discuss cheese microstructure, molecular genetics, and future challenges. For more information about the conference, which is sponsored by the Dairy Industry Association of Australia, try this website: [www.diaa.asn.au](http://www.diaa.asn.au)



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*The Dairy Pipeline*  
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*The Dairy Pipeline* is published by the Center for Dairy Research and funded by the Wisconsin Milk Marketing Board.

To subscribe to the Pipeline simply phone, fax, or e-mail your request to CDR. (Form on page 11) We welcome your questions and comments. Send them to:

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phone: 608/262-8015

You can also find the Dairy Pipeline on our website: [www.cdr.wisc.edu](http://www.cdr.wisc.edu)

## Calendar

Apr. 18 Introduction to Milking Machines, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

Apr. 19 Introduction to Milking Parlor Design, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

Apr. 20 Introduction to Milking Parlor Management, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

Apr. 25-27 International Cheese Technology Exposition, Madison, WI. For information, call Judy Keller at (608) 828-4550.

May 1-3 The Cheese Utilization Short Course, Madison, WI. Call Dean Sommer at (608) 265-6469.

May 8-9 Testing Milking Machine Vacuum Production and Control, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

May 9 Wisconsin CIP Workshop, Madison, WI. Call Bill Wendorff at (608) 263-2015.

May 10 Dairy HACCP Workshop, Madison, WI. Call Marianne Smukowski at (608) 265-6346.

May 10 Milking Machine Cleaning and Sanitation, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

May 11-12 Advanced Milking Machine Unit Evaluation, Madison, WI. For information, call Doug Reinemann at (608) 262-0223.

May 16-17 Applied Dairy Chemistry Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

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