Wisconsin Center for Dairy Research

DAIRY PIPELINE

A Technical Resource for Dairy Manufacturers

December 2004, Volume 16 Number 4

# Business Impact of International Standards

*By Rusty Bishop, Director of CDR*

Our industry is well aware of the ongoing saga around geographical indication protection of cheese names. However, you may not be aware of another standards issue which may have equal or greater financial impact on the U.S. dairy industry—protein conversion factors of dairy ingredients in infant formulas. I will address both of these topics.

Nutritional standards for infant formulas are established by the Codex Committee on Nutrition and Food for Special Dietary Uses. Protein is an important portion of any infant formula, and the value of that protein from different sources is not equal. Typically, protein levels are determined by conducting a Kjeldahl titration to ascertain nitrogen content, then using a conversion factor taking into account protein nitrogen and non-protein nitrogen. Historically, the conversion factor for dairy is 6.38 and the conversion factor for soy is 5.7, denoting the true protein content of each ingredient source.

## Adjusting the protein value of soy

In the past few years, soy ingredient suppliers have been successful in their attempt to increase the nitrogen–to–protein conversion factor from 5.7 to 6.25 (the factor used by WHO for mixed sources—dairy and soy—has been set at 6.25). The change was purely based on inexact information, is not science based, and greatly exaggerates (by 8.8%) the true protein content of soy ingredients. Recently there has been an attempt to lower the protein conversion factor for dairy ingredients, from 6.38 to 6.25, to simplify the protein conversion calculations for infant formulas. In essence, the protein value of soy would equal that of dairy, which we know is not the case. This move, by lowering the protein value of dairy by 2.1%, would artificially negate the improved protein value of dairy vs. soy (which amounts to an 11% difference).

The impact of this potential change in the standards is obvious:

- Lower cost soy ingredients would replace dairy as the protein source in infant formulas (why not, if the "protein values" are equal, choose the cheaper of the two ingredients)

- Lower relative protein value of all dairy ingredients used in all foods (Codex standards tend to run in a horizontal path, therefore, this change with CCNFSDU will influence all Codex standards.

- Overall loss of protein-based dairy ingredients, valued in the tens of millions of dollars (and Euros).

CDR, in conjunction with the International Dairy Federation (IDF) is preparing science based information on protein determination, nutritional profile of dairy vs. soy ingredients (including essential amino acids, bioactive peptides, digestibility, etc,) and overall functional attributes of dairy protein ingredients. This is a battle the dairy industry cannot afford to lose.

Now let's talk about the GI protections of cheese names. As you may have seen in late November of 2004, the WTO delivered a U.S. friendly ruling on the GI vs. trademark issue centered on the openness of the European procedure. This ruling was not as positive and exclusive as reported in some of the trade publications. This

*continued on page 2*

## What's Inside:

ruling did not rule EU cheese GI's illegal. It did, however, illustrate a key problem within the European process which gave higher status to GI's vs. trademarks and the closed EU system for GI protection and challenges. The EU was pushing for an extension of the STRESA Agreement to cover geographic protection of food items, which would overrule existing trademarks. (South American cola beans grown along the Coca River would own the term "Coca Cola," thereby eliminating the soft drink trademark designating use of the name.)

### What does this decision mean?

Additionally, the European system for challenging internal product name protection and challenging misuse of trademarked names was not an open forum. For example, if a European producer was growing and marketing "Idaho Potatoes" within the EU, the U.S. challenge would not be considered because we have no status within the European Commission or member states. This lack of openness does not meet WTO guidelines for open markets. What this decision means for geographical protection of cheese names remains unclear.

"What this decision means for geographical protection of cheese names remains unclear."

In July 2005, the Codex Alimentarius Commission is expected to make a ruling on the promulgation of a standard of identity for parmesan. Foods with a standard of identity have thereby, been designated as foods where the product's characteristics are protected, not the name. If the GI protection for the generic cheese name of parmesan is not upheld, it is expected that other cheese names—feta, emmental, edam, gouda, gorgonzola, etc.—will follow suit.

# 2005 Wisconsin Cheese Industry Conference

**La Crosse Center, La Crosse, WI**

**Wednesday, April 20, 2005**

9 AM — Joint Session WCDR/WCMA/WMMB
Demand Side Panel

1 to 5 PM — Exhibits

**Thursday, April 21, 2005**

9 AM — **Concurrent Session C** **Wisconsin Center for Dairy Research**
Cheese Research Update Dean Sommer, Moderator
Cheese Defects Revisited, Again (See note below) *
Mark Johnson & John Jaeggi

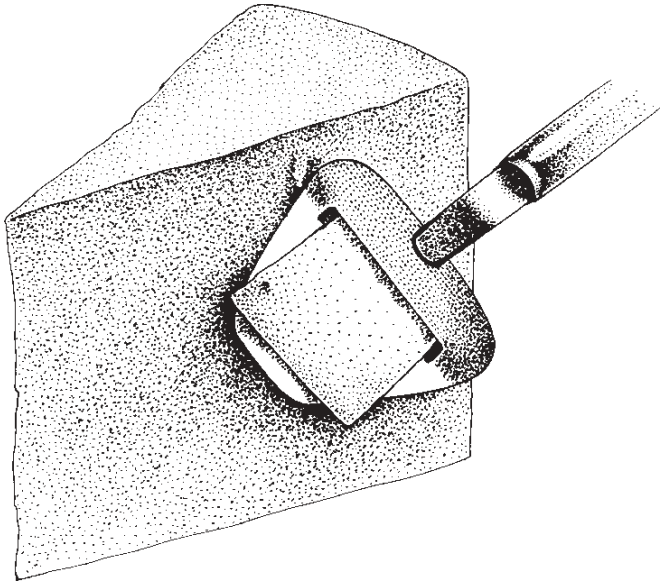
10:45 AM — **The Key to Cheese Functionality**
John Lucey, Dept of Food Science, UW-Madison
Dean Sommer, CDR

1:30 PM — **Concurrent Session F** **Wisconsin Center for Dairy Research**
Research Update, KJ Burrington, Moderator
Dairy's Weight Management Story – TBA
Beverage Marketing Study - TBA
End User Perspective - TBA

3 PM — **Future of Whey Processing and Handling**
Membrane Separation - TBA
Controlling Crystallization, Rich Hartel, Dept of Food Science, UW-Madison
The Solution to Whey Browning, Scott Rankin, Dept of Food Science, UW-Madison

### * Cheese defects

You can help us make this session useful and relevant by sending your questions about cheese defects, photos of defects, or even the cheese in question to CDR in advance. Please include some background information if you send photos. Direct your contribution—by March 1st, 2005—to: thompson@cdr.wisc.edu



Research Update

# Lactose—Optimized instead of overlooked

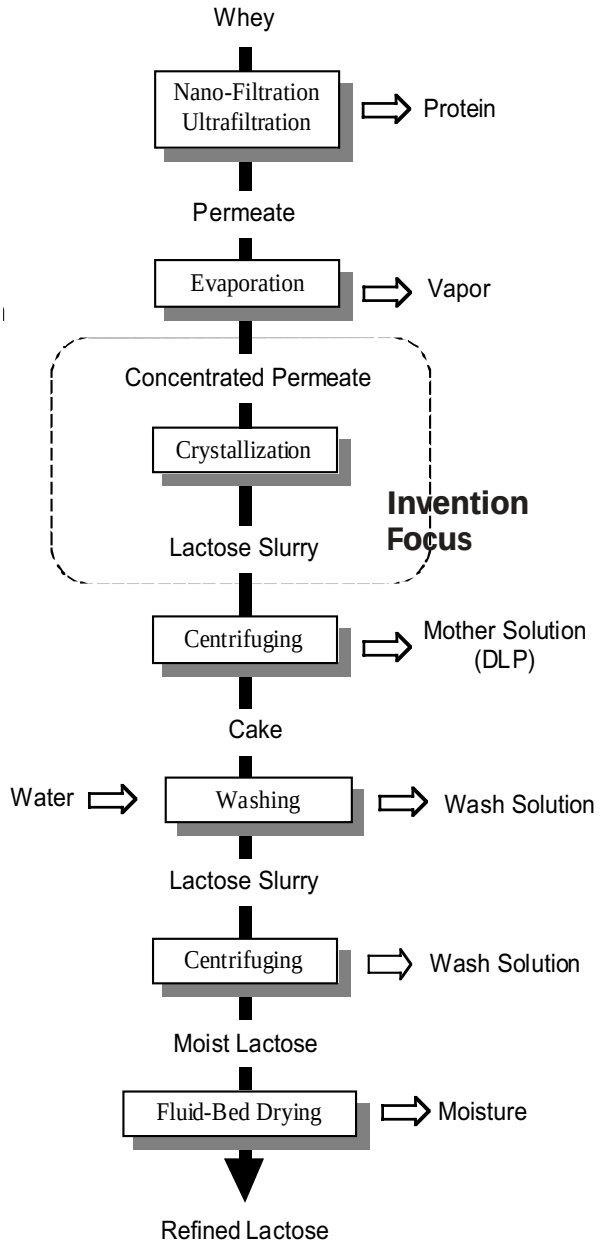



**Figure 1 Typical existing commercial process for refined lactose manufacture**

Nutritious and novel whey proteins have been getting a lot of attention in the world of food. That is a good thing. However, Rich Hartel and his research group recently followed a different research path, they took a fresh look at another component of milk which has been manufactured for decades—lactose.

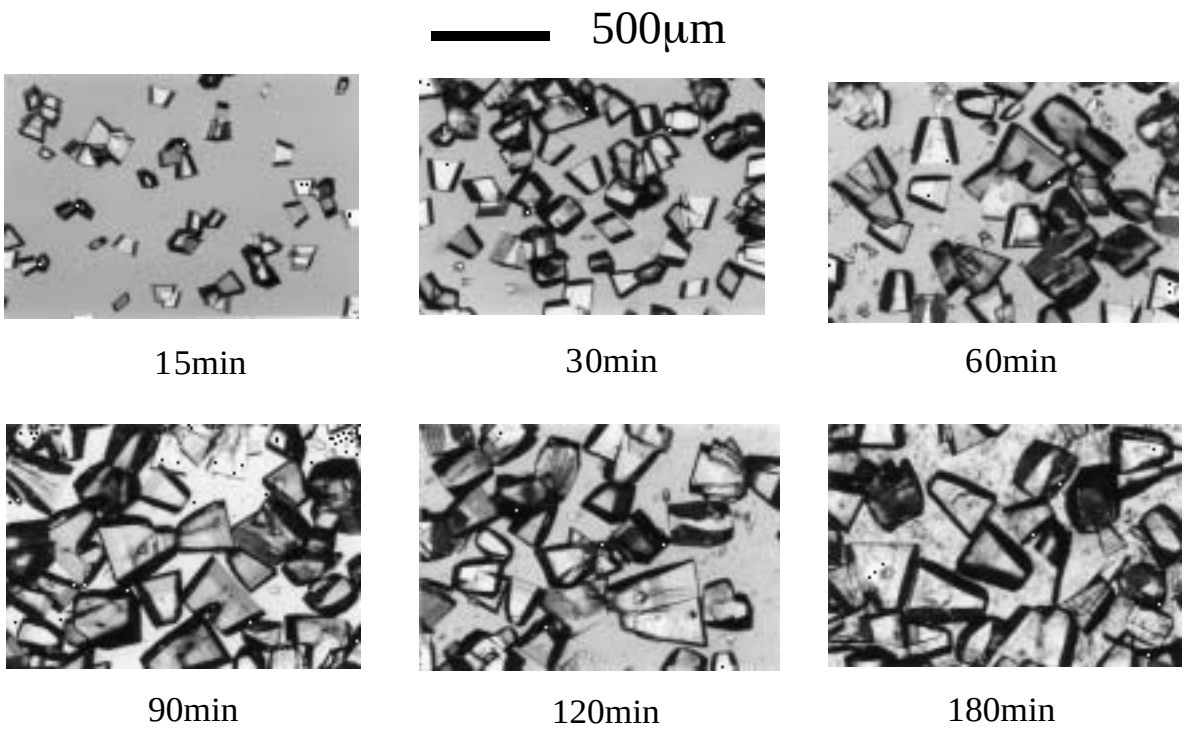
Lactose, or milk sugar, is only found in milk. And, in fact, a lot of it is found in milk and in whey. After removing water from whey, lactose is the major component left since 72 to 80% of the solids are lactose. Over 440 million lbs of lactose were produced in the U.S. in 2004 and this ubiquitous product is used by pharmaceutical manufacturers, in addition to the food and chemical industries. You can find lactose in candies, baked goods, and infant foods as well as many frozen and prepared foods. It helps pills and tablets stay in one piece till they are supposed to dissolve. Chemists use it as a base for producing lactulose and lactobionic acid. And, last but not least, lactose is used for feed in the world of agriculture.

Despite its long history and many uses, the process of making high quality, refined lactose was not fully optimized. Until now. Hartel, Food Science professor at the University of Wisconsin-Madison, and his colleagues postulated that revisiting the process and thoroughly analyzing it might allow them to improve it.

Generally speaking, high quality lactose contains low moisture, few impurities, low microorganism count, a bright white color and large crystals with little variation in size. Although the manufacturing process involves at least seven steps (See figure 1.) cystallization is one of the most complex and important. It is influenced by concentration, viscosity, temperature, and agitation speed. Because crystallization is such a big factor in the formation of high quality lactose it was a logical place for Hartel's group to focus their efforts. Applying theory to multiple trials allowed them to emerge with a process that provides optimal conditions for controlling the growth and size of lactose crystals. Not only can the researchers produce high quality crystals, but they can do it faster, and more efficiently while with using less energy. (See figure 2.)

This new process is unique enough that provisional patent application has been filed with the Wisconsin Alumni Research Foundation (WARF).

**Figure 2 Images of lactose crystals from whey permeate using the inventive technologies**




## New research projects at CDR

CDR's new research projects funded for 2005 include the following:

Cheese structure/function manipulations to improve shreddability

Improving WPI Functionality for beverage applications

Develop non-fat mozzarella for use in the school lunch program

Feasibility study for development of shelf-stable cheeses

Develop process for adhering meat products (pepperoni) to cheese for one-step pizza topping application

# Controlling the protean character of sweet whey powder

Like disappearing ink, thin ice, and pound cake made with margarine, sweet whey powder (SWP) can have a troubling tendency to take you by surprise. High quality SWP is bagged as a white, free flowing powder. However, during storage it often darkens, morphing into an undesirable brown product.

Sweet whey is the liquid remaining after milk is coagulated by rennet or other milk clotting enzymes during cheesemaking. Thus, cheeses like cheddar, swiss, and colby leave sweet whey behind while the counter point for cottage cheese is acid whey. The composition of whey depends on its cheese source and the extent of acidification before the whey is separated. In general, whey retains about half of the total solids present in milk, as well as most of the lactose and whey proteins, some fat and 50% to most of the milk salts (depending on whether it is acid whey or sweet whey).

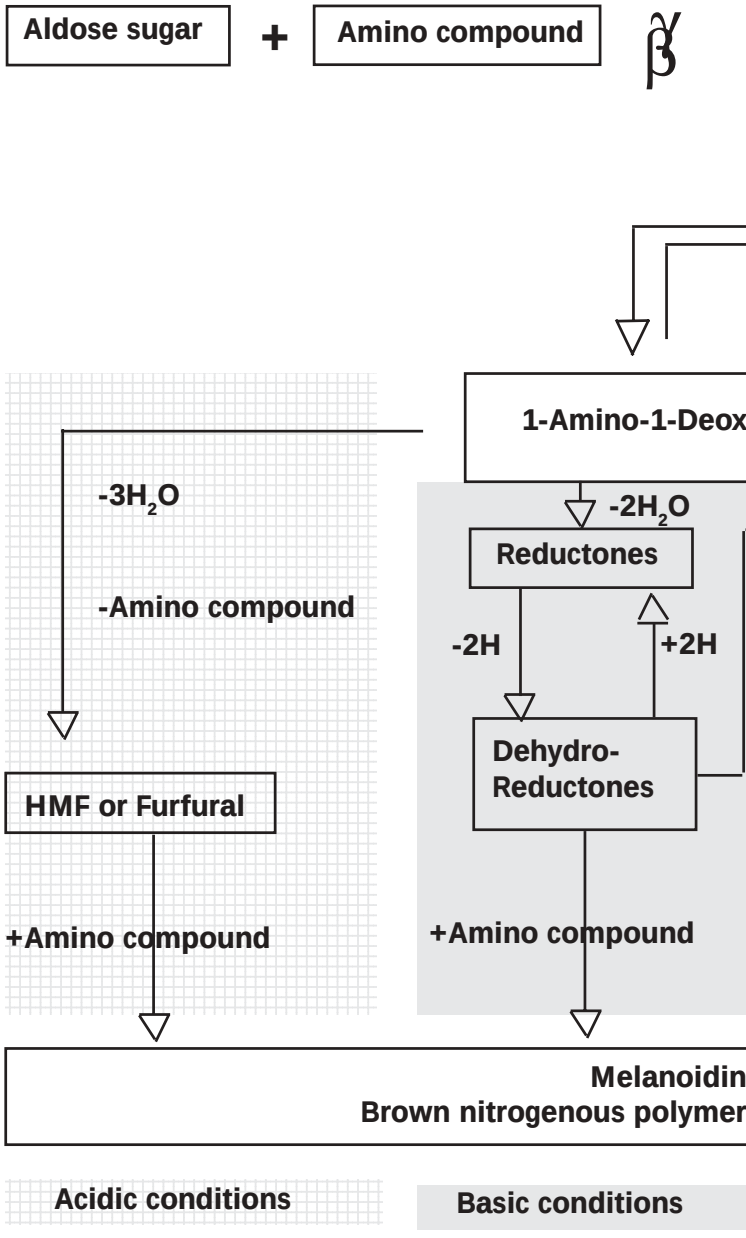
Sweet whey powders have been manufactured for years and the food industry has found many applications for them. For example, you can find sweet whey powder in a variety of products on the grocery shelf, including bakery goods like bread and cookies, meat products, and ice cream.

## Maillard reaction causes browning

The issue of whey powder turning brown over time has also been with us for years. As early as 1949 researchers focused on the Maillard reaction as the cause of browning, and since then they have investigated many food processing and storage variables that influence it. The Maillard reaction is a complex non-enzymatic browning reaction that involves the interaction of compounds containing amino groups and sugars. All of us have seen the results of the Maillard browning reaction in food because, according to Harold McGee in "On Food and Cooking," it is responsible for both color and flavor in bread crust, coffee beans, dark beer, chocolate, roasted meat and many other foods.

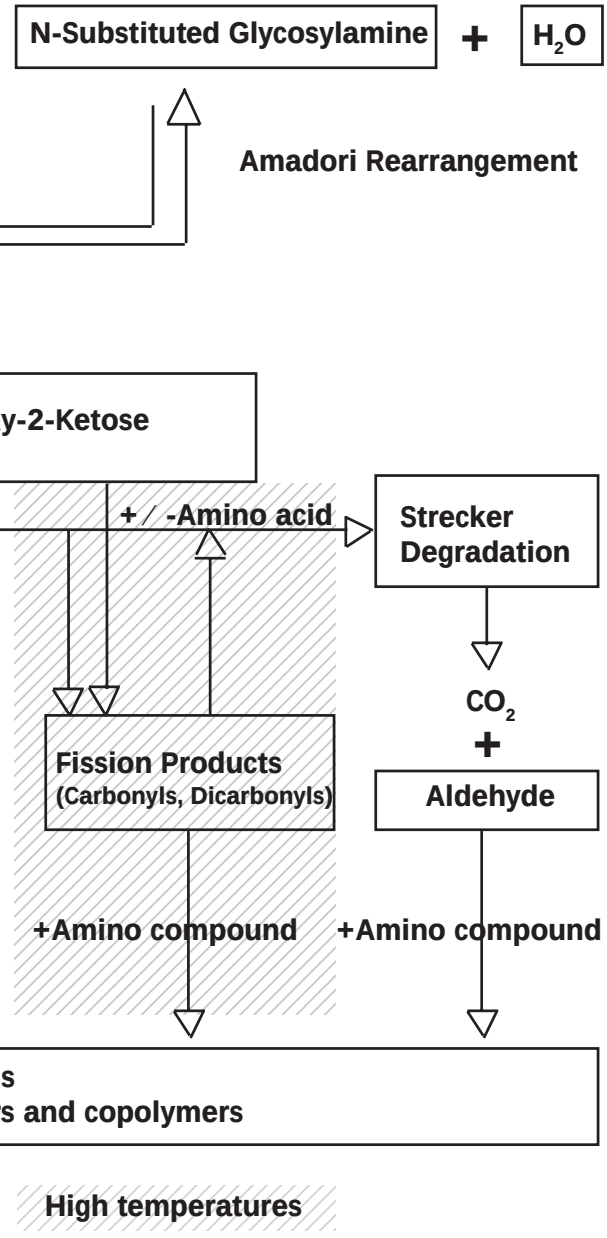
The Maillard reaction is not only complex; it is also influenced by complex factors. In sweet whey powders the reaction rate is influenced by the type of cheese it came from, by time and temperature during heating and storage, by water activity, and by physical structure. However, pH is a major factor because the Maillard reaction is pH dependent. Also, the reaction itself is influenced by the initial pH of the product, the buffering capacity of the system, and the type of amino groups present. Researchers have suggested that

**Figure 1**
**Non-enzymatic browning. Based on J.E. Hodge, 1953**



pH influences chemical pathways during the Maillard reaction, and perhaps the ratio of products formed. Thus, the compounds produced at an increasingly acidic pH may predispose SWP to brown at an accelerated rate.

What does this mean for producers of high quality sweet whey powder? Typically, it has meant conflicting advice regarding the browning issue. Scientists have suggested that acidic pH will inhibit Maillard browning in dried products held at a controlled temperature during storage. Others concluded that the influence of pH wasn't clear, but the rate of browning increased with increasing pH. Scott Rankin and his colleagues, Anupama Dattatreya and Dattatreya Banavara, in the Department of Food Science at the University of Wisconsin—Madison recently took a closer look at the issue of pH and it's effect on browning in sweet whey powder.




## Monitoring reaction progress

When Maillard reactions occur in a complex material like SWP, the range of possible compounds participating in the reaction complicates the process of identifying reactants and products. Decades earlier several scientists noted that hydroxy methyl furfural (HMF), a compound formed during one of three possible Maillard pathways, seemed to be an early indicator of browning in heat processed or stored milk. Rankin's group hypothesized that measuring the HMF content in SWP might monitor the progress of Maillard reaction and provide some information about the significance of pH on browning.

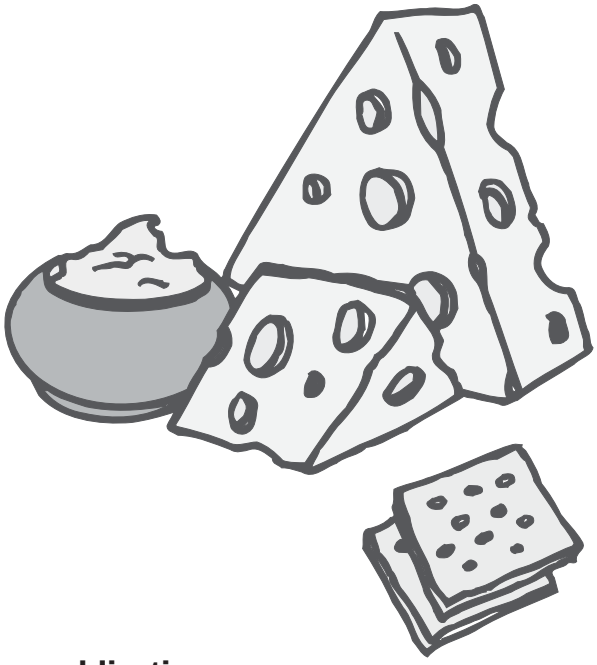
Rankin et al compared sweet whey (pH 6.3) recovered from swiss cheese to SWP with lower pH (4.04 and 4.93), produced by exposing the whey powder to acetic acid vapors. After accelerating typical storage conditions the scientists measured color, pH, and several chemicals involved in the Maillard reaction, including HMF.

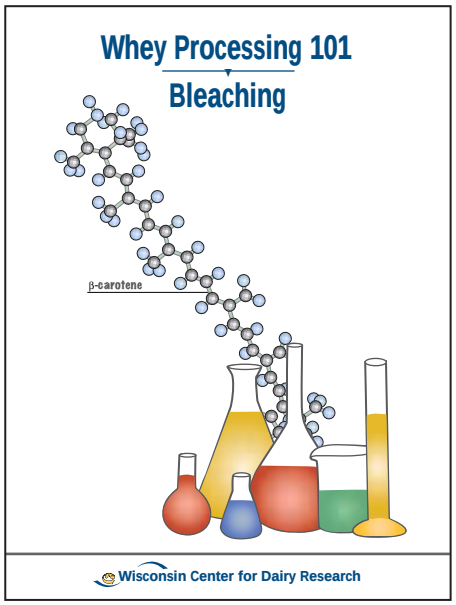
Their results suggest that a low pH in sweet whey promotes a significantly faster rate of browning in sweet whey powder. Not only did the low pH samples get darker faster, assaying HMF suggested that the chemical pathway followed by the components in sweet whey powder could be quantified and used to predict future browning. Rankin notes that their work supports the idea that "the reactions leading to browning in sweet whey begin long before drying." This means that the pH history of liquid sweet whey drives the browning mechanism. (See figure 1.) Thus, if the pH of sweet whey drops before drying, even if brought back to a pH of 6, the dry powder from that whey will brown faster. This is how pH history can have more influence than pH at drying on future browning in the dried powder.

Rankin and his group are continuing their work and developing an analytical assay that can measure Maillard browning precursors that may predict the future browning of sweet whey powder.

# News from CDR

The Wisconsin Milk Marketing 25 member Board of Directors spent a January morning at CDR to learn about current research and applications projects. They sampled several specialty cheeses—manchego, aged gouda, feta, and paneer. The Board also tried some fresh cheeses like ricotta, mascarpone and cream cheese before sampling cheese breads and low carb whey snacks. We think they learned a lot about CDR and we know they didn't leave hungry.






## New publications

Karen Smith, who works with CDR's Dairy Ingredients group (formerly the Whey Applications program) has produced two new publications. One is the short version, titled Whey Processing 101 Bleaching. If you want more information about the same subject you should read the CDR Technical Review on Bleaching. They will both be available on our website or you can request a printed copy by e-mailing smith@cdr.wisc.edu.

## Updating the website

The CDR communications group has been updating the website and we hope to put the new one online soon. Suggestions about content are always welcome.

## Don't miss this opportunity

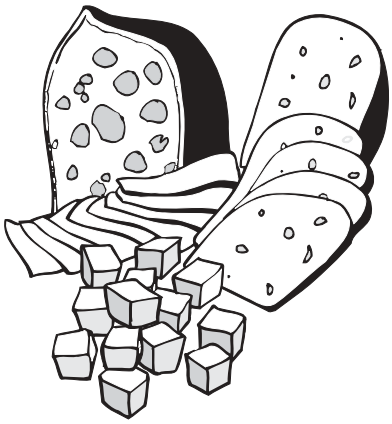
You can help us make the 2005 Wisconsin Cheese Industry Conference interesting, useful and relevant! Send your questions about cheese defects, photos of defects, or even the cheese in question to CDR so they can be assessed by the experts. Please include some background information if you send photos.

Direct your contribution—by March 1st, 2005—to: thompson@cdr.wisc.edu

## Looking forward

The International Dairy Federation invites you to the beautiful city of Vancouver for the 2005 IDF World Dairy Summit. The theme of this meeting is "Partnering—The future of the world dairy industry," and is co-hosted by Canada and the United States. Browsing through the schedule suggests that there is something here for every one; topics cover economics, nutrition, policy, marketing and animal health. Put it on your calendar now, September 17th to the 22nd.

See www.idf2005.com for more information.



## Dairy Innovation Forum

Mark Johnson and Rusty Bishop will be dodging the dreary end of February when they travel to New Orleans to speak at DMI's Dairy Innovation Forum 2005 on Feb 23rd.

Skimming the Shelf—

What's New in Print?

## Nature's Perfect Food

***How Milk Became America's Drink***

*By E. Melanie DuPuis*
New York University Press 2002

Sometimes winter offers enough quiet time to pick up a book, sit next to the fire and read. If you are a nonfiction fan you might want to look over this sociological take on the history of fluid milk consumption in the US. The author, an assistant professor in the Department of Sociology at the University of California, Santa Cruz, uses her analytical skills to develop her theory that drinking milk is "as much a product of cultural ideas as it is of material needs." Thus it became the "perfect food for the creation of perfect bodies."

Melanie DuPuis tells readers that her book does not advocate for or against milk, rather "the book is about where milk came from, what questions have been asked about it, and how these questions have been answered."

As I read this book I found that I was more interested in the historical tidbits offered by DuPuis rather than the social theories. For example, she tells us that, contrary to common histories of milk, drinking fresh milk was more likely "an afterthought than a major American beverage." Fluid milk, she asserts, "was an extremely minor aspect of the human diet until modern times." Instead, preserved or fermented forms of dairy products, like cheese and yogurt, were the chosen foods of the Northern Europeans.

DuPuis found New York City a useful focal point in her history, since it was "one of the earliest industrial mass markets for fluid milk." She notes "Manhattan was one of the first cities to develop an organized system of urban food supply." I found it fascinating that most of the milk provided to the city's residents in the mid-nineteenth century came from "swill" milk stables. These stables held as many as 2000 cows and they adjoined breweries and distilleries which provided the grain mush, or swill. Sometimes the swill arrived still warm, directly from brewery to stable. You can imagine the quality of milk produced by these cows, which were confined in dark and dirty pens. But this was the milk produced for the city children.

An entire chapter details the urban reform movements that focused on the quality and safety of fluid milk. DuPuis tells us "pasteurization, a process Pasteur invented in the 1860's, was not used to purify milk until the 1890's when Sheffield Farms Dairy —later part of Sealtest/Kraft— installed the first pasteurizer in a New Jersey plant." And, during the struggles to improve the quality of milk, "Pediatricians were among the supporters of feeding raw milk to infants, arguing that heating destroyed many of the nutritious properties of milk, as well as the beneficial bacteria."

The second part of this book focuses on "public discussions of dairy farming, dairy farmers' social movements, dairy regulation and current debates over biotechnology and organic food." DuPuis mines data from yearly surveys Cornell University economists conducted since the early 1900's to highlight changes on New York dairy farms as well as the evolving message from agriculture experts on developing the most profitable dairy farm. One example she offers us is the historical influence that consumer demand in the 1930's for fresh milk throughout the year had on farm management. I particularly relished a chapter titled "Alternative Visions of Dairying," which compared the history of dairying in Wisconsin, New York and California. Politics, social history and land use issues all converged to influence each state in unique ways.

Natures Perfect Food contains lots of information, some interesting old photos and ads, and pages of notes and references—it is a book that will get you through the winter!

# Curd Clinic

Curd Clinic doctor for this issue is John Lucey, associate professor of Food Science, University of Wisconsin—Madison

## Q.

I have heard that the calcium content of milk can vary. What influences the variation and what do I need to do to manage it?

## A.

The calcium content of milk does indeed vary, and one big influence is the nutritional state of the cow and in particular the casein content of milk as much of the calcium in milk is associated with casein. If you are making cheese from cows that are grazing then the calcium in your cheese milk may depend on the type and variety of grasses available. For example, a spate of dry weather, or a drought, will drastically decrease the quality and nutrition of grass.

The casein content of milk varies during the season and milk with low casein content will also have low calcium content. The metabolism of the cow can also influence calcium in milk, particularly the amount of soluble calcium ions. One of the culprits in this case is citrate, which then proceeds to take advantage of the affinity that calcium has for it. Citrate grabs onto the calcium. Citrate levels depend on the nutritional status of the cow and its concentration in milk is related to fat synthesis in the mammary gland. Any factor that depresses fat synthesis leads to high citrate levels in milk. Citrate may also leak into milk from blood as a result of mastitis or in late-lactation.

How do you know if your milk is a bit low in calcium and in particular if more calcium ions are needed for clotting? You can certainly test it, or you can test for casein. Watch for clues. For example, you might notice that your clotting time or set time is slower or cheese yields can drop. These changes can be caused by

> "The state calcium is in, soluble vs. insoluble, greatly influences the texture of cheese."

the combination of low casein and low calcium. I suggest that you try adding calcium chloride and if this solves the clotting problem then low total calcium or low calcium ions was the culprit. Standardizing your milk will help you control the problem if low protein was the issue.

Recent research at UW-Madison suggests that the calcium content is not the only variable you should consider in order to have consistent cheese texture. The state of calcium in cheese, soluble vs. insoluble, greatly influences the texture and functionality. Total calcium concentration may not be the best predictor of cheese texture. Instead, the amount of insoluble calcium, or the calcium still within the casein particles present in cheese, plays the key role in modulating cheese texture. During ripening there is a shift from insoluble to soluble calcium especially during the first few weeks (Hassan et al., 2004) and this contributes to textural changes including better curd fusion, increased melt and a slight increase in cheese pH.

### Reference

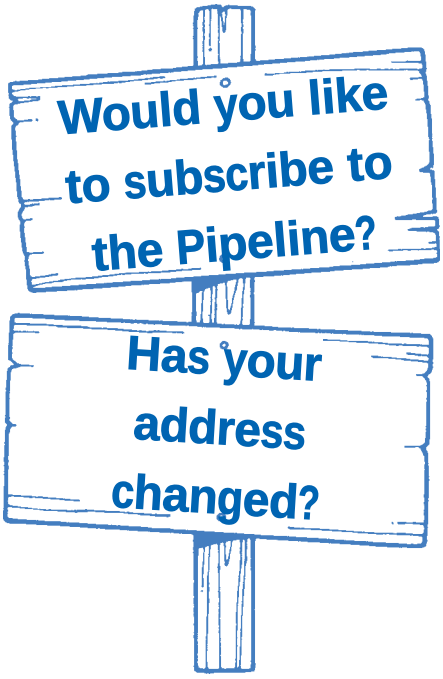
Hassan, A., M. E. Johnson and J. A. Lucey. 2004. Changes in the proportions of soluble and insoluble calcium during the ripening of Cheddar cheese. Journal of Dairy Science 87:854-862

## Calendar

*continued from back page*

July 21-23 American Cheese Society Annual Meeting. Louisville, KY. For info, call (502) 583-3783.

July 24-28 American Dairy Science Association Annual Meeting, sponsored by American Dairy Science Assn. Cincinnati, OH. For more information call ADSA, (217) 356-5146.

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# Calendar

Mar. 28-Apr. 1 Wisconsin Cheese Technology Short Course, Madison, WI Call Bill Wendorff at (608) 263-2015.

Apr. 20-21 Wisconsin Cheese Industry Conference, La Crosse, WI. For information, call Judy Keller at (608) 828-4550.

May 3-5 Cultured Dairy Products Short Course, Madison, WI. Call Bill Wendorff at (608) 263-2015.

May 10 Wisconsin CIP Workshop, Madison, WI. Call Bill Wendorff at (608) 263-2015.

May 11 Dairy HACCP Workshop, Madison, WI. Call Marianne Smukowski at (608) 265-6346.

May 17-18 Applied Dairy Chemistry Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

May 24-25 Cheese Packaging Short Course, Madison, WI. Call Bill Wendorff at (608) 263-2015.

June 7-8 Wisconsin Cheese Grading Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

June 21-23 WDPA and Marschall Dairy Symposium, Hyatt Regency, Milwaukee, WI. Sponsored by WI Dairy Products Assn. For further information, contact WDPA at (608) 836-3336.

July 16-20 IFT Annual Meeting, New Orleans, LA. For information see www.am-fe.ift.org.

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