Wisconsin Center for Dairy Research

DAIRY PIPELINE

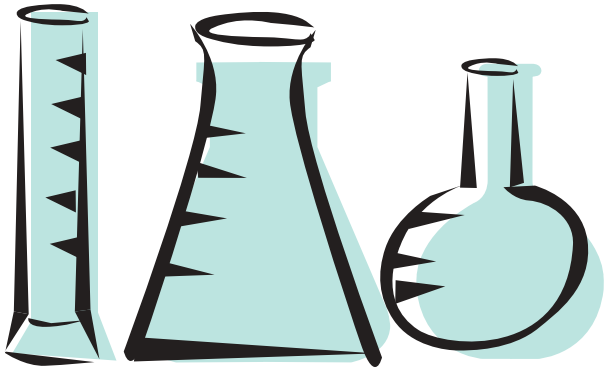
A Technical Resource for Dairy Manufacturers Volume 19 Number 1 2007

Distillers grains can add nutrition—and spores

Good management practices needed for prevention

K.B. Houck, WI Center for Dairy Research, W.L. Wendorff, Dept. of Food Science , and R.M. Kaiser, Coop. Extension, Dodge County University of Wisconsin-Madison

Recent reports of cheeses with late gas production have raised some questions about the potential impact of feeding distiller's grains to milking animals. We know that late gas blowing of cheeses has been associated with *Clostridium tyrobutyricum* spores present in milk from silage-fed livestock (1). High spore levels have also been reported in brewers grains fed to dairy animals (2). Reports from Europe, New Zealand, and Australia (2, 3, 4) have indicated that very low levels of spores in milk used for cheese production can cause late blowing of gouda, edam and swiss cheeses. To avoid the problem of late blowing of eyed-cheeses, New Zealand researchers (5) recommend that milk should contain less than 1 *C. tyrobutyricum* spore/5 ml. We conducted this study to determine if distillers grains fed to dairy animals could be a source of *C. tyrobutyricum* spores causing the late blowing defect of eyed cheeses.



Materials

Several samples of defective eyed-cheeses were obtained from plants that suspected the milk from farms feeding distillers grains caused the late blowing defect. Cheese samples included two swiss cheeses and one gouda cheese. All three cheeses had noticeable gas holes throughout the cheese.

A total of ten distillers grain samples were obtained from the five ethanol plants operating in Wisconsin. The samples were segregated into two lots of 5 samples each. One lot included wet distillers grains and the other lot comprised dried distillers grains. Wet grains were stored at 7ºC until analyzed, while dry grains were stored at 24ºC.

Analytical Methods

Reinforced Clostridial Medium (RCM) (DIFCO) was used for the enumeration of anaerobic spores. Modified RCM agar (RCM-lactate) (2) and lactate-acetate-thioglycollate-ammonium sulphate medium (LATA) (5) were used for presumptive and confirmed enumeration of *C. tyrobutyricum*, respectively.

All liquids used in the determination of both spores and *C. tyrobutyricum* were degassed by steaming for 10 minutes and then placed in a 45ºC water bath until use. A slurry of either the cheese or grain was prepared in the following manner: An 11g sample of material was weighed in a stomacher bag and 99ml of sterile Butterfield's phosphate buffer was added. The sample was homogenized for 2 minutes at 260rpm in a Steward Stomacher 400C to produce the slurry.

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Applications Update

Whey proteins boost noodle nutrition

By Kathy Nelson, Dairy Applications , Center for Dairy Research

From pad thai to pesto-drenched linguini, noodles are a prominent feature of the daily diet in many parts of the world. Dried noodles have an extra edge since they are shelf-stable, inexpensive and relatively nutritious. Noodles can be made from the flour of many grains, or even vegetables. However, most noodles are made from wheat and contain complex carbohydrates, protein, fiber, vitamins and minerals. Still, they are not considered a balanced food since the protein lacks some essential amino acids. Rice noodles, especially those using white rice flour, are low in protein, fat, and fiber.

In the United States, consumers are aware of the health benefits associated with specific proteins and/or high protein diets. Thus, the demand for protein-fortified foods has increased. Incorporating whey protein into noodles is an excellent way to boost the nutritional profile of any type of noodle, as well as feeding the demand for high protein foods.

> "Incorporating whey protein into noodles is an excellent way to boost the nutritional profile of any type of noodle..."

Whey, the liquid that remains after making cheese, contains lactose, minerals and valuable proteins. By removing the water, some of the minrals and lactose, whey proteins can be concentrated to different levels. Whey protein concentrates (WPC) range from 34% to 80% protein, and when purified to a level of 90% protein or above, they are called whey protein isolates (WPI). Typically, whey proteins are bland in flavor and off-white in color. They are functional proteins, high in all the essential amino acids, easily digested, and they add many positive health benefits.

The best way to fortify noodles

What is the best way to fortify noodles? That is the question the United States Dairy Export Council (USDEC) wanted answered. Recently, Kathy Nelson, of the dairy ingredients application program at CDR, stepped into the Apps Lab and took on the challenge.

Making pasta involves 4 different steps: mixing the dough, extruding or sheeting, drying (optional), and cooking. Pasta, like bread, is generally based on a flour and water mixture, which is transformed into a stiff, homogeneous dough, kneaded until smooth, and extruded into particular shapes, or sheeted and cut into strips. Unlike bread, pasta dough is unleavened, the final shapes are usually boiled, rather than baked, and have a soft, chewy texture. Pasta can be made from many types of flour.

For this project, whey proteins were added to both wheat and rice noodles—with and without eggs. The

objective was to determine the highest amount of whey protein that could be incorporated into noodles, without sacrificing the quality of the finished noodle or adversely affecting processing. After several rounds of noodle making, Nelson found she could make acceptable noodles by replacing as much as 20% of the flour with whey proteins. However, as levels increased, the dough became sticky and difficult to manipulate, and noodles stuck together when stored fresh. A high quality wheat noodle could be produced which contained 10.5 g whey protein/100 g noodle, representing a 50% protein increase over that found in a typical wheat noodle. A high quality rice noodle could be produced which contained about 16 g whey protein/100 g noodles, representing an 80% protein increase from a typical rice noodle. Total protein for each noodle was about 17.5 g/100 g noodles and the processing issues for either rice or wheat noodle were minimal.

In addition, changes in color, texture and cook times were observed and recorded. Particularly when using WPC-80, the higher levels of whey protein produced a noodle slightly more yellow than a typical noodle, and slightly firmer in texture. In addition, noodles with increased protein take longer to cook. Fresh wheat or rice noodles, without whey proteins, cook within 2-3 minutes, while those with added protein sometimes take up to 10 minutes. And finally, dried noodles containing protein, often tend to be somewhat brittle, but choosing an appropriate noodle shape and using processing aids, such as gums, can minimize this. In summary, adding whey proteins to noodles is an easy and effective way to add protein to the diet. Bon appetit!

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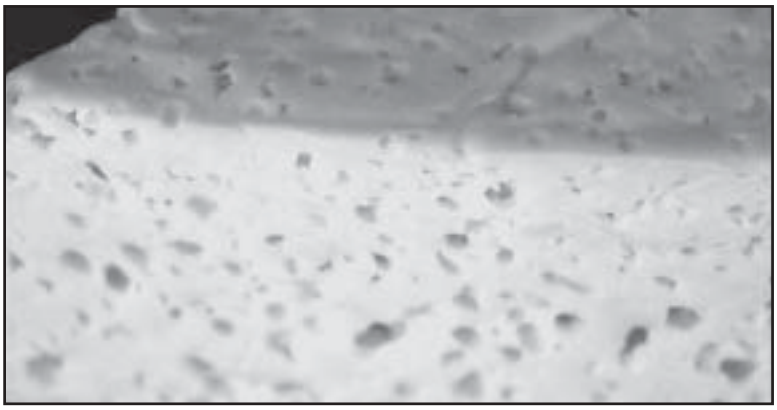


The level of anaerobic spores in the distiller grains was determined using the procedure outlined in the Standard Method for the Examination of Dairy Products (6). A 10 ml sample of slurry mixture was heated to 80ºC for 10 minutes in a water bath and then cooled in an ice bath to 7ºC. The multiple tube dilution procedure was employed, using 9 ml tubes of sterile Butterfield's phosphate buffer as the diluent and RCM broth as the inoculating media. After inoculation, the tubes were sealed by the addition of 2% sodium thioglycollate agar layer. Tubes were incubated at 3ºC for 10 days and observed for gas formation.

"...extremely foul odors and flavors are also produced."

To determine the level of presumptive *C. tyrobutyricum*, the multiple tube dilution procedure was also used. A 20 ml slurry sample of either the distiller grain(s) or cheese was heated to 62.5ºC for 30 minutes and then cooled in an ice bath. These samples were diluted a thousand-fold with phosphate buffer and for each dilution, 1 ml aliquots were inoculated into each of three tubes containing 9 ml RCM-lactate. Tubes were sealed with sodium thioglycollate agar and incubated at 37ºC for a maximum 10 days, being observed daily for gas production. From each tube with positive gas production, a 1 ml aliquot was taken and put into 9 ml phosphate buffer. From this dilution, 1 ml was inoculated into LATA, sealed with the agar plugs, incubated for up to 14 days at 37ºC.

Anaerobic spore and presumptive *C. tyrobutyricum* levels were determined from the most probable number chart.

Results

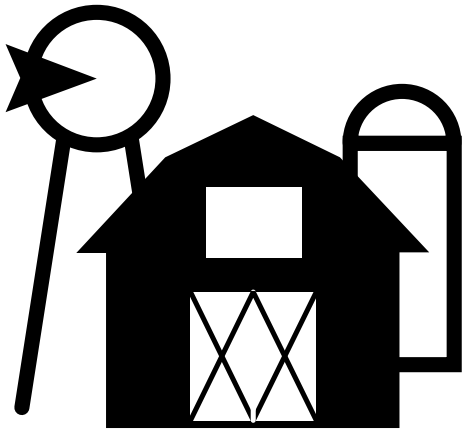
C. tyrobuytricum was present in all the cheese samples received. Levels ranged from 2.40×10^2 MPN/ml to $> 2.40 \times 10^5$ MPN/ml on RCM-lactate. Positive gas tubes of RCM-lactate, which is the presumptive test for *C. tyrobuytricum*, were confirmed with LATA.

Only two of ten distillers grain samples contained anaerobic spores, both containing 3 MPN spores/ml. One wet distillers grain and one dried distillers grain sample from different plants contained the positive counts. *C. tyrobutyricum* was not detected in any of the grain samples obtained from respective ethanol plants. To determine if possible storage of wet distillers grains under abusive summer conditions would result in potential problems, a sublot of each wet grain sample (250g) was incubated at 37ºC (98º F) for 5 days. This treatment replicated potential abusive conditions on-farm. An increase in both anaerobic spore count and confirmed *C. tyrobutyricum* counts

were seen. Three of the five wet abuse (60%) samples had spore counts ranging from 4.00 X 10^0 MPN/ml and 1.50 X 10^1 MPN/ml. Two of these same samples (40%) also had positive presumptive results for *C. tyrobutyricum*, with counts of 7.20 X 10^0 MPN/ml and 2.40 X 10^1 MPN/ml. One of the samples was confirmed with LATA as containing *C. tyrobuytricum*.

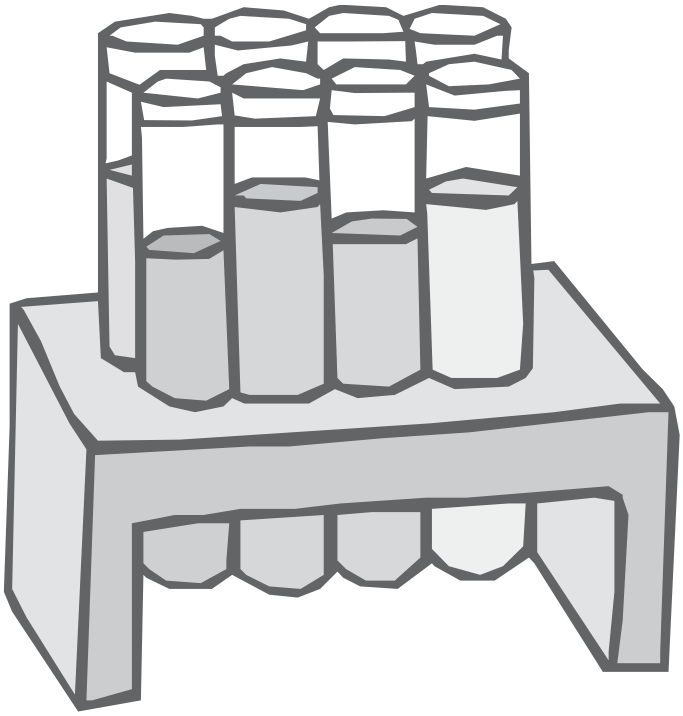
Discussion

One of the most serious microbiological problems that can occur in eyed-cheeses, e.g., gouda and swiss, is late blowing due to gas production from the growth of *C. tyrobutyricum*. Not only are the cheeses defective due to gas holes in the body of the cheese, but extremely foul odors and flavors are also produced. *C. tyrobutyricum* will convert lactic acid into butyric acid, acetic acid, carbon dioxide and hydrogen. Typically, *C. tyrobutyricum* is not a problem for most cheeses that are aged at temperatures below 15.6ºC (60ºF) since it will not grow at temperatures below 20ºC (68ºF). Optimum growth temperatures are 30-37ºC (86-100ºF). However, cheeses that are placed in warm rooms at temperatures of 20 to 24.4ºC (68-76ºF) for eye development are subject to growth of *C. tyrobutyricum* since it will grow slowly at those temperatures.



"Spores of *C. tyrobutyricum* typically reach raw milk on farms when contaminated silage or grain is fed to milking animals."

Spores of *C. tyrobutyricum* typically reach raw milk on farms when contaminated silage or grains is fed to milking animals (3). When animals consume contaminated feeds, large quantities of spores are excreted in their feces (2). Spores generally mix with raw milk when animals with contaminated teats or udders are milked. Since spores of *C. tyrobutyricum* survive pasteurization they can still be present in milk for cheesemaking. Fryer (7) reported that spore germination was not stimulated through pasteurization and therefore, double pasteurization would not reduce the number of spores in pasteurized milk. Thus, the only method to control the number of *C. tyrobutyricum* spores in cheese milk is to prevent introduction of spores during the milking process. This requires a good sanitation program for the udder and teats during the preparation step prior to milking. Swedish researchers (8) have reported only 66.5% of spores were removed from contaminated udders with routine manual cleaning while 98% of spores were removed with a mechanical teat cleaning system, which is a part of the DeLaval robotic milking system. A tight control of feed and bedding materials to reduce the spore level in the farm environment is also required. New Zealand researchers (5) recommend that milk should contain less than 1 *C. tyrobutyricum* spore/5 ml to avoid the problem of late blowing of eyed-cheeses.



In this current study, defective samples of gouda and swiss cheeses did contain significant numbers of *C. tyrobutyricum*, which caused late blowing of the

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cheeses. Processors reported that the problem cheeses were manufactured from milk that came from farms that were feeding distillers grains. When we surveyed fresh samples of both wet and dried distillers grains from the various Wisconsin ethanol plants, none of the samples contained any detectable *C. tyrobutyricum* spores. However, when we stored the samples of wet distillers grains at 37ºC for 5 days to simulate abusive summer storage conditions, 2 of the 5 samples contained *C. tyrobutyricum* counts of 7.20 X 10^0 MPN/ml and 2.40 X 10^1 MPN/ml. Good management and handling of wet distillers grains is necessary to reduce or eliminate the potential growth of *C. tyrobutyricum*.

Conclusions

C. tyrobutyricum spores in raw milk do represent a potential problem for manufacturers of eyed cheeses. The spores may be present in poor quality silage or contaminated grains fed to milking animals and then gain access during the milking procedure. However, using good management practices when handling feed materials, e.g., distillers grains, and using good sanitation procedures during the milking process, the potential for *C. tyrobutyricum* spores in raw milk for cheesemaking should be greatly reduced or eliminated.

Editor's note

There are a few other solutions you can consider. In Europe, they use bactofugation to kill spores, but it hasn't really caught on in the US. Lysozyme has now been approved for use in cheese but you have to label it separately in the ingredient listing since it comes from eggs and is an allergen. Since the primary focus of this study was managing distillers grains to reduce the potential introduction of spores into cheese milk, we decided not to explain other means of control within the cheese plant.

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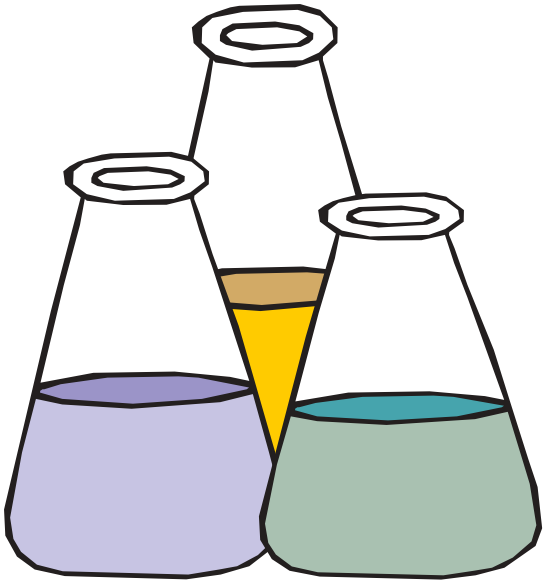


News from CDR

From March 12th to the 14th, the Wisconsin Cheese Makers Association (WCMA) held the 14th biennial United States Championship Cheese Contest, assisted by dozens of industry volunteers. Here are three from Madison who traveled to the Midwest Airlines Center for the 2007 contest.

Clockwise from the top, Dana Wolle, Bob Bradley, and Carol Chen

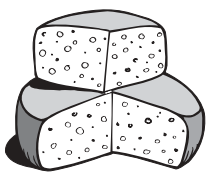
And this from Bill Wendorff, Dept. of Food Science ...
With the final results in from the 2007 US Cheese Championship Contest, we find that 66% of the winning cheesemakers are graduates of at least one of the University of Wisconsin's dairy manufacturing short courses. Of the winning cheese plants, at least 79% of them sent personnel to one of our short courses. In some cases, I am guessing that we may have trained the trainer and the winning cheesemaker benefited from information provided at one of our courses.

Join the winners

If you want to join the winner's circle, sign on for a short course. Consider the expansive 5 day Cheese Technology Short Course which is offered twice per year, in the Spring and the Fall. Or, a shorter class, like the 2 day Cheese Grading and Evaluation held in June. You can sign on to a new short course, the Cheese Affinage Short Course, offered for the first time in August 2007.

WI Cheese Industry Conference - visit CDR at booth #57

Don't miss the place to be in April….the Wisconsin Cheese Industry Conference, April 18-19, in La Crosse, WI. You'll want to hear the opening session on Niche Markets'– Myths and Reality, and take part in the CDR sponsored sessions on value-added opportunities for–cheese in the area of Health and Wellness and innovation using dairy ingredients featuring speakers Paul Ross from Teasgasc in Ireland and John Kepplinger from Kelloggs. We also invite you to stop by Booth 57 to visit with CDR staff.



Wisconsin Master Cheesemakers 2007

During the Wisconsin Cheesemakers awards banquet on April 19th, Jerome Zibrowski and Paul Reigle will raise the ranks of Wisconsin Master Cheesemakers to 49. At the same time, Terry Lensmire and Dave Lindgren will earn Master status for additional cheeses. Mozzarella and provolone for Lensmire and cheddar and monterey jack for Lindgren.

Zibrowski and Reigle have more in common than making up the Master class of 2007. They both started working in a cheese plant about the same time, 1982 and 1983. For the Zibrowski family, working at what is now the Swiss Valley Farms Co. cheese plant in Mindoro was a family tradition. Jerome's father, brother and sister all worked there over the years. The Mindoro Co-op Creamery Association opened in 1896 and, till it was sold to Tri-State Milk Cooperative of West Salem, it was one of the oldest continuous co-ops in the US. Zibrowski will earn master status for gorgonzola and blue cheese, which is made at the Swiss Valley Farms plant.

Reigle and his cousin, Jeff Wideman, work alongside each other at Maple Leaf Cheese Factory near Monroe. He is the first Master Cheesemaker to earn certification for yogurt cheese. Yes, that is right—yogurt cheese. Reigle says yogurt cheese is lactose free, a good choice for people who have problems with lactose intolerance. It's not surprising that Maple Leaf would have a cheesemaker specializing in an unusual cheese, they tend to work with their customers to develop unique cheeses and then follow up by consistently producing high quality product.

And, by the way, one more thing the latest 2007 Masters have in common; they both serve their communities as volunteer firefighters.

Jerome Zibrowski

Paul Reigle

Class of 2007

From left, Jerome Zibrowski, Dave Lindgren, Terry Lensmire, and Paul Reigle

Skimming the Shelf—

What's New in Print?

Food Safety Plans for the Artisanal Cheese Maker—Step by Step

By Diane Wright Hirsch and Patrice Sulik, University of Connecticut Cooperative Extension

Are you an artisan cheese maker wondering if you are doing every thing you can to produce a high quality, safe product? Do you have a food safety plan? Do you have a HACCP plan? Enough questions, I have the resource for you.

Diane Wright Hirsch and Patrice Sulik have produced a workbook to help you get started. Just like the title says, this book leads you through the process of creating your own food safety plan. The first sixty pages describe practical concepts, like sanitation and cleaning and how to develop a sanitation plan. In the first half of the book you can also find information on specific food safety issues in cheese making, recall plans, and the lead-in to a HACCP plan: prerequisite programs.

The rest of this 170 page manual takes the reader through the seven steps to developing a personalized HACCP plan, including sample plans for a raw milk cheddar plant, as well as plans for facilities that make pasteurized or unpasteurized goat milk feta cheese. Bill Wendorff, University of Wisconsin food scientist, took a look at this resource and decided that, "At 20$ it's a steal! And a lot better than a recall."

If you want a copy of this handbook, contact Diane Hirsch at Diane.Hirsch@uconn.edu or send her a note at:

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305 Skiff Street
North Haven, CT 06473-4451
Phone: (203) 407-3163
FAX: (203) 407-3176

Calendar

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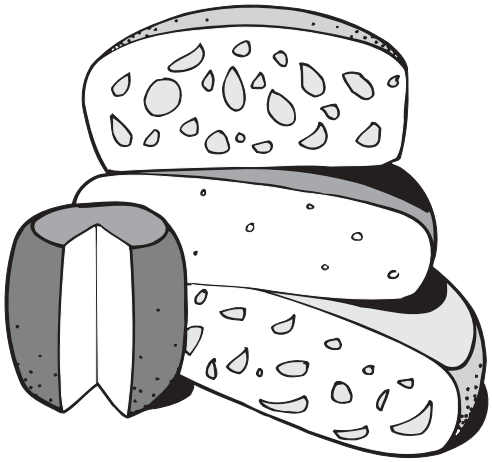
Aug. 1-5 American Cheese Society Annual Meeting. Burlington, VT. For info, see www.cheesesociety.org.

Aug. 7-8 Milk Pasteurization and Process Control School. Madison, WI. Call Scott Rankin at (608) 263-2008 for information, or the CALS Outreach Services (608) 263-1672 to register.

Aug. 21-22 Cheese Affinage Short Course, Madison, WI. Call John Jaeggi at (608) 262-2264 or Bill Wendorff at (608) 263-2015 for information.



Curd Clinic

Curd Clinic Doctor for this issue is Carol Chen, CDR researcher

Q. I noticed that shredded and grated cheeses make up two of the new categories in the Wisconsin Cheese Makers Association U.S. cheese contest in 2007. What are the characteristics of a winning entry?

A. That is an excellent question. Here at the CDR, we have evaluated many sizes, shapes and types of shredded cheese and I am happy to tell you what we've learned. Like all cheeses, shredded and grated cheese are judged on texture, appearance and flavor. However, the appearance definitely plays a bigger role in shredded cheese. High quality shreds are similar in both length and shape, and they are consistently similar. In fact, consistency is the most important attribute. Thus, you don't want to see many fines or a large variation in shredded cheese length, and curly shreds are not a sign of high quality.

"High quality shreds are similar in both length and shape, and they are consistently similar."

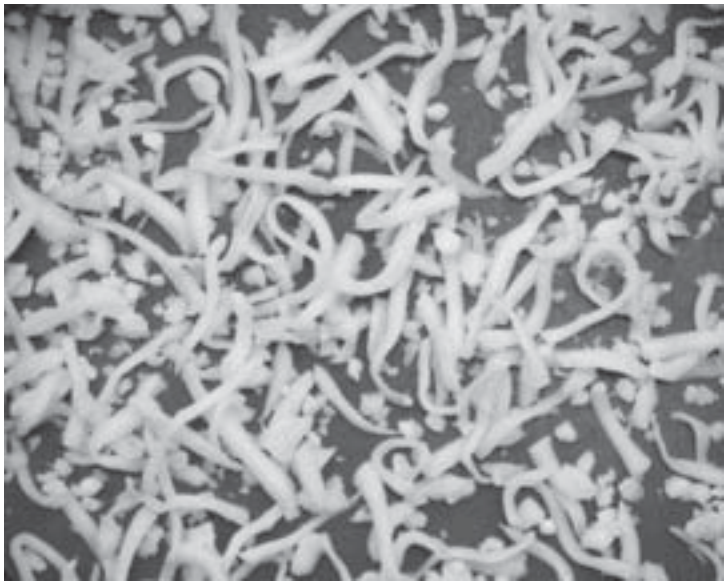
The texture of the cheese you grate or shred is important because the correct texture produces those shreds with a consistent length and shape. If your cheese is too brittle you can end up with fractured shreds, broken —and inconsistent—in the package. A more common scenario is cheese that is too soft or too sticky or both. These shreds will be inconsistent in shape, they can be thin on one end and thick on the other. In addition, you might see shreds bent or curled, varying in length and possibly clumped.

Judges Carol Chen, CDR, and Sandy Toney, Masters Gallery

Texture, and flavor, in grated and shredded cheese can also be influenced by the flow agent you use. For example, too much flow agent not only masks flavor but it can produce cheese with a gritty mouthfeel.

The winning entries in the 2007 grated cheese category had a fine texture and wonderful mouthfeel as the cheese dissolved in the mouth. Great flavor came through, something you should pay attention to also. Your romano shred should taste like romano!

Take a look at the photos on the right for a view of a variety of shred qualities. These are photos of coarse shredded mozzarella because the variation is easier to see. Many consumers prefer a finer shred and you will see both types are readily available.



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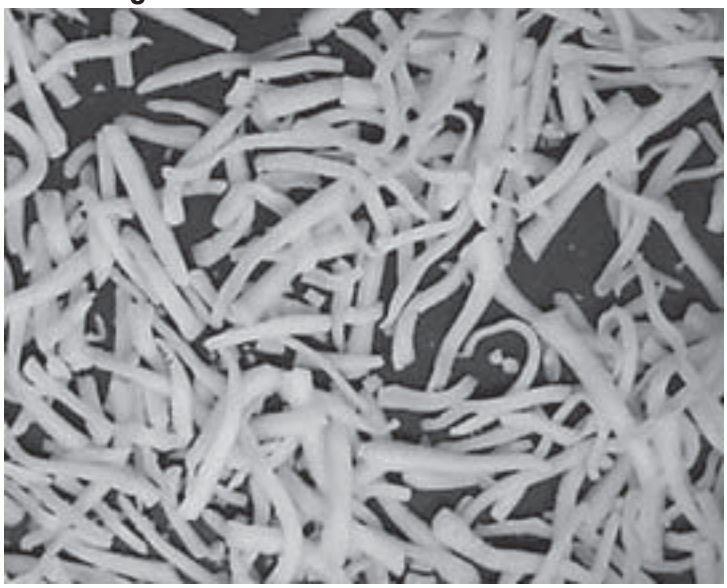

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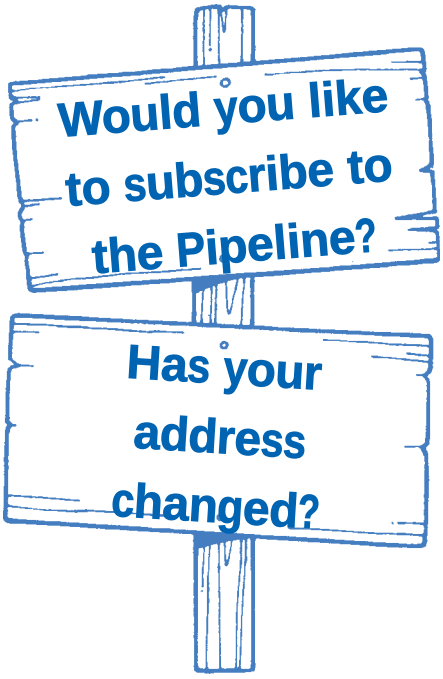

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You can also find the Dairy Pipeline on our website: www.cdr.wisc.edu

Calendar

Apr. 18-19 Wisconsin Cheese Industry Conference, La Crosse, WI. For information, call Judy Keller at (608) 828-4550.

Apr. 30-May 2 The World of Cheese from Pasture to Plate, Madison, WI. Call Dean Sommer at (608) 265-6469.

May 8 Wisconsin CIP Workshop, Madison, WI. Call Bill Wendorff at (608) 263-2015.

May 9 Dairy HACCP Workshop, Madison, WI. Call Marianne Smukowski at (608) 265-6346.

May 15-16 Applied Dairy Chemistry Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

June 5-6 Wisconsin Cheese Grading Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

July 8-12 American Dairy Science Association Annual Meeting, San Antonio, TX. For more information see www.adsa.org.

July 8-11 International Assn. for Food Protection Annual Meeting, Lake Buena Vista, FL. For information see www.foodprotection.org.

July 26-28 IFT Annual Meeting, Chicago, IL. For information see www.ift.org.

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