



UW Dairy Pipeline

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A Technical Resource for Dairy Manufacturers

Tests You Should be Running in Your Milk Monitoring Program

By Robert L. Bradley, Professor of Food Science

The following is a summary of Dr. Bradley's presentation at the CDR Cheese Research and Technology Conference, March 6-7, 1991 in Madison, WI.

Tests that are important to your milk monitoring program fall into one of three categories: tests for raw milk, tests for processed milk, and environmental tests in the plant. While some of these tests are more useful than others, all are most valuable when used to alert the processor to potential milk quality problems.

For a more detailed description of the procedures listed below, refer to *Standard Methods for the Examination of Dairy Products* (15th Edition, 1985), American Public Health Association, G.H. Richardson, Ed.*

Raw Milk Tests

All the tests in the world are of no material benefit unless you back the results with a field force that knows how to convince the producer to do a good job. The plant monitors raw milk quality, and some of these test results ultimately get fed back to the producer via the field force.

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An important component in controlling milk quality is the hauler. Haulers have distinct, well-defined responsibilities, including measuring, inspecting and sampling, that cannot be overlooked. They are the first line of inspection for raw milk, and it is their observations and sense of smell that ultimately accepts or rejects it. (Safe Milk Hauling: You're the Key, an educational videotape for bulk-milk haulers, is available from the Cornell University Food Science Extension for \$74.95 per copy. Contact Donna L. Scott at (607) 255-7922. — Editor)

When a competent hauler arrives at the plant, the milk and milk samples from each farm should be ready for the plant's quality control program to go to work. The sooner testing begins, the better.

1. Standard Plate Count: This is a legal necessity, but of little relevance. A high plate count tells you the cooler was off, etc.
2. Preliminary Incubation (P.I.): Even when standard plate counts are low, the psychrotrophic population as magnified by the P.I. test might be high (>100,000/ml). The P.I. requires a heat shock of 13°C (55°F) for 18 hours to accelerate the growth of psychrotrophs among other bacteria that are present. Since each psychrotroph has its own ideal growing conditions the results are somewhat arbitrary, thus relative. High numbers are a signal that you should be alert for subsequent problems.

Enumeration of psychrotrophs may be done by the procedures in *Standard Methods*, or by some other, faster test. Bishop (1) at Virginia Polytechnic Institute advocates plate count agar and 21°C (70°F) for 25-48 hours. The Australian method calls for penicillin in plate count agar (10 units Pen G/ml media) followed by incubation at 21°

* The 16th edition will be available from the publisher on or about July 15, 1991.

22°C for three days (2). Use whichever method or variation that suits you. If you want to be certain about these results, statistically compare them with the results of the longer *Standard Methods* test, i.e., 10 days at 7°C.

3. Coliforms: Of all microbiological tests performed, presumptive coliforms on violet red bile agar are the best indication of quality. Since just 18 hours are needed to get a result, it is also as quick a microbiological test as we have. Coliform populations in raw milk correlate directly to filth, manure, a virulent form of mastitis, and the condition of the cow's udder at milking. Less than 100 coliforms/ml in raw milk indicates high quality in this respect.

4. Somatic Cells: In the next edition of *Standard Methods* (16th Edition), a critical oversight will be corrected. Currently, a 36-hour window to assay somatic cells is enforced by regulation. However, if you use the Foss dye technique, somatic cells must be aged 24 hours to allow uniform dye adsorption and accurate assay. Aging less than 24 hours will yield lower values. The new edition allows 24-72 hours to assay by Foss dye adsorption with no change in count.

5. Antibiotic residues: In the current environment I would hesitate to unload a tanker without an antibiotic screen. With this requirement in mind, the competitive field is narrowed to methods that give rapid determinations. Of all the fast screening tests (less than 15 minute determinations), Charm Sciences Inc. (36 Franklin St., Malden, MA 02148) is the only one to have been collaboratively studied. Advanced Instruments Inc. (1000 Highland Ave., Needham Heights, MA 02194) has a collaborative study in development.

Both companies, Advanced and Charm, have developed dual purpose instruments — more

than one test can be run on them. Charm has a new pasteurization efficiency determination based on radioactivity, while the Advanced test relies on fluorescence. For antibiotics, both have the same sensitivities for β -lactams. Time lapse for the antibiotics tests is seven minutes for Advanced vs. 15 minutes for Charm. Charm also offers a sulfamethazine test, while Advanced still has its sulfamethazine test on the drawing board.

- Raw Milk Tests**

 - 1. Standard Plate Count**
 - 2. Preliminary Incubation**
 - 3. Coliforms**
 - 4. Somatic Cells**
 - 5. Antibiotic Residues**
 - 6. Freezing Point**
 - 7. Acid Degree Value**
 - 8. Sani-Guide**
 - 9. Milkfat Content**
 - 10. Protein Content**
 - 11. Titratable Acidity**
 - 12. Flavor**
 - 13. Temperature History**

One major difficulty in our industry is that nearly all the tests we use give results after the fact, leaving the field representative with the responsibility of dealing with the producer. But if you screened for antibiotics before unloading, discovered a hot load, and sent that tanker back to the offending farm as a result, that producer would become a believer that you will accept no antibiotics.

6. Freezing Point: Keep your patrons honest. This test could be run on every tanker as part of an acceptance

screen while you are waiting for the antibiotic result.

7. Acid Degree Value (ADV): This is a real concern in some plants. It is directly correlated with 3500 rpm centrifugal pumps and high line milking systems. Check each incoming load once a month, then pursue high values to individual farms. An ADV (lipase activity) greater than or equal to 1.0 is an indication of trouble.

8. Sani-Guide: A monthly plant inspection by 40X magnification on the light microscope of the debris found on these in-line screens will open management's eyes, as well as the eyes of many farmers.

First, you should be using the paper-edged Sani-Guides, not the plastic ones. Plastic will not retain the residue. These screens are excellent in the respect that all of the milk passes through them on the way to the bulk tank. Based on what

we have seen, it will keep your fieldmen busy cleaning up the supply. This is a qualitative test because milk volume through it is variable.

9-10. Fat/Protein: Use good standards, either from the State of Wisconsin or the Dairy Quality Control Institute in Minnesota, to calibrate your equipment and check infrared units. For Wisconsin standards, contact the Wisconsin Department of Agriculture, Trade and Consumer Protection, 801 Badger Rd., Madison, WI 53708.

11. Titratable Acidity: Run a TA periodically when you run ADV. It should be 0.15% to 0.18%.

12. Flavor: In spite of the problems with an occasional pathogen, some plants still periodically screen all supplies for flavor. Let the taster beware! It is better to pasteurize the milk before tasting.

13. Temperature history: California requires this test; it is a good requirement. If each farm bulk tank had a 48-hour recorder, you would have a permanent record of the temperature history of that supply from the first milking in the tank through clean-up. This is an excellent control tool.

A final consideration for raw milk quality is the length of time the plant should concern itself with a given load of milk. When a load of top-quality milk arrives and is pumped into a receiving silo, quality control does not stop; it follows that milk and all milk through the plant. It should reach as far as the plant's library samples, to be held long after the milk and its manufactured products are gone.

Processed Milk Tests

As with raw milk, tests on processed milk are of no value unless they are used in the plant's quality assurance programs. Control charts should be used to monitor test results and detect changes before major quality problems develop.

Processed Milk Tests

1. Standard Plate Count
2. Moseley Keeping Quality
3. Coliforms
4. Psychrotrophs
5. Freezing Point
6. Milkfat Content
7. Flavor
8. Pasteurization Efficiency
9. Acidity
10. Moisture Content
11. Cooling Water

1. Standard Plate Count: The same weakness appears here as when SPC is used with raw milk — the test doesn't specifically detect bacteria that spoil refrigerated products. Milk with an SPC count of <500/ml can still spoil from psychrotrophic bacteria in less than 10 days.

2. Moseley or Virginia Polytechnic Institute Keeping Quality: For the Moseley test, take a SPC, then incubate milk at 7°C (45°F) for five to seven days and re-plate. For the VPI test, milk is

kept at 21°C (70°F) for 18 hours, then plated at 21°C for 25-48 hours. You need to set up your own in-house test, and develop your own standards.

3. Coliforms: This is still the best quality index. Try to determine the source of contamination even if just one coliform is detected. In raw milk, coliforms indicated the presence of soil and filth in the milk; in processed milk they indicate post-pasteurization contamination. This is the shortest-term microbiological test for plant use. (For information

on coliform standards for cheese, see "The Curd Clinic" in the August 1990 UW Dairy Pipeline — Ed.)

4. Psychrotrophs: If *Standard Methods* is used, it will take 10 days to enumerate — that is too long to wait. Use a faster test such as the previously described VPI or Penicillin agar modifications.

5. Freezing Point: Run this test periodically. It is not as important in a cheese plant as it is for other dairy processors. Remove the first container of the day from the filler and test it.

6. Milkfat: This is done for legal purposes. Although the Babcock test for cheese is not the legal test, it is satisfactory for ballpark estimates. But if the result is close to 50% on dry matter, do a Mojonnier test with acid hydrolysis.

continued next page...

...Milk Monitoring, continued

7. Flavor evaluation: Do this for all products manufactured. You need trained participants who can recognize off-flavors. Collect samples of competitors' products from the marketplace. Get your own products from marketplaces throughout your distribution area to determine how they hold up under usual or adverse conditions. Run panels once per month. Be particularly critical of your own product.

8. Pasteurization Efficiency: The new Advanced Instruments test (Fluoro-Phos) is 10-100 times more sensitive than existing methods. It also allows testing of chocolate milk and some cheeses.

9. Acidity or pH: This is needed with some products like cheese and fermented milks, but is less important for non-fermented products.

10. Moisture: For cost effectiveness and analytical accuracy, use throw-away pans and fiberglass covers in a vac oven at 100°C for five hours. Use an electronic balance and blender with a sealed mason jar to keep moisture in. Control is very important with this test, and the cost of delay is high. At room temperature with 70% relative humidity, you lose .01% moisture from your sample in 10 seconds. If the relative humidity is 50%, you lose that amount of moisture in just five seconds.

11. Cooling Water: Pasteurized Milk Ordinance says to check it once or twice each year. Do it once each month instead, then run a protein check to see if milk solids are there.

Environment

A clean environment is just as important, if not more so, as clean milk. This is really where the action is.

1. Floor drains: Don't forget to check the restrooms and lab drains also. Use a systematic

approach to sampling or swabbing. Check once per month for *Listeria*. Collect samples before start-up, after the weekend or after a shut-down period, then send them out to a qualified laboratory for assay. Plants in rural areas have employees who may care for animals before work. These people **must** shower and change clothes before coming to work.

2. Swabs or Rodac Plates: Use them on product contact surfaces. Open HTST press weekly and leak check once per year. Check raw milk handling and storage areas and coolers. Send swabs out for *Listeria* determinations.

3. Air Quality/Pressure: Pressure should be high at the pasteurizer and lower outward. Pour plates should be left out for 15 minutes to determine airborne contamination.

4. **No pathogen testing in processing plants!**

Maintaining an effective quality control program is essential to dairy foods processors, as it is for all food processors, if they are to survive in today's market. If properly utilized, these tests provide the basics for ensuring high-quality, from raw milk to finished product.

References

1. Bishop, J.R. (1989) The preliminary incubation count — is it good enough?, *Dairy, Food and Environmental Sanitation* 9(3):122-124
2. Lightbody, L.G. (1964) Media containing penicillin for detecting spoilage organisms in milk and cream, *Australian Journal of Dairy Technology* 19(2):81-85

Dr. Bradley is a food science professor and an extension specialist in dairy technology at UW-Madison.

Environmental Tests

1. **Sample Selected Floor Drains**
2. **Swab or Rodac Plates**
3. **Air Quality — Microbes and Particles**
4. **No Pathogen Testing in the Processing Plants**

Most of the tests described in this article will be covered at the UW Dairy Products Analysis Workshops in June. See the *Calendar of Events* (back page) for details. — Ed.

The Cost of High-Protein Milk

Extra Value at the Plant, An Extra Expense on the Farm

by George E. Shook, Ph.D.

As both consumer preference for lowfat foods and milkfat surpluses continue to grow, protein has become a more important and valuable milk component for dairy foods processors. The increased prices for milk protein are shifting production emphasis toward protein and away from milk volume and fat content.

However, the relatively high costs associated with producing high-protein milk make protein production an economically unattractive option for most milk producers. Preliminary results of a UW-Madison study show that the costs of feeds needed to support increased protein production in milk are nearly double those for fat and four times those for lactose. These results have important implications for dairy producers, processors and policy makers.

Dairy producers can change milk composition genetically through selecting the breeds and sires of their dairy cows. These genetic increases in fat and protein yield must be supported by the cow's consumption of extra energy and protein in the diet. With the current emphasis on selection for protein yield, the additional cost of dietary protein needed to support added protein yield has become especially important. In addition, protein supplements are typically the most costly of ration ingredients.

Through our recent work, Research Assistant Richard Dado and Research Scientist David Mertens of the U.S. Dairy Forage Research Center and I have developed a model of the energy and protein requirements associated with genetic gain in milk component yields. The model is based on the biosynthetic pathways and chemical equations that describe the nutrient requirements for synthesis of each milk component.

We assumed that the nutrient requirements for increased protein production were supplied by increased consumption of concentrates, and that the cow's maintenance requirements and net

efficiency were not increased by genetic improvement for milk yield. Because of their wide availability and relatively low cost, we used corn and soybean meal to calculate the cost of nutrient requirements. Feed quantities were estimated by their energy and protein contents, and prices were modeled as a historic ratio of price paid by producers for feed to price received for milk.

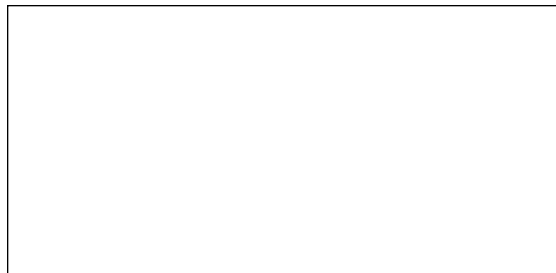
Results of our study are preliminary, as we continue to refine our models. Nevertheless, our general conclusion — that feed costs for producing protein are nearly double those for fat and four times those for lactose — is quite clear, and is rather insensitive to changes in our assumptions.

The implications of this conclusion impact all sectors of the dairy industry. Some of the more important considerations to emerge are:

- (1) Producers cannot ignore the high cost of protein synthesis as they select sires for breeding. The cost is a dis-incentive for increasing protein production.
- (2) Nutritionists and producers must continually seek low cost sources of protein for dairy cattle diets.
- (3) Dairy processors and policy makers must provide adequate compensation to producers for protein production. The high cost of protein production underscores the importance of an equitable pricing system for milk components that is consistent with their value in the marketplace.

Overall, the high production cost and rising value of milk protein at the processing plant give us reason to reconsider the long tradition of basing milk support prices on butterfat.

Dr. Shook is a Professor and Chair of the UW-Madison Department of Dairy Science



The Curd Clinic

Question: I'm told that too much sugar in cheese can cause the cheese to brown during cooking and drying. How can I control the sugar content of my cheese?

Answer: Not only can excess sugar cause cheese to brown when heated, but it can also promote the growth of undesirable bacteria which may contribute to flavor defects and gassiness. Fermentation of residual sugar also produces high levels of lactic acid, which can cause off-flavors and, in Cheddar-type cheeses, lead to the formation of calcium lactate crystals.

As a sugar content of only a few tenths of a percent can contribute to these kinds of problems, sugar levels should be kept to a minimum. However, most techniques for lowering sugar content also reduce flavor quality and stability. Maintaining a low sugar level in cheese must therefore be balanced against other factors such as flavor quality and intensity, moisture and fat content, shelf life, and the intended use of the particular product.

The following practices are useful for reducing the sugar content in cheeses of any variety:

1. Thoroughly drain the curd before pressing. A high level of sugar in finished cheese is often caused by inadequate whey drainage during manufacture. High-moisture cheeses are consequently more likely to be high in sugar than low-moisture cheese.
2. Rinse the curd after whey drainage. Greater amounts of water and longer rinsing times will remove more sugar. However, rinsing or soaking the curd usually reduces flavor development and the stability of cheese during ripening. Rinsing can

also affect both the moisture and fat contents of the cheese. Rinsing in warm water can remove both fat and moisture. A rinse temperature of about 110°-120°F will reduce moisture and wash out fat, while rinsing at 79°-80°F will increase cheese moisture. Rinsing with water at about 90°F will not affect cheese moisture.

3. When standardizing milk, be aware that the addition of solids (nonfat dry milk or condensed skim milk) to the cheesemilk will increase its lactose content. Consequently, standardized milk (or its whey) may require dilution, or the curd may need a more thorough rinse.

Cheddar and Other Dry-salted Cheeses

Sugar fermentation in dry-salted cheeses is sensitive to salt content. A high sugar content in cheese may be a result of the cheesemaker using too much salt. Lactose fermentation drops off dramatically when the salt content of the cheese reaches a critical level. That critical level is only slightly higher than the level needed to obtain optimum cheese characteristics, so a slightly high salt content can result in excess residual lactose in the cheese. A detailed description of the role of salt in Cheddar-type cheese chemistry can be found in *Cheese: Chemistry, Physics and Microbiology Vol. 2* (1).

Cheeses Made With High-Temperature Cultures

Because the high-temperature starters used for Italian-type cheeses ferment sugars differently than Cheddar-type (mesophilic) starter cultures, the amount of residual sugar and the extent of browning in Italian-type cheeses are strongly influenced by the choice of starter culture used.

Lactose, the sugar found in raw milk, is a disaccharide composed of the two simple sugars glucose and galactose. Cheddar-type starter cultures ferment lactose directly, so the residual sugar found in Cheddar-type cheese is primarily lactose. High-temperature starters break lactose down into its component sugars, glucose and galactose. Because the glucose is consumed more readily than galactose during ripening, the residual sugar in cheeses made with high-temperature cultures is usually galactose.

1. Select a starter that will ferment galactose. Because *Lactobacillus helveticus* ferments galactose while *L. delbrückii* ssp. *bulgaricus* does not, use a starter with a high ratio of *L. helveticus* to *L. delbrückii* ssp. *bulgaricus*. Using a higher ratio of *L. helveticus* to cocci (*Streptococcus salivarius* ssp. *thermophilus*) will also promote sugar fermentation. In addition, some cheesemakers add a small percentage of mesophilic cultures to the starter so that sugar fermentation will continue as the cheese cools. However, fermenting residual sugar with galactose-positive cultures is only a partial solution to the problem. If the sugar content of the cheese was too high to begin with, fermenting it will produce an acidic cheese. Also, using a too-high percentage of *L. helveticus* can make the culture too proteolytic. This can produce cheese with acid off-flavors, more oiling-off, and poor stretch and melt properties.

2. Recent research (2, 3) indicates that using a less-proteolytic starter culture will yield cheese that browns less, even though sugars may be present. Mozzarella cheese made by direct acidification without starter also showed less browning. This is because the mechanisms of browning are related to interactions between sugar and the peptides and amino acids that are produced in cheese during proteolysis. However, use of a less proteolytic starter results in less flavor development and a slower rate of softening in aged cheeses. As with rinsing the curd to control sugar content, the tradeoffs between using less proteolytic cultures and maintaining proper aging and flavor development must be considered.

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1. Lawrence, R.C. and J. Gilles. Cheddar Cheese and Related Dry-salted Cheese Varieties, pp. 1-44 IN: *Cheese: Chemistry, Physics and Microbiology*, Vol. 2, P.F. Fox ed. Elsevier Applied Science, 1987
2. Oberg, C.J., A. Wang, L.V. Moyes, R.J. Brown, and G.H. Richardson. 1991. Effects of proteolytic activity of thermolactic cultures on physical properties of mozzarella cheese, *Journal of Dairy Science* 74(2):389-397
3. Oberg, C.J. 1991. Controlling body and texture of mozzarella cheese: microbiological and chemical methods. *CDR Cheese Research and Technology Conference Proceedings, March 1991*. (Available from CDR, call Sarah Quinones at (608) 262-2217 for information.)

*Curd Clinic Doctor for this issue is
Dr. Norman Olson, CDR director.*

Please send your questions to:
David Gaeuman, CDR
UW Dairy Pipeline
1605 Linden Dr.
Madison, WI 53706
FAX: 608/262-1578

CDR Resource Center

These video selections and more are available for loan or purchase from the CDR Library. Call Sarah Quinones at 608-262-2217 or FAX 608-262-1578 for information.

Applied Dairy Chemistry: Dr. Patrick Fox

This three-part, 16-tape collection was recorded during a special topics graduate-level course taught at UW-Madison in August, 1990. Featuring Dr. Patrick Fox of University College, Ireland, the videos cover the chemistry of milk components, cheese manufacture and ripening, the functional properties of milk proteins and more. They come with detailed documentation, including tables, figures and references.

Determining pH During Cheesemaking: Step-by-step Instructions, Fritz Buss, Nelson-Jameson, Inc.

This new tape demonstrates recommended methods for measuring pH. It describes calibration, cleaning, and maintenance procedures for both glass and gold electrodes. Cost is \$15.

Fifteen Years of Swiss Cheese Research at Iowa State University, an overview by Dr. Earl Hammond
Controlling the Physical Properties of Mozzarella Cheese, Paul Kindstedt, Ph.D.

New Milking Equipment Research and Instruction Laboratory to Provide Unique Opportunities

by Douglas Reinemann, Ph.D.

A new Milking Research and Instruction Laboratory at UW-Madison will greatly expand the school's capabilities for training and research in milking systems. Designed for instruction, research, extension and outreach, the new laboratory will offer significant benefits to the dairy industry.

Improving the quality of raw milk delivered to dairy processing plants will be among the laboratory's primary objectives. Research and education will focus on milking procedures and the mechanics of the milking process to help reduce the occurrence of mastitis. In addition, new programs will be developed to address equipment sanitation and improve milk handling and storage.

Development of the laboratory is a cooperative effort between the UW Departments of Dairy Science and Agricultural Engineering, the milking equipment industry, and Wisconsin electric power suppliers. Milking equipment and laboratory instrumentation is being supplied by a number of milking equipment manufacturers and utility companies. Seed funds for the project were provided by the UW College of Agriculture and Life Sciences.

The new facilities will occupy available space within the present Agricultural Engineering Laboratory. Major modifications

to the existing rooms were recently completed, and equipment is expected to be installed by August. Research and instructional programs will begin in the fall, with access to the UW Dairy Cattle Center, a functioning milking parlor on campus, rounding out the hardware-oriented laboratory work.

Research

The milking laboratory will emphasize research in the following areas:

1. Interactions between the teatcup liner and the bovine teat in relation to udder health and milking performance.
2. Effective methods of cleaning and sanitizing milking systems to enhance milk quality.
3. Studies of energy conservation and load management in relation to milk cooling and water heating, and proper farm wiring.

These research areas were identified through discussion with representatives of the milking equipment industry, and take into account the expertise available on the UW campus. The first two areas were listed among the three highest priorities for further study by the Milking Machine and Mastitis Committee of National Mastitis Council during its meeting in February 1990, and by the

Milking Machine Manufacturer's Council. The third area is of special interest to utility companies serving the dairy industry. The laboratory will not be used for approvals testing or comparative ranking of milking system components.

Instruction

The laboratory will be used to teach the principles of milking system operation, testing and cleaning. Training will be based on practical demonstrations and hands-on experience with a wide range of milking machines, automatic detachers, vacuum controllers, pulsators, milk meters and testing equipment commonly used on farms. The facility will be equipped with a bulk tank, water heater, refrigeration system and heat recovery units for the study of milk cooling and washing systems. Programs will also cover the basic testing of farm electrical systems, energy audits and wiring to meet farm electrical code requirements. No other university in the country offers an equivalent training facility.

The facility will also be valuable in extension and outreach efforts for teaching, trouble-shooting and evaluating equipment and system performance. Training and instruction will be available to university students, extension agents, veterinarians, Vo-Ag teachers and other agricultural professionals. University faculty

...Milking Lab, continued

from the departments of Dairy Science, Agricultural Engineering, Food Science, and Medical Sciences-School of Veterinary Medicine will provide the instruction.

Planning and Management Committee

Allan Bringe, Professor,
Department of Dairy Science.

John Dahl, Director, Veterinary
Medical Teaching Hospital,
School of Veterinary Medicine.

Graeme Mein, Visiting Professor,
Departments of Dairy Science
and Medical Sciences, School of
Veterinary Medicine

Douglas Reinemann, Assistant
Professor, Department of Agri-
cultural Engineering.

Lewis Sheffield, Assistant
Professor, Department of Dairy
Science.

George Shook, Professor and
Chair, Department of Dairy
Science.

David Wieckert, Professor,
Department of Dairy Science.

For more information on the
Milking Research and Instruction
Laboratory contact Dr.
Reinemann at (608) 262-0223.

*Dr. Reinemann is an assistant
professor of Agricultural Engineer-
ing and an extension specialist in
milking systems and farm utilities
at UW-Madison.*

UW Dairy Research Projects — Milk Components and Their Uses

Numerous dairy-related research projects are underway at UW-Madison. The following are only those concerning milk components and their uses.

Milkfat Utilization

1. Enzymic modification of butterfat in supercritical carbon dioxide. Dr. Richard Hartel and Dr. Kirk Parkin, Dept. of Food Science.
2. Development of improved processes for enhanced melt properties and flavor stability of cold spreadable butter and other dairy-based spreads. Drs. Robert Lindsay and Richard Hartel, Dept. of Food Science.
3. Modification of milkfat composition by production of null mutants for acetyl-CoA carboxylase in transgenic mice. Dr. Robert Bremel, Dept. of Dairy Science and Dr. K.H. Kim, Purdue Univ.
4. Interesterification of butterfat with gel-entrapped cells. Dr. J.P. Chen, CDR.
5. Assess the feasibility of using a reverse micelle technology to modify milkfat. Dr. J.P. Chen, CDR.
6. A new technology for milkfat products. Dr. Richard Hartel, Dept. of Food Science, and R.S. Jebson, Massey University, Dept. of Food Science, New Zealand.
7. Use of Immobilized Enzymes in the Treatment of Milkfat. Dr. Charles Hill, Dept. of Chemical Engineering.

Whey Utilization

1. Conversion of whey components to commercially valuable products. Dr. Doug Cameron, Dept. of Chemical Engineering.
2. Effect of protein and non-protein components on thermal gelation of whey protein concentrate. Dr. Damodaran Srinivasan. Dept. of Food Science.
3. Removal of lipids from whey. Dr. J.P. Chen, CDR.
4. Novel affinity methods for recovery of enzymes from agricultural liquids. Dr. Mark Etzel, Dept. of Food Science.
5. Nondestructive techniques for evaluating physical properties and quality of food materials. Dr. Sundaram Gunasekaran, Depts. of Food Science and Agricultural Engineering.
6. Construction of a D-lactic dehydrogenase negative strain of *Lactobacillus helveticus*. Dr. James Steele, Dept. of Food Science.
7. Use of a novel beta-galactosidase reactor to hydrolyze the lactose constituent of skim milk. Dr. Charles Hill, Dept. of Chemical Engineering.

Detecting Defects

Results of the CDR Conference Cheese-Tasting Panel

by Dr. Mark Johnson, CDR Senior Scientist and Carol Chen, CDR Associate Researcher

Editor's note: A unique cheese-tasting experiment at the 1991 CDR Cheese Research and Technology Conference in March saw 172 conference attendees sample and grade four lowfat Cheddar cheeses during a presentation by CDR Senior Scientist Mark Johnson. Although this mass tasting experiment provided little new information about the cheese samples, it did turn up some interesting data on the samplers.

The cheeses used in the taste panel were lowfat Cheddars made using various make-schedules as part of a lowfat cheese project we are conducting at CDR. We decided to use cheeses with noticeable flavor and body defects to determine how the perceptions of a cross-section of dairy industry personnel would compare to those of the CDR research staff.

Prior to the conference, a small panel of CDR researchers graded the four cheeses used in the taste test. Their comments were:

Cheese No. 1 (Three month old, curd not washed): Clean, acid flavor; curdy, firm body.

Cheese No. 2 (Eight months old, washed curd): Bitter and extremely meaty off-flavors; weak, soft body.

Cheese No. 3 (Eight months old, curd not washed): Slightly meaty, slightly bitter off-flavors; not curdy.

Cheese No. 4 (Eight months old, curd not washed, enzyme added to accelerate ripening): Slightly meaty, slightly bitter, slightly unclean, and strong sulfur off-flavors; not curdy.

Table 1: The number of conference attendees who liked, disliked, or were indifferent to the four cheese samples used in the taste test, and the average score for each sample on a scale of from 1 to 7.

Sample No.	No. 1	No. 2	No. 3	No. 4
Liked Sample (Score= 5, 6, or 7)	106	78	118	104
Disliked Sample (Score= 1, 2, or 3)	48	77	32	51
Neither like nor dislike (Score= 4)	18	17	20	15
Average Score	4.7	4.0	4.9	4.6

Table 2: Average scores given each cheese sample by tasters of various occupations. * = high score, ** = low score given each sample on a scale from 1 to 7.

Sample No.	No. 1	No. 2	No. 3	No. 4
Academic	5.1*	3.7	5.3	5.0
Cheesemakers	4.7	4.0	5.4*	4.2
Graders/Buyers	4.7	2.9**	4.6	3.3**
Plant Managers	4.4	3.7	5.1	5.3*
Quality Assurance	4.4**	4.4	4.7	4.3
Research	4.8	4.2	4.8	4.5
Sales	4.5	4.9*	4.6	3.5
Technical Services	4.4	3.3	3.4**	5.0

Overall, the small CDR panel gave Cheese No. 3 the highest score of the four, while Cheese No. 2 was graded lowest by a wide margin.

Results of the Conference Test

Comments and scores gathered at the conference suggested that the participants generally agreed with our perceptions of the cheese defects. Like us, they ranked Cheese No. 2 lowest and Cheese No. 3 highest of the four (Table 1). But compared to the CDR panel, conference attendees were less critical of flavor defects and showed considerable variability in their preferences. For example, in spite of having what we perceived as an extreme meaty off-flavor, Cheese No. 2 received an average score at the conference

Table 3: Average scores given each cheese sample by tasters grouped by years of tasting experience. Scale is from 1 to 7.

Sample No.	No. 1	No. 2	No. 3	No. 4
<2 years	4.9	4.4	5.3	5.1
2-10 years	4.4	4.0	4.6	4.6
10-25 years	4.7	3.6	4.7	4.1
>25 years	4.6	4.9	5.6	5.1

of 4.0 on a scale of from 1 to 7 (1= "dislike very much," 7= "like very much"). Surprisingly, 37 people scored it as high as 6 or 7.

When tabulated by occupation of the tester, the results show that cheese graders and buyers and those in technical services were more critical than the other groups (Table 2). Graders and buyers were particularly harsh, scoring both Cheese No. 2 and Cheese No. 4 lower than any other occupational group.

We also collected information on how many years of cheese tasting experience each panel participants had. Our analysis indicates that tasters with more years of tasting experience were more likely to agree with our perceptions of the samples than were those with less experience (Table 3). The exception to this trend is the group of tasters with more than 25 years of experience, who gave the cheeses relatively high scores.

The results of this taste test demonstrate the wide diversity of likes, dislikes, and opinions of what constitutes an acceptable reduced-fat cheese among dairy professionals.

This and That...

The first phase of a planned two-phase **construction and remodeling project** is nearing completion at Babcock Hall, home of CDR, the UW Department of Food Science, and the UW Dairy Plant.

Phase I construction, including a 15,000-square-foot addition to Babcock Hall and extensive remodeling of the existing building, will be completed by the end of June, says UW Department of Food Science Chair J.H. von Elbe. The addition is

already finished, and ongoing work is focused on renovating existing space. While some food science and CDR researchers will relocate to the remodeled area when work is finished, most have already settled in permanent new offices and laboratories. The project has quadrupled CDR's available laboratory space. Prior to construction CDR had just two laboratories; it now has a total of nine, including five new laboratories for chemistry, engineering, and microbiological research. The additional space will allow CDR to add new equipment, such as an ion-exchange amino acid analyzer, while a new media-transfer room equipped with biological hoods will make it possible to conduct sensitive in-house microbiological research.

Phase II improvements, which will involve further Babcock remodeling, are included in a University budget request and are expected to begin within a few years.

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Carla Buijsse, a visiting scientist from The Netherlands, is working with Assistant Professor of Food Science Mark Etzel on a new technology to stimulate flavor development and reduce bitterness in cheese. Their research is focused on determining how and when bacterial culture enzymes are inactivated during spray drying. Buijsse, whose visit is funded by CDR, is a researcher at Wageningen Agricultural University, The Netherlands. She arrived April 1 and will work at UW-Madison until August.

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William C. Winder, an emeritus professor of food science at UW, died April 5 in Madison. He was 76. Winder, who taught courses in market milk, condensed milk products, ice cream, and the physical chemistry of food, retired in 1981. He supervised the UW Dairy Plant in Babcock Hall for 32 years, where his expertise with frozen deserts earned him the unofficial title "Emperor of Ice Cream." He also guided his students to 27 M.S. and 22 Ph.D. degrees, and was a 1967 recipient of the American Dairy Science Association Milk Industry Foundation Distinguished Teaching Award.

Born in Salt Lake City, Utah, Winder earned his B.S. and M.S. degrees at Utah State University. He received his doctorate from UW-Madison in 1949 before joining the UW food science faculty.

Calendar of Events

June *UW Dairy Product Analysis Workshops (six dates listed below).* For information call Dr. Bob Bradley at (608) 263-2007 or Dr. Bill Wendorff at (608) 263-2015.

June 11 and 18 Nelson-Jameson Training Center, Marshfield, WI

June 12 and 19 Brown County Ag. and Extension Service Center, Green Bay, WI

June 13 and 20 Babcock Hall, UW-Madison, Madison, WI

June 25-26 *Applying Value Engineering Team Procedures to Achieve High Value Products and Designs.* Engineering Professional Development Course. Call 1-800-462-0876 (262-1299 local) for information.

July 11 *WDPA Butter and Cheese Grading Clinic,* The Mead Inn, Wisconsin Rapids, WI. Call Brad Legreid at (608) 221-1035.

Aug. 19-22 *Milk Pasteurization and Process Control School,* Babcock Hall, UW-Madison. Call Bob Bradley at (608) 263-2007.

Sept. 23-27 *Wisconsin Cheese Technology Short Course,* The Inn Towner Hotel, Madison, WI. Call Bill Wendorff at (608) 263-2015.

Oct. *CDR Lowfat Cheese Training Seminar,* Inn on the Park, Madison, WI. Call the CALS Conference Office (608) 263-1672 for date and registration information.

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Sarah Hundt Quinones, Managing Editor
David Gaeuman, Editor

We welcome your questions and input. Send correspondence to:

The UW Dairy Pipeline
CDR, 1605 Linden Dr. , Madison, WI 53706
Phone: 608/262-2217 or 608/262-8015
FAX: 608/262-1578

Technical Reviewers:

Mark Johnson, Senior Scientist, CDR
Norman Olson, Director, CDR
Tom Szalkucki, Administrative Officer, CDR
Bill Wendorff, Asst. Professor, Dept. of Food Science

Oct. 21-23 *Whey Protein Workshop: Chemistry, Manufacture, Functionality, Utilization,* Holiday Inn-East Towne. Co-sponsored by CDR and the American Dairy Products Institute. For information call Sarah Quinones at (608) 262-2217.

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April 29-30, 1992 *Dairy Products Technical Conference,* O'Hare Marriott, Chicago, IL. Sponsored by CDR and the American Dairy Products Institute.

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University of Wisconsin-Madison
1605 Linden Drive
Madison, Wisconsin 53706

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