UW Dairy Pipeline

January, 1990 Vol. 2 No. 1 A Technical Update for Dairy Manufacturers

A Word from UW-Extension

by Bill Wendorff, PhD

I have completed about eight months now, as the Extension *dairy manufacturing specialist* at the University of Wisconsin-Madison. Recently I attended a number of the regional cheesemaker association annual conventions and was pleased to have the opportunity to discuss with you a number of the concerns of the Wisconsin cheese industry. At upcoming regional meetings, conferences, and seminars, I look forward to visiting with more of you.

When CDR and Extension initiated this *UW Dairy Pipeline* technical update series, Sarah Quinones and I indicated that it would be one of the tools we would use to address issues facing the industry. We ask for your input to make this series as useful to your business as possible. At this past Central Wisconsin Cheesemakers and Buttermakers Association Annual Convention, a potential industry problem was brought to our attention for review; this problem – hydrogen peroxide in milk – is the spotlighted topic of this issue of the *UW Dairy Pipeline*.

Please route!

We encourage you as a reader of the *UW Dairy Pipeline* to route it through all levels of your organization. We need the input of the cheesemaking staff at all levels. Only with consideration of the ideas and questions of everyone involved can we keep Wisconsin *number one* in the United States cheesemaking scene.

A new addition to the *Pipeline*

A question and answer column titled *The Curd Clinic* will be a regular feature. Questions that you call in or write in will be addressed by the cheese/dairy foods research team at the Center for Dairy Research. Authors of the questions will not be identified in the column to protect any proprietary interests.

Hydrogen Peroxide in Milk -- *Cheesemaker beware*

by Bill Wendorff, PhD

Over the past several years some cheese plants have established quality premiums for their farm patrons based on protein content, bacteria count, and somatic cell count of the milk. These premiums provide the incentive for farmers to supply low bacteria/somatic cell count milk that can translate into higher cheese yields for the cheesemaker. With quality milk supplies, cheese plants are able to produce quality cheese at profitable yield levels.

Getting "quality" the unethical way

In recent months cheesemakers have become concerned that some farmers are trying to obtain low bacteria/somatic cell counts by adding hydrogen peroxide to the bulk tank. On one hand this sounds like this may be intentional adulteration of milk but in actuality hydrogen peroxide (H_2O_2) has been used as a germicide in cheesemaking since 1962 when the FDA approved the use of hydrogen peroxide to treat milk used to make Cheddar and Swiss cheese.

The regulation states that the weight of the hydrogen peroxide cannot exceed 0.05 percent of the weight of the milk. This treatment kills many of the bacteria in milk but not all of them. Anaerobic sporeformers and coliforms seem to be the most sensitive bacteria to hydrogen peroxide and the aerobic sporeformers are the most resistant (5). Some of the pathogens such as *Staphylococcus aureus, Salmonella typhimurium*, and *Shigella paradysenteriae* can be killed by hydrogen peroxide, but others, such as *Mycobacterium tuberculosis* are very persistant to the treatment (1).

The overall effectiveness of the hydrogen peroxide treatment depends on the amount added to the milk, the time and temperature of exposure, and the bacteria present in the milk. Since residual

hydrogen peroxide in milk could destroy the cheese starter organisms, FDA allows up to 20 parts of catalase enzyme per million parts of milk to be used to destroy the excess hydrogen peroxide that remains in the milk after the treatment.

Concerns for the cheesemaker

If the FDA has approved the hydrogen peroxide/catalase treatment for cheesemaking milk, why should the cheese industry be concerned? There are four problems the cheesemaker should be concerned with: 1) the adulteration of the incoming raw milk, 2) effect on cheese starters, 3) effect on cheese yields, and 4) effect on cheese quality.

Wisconsin Administrative Code Ag. 60.15 states that chemical substances cannot be legally added to milk, so milk containing hydrogen peroxide would be considered adulterated and should be rejected. Subchapter IV covering Milk Quality Standards also states "milk shall be free of...and toxic substances." The use of chemical additives in milk has not been generally accepted by the regulatory agencies or the consumer.

Effects of treatment on starter bacteria and proteolysis

Residual hydrogen peroxide concentrations as low as 5ppm (6) has been shown to inhibit lactic acid bacteria. Even with the approved hydrogen peroxide/catalase treatment procedure for Cheddar or Swiss cheese milk, there is a lag period of about an hour after catalase destruction of residual hydrogen peroxide before the lactic starters are fully active in the treated milk.

The hydrogen peroxide treatment results in increased casein proteolysis by rennin in the cheesemaking process (3). There is little evidence of significant loss in yields during the make process, but this increased proteolysis does lead to an increased softness of body in final Cheddar cheese. The increased solubility of calcium caseinate in treated milk can also contribute to the softer body in the unripened cheese (4).

Although bacterial counts may be low after treatment with hydrogen peroxide, significant bacterial growth that occurred before the treatment produced enzymes that will degrade the casein levels enough to reduce cheese yields significantly.

Flavor will also be affected by the treatment. Cheddar made from treated milk normally has higher moisture and develops bitter and acid flavors with aging. The nutritional composition of cheese remains basically unaffected with treated milk, although vitamin C and thiamine are partially destroyed by the hydrogen peroxide (7).

Keeping treated milk out of your milk supplies

So what can you as a cheesemaker do to protect yourself from this unethical practice? First I would recommend that you send an educational warning out to your farm patrons. It should explain the events occurring and the gravity of the situation. If you have identified a patron that may be using this treatment with his/her milk then you should confirm the source.

Ag. 60 allows the hauler to reject milk which has an objectionable odor, which is abnormal in appearance or consistency, or which is visibly adulterated. Hydrogen peroxide-treated milk will appear normal so the hauler will generally have to pick it up from the farm. However, the hauler can run a screening test at the farm for hydrogen peroxide in milk to determine if hydrogen peroxide had been added and if residual hydrogen peroxide is present.

The test the hauler would conduct goes as follows: Place 5 ml of milk into a clean test tube, add 3 drops of fresh 30% potassium iodide (KI) solution. If the milk solution turns a canary yellow color there is a residual hydrogen peroxide in the milk. Ag. 60 does not allow for rejection of the milk based on chemical screening tests at the farm. However, if the hauler gets a positive result on the screening procedure, he should immediately pull a sufficient sample for confirmatory tests at a certified lab. It is important to act quickly because hydrogen peroxide reacts very quickly in milk to produce water and oxygen, this makes it extremely difficult to confirm that a milk source has been treated with hydrogen peroxide.

Confirmatory tests at the plant

To confirm a positive obtained from a test conducted at the farm, do the following: Pipette about 5 ml of the milk into a clean test tube. Set aside another test tube with milk that you know has no hydrogen peroxide residue – this will be your control. You know it will test negative. Next add three drops of fresh 30% potassium iodide solution to each tube and move the tubes in a swirling motion to mix. Milk that contains hydrogen peroxide will develop a distinct yellow color when potassium iodide is added to it. Milk that does not contain peroxide will remain white like the control milk sample.

For an additional confirmation that hydrogen peroxide is the agent giving the positive test result, add a small amount of catalase enzyme (available from Miles Laboratories, Biotechnology Products Division, Elkhart, IN 46515) to 100 ml of the milk sample, allow it to react for 20 minutes, and rerun the potassium iodide test on the reacted sample. If hydrogen peroxide is present in the milk sample it will be destroyed by the catalase enzyme and the sample will give a negative test result. If you acquire a confirmed positive test that hydrogen peroxide was present in the milk, then the milk would be considered "adulterated." If you want to try to quantify the amount of hydrogen peroxide present in the milk for legal purposes, we would recommend using an analytical procedure developed at the University of Wisconsin (2). Remember that you will need a certified laboratory test to *legally* confirm the milk has been adulterated.

Adulterated milk is frustrating for dairy plants that are paying a quality premium expecting that the "quality" milk will produce high quality cheese at profitable yields. As you can now see, that may not be the case. The best solution to this potential problem is informing your milk producers of the gravity of this problem and of the consequences if adulterated milk is found in your milk supply.

References

1. Cook, D.J. 1963. Hydrogen peroxide and the world's dairy industry. *The Milk Industry* 53(3):37-41.

2. Ferrier, L.K., N.F. Olson, and T. Richardson. 1970. Analysis of hydrogen peroxide in milk using titaxium tetrachloride. *J.Dairy Sci.* 53:598-599.

3. Fox, P.F. and F.V. Kosikowski. 1967. Some effects of hydrogen peroxide on casein and its implications in cheesemaking. *J. Dairy Sci.* 50:1183-1188.

4. Morris, H.A. and J.J. Jegeski. 1964. Influence of hydrogen peroxide-catalase milk treatment on Cheddar cheese hardness. *J. Dairy Sci.* 47:681.

5. Roundy, Z.D. 1958. Treatment of milk for cheese with hydrogen peroxide. *J. Dairy Sci.* 41:1460-1465.

6. Subramanian, C.S. and N.F. Olson. 1968. Effect of hydrogen peroxide on activity of lactic cultures in milk. *J. Dairy Sci.* 51:517-519.

7. Teply, L.J., P.H. Derse, and W.V. Price. 1958. Composition and nutritive value of cheese produced from milk treated with hydrogen peroxide and catalase. *J. Dairy Sci.* 41:593-605.

CDR Research

The following article discusses an innovative research project underway at CDR which investigates putting fiber in cheese. We hope you find it interesting.

Fiber in cheese--why not?

by Ingrid Rosemeyer

Cheese and fiber. Would you believe it? This duo is an unusual combination which may offer health benefits, and to the dairy foods industry, it could open up doors to new products. Fiber added to cheese possibly can improve the functional properties of cheese -- accomplishing this is the focus of graduate student Sharon Brummel's research under the direction of Associate Professor Dr. Ken Lee of the UW-Madison Food Science Department. This is just one example of the innovative research underway at the UW's Center for Dairy Research where researchers are trying to make dairy products more desirable to the consumer.

Smoother texture and a better response to cooking methods such as baking, spreading, or microwaving are some of the benefits that may lie in the fiber-fortified cheese. Food scientists have found that because soluble fiber can bind water it influences the physical properties of the substrate it is added to. Soluble fiber is intriguing to cheese researchers who are trying to develop low-fat cheese. A common defect in low-fat cheese is the poor texture due to the reduced fat level. To maintain a suitable texture, the moisture content must be increased. By adding soluble fiber, scientists hope to achieve the desired moisture content and to have a lower fat cheese.

There are two kinds of fiber--soluble and insoluble. Fiber that dissolves in water is the most basic definition one can give to soluble fiber. Examples include pectin, carrageenan, and algin. While these may sound exotic, they are commonly found on the ingredient labels for many foods such as ice cream and yogurt. Components like these allow food scientists to tailor-make food to have the desired functional nature and nutritional composition.

Why add fiber to cheese?

Milk, and likewise cheese, is one of the most complete foods we have. It provides the nutritional needs for an infant. Only lacking in Vitamin C and iron, cheese is an ideal candidate for fiber. Why not? With recent studies linking fiber intake to a reduction in blood serum cholesterol, cheese is a perfect place to put fiber. In addition to the potential health benefits,"new functional properties can possibly be gained by using soluble fiber, so it makes sense to add it," Lee, a leading food scientist at the UW-Madison commented.

Fiber binds some minerals like calcium, but Lee does not see a problem with this occuring in dairy products. "Although the soluble fibers we are using--guar gum, carrageenan, algin, and pectin--do associate with calcium, there is not good evidence to believe that calcium is going to be unavailable." Lee is working with Dr. Janet Greger of the UW Nutritional Sciences Department on the interaction of guar gum with calcium and expects to have results by next year.

Soluble vs. Insoluble Fiber

How much fiber would one get in a serving of their fiber-fortified cheese? The highest concentration Brummel worked with was 4% fiber. A 3 1/2 oz. serving of cheese would supply four grams of soluble fiber. Dr. Lee noted that, "Health claims being made for cereals are confusing because they talk about total fiber, and some MD's and nutritionists believe that soluble fiber should be identified. Actually, only 30-40% of fiber such as that found in oat cereal would be soluble fiber." Brummel added that the methods for measuring soluble fiber are not advanced enough to make good claims, in which case labeling becomes a problem when one tries to split up total dietary fiber into soluble and insoluble fiber. Lee says this is an example of where "marketing has gone beyond science. We've seen a lot of examples of that in recent food advertising."

Local cheese producers show interest in fiber-fortified cheese, but Lee leaves it up to marketing experts to determine if fiber would increase cheese consumption. "I can make a case where if people had a choice to buy a regular cheese versus a fiber-enhanced cheese, and they were concerned about

getting fiber, that might influence a purchase decision."

The Question of Standards

Even if it tastes and looks like cheese and the consumer thinks it's cheese—the FDA standards may not describe it that way. "Standard of identity is something we have to stop getting hung up on because there are so many non standard-of-identity products out there now. For example, there are many names for lighter or lower fat mayonnaise. There is no intent to deceive in this case, and likewise when we are adding fiber," Lee commented. Another classic example is the struggle the FDA had with the concept of goat's milk yogurt. If yogurt is made from goat's milk, is it really yogurt? The final position was that if it's called goat's milk yogurt, there's no problem because it says so on the label, and anyone buying the product would see that it was made from goat's milk.

While legal experts wrestle with the legal-play behind labels and standards, scientists are trying to explain the relationship between fiber consumption and blood serum cholesterol levels. The following are some of the theories circulating among the experts. First, there is the idea that fiber will bind bile acids, which are breakdown products of cholesterol. As these acids are excreted, more cholesterol must be broken down to replace them. Another theory is that fiber, once thought to be inert, is metabolized by bacteria in the large bowel into forms such as propionic acid. Propionic acid apparently goes back into the hepatic (liver) circulation and shuts down cholesterol synthesis in the liver, where about 70% of the average American's blood cholesterol is synthesized (30 percent generally comes from the diet). The soluble fibers Lee and Brummel are using work on dietary as well as endogenous cholesterol. If a person were to eliminate cholesterol from his/her diet, the liver would increase cholesterol production to maintain the normal blood serum level. Therefore, cholesterol levels will remain steady despite fluctuations in cholesterol intake.

The Verdict?

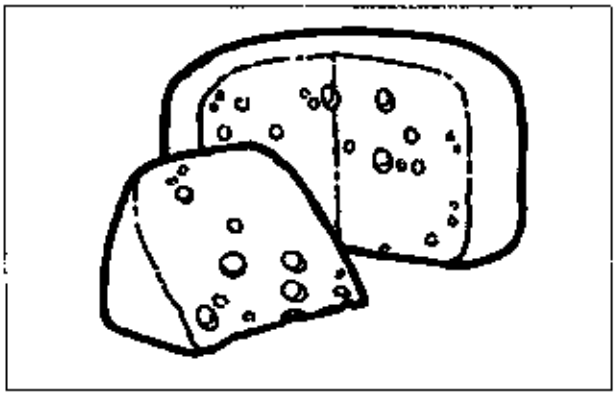
The caveat Lee gives is that although advertising campaigns promote certain dietary changes to modify cholesterol levels, there is actually very little data on which to support their claims. Yet the food industry has its eye on the health-hyper consumer. In recent years, the focus has been on designer foods. Not only do the marketers see the dollar signs, the National Institute of Health (NIH) sees treatments. Designer foodsare produced to specifically ameliorate or treat the symptoms of various diseases, such as heart disease, cancer, diabetes, phenylketonuria, or any disease/ailment that has a dietary origin. Designer foods are common. Orange juice with added calcium to prevent osteoporosis; cereal with added psyllium fiber, a suspected cholesterol reducer labeled as "heart-healthy;" and reduced-cholesterol eggs, the result of selective chicken breeding, are available at the local grocery store. There are also designer foods used to manage heart disease, but right now, there are no dairy products that may be included in the diet of someone who has heart disease because saturated fats and cholesterol are common to most dairy products unless fat has been completely removed, like skim milk. The study of fiber in cheese at the UW's Center for Dairy Research is a step in the right direction.

The *UW Dairy Pipeline* is published by UW-Extension and the Center for Dairy Research at UW-Madison. The intent of this fact sheet series is to provide updates on research and technology developments to the Wisconsin cheese industry. We welcome our readers' ideas and questions which we believe will make this a more effective publication.

Please send your correspondence to the editors:

Dr. Bill Wendorff
Sarah Quinones

CDR
Rm. 241
1605 Linden Dr.
Madison, WI 53706



The Curd Clinic

Question:

I manufacture Swiss cheese and occassionally I get brown spots in my cheese which are not evident until it is sliced. What could cause this and how could it be corrected?

Answer:

The brown spots in Swiss cheese may be caused by one of several things. If the brown spots are small, like the size of a pen point, and distributed through out the cheese, the problem may be the presence of propionibacteria (eye formers). There are strains of pigmented propionibacteria which will grow in cheese, but do not produce any carbon dioxide gas. Care should be taken in selecting the strains of propionibacteria carried by the cheese factory to eliminate this possible source of the problem. Equally important is the quality of the cheesemilk.

Colored spots can also be the result of other pigmented bacteria of the *Bacillus* or *Lactobacillus* spp. These spots range from red or pink to gray or black. Again the corrective measure would be taking a look at the quality of the starter, cheesemilk, and the manufacturing practices.

If the brown spots are of irregular shape and size and spread throughout the cheese or possibly concentrated toward the top of the block, the source may be dried curd particles from a previous vat. The small curd particles may stick to the side of the vat or hang up in the transfer equipment and become dried out. This curd could then be incorporated into the next vat and rehydrate, but appear as a dark tan or brown spot. Proper cleaning between vats will eliminate this possible source of the problem.

Brian Riesterer
Associate Researcher, CDR

If you have any questions or problems you would like addressed in *The Curd Clinic*, send them to:

The Curd Clinic/UW Dairy Pipeline
Center for Dairy Research
1605 Linden Drive, Rm. 241
Madison, WI 53706

or call:

Bill Wendorff (UWEX): 608/263-2015
Sarah Quinones (CDR): 608/262-2217

This and That

Dr. P.C. Vasavada, Extension food microbiologist at UW-River Falls, will be on sabbatical leave to the dairy research organization CSIRO in Australia from November 1989-June 1990. If you have dairy microbiology questions while he is gone, contact Professor Al Bringe of the UW-Madison dairy science department, at (608) 263-3307.

Mr. Brian Riesterer, an associate researcher at the Center for Dairy Research has taken a new position as a cheese technologist with Auro Tech, Inc., Menomonee Falls, beginning January 15, 1990. Brian has been with the Center for Dairy Research for the past 3 1/2 years and has been extensively involved with cheese research and consulting with the dairy industry. Kathy Riesterer, Brian's wife, will also be joining Auro Tech, Inc. as a cheese microbiologist.

David Bogenrief, joins the Center for Dairy Research January 8, 1990 as a cheese technologist. Mr. Bogenrief will be working closely with Dr. Norm Olson on a project where the properties of cheese as a food ingredient will be studied. Mr. Bogenrief recently received his Bachelor of Science degree in dairy manufacturing from South Dakota State University. In the past four years while attending college and during summers, Mr. Bogenrief has worked at dairy plants in Iowa, Kansas, and in South Dakota.

Grant Awards

Ten companies were awarded $2.3 million in grants from the Wisconsin Development Fund in December. The Department of Development has grant programs in three areas: funds to support upgrading of technical facilities in a company, funds to train staff to improve their skills, and funds that will create new positions in a company and thereby impact the community. The next issue of the *UW Dairy Pipeline* will highlight the grant programs available and the assistance provided in writing proposals for grants. There will also be a list of individuals who you can contact to assist in developing a proposal. If you want more information before the next issue of the *Pipeline* is sent out, contact the Department of Development at 608/266-9467.

Upcoming Events:

Ice Cream Makers Short Course

This course will combine lectures and laboratory experiences covering frozen desserts. It will be offered in Madison on January 8-12, 1990. For more information call Dr. Robert L. Bradley at 608/263-2007.

Wisconsin Cheesemakers Short Course

This intense five-day course covering cheesemaking production principles and technology will be offered in Madison on March 19-23, 1990. For more information call Dr. Bill Wendorff at 608/263-2015.

UW Dairy Manufacturer's Conference

UW-Extension/Dept. of Food Science and the Center for Dairy Research will host the first annual *UW Dairy Manufacturer's Conference* which will be held May 23, 1990 at The Mead Inn in Wisconsin Rapids. The program will address the themes: "Current issues for the cheese industry" and "Getting the most out of your whey components." For additional information regarding registration call 608/263-1672 and for additional information about the program call Dr. Bill Wendorff at 608/263-2015.

Dairy Products Technical Conference

The American Dairy Products Institute and the Center for Dairy Research will host the *Dairy Products Technical Conference* which will be held April 25-26 in Chicago at the O'Hare Marriott Hotel. The conference program will address issues regarding the future prospects for whey in the industrial and research arenas. Talks will be presented by researchers and representatives of both the academic and industry sectors. For additional information on registration call Dr. Warren Clark, ADPI at 312/782-4888 or Sarah Quinones, CDR at 608/262-2217.

CDR Seminars:

For more information on the following, please call Sarah Quinones at 608/262-2217.

"Affinity Purification of Food Proteins – the Broad Picture," Dr. J.P. Chen, CDR, Thursday, January 18, 1990 at UW-Madison.

"Advances in Dairy Foods Research – Cholesterol Removal and Genetic Engineering Techniques," Dr. Raphael Flores, University of California - Davis. March, 1990 at UW-Madison.

Your ideas for seminar speakers?
If you have a suggestion for a speaker that CDR could invite to give a seminar, please call Sarah Quinones at 608/262-2217.