DAIRY PIPELINE

CDR

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Wisconsin Center for Dairy Research

Yeasts and Molds: Friends and Foes

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Compared to some other microbes, yeasts and molds receive scant attention from the dairy industry. This is true even though both groups of organisms can be beneficial in some instances and detrimental at other times.

Yeasts

Yeasts are single-celled organisms, generally spherical to ovoid, or lemon-shaped to pear-shaped. Cells can form a mycelium-like growth, where cells adhere to each other to form what appears to be a series of filaments. Commonly, yeast cells reproduce asexually by budding. When a yeast cell buds, a small cell-like structure initially appears on the "mother" cell's surface. This bud gradually enlarges and generally splits from the "mother" cell to become a new cell which, in time, can produce its own bud. During its lifetime a single yeast cell can give rise to up to about 200 buds. The budding process can also lead to mycelium-like growth.

Yeasts grow best at 25 to 30°C but they can grow, slowly, at or below 0°C. The upper limit for growth is 35 to 47°C. Most yeasts grow best with plentiful water, but they actually need less water than bacteria. There are osmophilic and halophilic yeasts; the former grow in the presence of high concentrations of sugar found in syrups or honey and the latter in high concentrations of salt, like cheese brines.

There are two general types of yeasts; oxidative or film yeasts and fermentative yeasts. The oxidative yeasts, in addition to sugar, can metabolize organic acids or alcohol to gain energy. In contrast, the fermentative types use sugar. If they grow aerobically, or in the presence of oxygen, they produce many yeast cells, some carbon dioxide and little ethyl alcohol. Anaerobic incubation, without oxygen, results in few yeast cells, some carbon dioxide and much alcohol.

Yeasts as friends

Yeasts play an important role in the manufacture of fermented milks, like the common European products of Kefir and Kumiss. Both of these products are made with a combination of lactic acid bacteria and yeasts. Finished Kefir contains about 0.8% lactic acid 1% ethanol and some carbon dioxide. In contrast, Kumiss has about 0.6 to 1.8% lactic acid, 0.7 to 2.5% ethanol and carbon dioxide. In Europe, they contain more than 0.5% alcohol and if they were made the same way here they would be regulated by the Bureau of Alcohol, Tobacco and Fire Arms of the U.S. Department of Interior. Thus, domestic Kefir is made without yeast and contains no alcohol.

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What's Inside:

Wisconsin Center for Dairy Research, 1986-1996

by Norm Olson

The establishment of the Center for Dairy Research at University of Wisconsin-Madison in 1986 resulted from several converging factors: an erosion of dairy research in the 1970's prompting the need for it's revitalization in the 1980's; the existence of the Walter V. Price Cheese Research Institute on the Madison campus; and the formation of the Wisconsin Milk Marketing Board in 1983 which served as the catalyst in creating the Center. From its inception, the goals of CDR have been to enhance the well-being of the dairy industry, especially the

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Inventing a New Niche Product, Part 7

Paul Scharfman, Specialty Cheese Company and Wisconsin Specialty Cheese Institute

The results had arrived!

"Now we can really understand what to make of our new product concepts," thought Don.

Over the past few months the Reenap Company, a small manufacturer of Cheddar cheese, had started the process of new product development. Don, along with several other employees, formed a New Product Development Team. Together, they already accomplished many of their goals, including assessing their company to ensure that the facility could make newly developed products, researching the competitive products already in the marketplace, analyzing the needs of their customers and consumers, and brainstorming many possible new product ideas. In addition, the team used consumer feedback to develop "positioned" concept statements for their favorite new product ideas, and they fielded a "concept test " to evaluate and improve their new product ideas.

As Don started to analyze the questionnaire results for his team's concept his curiosity grew and he wondered what he would find.

Communication

Did the consumers understand the central idea in the concept? Don realized that he had to start his analysis by determining their intrepretation. He realized that all too often the audience understands the concept differently than the New Product Development Team intends.

"What did this concept communicate?" he muttered to himself.

To find out, Don reviewed the questions that addressed "Who is the product intended for?" and "What are the benefits of the product?" What he found surprised him.

While his Team had intended to write a concept targeted to Senior citizens, most respondents said that their whole family would want to eat this product. In fact, Don found no discernible skew towards older people in the data. Even when he looked at the data collected only from respondents who were positively inclined to the concept (as determined by their answers to the purchase intent question) he found no skew to older people. Here is the data Don derived from the response to the question that asked, "In your family, who would eat this product?

Responses to "who would eat this product?"

	Among all respondents	Among respondents who had positive purchase intent
	N=96	N=68
Children under 6	24%	27%
Children 6 - 12	20%	22%
Teens, 13-17	23%	29%
Adult females, 18-25	21%	24%
Adult females, 26-50	31%	35%
Adult females, 50+	31%	37%
Adult males, 18-25	26%	29%
Adult males, 26-50	36%	39%
Adult males, 50 +	34%	37%
no response	2%	2%

Don compared these results to the demographic data on the respondents and found that his concept, in fact, seemed to have very broad appeal – it was not limited to seniors!

Demographic Results among all respondents

	Among all respondents	Among respondents who had positive purchase intent
	N=96	N=68
Children under 6	21%	25%
Children 6 - 12	22%	26%
Teens, 13-17	36%	48%
Adult females, 18-25	26%	30%
Adult females, 26-50	38%	44%
Adult females, 50+	34%	44%
Adult males, 18-25	35%	41%
Adult males, 26-50	47%	54%
Adult males, 50 +	40%	48%
no response	2%	2%

Index of "who would eat" vs Demographics

	Among all respondents	Among respondents who had positive purchase intent
	N=96	N=68
Children under 6	86	93
Children 6 - 12	91	85
Teens, 13-17	64	60
Adult females, 18-25	81	80
Adult females, 26-50	82	80
Adult females, 50+	91	84
Adult males, 18-25	74	71
Adult males, 26-50	77	72
Adult males, 50 +	87	77

Don's second surprise came as he reviewed the responses to the question about perceived benefits of the new product concept. He found that most people saw the concept as promising great taste, a wholesome product, and a real treat compared to their usual snacks. These findings contradicted what his Team had expected. The original concept was aimed at Seniors with a benefit of "an easy way to enjoy cheese anywhere, anytime." That wasn't the highest ranking benefit when he analyzed these results.

% Response to list of benefits this product offers

	Among all respondents	Among respondents who had positive purchase intent
	N=96	N=68
It's ready to eat right out of the package	12	14
This is a healthier food than other alternatives	8	6
It looks like it would taste great	28	29
It's nutritious	16	13
It's very satisfying to eat	20	19
It's an easy way to enjoy cheese anytime, anywhere	21	17
It's something I think tastes great and it is wholesome, too	36	38
It tastes better than most convenience foods	21	20
This is a real treat compared to the same boring snacks, lunches	32	34

To continue the evaluation of communicating the concept, Don looked at the respondents choice of a name. Don saw from the results below that consumers did not feel his team's concept was Cheddar targeted to Seniors. Instead, the team had delivered a concept that communicated "real Cheddar"/"aged Cheddar."

	Among all respondents	Among respondents who had positive purchase intent
	N=96	N=68
Munchy cheese	17	13
Real cheese	22	21
Cheddar smokers	9	5
Fun cheese	6	3
Cheddar for seniors	17	16
Cheddar, the way it used to be	50	54
Reenap Aged Cheddar	32	37
Old Fashioned Aged Cheddar	56	63
Zesty Cheddar	11	8
Pure Aged Cheddar	64	70

Do consumers want this concept?

While Don was surprised – and a little uncomfortable– that the consumer's interpretation of the concept was so different from the one the team intended, he was taken aback by the degree of positive purchase intent consumers showed.

Purchase Intent at 99¢ per package

	Among all respondents	Among respondents who had positive purchase intent
	N=96	N=68
Definitely would buy	21	30
Probably would buy	48	7
Might or might not buy	20	0
Probably would not buy	8	0
Definitely would not buy	3	0

Don recognized that this was very strong concept interest. Interpreted literally, these results meant that if the Reenap company could make 100 people aware of their new product than at least 20 would try it. Assuming the company could make Cheddar that tasted as good as their concept promised, they could enjoy a lasting repeat business of significant size!

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Revise the Positioning Based on Concept Results

Based on these results, Don and his Team saw that their original idea of targeting Seniors was smaller than the "need" consumers were reporting. More people than just Seniors wanted "Cheddar the Way it used to Be"! The Team set to work to redraft the positioning statement for their concept.

> To people who love Cheddar cheese, new Reenap Real Aged Cheddar offers the taste of Cheddar the it used to be. Our cheese is made in a small factory by cheesemakers who make it the old fashioned way – using more flavor producing cheese cultures than most commercial Cheddar.

Don and his team felt they could still offer Seniors a concept they wanted, but their concept also had the chance to develop broader trial and usage. Perhaps, they thought, the product could be introduced to supermarkets around the country!

In my next article, I will discuss how the Reenap company created prototype products, packages, and labels and tested them with consumers.

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Wisconsin industry, and to facilitate multi-disciplinary dairy research at the University of Wisconsin. Its program has focused on creating productive links among research activities in milk production, milk processing and dairy economics.

In 1986, the objectives of CDR were developing, supporting and coordinating multidisciplinary research program in: economics and marketing, modification of properties and composition of milk, new uses for milk components and by-products, dairy product and process development, defining the role of dairy products in human nutrition and enhancing the nutritional quality of safety of dairy products. Additional objectives included collecting, interpreting, and disseminating data and technology important to dairy researchers and the dairy industry through the World-wide Information and Technology Exchange Program (WITEP), which is now CDR Communications. We accomplished this by hosting conferences, seminars and visiting scientists; producing newsletters, publications and videotapes; and developing on-line information retrieval and dairy information networks.

Sharpening the focus

The objectives of the CDR research program were sharpened in 1987 to focus on milkfat utilization, nonfat solids utilization (primarily whey), cheese (specialty types, and flavor and texture improvement), and safety. These four areas of emphasis continue in the 1996 research program of CDR.

The growth of CDR can be measured also by numbers of staff and participants in the research program and by its operating budget. Prior to 1987, the budget of the Walter V. Price Cheese Research Institute, including research projects, was $300,000. With initial funding from WMMB and NDPRB, the 1989 CDR budget increased to $2 million. The present operating budget for CDR is $3.1 million. Dr. Nina Albanese-Kotar plus the Director were the staff of CDR in 1986, along with 3 research staff members funded by the Walter V. Price Cheese Research Institute. In 1996, twenty staff members carry out the research and information transfer functions of CDR.

Important milestones in the evolution of CDR :

1976 Walter V. Price Cheese Research Institute (WVPCRI) formed

1979 State of Wisconsin allocated funds for WVPCRI adding two full-time researchers and funding for five research assistantships. Staff gradually increased to 3.5 FTE's.

1979-80 New facility for the U.S. Dairy Forage Research Center built on Madison campus. Current research emphasizes forage utilization, production efficiency, control of milk composition, and animal health.

1983 Wisconsin Milk Marketing Board (WMMB) is formed by Wisconsin dairy farmers through mandatory milk marketing order.

1985 WMMB staff and UW faculty discussed creation of a dairy research center.

1986 Center for Dairy Research (CDR) formed with the initial operating budget provided by a 10 year irrevocable trust fund set up by WMMB.
Wisconsin Legislature appropriated $244,000 for construction of an office complex for CDR.
CDR submitted proposals to WMMB, the National Dairy Promotion and Research Board, and the State of Wisconsin for additional funding.

1987 WMMB approved funding of the Basic Research Program and the Worldwide Information and Technology Exchange Program of CDR.
CDR held its first Annual Meeting on January 21.
On February 17, the Higher Education Subcommittee of the State Building Commission recommended approval of $4.1 million to expand and remodel Babcock Hall.

1988 The National Dairy Promotion and Research Board (NDPRB) recognized CDR as one of six United States dairy foods research centers and provided funding commitment, March 20.
Dedication of new CDR office complex over the Deck, May 16.

1989-91 Babcock Hall additions and remodeling increased staff offices and laboratory space for CDR.

1993 Renewal of designation of CDR as one of the national dairy research centers by the National Dairy Promotion and Research Board
J. Russell Bishop appointed as Director of CDR.

Photo at left: Dedication of new CDR office complex, May 16, 1988. From left, Norm Olson, the 1st Director of CDR, middle, former Senator Walter Chilsen, Wausau, and right, Laurence Weinstein, former President of the University of Wisconsin Board of Regents.

Important accomplishments:

Solved the puzzle of calcium lactate crystals

CDR scientists identified the crystals and then developed several steps to prevent them, including manufacturing adjustments to lower the lactic acid levels and modifying packaging. Calcium lactate crystals growing on the surface of cheese are harmless, however the crystals did harm cheese sales. Using these tips to prevent calcium lactate crystal formation may save the cheese industry over 15 million annually.

Tasty reduced fat cheese

CDR's cheese scientists reviewed a considerable knowledge base about cheese flavor before they started experimenting with reduced fat cheese. They adjusted conventional procedures, varied starter cultures, and increased the flavor to improve the quality of reduced fat cheese.

Specialty cheese

You may have seen, and tasted, a few of the increasing numbers of specialty cheeses in the marketplace. Perhaps you tried Wisconsin Style Havarti ™, developed by CDR. Jim Path organized training workshops to teach cheesemakers how to make Scandinavian, Dutch, British and Hispanic cheeses. Cheesemakers can continue their education by signing on with the Master Cheesemaker Program.

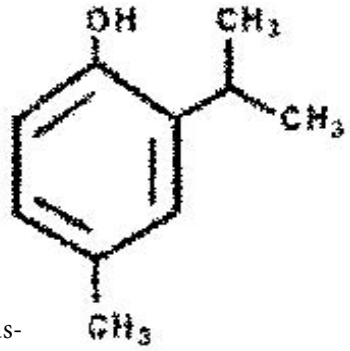
Milkfat fractions

CDR is moving forward with milkfat fractionation by setting up an industry consortium to commercialize this technology. The basement of Babcock Hall now holds a pilot plant, purchased by the Wisconsin Milk Marketing Board, which will produce fractions for research and applications.

Industry Teams

CDR organized Industry Research Teams to evaluate and discuss research questions. This outreach effort ensures a practical approach to solving problems and fostering creative research in the dairy industry.

A Bake-through Butter Breakthrough



by Robert C. Lindsay, Ph.D, Dept of Food Science, University of Wisconsin-Madison

The majority of butter produced in the United States is sweet cream butter, so many people think of it as "butter flavor." You can taste some of the unique flavors of milkfat in sweet cream butter, but European cultured cream butters are more flavorful because they carry culture flavors. Now we have isolated the "true butter flavor" found in butter cookies, it is the distinctive flavor of bake-through butter.

In a project funded by the Wisconsin Milk Marketing Board, through the Center for Dairy Research, we looked for the source of the bake-through butter flavor.

Understanding the chemistry of bake-through butter flavor was the first goal of the project, and initially this proved very difficult. However, discovering a new class of flavor compounds, alkyl phenols, proved to be a breakthrough. Systematic tasting studies showed that other, more well-known flavor compounds in butter blended with alkyl phenols to yield intensified bake-through butter flavors.

You can find small amounts of the bake-through butter flavor components in fresh milk because they are byproducts of the bovine diet. In fact, green feed and grasses supply more of the actual flavor components than dry feeds. This means that rotational grazing can increase the concentration of these potentially valuable components in milk.

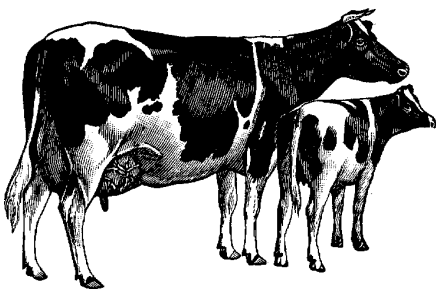
Substantial amounts of the flavor components in milk are bound to other molecules. The actual bake-through butter flavor is produced from precursor molecules released at high oven temperatures. In order to amplify the flavor you have to liberate flavor components ... and you have to do it in the correct proportions. It is easy to tell when you fail – cowy, feedy flavors overpower and distort the bake-through butter flavor.

The second goal of the project was to develop prototype intensely flavored butter-like ingredients that commercial bakeries and candy makers could use. Margarines and hydrogenated vegetable fats have supplanted butter in these industries because of cost considerations and the lack of easily recognized buttery flavors from sweet cream butter.

We have now developed prototype processes for manufacturing intensely flavored butter based on enzymic conversions of flavor precursors and high heating. They use dairy ingredients, such as powdered buttermilk, a by product of sweet cream butter churning, and butterfat. These butter-like ingredients provide up to 20 times the intensity of bake-through butter flavor obtained from sweet cream butter, and they work especially well in cookies, milk chocolate, and butter toffee candy. Because of their strong flavors, bake-through flavor butter ingredients do not taste good when spread on toast or when they are used for other table purposes.

Developing commercial scale processes for intensely flavored butter ingredients should allow the butter industry to recapture some of the bakery and confectioner market lost to vegetable fat substitutes. Using smaller amounts of butter, but still producing distinctive bake-through butter flavor, should encourage the replacement of the generally bland flavored vegetable fats in many foods.

Finally, we don't see much chance that the vegetable fat industries will be able to emulate the bake-through butter flavor ingredients. Good bake-through butter flavor not only requires the flavors from the enzymic and heat treatments but it also absolutely requires the complex supporting flavor contributions provided by butterfat itself. Vegetable fats are so different from butter fat that they simply cannot provide those essential supporting portions of the flavor.



"... green feed and grasses supply more of the actual flavor components than dry feeds. This means that rotational grazing can increase the concentration of these potentially valuable components in milk."

News from CDR

Late winter has been a busy time for international conferences and meetings. Kerry Kaylegian attended the Milkfat Update Conference at the Australian Food Industry Science Center in Werribee, Australia on February 27 and 28. Rusty Bishop and Mark Johnson headed to France for the International Dairy Federation Symposium and Conference during the last week of February. Food scientists R.C. Lindsay and Jim Steele attended the same conference, presented their research. Jim Path and John Jaeggi went on another scouting trip for European cheesemakers, traveling to Switzerland and Italy in early March.

Pilot plant arrives in Madison (See Photo!)

On one of the coldest days in January, the milkfat fractionation pilot plant arrived from Tirtiaux, in Belgium. CDR purchased the pilot plant with funding from the Wisconsin Milk Marketing Board to develop milkfat samples for research and the milkfat applications program. DMI, WMMB, and CDR are coordinating their efforts to jointly develop milkfat research. In addition, to promote industry support and develop an integrated research program, CDR has formed an industry milkfat consortium. Technical consultation is available and CDR staff can assist with product development, evaluation, and analysis. For more information call Kerry Kaylegian at (608) 265-3086.

Course Announcements

Dairy Plant Water and Waste Management Short Course

May14-15
Babcock Hall, University of Wisconsin-Madison

This intensive two day short course is ideal for cheesemakers, production supervisors, plant engineers and waste water treatment quality control personnel. This course will provide information to help you comply with the new environmental standards, including methods to reduce costs and pretreatment of dairy waste.

Enrollment is limited to the first 50 paid students. Registration fee of $175 includes instructional costs, supplies, and breaks. Enrollment handled by CALS Conference Office, phone (608) 263-1672, FAX(608) 262-5088. For course info, call Bill Wendorff, (608) 263-2015.

Food Microbiology And Safety: An International Perspective

May 20-24, 1996
University Of Wisconsin - River Falls
River Falls, WI 54022

This is a Food Microbiology short course based on the European Community's (ATQA) of consumer foods. The course, designed by the Eijkman Foundation for the Post-Graduate Education in Food and Water Microbiology at the University of Utrecht and the UW River Falls, will emphasize systems and methods for the microbiological safety and quality assurance of foods. Lectures, case studies and laboratory work will train participants in microbiological sampling, methods validation, and quality assurance in food microbiology.

An international faculty, including Professors Corry Struijk and D.A.A. Mossel of the Eijkman Foundation, University of Utrecht, Utrecht, the Netherlands will cover both U.S. and European control systems.

Course enrollment is limited and preregistration is required by April 15, 1996. Applications and nominations are invited from food industry professionals and graduate students interested in this international perspective on food microbiology.

The course fee of $450.00 includes course materials, opening reception and a banquet dinner. For further information contact:

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E-mail: Purnendu.C.Vasavada@uwrf.edu

Yeast and Molds, *continued from page 1*

Yeasts are important when producing surface-ripened cheeses such as brick and Limburger. Depending on water activity (availability of moisture) at the surface of the cheese, yeasts in one or more of the following genera may develop: Debar*yomyces, Rhodotorula, Trichosporon*, and *Candida*. Yeast growth serves to modify the surface of cheese so the ripening bacteria, *Brevibacterium linens* and micrococci, can develop. Yeasts do this by metabolizing lactic acid, raising the pH of the cheese above the minimum for bacterial growth. Additionally, yeasts produce vitamins which may enhance bacterial growth. Also, growth of the yeasts may contribute to the final flavor of the cheese.

Not all yeasts can use the sugar, lactose, but those that do can produce ethyl alcohol from whey. *Kluyveromyces marxianus* var. *lactis* is most commonly used for this purpose. This yeast once was know as *Kluyveromyces fragilis*, and earlier as *Saccharomyces fragilis*. If whey contains about 5% lactose, the fermented whey will contain about 2.3% ethyl alcohol. Consequently, considerable concentration – through evaporation and distillation, is necessary to obtain a product with 70% or more alcohol. This is one limitation when producing alcohol from whey.

Kluyveromyces marxianus var. *lactis* also can be used to produce yeast cells from whey. After the cells are harvested, they can be dried and used as an ingredient in foods or feeds. The same yeast, when grown in whey, will yield lactase (ß-D-galactosidase), an enzyme which catalyzes hydrolysis of lactose to glucose and galactose. The enzyme can be used to treat milk for people with lactose intolerance.

Yeast as a foe

Over the years, yeasts have been responsible for such problems as: producing gas and off-flavors in improperly handled cream, producing gas in sweetened condensed milk, producing gas and off-flavors in cheese, growth, often on the surface, in cottage cheese resulting in off-flavors and reduced shelf-life and producing rancidity and other flavor defects in butter. Proper use of hygienic practices before, during and after manufacture of products, using proper heat treatments, refrigerated storage and an acceptable antimicrobial agent such as sorbic acid or its salts all help to control or eliminate the product defects caused by yeasts.

Another problem is worthy of mention. Some yeasts can thrive in the high concentrations of salt in cheese brines. If cheese is immersed in a yeast infected brine, the surface of the cheese will become contaminated with yeast. If the cheese is then coated with wax, anaerobic growth of the yeast during storage will produce carbon dioxide, causing the wax coating to bulge or even rupture. Consequently it is important to avoid contamination of cheese brines with halophilic yeasts.

Molds

Molds are many-celled filamentous fungi. Mold growth on cheese and other substrates has a fuzzy or cottony appearance. This mold growth (mycelium) consists of a mass of intertwined filaments or hyphae. Some of the filaments are fertile and produce large numbers of vividly colored spores – including red, green, blue, black. After germination, each these spores can give rise to new mold growth. Molds require less water to grow than do yeasts. The optimum temperature for growth is 25 to 30°C, with some molds growing well at 35 to 37°C. Many molds grow well at or slightly above 0°C. Most molds can grow at pH values from 2 to 10 and favor an acid pH (from 3.5 to 5.0). Because molds possess a variety of hydrolytic enzymes, they can grow on almost any food product. It is important to note that molds are aerobic, they require air or oxygen for growth.

Molds as Friends

Two species of Penicillium are particularly useful if one wishes to make Camembert or Roquefort cheese. *Penicillium camemberti* (also known as *P. caseicolum*) is, to a great extent, responsible for ripening Camembert cheese. The mold is ably assisted by film yeast, *Geotrichum*, *Brevibacterium linens* and related bacteria. *Penicillium camemberti* also is involved in the ripening of Brie and other Camembert-like cheeses.

Blue cheese and related varieties as Roquefort, Gorgonzola and Stilton, all are ripened, in part, through the action of *Penicillium roqueforti*. This mold hydrolyzes milkfat, releasing fatty acids, then converts some of the acids to ketones, and further converts some of the ketones to secondary alsohols. This combination of compounds, to a large extent, is responsible for the flavor of blue cheese. In addition to producing flavor compounds, proteolytic enzymes from the mold soften the curd and produce a desired body in the cheese.

Molds as foes

Under the right conditions, molds can spoil a variety of dairy products - cheese, butter, yogurt, sweetened condensed milk and even nonfat dry milk if it gains sufficient moisture to permit mold growth during storage. The amount of dairy products spoiled by mold growth is unknown, but some years ago it was thought that 1 to 3% of cheese is lost through this form of spoilage. Even if it is 1% or even 0.5%, this spoilage represents a major loss for the industry.

What can be done to control the problem?

What can be done to control the problem? First, mold spores can be kept away from the product through proper sanitation. This includes treating air entering the factory, particularly in the packaging area. However, other measures are often needed since this is seldom completely effective. One additional method involves removing the air in a packaged product and replacing it with nitrogen. This works because molds are aerobic and without oxygen, (less than 0.5% oxygen), they will not grow.

Certain antifungal agents can be added to some dairy products to inhibit mold growth, prevent spoilage and extend the shelf life of the products. They include sorbic acid (sorbates), propionic acid (propionates) and natamycin (also known as pimaricin). If you use sorbates, remember that some penicillia can grow in the presence of more than 3000 ppm sorbic acid, the maximum amount that you can legally add to a product. When these molds grow they will decarboxylate sorbic acid and the result will be 1, 3-pentadiene. The pentadiene is far more toxic than sorbic acid and smells like kerosene. Packaging materials sometimes have been blamed for this solvent-like odor when, in fact, it is 1, 3-pentadiene produced from sorbic acid, often by a small amount of mold growth that is barely visible.

Molds produce aflatoxin

In completing our discussion of molds it is necessary to mention that many can produce an array of substances toxic to humans and animals. Best known and most notorious is the mycotoxin called aflatoxin – which is actually a group of compounds that are toxic and carcinogenic. The alfatoxins are produced by three species of molds in the genus *Aspergillus*. When these aspergilli grow on cheese, usually at temperatures above 10-12°C, they synthesize alfatoxin which then penetrates into the cheese to a depth of about one-half inch.

If cows consume moldy feed containing aflatoxin, about 1 to 3% of the ingested toxin appears in milk in a slightly modified but still toxic and carcinogenic form. The toxin, which is very heat-stable, becomes loosely associated with casein and then appears in any products which contain the casein. Thus little, it any, toxin appears in butter but it does occur in virtually all other products that contain casein, including cheese, fermented milks, concentrated milks and nonfat dried milk. The problem is greatest in this country in the southeast, where corn and cottonseed often are contaminated with aflatoxin and then are consumed by lactating cows. The problem, because of weather conditions, came to Wisconsin in 1988 when some corn consumed by cows contained aflatoxin. Some milk from these cows was contaminated and had to be dumped. More recently the problem came to Wisconsin in milk produced in Arkansas which contained more than 0.5 ppb aflatoxin (0.5 ppb is the maximum permitted by the FDA). The milk should have been discarded. Instead, it was illegally made into cheese curd and sent to Wisconsin for processing into a finished product. Legal action on this case has not been completed.

Testing for yeasts and molds

The conventional way to test a product for these organisms is to use the plate count with acidified (to pH 3.5 with tartaric acid) potato glucose (dextrose) agar and incubation at 20-25°C for 5-7 days. The low pH of the medium restricts growth of bacteria while allowing yeasts and molds to proliferate. This long incubation is needed because some molds grow slowly.

An alternative is to use standard methods, agar fortified with antibiotics – a mixture of chlortetracycline and chloramphenicol is commonly used. The antibiotics inhibit bacterial growth; however incubation remains at 20-25°C for 5-7 days. Similarly, rose bengal agar with added antibiotics has been used. Rose bengal, a dye, restricts mold growth so discrete, easy-to-count colonies are formed. Incubation is the same as for the other media just mentioned.

In recent years, enzyme-linked immunosorbent assays (ELISA) have been used to detect molds in foods. Once you have the equipment and reagents, test results can be obtained in a day. Unfortunately the results are not expressed in numbers per gram or milliliter and ELISA readings are not directly related to amount of mold present. Thus the test appears best suited to indicate absence or presence of mold.

Enter the Internet and visit CDR's Web Site

A common complaint heard from early users of the Internet was that it was cumbersome, complicated and just too difficult to use. Several new tools are making the whole process of electronic information exchange much simpler, and much more popular. The most common way to enter the Internet these days is through the World Wide Web. (See sidebar)

You can visit CDR via our web site. You'll find a variety of information now, and even more in the future. For now the web site includes:

CDR Databases

Right now this site includes a Dairy Pipeline Index, and a CDR Research Projects database. Future efforts will include a Dairy Foods Safety Database, a Specialty Cheese Encyclopedia and a Milkfat Fractionation and Applications Database.

CDR Staff

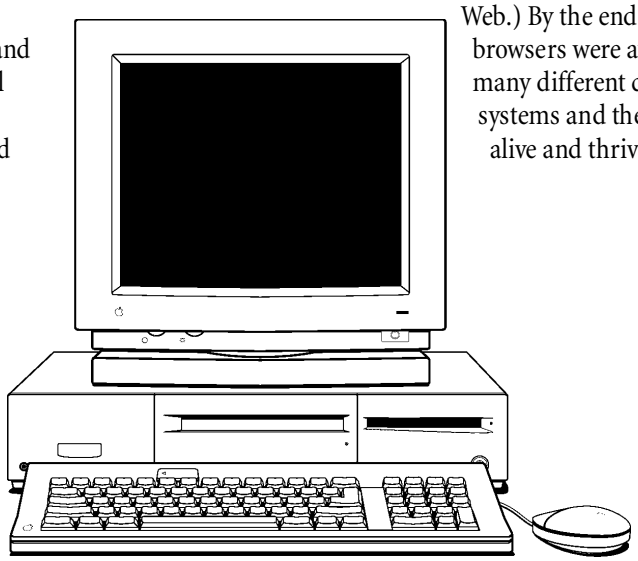
A list of the people who work at CDR and descriptions of what they do. Includes e-mail links for you to send messages directly to individuals.

CDR Calendar

Links to other dairy related sites

Since we developed a web site we no longer have an electronic bulletin board operating. Please look us up and let us know if this site is useful for you.

The most striking aspect of the WWW or World Wide Web is its short history and amazing growth. The WWW was developed at CERN, the European Laboratory for Particle Physics, because researchers wanted to develop a better way to get information to widely dispersed research groups. They developed a proposal in 1989 and by 1991 they had developed both a text browser and a graphics browser. (Browsers are applications that allow you to access and open documents on the Web.) By the end of 1993 browsers were available for many different computer systems and the WWW was alive and thriving.



CDR's Web site address: http://www.cdr.wisc.edu

Calendar, continued from back page

Aug. 19-22 Milk Pasteurization and Process Control School. Madison, WI. Call Bob Bradley at (608) 263-2007 for information, or the CALS Conference Office (608) 263-1672 to register.

Sept. 10-12 Producing Safe Dairy Foods. Madison, WI. Call Sarah Quinones at (608) 262-2217 for information and CALS Conference Office for registration, (608) 263-1672.

Sept. 19-20 Dairy, Food and Environmental Health Symposium. cosponsored by Wisconsin Association of Milk and Food Sanitarians, WI Association of Dairy Plant Field Reps, and WI Environmental Health Assn., Stevens Point, WI. For more information, call Bill Wendorff at (608) 263-2015.

Oct. 7-11 Wisconsin Cheese Technology Short Course. Madison, WI. Call Bill Wendorff at (608) 263-2015.

Oct. 22-23 Milkfat as a Food Ingredient Short Course. Madison, WI. Call Kerry Kaylegian for more information, (608) 265-3086.

Curd Clinic

Q. One of our major Mozzarella customers is a fast growing pizza chain. Recently they've started getting complaints from their restaurant managers about excess browning and blistering on the pizza tops. We haven't changed our manufacturing procedure and they haven't changed ovens, so what could be causing the problem?

A. There are actually several factors that influence surface browning of cheese during cooking. One of them is the well-known Maillard reaction; the heat induced reactions between sugars and proteins during baking. For example, Johnson and Olson have shown that incomplete fermentation of lactose by the starter culture leads to accumulating galactose – a major determinant in browning.

However you noted that you haven't changed your manufacturing procedure – this is a new problem. Since you also mentioned that this is a fast growing pizza business I'm guessing those distribution patterns and schedules may have changed. If so, these changes may be causing your problem indirectly. Perhaps you haven't discovered the trick of "tempering" your frozen pizza cheese.

A second, less well known, factor in cheese browning is something you see when frozen cheese is cooked. Pizza cheese is a good example. Since the early 70's, consumption and manufacture of pizza cheese has increased, driven by the growing popularity of pizza in pizza restaurants, cafeterias, and frozen pizzas. Key physical properties of common pizza cheeses like Mozzarella and modified Mozzarella are unstable during long periods of storage. Thus, manufacturers typically freeze pizza cheese to preserve the stretch and melt properties. Often the cheese is shredded before freezing to extend the shelflife and make it easier to use after thawing.

The browning, blistering problem starts when frozen shredded pizza cheese is tossed on the pizza and placed in the oven. Look closely and you can see a thin coating of ice on the shredded cheese. This is water that migrated from the within the cheese during freezing and storage. When you heat the shredded cheese, particularly in a hot pizza oven, the water is flashed off very quickly as steam – leaving the cheese proteins exposed to the intense heat of the oven. These exposed proteins are more likely to brown and blister.

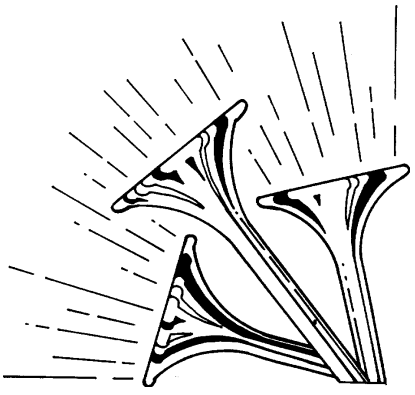
There is an easy solution to this problem. Simply temper the pizza cheese by thawing it gradually and it will reabsorb the water. Holding periods of 4 to 5 days allow substantial moisture movement, tempering the cheese for 14 to 21 days regains optimal quality.

Curd Clinic doctor is Carol Chen
Researcher, CDR

Questions for the Curd Clinic?
Write to:
CDR, *UW Dairy Pipeline*
1605 Linden Dr.
Madison, WI 53706
FAX: 608/262-1578
e-mail: Paulus@ahabs.wisc.edu

1996 marks our 10th Anniversary!

CDR is celebrating by sponsoring an Open House for the dairy industry. Join us on March 27, 1996 from 8 to 3 for a full day of presentations about our research and applications programs. RSVP required, call (608) 265-2117 or FAX (608) 262-1578.



Calendar

March 27 CDR Open House and 10th Anniversary. Madison, WI. Call (608) 262-5970 for more information.

April 9-11 Wisconsin Cheesemakers 1996 Cheese Show. La Crosse, WI. CDR's Maximizing Cheese Yield Technical Session on 4-11. Call Judy Keller for more information, (608) 255-2027.

April 23-25 Swiss Cheese Artisan Course. Madison, WI. Call Jim Path at (608) 262-2253 for more information.

May 7-8 Applied Dairy Chemistry Short Course. Madison, WI. Call Bill Wendorff at (608) 263-2015.

May 14-15 Dairy Plant Water & Waste Management Short Course. Madison, WI. For more information, call Bill Wendorff at (608) 263-2015.

May 20-24 Food Microbiology and Safety: an International Perspective. River Falls, WI. Call P. C. Vasavada at (715) 425-3150 for information.

June 6-7 Wisconsin Cheese Grading Short Course. Madison, WI. Call Bill Wendorff at (608) 263-2015.

June 22-26 Institute of Food Technologists Annual Meeting, sponsored by the Institute of Food Technologists. New Orleans, LA. For information, call IFT, (312) 782-8424.

July 11 Wisconsin Dairy Products Association Annual Butter and Cheese Grading Clinic. Wisconsin Dells, WI. For information call WDPA, (608) 836-3336.

July 14-17 American Dairy Science Association Annual Meeting, sponsored by American Dairy Science Assn. Corvallis, OR. For more information call ADSA, (217) 356-3182.

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Wisconsin CENTER FOR DAIRY RESEARCH
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