# UW Dairy Pipeline

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# Are phage-inhibitory media necessary?

## A New Zealand expert suggests an alternative approach

*by Dr. Peter Robertson, former director and chief bacteriologist, New Zealand Dairy Research Institute*

Phage are virus-like microorganisms that can attack and destroy bacteria, including the bacterial starter cultures vital to cheesemaking and cheese flavor development. In the past, phage were the primary cause of "slow" and "dead" vats. Nowadays, however, application of appropriate science and technology has almost eliminated starter failure due to phage.

My former colleagues, Heap and Lawrence, succinctly outlined some key points regarding phage and dairy culture systems:

> *"The manufacture of fermented milk products of uniformly high quality depends upon the use of reliable culture systems. The single most important problem in milk fermentations is the lysis of the lactic acid bacteria by bacteriophage (phage). Inhibition of one or more starter strains in a culture usually affects both the rate of acid production and the acceptability of the final product. Whey is by far the most important reservoir of phage in dairy plants and care must be taken to prevent the airborne dispersal of fine droplets of whey, both inside the plant and in its immediate vicinity. Effective control of phage build-up can be achieved by the careful selection of starter strains, limiting the number of strains used at any one time, eliminating the sub-culturing of strains by the use of frozen or freeze-dried cultures and maintaining a high standard of plant hygiene."*
>
> *Heap and Lawrence (1988)*

The U.S. cheese industry relies heavily on phage-inhibitory media (PIM) to control phage during manufacture of bulk starter cultures. But in spite of their effectiveness in preventing phage propagation, PIM also present several disadvantages to the cheesemaker, including added expense, the implications of additives in the cheese, and adverse effects on starter culture growth.

Moreover, PIM are unnecessary for manufacturing good bulk starter and quality cheese. Cheese plants in New Zealand do not use PIM, and in most plants just one starter pair (or triplet) is used vat fill after vat fill, day after day and month after month. This is true even in the largest plants — Kiwi Coop Dairies, for example, whose new Cheddarmaster mechanized cheesemaking machine produces 28,000 pounds of Cheddar per hour.

### Phage control

The modern cheese industry relies on one of two basic approaches to controlling phage during bulk starter manufacture. Both are usually accompanied by pH adjustment of the media during culture preparation and the use of defined starter strains. They are:

1. Exclusion of phage from the bulk starter milk (non-fat, whole or non-fat milk powder) through the use of rigorous hygiene and aseptic procedures. This requires the use of separate starter rooms, enclosed starter tanks, aseptic inoculation, and a supply of sterilized air under positive pressure to the starter room and starter tanks. With the notable exception of the United States, this approach is overwhelmingly predominant around the world.

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### *What's Inside:*

2. The use of phage-inhibitory media, chemically modified culture media in which some starters can grow but any phage that may attack the starter cannot propagate. The use of PIM is the norm in the United States, at least for production of hard and semi-soft cheese varieties.

It must be emphasized that bulk starter, no matter how it is made, remains susceptible to destruction by phage that contaminates the surface of cheese vats or is otherwise present in the cheesemilk. Reliable bulk starter can only mean quality cheese if phage is rigorously excluded during the cheesemaking process at least until the rennet coagulum has formed.

## Factors influencing phage propagation

Numerous factors affect the reproduction of phage in the lactic starter cultures used in cheesemaking. Some of the more important of these are:

- The susceptibility of the bacterial strain(s) employed as starter. This ranges from strains with total immunity to those subject to very high overall rates of phage propagation.

- Incubation temperature of the bulk starter to be used for inoculating the cheese vats (phage are generally less virulent at lower temperatures).

- Calcium ions (Ca2+) are essential for phage propagation, and a low enough level of available calcium in a culture medium will inhibit phage reproduction.

This last factor is the basis for the PIM used for starter protection in the United States. Most PIM are based on low calcium or calcium-reduced raw material and contain a significant proportion of phosphates (usually mono- and di-basic orthophosphates) to bind available calcium.

However, insufficient calcium in media can also prevent or markedly retard the growth of many starter cultures of potential value for cheesemaking. Because most strains of mesophilic starter bacteria require some calcium for growth, many strains which could be available to cheesemakers do not grow satisfactorily in the various PIM. Where more than one strain is present, the strain balance required for good cheese flavor development can be markedly distorted. Also, some strains of starter bacteria have difficulty growing in media containing high levels of phosphate (Daly).

## Pros and cons of PIM

When using PIM, the cheese plant faces little or no risk of culture lysis during bulk starter manufacture, even when handling and starter equipment are less than ideal. (Note that PIM do not prevent propagation of phage present in the cheesemilk or vat; these must still be guarded against phage contamination.) However, this slight advantage carries with it a number of disadvantages. Some of the problems presented by use of PIM are:

- Not all strains of lactic starter cultures suitable for use in cheesemaking will grow satisfactorily in media that are low in $Ca^{2+}$. The importance of starter cultures for cheese flavor is such that researchers and cheesemakers want to have available as many cultures that grow well in starter milk and in cheese as possible.

- The ratio of strains in a starter system with two or more strains may be markedly distorted by propagation in PIM. This can make it more difficult to achieve the requisite ratio during cheesemaking and in the young cheese.

- PIM containing phosphates or other additives raise ethical questions. Their use represents a significant departure from the tradition that rennet, salt, and starter bacteria are the only additives used in cheesemaking. To some extent, starter propagation in milk coupled with near asepsis reflects a preference for producing cheese that is as natural as possible; i.e., avoiding the use of non-milk ingredients and chemical additives implicit in the low calcium approach to phage control.

- PIM account for a major fraction of the cost of materials needed to convert milk to cheese. In 1976 Jonas et al. estimated that the U.S. dairy industry spent more than $25 million per annum on PIM, while an informal 1992 estimate suggests an annual figure of about $12 million for PIM used in the manufacture of Cheddar and American-type cheeses. The

apparent reduction in cost since 1976 may reflect the much higher activity of a given volume of starter now that pH control during growth is ubiquitous. The cost of PIM, about one-half cent per pound of cheese, may be partially offset by an increase in yield due to inclusion of some of the media components in the cheese.

***Figure 1.*** *A simple yet effective bulk starter vessel suitable for making phage-free starter without the use of PIM. This schematic design (provision for pH adjustment not shown) is typical of the starter machines used throughout New Zealand.*

## Making starter without PIM

North American dairy industry personnel are familiar with the methods for manufacturing bulk cheese starter with one or another of the commercially available PIM, and the methods used for making starter without PIM are fundamentally the same. The differences are only a matter of degree. Starter-making without PIM is typically characterized by greater attention to aseptic handling of mother cultures, more sophisticated bulk-starter vessels maintained under positive pressure with sterile air, and thorough heat-treatment of the vessel and bulk-starter growth medium before inoculation. To ensure complete freedom from inhibitory substances, the medium is usually reconstituted from non-fat milk powder bought in bulk, and each batch of reconstituted medium is thoroughly pre-tested. The casein, some whey protein, and any fat present in the starter milk are substantially recovered in the cheese (McDowall; Banks and Muir; Banks et al.).

For decades more than 99 percent of all cultures used for cheese bulk starter in New Zealand has been obtained from the New Zealand Dairy Research Institute, and is used in accordance with the Institute's recommendations. These recommendations include the use of a pair or triplet of single strains which are usually supplied and stored in a concentrated, deep-frozen (< -35°C) state. Component strains in these closely defined mini-mixtures are chosen and the proportions arranged so as to achieve the desired strain balance during and after cheesemaking. Determining the appropriate balance is a research activity of some magnitude; it involves the consideration of phage relationships and balance between fast and slow acid production, temperature sensitivity, proteolytic activity, tendency for the formation or removal of bitterness, symbiotic relationships among the bacteria, and other factors. Despite the convenience of computer modeling for this complex set of interactions, the complexity would be much increased if the effects of PIM on culture growth and strain balance had to be taken into account as well.

## Conclusion

Outside North America, methods of rigorously excluding contamination of the bulk culture milk coupled with isolation of insensitive or low phage-susceptibility starter strains have proven effective in eliminating phage problems without resorting to the use of PIM.

U.S. cheese companies with good starter-making facilities and competent technical staff may benefit from reverting to the use of conventional starter media rather than PIM. With the proper choice of starter strains, better quality is the likely result. In addition, use of traditional starter media in cheesemaking implies both better plant hygiene and the elimination of unnecessary additives.

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# Lowfat processed cheese products and ingredients technology seminar

**May 11, 1993**
**InnTowner Hotel, Madison, WI**

**Seminar moderator**
**Dr. R.C. Lindsay, professor, UW-Madison Dept. of Food Science**

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| 9:00 a.m. | Welcome from Dr. Rusty Bishop, director, Wisconsin Center for Dairy Research |
| 9:10-10:30 a.m. | *Basic process cheese chemistry and technology*; Dr. Andrea Maurer-Rothmann, R&D scientist, BK Ladenburg |
| 10:30-10:45 a.m. | Break |
| 10:45-11:15 a.m. | *Ingredients for processed cheese manufacture (cheese, emulsifiers, special proteins, gums, and flavors)*; Dieter Jensen, dairy engineer and technical advisor, BK Ladenburg |
| 11:15 a.m.-noon | *Cooking Equipment for processed cheese and cheese sauce manufacture*; Pat Foley, equipment installation engineer, Cherry-Burrell Corp. |
| Noon-1:30 p.m. | Lunch |
| 1:30-2:30 p.m. | *Evaluation of condensed phosphate emulsifiers and properties of lowfat process cheese blocks and sauces*; R.C. Lindsay, professor of food science, UW-Madison |
| 2:30-3:00 p.m. | *Applications for microparticulate proteins in processed cheese and other cheese products*; Paula Gerlat, applications scientist, The NutraSweet Co. |
| 3:00-3:30 p.m. | *Tasting of products from UW research, BK Ladenburg, and NutraSweet applications followed by discussion*; R.C. Lindsay, Paula Gerlat, and Jeff Pfaff (BK Ladenburg) |
| 3:30-4:30 p.m. | *Tasting of lowfat process cheeses from around the world — brief discussion and wrap-up;* R.C. Lindsay |

***To register call the CALS Conference Office at (608) 263-1672. Registration costs $75, and includes lunch. For program details call Robert Lindsay at (608) 263-2568***

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*Dr. Peter Robertson spent three months at CDR in 1992 while participating in the Center's visiting scientist program. This article reflects his opinions regarding the relative merits of starter media used in the United States and abroad. It is not necessarily a recommendation on the part of the* Pipeline.

# Getting the bugs out: Pest control for food processors

*The following article was adapted from* Insect control in food handling facilities and dwellings, *a 43-page booklet by UW Entomology Professor Walter L. Gojmerac. The booklet contains additional suggestions for non-chemical insect control, as well as sections on insect identification, pesticide use, and recommended control methods for specific species. It can be purchased for $5 from the CALS Conference Office, phone (608) 263-1672.*

Effective pest control means selecting and using economical management techniques that ensure product quality, while minimizing detrimental effects to the environment. It includes non-chemical techniques, as well as the use of pesticides. Often, minor changes can be made during routine maintenance that reduce or eliminate pests at little or no added cost.

Pesticides, when properly used, can be a useful tool in and around food plants. However, the use of toxic substances on or in close proximity to where food is processed or stored can be a source of public concern. Individuals responsible for dealing with pests need to have a clear understanding of the points at issue, and be able to explain in a believable fashion the differences between fact and unsubstantiated opinion. Normally, food handling establishments should consider non-chemical pest control procedures before making a decision to use pesticides. In many cases this amounts to good management practices and maintenance procedures.

## Pest control management practices

All insects (plus spiders and some other arthropods) found in or around a food plant are considered pests. When dealing with pest problems, consider the entire plant as a unit. This includes the outside storage area, lot, trees and landscaping, railroad sidings, truck loading dock, trash storage area, disposal sites, and sometimes nearby neighbors. Insects may enter the plant accidentally (through doors or windows, on clothing, on pallets or cartons, etc.) or as contaminants in purchased products. Once they have gained access to the plant, a breakdown in cleanliness and proper housekeeping practices can allow certain insects to become residents, living and multiplying inside the plant.

The keys to effective insect control are to prevent pests from entering the plant, to maintain good cleaning and maintenance practices that reduce places where they can feed and hide, and to detect their presence early. Even if all insect-producing factors surrounding a plant cannot be controlled, most improvements will be rewarded.

### *Garbage facilities*

Garbage facilities should not create environments conducive to pest development or sanctuary. Remove trash at regular intervals and make sure that the storage area is adequately drained and regularly cleaned. Containers should be covered and stored on an impervious base.

### *Grounds*

Because ants, certain beetles, sowbugs, millipedes, and other arthropods thrive in vegetation and live in the soil, maintaining a vegetation-free barrier (coarse gravel or crushed rock) approximately two feet wide around the foundation of the building is helpful in discouraging some pests. Also when possible avoid the use of spirea, hackberry, and boxelder trees in landscaping. These plants attract large numbers of insects that may enter the plant and cause problems.

### *Building exterior*

Doors and window should fit tightly, have screens, and be checked frequently to see that they close properly. Fresh-air intakes should have screens. Make sure that frequently-used doorways are self-closing, screened, and/or protected with air curtains. Double doors may be of value in some situations. Birds nesting or roosting in or on buildings are undesirable; they should be screened out from the structure. Exhaust fans on the roof may cause accumulations of food debris that may attract pests. Lights attract many night-flying insects, so if outdoor lighting is required, place

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lights away from the building and not directly above windows or doorways. Consider using lights with a yellowish tinge because they generally attract fewer insects than other colors, including white.

## *Receiving areas*

Inspect shipments arriving at the plant, and reject those with insect infestation or damage. Inspect purchased packaging material or other non-food items as carefully as you would food products. Multi-walled containers and bags, in particular, can hide hitchhiking insects. Check pallets for pests such as ants, dermestids, and powderpost beetles. Pallets are easily infested because they are sometimes stored outside, used infrequently, and exchanged between businesses.

## *Cleaning*

Cleaning problems inside a building generally increase with crowded conditions or space limitations, because material is allowed to be stored "temporarily" in corners, walkways, and under stairs. Plants handling dry milk need special attention to accumulated dust, which is easily overlooked yet provides an excellent diet for some insects. Regular vacuuming is essential, so post a schedule and record when vacuuming is completed. Include exposed beams, ledges, cabinets, and other places where dust accumulates. Machinery, pipes, ducts, hand rails, lockers, vending machines, and drinking fountains should be sealed to the wall and/or ceiling, or placed in a postition that allows the area around them to be easily cleaned. Hollow or tubular material used in constructing hand rails, tables, shelves, and carts should be sealed or filled. Pits, elevators, motors, and pumps should be inspected regularly and cleaned when necessary.

## *Interior lights*

Do not hang lights directly above processing areas because insects flying to these lights could fall into the product. Place light traps so they will draw flying insects away from processing areas. Clean light traps regularly to avoid build-up of dead insects that serve as food for more serious pests such as dermestid beetles.

## *Walls, floors, and ceilings*

Porous walls such as cement blocks, brick, and wood should be painted, preferably with an enamel, concrete, or epoxy paint. Repair cracks, especially those at the floor-wall junction. Expansion joints, base-boards, drains, light switches, and other fixtures all should be tight-fitting. Voids above ceilings should be sealed. If not, be sure they are cleaned regularly. Don't allow dust to accumulate on the topside of exposed beams.

## *Plumbing, floor drains*

Due to changes in work schedules, inventory, or operational procedures, water standing in an infrequently used or abandoned drain trap can become stagnant and act as a breeding site for several pests collectively referred to as "drain flies." A weekly flushing with hot water will prevent this problem. Unused drains no longer needed should be sealed.

## *Surveillance*

It's much easier to eliminate a few insects discovered during routine cleaning than to wait until damaging populations are found. The presence of insect webbing, spider tracks, live or dead insects, head or egg capsules, legs, wings, and skins of insects are identifiable indicators of an infestation. Some insects are nocturnal (cockroaches and silverfish). It may be necessary to check the plant at night or some time when the rooms are dark. Also carefully check storage areas for evidence of damage.

The person responsible for pest surveillance should have a flashlight, tweezers, and a number of small bottles (vials). On routine inspections, collect and place suspicious items in a vial. A label on the vial should indicate where the item was found. Traps can be useful in a surveillance program. They can be baited with a variety of attractants, including but not limited to food, chemical attractants and/or including pheromones, chemical substances that influence specific behavior patterns in certain species. As a rule, a pheromone is species specific, so if for example a warehouse is to be monitored for undesirable insects, a blend of several pheromones and/or attractants must be used.

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## Pesticides

Pests must be accurately identified before widespread insecticide treatments are considered. Most insects can be identified with a 10-X magnifying glass, but sometimes it is necessary to submit specimens to experts for exact identification. The local university extension office or land grant university can help. If insects are submitted to specialists for identification, they should be in good condition and accompanied with adequate background information. Follow these procedures to ensure quick and accurate insect identification:

1. Place dead and dried specimens in a clean vial or strong box. A little cotton or tissue paper will prevent damage in transit.

2. Moths, mosquitoes, and insects covered with fine scales or hairs must be kept dry. Identification is difficult if scales or hairs are rubbed off or lost.

3. Worms and most soft body insects will travel well in 70-percent alcohol. Rubbing alcohol is satisfactory.

4. Don't ship living bugs through the mail. Place them in alcohol to kill them.

5. Send several specimens in case some are damaged during shipment. Also, insects that appear to be the same may in fact be different species.

6. Include a description of where the insects were found, how many were found, and how frequently this type of insect has been found in the plant.

# *Resource center*

## CDR Cheese Research and Technology Conference

Slated for April 12-13 in Madison, the 1993 CDR Cheese Research and Technology Conference will provide a forum for a wide array of dairy-related resources and information.

More than 20 experts from academia, industry, and government will address a variety of topics in cheese technology, while a poster exhibit will highlight additional research underway at the University of Wisconsin. Proceedings, which will be published in time for distribution at the conference, will document the presentations and poster exhibits.

Other resources available at the conference will include CDR databases, training videotapes, demonstrations of newly developed computer software for anaylzing cheese plant economics, and a host of CDR publications.

The program includes the following full-length presentations:

*A review of the status of dairy foods pathogens.*

*Research developments in Listeria control and testing.*

*Biofilms — significance, detection, and control.*

*Luncheon presentation: Future markets for cheese — taking the volatility out of prices.*

*Animal viruses destroyed by pasteurization.*

*Setting up an environmental monitoring system and rapid methods of pathogen detection.*

*Effect of genetic selection and rotational grazing on milk composition and cheese yield.*

*Use of biotechnology to improve starter cultures.*

*Factors affecting the physical properties of cheese.*

*Dinner banquet: Dairy foods megatrends in the 1990s.*

*Don't compromise quality with shortcuts.*

*Impact of non-starter bacteria on flavor.*

*Achieving quality lowfat cheese — use of spray drying to improve starter cultures.*

*Water and waste management in dairy plants.*

*Methods for reducing phosphorus — treatment systems.*

*What the plant inspector looks for.*

*Drug residues in milk.*

**Conference registration**

Cost for the conference is $100 for registrations postmarked after March 30 ($90 before March 30). The fee covers refreshments, two luncheons and a dinner banquet. Call the CALS Conference Office at (608) 263-1672 for information.

# *This and that...*

CDR Senior Scientist **Mark Johnson** presented a talk on factors influencing the quality of reduced-fat cheese at the Oregon Dairy Industries Conference in February. The conference, sponsored by ODI and Oregon State University, was held Feb. 9-10 in Eugene, Oregon.

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University of Vermont Research Scientist **Joe Kiely** is currently visiting CDR as part of a joint CDR-UVM research project examining cheese structure. Kiely, who arrived at CDR in January, is using electron microscopy to study the microstructure of Cheddar cheese. He plans to work in Madison until July. Collaborating with Kiely on the project are **Paul Kindstedt** of the University of Vermont and CDR Senior Scientist **Mark Johnson.**

###

UW food engineer **Sundaram Gunasekaran** and graduate student Chyung Ay are exploring the use of ultrasound (sound waves above the range of human hearing) to determine the right moment for cutting the curd during cheesemaking.

To monitor gel formation during cheesemaking, the researchers measure the strength and speed of ultrasonic waves as they travel through the coagulating milk. Because the waves travel faster and lose less energy as the milk becomes denser, changes in wave behavior are diagnostic of physical changes in the gel. This ultrasound technology offers the advantage of continuous sampling throughout the vat.

Gunasekaran plans to develop an ultrasonic sensor suitable for use in commercial cheese production within three years. Funding for this research was provided by a federal Hatch grant.

# *The Curd Clinic*

**Question:** I make a low-moisture part-skim mozzarella cheese. My problem is that the cheese becomes too soft and loses its stretch after about three weeks. My largest customer (a pizza restaurant chain) is threatening to change suppliers because their specifications call for a one-month shelf life. How can I increase the shelf life of my cheese?

**Answer:** Mozzarella cheese characteristically becomes softer during the weeks and months after manufacture. At the same time, its melted consistency is transformed from tough and fibrous to tender and stretchable, and ultimately to flowable and soupy. The key to satisfying your customer is to modulate the rate of change in these functional characteristics so that they are optimal when the customer uses the cheese.

A number of factors influence how quickly the functional characteristics of mozzarella cheese change during aging. By manipulating cheese composition and manufacturing practices, you may be able to increase the shelf life of your cheese.

Salt and moisture contents both have a large impact on the rate that functional properties change during cheese aging. When other conditions are held constant, increasing the salt content or decreasing the moisture content will slow the rate of cheese softening. If your salt content is at the low end of the usual range (e.g., 1.2-1.3 percent), raising it to 1.6-1.8 percent will slow the aging process considerably. Of course, increasing the salt content usually requires increasing the brining time, which may or may not be practical for your plant. As for moisture, a one percent decrease in moisture content will also slow aging; however, it will also decrease your cheese yield. Therefore, you must weigh the benefit of longer shelf life against the cost of lower yield.

A relatively simple manipulation that can be used to "buy shelf life" is to stretch at a slightly higher pH. For example, if you normally begin stretching at a curd pH value of 5.25, increase the stretching pH to 5.30. This tends to produce a slightly tougher cheese that will take a little longer to develop optimum functional characteristics.

Your choice of coagulant can also have a large impact on shelf life. Proteolysis caused by residual coagulant is a major driving force behind functional changes during aging, and coagulants derived from different sources can differ greatly in residual activity. For example, microbial coagulant derived from *Endothia parasitica* (EP) is much more proteolytic than chymosin, and results in accelerated functional changes during ripening. Thus, in some cases, increasing shelf life may be achieved merely by switching from a highly proteolytic coagulant such as EP to a less proteolytic one (e.g., chymosin).

However, manipulating the aging characteristics of mozzarella cheese by changing coagulants is tricky business because different coagulants have different heat stabilities. A coagulant with a lower heat stability such as EP may be heat-inactivated during stretching at a temperature that would not inactivate a more stable coagulant such as chymosin. Therefore, the stretching temperature that you employ needs to be tailored to the heat stability characteristics of your coagulant so that the final cheese possesses an appropriate level of residual enzyme activity.

Finally, higher temperatures during storage will accelerate changes in functional characteristics. Maintain your storage temperature at or below 4°C. Make certain that your cheese is not subjected to higher temperatures during shipping, and be sure that your customers understand that they must maintain proper temperature conditions in their storage facilities. ▮▮

*Curd Clinic Doctor for this issue is*
*Dr. Paul Kindstedt, University of Vermont.*

Questions for the Curd Clinic?
Write to:
*The UW Dairy Pipeline*
1605 Linden Dr.
Madison, WI 53706
**FAX: 608/262-1578**

# *Project Profile: Biological significance of conjugated dienoic derivatives of linoleic acid; Dr. Michael Pariza, Food Research Institute*

Conjugated dienoic derivatives of linoleic acid (CLA) are the only fatty acids that have been shown to reduce the incidence of cancer when fed to laboratory animals. Dairy products are among the top dietary sources of CLA.

Dr. Pariza and his colleagues are determining the mechanisms of CLA's ability to inhibit cancer formation. They are also exploring the possible use of CLA, which appears to have anti-oxidation and mold inhibiting properties, as a natural food preservative.

CLA is naturally produced from linoleic acid in the digestive tracts of cattle and sheep. As a consequence, it is relatively abundant in milk and dairy products. In general, meat and milk from cattle and sheep contain considerably more CLA per gram of fat than foods from

## UW dairy research projects: Milkfat management and utilization

*Numerous dairy foods research projects are underway at UW-Madison. The following are only those involving milkfat management and utilization.*

1. **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 University. (NDPRB) 7/89-6/93

2. **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. (WMMB) 9/90-8/92

3. **Use of immobilized enzymes in the treatment of milkfat.** Dr. Charles Hill, Dept. of Chemical Engineering. (NDPRB) 7/89-6/93

4. **Effects of defined milkfat fractions on postprandial lipid metabolism in the rat.** Dr. Denise Ney, Dept. of Nutritional Sciences. (WMMB) 7/92-12/93

5. **Enzymatic modification of butterfat in supercritical CO2.** Dr. Richard Hartel, Dept. of Food Science. (WMMB) 6/91-7/93

6. **Milkfat technology research applications program.** Kerry Kaylegian, CDR and Dr. Norm Olson, Dept. of Food Science. (WMMB) 6/93

7. **Glycerolysis of butterfat in organic solvent and solvent-free systems.** Drs. Kirk Parkin and Norm Olson, Dept. of Food Science. (WMMB) 7/92-7/93

8. **Investigation of baked milkfat flavor development in milkfat ingredients for the bakery and food industries.** Dr. Robert Lindsay, Dept. of Food Science. (WMMB) 7/92-793

9. **Incorporation of milkfat fractions in chocolates.** Dr. Richard Hartel, Dept. of Food Science. (WMMB) 9/92-9/94

10. **Biological significance of conjugated dienoic derivatives of linoleic acid.** Dr. Michael Pariza, Food Research Institute. (WMMB) 12/90-11/95

plants or other animals. For example, homogenized milk contains about 5.5 mg of CLA per gram of fat. The CLA content of cheese ranges from 2.9 mg/g fat in Romano cheese to 7.1 mg/g fat in brick cheese. By contrast, plant oils contain far less CLA. It would take almost 8 grams of peanut or corn oil and 27 grams of safflower oil to equal the amount of CLA found in one gram of milkfat.

More than 90% of the CLA present in milk is the cis-9,trans-11 isomer, the variety of CLA believed to be responsible for its anti-cancer properties. In plant oils, by comparison, the cis-9,trans-11 isomer accounts for less than 50% of the CLA present.

Pariza and his colleagues have found evidence that CLA is a natural regulator of an important biochemical process related to cancer formation. When a chemically-synthesized CLA mixture is fed to mice, one variety of CLA — the cis-9,trans-11 isomer — is specifically taken up and incorporated into the animals' cell membrane phospholipid. Experimental results indicate that CLA in the cell membrane modifies the activity of protein kinase C (PK-C), a key enzyme in cell growth and differentiation. Activation of PK-C under certain circumstances is directly linked to cancer formation. CLA appears to prevent this activation.

In addition, the researchers have demonstrated that CLA acts as an in vitro antioxidant, protecting the cell membranes from oxidative attack. Free radical generation and cell damage due to oxidation is thought to be important in the early phases of cancer development.

# Dairy product handling tips: guidelines for the cold room

*Excerpted from* Guidelines for handling dairy products from processing to consumption*, Northeast Dairy Practices Council Guideline No. 16. For information on NDPC publications, contact G.H. Porter, NDPC, P.O. Box 4851, Syracuse, NY 13221.*

A constant temperature of 35°F (1.7°C) should be maintained in the storage room for fluid and cultured dairy products. A temperature of 40°F (4.4°C) should be considered as maximum. Product temperatures should be 40°F (4.4°C) or lower when they enter the cold room. Air circulation cannot be expected to cool any packaged product. Avoid freezing fluid products.

General purpose thermometers should be located in the warmest zones of the cold rooms. Stack the product in a fashion that permits proper air circulation. Don't block air circulation ducts or blowers. To prevent escape of cold air, keep all cold room doors closed. Use air curtains, canvas, or metal barriers at all cold room openings.

Do not use fluorescent, mercury vapor, or sodium lights in cold rooms. This includes all types of lighting that emit wavelengths in the 350 to 500 nanometer range. These lights will cause a cardboard-like taste in milk or dairy products, especially those packaged in glass or plastic containers. They will also initiate the development of light-induced flavors in products packaged in paper containers.

Proper rotation is a must. Schedule processing according to sales needs. Never pre-date product containers. Plan to move all fluid product from the cold rooms within 48 hours of processing, if possible. Product is better held pasteurized than raw; this is critical in areas where 10- to 12-day open dating regulations are in effect (up to 12 days in Maryland).

Be sure that personnel responsible for cooler operation move the oldest product first. Try colored signs in top cases or other easily identifiable means to indicate which product to use first. When loading trucks, keep cold air loss from the cooler and truck at a minimum. Use foam and canvas closures for connecting the truck bodies to the cooler door. This is considered essential for frozen desserts.

Never allow fluid, cultured, or frozen product to sit on the loading dock. Sunlight will cause flavor changes in all products. Temperature increases are very rapid when outdoor temperatures are 70°F (21.1°C) or above.

# Calendar of Events

**April 13-14** ***CDR Cheese Research and Technology Conference.*** Holiday Inn-West Towne, Madison, WI. For details call the CALS Conference Office at (608) 263-1672.

**April 20-23** ***Basic Cheesemaker's License Short Course.*** River Falls, WI. Call Ranee May at (715) 425-3702 for information.

**April 26-29** ***ADPI Annual Meeting and Dairy Products Marketing Conference.*** Chicago Hilton & Towers Hotel, Chicago, IL. For details call Dr. Warren Clark, Jr., at (312) 782-4888.

**May 11** ***Lowfat Processed Cheese: Processing and Ingredients Technology.*** InnTowner Hotel, Madison, WI. For details call the CALS Conference Office at (608) 263-1672.

**June 3-4** ***Wisconsin Cheese Grading Short Course.*** Madison, WI. For information call Bill Wendorff at (608) 263-2015.

**June 13-16** ***American Dairy Science Association Annual Meeting.*** College Park, MD. For information call ADSA at (217) 356-3182.

**July 13-14** ***Wisconsin Dairy Products Association Annual Cheese and Butter Grading Clinic.*** Wisconsin Rapids, WI. For information call WDPA, (608) 836-3336.

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**July 20-22** ***Wisconsin Farm Progress Days.*** Chilton, WI. For information call Calumet County UWEX at (414) 849-1426.

**Aug. 16-19** ***Milk Pasteurization and Process Control School,*** Madison, WI. Call Bob Bradley (608/263-2007) for information, or the CALS Conference Office (608/263-1672) to register.

**Oct. 11-15** ***Wisconsin Cheese Technology Short Course.*** Madison, WI. For information call Bill Wendorff at (608) 263-2015.

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