Wisconsin Center for Dairy Research

# DAIRY PIPELINE

A Technical Resource for Dairy Manufacturers
June 2002, Volume 14 Number 2

# The Whey to Nutrition

*by K. J. Burrington, Whey Applications, Center for Dairy Research*

The focus today on food ingredients is all about added value. Almost every food ingredient is highlighting a newly discovered health benefit, whether it's lycopene in tomatoes to prevent prostate cancer, lutein in eggs to prevent macular degeneration, or calcium in milk and its ability to prevent osteoporosis and reduce blood pressure. Though many people think of whey as a by-product of cheesemaking, it has become much more than that.

Whey contains approximately 93% water, 5% lactose, 0.5% minerals, 0.3% fat, and 0.8% whey proteins, amounting to roughly half the solids or nutrients from the original milk used for cheesemaking. Cheese has always been looked at as the more nutritional, value-added product, but research is starting to show that the whey proteins may have more nutritional properties with specific health benefits. Whey proteins consist of several different proteins found in varying amounts. Listed according to their relative quantity, whey proteins include β-lactoglobulin, α-lactalbumin, proteose peptones, immunoglobulins, glycomacropeptide, bovine serum albumin, lactoferrin, and lactoperoxidase. Collectively, whey proteins contain all the essential amino acids the body requires, which makes them high quality proteins. Whey contains more essential amino acids than egg albumin, casein, or soy proteins. Whey proteins are most famous for their application in sports nutrition. High protein drinks, available for over a decade, have featured whey proteins as a good source of the branched chain amino acids, leucine, isoleucine, and valine. These amino acids are readily absorbed by muscle tissue, which is important for both building and repairing muscle. Bodybuilders, weightlifters, and endurance athletes recognize whey proteins as a valuable performance enhancing ingredient. Individually, whey proteins have even more enhancing properties.

## Bioactivities of whey proteins

Each whey protein has documented bioactivities (specific biological activities or functions in the body) published from in vitro and/or animal studies, but not all their activities are linked to a health benefit. Keep in mind, as you read through the list of bio-activities that they have been tested only in animals or in vitro studies. Human clinical trials are the next step.

Beta-lactoglobulin represents about 50-60% of the whey proteins. It is a retinol binding protein, which is thought to play a part in the absorption and availability of Vitamin A. Beta-lactoglobulin is considered to be the major milk allergen, so for people who are allergic to milk, β-lactoglobulin is the likely culprit. Beta-lactoglobulin has no documented health benefits.

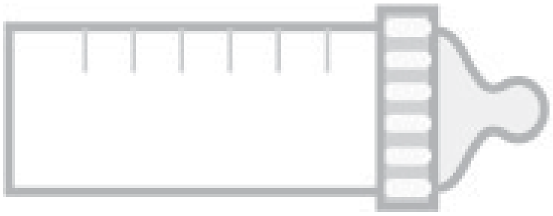
Alpha-lactalbumin makes up about 20-25% of whey proteins. It is rich in the amino acids lysine, leucine, threonine, tryptophan, and cysteine. Alpha-lactalbumin is a metalloprotein, which means it binds metal ions, specifically calcium. Its ability to bind calcium is thought to give it protection from thermal denaturation. In the cow, α-lactalbumin is associated with inducing lactation. Alpha-lactalbumin has been researched for its ability to reverse the proliferation of transformed cancer cell lines in vitro. It may have anti-cancer benefits in the

*continued on page 2*

What's Inside:

*continued from page 1*

human body also. As a commercially available protein, $\alpha$-lactalbumin's main target has been infant formula. Most dairy-based infant formulas contain ingredients such as demineralized whey so they have a substantial amount of $\beta$-lactoglobulin. Human milk contains no $\beta$-lactoglobulin. Thus, producers of $\alpha$-lactalbumin have tried to sell their ingredient to infant formula manufacturers who may have an interest in producing an infant formula closer in composition to human milk. So far, the cost to benefit ratio has not been in the favor of $\alpha$-lactalbumin.



"Whey contains approximately 93% water, 5% lactose, 0.5% minerals, 0.3% fat, and 0.8% whey proteins, amounting to roughly half the solids or nutrients from the original milk used for cheesemaking."

The proteose peptones make up 2-10% of the whey proteins and are considered the acid and heat stable whey proteins. They are categorized as glycoproteins, phosphoproteins, or phospho-glycoproteins. The most notable bioactivity of the proteose peptones is their anti-toxin activity. Two of the proteose peptone proteins have exhibited the ability to bind *Escherichia coli* enterotoxin.

The immunoglobulins represent about 9% of the whey proteins. All the immunglobulins are glycoproteins. These proteins have antimicrobial activity against *E. coli*, *Campylobacter jejuni*, and *Helicobacter pylori*. This antimicrobial activity makes them well suited for promoting intestinal health and inhibiting the bacteria responsible for food borne illnesses.

## Glycomacropeptide

Glycomacropeptide (GMP), often referred to as casein-macropeptide, is a protein present in whey due to the action of chymosin on $\kappa$–casein during the cheesemaking process. GMP represents about 10-15% of the whey proteins, unless the whey is from a cheese made without chymosin, like cottage cheese. It is high in the branched chain amino acids, leucine, isoleucine, and valine but lacks all the aromatic amino acids, phenylalanine, tryptophan, and tyrosine. GMP has several bioactivities associated with it; for example GMP has the ability to bind cholera and *E. coli* enterotoxins. It has also been found to inhibit bacterial and viral adhesion and it is involved with the suppression of gastric secretions and the promotion of bifidobacterial growth. GMP is also linked with the modulation of immune system responses.

The lack of phenylalanine makes GMP a suitable protein for people with phenylketonuria (PKU). In fact, it is the only naturally occurring protein we know of that is phenylalanine free. People with PKU lack the enzyme that breaks down phenylalanine and when it builds up in the bloodstream it becomes toxic to the brain. GMP is now being isolated commercially from whey so it can be used to formulate foods containing protein for people with PKU. Some other applications for GMP could be diet products for its appetite suppressing properties, or toothpaste, chewing gum and/or mouthwash for its anticariogenic properties, or as supplements to benefit from its anti-toxin activity and improve intestinal health.

Bovine serum albumin (BSA) makes up approximately 5% of the whey proteins. The biological function of BSA is not clear. Its primary biological role has been related to its lipid binding properties. It is thought to play a part in the mediation of lipid oxidation. Lactoferrin and lactoperoxidase are found at the lowest levels of all the whey proteins, at about 0.35% and 0.25% respectively. Lactoferrin is an iron-binding protein so the focus of its benefits have been on its ability to transport iron in the body and to chelate iron, making it unavailable for the growth of bacteria. Lactoferrin has also exhibited antifungal and antiviral activity and toxin binding properties. It is also known for enhancing immunity, promoting intestinal cell growth and for its bifidogenic properties. GRAS status for lactoferrin has been granted for its use as a topical antimicrobial applied to beef and as an ingredient in sports and functional foods at a level of 100 mg per serving.

**Lactoperoxidase, the most abundant milk enzyme**

Lactoperoxidase is a thermostable enzyme that is bacteriocidal to *E. coli*, *Pseudomonas aeruginosa*, and *Salmonella typhimurium* and bacteriostatic to gram positive bacteria. It is the most abundant enzyme in milk but the majority of it ends up in the whey after cheese making. Lactoperoxidase has been involved in the preservation of milk through the addition of hydrogen peroxide, which oxidizes thiocyanate ions in milk. Both lactoperoxidase and thiocyanate work together to make up the lactoperoxidase system. Both lactoferrin and lactoperoxidase have antimicrobial properties well designed for other applications such as dental products, cosmetics, wound treatments, and as anti-tumor agents.

Although the list of health benefits appears long for whey proteins, most of the nutritional research has not reached the level of human clinical trials. This situation makes it difficult for the whey industry to give the U.S. consumer some solid evidence to justify the cost of these new ingredients. Currently, the market for these ingredients exists overseas where health claims are not required before product label claims can be made. Human clinical trials are very costly and few dairy companies can afford the expense. It may take a collaborative effort among dairy companies, dairy associations, and possibly food manufacturers to fund the needed nutritional research in order to prove some of the benefits.

Listed according to their relative quantity, whey proteins include:
$\beta$-lactoglobulin
$\alpha$-lactalbumin
proteose peptones
immunoglobulins
glycomacropeptide
bovine serum albumin
lactoferrin
lactoperoxidase

**References**

Some good references on the biological properties of whey proteins:

Biological Properties of Whey Components A Review, W. James, Harper, Prepared for and published by The American Dairy Products Institute, 2000 and Update 2001.

Beneficial Natural Bioactive Substances in Milk and Colostrum, British Journal of Nutrition, Vol. 84, Supplement 1, November 2000.

# Alkaline Phosphatase Monitoring Revisited

*by R.L. Bradley, Emeritus Professor, Department of Food Science*

If you put two glasses of milk side by side, one pasteurized and the other unpasteurized, chances are you couldn't tell the difference by looking at them. Certainly you could measure the bacteria counts, and they would differ. You could also use the conventional test of pasteurization, which measures the enzyme alkaline phosphatase or ALP. This enzyme is inactivated by pasteurization, thus it has been used as an indicator, or marker, to demonstrate effective pasteurization. Recently, monitoring ALP in pasteurized dairy foods that were "heat shocked" suggests that we need to take a closer look at this indicator.

The classic method for measuring ALP in milk was developed in 1935 by Kay and Graham (1). Following, in 1938, the Sharer method (4) was researched and then improved by Sanders and Sager (3) in 1948. The best that these methods could detect was 0.1% contamination of pasteurized milk with raw milk. Textbook information from that time suggests that underpasteurization by 1°F, or five minutes on hold time, could be detected. However, when you consider present day standards, this lack of sensitivity is unacceptable. Further, this test was developed in the infancy of HTST pasteurization.

Two new, more sensitive methods have been developed in the 1990's. One, Charm Sciences, is approved only by IMS (Interstate Milk Shippers) while the other, Advanced Instruments, has been approved by IMS, AOAC (Association of Official Analytical Chemists), ISO (International Standards Organization) and IDF (International Dairy Federation). Both of these new methods allow greater accuracy and precision in assessment of residual ALP. Comparing the old methods with the new Advanced Instruments Fluorophos method, 1 µg of phenol is equal to 500 milleunits of alkaline phosphatase activity/liter of milk (mU ALP/L). However, in the PMO, because of the increased sensitivity of the method, above 350 mU ALP/L is reason to question pasteurization efficiency. It is well known that

| Temp (F) | Whole | 2% | 1% | Skim |
|---|---|---|---|---|
| | ALP values in mU/L | | | |
| 155 | 40061 | 26301 | 21578 | 20523 |
| 158 | 4902 | 4091 | 3260 | 2625 |
| 161 | 185 | 136 | 109 | 90 |
| 164 | 33 | 24 | 20 | 18 |
| 167 | 23 | 20 | 18 | 13 |

**Table 1.**
**Residual alkaline phosphatase activity in milk**
Products HTST pasteurized for 15 seconds at the given temperatures (constant time-variable temperature)

| Creamer Production/ Pull Date | Control (May 1) | Day 1 (May 2) | Day 2 (May 3) | Day 3 (May 4) | Day 4 (May 5) | Control (May 6) | Std Plate Count (CFU) |
|---|---|---|---|---|---|---|---|
| | Alkaline Phosphatase values in (mU/L) | | | | | | |
| 2/27-4/25 | 14 | 71 | 112 | 153 | 152 | 12 | 1 |
| 3/24-5/6 | <10 | 94 | 155 | 182 | 227 | 12 | 2 |
| 3/30-5/13 | <10 | 61 | 69 | 84 | 100 | 12 | 0 |
| 4/2-5/17 | <10 | 67 | 117 | 152 | 161 | 12 | 0 |
| 4/14-6/4 | 12 | 77 | 116 | 149 | 166 | 12 | 0 |

**Table 2.**
**Creamer ALP values and Standard Plate Counts when held at ambient temperature**

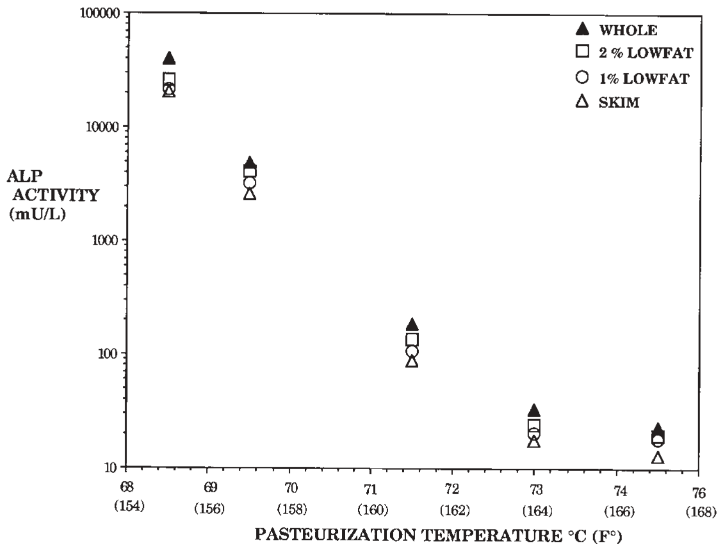



**Figure 1. Residual alkaline phosphatase Fixed Time/Variable Temperature**

pasteurization of all dairy foods does not destroy all of the ALP present. In addition, 30-40% of the ALP orients on the fat globule as part of the membrane, the remainder is found in the skim milk portion. The thermal destruction of enzymes or bacteria is more difficult in milkfat than skim milk, thus higher milkfat levels will have more residual ALP. When measuring residual ALP in milks exposed to various times and temperatures using HTST pasteurization, Painter and Bradley (2) found an average of 185, 136, 109 and 90 mU ALP/L in whole, 2%, 1% and skim milk, respectively, processed at 161˚F for 15 seconds, (Table 1). The data in Figure 1 show the effect of milkfat at any process temperature. Each data point represents the average of 27 assays from three separate trials (2).

No instruments were available prior to the Fluorophos method to allow these accurate assessments. Normally, HTST pasteurized milk will have values between <10-25 mU ALP/L because most milks are heated above 161˚F and held longer than 15 seconds. This ALP test is now so sensitive that it has become an excellent quality test. For example, two paper gaskets used to seal the faceplate of the positive pump in the HTST pasteurizer loop will produce lower ALP values. Replace the rotors in the same positive pump and the value will rise. One drop of raw milk in a 1/2 pint of pasteurized milk will cause a significant increase in residual ALP, i.e. <10 to 100+. With sensitivities like these, quality assurance can build a database that allows reliable control of all production.

With this improved assay for ALP another unique feature of ALP can now be easily measured. That unique characteristic is reactivation. If ALP is exposed to elevated temperatures after thermal inactivation, and either zinc or magnesium ions, it will exhibit renewed activity. Further, it appears that an elevated thermal process may accelerate reactivation when heat shock occurs. The fact of reactivation is troublesome and demands that a true zero time analysis be made to validate the pasteurization process. It is likely that the subject of reactivation will generate much more regulatory concern in the future as more products are processed by UHT.

## Reactivated ALP

Coffee creamers are often left at room temperature in restaurants and, as anticipated, the ALP will reactivate. Portion packs of half and half were collected from the library samples of a manufacturer and were left at ambient temperature for five days. Initially, and each day, a sample of each production lot was assayed for ALP. On the last day, refrigerated control samples were assayed again. Also, these control samples were checked for microbiology to determine if microbial ALP were possible. This is reactivated ALP (Table 2). Since this half and half was UHT processed zero time analysis should have yielded a <10 mU ALP/L. Thermal abuse, even to the control samples, caused the higher values.

*continued on page 8*

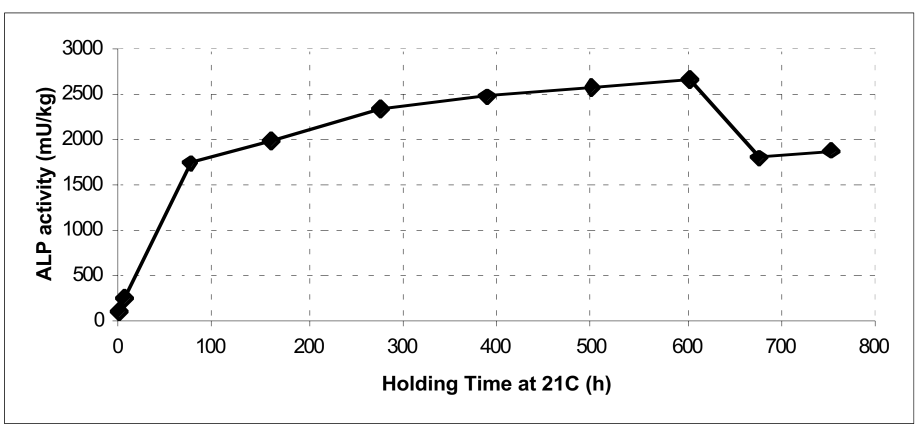



**Figure 2. Reactivated ALP in butter held at ambient temperature**

# Judging Cheese Flavor

## An Overview of Cheese Flavor, Part III

When tasting cheese you may notice that some flavors come to you in waves of different intensity. Sweetness is an early taste, sour and salt are second flavors and bitter is the last. That is why Bill Schlinsog tells his judges not to be in a hurry; he wants them to wait for all the flavors of each cheese to be revealed.

Bill Schlinsog didn't hurry down a career path to be a cheese judge either, but he did start early. Bill remembers attending Career Day while in high school; knowing that he was wasting his time. He already planned to follow in his father's footsteps and be a cheese maker. Bill began his career in the family cheese factory; eventually he joined the Department of Agriculture, moving from the regulatory area to grading and marketing before he retired. He hasn't completely retired, though. For the last nineteen years Bill has served as the chief judge of Wisconsin Cheese Makers Association's Cheese Contest.

Wisconsin Cheese Makers Association has held cheese judging competitions for over 100 years. Since they created the first World Championship in 1957, the World Contest has been held on even years and the National Championship on odd years. Bill gets the word out when the contest is coming up and asks for applicants to fill his roster of judges. Sometimes he gets nominations, and sometimes he gets volunteers.

"It is an honor to be chosen to judge this contest, and we always try to find the very best people. International judges might wonder what they are getting into at first, but by the time they leave they let me know they would be glad to come back and do it again," Schlinsog asserts.

### Experienced Wisconsin judges

"I don't have problems finding Wisconsin judges," notes Schlinsog, "There are many people with a lot of experience here." Bill Wendorff, current chair of the University of Wisconsin—Madison, Food Science Department, is one of them. County fairs first got Bill involved in judging, he examined everything from rabbits and vegetables to field crops. When he moved into the cheese world he drew on previous judging experiences while developing an expert cheese palate. Wendorff has judged cheese for both the American Cheese Society and the Wisconsin Cheese Makers.

Schlinsog explains that learning to judge cheese is often a matter or working alongside someone with experience, sometimes at county and state fairs and sometimes with a mentor in the cheese industry. Scott Rankin, assistant professor in the Food Science Department, began to develop his dairy palate as a student on the judging team at Brigham Young University. More experience coaching the judging team as an Oregon State graduate student followed, and now, with a research program in flavor chemistry, he is also conscious of the chemistry of cheese as he is judging. Rankin enjoyed serving as a judge for the Wisconsin Cheese Makers, noting that working alongside a "global dream team" of international judges on almost 1200 cheeses from around the world is an extraordinary experience.

### Evaluating judges

Besides experience, Bill Schlinsog evaluates his judges on their fairness and impartiality as well as how they work together. Although they are directed to work alone and score each cheese independently, the judges are paired and assigned classes for judging. Each cheese receives a score that is the average of the paired judges. Consistency is critical, but it also best if the judges are somewhat close together on their scores. Schlinsog monitors his judges closely in the beginning of the competition. "If they aren't in line with their scoring, I'll pull out the entry again and ask that they to look at it and discuss it."

Not all cheese contests follow these rules. For example, in Germany, where Schlinsog recently judged a contest, more than one entry may receive the same score. So instead of having one winner in each class, a number of entries can have the same highest score. Schlinsog notes, "Some of the judges that come take a little while to adjust to a different system—but they are all using the same senses."

According to Shlinsog, cheese judges need to know what most people expect to find in a particular product—what most people enjoy. For example, Cheddar cheese is a standard product that most people like, although some people prefer a particular flavor in it that others might find objectionable. Judges need to be somewhere in the center when they are judging a product, they start by looking at the flavor that should be there, while they are also looking for off-flavors that shouldn't be there.

Of course, cheese flavor isn't the only hurdle for contest entries; body and texture, appearance, and color are scrutinized, too. However, flavor is the key. According to Schlinsog, "Flavor is, by far, the most important thing. If it doesn't taste like it is supposed to the rest of it is immaterial."

When judges are chosen for the contest Bill asks them to list the top twenty cheeses they are familiar with, which gives him a chance to pair his judges for the contest. This is a challenge he enjoys and it gives him a chance to challenge his judges a bit, also.

## Challenging and educational

Challenging and educational are descriptors that both cheese makers and judges could use to describe the Wisconsin Cheese Makers contest. Judging sheets are returned to entrants after the contest, one reason why judges take the time to note problems with each entry. This "report card" contains valuable information, says Schlinsog. "Many cheese makers only see their own product and that is what they are familiar with. They don't always get to compare it to other cheeses." Some cheese plants take the time and effort to have their cheese makers grade the entry before sending it off to the contest, and then compare their results to that of the judges.

Judges consider this contest educational, also. The cultural exchange is a unique experience, and so is the opportunity to challenge themselves. Daphne Zepos, a cheese consultant from San Francisco, explains that, after judging for such a large and varied contest, " You get a better understanding of your own palate."

Cheese judges need a discriminating palate since most of the cheese defects in the cheese contest entries are very subtle and difficult to detect. However, that wasn't always the case. Today, high quality, pasteurized milk is commingled before made into cheese. In the past, raw milk produced more variation, which might mean more off-flavors in the cheese. Cheese makers were likely to use local milk for their cheese and Schlinsog remembers being able to taste the influence of the pasture; it could tell him where the cheese came from.

## Filling the "Open Class"

Although judging cheese has not changed much, this particular cheese contest certainly has. In fact, the history of the Wisconsin Cheese Makers contest illustrates a few noteworthy trends. It actually started as a Cheddar contest, with other entries filling the "Open Class." Contest organizers keep pulling categories out of the open class and it still keeps getting bigger. In fact, when you look at the continuing growth in specialty and artisan cheeses you might think we have come full circle from those days of local cheeses that hold the flavor of the Wisconsin countryside. According to the International Dairy Foods Association, the largest percentage growth of cheese is found in the specialty cheese category. IDFA notes that Asiago showed double digit increases—nearly 50% growth in supermarket sales, and Gorgonzola and Provolone aren't far behind. Stellar artisan cheese makers from Wisconsin, like Mary Falk and Mike Gingrich, have demonstrated successful approaches to farmstead cheese production. You can travel around Wisconsin, visiting places like Bass Lake Cheese in Somerset or the Cedar Grove plant in Plain, to see that many other Wisconsin cheese makers have exploited the specialty cheese niche in their successful plants.

When Bill Schlinsog looks into the future he sees growing consumer awareness of specialty cheese and more sof them coming into the contest—continuing to fill and expand that Open Class.

---

How can a cheese with the lowest Best of Class score win the overall contest? Here's how:

Consistency is one of the most important attributes of a cheese judge. Guidelines for subtracting points for defects in flavor, body, or appearance are just that—guidelines. These two factors explain the following scenario. A very consistent, but prudent, judge scores the Cheddar class awarding a fine Cheddar the top score of 98.0. During the final round of judging, the rest of the judges find that the Cheddar is such a clean, flavorful example of Cheddar cheese that it stands out among the Swiss (99.2), the Muenster (99.5), the Colby (99.7), etc. Even though other cheeses scored higher, in the final round the Cheddar is awarded Best of Show.

The final round of the Wisconsin Cheese Makers contest is also based on merit. Instead of subtracting points for defects, each Best of Class winner is evaluated on its own merit for that variety of cheese, like the example above. The cheese is not compared to another type.

---

*continued from page 5*

Butter, which showed a positive ALP by the Sharer method, resulted in regulatory seizure. Since cream for butter manufacture is heated to 185°F for 15 seconds minimum, a zero time analysis will show <10 mU ALP/L. Subsequent equilibration of the cream at 48-52ºF for up to 24 hours will cause some reactivation. The following (Figure 2) shows the extent of ALP reactivation when store purchased butter was left at room temperature.

## Cheese shows reactivation

Even cheese made from pasteurized milk will show the effect of reactivation of ALP during ripening (Figure 3). These data are from Cheddar cheese made at the Hannah Research Institute in Scotland. It is apparent that the cheese making process causes reactivation based on the elevated values at 24 weeks.

Milk in 1/2 pints, taken directly from the filler, was refrigerated (1 carton) and left at room temperature for four hours (1 carton). ALP assays were performed on each carton. The milk in the refrigerated carton had 20 mU ALP/L and the milk in the carton held at ambient for four hours had 195 mU ALP/L. Considering the results of this experiment, what might be expected from the analysis of yogurt for ALP? Pasteurization of yogurt milk is 180-190ºF for 10 to 20 minutes. Incubation temperatures for yogurt are in the range of 95 to 120ºF for 6 to 15 hours, which will reactivate ALP.

To summarize, reactivation of ALP is likely to occur even in refrigerated samples. The higher the heat treatment and the higher the fat content, the higher the ALP value will be. The lower the storage temperature, the slower the reactivation.

Your only protection from "problems" associated with high ALP values is to do a true zero time analysis and correctly fill in pasteurization charts. In-house collection and handling of product samples is of great importance. No thermal abuse can occur. A zero time sample must represent product that is direct from the pasteurizer. This prompts a reconsideration of your current sampling plan. If any product that you produce shows an elevated (300+ mU ALP/L) value for ALP upon regulatory evaluation, your product handling and sampling could be scrutinized. A test procedure is in Standard Methods for the Evaluation of Dairy Products to show the presence of reactivated ALP. It is time consuming and thus expensive to perform. Again your best protection is properly taken, zero time sample evaluated by an approved method in an apparatus that delivers a result on a print out.

## References


1. Kay, H.D. and W.R. Graham. 1935. The Phosphatase Test for Pasteurized Milk. J. Dairy Res. 6: 191-203.

2. Painter C.J. and R.L. Bradley, Jr. 1997. Residual Alkaline Phosphatase Activity in Milks Subjected to Various Time-Temperature Treatments. J. Food Protect. 60: 525-530.

3. Sanders, G.P. and O.S. Sager. 1948. Heat Inactivation of Milk Phosphatase in Dairy Products. J. Dairy Science. 31: 845-857.

4. Scharer, H. 1938. A Rapid Phosphomono-esterase Test for Control of Dairy Pasteurization. J. Dairy Science. 21: 21-34.

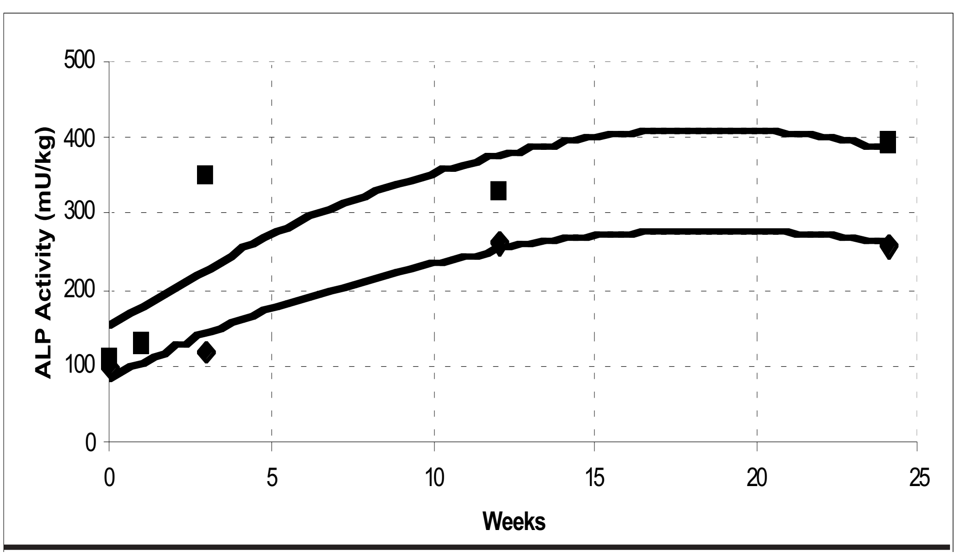
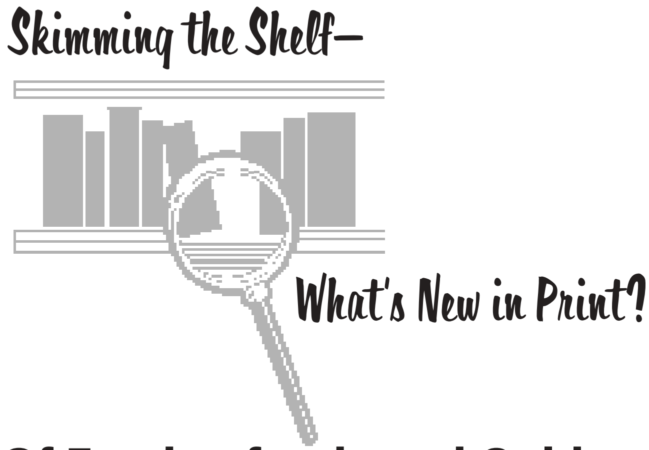




**Figure 3.**
**Reactivated ALP in Cheddar cheese during ripening**

Data supplied by Dr. Jean Banks, Hannah Research Institute, Ayr, Scotland




"There has never before been a sociotechnical issue in agriculture that has so divided citizens, agricultural scientists, and countries as this one."

# Of Frankenfoods and Golden Rice
# Risks, Rewards, Realities of Genetically Modified Foods

**Transactions Volume 89, 2001**
**Wisconsin Academy of Sciences, Arts and Letters**
*Edited by Frederick H. Buttel and Robert M. Goodman*

Are you curious about genetic engineering? Do you have trouble understanding why people would reject genetically modified food?

Pick up a copy of "Of Frankenfoods and Golden Rice"if you want to monitor a public discussion of the complex issues behind genetically modified food. This is a discussion with a medley of voices, from a Nobel prize winner who helped launch the "green revolution" to an environmental journalist from Montana. You can even follow a philosopher's points in an essay on the ethics of genetic engineering debates, and why ethics matters.

This book originated from a forum in November 2000, sponsored by the Wisconsin Academy of Sciences, Arts, and Letters, an independent, nonprofit organization whose mission is to "gather, share, and act upon knowledge in the sciences, arts, and letters for the benefit of the people of Wisconsin." The forum brought together a diverse collection of thinkers, and included scientists, journalists, policymakers and representatives from industry and agriculture.

What are the questions we might want to ask the experts? Frederick Kirschenmann, director of the Leopold Center for Sustainable Agriculture at Iowa State University, begins his chapter with the following assessment, "The controversy surrounding the use of transgenic technology appears to be based largely on different assessments of the merits of that technology. Proponents argue that genetic manipulation will help us feed the world, cure diseases, and solve many other problems facing the human species. Opponents argue that the projected benefits are overblown and that the technology poses many risks that have not been adequately assessed. But these quarrels inevitably lead us into circular arguments." Kirschenmann concludes with his own list of questions for us to ponder as we develop new technologies, cautioning us to heed the context we are releasing the technology into and to be clear about the problems we are attempting to solve.

Of course, in the case genetically modified foods, the horse is already out of the barn. The editors remind us that genetically modified ingredients have already permeated the food supply in the United States. Most estimates indicate that over half of all foods produced in the U.S. contain modified ingredients. At the same time, the market for organic foods continues to increase and European and Asian countries have concerns about importing some of the food we produce. Buttel and Goodman suggest that this issue of genetically modified organisms (GMO's) is unique, "There has never before been a sociotechnical issue in agriculture that has so divided citizens, agricultural scientists, and countries as this one."

If you are curious about this division, the range of opinions on GM food, and the reasoning behind them, then this might be a book for you.

You can order "Of Frankenfoods and Golden Rice" (It only costs $8 plus $2.50 for handling) from:
Wisconsin Academy
1922 University Ave.
Madison, WI 53705-4099
Phone: 608-263-1692
Fax: 608-265-3039
http://www.wisconsinacademy.org

# Curd Clinic

*The curd clinic doctor for this issue is Juan Romero, Analytical Services, Center for Dairy Research*

**Q.** We are paying much closer attention to cheese yield lately and, in the process, are tracking cheese composition more carefully. I've noticed that, for certain cheeses, the salt determinations seem to be running a little high. Are we doing something wrong?

**A.** Well, this problem popped up in our lab, too. It puzzled me for a while–particularly since all of the standards and the reagent blanks were well within specifications. Further digging pointed me to the answer, which boils down to the difference between measuring the actual salt,(NaCl) or the chloride ion,($Cl^-$). It often turns out that the cheeses with suspiciously high salt levels have calcium chloride ($CaCl_2$) added in their make procedure. Allow me to explain.

In an aqueous solution, soluble ionic compounds separate into cations and anions, which are surrounded by water molecules. For our problem, sodium chloride dissolves in water to form sodium cations, $Na^+$, and chloride anions, $Cl^-$. Ionic compounds containing polyatomic ions also dissolve in water to form separate anions and cations, but the polyatomic ions remain intact.

In cheese, when the test portion is boiled or homogenized to form a solution of sodium chloride in the presence of known amount of silver nitrate, the reaction can be written in complete form as:

$$NaCl + AgNO_3 \ddagger AgCl + NaNO_3$$

The insoluble precipitate, AgCl, is not broken down into separate ions, since it is not dissolved. The sodium and nitrate ions are spectators to the precipitation reaction between silver and chloride ions. If we remove the spectator ions, the net ionic equation can be written:

$$Cl^- + Ag^+ \ddagger AgCl$$

The equation above assumes that $Cl^-$ cations from NaCl are the sole source of ions reacting with the $AgNO_3$. However, if calcium chloride has been added, then that assumption is not accurate since$CaCl_2$ would ionize to $Ca^{++}$ and $Cl^-$.

The second reaction occurs as the excess silver nitrate reacts with the potassium chromate indicator to form silver chromate, which produces a brown color.

$$2AgNO_3(\text{excess}) + K_2CrO_4 \ddagger Ag_2CrO_4 + 2KNO_3$$

So now we have measured chloride indirectly by quantifying the excess silver nitrate. Using the formula weight of NaCl (FW=58.5), we can then calculate the total "salt' content of the cheese:

$$\%NaCl = \frac{(\text{ml } AgNO_3)(N)-(\text{ml } K_2CrO_4)(N) \text{ x } .0585\text{x}100}{\text{grams sample}}$$

This calculation assumes that all chloride is from NaCl, regardless of where it really came from, ie. calcium chloride. If we wanted to know the actual NaCl content, rather than the Cl content, of the cheese we need to determine the amount of sodium in the sample and determine sodium chloride by stoichiometry. This is time consuming and expensive. In conclusion, if you want to understand your results then know the ingredients used and how the test works. Whatever you do, don't blame the analyst!

# News from CDR

### Norman F. Olson graduate scholarship awarded

Vidya Sridhar was awarded the Norman F. Olson graduate scholarship during the International Cheese Technology Exhibition in April. Vidya, an articulate and enthusiastic graduate student is working on the biochemistry of bitter peptides that influence cheese flavor. This is an annual award, funded by Wisconsin Cheese Makers Association.

### Highly cited researchers

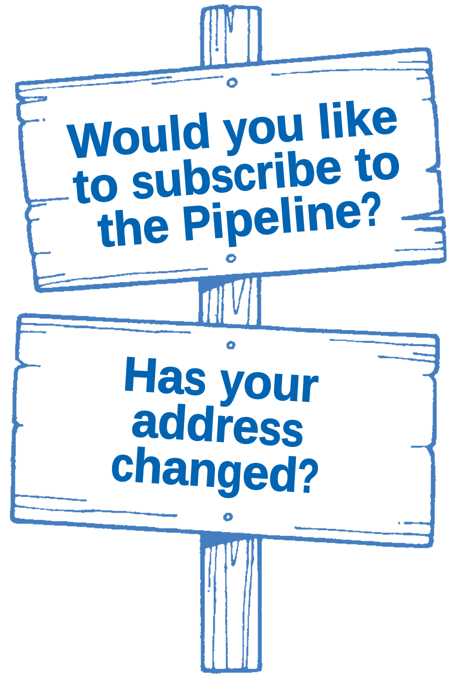
The Institute for Scientific Information (ISI), publisher of Current Contents, recently identified two former professors of food science as highly cited researchers. Both Elmer H. Marth and Norman F. Olson were 2 of 111 agricultural science researchers who were frequently cited, a key measure of the author's influence on science and technology.

### Lorraine Heins joins CDR

If you are planning any projects in CDR's pilot plant you may notice another new face in the group around the cheese vat. Lorraine Heins recently joined CDR's Cheese Industry and Applications program. Lorrie, who comes to us from Chr.Hansen, Inc., recently earned a Masters Degree in Food Science from the University of Illinois. The applications program is happy to have her enthusiasm and knowledge, and they've already got her immersed in process cheese projects.

### Rusty Bishop, new chairperson of IDF committee

Rusty Bishop, CDR director, was nominated and appointed Chair of the United States National Committee of the International Dairy Federation (IDF). This committee represents the U.S. dairy industry in the IDF, an independent, non-governmental group that promotes the image, trade and consumption of milk and milk products.




Please help us keep our mailing list current! Simply phone, fax or e-mail the information requested below to:

*The Dairy Pipeline*
Center for Dairy Research
1605 Linden Dr.
Madison, WI 53706
phone: 608/262-8015
fax: 608/262-1578

You can also choose to forgo a mailed copy and get on our e-mail subscription list which will remind you to read the Pipeline on the web. E-mail this request to hogensen@cdr.wisc.edu

**Name** ____________________

**Company** ____________________

**Street Address** ____________________

____________________

**City** ____________________

**State** ____________________

**Zip** ____________________

**Country (and mailing code)** ____________________

☐ CHANGE ☐ ADD ☐ REMOVE

# Dairy Pipeline

*The Dairy Pipeline*
Center for Dairy Research
1605 Linden Dr.
Madison, WI 53706-1565
phone: 608/262-5970
fax: 608/262-1578

Karen Paulus, Editor

Technical Reviewers:
Mark Johnson, CDR
Norm Olson, Dept. of Food Science
Jim Path, CDR
Marianne Smukowski, CDR
Tom Szalkucki, CDR
Karen Smith, CDR
Bill Wendorff, Dept. of Food Science

The *Dairy Pipeline* is published by the Center for Dairy Research and funded by the Wisconsin Milk Marketing Board.

To subscribe to the Pipeline simply phone, fax, or e-mail your request to CDR. (Form on page 11) We welcome your questions and comments. Send them to:

Karen Paulus, Editor
e-mail: Paulus@cdr.wisc.edu
phone: 608/262-8015

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

## Calendar

**July 22-25 American Dairy Science Association Annual Meeting,** sponsored by American Dairy Science Assn. Quebec City, Quebec. For more information call ADSA, (217) 356-5146.

**Aug. 1-3 American Cheese Society Annual Meeting.** Washington, DC. For info, call (502) 583-3783.

**Aug. 20-21 Milk Pasteurization and Process Control School.** Madison, WI. Call Scott Rankin at (608) 263-2008 for information, or the CALS Outreach Services (608) 263-1672 to register.

**Sept. 18-19 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., Wisconsin Dells, WI. For more information, call Kathy Glass, FRI at (608) 263-6935.

**Sept. 24-25 A Fresh Look at Fresh and Other Unique Cheeses Artisan Course,** Madison, WI. (Wisconsin cheesemakers only) Program Coordinator: Jim Path, (608) 262-2253.

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

**Oct. 16-17 North Central Cheese Industries Assn. Annual Convention.** Brookings, SD. For information, call Dr. David Henning at (605) 688-5477.

**Oct. 17-18 Pasteurization Short Course for Trained Operators.** River Falls, WI. Sponsored by UWRF. Program Coordinator: Ranee May (715) 425-3704.

**Oct. 29-30 Membrane Processing of Dairy Products Short Course.** Madison, WI. Program Coordinator: Bill Wendorff (608) 263-2015 and Karen Smith (608) 265-9605.

***Wisconsin* Center for Dairy Research**
**University of Wisconsin-Madison**
**1605 Linden Drive**
**Madison, Wisconsin 53706-1565**

**ADDRESS SERVICE REQUESTED**