DAIRY PIPELINE

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Wisconsin Center for Dairy Research

Ammonia Nitrogen—the Next Environmental Challenge For Dairy Plants

by W. L. Wendorff, Dept. of Food Science, University of Wisconisn—Madison

Over the past several years, we have seen new environmental regulations established for phosphorus and chloride in dairy plant effluents. The next compound of concern is ammonia nitrogen. Since 1996, a Department of Natural Resources industry advisory committee has been discussing establishing new regulations covering ammonia nitrogen limits in discharges to Wisconsin surface waters.

Initially, the proposed regulations did not seem to have a significant impact on dairy plants. In most cases, process effluents from dairy plants are treated with biological treatments systems prior to discharging the treated effluents to any surface waters. This biological treatment generally removes the low levels of ammonia nitrogen from milk wastes. The only area of concern has been the presence of ammonia nitrogen in some sources of cowwater (condensate from evaporative concentration of milk or whey) in dairy plants. Since fathead minnows tend to be very sensitive to ammonia, cow water containing significant levels of ammonia nitrogen would have to be eliminated from discharges to surface waters.

The newest challenge from ammonia nitrogen will be to those small to medium-sized dairy plants discharging process wastewater to land application systems (e.g., ridge & furrow or spray irrigation). Currently, ammonia nitrogen is listed as a water quality indicator parameter in Chapter NR140 (Groundwater Quality). Now the preventative action limit (PAL) for ammonia nitrogen is a 2 mg/L increase over the background water quality of the area.

The DNR Bureau of Drinking Water and Groundwater is proposing that ammonia nitrogen be deleted from the indicator parameters and be placed in the category of health based standards under NR 140. This proposed action is based on a review of toxicology information and recommendations from the Department of Health & Family Services. The new proposed Enforcement Standard (ES) for ammonia nitrogen is 9.7 mg/L and the PAL is 1.9 mg/L. These new standards are based on human toxicity of ammonium chloride in people suffering from kidney or liver disease.

Currently, the DNR Board is reviewing these proposed standards and they may come up for hearings in the next few months. Once the revised standards to NR 140 are approved by the DNR Board and the final rule is in place, those new standards (PAL's) will be put in as limits in requirements on your monitoring wells covering your land applications of waste solutions. Since ammonia nitrogen is closely associated with nitrate nitrogen in the breakdown of milk proteins in the soil systems, the PAL of 2.0 mg/L of nitrate nitrogen may also appear on permits at the same time.

Groundwater is the source of drinking water for over half of the population in the US and for over 85% of rural populations. That is why these new limits are considered critical for human health. As these new standards for ammonia nitrogen are approved, we will develop and circulate a UW Dairy Alert covering the management of nitrogen in dairy wastewater. This new Alert will cover both ammonia and nitrate nitrogen control in both land applications and discharge to surface waters. If you have specific concerns in any of these environmental areas, please let us know.

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What's Inside:

Cheese and Other Dairy Manufacturers
Using Dairy Based Futures Contracts

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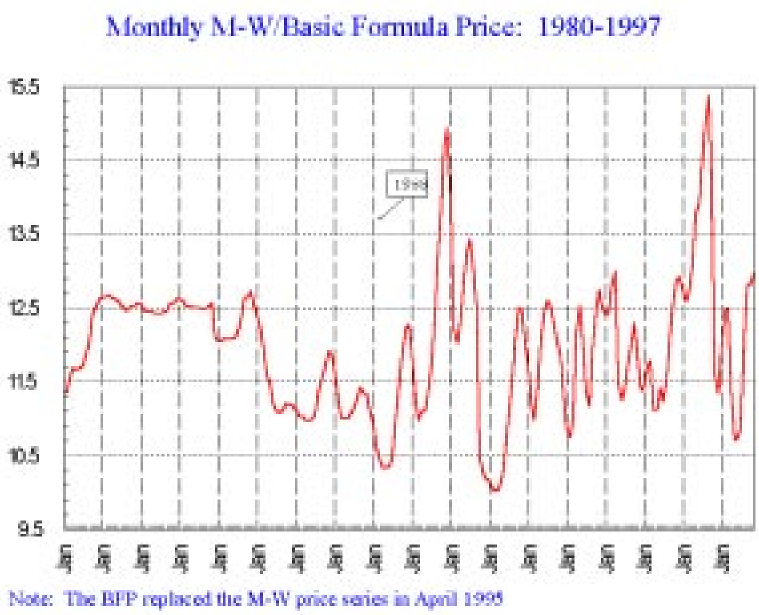
As the U.S. dairy policy evolves to a more market oriented system the dairy industry is undergoing tremendous change. The Federal Agricultural Improvement and Reform Act of 1996 will eliminate dairy price supports by the end of 1999. Under this act, the U.S. Secretary of Agriculture has been given the authority to undertake major reforms to the Federal Milk Marketing Order system. These changes point to the potential for increased variability in farm milk prices. This is likely since even without these changes, the dairy industry has experienced increased milk price variability over the last decade (See Figure 1).

Cheese manufacturers will experience more uncertainty surrounding the cost of their major input— raw milk —as well as the price they receive for their products. They can use a new mechanism to assist in developing risk management strategies to respond to this uncertainty: futures contracts. Modern futures markets for dairy products were established in 1993 with the Coffee, Sugar & Cocoa Exchange's (CSCE) futures establishing contracts for cheese, non-fat dry milk (NFDM) and fluid milk.

Since the inception of these contracts, the choices available have continued to evolve. For example, allowable trading months increased, the types of dairy futures contracts increased, "options" contracts for dairy products have been established, and trading in futures contracts for dairy products started at the Chicago Mercantile Exchange (CME). Currently there are futures and options contracts for Cheddar cheese, NFDM, fluid milk and the Baisc Formula Price at the CSCE and at the CME Cheddar cheese, NFDM, BFP and butter. With these innovations, there has been a steady increase in the use of futures contracts by participants in the dairy industry. In spite of this increased interest, confusion regarding how cheese manufacturers can use these markets to manage input (and output) price risk continues. This article is the first of a series explaining futures contracts and attempting to reduce the confusion.

Figure 1.



I will present an an overview of the functions of futures markets and define some commonly used terms. In subsequent articles, we will work through some simple examples showing how dairy (cheese) manufacturers can use futures markets to lock in their milk costs, set a maximum price for their milk, establish a forward pricing system for their patrons, and enable manufacturers to enter into long term pricing arrangement for their final product.

What are Futures Contracts?

Commodity futures contracts have been traded in organized markets in the U.S. since the 1860s. By definition, a futures market is a forward pricing market. Participants are attempting to estimate, using currently available market information, what the price of a commodity should be at some time in the future. Two of the primary functions of such a market are to assist in the process of *price discovery* and to provide the mechanism to transfer *price risk* by those involved with the production, distribution, or use of a particular commodity. Price discovery is the process of interpreting information of supply and demand, formulating a trading price and adjusting formulations to new information. Price risk occurs when someone believes that a certain set of prices will be true in the future, but the price expectations may differ from what is actually observed.

A commodity *futures contract* represents a legal obligation which

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normally requires the holder either to deliver or to accept delivery of a commodity on or by some future date. Futures contracts are standardized with respect to quality, quantity and terms of delivery. Given this standardization, the only characteristic of these contracts that vary between traders and delivery period is the contract price. Futures contracts are traded for specific months. Some commodities like cattle and hogs are traded for less than 12 months due to the commodity's underlying production or demand characteristics. Other contracts, such as the CSCE's Basic Formula Price (BFP) contract, are traded every month.

When a trader buys (goes *long*) or sells (goes *short*) a particular futures contract, this transaction creates an *open position* in the futures market. The contractual obligations implied by the futures contract can be met by actually accepting delivery or making delivery according to contract specifications at the contracted future date. This rarely happens. In reality, ones contractual obligations can be *lifted* by either selling or purchasing the futures contract for the same month at some time before the expiration of the futures contract. If a trader does not lift his/her futures market position, then transfer of the physical commodity must take place.

Dairy futures contracts are unique

A number of the dairy futures contracts are unique. Instead of having someone deliver or take delivery when a futures contract expires, they are *cash settled* according to a predefined cash price. Feeder cattle and interest rate futures are examples of other contracts with cash settlement procedures. For futures contracts that are cash settled, you still have the opportunity to eliminate the open positions by using the traditional method of purchasing or selling futures contracts to offset the original futures market transaction.

The CSCE, the CME BFP contracts, and the CME Cheddar contract are cash settle contracts. Using the CSCE BFP contract as an example, each BFP contract is for 100,000 lbs (1,000 cwt) of milk. Contracts for each delivery month trade until the day before the USDA announces the BFP for that month. This announcement occurs on or before the 5th of the month following the month for which the BFP pertains. This contract trades for each month and is on a 13 month cycle. For example, in April, there would be futures contracts trading for delivery each month from the current month until, and including, the following April. In May, the current April contract would expire, and a May contract expiring the following year would be added to the trading possibilities. All other contract months would continue trading. When the April BFP contract expires on May 5th, any open BFP positions will be cash settled against the USDA announced April BFP. The CME cheddar cheese futures contract has a similar provision except that it is settled against the NASS cheese price survey.

Producers, processors, buyers and others who have an interest in a particular physical commodity and who use the futures markets to offset the price risk they face in the cash market are called *hedgers*. Purchasers or sellers of futures contracts who neither have, nor wish to possess, the actual (cash) commodity are called *speculators* and they provide the necessary volume in the futures markets. The objectives of the hedgers and speculators are different. By participating in a futures market, speculators are attempting to earn profits as an investor in commodity futures or options. Conversely, hedgers are attempting to use the futures market to transfer their price risk to someone else, e.g. the speculator.

In contrast to a futures contract, *options* on futures contracts are a different type of contract that have the potential for significant use by the dairy industry. Options provide the option owner the right, but not the obligation, to enter into a futures contract commitment at a later date for a predetermined price. The price at which an option owner can enter the futures market is called the *strike price*. The only variable in a futures options is the price of the option, the *option premium*. If the option owner decides to exercise the option, he then has the ability to purchase or sell a particular futures contract at the strike price as defined by the options contract. (In my next article I will explain how dairy processors can use these options to set the maximum price for their milk.) Futures options are traded in pits at futures exchanges in close proximity to the pits for the futures contracts to which the options correspond.

Figure 2 depicts how a trader (for example, a dairy processor) purchases or sells a futures or options con-

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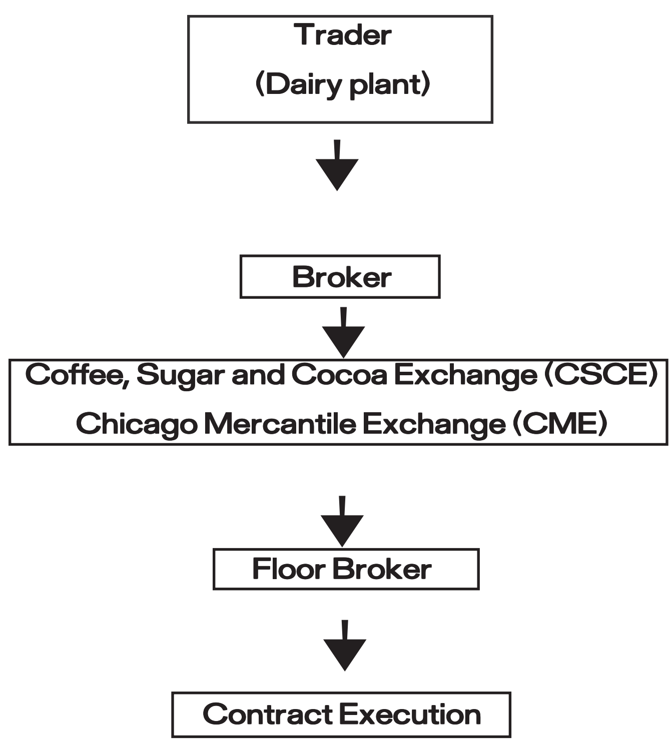
Figure 2.
How futures contracts are bought and sold



tract. Traders (processors) call their broker and place an order to buy or sell a futures contract or option in a particular market. Brokers typically charge a commission on each transaction. Some brokers give a discounted commission for futures market hedgers who complete a *round turn* which is defined as the completion of a "sell and buy back" or of a "buy and then sell" set of futures transactions.

The broker then transmits the order to the floor of the exchange via the floor broker representing the brokerage firm that received the original order. Orders are filled by an open outcry auction system. The floor broker asks for a certain price if the trader wants to sell or bids a certain price if the trader wants to buy. If other floor brokers representing other clients have orders which allow them to purchase or sell at the price being asked or bid by the original broker, a trade is completed. The important point to remember is that the resulting prices are highly visible and are used by decision makers as price expectations.

As noted, the futures market provides a mechanism for users of a commodity to formulate a "best guess" as to what the price of a particular commodity will be at a particular point in time. The consensus of the future price is based on the available information and consensus will change over time as expectations for supply and demand levels for the future time period change.

Cash-Futures Basis: An Important Relationship

An important concept that must be understood when incorporating the futures market as a risk management tool is *basis*. Basis is the difference between cash and futures prices for a particular commodity. It is usually defined as cash minus futures price for a specific location and for a specific point in time. For example, the XYZ cheese plant could caclulate the delivered milk cost/BFP futures basis. Alternatively, plant management may want to estimate their contracted cheese cash price with a specific CME cheese futures contract. No matter what type of basis is calculated, it is designed to reflect the difference between supply/demand conditions in the local market and the more aggregate supply/demand conditions represented by the futures market.

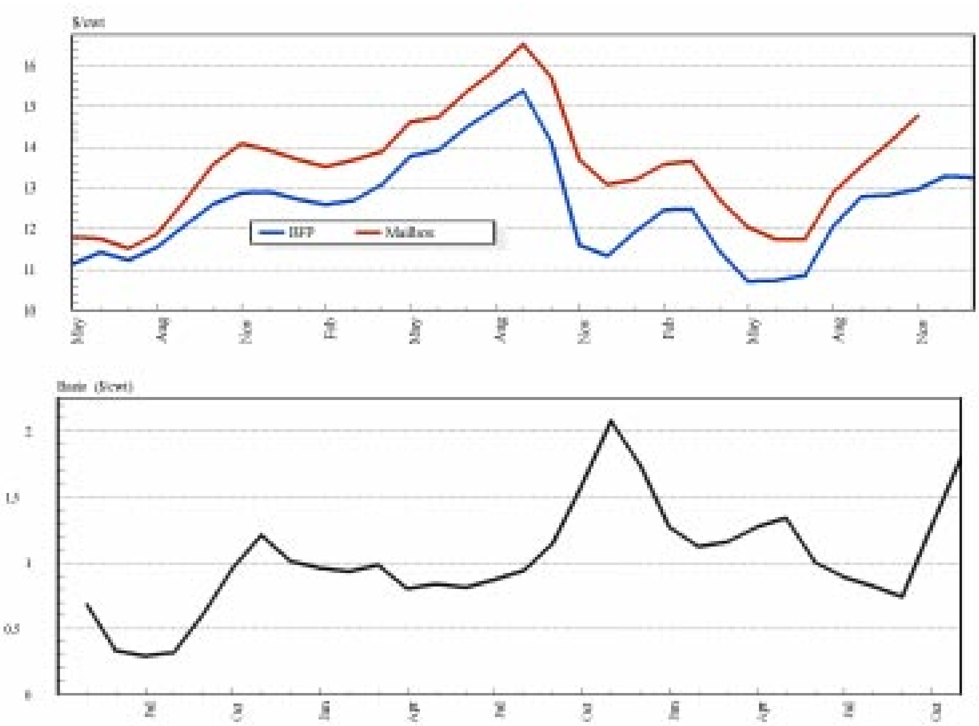
Using the BFP contracts as an example, the BFP futures price on a particular trading day represents the market consensus as to where the BFP will end up in the delivery month identified in the contract. From trading day to trading day, these expectations may change as new information about future supply/demand conditions are obtained. These modified expectations may result in changes in the consensus of where the BFP contract will be at contract expiration, e.g. the actual BFP. By understanding the relationship between the cash/futures basis, the producer and user of fluid milk can provide them with some insights regarding what their local conditions will be in the future.

Figure 3a shows the relationship between monthly M-W/BFP and the Chicago Order mailbox milk price. The BFP and mailbox price tends to move together and be quiet variable. The difference between the two prices (e.g., the

Figure 3. *Comparison of BFP and Chicago Order Mailbox Prices*

3a.

3b.



basis) is less volatile (Figure 3b). Since the basis is more stable than either the mailbox or BFP price series, it can be more accurately forecasted than either price series. This implies that a market participant may not have much success forecasting price changes but may be able to accurately forecast the price which could be locked in for later delivery given a current futures price for the deferred delivery month and an expectation of the basis that will exist in that delivery month (Fortenbery, p.7).

Where Do We Go From Here?

In future issues of the Pipeline we will show how users of milk can hedge (lock-in) their milk costs using a *long hedge* (e.g., purchase a futures contract) of anticipated cash market purchases of fluid milk. We will also provide a simple example where a cheese plant can use a *short hedge* (e.g., sell a futures contract) to protect the price the cheese plant receives for its product. Finally we will show how a short hedge can be used to establish a forward cash price system for the plant's milk suppliers.

For a more detailed review of futures markets and futures contracts, the reader may want to refer to W.D. Purcell, Agricultural Futures and Options: Principles and Strategies, Prentice-Hall, New York, 1991. Also, refer to T.R. Fortenbery, Hedging with the BFP Futures and Options Contracts: A Guide for Price Risk Management in the Dairy Sector, Department of Agricultural and Applied Economics, University of Wisconsin-Madison, 1997, for a specific discussion of BFP futures contracts and their uses.

Mold Growth in Cheese—Variation by Variety

by W.L. Wendorff and I. Jonata, Dept. of Food Science, University of Wiscon sin-Madison

Molds are one of the major spoilage agents of cheese during their aging and marketing. Not only do molds cause appearance and flavor problems, but some produce harmful toxins. Also, molds spoiling shredded cheese sold in resealable retail units can be a problem. After the consumer has opened the initial package and resealed it, molds tend to grow in the remaining product. To reduce the potential of mold growth in resealable packages, Marcy and Bishop (4) have been investigating the use of antimycotic agents and packaging systems.

The type and incidence of spoilage molds in natural cheeses have been previously reported (2,3,7,11). Bullerman and Olivigni (2) reported that 82% of the molds on refrigerated Cheddar cheese were *Penicillium* species, 7% were *Aspergillus* species, 1% were *Fusarium* species, 1% *Alternaria* species, and 9% were other species. Torrey and Marth (7) found that 84% of the isolates from cheese samples from home refrigerators were *Penicillium* species, 8% were *Aspergillus* species, 1% *Mucor* species, and 1% were unclassified. In previous studies, we have reported on mold growth on smoked cheeses (8) and oil-coated specialty cheeses (9).

The purpose of our current study was to determine if certain varieties of cheese used in shredded cheese blends might be more susceptible to mold growth than others.

Materials And Methods

Molds

We used three molds used in this study: *Penicillium roqueforti* NRRL 849, *Penicillium camemberti* NRRL 877, and a *Penicillim* sp. isolated from imported French cheese. *P. rouqueforti* NRRL 849 and *P. camemberti* NRRL 877 have been used in previous studies on mold growth on cheeses (8,9). Molds were grown on slants of Mycological Agar (Difco Laboratories, Detroit, MI) at 22˚C for 3 weeks to allow sufficient production of spores. Spores were harvested with 5 ml of sterile aqueous solution of 0.1% peptone. The suspensions of each mold contained 10^5 to 10^6 spores/ml.

Cheese

Cheeses, purchased from local supermarkets in the Madison area, all had more than 3 months left on their pull dates. The cheese knife, cutting board, and surfaces of the cheese block were swabbed with ethyl alcohol before the cheese was cut. The outer 5mm of cheese was removed from the block with the sterile knife. The block of cheese was then cut into pieces with dimensions of 6 X 6 X 0.75 cm. Samples were placed in sterile petri plates and covered until inoculated.

Measuring mold growth

Growth of molds on cheese samples was measured by the procedure of Yousef and Marth (10). One µl of the spore suspension was inoculated onto the cheese at the center of the plates. Plates were partially sealed with an adhesive tape and incubated at 22˚C. The radius of mold colonies was measured at 24-h intervals. The lag in growth of each mold and rate of radial growth were calculated for each sample as outlined by Yousef and Marth (10). Each block of cheese was prepared and tested in triplicate. Two samples of each variety of cheese were evaluated in the study.

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More Master Cheesemakers

Another group of Wisconsin cheesemakers have achieved Master Cheesemaker status and will be recognized at the Awards Banuet during the 1998 Cheese Show on April 23, 1998 in Madison, WI. The Wisconsin Master Cheesemaker® program offers a formal sequence of seminars and course work leading to recognition as a “Master” in the cheese making trade. This program, unique in the United States, was established by the Wisconsin Center for Dairy Research, UW-Extension, and the Wisconsin Milk Marketing Board to nurture and reward the talent and dedication of Wisconsin’s cheese makers.

While completing this three year “apprenticeship” the Master Cheesemaker’s have attended at least seven courses and passed both oral and written exams. In addition, their cheeses have been tested annually and measured against the accepted standards of identity. However, the strength of this program lies in the creativity, skill, and abilities—and the identity of each cheesemaker—that completes it. Join them in the celebration!

Interested in the Master Cheesem

Applications will be accepted through May
cheesemakers. Call Jim Path (608/262-225
263-1874) for more information.

Ron Sullivan

Ron works for Old Wisconsin Cheese in Platteville, owned by Swiss Valley. He is a Master Cheesemaker of Swiss cheese.

aker program?

from licensed Wisconsin
3) or JoAnn Gauthier (609/

Ken Nett

Ken Nett works for Sartori Foods in Plymouth, Wisconsin. He is a Master Cheesemaker of Parmesan cheese.

Joe Widmer

Joe Widmer owns and operates Widmer's Cheese in Theresa, Wisconsin. He is a Master Cheesemaker of Colby and brick cheese.

Scott Erickson

Scott owns and operates Bass Lake Cheese near Hudson. He is a Master Cheesemaker of Cheddar and Colby.

Summary

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The potential for mold growth on each variety of cheese is shown in Table 1. Parmesan, Romano and Swiss cheeses did not support the growth of molds during the 14 days of evaluation. Asiago only supported the growth of the French *Penicillium* mold. Queso Blanco, Monterey Jack, Colby, and aged Cheddar retarded the growth of the French *penicillium* mold better than the remaining varieties of cheese. With *P. camemberti*, Provolone cheese retarded growth more effectively than the other varieties.

Inhibition of mold growth by Parmesan, Romano, and Asiago cheeses was most likely due to reduced moisture in those cheeses, or the increased presence of free fatty acids(10). In some aged cheeses, e.g., aged Cheddar, ripening reduces the availability of moisture in the cheese (5). Mold inhibition by Swiss cheese was most likely due to the presence of propionic acid, which is a potential mold inhibitor (6). Yousef and Marth (10) reported that the ability of cheeses to delay initiation of mold growth is more significant than their ability to suppress growth of an established mold.

Rate of Mold Growth

The French *Penicillium* mold appeared to have a faster rate of growth than *P. rouqueforti* and *P. camemberti* on many of the cheeses. Molds did not grow on Parmesan, Romano, and Swiss cheeses. Only the French *Penicillium* mold grew on Asiago cheese. Molds grew faster on Mozzarella, Queso Quesadilla, Colby and Monterey Jack cheeses than the other varieties. Mild Cheddar provided a faster growth of molds than aged and medium Cheddar cheeses. This was similar to the findings of Yousef and Marth (10).

The potential growth of spoilage molds on natural cheese seems to vary. By selecting cheeses with lower available moisture, increased ripening and natural mold inhibitors, shredded cheese blends could be produced which would resist mold spoilage and have increased shelf life in resealable bags.

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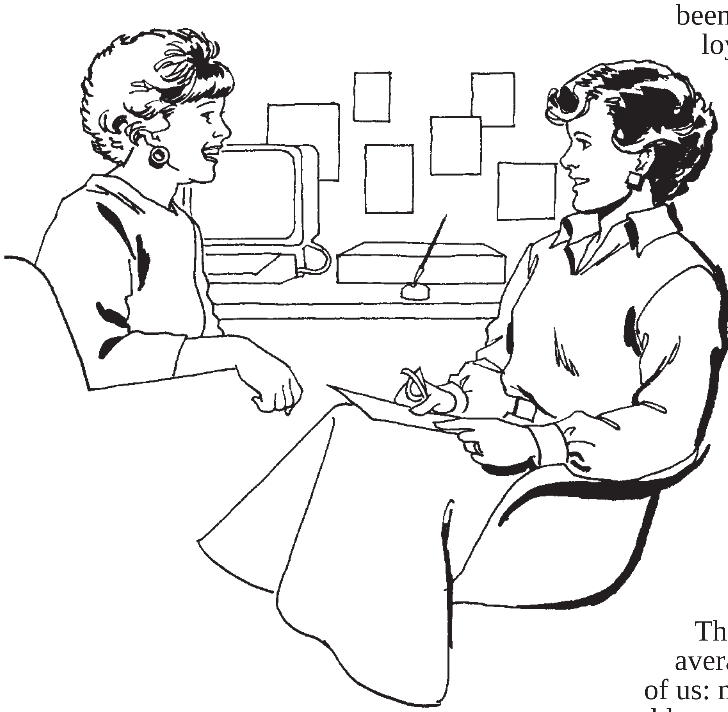
Table 1. Lag in growth and rate of radial growth of colonies of spoilage molds on various varieties of natural cheeses

	Lag period (h)			Radial growth (mm/h)		
Cheese	*P. camemberti*	*P. rouqueforti*	*Penicillium PF*	*P. camemberti*	*P. rouqueforti*	*Penicillium PF*
Parmesan	336.0^{a}	336.0^{a}	336.0^{a}	NG^{de}	NG^{de}	NG^{de}
Romano	336.0^{a}	336.0^{a}	336.0^{a}	NG^{de}	NG^{de}	NG^{de}
Asiago	336.0^{a}	336.0^{a}	20.3^{b}	NG^{de}	NG^{de}	.020^{c}
Swiss	336.0^{a}	336.0^{a}	336.0^{a}	NG^{de}	NG^{de}	NG^{de}
Queso Blanco	336.0^{a}	5.1^{b}	25.6^{bc}	NG^{de}	.042^{c}	.038^{bc}
Monterey Jack	15.6^{c}	18.0^{b}	44.1^{b}	.036^{ab}	.071^{a}	.072^{ab}
Colby	6.3^{c}	9.8^{b}	38.5^{b}	.040^{ab}	.066^{b}	.084^{ab}
Aged Cheddar	21.8^{c}	21.2^{b}	25.7^{bc}	.031^{b}	.037^{c}	.042^{bc}
Medium Cheddar	15.6^{c}	18.2^{b}	18.0^{c}	.026^{b}	.027^{c}	.018^{c}
Mild Cheddar	9.6^{c}	18.5^{b}	23.4^{c}	.056^{ab}	.064^{b}	.061^{b}
Queso Quesadilla	16.8^{c}	16.5^{b}	19.2^{c}	.079^{a}	.088^{ab}	.095^{a}
Provolone (unsmoked)	46.4^{b}	9.4^{b}	9.4^{c}	.018^{b}	.036^{c}	.036^{bc}
Mozzarella	4.8^{c}	15.2^{b}	20.2^{c}	.078^{a}	.089^{a}	.099^{a}

[abcd] Means in the column with different superscripts are significantly different ($P < 0.05$).
[e] NG = No growth of the mold within the 14 days of assessment.

Keeping Competitive —What an Employee Assistance Program (EAP) Can Do for Your Business



Imagine this scenario. You are the plant manager. You notice that your head cheese maker has been sick a lot over the past few months. When he is at work, he alternates between being excessively angry and withdrawn. He has been with your company for 24 years and he's been a loyal employee and well respected by his fellow employees. You know his wife and kids. However, his new attitude is adversely affecting the productivity of the plant. You bring him into your office and ask him how things are going, pointing out the changes you've noticed. He says everything is fine and he'll try to do better. He shuffles out of your office, watching his feet as he walks. You know something is very wrong, but you don't know what to do.

In the old days, you might have said to yourself that his problems were his business not yours. You might have started a disciplinary process designed to force him to address the performance issues you've observed, while underscoring that personal problems need to be left at home. If things didn't turn around, you would have terminated him.

These days it is not so simple. Chances are your average employee feels the same pressures as the rest of us: more stress, chemical dependency and marital problems, fewer family and community ties for support.

Fortunately, Employee Assistance Programs, or EAP's, have evolved to help managers help their employees solve their problems. Most comprehensive EAP programs are staffed with professionals trained to work with adults on a wide variety of personal problems including substance abuse, mental health, stress management, family and legal problems. The best programs are voluntary and confidential, but can be used as a precursor to a disciplinary process.

EAP programs differ in scope, delivery method, and program cost. As an employer, it is important to know what you want to get from an EAP before you start to shop around. Here are some tips to get you started:

If you are a relatively small employer looking for a solution to a specific problem with one or two employees, check to see if your current health insurance plan or HMO provides coverage for employee assistance or other counseling services.

If you are a medium-sized employer looking for a more coordinated approach, try an off-site provider of EAP referral-only or complete counseling services. A prospective EAP provider should be able to perform an organizational analysis to determine whether your company's insurance will cover the cost of the program.

If you are a large employer (several hundred employees), it may be cost effective to bring your EAP in-house. This approach only works if employee confidentiality is absolutely protected.

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News from CDR

You're invited...

CDR's Open House
April 21, 1998
1-5 p.m.
Babcock Hall
1605 Linden Dr.

Please call (608) 262-5970 for information, RSVP, parking details.

CDR's Open House
A Window of Opportunity

Employee Assistance, *continued from page 9*

Regardless of the approach you use, keep in mind that research on the cost effectiveness of EAP's has shown that for every dollar spent on an EAP, employers save roughly five dollars in employee-related costs later. It may be as high a $16 in cases of alcohol and drug abuse.

As for you head cheese maker, think how good it feels to have him back—as a contributing member of your team. His clinical depression was successfully diagnosed and treated with the help of an Employee Assistance Program.

Calendar *continued from back page*

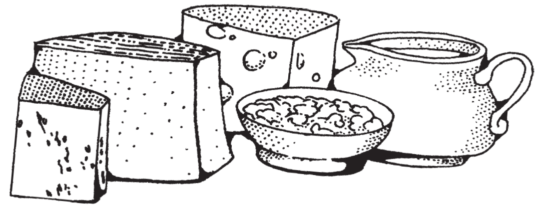
Aug. 16-19 IAMFES Annual Meeting, Nashville, TN. For Info, call (515) 276-3344.

Sept. 16-17 Marschall Italian & Specialty Cheese Seminar, Madison, WI. For info, call (219) 264-2557.

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., Oshkosh, WI. For more information, call Bill Wendorff at (608) 263-2015.

Oct. 19-23 Wisconsin Cheese Technology Short Course. Madison, WI. Call Bill Wendorff at (608) 263-2015.

Curd Clinic



Q. I am having texture problems with the cottage cheese I make, sometimes it is too soft and mushy. Can you help me solve this problem?

A Textural properties are certainly on the list of cottage cheese quality problems. Like you, other cheese makers have found product that is too soft and/or mushy can be one of the most common problems. To overcome this problem, you need to understand the effects of composition and process variables on the textural properties of the product. Once you have an overall understanding, you can then look systematically for particular reasons.

Rheological, or textural, properties of cottage cheese are affected by the composition and texture of the curd ,the cream dressing (or liquid part of cottage cheese), the ratio of curd-to-dressing, and by the interactions between curd and dressing. The latter refers to mass-transfer between the curd and the dressing—dressing absorption by the curd.

For a given milk composition, the texture of the curd is determined by the acidification profile, pH at cutting, amount of coagulating enzyme you use, cutting variables, curd cooking parameters, and stirring variables.

A soft curd is usually associated with curd that has been cut when the pH is too low, and/or curd that has been cooked at a temperature and rate that is too low or too high. A pH that is too low produces a soft curd that is very low in calcium. Cutting at a higher pH can help solve the problem. If the cooking rate is too high, moisture (whey) becomes "locked" within the curd particles. This produces curd that is too soft. Cooking at a temperature that is too low will not induce the necessary driving-force for whey expulsion. This will also produce a moisture content that is too high and softer curd than desired.

Foaming during vat filling is another factor that can lead to soft curd, especially when you use coagulating enzymes in combination with starter culture. Foam will prevent even distribution of the enzyme in the milk and you will find that the proportion of enzyme actually assisting in coagulating the milk will be significantly lower than what you want. Since enzyme concentration is related to curd firmness, it is clear that uneven distribution can lead to a softer curd. Cheese makers should eliminate foaming during vat filling. The best way to accomplish this is by filling the vat from the bottom.

Curd shattering is another explanation for soft or mushy product. Curd shattering is the result of poor cutting, excessive stirring (during cooking), too-powerful curd pumping, using the wrong pump,or excessive mixing during creaming. You'll find that each of the above, or even a combination of some of them, leads to accumulating relatively high proportions of curd-fines (or dust). These small particles, together, have a very large surface area. Large surface area leads to a massive absorption of dressing and the formation of a "mushy" mixture. I highly recommended that you carefully study the effect of each of the aforementioned variables on curd particle size-distribution. You can use a set of standard sieves to identify the stages in the process that generate fines and then solve the problem.

Following creaming there are many mass-transfer interactions that result in selective absorption of dressing components by the washed-curd particles. Of special interest is the total surface area of the curd, which is determined by the curd particle-size, dressing composition and curd-to-dressing mass ratio. Curd particles that are too small, fines, and a high proportion of dressing will produce soft curd. Adjusting curd particle size (elimination of fines) and/or reducing dressing proportion are approaches you can take to overcome the problem.

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You also need to recognize that there are significant differences in the way a given curd interacts with different dressings. The common practice is to use the same curd in formulating full fat (FF) low fat (LF) and fat-free (FFR) cottage cheese. Fat, in the form of globules, has a critical role in controlling dressing uptake by curd. In dressings containing fat, milkfat globules adhere to the outer surface of the curd and block pore openings. This limits the flow of water into the curd particles. The effect is inversely related to milkfat content of the dressing. Thus, dressing uptake (by a given curd) is in the order FF > LF > FFR. This is one of the reasons that many reduced fat and fat-free cottage products are too soft. When making reduced fat varieties you should adjust the curd solids to a higher level, and/or increase water-holding capacity of dressing (by proper selection of hydrocolloids), and/or lower the proportion of dressing in the product.

Calendar

Apr. 14-17 Basic Cheesemaker's License Short Course, River Falls, WI. Call Ranee May at (715) 425-3150.

Apr. 16 Wisconsin Dairy Products Association Annual Butter and Cheese Grading Clinic. Wisconsin Dells, WI. For information call WDPA, (608) 836-3336.

Apr. 21 CDR Open House. 1-5 pm. Call (608) 262-5970 for information.

Apr. 22-23 International Cheese Technology Exposition, Madison, WI. For information, call Judy Keller at (608) 255-2027.

May 5-6 Whey and Whey Utilization Short Course, Madison, WI. Call Bill Wendorff at (608) 263-2015.

May 12-13 Chr. Hansen's Cultured Dairy Products Symposium, Milwaukee, WI. Sponsored by Chr. Hansen's Lab., (414) 476-3630.

May 19-20 Cheese Technology- a Northern European Approach, Madison, WI. Call Jim Path at (608) 262-2253.

May 20-21 Applied Dairy Chemistry Short Course, Madison, WI. Call Bill Wendorff at (608) 263-2015.

June 3-4 Wisconsin Cheese Grading Short Course. River Fallls, WI. Call Bill Wendorff at (608) 263-2015.

June 20-24 Institute of Food Technologists Annual Meeting, sponsored by the Institute of Food Technologists. Atlanta, GA. For information, call IFT, (312) 782-8424.

July 27-30 American Dairy Science Association Annual Meeting, sponsored by American Dairy Science Assn. Denver, CO. For more information call ADSA, (217) 356-3182.

Aug. 10-13 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.

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CDR

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