DAIRY PIPELINE

Spring 1998 Vol. 10 No. 2 A Technical Resource for Dairy Manufacturers

Wisconsin
Center for Dairy Research

Making Cheese with UF Raw Milk

by Mark Johnson, Center for Dairy Research and Bill Wendorff, Dept. of Food Science, Univ. of Wisconsin-Madison

Although using ultrafiltration (UF) to concentrate raw milk on the farm is not a new concept, recent modifications are making the process more feasible. Perhaps it's an idea whose time has come. At the March International Cheese Technology Exposition, Ted Jacoby gave an update on the potential use of on-farm concentration of raw milk for cheesemaking (1). Using UF allows you to concentrate milk proteins and fat in raw milk, reducing the volume of milk and cutting transportation costs.

In 1982, Amundson and coworkers (2) concentrated raw whole milk three-fold with a spiral wound UF membrane on the farm. Milk was taken from the automatic milk line, without cooling, and concentrated up to 24% total solids, 9.8% protein and 11.5% fat. They recovered about 99% of the protein and 100% of the fat in the raw milk retentate. Economic analysis of the UF process showed that it was economically feasible for farms with over 100 cows (3).

Heat treatment

In 1986, Zall and Chen (4) reported that milk that was heat treated at 165˚F for 10 seconds, before concentration with UF, yielded more Cottage cheese than milk that was concentrated first and then heat-treated. During 1984-86, Zall (5) also operated an on-farm UF system in which they processed over 14 million pounds of milk. They heat-treated the raw milk at 158˚F for 10-20 seconds prior to concentration. Storage studies showed that the unpasteurized concentrates could be held up to 4 days with negligible rancidity. Microbiological results indicated that bacterial counts of the UF retentates were similar to those of the raw milk. In spite of the success with the system, FDA would not approve the process since there were lingering questions about the heat treatments and microbial safety of the retentates (6). They also had some concerns about cleaning the UF system.

In 1995, Raghumath and Hibbard of Membrane System Specialists of Wisconsin Rapids (7) filed for a patent on an improved UF process for concentrating raw milk at the farm. Their process involved cooling the raw milk to less than 45˚F and directing the cooled raw milk through serial membrane separation units while maintaining the cool temperatures. By using serial membranes, they claim that they were able to concentrate the milk in the system without the problem of bacterial buildup experienced in closed loop or recirculating systems. About a year and a half ago, they were able to get FDA approval for their process which concentrates raw milk for cheesemaking (1).

UF processing plant

This past year, Membrane System Specialists, Select Milk Producers of New Mexico, and North American Milk Products of St. Louis, MO formed a joint venture and built a UF processing plant on one of Select Milk Producer's farms. Milk concentrated by the licensed process is cooled to 34˚F prior to ultrafiltration. Milk is concentrated 3:1, producing a retentate with about 10.5% fat, 9.3% protein, 4.8% lactose and 1.7% ash (1). The current process costs about 70 cents per cwt. of raw milk fed to the system and the UF retentate is currently priced about $2.20 over the Basic Formula Price (BFP) delivered (1).

There are a number of reasons for using the UF process to concentrate raw milk at the farm. Slack et al. (3) reported that reducing fluid volume and weight would lower refrigeration and hauling costs for producers. Cheesemakers would save on the reduced cost for refrigeration, pasteurization and heating, reduced requirements for storage capacity, reduced need for whey processing, increased production capacity, and reduced requirements for rennet and possibly starter. Jacoby indicated that the UF connJntrated milk offers cost saving advantages in

continued on page 6

What's Inside:

Using Dairy Based Futures Contracts, Part 2

To Hedge or Not to Hedge, is that the Question?

Brian W. Gould, Senior Scientist, Wisconsin Center for Dairy Research

Dairy farm operators and dairy food manufacturers have an important new tool to manage their price risk—dairy-based futures contracts. In the last issue of the *Dairy Pipeline* I reviewed some of the basic principles of futures markets and provided definitions of common terms. In this issue I'd like to continue this discussion and show you how cheese plants (and other types of manufacturers) can use a futures market hedge. I will present examples showing how a cheese plant manager can use futures contracts to protect a desired operating margin. Then I will use a second example to show how you can use futures markets to offer your patrons a forward price contract for their milk.

Using a futures hedge to minimize operating margin variability

Suppose Good Cheese Co. has agreed to supply a major grocery chain with 20,000 lbs. of Colby cheese in April. However, Good Cheese must sign the contract in January for their April production without knowing the cost of the milk that will be used to produce the contracted cheese. Even though the plant manager doesn't know what the Basic Formula Price (BFP) will be in April, he knows that he can incorporate a futures market hedge based on the milk required for contracted production and greatly reduce the uncertainty of future milk prices.

On January 15th plant management needs to enter into a contract with the store chain. On this day, plant management finds that the April BFP futures contract is trading at $12.00/cwt. Again, this represents the market's best guess in January as to the expected value of the April BFP. From past history, the plant manager typically has to pay $1.25 over the BFP reflecting the normal "pool draw," quality differentials and local demand conditions. We can refer to this difference as the BFP-cheese plant *basis*. When deciding on the sale price the plant manager would like to ensure that his operating margin (including profit) is covered. Non-milk costs (including profit) are $0.12/lb of cheese.

With futures market's evaluation of the April BFP in January ($12.00), the BFP-cheese plant basis ($1.25), operating margin ($0.12), and a yield of 10 lbs. of cheese/cwt, the manager agrees to supply his customer the cheese for a price of: ($12.00+$1.25)/10 + $0.12 = $1.445/lb. How can the plant manager use futures markets to protect the operating margin against rising milk

Table 1. Using BFP Contract to Hedge Cheese Plant Operating Margin Assuming No Basis Change

Date	Cash Market	Futures Market	Basis
Jan. 98	Cheese plant commits to providing 20,000 lbs. of cheese during April 1998 at a fixed price of $1.445/lb	Purchases 1 April BFP contracts at $12.00 from the CME	$1.25
May 98	April BFP announced at $13.00	Cash Settles April BFP contracts at $13.00	$1.25
	Cheese plant pays $13.00 + $1.25 per cwt.	Pays Commission at $0.08/cwt of milk	
	End of April, make and deliver cheese at $1.445/lb		
	Loss = $1.445 - $ 0.120 - ($14.45/10) = $0.10/lb of cheese	Gain = ($13.00 - $12.00 - $0.08)/10 = $0.092/lb of cheese	
	Net Price Received for Cheese $1.445 - $0.10 + $0.092 = $1.437		

Note: We are assuming a cheese yield of 10 lbs. of cheese/cwt of milk.

prices given that he has to enter into a long term sales agreement with the grocery chain?

Table 1 shows how dairy futures can be integrated into the cheese plant's marketing strategy to minimize the risk from entering into a long term contract. Since the cheese plant does not own the milk that will be needed to produce the cheese in April, the cheese plant is *short* in cash milk. To undertake a successful hedge, the plant manager needs to take an equal and opposite *position* in the futures market as exists in the cash market. Thus, the cheese plant needs to go *long* in the futures market, that is purchase BFP futures contracts. In order to hedge the operating margin for the April production, plant management needs to purchase April BFP contracts, in January, equivalent to 200,000 lbs.of milk.

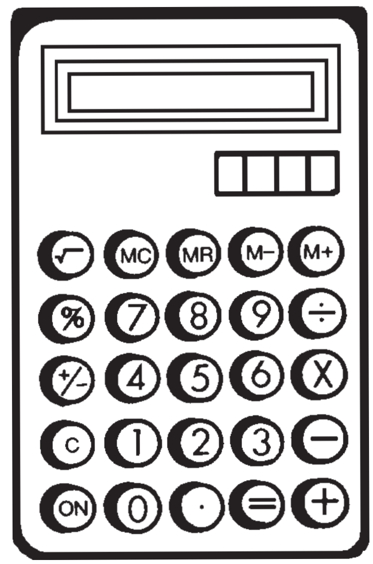
Both the Coffee, Sugar and Cocoa Exchange (CSCE) the Chicago Mercantile Exchange (CME) have BFP contracts that are cash settlement types of contracts. The CSCE BFP is for 100,000 pounds of milk while the CME contract represents 200,000 lbs of milk. The plant manager decides to go long in the CME futures market by purchasing April BFP contracts in January. (Note that we are assuming the operating margin is unchanged.)

At the end of April, Good Cheese Co. makes and delivers 20,000 pounds of cheese at the contract price of $1.445/lb. On May 5th the April BFP price is announced as $13.00, $1.00 over the target milk price used to establish the cheese contract. Therefore, on the cash market, the cheese manufacturer has experienced a loss of $1.00 assuming that the BFP-cheese plant basis remains at $1.25. If the basis where to increase or decrease, the subsequent loss would also increase or decrease. Historically, plant management has found the month-to-month variation in basis to be less than the monthly variation in BFP. That is, the basis risk faced by plant management is less than cash price risk.

Lifting the hedge

If Good Cheese had not been hedging, then the above price movements would have resulted in an actual loss of $0.10/lb of cheese. To offset the loss experienced in the cash market, the plant manager needs to *lift the hedge* by selling the April BFP futures contracts purchased in January. Since the BFP futures is a cash settlement contract, all plant management has to do is to allow the contract expire and the CME will simply credit the difference between the purchase and sales prices to the plant's account. When the plant purchased an April BFP contract for $12.00 in January, and then cash settles the contract at the announced $13.00 April BFP price, there is a profit of $1.00 minus the brokerage commission. This profit can then be used against the cash market loss. The net price received for the plant's cheese is just slightly less than the desired level.

This example illustrates a number of important points involved with using futures markets for hedging purposes. First, the objective of incorporating hedging strategy into your marketing plan is not to increase profits. Rather, the objective is to minimize the risk (variation) of these profits. Thus, when using a hedging strategy, it is important to remember that you may not be able to take advantage of the cash market if it moves in an unanticipated positive direction after you placed your hedge. For example, rework the above with the announced April BFP as $11.50 instead of $13.00. Once you set in motion a particular hedging strategy you should continue with it until its normal termination. Secondly, when using a hedge strategy you are trading off basis risk for cash price risk. As shown in the previous issue of the *Dairy Pipeline*, basis usually changes much less from day to day or month to month than what is observed in the cash market. There still may be some risk to whatever you are attempting to hedge, but this risk will be substantially less than if you are only in the cash market. Rework the above example if the basis were to increase to $1.50 or decrease to $1.00. What are the implications? Finally, as with any hedge, the above strategy reduces the plant's operating margin variation because you are taking an equal and opposite stance in the cash versus futures market.



Using futures markets to cash forward price

Using forward pricing to purchase raw milk is an increasing trend in the dairy industry. Both dairy farm operators and milk processors benefit from this arrangement. For dairy farm operators, it provides some stability in the price received for their output, which allows longer term business planning. For the dairy processor, it provides some stability in the price of a major input. A number of cheese manufacturers have used cheese futures contracts as a basis for forward (fixed) price contracts given the early development of cheese futures. Since the establishment of cash settle BFP contracts on the CSCE and CME, these contracts are beginning to be used as a basis for a number of forward price systems. The example in Table 2 shows how a simplified version of such a system would work.

Suppose, like the previous hedge example, in January the BFP futures contract for the April BFP is trading at $12.00/cwt. Cheese plant management would like to offer its producers a forward price for milk delivered during April. How can management use the futures market to forward price? As shown in Table

next page

continued from page 3

2, plant management in January can use the April BFP contract to set the forward price. The April forward contract price ($13.17) is determined in January by adding the plant's expected "pool draw" ($1.00) and plant premium ($0.25) and subtracting commission costs ($0.08) from the April BFP futures price ($12.00) observed at the time the forward price contract is set.

In January, the cheese plant makes a commitment to purchase a producers milk in April at a fixed price— the cheese plant is *long* in the cash market. Therefore, the cheese plant must go *short* (sell a contract) in the futures market to offset this long cash position. Remember, to be completed hedged, you need to have equal but opposite positions in the cash versus futures markets. For every 200,000 pounds of milk contracted for purchase in April, the cheese plant sells a BFP contract on the CME.

By placing the above hedge, the plant is protected against adverse price movements. Assuming no change in the basis, if the futures market prices decreases, the resulting loss in the cash market, measured relative to what competitors pay for milk, will be offset by futures market gains when the hedged is lifted in April. To see this, look at Case I in Table 2 which shows the impact of a decline in the actual BFP price observed in April. If the April BFP turns out to be $11.25, implying an actual April pay price of $11.25+$1.00+$0.25 = $12.50. This firm will be paying $0.67/cwt more than other cheese plants given that the plant has forward priced milk for $13.17 . This "loss" will be offset by the $0.75-$0.08=$0.67/cwt profit in the futures market since the firm is purchasing back the futures contract at a lower cost ($11.25) than originally sold ($12.00).

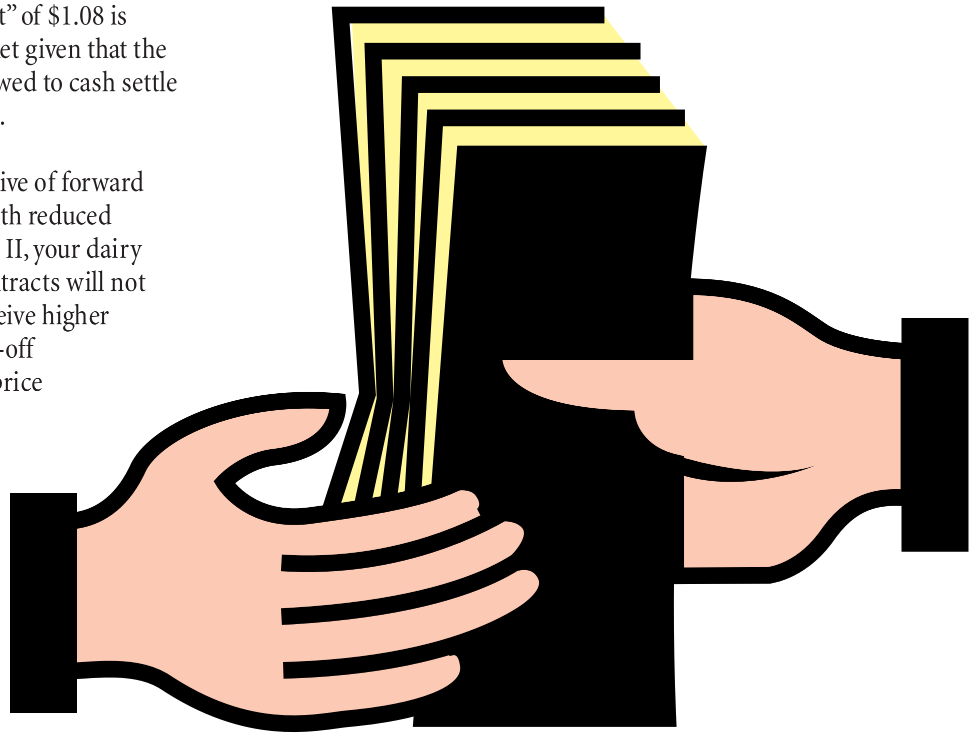
Table 2.
Using a BFP Contract to Offer a Forward Price Contract to Dairy Farm Operators Assuming No Basis Change

Date	Cash Market	Futures Market	Basis
Jan. 98	Cheese plant offers fixed price contract to Grade A patrons with 3.5% milk for April milk for $13.17 = $12.00 + $1.00 + $0.25 - $0.08	Sells an April BFP contract at $12.00	$1.25 = $1.00 "pool draw" + $0.25 premium
Case I: Impact of a Futures Price Decline			
May 98	April BFP announced at $11.25	Cash Settles BFP contract at announced April BFP: $11.25	$1.25
	Competitors pay price is $12.50		
	Cheese plant pays producers at the agreed contract price of $13.17	Pay commission at $0.08/cwt	
	"Loss" = $12.50 - $13.17	Gain = $12.00 - $11.25 - $0.08 = $0.67	
Case II: Impact of a Futures Price Increase			
May 98	April BFP announced at $13.00	Cash Settles BFP contract at announced April BFP: $13.00	$1.25
	Competitors pay price is $14.25		
	Cheese plant pays producers at the fixed price contract price of $13.17	Pays Commission at $0.08/cwt	
	"Gain" = $1.08	Loss = $12.00 - $13.00 - $0.08 = $1.08/cwt	

This example is based on the material contained in, *The Basic Formula Price Milk Futures Contract: A New Industry Risk Management Tool*, by E. Jesse and R. Cropp, Coffee, Sugar and Cocoa Exchange, 1996.

In Case II we show the impact of having a forward price contract when the actual BFP observed in April is $13.00 . Given the assumed basis of $1.25, competitors will be paying $14.25 for their milk while this plant continues to pay the fixed contract price of $13.17 . This "profit" of $1.08 is offset by the loss in the futures market given that the cheese plant's BFP contracts are allowed to cash settle at the announced April BFP contract.

Like any hedging strategy, the objective of forward pricing is to provide your patrons with reduced levels of price risk. Thus, under Case II, your dairy farm patrons holding fixed price contracts will not be pleased with their inability to receive higher pay prices. This represents the trade-off required when trying to control for price variability.



The above examples provide a sampling of the types of creative marketing that you can do to manage your price risk through the use of dairy-based futures contracts— whether this risk is associated with your output price or input costs. The two hedging examples we reviewed have been used to minimize price (income) variability. As noted above, an advantage of the futures hedge is that it protects market participants when prices move against their interests. However, a disadvantage of this marketing strategy is that you can't take advantage of price movements in your favor.

An alternative to the traditional hedging strategy is futures *options* — which offers plant management the opportunity to protect the firm from adverse price moves while retaining the opportunity to benefit from advantageous price movements.[4] Remember that an option provides the owner the right, but not the obligation, to enter into a futures contract commitment on a later date, at a predetermined price. This right is obtained via the payment of an options premium. In the next issue of the *Dairy Pipeline* I will review how you can use a *call* option to set a maximum price for purchased milk and a *put* option to establish a minimum cheese price. I'll then compare the results to those obtained from the traditional hedging strategy.

If you would like more information, try *Hedging with the BFP Futures and Options Contracts: A Guide for Price Risk Management in the Dairy Sector* by T.R. Fortenbery, Department of Agricultural and Applied Economics, University of Wisconsin-Madison, 1997.

Or, *From Price Taker to Price Maker: A Guide to Dairy Risk Management Using Futures and Options* by P. Plourd, Coffee, Sugar and Cocoa Exchange, New York, 1997.

continued from page one

the following ways:

- Reduces hauling costs from the dairy farm to the plant
- Improves efficiency during cheesemaking
- Reduces the cost of fortification
- Balances cost reduction
- Enhances yield
- Diversifying the milk supply

Currently, UF milk is added to the vat at a rate of 6.7%, bringing the total solids up to 12.2-12.5%. Jacoby reported that the yield enhancement seen to date has been up to $.50 per cwt.

Generally, UF concentrated raw milk will not be used as the sole source of milk solids for cheesemaking. Rather, it will compete with condensed skim milk and nonfat dry milk (NDM) as a source of supplemental solids for standardizing milk for cheese manufacture. The higher ratio of protein and fat in the milk solids of UF concentrate suggests that, compared to condensed skim milk or NDM, it would be more advantageous to use UF milk for fortification. Particularly since condensed skim milk and NDM can elevate lactose levels in the cheese milk, making it very easy to produce a high acid cheese.

There is another key feature to keep in mind if you use UF concentrate to standardize. During the ultrafiltration process, some of the non-protein nitrogen fraction of the milk will be removed. This means more of the remaining nitrogen will be protein nitrogen, or "true" protein. The protein content of milk is commonly tested with infra-red technology since peptide bonds (bonds linking amino acids together to form peptides and proteins) absorb infrared energy in proportion to their number in samples. Although both proteins and peptides (included in the non-protein nitrogen fraction) contain peptide bonds, the IR test produces a number that calculates the contribution of peptides as if they were protein. This is because the IR test is calibrated with a standard protein solution. The result of the IR test is often called total protein or crude protein. True protein is total protein minus the non-protein nitrogen fraction (usually about 3-7% of the total protein).

Calculating casein

For cheesemaking, it is the casein fraction that is used to determine yield. Casein is determined by multiplying a factor times the protein value (casein as a percent of the protein). However, the factor used varies with the milk supply—influenced by the breed of cow, and the time of year. It also varies with what is meant by the "protein." True vs total. If casein is calculated from total protein, the total protein is multiplied by the factor .78. Different factories may use different factors. The factor .78 is an average number based on Kjeldahl nitrogen tests of the different nitrogen containing fractions in milk; the total protein

Figure 1

Measuring Protein

Is your analytical equipment calibrated for

True Protein
(Crude protein – non protein nitrogen)

or

Crude Protein
(also called Total Protein)

3.0% Protein

Casein = 2.34%
Calculated using the conventional factor of .78 x 3.0%

Casein = 2.5%
Calculated using the actual* factor of .83 x 3.0%

3.2% Protein

Casein = 2.5%
Calculated using the conventional factor of .78 x 3.2%

Casein = 2.43%
Calculated using the actual* factor of .76 x 3.2%

*Calculate the actual factor for casein by analyzing the protein % (#1), then taking a second sample, extract the casein and again analyze protein %, (#2). Protein #1 – Protein #2= casein factor.

including non-protein nitrogen (contains peptides and urea). True protein is calculated by difference. See Figure 1 for a description of the varied casein percentages that you can calculate when measuring protein.

In addition, with selected precipitation, you can remove casein from the milk and retain all other fractions. The amount of nitrogen in the non-casein nitrogen fraction is determined and subtracted from the amount of total nitrogen in the milk to yield the amount of nitrogen contributed by casein. (Referred to as actual casein factor in Figure 1.) The casein nitrogen divided by total nitrogen is commonly given as .78, but the number may actually be higher or lower, depending on the breed and genetics of the cow, feeding practices, etc. By convention, the % nitrogen obtained by Kjeldahl test is converted to protein by multiplying by 6.38. Actually this factor is not correct— it changes, depending on the type of protein. The correct factor for casein is 6.35 and for rennet whey protein it is 6.41 (van Boekel). The factor used to calculate casein from true protein is in the range of .80-.86. Since casein is a major factor that you use to calculate potential cheese yield, and for standardization, it is important to know how casein was determined.

Converting "protein" to casein

With UF milk, some of the non-protein nitrogen fraction has been removed. But how does this affect the casein test? It presents a dilemma. You need to know exactly what you are measuring and the correct factor to use to convert "protein" to casein. This can be alleviated by calibrating the IR unit to read true protein, although the best solution would be to read casein directly—without using conversion factors.

In the past, processing UF milk involved heating. However, when you use the new technology, the temperature does not get above 45°F. This is an important difference since the hot process denatures the whey proteins and they react with casein. This denaturing hindered syneresis and flavor development. Although denaturing doesn't happen during the new cold UF process, the new process does remove some of the lactose. If you rehydrate to the original volume then the lactose level is reduced. With less sugar you are less likely to get a high acid cheese.

Using cold UF milk as a standardizing agent would seem to be a better alternative to using NFDM, or condensed milk since there is no protein denaturation and lactose is reduced. In additon, if the UF is fresh there should be few of the off-flavors (especially heated and stale flavors) often seen in cheese when NDFM or condensed milk is used.

References

1. Jacoby, T.C. 1998. On-farm milk concentration for cheesemaking. Presentation at Intl. Cheese Technol. Expo., April 22, 1998, Wis. Cheese Makers Assn., Madison, WI.

2. Slack, A.W., C.H. Amundson, C.G. Hill, Jr., and N.A. Jorgensen. 1982. On-farm ultrafiltration of milk: Part 1 – Technical feasibility studies. Process Biochem. 17(4): 6,8-11.

3. Slack, A.W., C.H. Amundson, and C.G. Hill, Jr. 1982. On-farm ultrafiltration of milk: Part 2 – Economic analysis. Process Biochem. 17(5): 23-25, 30, 33.

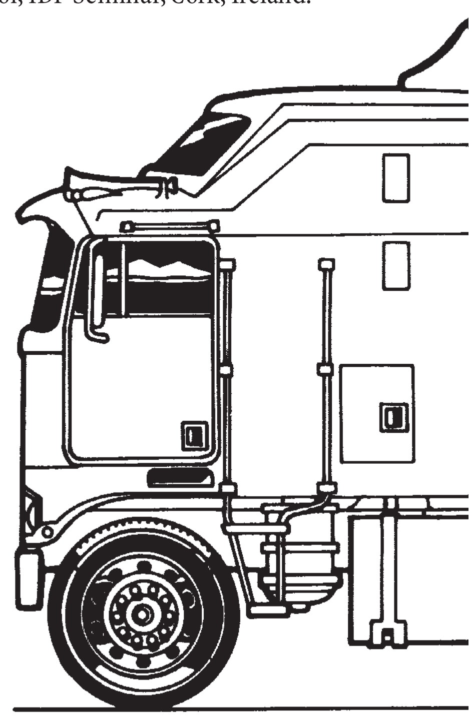
4. Zall, R.R., and J.H. Chen. 1986. Thermalizing milk as opposed to milk concentrate in a UF system affects cheese yield. Milchwissenschaft 41: 217-218.

5. Zall, R.R. 1987. On-farm ultrafiltration of milk: The California experience. Milchwissenschaft 42: 3-7.

6. Kenyon, S. 1997. Concentrated value: raw milk concentrated on the farm could open new marketing avenues. The Dairy Producer

7. Raghumath, B., and D.C. Hibbard. 1997. Ultrafiltration of cooled milk. U.S. Patent No. 5,654,025, Aug. 5, 1997.

8. van Boekel, M.A. J. S. , 1993. Transfer of milk components to cheese: scientific considerations. Cheese Yield and Factors Affecting its Control, IDF Seminar, Cork, Ireland.



News from CDR

Dairy Foods Safety: 1995-1996, compiled and edited by Emeritus Professor Elmer H. Marth, is now available from the publisher, Food and Nutrition Press, P.O. Box 374, Trumbull, CT 06611. This 710-page book contains edited summaries and complete bibliographic citations of over 1300 articles gleaned from the world's scientific literature. Within chapters, summaries are grouped according to topics like dairy foods, other foods, growth and other characteristics, control, test methods, pathogenesis, and review articles.

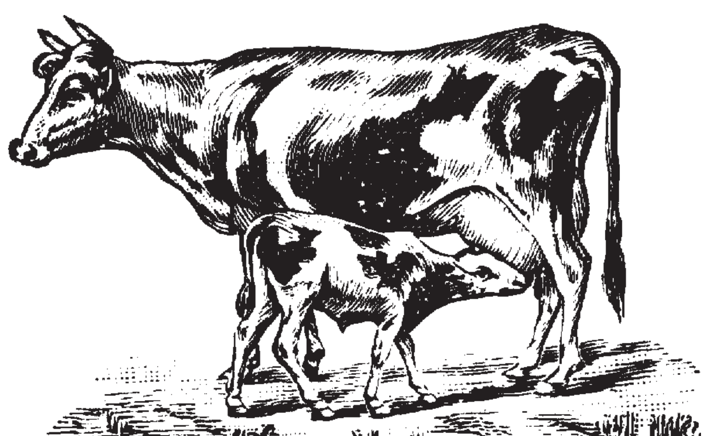
Contents include:

Highlights of Summaries
Aeromonas hydrophila (30 summaries)
Aflatoxin/Cyclopiazonic Acid/Fumonisin (73)
Bacillus cereus (34)
Borrelia burgdorferi (13)
Bovine Spongiform Encephalopathy and Creutzfeldt-Jakob Disease (59)
Brucellae (42)
Campylobacter jejuni (62)
Clostridium botulinum (29)
Coxiella burnetii and Q-fever (31)
Escherichia coli (210)
Helicobacter pylori (102)
Listeria monocytogenes (268)
Mycobacterium paratuberculosis (25)
Mycobacterium/Tuberculosis (63)
Salmonellae (128)
Staphylococcus aureus (83)
Streptococci (38)
Yersinia enterocolitica (48)

CDR's new Whey Applications program is growing! Karen Smith, formerly of Wisconsin Whey International, has been hired as a researcher in whey processing. Right now, she is available to answer industry questions about whey and whey processing. Future plans include setting up whey processing equipment and working with whey applications. Karen's number is 608/ 265-9605, or you can reach her by e-mail: smith@cdr.wisc.edu

Designing efficient milking systems

Do you design, manufacture, or install milking systems? Then you might be interested in this collection of research papers on energy-saving standards for designing milking systems. *Efficient Milking Systems: Energy Conservation Through Improved Design* focuses on cleaning methods and vacuum pump sizing and includes educational papers for milking system designers and installers, as well as in-depth discussion of the 1996 ASAE S518 standards. These standards include recommendations for smaller milklines, reduced vacuum capacity, and placement of the vacuum pump near the sanitary trap.



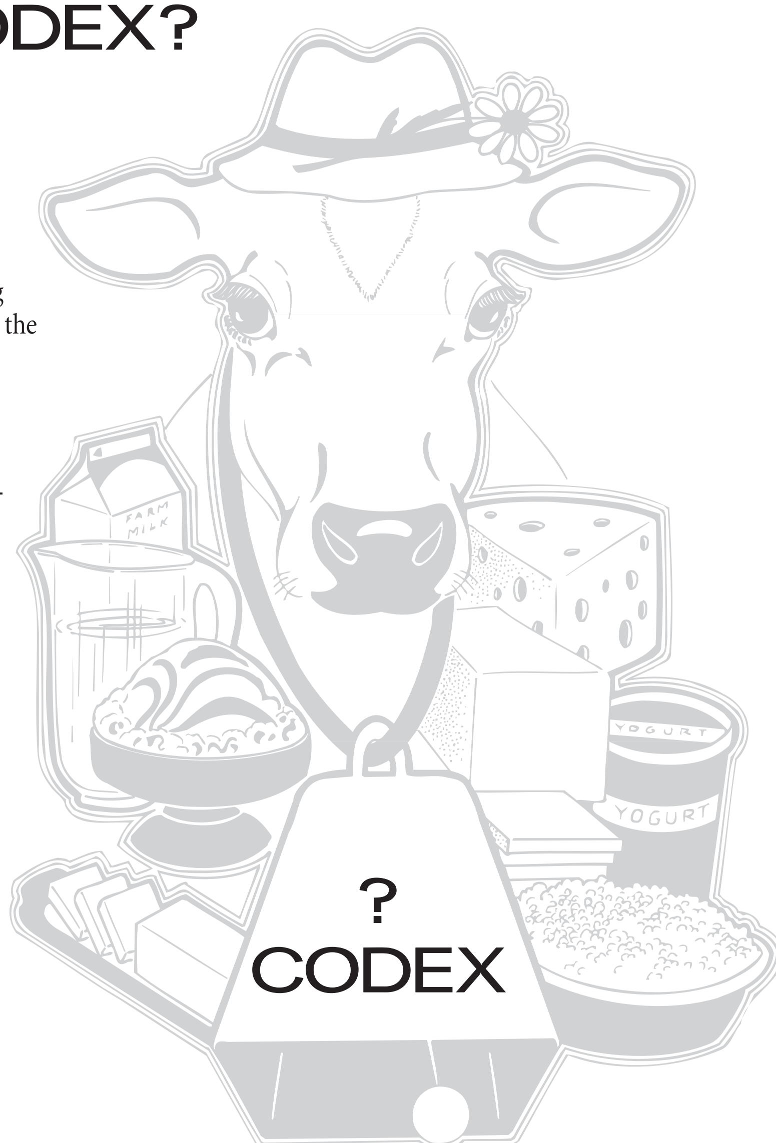
Price: $5 for Wisconsin residents, $20 out of state. A nontechnical companion brochure, *New design practices for milking systems*, is also available for $5. To order, contact Sherry Benzmiller at (608) 238-8276, x59, sbenzmiller@ecw.org at the Energy Center of Wisconsin. The Energy Center of Wisconsin is a private nonprofit organization dedicated to improving energy efficiency in Wisconsin.

Questions about CODEX?

Well it's done! The 3rd session of CODEX Milk and Milk Products Committee approved the A-6 General Cheese Standards, the next step is a move to the CODEX Alimentarius Commission for final approval in June of 1999.

The CODEX language for allowable raw ingredients stating "milk and/or products obtained from milk" will now open the door for using any dairy-derived ingredients in natural cheeses. This could include whey and whey components, casein/caseinates, dairy-based flavors, etc. These changes could have a significant impact on all cheese in all market categories and may influence flavor, functionality, machinability, and ultimately, customer acceptability. All of these attributes are closely related to using cheese as a food ingredient.

How **do** you manipulate cheese make procedures to control flavor, melt, stretch, machinability, shelf-life, and moisture so you can meet buyer specs and add value to your cheese? We invite you to the Wisconsin Center for Dairy Research to find the answers.



When?

Questions about CODEX Workshop
Wednesday, October 28, 1998
Using cheese as a food ingredient Workshop
Thursday, October 29, 1998

Where?

Howard Johnson Plaza Hotel
525 West Johnson Street
Madison, WI 53703
phone: (608)251-5511 or (800)654-2000
fax: (608)251-4824

Cost?

	General Registration	WI Master Cheesemaker	CDR Cheese Industry Team Member
Day 1 - CODEX	$320	$270	$220
Day 2 - Using cheese as a food ingredient	$175	$130	$100
Both Days	$450	$355	$275

Make checks payable to **WI Cheese Makers Association**

For more information:

Conference information:

Mary Thompson
WI Center for Dairy Research
1605 Linden Drive
Madison, WI 53706-1565
phone (608)262-2217
email: thompson@cdr.wisc.edu

Registration:

Judy Keller
WI Cheese Makers Association
3 South Pickney
Madison, WI 53703
phone (608) 855-2027

For even more information, check our website: http://www.cdr.wisc.edu

Curd Clinic

Q. My customers are complaining that the quality of my cheese is inconsistent. What can I do?

A. Let's start by looking at one of the primary factors influencing quality—cheese composition. To consistently produce cheese with the same composition, you need to start by standardizing your milk to the same casein to fat ratio. Standardization helps you control the fat in the dry matter (FDM) in cheese, and it also helps you regulate moisture. If you don't standardize the cheese milk, your moisture may vary due to differences in the rate of moisture expulsion (syneresis) during manufacture.

To really control moisture you need to follow a consistent manufacturing protocol. In Europe, milk is also standardized to cheese yield, that is, the same amount of cheese is obtained from each vat. Thus, if you use the same manufacturing process, and the milk is the same, then you should be making identical cheese. Processing variables can and do change, which can easily produce a different cheese—with a differing moisture. When you allow the proportion of moisture (water) to the nonfat substance to vary in your cheese you'll find that the quality also varies.

As the moisture in the cheese increases, the lactose content also increases, eventually fermenting to lactic acid. The amount of acid formed in relation to the buffering capacity of the cheese determines the pH. Different pH values produce cheeses with different body and flavor. For example, high pH cheeses tend to be firmer, more curdy and some develop fruitiness. Low pH cheeses tend to be brittle and can develop an acid taste. The key to consistent cheese body and flavor is to develop a consistent pH in the cheese—this begins by manufacturing a cheese of consistent moisture.

The table below (Table 1) summarizes the factors that influence cheese quality. The top half of the table lists the interrelated factors that you, the cheese maker, control. Together, these factors influence two measurable variables—the minimum pH of your cheese and the moisture content in the nonfat substance (also referred to as water in the fat free substance, WFFS, or moisture in the fat free substance, MFFS). Since the moisture influences the pH of your cheese, together these variables play an important role in controlling the quality of your cheese.

Calculating quality

You can monitor moisture, and thus quality, using a simple two-step process based on the WFFS. This information is particularly useful if you don't standardize.
Calculate %WFFS this way:

$$\frac{\%\ H_2O \text{ in cheese x } 100}{100 - \%\text{ fat}}$$

This calculation correlates with the quality of your cheese because it gives you crucial information about the proportion of moisture:nonfat substance (particularly protein). If you make a cheese that you really like, you should know the WFFS of that cheese. When you use this number, along with information about

Table 1 *Reprinted from* ***Cheese Technology*** *by J. M. Buch Kristensen, Dalum Technical College, Denmark*

Factors controlled by the cheesemaker	Temperatures			
	Quantity of starter	Water addition	Ripening	Curd size
	Timing for draining whey	Time and temperature of cooking	Quantity of salt (NaCl) added	Pressing
which control:	Minimum pH and moisture content in the nonfat substance			
which control:	Cheese Quality			

your milk, then you can always determine how much moisture you need to replicate your best cheese. This equation is very important when the composition of your milk varies and the relation of nonfat solids to moisture is different from day to day.

Let's use Gouda cheese as an example. You know the WFFS for your best cheese—this is the target you continue to aim for every time you make cheese. You know the casein to fat ratio in your milk. From this you can calculate FDM (fat in the dry matter). Instead of experimenting in the vat, you can plug different numbers into the equation to figure out how much moisture you need to make your best cheese.

Table 2 shows how varying parameters can produce the same cheese—your best Gouda with a WFFS of 58. Table 3 illustrates a different picture, the FDM is the same but the WFFS is different. Each of these cheeses is a different cheese because that crucial WFFS is different. You adjust that ratio by adjusting the % moisture to get your best cheese, WFFS = 58.

Table 2

FDM	C/F	% Wet Fat	% Moisture	WFFS
.48	.84	27.9	41.8	58
.50	.77	29.5	41.0	58
.52	.70	31.3	39.9	58
.54	.64	33.0	38.9	58

Table 3

FDM	% Wet Fat	% Moisture	WFFS
.50	30.5	39	56
.50	29.5	41	58
.50	28.5	43	60
.50	27.5	45	62

Codex Alimentarius looming in the future is another reason to learn and use the WFFS calculation. Composition standards are separated into "Contents of fat in dry matter (w/w)" and "Corresponding dry matter content (w/w)" For Gouda these standards are:

Contents of fat in dry matter (w/w)	Corresponding dry matter content (w/w) Weights below 2 kg.	Weights from 2 kg.
Minimum 48% and less than 55%:	minimum 55%	minimum 57%
Minimum 55%:	minimum 59%	minimum 61%

Curd Clinic Doctors are Paul Stein Jensen, Dalum Technical College, Denmark.and Mark Johnson, Wisconsin Center for Dairy Research

Paul Stein Jensen, Dalum Technical School, Denmark

Mark Johnson, CDR
If you have questions about this column, you can reach Mark at (608) 262-0275 or jumbo@cdr.wisc.edu

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

Calendar

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. 6-9 American Cheese Society 15th Annual Conference. Madison, WI. For information call Amer. Cheese Soc., (414) 728-4458.

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.

Aug. 16-19 Int. Assn. of Milk, Food and Environ. Sanitarians Annual Meeting. Nashville, TN. Call IAMFES (515) 276-3344 for more details.

Sept. 29-30 Dairy, Food and Environmental Health Symposium. cosponsored by Wisconsin Association of Milk and Food Sanitarians, WI Association of Dairy Plant Field Reps, and WI Environmental Health Assn., Stevens Point, WI. For more information, call Bill Wendorff at (608) 263-2015.

Oct. 14-15 North Central Cheese Industries Assn. Annual Convention. Watertown, SD. For info, call Dr. David Henning at (605) 688-5477.

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

Oct. 28-29 Questions about CODEX and Cheese Ingredient Seminars. Madison, WI. Call Mary Thompson at (608) 262-2217.

Nov. 10-11 Wisconsin Cheese Grading Short Course. Madison, WI. Call Bill Wendorff at (608) 263-2015.

Wisconsin CENTER FOR DAIRY RESEARCH
University of Wisconsin-Madison
1605 Linden Drive
Madison, Wisconsin 53706

ADDRESS CORRECTION REQUESTED

Nonprofit Org.
U.S. Postage
PAID
Madison, WI
Permit No. 658