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A Technical Resource for Dairy Manufacturers

Altering Milk Protein

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In the Upper Midwest, a large percentage of milk is made into cheese. Cheese yield is directly related to the protein content of milk; how many pounds of cheese a plant manufactures largely depends on how many pounds of protein dairy producers are shipping to the plant. What can dairy producers do at the farm level to provide a product that has the greatest value to cheese processors?

Most dairy producers in Wisconsin are paid for the fat, protein, and carrier components of milk. (Carrier includes everything other than fat and protein, mostly water and some minerals.) The value of fat has declined dramatically in the past five years, causing the value of protein relative to fat to increase. Dairy producers are particularly interested in modifying the protein content of their cows' milk to maximize the income from milk sales. Changing management, the environment, and genetics can alter milk protein contents.

Changing management is the quickest, most reversible way to alter composition. Changing milk composition by genetics is permanent and cumulative, although the process is quite slow. There are two approaches to altering milk composition by genetics. One approach is through conventional breeding schemes; a second, more experimental, approach is to alter composition through the use of transgenic animals.

What's Inside:

Trends in milk pricing

Dairy producers are motivated to change management and improve genetic selection when economic incentives exist. Let's review the milk prices that dairy producers in the U.S. have received for their product over the past several years.

Figure 1 shows the value of fat, protein, and carrier in 100 pounds of milk for 1986 through 1994, using prices and differentials from table 1. Using differential standards of 3.5% fat and 3.2% protein, 100 pounds of milk would contain 3.5 pounds fat and 3.2 pounds protein. The value of the carrier is determined by subtracting the value of 3.5 pounds fat and 3.2 pounds protein from the overall price per 100 pounds of milk. Because the steady decline in fat value has not been counterbalanced by an equal increase in protein value, the value of carrier has been slowly increasing since 1987. As figure 1 shows, the value of protein and carrier in 100 pounds of milk has remained approximately the same for the US in recent years.

Differentials for fat and protein

Predicted Transmitting Ability Dollars (PTA$) is a genetic measure that dairy producers commonly use when selecting bulls and cows for breeding purposes. Researchers at USDA who do national genetic evaluations for dairy bulls and cows calculate the PTA$ value and rank animals on expected income generated from milk sales of offspring over the course of a lactation. Each January they use national average milk prices from the previous year to develop PTA$ formulas. Table 1 shows the average milk price and differentials for fat and protein used to calculate PTA$ from 1986 to 1994, which were quite stable from 1986 through 1989. Beginning in 1990, prices have been more volatile from year to year. However, since 1987 a

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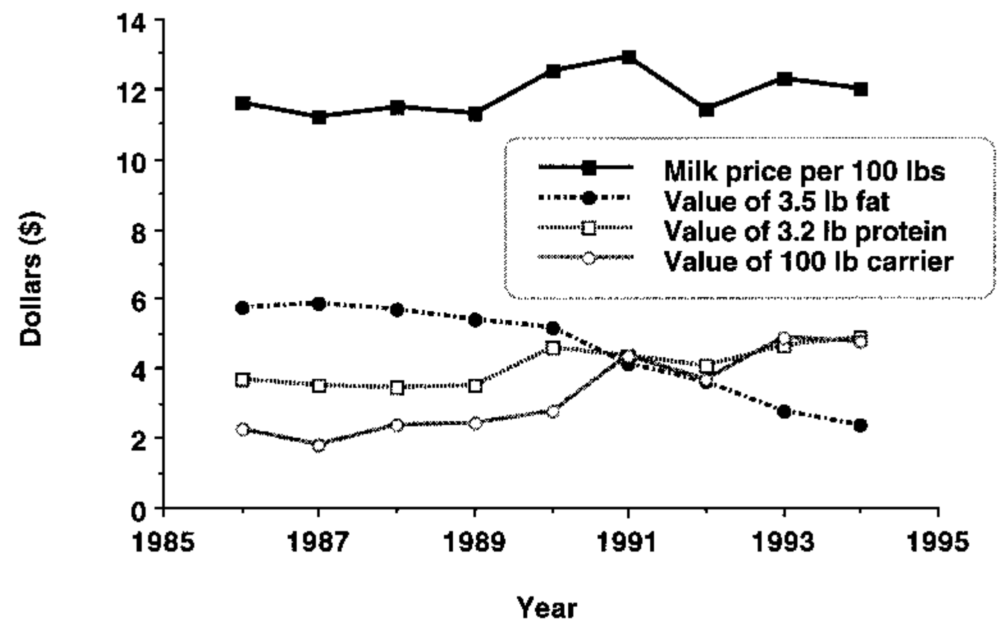
Figure 1. **Trend - Milk price and components**



clear trend towards lower differentials for fat emerged. Protein differentials increased in 1990, but have not changed much since then.

Before making management decisions to alter milk components, dairy producers should assess the value of each of the components of milk based on the milk prices they currently receive, as well as the milk prices they anticipate in the future.

Altering milk protein - feeding

Altering milk composition is easier for some components than others. Changing the diet can alter fat content by about 3 percentage units (which means total fat % can range from 2% to 5%), but diet changes only alter protein content by about 0.6 percentage units (11). Although physiology probably explains the difference, several other explanations are possible. For example, there may be less genetic variation associated with protein content than with fat content. Also, we know more about the effect of diet on milk fat content since researchers have studied it more. However, we do know how some dietary factors affect protein content, even though payment for protein is a relatively recent occurrence.

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Table 1. Milk prices and component differentials used to compute USDA PTA$ values.

Year	Milk Price ($ per 100 lb)	Fat Differential ($ per .1 lb)	Protein Differential ($ per .1 lb)
1986	$11.60	$.164	$.114
1987	$11.20	$.168	$.110
1988	$11.50	$.163	$.108
1989	$11.30	$.154	$.109
1990	$12.50	$.148	$.143
1991	$12.90	$.118	$.137
1992	$11.40	$.104	$.128
1993	$12.30	$.079	$.145
1994	$12.00	$.068	$.152

From the Southeast Dairy Foods Research Center

Whey proteins — moving from *one size fits all* to a *tailored fit*

by E. Allen Foegeding, Professor, Department of Food Science, North Carolina State University

Clothing as a metaphor for whey products may seem odd at first, but it is appropriate. A basic approach to whey processing is simply to dry it. A feed sack, modified by cutting holes for neck and arms, is a comparable basic approach to clothing. It is more functional to wear than an unmodified feed sack, which requires some unfamiliar hopping skills for movement, but it lacks the style required for formal occasions. High protein products developed from cheese whey are like the tuxedos and gowns designed for gala events — both are tailored for a specific function.

One of our objectives at the Southeast Dairy Foods Research Center (SDFRC) is to develop the fundamental information needed to make whey protein products for specific food ingredient applications. To accomplish this we need to understand the molecular mechanisms of food functionality and then determine which processing methods we can use to control and modify functionality.

Whey proteins and gel strength

Since there is a large Asian market for whey proteins in meat products, and they use gel strength to indicate quality, we began by looking at gel strength. Another reason for this focus is that proteins with high gel strength also have high functionality. We started by asking questions. What is gel strength and how is it measured? What properties of gel structure determine gel strength? What factors regulate gel strength? What increases gel strength? We answered these questions through a series of research projects funded by SDFRC and the National Dairy Promotion and Research Board.

Before we define gel strength, let's take a look at food gels. Picture a gel as a structure, a solid framework that immobilizes water molecules and forms a solid sponge. Jams and jellies are food gels made from sugar, water, acid, and pectin from apples to supply the structure. Other food gels, like gelatin, are made from animal proteins. Another well-known protein gel is the one formed during cheesemaking when renin coagulates casein.

To describe gels we need a common language with set standards. That language is physics. Chemistry explains the underlying molecular mechanisms of gels, but physics describes the action of gels in food applications.

What is gel strength and how is it measured?

Physical testing of solid materials, such as gels, involves applying a controlled force — expressed in standard terms of force/unit area or *stress*. The result of this stress application is measured in standard terms of *strain*, or deformation per unit length. The most common procedure for measuring gel strength is to record the force or *stress* required to push a probe, like a cylinder, a given distance, or *strain*, into the gel. If the distance is constant, this value is reported as a modulus, or stress/strain. Gel strength values are normally presented as force values but they are really moduli values since they are measured at a common strain.

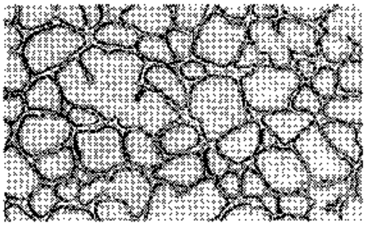
If you want to compare gel strength values, you should know the stress and strain . For example, if you use slightly higher levels of strain, which means the cylinder has to travel further into the gel, then you get higher stress levels needed to achieve the strain. These apparently greater "strength" values are due to testing methods and not the protein functionality. Our goal was to figure out which whey protein factors determine the true stress and strain of whey protein gels.

We use twisting, or torsional testing to measure stress and strain of the gels by recording stress and strain at the fracture point. We use this somewhat unique approach because the gel does not change shape or volume when twisted, thus gels with low water-holding properties do not cause erroneous results by leaking. *continued on page 4*

What properties of gel structure determine gel strength?

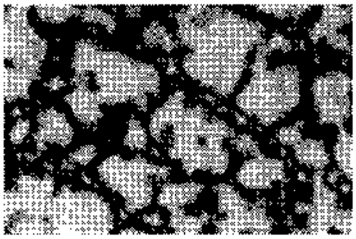
Using our observations, and those of other researchers, allowed us to define three general types of matrices formed by whey proteins. The matrix is the gel structure that holds the immobilized water molecules in the solid sponge structure of the gel. We found that whey solutions containing low amounts of salts and denatured proteins form a fine-stranded matrix. These gels have low gel strength because they fracture under minimal force. As salt concentration increases, stress increases and strain decreases, leading to stronger fine-stranded gels.

Fine stranded matrix



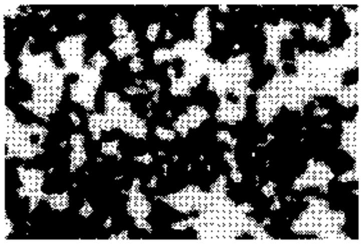
We observed maximum gel strength when the fine-stranded matrix is transformed into a mixed matrix, the second type of matrix. This mixed matrix contains both fine-stranded and particulate structures, the third type of matrix. As the gel develops more particles in its structure, stress remains constant or decreases but strain greatly increases. The result is a decrease in gel strength.

Mixed matrix



The ideal way to maximize gel strength is to find a way to produce a mixed matrix. However, when considering potential food products, product development scientists may find that the soft texture of the fine-stranded gels is a good place to start.

Particulate matrix



What regulates gel strength?

It's old news that calcium and fat have a negative influence on gel strength. We found that a small amount of calcium (or any other divalent cation) decreases gel strength by promoting particulate gel formation. The fact that phosphate increases gel strength is another well known observation. We demonstrated that phosphate forms a complex (or chelates) with calcium which partially explains the increase. However, phosphate also seems to have some unique property, unrelated to the calcium complex. In related work, we found that combining ß-lactoglobulin and bovine serum albumin is the best mixture of whey proteins for producing a high strength gel.

Is there a process that will increase gel strength?

Our results led us to conclude that a whey protein product high in ß-lactoglobulin and bovine serum albumin, and low in fat and salts, would be the ideal candidate for maximum gel strength. We collaborated with SDFRC researchers Dr. H. Swaisgood and Dr. J. Allen to produce this ideal whey protein product. We used immobilized retinol, or Vitamin A, affinity chromatography to separate the preferred whey proteins. After adjusting whey to pH 5.1, it flows by bound retinol — ß-lactoglobulin and bovine serum albumin attach to retinol and the other proteins, salts, lactose and lipids flow through. Adding a phosphate solution releases the proteins from retinol, producing a mixture high in ß-lactoglobulin and bovine serum albumin, low in calcium, and containing phosphate. All the factors that increase gel strength!

How can we move this technology from the lab to the plant?

Our current goals include developing this technology into commercial scale. Since whey proteins attach to retinol at pH 5.1, this technology applies to both sweet and acid whey. Our next step involves forming industrial partnerships to evaluate the full range of potential food applications while assessing the cost of the process. We believe that our whey products work is an excellent illustration of the overall purpose of the Southeast Dairy Foods Research Center — to develop new technologies that will expand the market for milk and dairy products.

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Energy intake

Intake appears to affect protein concentration. Researchers report protein content increased fractionally when net energy (NE) of intake increased. When cows do not have their energy needs met, slightly lower protein contents in their milk are predicted.

Forage to concentrate ratio

Altering the forage:concentrate ratio often changes energy intake. However, some researchers found a negative relationship between dietary fiber and protein content of milk. Other studies report an increase in protein content when intake is held constant and dietary fiber is reduced. Trials which varied the forage:concentrate ratio with ground corn report mixed results and others found no variation in protein content despite wide differences in forage:concentrate ratios.

Feeding extra fat and protein

To increase the energy intake of high producing cows, many dairy producers feed additional fat. Adding fat to the ration appears most beneficial for cows that have reached the peak of their lactations; fat usually improves milk yield and persistence, and often improves fat percent. We don't know why, but adding fat to the diet frequently reduces protein content by 0.05 to 0.15 percentage units. Despite the lower protein percentage, total pounds of protein often increases because increased milk production more than compensates for the decline in protein percentage. In general, increasing protein in the diet beyond recommended feeding levels does not produce an economical response in milk or protein yield.

Summary of feeding trials

Currently, we know more about the factors that depress protein content than we know about factors that increase protein content. Clearly, many producers who have tried feeding additional fat to meet energy needs have noticed a decline in protein percent. However, in most cases, additional dietary fat still produces more pounds of milk protein. Some speculate that fat feeding may cause a dilution effect; both milk yield and protein yield are increased, but milk yield increases at a higher rate. Considering the current pricing for protein and carrier, both of these would increase the value to the producer but not the cheese manufacturer.

Altering milk protein - conventional breeding programs

When dairy producers design a breeding program to alter a trait, they need to consider several points.

1. What is the heritability of the trait? That is, how often is the trait passed on to offspring?
2. How much variability is there in the population for the trait?
3. What is the genetic correlation with other traits being selected, or how often are specific traits inherited together?
4. What are the relative economic weights associated with the traits?

Heritabilities for percent are higher than the heritability factors for yield. This means that genes influence the tendency to produce percent fat and percent protein more than they influence yield. Thus, percent can be changed more readily than yield, although changing percent without regard for yield is not the best approach.

Extreme individuals, or the producers that really stand out, are easier to find if there is large variation in the population. The smaller the variation, the more difficult it is to find the extreme individuals that can make an impact on a breeding program. The phenotypic variability, which is the physical variation influenced by genes, is greater for fat than for protein, indicating that it is more difficult to make genetic change in the dairy population for protein than for fat.

Using the scientific terms, we can say that yield traits have a high positive correlation with each other. This means they are often inherited together, like red hair and freckles in humans. The genetic correlation between protein yield and milk yield is slightly higher than the genetic correlation between fat yield and milk yield. Because these traits are often inherited together, selecting for increased milk yield will indirectly result in increased fat yield and increased protein yield. The relationships between yield traits are not correlated in a 1:1 ratio, however. Since there is a negative correlation between milk yield and fat percent and between milk yield and protein percent, selecting for increased milk yield will generally result in lower milk composition. Likewise, selecting for increased composition will generally result in decreased milk yield.

Because milk price per hundredweight for most producers depends on fat percent and protein percent, many dairy farmers are tempted to select bulls on percent. This breeding program can lead to financial disaster because of the negative relationship between yield and percent. It is easy to breed for higher percentage, but usually at the expense of yield — so it's best to avoid high percentage bulls with low yields. Again, because of the high correlation between yield traits, there is not much difference between the top 50 bulls for each of the yield traits. Whether you select on milk yield, fat yield, protein yield, combined fat and protein yield, or dollars, you get about the same bulls.

Table 2 lists feed costs per pound of product. Although fat has about twice the energy value of protein, it costs about twice as much to feed for a pound of protein as it does to feed for a pound of fat. Protein payments should reflect economic costs to produce the product.

Table 2. Feed costs per pound of product†

	Fat	Protein	Lactose
Feed cost/lb	$.198	$.373	$.101

Assumptions:
Milk price = $11.30/cwt.
Corn : milk price ratio = .51
Soybean : milk price ratio = 1.21

†Reference (2)

Selection for protein fractions

Currently, dairy producers who are paid for protein are paid for total protein yield, not for individual protein fractions. Milk proteins include various caseins, such as kappa, alpha s-1, alpha s-2, and beta, and whey proteins, such as alpha-lactalbumin and beta-lactoglobulin. Some breeds exhibit notable differences, particularly for kappa casein. For example, in Jersey cattle, the gene frequency for the A and B variants of kappa casein is nearly the opposite of the frequency found in Holsteins (12).

The genetics of milk proteins does influence cheese-yield capacity and coagulating properties. Milk containing the B variant of kappa casein improves rennet clotting time, rate of curd formation, and coagulum strength (9). Improved cheese yield has been associated with with milk containing B variants of kappa casein and beta-lactoglubulin (1, 6). The kappa casein B variant may also increase milk protein content (8).

Even though studies have reported an association between cheese yields and various casein proteins (6, 7), most show only a small difference(3). Genetic selection for casein might improve cheese yields, but national procedures for recording and evaluating have not been developed. Gibson (3) points out that dairy producers are not likely to alter their breeding programs unless clear economic incentives exist. Currently, dairy producers do not select for traits other than overall protein yield and unless dairy processing plants begin payment for specific protein fractions, dairy producers are unlikely to modify their selection programs to include these specific protein fractions.

Summary - conventional breeding programs

Although producers can use traditional breeding strategies to alter milk composition, changes will be slow. Genetic variation for milk components exists in the population, but economic signals to dairy producers need to be clear and consistent for them to alter their breeding programs.

Transgenic cattle

A great deal of basic research is currently directed towards the goal of developing transgenic animals by transferring genes into cows from unrelated organisms. Researchers have used this procedure to transfer genes into bacteria, efficiently producing enzymes like chymosin. Transgenic animals offer the potential advantage of making specific, relatively large genetic alterations — the kind that are currently limited by existing genetic variation (4). For example, some scientists are attempting to incorporate additional casein genes into the genes of dairy cows. Transgenic alteration will require extensive testing and development, and only substantial alterations are likely to be cost effective when competing with existing methods (4, 5, 10). Hoeschele (5) further points out that even with cost effective transgenic improvement, the impact on the total cow population over a 20 year time period would be relatively small since it takes a long time to incorporate transgenes into all the animals in the dairy cow population of 9.7 million cows.

The short-range usefulness of transgenes is uncertain and not expected to substantially affect the dairy industry over the next 10 to 20 years (4).

Summary - Altering milk protein by genetics

Can changes in milk composition be made through breeding? Absolutely. Almost anything can be accomplished through breeding, given enough time. But changing the dairy population through breeding is a slow process. Genetics can not be responsive to wide and frequent swings in prices. Management practices offer the best opportunity here. But if milk price programs are fairly steady and consistent, genetic programs can certainly respond. We just need a good crystal ball to tell us what milk composition we will need 5 to 10 years down the road.

Dairy producers can alter the composition of milk at the farm by feeding and by genetic selection. Rations that meet cows energy, protein, and dry matter intake requirements will likely maximize pounds of milk protein, even though some of these rations may cause a slight depression in milk protein percent. Although changing the composition of milk by genetics is slow, these changes are permanent and cumulative. Dairy cattle have more genetic variation for fat than for protein, so efforts to genetically change protein content of milk will be slower than efforts to change fat content.

Editors Note: If your company has a patron newsletter, you are welcome to reprint this article in it.

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The Feta Story

by Sarah Quinoñes, WITEP Program Coordinator, CDR
Karen Paulus, Editor, CDR

Paul Stein Jensen, Lecturer on cheesemaking at Dalum Dairy College, and Buch Kristensen, Director of Dalum Technical College, Denmark, told us this true tale when they journeyed to Madison to teach the Scandinavian Cheese Seminar in April. So, even though seminar participants already heard this unique story, we're repeating it because we thought it deserved a larger audience.

In the early 1970's Danish feta cheese took an abrupt turn on the path it traveled from factory to market. Greece, one of the main importers of Danish feta, suspended shipments after a military coup. Overnight, the Danes needed to find a new market.

At the same time, oil prices were rising and the Middle East was experiencing an economic boom. To entice these new oil-rich consumers, Prince Henrik and a Danish government delegation prepared an array of Danish products which included feta cheese. The Iranians liked the feta samples and asked for 60 tons to evaluate. Three weeks later the enthusiastic call to Denmark was "Send all you've got, produce as much as you can!"

This story is more than just good luck. The Danes had done their homework, by researching customer needs and likes they improved the odds that feta would be well received. They found that Iranians needed a source of inexpensive, non-meat protein. Foods that perish in warm temperatures don't last long in the desert heat of Iran, a climate that also gives people a taste for high salt foods. Feta now has a niche as a protein staple in Iran because it is a very salty cheese (4% salt) and it can stay fresh without expensive refrigeration.

Iran's arid, dry soil cannot support grazing by cattle, goats or sheep. Since dairy cattle can't thrive in the desert climate and the Iranians lack a source of quality feed for milk production it was clear that feta had to imported to meet a growing demand.

Meeting the customer's expectations

True feta cheese is made from goat or sheep's milk. However, the Danes use cows' milk to make their feta, presenting some tough challenges for food scientists.

The flavor challenge

Early on, when supplying Greece, the Danes discovered how to make the cows' milk feta taste like feta from goat or sheeps' milk. Since the milks have very different flavors the Danes had to get the goat milk flavor into their feta. First they homogenized the cow's milk to break the fat into very small globules. Then they added goat lipase and other goat stomach enzymes to produce the flavor profile they wanted.

Color considerations

Carotene gives cows' milk a yellowish caste instead of a pure white color, like goat or sheep's milk. This became a problem when shoppers in the Iranian market could see Danish and Iranian fetas side by side. The slightly off-white color of the cow's milk feta was obvious and shoppers, thinking it wasn't good, chose not to buy it. This was another R&D challenge to tackle — how to make Danish feta white. Cleverly, the scientists started by considering what makes up color. After consulting an artist's color wheel, they discovered that adding green from plant chlorophyll, plus a synthetic blue called patent blue, allowed them to make cows milk almost as white as the goat or sheep's milk. However, in 1993 the ECC (European Economic Community) banned the use of synthetic color in cheese and now using synthetic blue is a problem. The Danes hope to find another natural source of blue, they have until 1996 to find an alternative.

Popular packaging

Traditionally, shopkeepers in Iranian markets sold feta cheese in bulk from a 40# can. Dispensing the Danish feta this way led to color comparisons by the shoppers. To avoid problems with the slight color difference, the Danes began making decora-

Feta

tive 1/2 to 1 pound individual tetrapak™ cartons about 5 years ago. These UHT packed cartons have become very popular.

The Danes learned to transform an exporting crisis into a prosperous opportunity. They now produce 111, 857,000 kilos or 246,598,942 pounds of feta, which is 25% of the world supply. What can we learn from Danish feta story? In the dairy industry, finding your market niche and keeping it is critical for success. The feta story illustrates that strategic thinking, market research, and a good understanding and application of the science and technology of cheese — mixed with a little luck — can pay off.

Tips for buying a modem

The CDR bulletin board is up and running. Use it to get a variety of information, including current research projects and CDR calendar of events. Or leave a message for CDR scientists. If you want to connect to the CDR bulletin board, you'll need a modem for your computer. A modem uses your telephone line to connect your computer to other computers. We recommend a Ha*yes compatible* modem, with a transmission rate of 14,400 bps (14.4 kilo baud), version .32 or version .42. Even though many computers now come equipped with an internal modem, consider buying an external modem.

Most modems sold today are Hayes compatible; it is now an industry standard, like IBM PC compatible. This means the modem will work well with all other Hayes compatible modems.

External modems might be a better choice because they are easier to move from computer to computer, easier to reset, and easier to monitor when the modem is dialing and connecting. Also, external modems are easier to install since you can just plug it into a port on the back of the computer.

Modem cost and transmission rate

The prices of modems range from around $60 to over $500. On the lower end you can get a simple 2400 bps modem, at the top end you can get a 14,400 bps, v.42 modem with built in answering machine and FAX capabilities. Review your budget and your needs before making this decision.

We recommend at least a 9600 bps modem, which will cost around $100-$150. If your budget allows, it's better to get a 14,400 bps modem that will give you a comfortable transmission speed— you'll experience less frustration when waiting for responses on the computer. With this modem you can also get a v.32 or v.42 data compression option to speed up transmissions. These are often FAX Modems, which means they can send and receive faxes through the computer (not in hard-copy form) if you have the correct software. A 14,400 bps modem will cost from $150 - $300, depending on data compression and options.

Where to buy a modem

You can get your modem from your local computer store or from a computer catalogue. Local stores offer the advantages of assistance and better service if you have problems. Local stores are more likely to honor your warranty if you do run into a problem. Computer catalogues are usually cheaper and they can be just as safe if you buy from a reputable company. Mail order has a few drawbacks — you get technical assistance by phone only and it may take more time when you have to send something for service. These catalogues are usually available at local bookstores, grocery stores, or computer stores. If you can't locate what you need, call us.

Communications software

Once you have a modem you will need software for the modem to communicate in a known language, or protocol. Software also dials the numbers and helps to download and upload other software. A number of good communications software packages are available. When you buy a modem often you get a basic communications program with it. If you use Windows, Windows 3.1 comes with its own communications software called "Terminal." Try this first, it may be all you need. PC Anywhere and Carbon Copy are two fairly popular communications programs to consider.

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Modems...

Shareware is another route you can try. Shareware refers to software that you download from a bulletin board or a commercial service like Compuserve or America On Line. You can use the communications software that comes with your modem to call into one of these services and then download the shareware and some documentation. This allows you to try the software for a limited time and if you like it you can buy the complete package with documentation. These programs offer more options than the limited choices you'll get with your modem software. The CDR bulletin board now has some shareware for you to try, including selections for Windows users. We encourage everyone to try the bulletin board. Please call us if you have questions, suggestions, or problems. The best time to reach Warren, our technical advisor and programmer, is Tuesday, between 8 am and 11:30 am. Call him at (608) 262-5970 or phone Sarah Quiñones at (608) 262-2217.

Bulletin Board Alert
The CDR bulletin board is now available at anytime, 24 hours a day. Try it! Have your modem dial (608) 265-2133. See the sample screens below for a sneak preview.

DAIRY FOODS EXTENSION RESOURCES

Bulletins Available:
(1) Short Course Calendar
(2) General Short Course Information
(3) Cheese Technology Short Course Information

(COMM) Additional Commands (download, search, etc.)
(MAIN) Return to Main Menu
(QUIT) Quit (Logoff)

Please type a number or command shown in ( ) above and press ENTER.
For help on commands listed above type: H **[command]**.

CDR MAIN MENU

Commands available:
(CDRINFO) Center for Dairy Research Informational Resources
(DFEINFO) Dairy Foods Extension Informational Resources
(ASK) Leave Questions and Messages for CDR/UW Staff
(NEWS) Information on Updates to the CDR Bulletin Board

(C) Leave a Message for the System Operator
(CHG) Change your password, address, etc.
(QUIT) Quit (Logoff)

Please type the command shown in ( ) above and press ENTER.
For HELP on a command listed above type: H **[command]**.

CDR INFORMATIONAL RESOURCES

Bulletins Available:
(1) About CDR
(2) Calendar of Events
(3) Dairy Foods Researcher Directory
(4) "Pipeline" Index of Articles
(5) CDR Current Research Project List
(6) CDR Video Catalog
(7) Directory of Dairy Research Centers in the U.S.
(F) A List of Files to Download

(COMM) Additional Commands (download, search, etc.)
(MAIN) Return to Main Menu
(QUIT) Quit (Logoff)
Please type a number or command show in ( ) above and press ENTER.
For help on commands listed above type: H **[command]**.

The Curd Clinic

by Jim Steele
Associate Professor, Department of Food Science,
University of Wisconsin-Madison

Q. I recently expanded my cheese operation and I'm using a culture that provides very fast acid development in the vat to produce more cheese faster. How can I eliminate the bitter flavors I'm getting with these new cultures that I've started using?

A. During ripening, chymosin and starter culture enzymes break the milk proteins into smaller pieces. This breakdown, or hydrolysis, of milk proteins is essential to develop the texture and good flavor of ripened cheese. However, you can get bitterness instead of good flavor if the enzymes hydrolyzing the milk proteins get out of balance. Fast starter cultures grow to high cell densities during cheese making, contributing a high level of a specific enzyme. This enzyme breaks large pieces of casein into smaller, potentially bitter pieces of casein. Some starter cultures also produce enzymes capable of counter-acting the bitterness because they break the bitter fragments of milk proteins into smaller non-bitter pieces and amino acids, the building blocks of proteins. Problems start when these starter culture enzymes aren't produced at a high enough level to break down the bitter peptides as fast as they are produced. The same flavor problem arises when these enzymes are trapped within the bacterial cell and not available to break down the bitter peptides. So, solving the bitterness question involves controlling the levels of the enzymes that produce and hydrolyze bitter peptides.

Possible solutions

The first thing you can try is switching to a slower starter culture. Most slower cultures won't produce as much of the enzyme that produces the bitter pieces of casein. Of course, this solution may create other problems if you switched to a faster culture to produce more cheese faster.

A second approach involves increasing the level of enzymes that break down the bitter peptides. There are several ways that you can do this. Ask your culture supplier to provide you with a starter culture that not only produces a high level of the enzymes that break down the bitter proteins, but one that also dies and releases these enzymes rapidly into the cheese matrix. You can use this with the fast acid producer as part of the starter culture.

Another possibility is to add a starter adjunct, a culture that enhances flavor and texture development but doesn't affect acid development. Certain cultures of *Lactobacillus helveticus* have particularly high levels of the enzymes believed to actively hydrolyze the bitter peptides.

The third possible solution is to add the enzymes required for the hydrolysis of the bitter peptides to the cheese curds before pressing. A number of companies sell enzyme systems for this application.

After trying these suggestions, it's important to age and evaluate your cheese to determine the most effective solution.

Bulletin Board Update

Reviews of the CDR eclectronic bulletin board have been very positve. In particular, users have been delighted to find it easy to use. Look over the screens on the left, when you select a command a detailed screen appears to provide more information. Try it!
Sarah Quiñones, Outreach program manager

Calendar of Events

June 25-29 IFT (Institute of Food Technologists) Annual Meeting, Atlanta, GA.

July 11-15 American Dairy Science Association Annual Meeting, cosponsored by American Dairy Science Assn. and the American Society of Animal Science. Minneapolis Convention Center, Minneapolis, MN. For more information call ADSA, (217) 356-3182.

July 28 Wisconsin Dairy Products Association Annual Butter and Cheese Grading Clinic. Wisconsin Dells, WI. For information call WDPA, (608) 836-3336.

August 9-10 Producing Safe Dairy Foods, Madison, WI. CDR is sponsoring this short course which will cover dairy food pathogens, including their behavior and control. Contact the CALS Conference office at (608) 263-1672 for more information.

August 22-25 Milk Pasteurization and Process Control School, Madison, WI. Call Bob Bradley (608) 263-2007 for information, or the CALS Conference office (608) 263-1672 to register.

Sept 21-22 Dairy, Food and Enviromental Health Symposium. Cosponsored by Wisconsin Association of Milk and Food Sanitarians, WI Association of Dairy Plant Field Reps, and WI Environmental Health Assn. Waukesha, WI. For more information call Fritz Buss at Nelson-Jameson, (715) 387-1151.

Oct. 17-21 Wisconsin Cheese Technology Short Course. Madison, WI Call Bill Wendorff at (608) 263-2015 for details.

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