



## Effect Of C:F Ratio On Stirred Curd Cheddar Cheese Yield

Carol M. Chen, David D. Bogenrief, Mark E. Johnson, Brian Gould  
Wisconsin Center for Dairy Research

One of the many problems that plague the manufacture of lower fat cheese is lower cheese yield. It is well known that reducing the fat content in milk leads to lower cheese yields because fewer milk solids are available for cheesemaking. Our study evaluates the effect of initial milk casein to fat ratio on cheese yield performance. We used nitrogen, fat and solids non-fat recovery in the cheese to evaluate yield. We used a no-wash protocol to make cheese, however, we also incorporated other techniques, such as a firmer milk coagulum at cutting, lower cook temperatures, shorter stir out times, and a higher curd pH at draining and salting to help increase cheese moisture in the lower fat cheeses.

A study by Banks and Tamime evaluated the effect of casein to fat (C:F) ratio on fat recovery in full fat Cheddar cheese. They evaluated C:F ratios from .65 to .75, and determined that a ratio of .72 was optimal. Below .72, fat recovery was lower because the curd was saturated with fat. Banks and Tamime suggested that above .72, inherent structural changes in the curd may reduce the level of fat retention. Two independent studies conducted at the CDR on milled curd Cheddar demonstrated a decrease in the percentage of fat recovered, from 90.5 for full fat to 87.3 for 50% reduced fat cheese.

### Cheese Composition

We analyzed the moisture, fat, and protein in the cheeses. Results are listed in Table 1. As the C:F ratio increased, the percentage of fat in the cheese decreased and the percentage of moisture, protein and solids-non fat/non-protein increased. Fat only contributes its own weight to the yield of cheese, but casein (the major cheese protein in cheese) plays a much more important role. Casein forms the structural matrix that traps moisture and fat. Casein can also contribute absorbed water to cheese yield, in addition to its own weight. It has been suggested

Table 1. Cheese Composition

Description	C:F <sup>1</sup>	% Moisture	% Fat	% Protein	Moisture: Protein
Full fat	74	39.6	30.9	24.4	1.62
25% RF <sup>2</sup>	.96	41.6	26.1	27.1	1.54
33% RF	1.39	43.9	20.1	30.5	1.44
50% RF	2.00	46.3	14.7	32.1	1.46
75% RF	3.38	49.3	8.9	34.3	1.44
Skim milk	20.13	52.4	1.5	37.4	1.39

<sup>1</sup> Casein to Fat Ratio  
<sup>2</sup> Reduced Fat Cheddar

that the moisture to protein ratio remains constant in cheese, however, in our study this ratio decreases. The practical significance is that the protein matrix of the cheese is separated by less moisture; it is denser. The result is a firmer, harder cheese.

### Protein Recovery

Table 1 shows that the actual protein contents (%N x 6.38) of the cheese did vary. The higher the C:F ratio of the initial milk, the higher the protein content of the cheese. Because it is difficult to measure protein in cheese (not all of the nitrogen in cheese originates from casein) we used a nitrogen balance to evaluate protein accountability in the cheese system. We found no significant differences in the percentage of nitrogen recovered in

*continued on next page*

### What's Inside:

Effect Of C:F Ratio On Stirred Curd Cheddar Cheese Yield .....	1
Inventing a New Niche Product, 8 .....	3
The Effect of Cutting and Coagulation on Cheese Yield – The New Zealand Experience .....	6
Chloride Regulation Update .....	9
Curd Clinic .....	10
Calendar .....	Back Page

the cheese, whey and total system. The percentage of nitrogen recovered in the cheese for the six different C:F ratios ranged from 72.9 to 73.8%, which falls slightly below the typical range of 74 - 77% (includes casein and entrapped whey proteins). It is unusual to see differences in protein recovery, unless there are extreme differences in milk composition or abnormal milk processing conditions.

**Fat recovery**

Variations in the percentage of fat recovered in the total system, cheese, and whey were significantly different among the six different C:F ratios (Table 2). Notice that the total percentage of fat recovered for the skim milk cheeses was 111.8%. This is because skim milk cheeses contain very little fat in the system, so any errors in sampling or analytical testing are misleadingly amplified. For example, in full fat Cheddar cheese, 98.8% of the fat was recovered or 3 oz of fat in the fat balance were missing. For the skim milk cheese 111.8% of the fat was recovered, or an extra 0.5 oz of fat is in this system. The fat balance clearly shows the trend of a lower percentage of fat recovered in the cheese and a higher percentage of fat recovered in the whey as the C:F ratio of the initial milk increases. Scanning electron microscopy showed that lower fat cheeses have a denser protein matrix, fewer fat globules, and the existing fat globules are smaller in size. Smaller fat globules in the cheese matrix can be shed more readily from the curd during manufacture. In this cheesemaking trial, the different initial milk fat levels were achieved by blending whole and skim milk. Preparing milk this way produces a wide distribution of fat globule sizes, while skimming removes the largest fat globules.

Table 2. Percentage of fat recovery in cheese and whey for 6 different fat levels of stirred curd cheese.

Fat level	Cheese	Whey	Total
Full fat	89.55 <sup>a</sup>	9.28 <sup>d</sup>	98.82 <sup>b</sup>
25% RF	87.68 <sup>a</sup>	10.65 <sup>cd</sup>	98.33 <sup>b</sup>
33% RF	87.45 <sup>a</sup>	11.79 <sup>cd</sup>	99.23 <sup>b</sup>
50% RF	86.00 <sup>ab</sup>	13.81 <sup>bc</sup>	99.81 <sup>b</sup>
75% RF	81.87 <sup>b</sup>	17.03 <sup>b</sup>	98.90 <sup>b</sup>
Skim milk	65.78 <sup>b</sup>	46.04 <sup>a</sup>	111.82 <sup>a</sup>
p-value	0.0001	0.0001	0.008

<sup>abcd</sup> Letters in the same column that are different indicate a significant difference.

**Solids-non-fat factor, R value**

You can calculate the solids-non-fat of cheese, or R value, from the Van Slyke cheese yield equation and the Fat in the Dry Matter (FDM) yield equation. The R value represents water soluble components, including salts, organic acids (lactic acid, citric acid), sugars (lactose, glucose, galactose), minerals, whey proteins and casein hydrolysis products. Noted previously in Table 1, as the C:F ratio increased, the moisture content of the cheese increased and the R increased. The increase in cheese moisture allows for more soluble components, such as salt (NaCl), lactose and lactic acid. The ratio of soluble components (salt, lactose, lactic acid) to cheese moisture remains constant for the six C:F ratios.

*next page*

**Pricing your lower fat cheese**

Reducing the fat content of milk leads to lower cheese yield. How much more should you charge for lower fat Cheddar cheese? The following table uses the component recovery system from this study to determine price. We started with 100 lbs. of whole milk (3.7% milkfat, 3.2% protein), skimmed it, made butter, cheese, and whey powder.

	Grade A Butter		Grade B Butter		Dried Whey Powder		Cheese		
	yield (lb)	value	yield (lb)	value	yield (lb)	value	yield (lb)	value	\$/lb
Full Fat	0.42	\$0.266	0.34	\$0.196	6.39	\$1.279	9.74	\$13.543	\$1.390
25% RF	1.44	\$0.901	0.30	\$0.176	6.33	\$1.266	8.61	\$12.941	\$1.504
33% RF	2.45	\$1.533	0.24	\$0.137	6.26	\$1.252	7.60	\$12.363	\$1.626
50% RF	3.12	\$1.957	0.20	\$0.113	6.20	\$1.241	7.03	\$11.974	\$1.703
75% RF	3.75	\$2.347	0.14	\$0.081	6.15	\$1.230	6.56	\$11.626	\$1.773
Skim	4.47	\$2.800	0.07	\$0.042	6.11	\$1.222	5.63	\$11.220	\$1.993

**Assumptions:**

- Grade A Butter Price \$0.627
- Grade B Butter Price \$0.577
- Dried Whey Powder Price \$0.200
- Full Fat Cheddar Price \$1.390

Starting with 100 lb of unstandardized whole milk (3.7 % milkfat, 3.2% protein)

*continued from page 2*

As you increase the C:F ratio of cheesemaking milk, or reduce fat in the cheese, the percentage of nitrogen recovered remains constant, water soluble solids increase and overall cheese yield decreases. If moisture increases, solids-non-fat increases also. It remains possible that higher fat losses were also due to the firmer coagulum at cutting.

Originally presented at the Wisconsin Cheese Industry Conference, March 23, 1995

## Inventing a New Niche Product, Part 8

*Paul Scharfman, Specialty Cheese Company and Wisconsin Specialty Cheese Institute*

“Hey, this is terrific! Now we know what people want in a Cheddar cheese. Looks like we’re going to need a bigger milk silo to handle the volume.”

“Slow down, Jim” said Don, “We don’t even know if we can make this stuff.”

“What are you talking about, Don? All the concept says is that people want good, aged Cheddar. That’ll be easy for us.”

“I hope you’re right,” Don responded, “But maybe we’d better check with some consumers.”

Jim and Don were discussing the Reenap Company’s new product project. During the past year the company, a small manufacturer of common Cheddar cheese, started the process to develop a new product. Don, Jim, and the other employees started by forming a New Product Development team, then they assessed the capabilities of their company to be sure that any new products the Team developed could be made in their facility. They continued by researching the competitive products that were already in the marketplace, analyzing the needs of their customers and consumers, and brainstorming many possible new product ideas. Next, they used consumer feedback to develop “positioned” concept statements for the Team’s favorite new product ideas, and they fielded a “concept test” to evaluate and improve their new product ideas.

They found this new product concept had the broadest appeal:

To people who love Cheddar cheese, new Reenap Real Aged Cheddar offers the taste of Cheddar the way it used to be because it is made in a small factory by cheesemakers who make the cheese the old fashioned way – using more flavor producing cheese cultures.

### References

Banks, J. M. and A. Y. Tamime. 1987. Seasonal trends in the efficiency of recovery of milk fat and casein in cheese manufacturing. *J. Soc. Dairy Technol.* 40(3):64-66. 

Now the team needed to know – how could they produce the product described by this concept?

### Develop product prototypes and test them with consumers

Developing an appealing concept for a new product is an enormous step towards success. But, it is only a step. For a new product to succeed, it must fulfill the promise of its concept.

The Reenap Company had found an appealing concept. Could they find a single formulation of cheese that fulfilled that concept? Unfortunately, a product that one person describes as a wonderful “taste of Cheddar the way it used to be” can easily be perceived by another person as the “taste of Cheddar the way it shouldn’t be.”

“All right,” said Jim, “Let’s have some people taste our aged cheese and see what they say?”

At that point Sara spoke up. “Who do you want to taste the cheese, Jim? I say we only ask those people who like the concept. Everyone else is unlikely to pick up a package of our new product, so we don’t need to worry about their opinions.”

“Good thinking,” said Don, “What if we offer those people some of the other aged Cheddar on the market, along with our current cheese? I’d like to know if someone else’s cheese is better than ours at fulfilling the concept that we developed.”

“You know,” interrupted Jim, “I think we could learn a great deal from seeing how people rated our competition’s aged Cheddar. I’ve always wondered why that salty Noftag brand sells so well and why that bitter tasting Nurchy brand is still on the shelf.”

Don laughed at that. “You think Noftag is salty? I think its great. I can’t figure out why some brands sell when they are white, others when they are off-white, and the rest when they’re orange.”

Sara jumped in. “What we’re really saying is that we need to test a wide range of cheese attributes in our potential market. Saltiness, acidity, color are only a few of the attributes. I bet there are lots more. Let’s start by trying to figure out what consumers care about when they are choosing aged Cheddar.”

**Which product attributes matter to consumers?**

The Team agreed. They asked 30 people to read their concept, thanking those who were not interested in the concept and continuing with the rest. The remaining 20 people were given three pieces of aged Cheddar from three different companies. Each person was asked to rate the three pieces of cheese for overall appeal and taste appeal on a 1 to 10 scale. Then the Team asked the tasters to rate each piece of cheese on attributes they listed. In addition, the consumers were encouraged to add attributes of the cheese that mattered to them. Here’s what they found.

Cheese Ratings (1-10 scale, 10 best and 1 worst)

Think of an ideal cheese as one that has “the taste of Cheddar the way it used to be” How does this cheese rate?

	Cheese A	Cheese B	Cheese C
overall appeal	7	8	9
overall taste	9	9	10
saltiness	9	9	8
whiteness	6	7	4
orangeness	4	3	7
crumbliness	4	5	6
smoothness	6	5	5
greasiness	3	6	6
“old fashioned flavor”	9	9	10
strong flavor	9	8	10
sharp flavor	8	10	10
pleasant fragrance	7	8	9
easy to slice	3	4	5
dryness	5	6	6
moistness	6	5	5
Added attributes			
no openings in cheese	5	4	7
nice wax rind	7	6	6
big enough to slice for a sandwich	3	6	5
my kids will like it	4	5	4

Based on these results, the team could determine which attributes of Cheddar cheese mattered most to their potential consumers. They chose the attributes that correlated best with the overall appeal and overall taste scores to use for their future product testing. Even without using any sophisticated statistical analysis, the Team could look at these results and see that attributes like “my kids will like it” did not seem important when determining overall appeal of the cheeses as aged Cheddar.

**Test your prototypes by focusing on the important physical attributes.**

The Team set up a grid of the important attributes as the basis for testing its products. Each consumer would be given several pieces of cheese and asked to rate these cheeses on a handful of attributes using the grid below.

Key Product Test Questions  
(given only to those people who were likely to buy after reading the concept)

- Now that you have tested the sample X, how likely are you to buy the product?
  - Definitely would buy
  - Probably would buy
  - Might or might not buy
  - Probably would not buy
  - Definitely would not buy



2) Using the grid below, place an X on each axis nearest the place where you feel sample X lies. Also, please mark an I nearest the place on each axis where you feel the ideal cheese with the “taste of cheddar the way it used to be” would lie.

strong flavor \_\_\_\_\_ weak flavor  
 sharp flavor \_\_\_\_\_ mild flavor  
 pure white color \_\_\_\_\_ yellow white color  
 deep orange color \_\_\_\_\_ yellow color  
 mild smelling \_\_\_\_\_ strong smelling  
 has a wax rind \_\_\_\_\_ doesn't have a wax rind  
 too much salt \_\_\_\_\_ too little salt

The Team took four samples of aged Cheddar – their own and three other brands – and labeled them samples A, B, C, D, and E. They then asked 50 consumers who liked their concept to respond to the questionnaire. Here's what they found.

**Product Test Results**

strong flavor  B I A C D  weak flavor  
 sharp flavor  B I A C D  mild flavor  
 pure white color  B I C A D  yellow white color  
 deep orange color  D I C A  yellow color  
 mild smelling  C A I B D  strong smelling  
 has a wax rind  B D I C A  doesn't have a wax rind  
 too much salt  B D C I A  too little salt

These findings represent an incredible treasure trove of knowledge. First, notice that the Team knows what the cheese with the “taste of Cheddar the way it used to be” should be like on all the important attributes of Cheddar! (Those scores are represented by the “I” markings). Next notice, that none of the cheeses score consistently near the ideal. They can all be improved!

The Team can now “engineer” the ideal cheese with the “taste of Cheddar the way it used to be.” They need to produce a cheese that has:

- the strong/sharp flavor of sample A
- either the white color sample C or the orange color of sample D
- the fragrance of sample B
- a waxed rind like samples B and D
- the salt level of sample C

Of course, there is no guarantee that such a cheese will appeal equally well to all consumers. Easterners, with their well-known desire for pungent, white cheddar might not agree with Westerners who tend to prefer milder cheeses. But if the Reenap Company can make the product these tests indicate, it is very likely to be superior to any product that is on the market.

**Time for the cheesemakers to prove their skill and art**

If developing an appealing concept is one giant step in the New Product Development Process, and identifying the ideal physical product is a second giant step, then the third step is actually making the product in the plant. It took the Reenap Company three months of experimenting before they felt they could make several versions of the cheese their research pointed to. And, of course, it took them another six months to age the cheese before they could test their prototypes among consumers.

When they were finally able to test their experimental product, they asked 50 people who liked their concept to taste their prototype cheeses and compare them to the tasters idea of cheese with the “taste of Cheddar the way it used to be.” They also asked the people to rate the market leading aged cheddar on this basis. The good news was that one of their prototypes was rated equal to the market leader. The bad news was that none of their prototypes emerged clearly superior.

The Team recognized, however, that they could analyze their test grid data – in the same way they had nine months earlier – to determine exactly how to improve their prototypes. The cheesemaking challenge was enormous, but nine months later the Team was ready to test again. This time their efforts paid off. Their cheese fulfilled their concept and it fulfilled better than any other cheese on the market.

**Product development requires checking with consumers**

The reason that developing the “right” product took the Reenap company such a long time is only partially explained by the aging of the Cheddar prototypes. The fundamental reason that the process took so long was that the employees of the Reenap company knew they had to use the consumer as their guide. Doing so takes time. It may seem easier to develop products that you, and your employees “know” taste good. After all, you’ve been in the business a lot longer than any consumer! Unfortunately, this approach usually leads to failure in the marketplace. New

*next page*

# The Effect of Cutting and Coagulation on Cheese Yield – The New Zealand Experience

K. A. Johnston, F. Dunlop & M. Lawson, New Zealand Dairy Research Institute Palmerston North, New Zealand

Using rennet to convert liquid milk to a semi-soft gel is the first major step in the cheese making process. This is followed by cutting the gel, which initiates and encourages syneresis of the cheese curd during the cooking stage of the process. Although we do have evaluations of these stages of cheese making and cheese yield in particular vat types, no detailed information relating changes in speed and duration of cutting to curd particle size distribution is available. Perhaps more importantly, we lack information about the effect of varying the speed and duration of cutting in the modern mechanized cheese making process. How do these variables affect cheese yield, particularly regarding the components lost to the whey? We know (Whitehead & Harkness, 1954) that the size of the surface-to-volume ratio of the curd particle at draining influences the moisture content of both the milled, unsalted curd and the pressed curd. To date, manipulating the size of the curd particle prior to draining has been a commonly used method of ‘fine-tuning’ moisture levels in the final cheese.

We wanted to understand how changing the speed and duration of cutting affects both the curd particle size distribution at draining and the losses of fat and fines to the whey. The trials were carried out in a commercial plant during routine production, where we produced Cheddar cheese in vertical, 18 000 L, Double O Damrow vats. The plant uses an Alfomatic draining system and the curd was pressed in Wincanton towers.

## Speed and duration of cutting

On each of 3 consecutive days, the speed and duration of cutting were varied in each of nine Damrow cheese vats. Three speeds of cutting (2, 5 and 8 rpm) were used over 3, 6, and 9 minutes. We measured the cumulative % of curd particles sized < 7.5 mm (%CPS) and fat and fines losses to the whey at draining for each vat. In addition, we also measured the moisture content of the milled, unsalted curd.

The relationship between curd particle size and the total revolutions made by the knives during cutting (speed multiplied

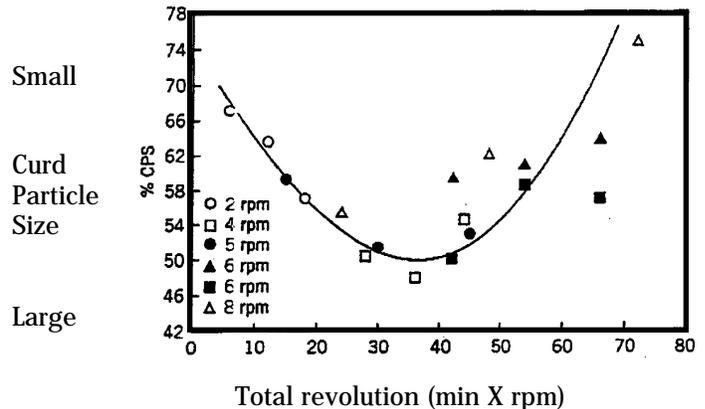


Fig 1. Effect of speed and duration of cutting on the cumulative % of curd particle speed < 7.5 min. (%CPS)

by time of cutting) is shown in Fig 1. Notice the unusual ‘V’ trend. We sampled at draining rather than immediately after cutting and we suspect the trend reflects not only the cutting sequence used, but also whatever happened to the curd between the end of cutting and the start of draining.

Initial increases in the duration and speed of cutting reduced the number of large particles available for smashing during the stirring phase. Consequently, overall curd particle size appeared to increase. When the cutting sequence alone produced curd particles small enough to avoid smashing, shattering was no longer a problem. Continued cutting decreased curd particle.

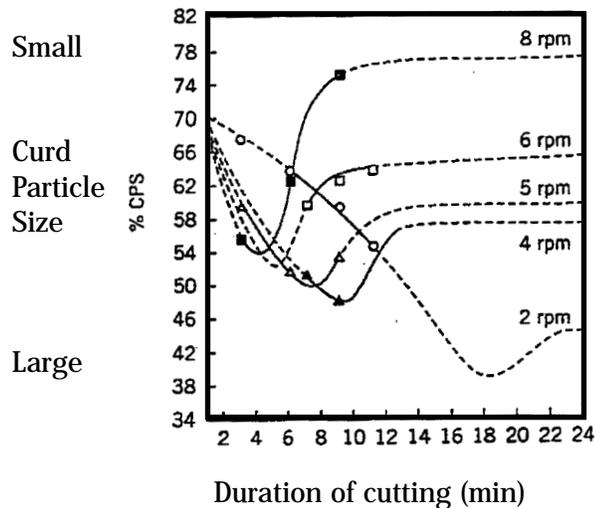
Initial shattering of the curd resulted in high fat losses to the whey. When curd particles were cut small enough to avoid shattering during stirring, fat losses were at a minimum. Based on these results, we have proposed a model explaining how the variation in cutting, followed by a constant stirring speed, determines curd particle size distribution in a Damrow cheese vat.

*continued from page 5*

Product Development Teams must remember that there are no “experienced experts” for their product. There can not be – because their product is new!

In my next article I will discuss creating the graphics, packaging, and selling materials for the new product that the Reenap company developed. 

**Figure 2. Model of the change in cumulative % of curd particles sized <7.5 mm (%CPS) with increasing duration of cutting.**



Each of the five curves in Fig 2 represent the variation in curd particle size distribution with duration of cutting, for a constant speed of cut. The dotted lines represent an estimated trend. Values connected by continuous lines are those obtained from this and two previous trials.

Each trend is characterized by a specific duration of cutting, with maximum curd particle size. Shorter times produce curd particles which shatter during stirring, causing higher fat losses in the whey and smaller curd particles. A longer cutting time produces smaller curd particles, but does not elevate whey fat losses. As you reduce cutting speed, in this case from 8 rpm to 2 rpm, increase the duration of cutting to avoid shattering, curd particle size increases.

### Coagulation during cheese making

A number of reports from New Zealand and elsewhere describe the effect of various cheese making practices on cheese yield and quality. These effects are complex and difficult to quantify.

In recent years, the strength of the cheese gel at cutting during cheese making has attracted particular interest. However, as Lawrence (1993) indicates in his review of processing factors which affect cheese yield, results from reports on the influence of curd firmness at cutting on cheese yield are inconsistent.

We began our investigation to define, under New Zealand conditions, the effect that changes in gel strength at cutting had on curd particle size and fat and fines losses to the whey. The experimental design is shown in Fig 3 on page 8. We did this research in the same plant that was used for the cutting trials. All remaining cheese making conditions were kept constant.

Three levels of rennet 10.6, 16, and 24 ml rennet per 100 L of milk were included in the trial. We altered the temperature at setting for these three levels of rennet to 35°C, 32°C and 29°C respectively, so the firmness of the gel at cutting was similar for each combination for any one set-to-cut time. To determine the influence of firmness or gel strength at cutting, the gel was cut either 10 min earlier or 10 min later than the standard 40 min set-to-cut time. Adding the starter was staggered (point A) so that the pH at setting (point B) was similar for each vat. We cut all gels using the same cutting program (6 rpm x 11 min). Samples were taken at drain for curd particle size, fat and fines analyses.

In terms of yield, curd moisture increases on average by approximately 1% when increasing the set-to-cut time from 30 to 50 min, despite all vats having the same cut-to-drain times. Fines in the whey also increased, but only slightly. Curd particle size and fat losses to the whey remained unchanged.

Averaging the data over each coagulant combination for each set-to-cut time showed no real effect on losses to the whey. We concluded that, under New Zealand cheese making conditions, small changes in gel strength at cutting would not significantly affect yield.

### Unexpected trends in yield

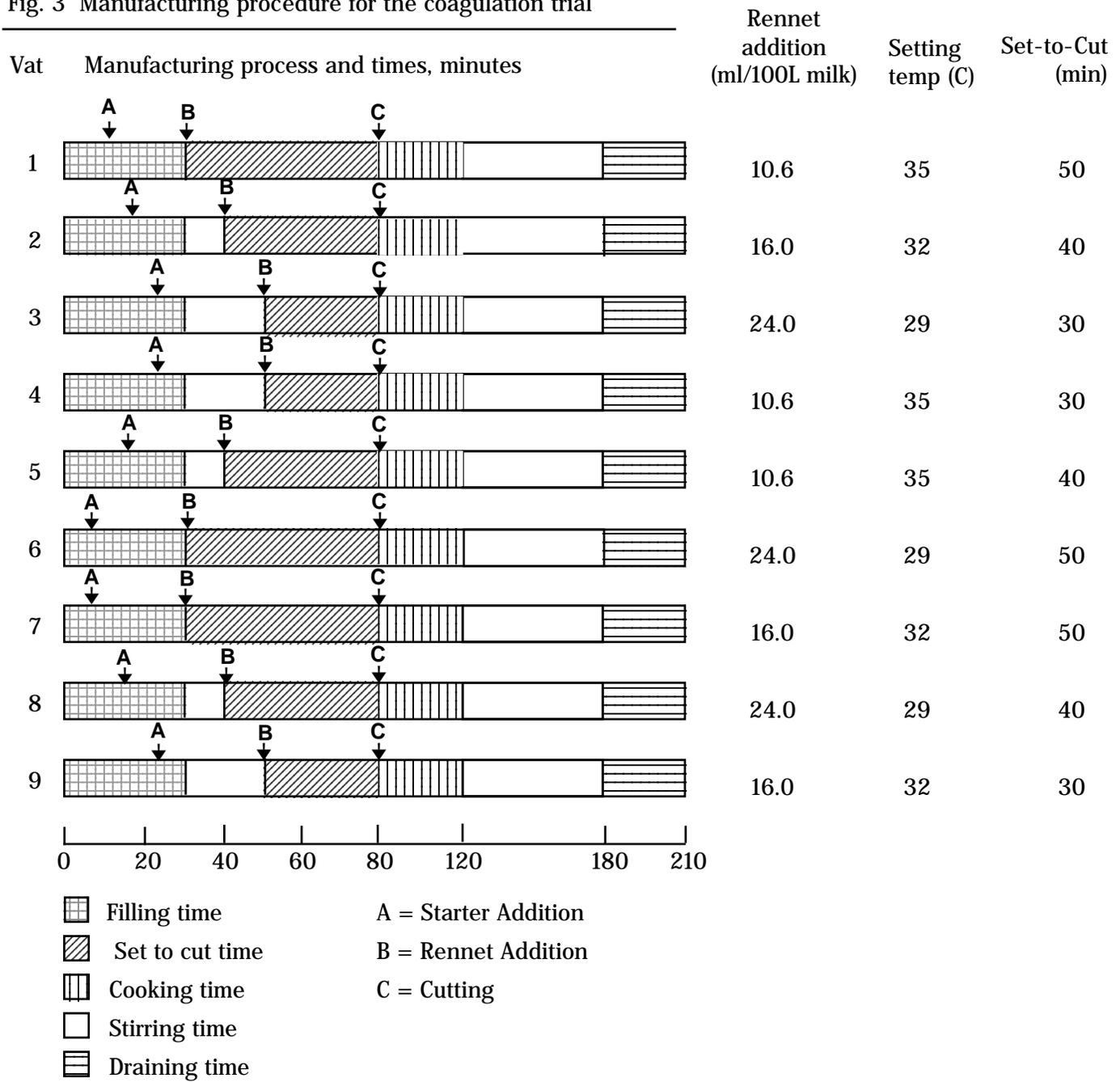
However, averaging the data over each set-to-cut time for each coagulant combination produced unexpected trends in yield. As a coagulant concentration was increased and set temperature decreased, curd particle size, curd moisture and fat lost to the whey all decreased significantly.

A light microscopy study of the protein structures at draining showed that using a high rennet level and a low set temperature produced a curd structure that appeared highly cross linked and continuous. Using a low level of rennet and a high set temperature produced a structure that was much more open, discontinuous and sparsely linked.

Another important consideration is that we kept the cooking temperature constant at 38°C for all vats. Consequently, where low levels of rennet were used, the temperature differential between setting and cooking was only 3°C. Moisture was retained, fat was lost and curd particle size remained relatively unchanged. However, where high levels of rennet were used, the differential was 9°C. Moisture was lost and curd particle size decreased, possibly due to the increased synergetic effect produced by a larger difference between set and cook temperatures. Further work is needed to clarify the reasons for this change in structure and the possible downstream effect on cheese composition, quality and yield.

*continued on page 8*

Fig. 3 Manufacturing procedure for the coagulation trial



References

Lawrence, R. C. 1993 Factors affecting the yield of cheese International Dairy Federation Special Issues No. 9801 71-72.

Whitehead, H. R. & Harkness, W. L. 1954 The influence of variation in cheese making procedure on the expulsion of moisture from Cheddar cheese curd. Australian Journal of Dairy Technology 9 103-107.

Authors' note: The practical work for the cutting trial was completed in December 1989 and the results published in the Journal of Dairy Research in 1991 (Vol. 58, 345-354). The coagulation trial was done in 1990.

# Chloride Regulation Update

Bill Wendorff, Associate Professor

Dept. of Food Science, University of Wisconsin-Madison

Progress is being made in the development of the new chloride regulatory policy for the State of Wisconsin. On April 18th, Bill Wendorff, UW Food Science Dept.; Dave Myers, Foremost Farms, USA; and Tom McElligott, Quarles & Brady presented preliminary reports from industries that would feel the impact of the new regulations to the Department of Natural Resources (DNR) Chloride Advisory Committee. A major portion of the report was based on an industry survey completed in April by the UW Food Science Dept. A total of 95 (out of 145) cheese plants responded to the survey, which is printed below.

Do you have any outfalls covered by WPDES permits?

Yes	83
No	12

Current disposal of process wastewater from plant: (# of plants)

Own waste treatment system .....	13
Pretreatment system .....	14
Municipal POTW .....	39
Ridge & furrow .....	11
Pond or lagoon .....	20
Landspreading .....	52
Other to the river .....	(1)

Salty whey pressings and drippings are currently disposed of by: (% of plants)

Landspreading .....	75
Municipal POTW .....	19
Whey processor .....	5
Membrane system .....	1

Frequency of spent brine disposal: (# of plants)

Annually .....	11
Semiannually .....	4
Quarterly .....	3
Monthly .....	7
None (use membranesystem) .....	6

Spent brine solutions are disposed of by:

Municipal POTW .....	50% of plants
Landspreading .....	35 " "
Manure pits .....	15 " "

Currently, the EPA has a standard of 230 mg/L for chronic toxicity for chlorides in surface water discharges. DNR has an

interim standard of 399 mg/L for chronic toxicity but is proposing to lower that to 310 mg/L under NR 105 and NR 106 (Surface Quality Criteria for Toxic Substances). EPA is requiring the state to have a policy in place to address the chloride problem in Wisconsin by the end of 1996.

The DNR has identified about 300 WPDES (Wisconsin Pollution Discharge Elimination System) permittees that they feel currently exceed the 310 mg/L limit for chlorides in discharges to surface waters. About 150 of those plants are cheese and food processing plants. Their current monitoring reports show the quarterly chloride average from cheese plants to be 705 mg/L with an average minimum of 637 mg/L and a maximum of 911 mg/L. Individual samples ranged from 27-1689 mg/L.

## Source reduction approach

At the April 18th DNR Chloride Advisory Committee meeting, the committee agreed to pursue a "source reduction" approach to developing a chloride policy for the state of Wisconsin instead of the water quality criteria as required under NR 105 and 106. At the May 16th meeting of the DNR Chloride Advisory Committee, DNR management indicated that they support the attempt to develop a chloride regulatory policy based on source reduction. However, they will require identification of discharge category-specific source reduction measures. They will also require the establishment of achievable end points. That is, after a facility has implemented the source reduction measures applicable to its discharge category, the chloride concentration in the effluent discharge to surface waters should not exceed 310 mg/L.

To establish chloride source reduction measures for the cheese industry, DNR is requesting pilot studies. The studies need to be done in cheese plants where you can measure both the costs of source reduction measures in actual facilities and effluent improvements. The Chloride Advisory Committee will evaluate the pilot studies on August 8th. Any plants willing to share information on salt management programs that have reduced chloride discharges from cheese plants should contact Bill Wendorff at the UW Food Science Dept., (608) 263-2015. 

## Curd Clinic

**Q.** Is Bovine Spongiform Encephalopathy (BSE) a threat to the safety of dairy products?

**A.** Right now, scientists have more questions than answers about bovine spongiform encephalopathy, or BSE. However, current information suggests that dairy products are safe and not involved in the transmission of BSE.

BSE has caused enormous economic hardship for farmers in Great Britain. (See sidebar on page 11) Since the first cases in cattle were reported in 1986 the epidemic has spread throughout Britain and by 1996 nearly 160,000 cases were reported. A 1987 study indicated that feed containing protein supplements derived from meat and bone meal was the only common factor shared by affected cattle. This practice was banned in 1988. BSE has a long incubation time, so even though this exposure stopped in 1988, the epidemic didn't start to slow until 1993.

### BSE caused by "prions"

The causative agent of BSE has been described in the past as a "slow virus" a "self-replicating protein," and now as a "prion." Research continues to support the hypothesis that the prion causes disease by contacting normal proteins in brain cells and inducing the normal protein to re-fold into an abnormal configuration. The abnormal protein can then induce neighboring proteins to re-fold as well. A similar process probably occurs in scrapie, a fatal brain disease of sheep and goats. Creutzfeldt-Jakob disease (CJD), is a rare (estimated one case per million people per year) but fatal human disease that produces the same type of brain damage. There is no direct scientific evidence that the BSE prion causes CJD in humans. However, recently a cluster of variant CJD cases turned up in the United Kingdom (UK). These individuals were affected by CJD at a younger age (avg. of 27 instead of over 63), the illness lasted longer, and the brain pathology was recognizable as CJD, but it looked somewhat different. This led the Spongiform Encephalopathy Advisory Committee in the United Kingdom to declare that these case were "most likely" caused by exposure to BSE infected cattle brain or spinal cord prior to 1989, when these offal were banned from the food chain.

To date, the only parts of a cow known to carry the BSE infective agent are the brain, spinal cord, and retina. Based on a rudimentary, but sensitive, mouse assay involving intracerebral injection, scientists found no evidence that milk and beef muscle carry the infective agent. Nonetheless, in the UK, milk from cattle suspected of having BSE is destroyed.

### Risk to humans

Three conditions would have to exist before there is a risk of humans contracting BSE from dairy products. They are: (1) evidence that the BSE infective agent causes illness in humans, 2) that the infective agent is present in milk and 3) that the infective agent would survive dairy processing.

Unfortunately, experiments have shown that the BSE prion is highly resistant to heat and common chemical sterilants. Very severe treatments are necessary to destroy the agents, e.g. heating at temperatures about 121°C (250°F) or exposure to sodium hypochlorite at active chlorine levels of 20,000 ppm for one hour. Thus, it is likely that typical dairy processing procedures would not inactivate the agent.



*Curd clinic doctor for this issue is Steve Ingham, Asst. Professor, Dept of Food Science, University of Wisconsin-Madison.*

The cases of variant CJD suggest more questions for researchers. Are there other explanations for the outbreak? If BSE is implicated, how was it transmitted? If the disease has a long latent period, will the number of human cases increase? How can we test for them? It is important to continue basic research on prions – we need to know how they cause disease.

So far, BSE has not been found in cattle in the United States. There is no firm evidence showing that the BSE infective agent can cause illness in humans or be transmitted in milk and dairy products. We can't help but wonder about BSE, but right now there is no reason to worry about ingesting the BSE prion in dairy products. 

Questions for the Curd Clinic?

Write to:

CDR, UW Dairy Pipeline

1605 Linden Dr.

Madison, WI 53706

FAX: 608/262-1578

e-mail: Paulus@ahabs.wisc.edu

## BSE in the UK

- 1986 First confirmed cases of BSE in England
- 1987 Studies link BSE to feed
- 1988 Ruminant material banned from animal feed
- 1988 Sale or use of milk from suspected cases of BSE banned
- 1988 BSE notifiable disease, compulsory slaughter of suspect animals
- 1996 Variant cases of CJD appear in humans

The Internet is an ideal resource for current information about BSE. Start your search with the following website: <http://www.easynet.co.uk/ifest/>

USDA's Meat and Poultry Hotline:  
1 (800) 535-4555

## News from CDR

Over 50 researchers, industry representatives, board members, and producers met in Madison on April 23rd and 24th. They came to participate in a National Milkfat Technology Forum, co-sponsored by Dairy Management Inc., the Wisconsin Milk Marketing Board and the California Dairy Research Foundation. Scientists presented updates on all aspects of milkfat technology and applications, including pre-harvest technologies, butter manufacturing, milkfat fractionation, enzymatic modification, butter flavor, and nutrition. The presentations were followed by a lengthy discussion of the current program and issues, and needs for future milkfat research. DMI, WMMB and CDR are using the information to plan next years National Milkfat Plan.

### New Olson scholarship

The Wisconsin Cheese Makers Association has named a new scholarship in honor of Norm Olson, Ph.D., University of Wisconsin professor in Food Science and former director of the Center for Dairy Research. Dr. Olson is one of the nation's preeminent cheese researchers. WCMA President Ron Buholzer presented the first contribution to the scholarship fund, which will award a \$1000 scholarship to student who is emphasizing cheese research or cheese technology in their studies. 

## Alto Dairy and University Team Up for Honor

by Bill Wendorff, Associate Professor  
Dept. of Food Science, University of Wisconsin-Madison

Alto Dairy Cooperative of Waupun, WI was presented with the Wisconsin Idea Award at the University of Wisconsin Extension Awards Banquet on May 9th in Madison. Ayse Somersan, Dean of Cooperative Extension, presented the award to Larry Lemmenes, President of Alto Dairy. The Wisconsin Idea Award is presented to an industry that has worked cooperatively with the University of Wisconsin to test and implement new technology that helps strengthen the competitiveness of Wisconsin industry.

The Alto Dairy/University teams recognized for contributing were:

Total Quality Management Project: Dr. Ken Huddleston, UW- Extension Business Management Educator, Oshkosh; Dennis Kasuboski, Packaging Plant Manager and Nancy Schweitzer, TQM/EI Coordinator of Alto Dairy.

National Food Safety Project: Dr. Rusty Bishop, Director, and Marianne Smukowski, Research Specialist of UW Center for Dairy Research; Dean Sommer, VP Technical Services and Quality Control of Alto Dairy.

Continuing Education Project: Dr. Bill Wendorff, Dairy Mfg. Specialist, and Dr. Bob Bradley, Dairy Processing Specialist, UW Food Science Dept.; Ken Leitner, VP Manufacturing and Operations of Alto Dairy.

Milk Futures Project: Dr. Bob Cropp, Dairy Marketing Specialist, UW Center for Cooperatives; Jeff Key, Winnebago County Extension Agriculture Agent; Don Desjarlais, VP Finance of Alto Dairy.

Through cooperative effort in these projects, not only did Alto Dairy gain from the research/extension efforts but the dairy industry gained useful information. We thank the officers of Alto Dairy for the openness they showed while working with the University of Wisconsin and gratefully recognize the people who contributed to the projects. 



## UW DAIRY PIPELINE

### Calendar

**June 22-26 Institute of Food Technologists Annual Meeting**, sponsored by the Institute of Food Technologists. New Orleans, LA. For information, call IFT, (312) 782-8424.

**July 11 Wisconsin Dairy Products Association Annual Butter and Cheese Grading Clinic.** Wisconsin Dells, WI. For info call WDPA, (608) 836-3336.

**July 14-17 American Dairy Science Association Annual Meeting**, sponsored by American Dairy Science Assn. Corvallis, OR. For more information call ADSA, (217) 356-3182.

**Aug. 19-22 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.

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

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

**Oct. 16-18 Current concepts in Foodborne Pathogens and Rapid and Automated Methods in Food Microbiology.** University of Wisconsin-River Falls. Call P.C. Vasavada (715) 425-3150.

**Oct. 22-23 Milkfat as an Ingredient Short Course.** Madison, WI. Call Kerry Kaylegian at (608) 265-3086.

**Oct. 29-31 Producing Safe Dairy Foods, a Master Cheesemaker Safety Short Course.** Madison, WI. For more information, call Marianne Smukowski at (608) 265-6346.

**Nov. 12-13 Wisconsin Cheese Grading Short Course.** Madison, WI. Call Bill Wendorff at (608) 263-2015.

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

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

Karen Paulus, Editor  
e-mail: Paulus@ahabs.wisc.edu  
phone: 608/262-8015  
Produced by CDR Communications  
Rusty Bishop  
Sarah Quinones  
Karen Paulus

Technical Reviewers:  
Mark Johnson, CDR  
Norman Olson, Dept. of Food Science  
Jim Path, CDR  
Tom Szalkucki, CDR  
Bill Wendorff, Dept. of Food Science  
Cathy Hart, Wisconsin Milk Marketing Board

The *UW Dairy Pipeline* is published by the Center for Dairy Research. Funding provided by the Wisconsin Milk Marketing Board.



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

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

ADDRESS CORRECTION REQUESTED