

SARE FARMER/GROWER GRANT REPORT

PROJECT TITLE: Food Safety and Quality Control Program
for Farmstead Sheep Cheese (FNE 01-363)

GOALS

The goals of this project were to:

- 1) create a formalized food safety / quality control program to assure consumers that the cheeses made by the four participating farmstead cheesemakers are safe,
- 2) develop this program to serve as a model for all farmstead cheesemakers in New England, and
- 3) generate data from milk and cheese analyses to form standards and Best Manufacturing Practices (BMP's) for farmstead raw milk cheesemakers in lieu of pasteurization.

COOPERATORS

Four of the original five farms, that applied for this grant, participated in the project; Highland Farm did not milk sheep and make cheese this year. In general, the milking and cheesemaking season began in May and ended in late October. Bonnieview and Peaked Mountain farms finished cheesemaking in late-September.

Each participating farm produced different types of cheese as follows:

Farm	Cheese type	% of Total	Pounds
• Major Farm	Vermont Shepherd	100%	9,000
• Peaked Mountain	Vermont Shepherd	90%	900
	Camembert	10%	100
• Woodcock	Vermont Shepherd	5%	200
	Feta, Tomme, and Brie	95%	3,800
• Bonnieview	Vermont Shepherd	50%	4,000
	Feta and Blue	50%	4,000

Peter Dixon provided the technical assistance, including:

- milk and cheese sampling and deliveries to the Agri-Mark Central lab
- reporting results to the farmers
- troubleshooting high bacteria and SCC counts
- on-site cheese development and improvement
- reviews of production records
- participation as a judge in the Vermont Shepherd cheese grading panel

The participants had prior experience from the previous year in operating their own food safety programs. Changes were made to make this year's version less complicated.

PROCEDURES

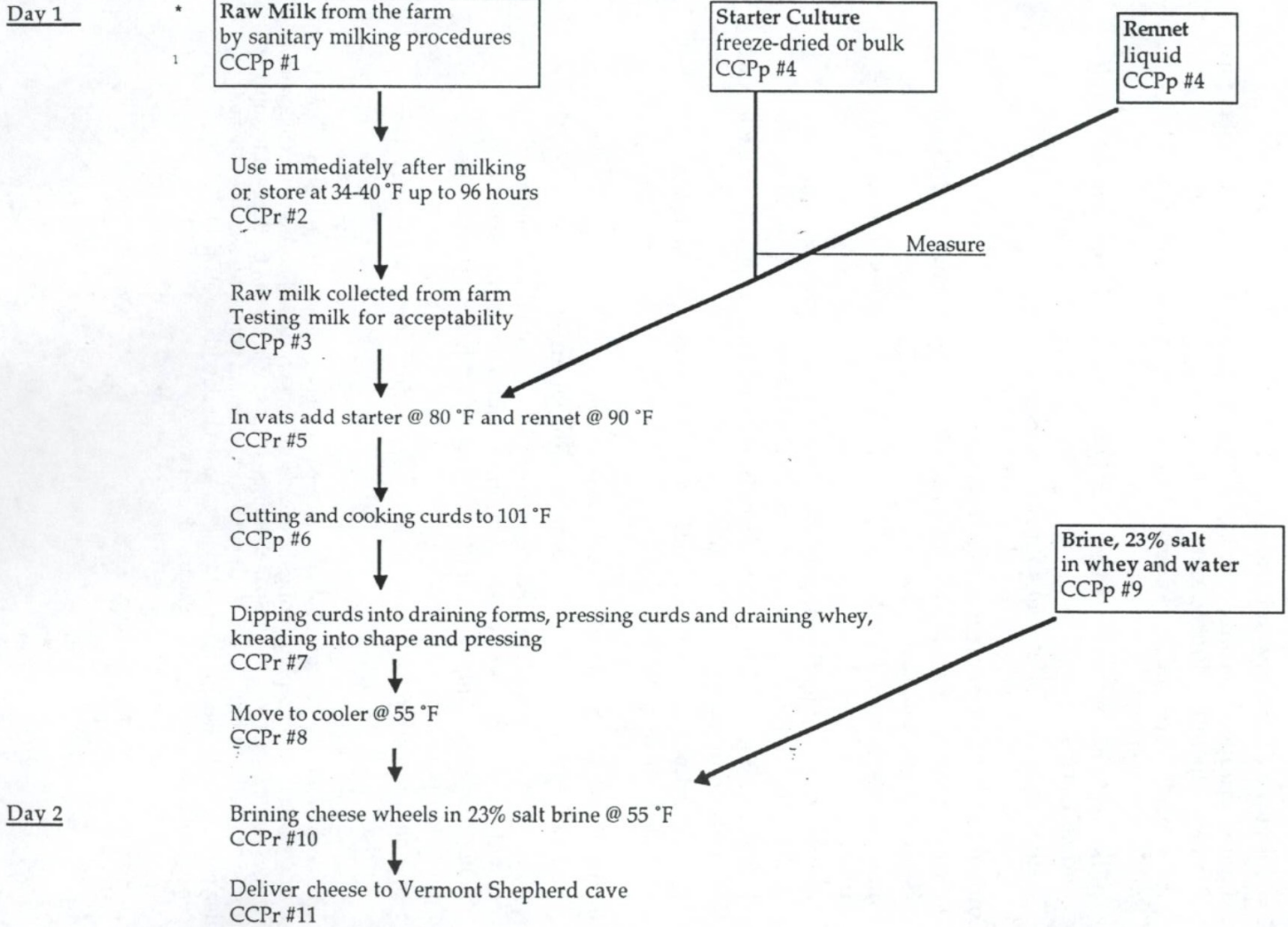
Cheese Safety - the Risk Reduction Program

I established a cheese safety program for each participant, which reduced the risk of placing contaminated cheese on the market. The program was essentially composed of three "steps" or "control points" to monitor the incidence of microbiological contaminants entering a representative sample of raw milk and cheese. This represented a significant departure from last year's program, which had eleven control points (figure 1).

The new program maintained the same level of control over the raw milk (new control point #1) and increased the frequency of testing the final products (sheep cheeses) before sale (new control point #3), but placed the nine steps related to the cheese-making process into one control point (new control point #2). The new program is outlined in Figure 2.

All of the milk and cheese testing was done at the Agri-Mark Central Testing Laboratory in West Springfield, MA.

Figure 1. HACCP Plan for 2000 Vermont Shepherd Cheese Production: Flow Chart



¹ CCPp = prevents hazards CCPr = reduces, delays or minimizes hazards

Figure 2. Risk Reduction Program for Sheep Cheese Production in 2002

Control point #1 - Safety and Quality of Raw Milk

- milk is produced according to Good Manufacturing Practices and Standard Sanitary Operating Procedures
- milk meets Vermont and Federal standards for bacteria, SCC, and antibiotic residues
- milk meets European Union standards for *Staphylococcus aureus*, *E. coli* and coliforms
- milk is tested every 2 weeks for compliance

Control Point #2 - Cheese-making Procedure

- cheese is made according to Good Manufacturing Practices and Standard Sanitary Operating Procedures
- ingredients: rennet, cultures, salt, and herbs, are checked for activity and purity
- development of acidity during the cheese-making process is monitored and recorded at key points for each batch to show proper fermentation
- brine strength and brining time are monitored and recorded for each batch to show adequate salt in the cheese
- any deviations from normal make procedures and parameters are recorded for each batch

Control Point #3 - Safety of Cheese Prior to Sale*

- a representative sample of cheese is pathogen-free
- a representative sample of cheese (from 10-15% of all batches made) is tested (according to European Union regulations) for *Listeria monocytogenes*, *Staphylococcus aureus*, *Salmonella species*, and pathogenic *E. coli*.
- one out of every 6 batches is tested, which equals one batch every two weeks

* Although monitoring cheese quality is not a part of this program per se, it is monitored because of the record keeping during the cheese-making process. The Vermont Shepherd cheese is graded prior to sale by a panel of three judges. Cheese can be deemed unsuitable for sale or worthy of bearing the Vermont Shepherd brand name. I was one of the judges this year. I also made periodic visits to the cave to check with the affineur ("cheese ripener") on the condition of the cheeses during aging.

Milk testing began on June 18, 2001 and ended on October 15, 2002. Standards were established for limits (not to be exceeded to assure safety) and targets (for best quality) as follows:

1. **Total bacteria** - for compliance with VT state limits.
This test was only useful in that it gave a measure of compliance with VT state standards for total bacteria in milk. We used a critical limit of <20,000 CFU/ml and a target level of <10,000 CFU/ml.
2. **Total coliforms** - indicator of level of hygiene during milking.
This test was very useful as high coliform levels indicated poor cleaning of milking animals, i.e., an excessive amount of fecal contamination entering the milk from the teat skin. Early gassing in cheese can be attributed to high coliform counts. We used a critical limit of <100 CFU/ml and a target level of <10 CFU/ml.
3. **E. coli** - indicator of level of hygiene during milking; specifically the presence of enteric bacteria.
This test was useful because it indicated the first point where disease-causing organisms could enter the cheese making process. The critical limit and target level were absence in one ml. This test was used only if the coliform count was >100 CFU/ml.
4. **Thermoduric (aerobic sporeformers)** - indicator of milking equipment sanitation and contamination from silage and soil.
This test was useful because the source of high total bacteria counts could be diagnosed by using a combination of the thermoduric and coliform tests. Late gassing in cheese can be caused by high thermoduric counts. The most accurate test for predicting late gassing is the butyric sporeformer test, which was not used due to cost. The critical limit and target level were <10 CFU/ml.
5. **Staph. aureus** - indicator of poorly cleaned equipment because it concentrates in fat residues and an indicator of animal and/or personal health. The critical limit was <2,500 CFU/ml and the target was <500/ml.
6. **Somatic cells (SCC)** - for compliance with VT state limits (<750,000/ml).
This test was a good indicator of animal health. A SCC of greater than 500,000/ml indicated the presence of mastitis or subclinical mastitis in the milking string. There seemed to be higher SCC (500,000 - 1,000,000) in the first month for most farms. Producers were able to lower high SCC by screening ewes with the CMT. This proved to be a very useful test. The critical limit was <500,000/ml and the target level was <250,000/ml.

Cheese was tested from July 15 to January 31, 2002.

By regular testing of raw milk and aged cheese, a representative sample of all the milk and cheese produced during the season was obtained. By using risk assessment, the assumption was made that if the representative sample achieved a sufficient level of safety then the total production was also safe.

Although this "risk reduction" program did not use a genuine HACCP (Hazard Analysis and Critical Control Point) approach, where the safety of all batches is monitored by testing at critical points in the cheese-making process where a contaminant may exist, it achieved a level of safety assurance greater than that provided by the current regulatory system for farmstead cheese in Vermont. This risk reduction program can be adapted to any producer's operation regardless of the cheese they make.

The participants were responsible for keeping accurate records of each batch of cheese they made. Acid development and brining times were tracked during the cheese-making process. Sufficient acidity and salt are two essential criteria for making safe cheese. I was responsible for reviewing the records and providing results of milk and cheese testing to the participants in time for them to correct any problems.

Technical Assistance.

I worked with the Fischers at Woodcock Farm to develop new varieties of cheese for their business, including washed-rind and Romano cheeses. We continued working on the production of a soft mold-ripened cheese, which did very well in the market this year. I also advised Neil Urie of Bonnieview Farm about producing Feta cheese and Bob Works of Peaked Mountain Farm about making a soft-ripened, Camembert-type cheese.

RESULTS

Milk:

The results of milk testing are shown Table 1. Improvements were made from last year in all categories as can be seen by comparing with the results from 2000 shown in Table 2.

Table 1. Results of microbiological testing of sheep milk in 2001, showing critical limits and target levels used in the risk reduction program.

	Total count	Coliform count	E. coli count	Staph. aureus	Thermo count	SCC
No. samples	27	27	27	27	27	27
Critical limit	20,000	100	0	2,500	10	500,000
No. >	1	1	0	2	1	3
Target level	10,000	10	0	500	10	250,000
No. >	2	4	0	6	2	8

Table 2. Results of microbiological testing of sheep milk in 2000, showing critical limits and target levels used in the cheese safety program.

	Total count	Coliform count	E. coli count	PI count	Thermo count	SCC
No. samples	40	40	10	38	37	40
Critical limit	20,000	100	0	50,000	10	500,000
No. >	4	5	1	13	9	8
Target level	10,000	10	0	20,000	10	250,000
No. >	5	16	1	19	9	18

Cheese:

No pathogens were found in samples from 30 batches of 250 batches of cheese made (12% of the total).

Cheese-making Records:

The key points for testing the acidity were:

1. milk at receiving and filling vat
2. whey during end of pressing
3. cheese pH or acidity before brining

Comments:

The participants still had problems getting reliable pH readings during the season. Measuring titratable acidity may be a simpler method to use. The brine salinity is still not being measured frequently enough.

The results showed that the risk reduction program was effective in controlling contaminants, improving milk quality, and assuring the production of safe cheese. However, there was a larger percentage of Grade B and unsaleable Vermont Shepherd brand cheese this year compared to last. Therefore, the program did not necessarily assure high quality. Improvements in quality must be made by greater emphasis on quality control within the Vermont Shepherd Cheesemakers Guild. Other styles of cheese also varied in quality but there were no figures to support gains or losses in quality from last year to this year. The majority of the other cheese varieties were being made in significant quantities for the first time this year.

The participants felt strongly that the milk testing was very helpful and have made arrangements to continue this part of the program next year.

ECONOMIC FINDINGS

The cost for the program for each farm was \$270 per month:

Milk testing:	2 x \$13 = \$26
Cheese tests:	2 x \$45 = \$90
Sample handling	2 x \$76 = \$154
TOTAL =	\$270

The risk reduction program did not produce economic gains for the participants since there was no increase in the quantity of best grade Vermont Shepherd cheese.

NEW IDEAS

The most difficult part of operating the program was sample handling (collection and delivery). These costs were higher than the fees for the tests. These costs could be reduced if more farms participated. Ultimately, the agency in charge of regulating dairy products should incorporate the concepts from this project into a framework for an alternative system for regulating farmstead cheese, i.e., made on the farm only from the milk of the farm's herd or flock.

The next step is to implement this program on a larger scale in New England.

PRACTICES

The program was effective. However, it has only been tried by myself and is largely my creation. I propose that experienced dairy microbiologists and technicians become involved in a larger discussion concerning the best strategy to assure safe farmstead cheese production. I would like the results from the past two years to act as building blocks for the construction of a regulatory system, which concerns itself with farmstead cheese. The European Union has this type of system.

The practice of testing raw milk for the bacteria in the program should be continued as it provides farmstead cheesemakers with timely results to improve and maintain the quality of their milk and cheese.

Assurance of product safety is of paramount concern to food producers. Food safety problems and associated negative publicity threaten the viability of farmstead cheesemakers, so pro-active steps such as the development and implementation of risk reduction programs are necessary. Although larger companies have adequate resources to develop HACCP plans, this is not easy for small-scale and farmstead cheese producers to accomplish. This project showed that a technician could effectively meet the needs of four farmstead cheese producers. This approach could serve as a model for future efforts to create HACCP-type plans or "risk reduction" programs for other small-scale cheese businesses.

PROJECT LEADER: Bruce Clement
January 31, 2002