Controlling On-Farm Inventories of Bulk-Tank Raw Milk—
An Opportunity to Protect Public Health

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ABSTRACT

Hazard Analysis Critical Control Point programs provide a systematic approach for the reduction of food safety problems through preventive measures. On-farm programs similar to Hazard Analysis Critical Control Point, which target pathogen reduction and screening can provide assurance to processors and consumers that on-farm food safety is a high priority. Additional voluntary oversight of farm practices, including monitoring of and controlled access to raw milk supplies on the farm could further contribute to public food safety. Off-farm sales of raw milk directly to the public have resulted in foodborne outbreaks of multidrug resistant 
Salmonella serotype Typhimurium DT104; the vehicle for the outbreak was illegally manufactured cheese sold to Hispanic consumers by door-to-door vendors, at flea markets, and in small neighborhood markets; licensed dairy farms were raw milk suppliers to the illegal cheese makers. These outbreaks were especially serious for the dairy industry because it was the first time multidrug resistant 
Salmonella was linked directly to a product made from raw milk (Cody et al., 1998; Villar et al., 1999). Incidents such as these contribute to the human and economic costs of foodborne illness in the United States, which affects as many as 76 million people/yr, causes as many as 5000 deaths annually, and costs society upwards of 20 billion dollars (Mead et al., 1999; USDA, 2000).

INTRODUCTION

In February and April of 1997, more than 150 people, mostly very young Hispanic children, became ill in California when they ate 
Salmonella-contaminated queso fresco, a mild, fresh, Mexican-style soft cheese. An incident of similar etiology occurred in Washington State between January and May of the same year. In both outbreaks, the pathogen causing illness was multidrug resistant 
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A WIDESPREAD PROBLEM

Making fresh cheeses from raw milk is a traditional food practice and an important part of Hispanic culture [California Milk Advisory Board (CMAB), 1998]. Enforcement actions by the California Department of Food and Agriculture (CDFA) indicate that most California production and consumption of illegal cheese occurs within the Hispanic community. Investigations conducted by following the 1997 outbreak provided evidence that the culture of street food manufacturing lacks appropriate sanitary practices (CDFA, 1997; Freese et al., 1998). Compounding the problem is consumer preference for the organoleptic characteristics of raw milk cheese made by traditional methods (CMAB, 1998; Rodriguez-Medina et al., 1995; Tavaria et al., 1998).

The Milk Dairy Foods Control Branch of the CDFA and the CMAB suspect the illegal Mexican-style cheese industry produces as much as 21,000 tonne of cheese each year, which is as much Mexican-style cheese as is produced legally and is equivalent to just over 4% of California’s total licensed cheese production (CDFA, 1996). Approximately 0.5 kg of fresh cheese can be made from 3.78 L of milk, resulting in a demand for 179,000
tonne of milk to produce illegal cheese. By average production figures for California, this represents the annual production of 20,000 cows. Because of the size of this unregulated industry and its practice of using raw milk, the potential for an epidemic of foodborne illness is great. Therefore, control of raw milk supplies can have a huge impact on food safety in California.

CDFA investigations have shown that while some dairy employees steal milk or cheese makers own their own cows or purchase outdated milk from small grocery stores, the most significant source of raw milk comes from bulk tanks of licensed dairies. Buyers use the common story that milk is needed to feed young livestock and load up purchased milk into pick-up trucks full of plastic 19-L buckets. On a farm that produces 20,000 to 40,000 L of milk each day, 200 L is a literal “drop in the bucket.” Each 19-L bucket can be sold for 12 dollars, which means the dairy farmer receives double the price compared to shipping it to a processing plant (CDFA, 1997). As long as dairy producers believe they are selling milk to feed livestock, this diversion of milk is a legitimate source of significant additional income. Unless it can be proven farmers have knowingly sold milk to unlicensed cheesemakers, they cannot be prosecuted under California State Law and face no legal penalty. The dairies involved in the California and Washington salmonella outbreaks did not face criminal charges. Regardless of the legal implications, dairy producers should be aware of the public health risks of distributing raw milk to unknown buyers, and view adoption of tighter inventory control as an opportunity to protect public health.

**RAW MILK AND ON-FARM RISK MANAGEMENT**

In California, raw milk can be given to dairy employees legally because it is not specifically prohibited in the State Agricultural Code. While this may be a legitimate noncash benefit of employment, it is also a health hazard to the families consuming raw milk, especially those with very young or old household members. Surveys for mastitis-causing organisms and human pathogens on dairies reveal the presence of a variety of bacteria that can make people ill including *Campylobacter* spp., *Escherichia coli*, *Listeria* spp., *Salmonella* spp., *Staphylococcus* spp., and *Yersinia* spp. (Jayarao and Wang, 1999; Sargeant et al., 1998; Wilson et al., 1997). In California, raw milk consumption has often been associated with foodborne epidemics due to pathogens such as *Campylobacter* spp., *Listeria* spp., and *Salmonella dublin*. In the 1980s, as a result of these outbreaks, the FDA advised state school officers to forbid consumption of raw milk by children on field trips to dairies (Centers for Disease Control and Prevention, 1986). In California, a greater percentage of Hispanic (34%) versus non-Hispanic (17%) raw milk consumers acquire raw milk directly from farms or ranches (Headrick et al., 1997).

In recent botulism outbreaks on California dairies, owners and employees continued to consume raw milk as usual. There was no evidence to suggest that botulism toxin was transferred into raw milk from the affected cows. However, this incident and another involving organophosphate poisoning of cattle highlights the importance of controlling on-farm inventories of bulk-tank raw milk (Ardans, 1999; California Veterinary Diagnostic Laboratory, 1997a, 1997b). It also reflects a need for safety training for dairy farmers and their employees that includes the fundamentals of toxin and disease transmission and pathogen effects on human health.

**Table 1. Suggested strategies for control and monitoring of on-farm raw milk inventories.**

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Control point</th>
<th>Routine monitoring and corrective actions</th>
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<tbody>
<tr>
<td>Human consumption of raw milk</td>
<td>Access to bulk tank</td>
<td>Lock down bulk tank and limit access to trained personnel</td>
</tr>
<tr>
<td>Control access to, and verify legitimacy of off-farm buyers</td>
<td>Check production records against milk delivered to creamery and calf milk fed</td>
<td>Identify all “livestock milk” with edible dye</td>
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<tr>
<td>Identify all “livestock milk” with edible dye</td>
<td>Provide alternative source of fluid milk to employees via vouchers, farm delivery of grade A pasteurized milk, or small capacity pasteurizers on site</td>
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<tr>
<td>Provide food safety education and training to all farm employees</td>
<td>on food-borne illness and raw milk dangers</td>
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**DISCUSSION**

While the FDA is considering Hazard Analysis Critical Control Point (HACCP) for the US Food Safety Assurance Program and states bear the burden of enforcement activities, other authors have suggested dairy producers should consider voluntary and immediate adoption of HACCP practices (Coleman, 1995; Cullor, 1997). HACCP programs have focused primarily on drug residues and rejection of contaminated meat and milk in legitimate marketing channels, but little consideration has been given to the diversion of raw product into a black market (Gardner, 1997; Stefan, 1997). Risk management should also include oversight of raw milk inventories to insure the health and well being of dairy families, employees, and the public. Suggested strategies for monitoring raw milk inventories are described in Table 1.

On-farm control of raw milk can be included as part of on-farm biosecurity. The primary purpose of biosecurity screening and control is to prevent the introduction of new diseases to the farm. As dairy farmers develop
strategies to minimize the spread of disease, an on-farm system for monitoring both animals and people who come and go on dairies can also address oversight of raw milk sales. Potential “livestock milk” buyers can be screened to determine the legitimacy of their need, or they could be denied farm access as a matter of policy.

In finding ways to improve risk management, part of on-farm inventory control of bulk-tank raw milk can be bulk tank lockup. Only one or two employees and the milk truck driver would then have access to the tank. All livestock milk could be readily identified by coloring it with edible dye. This would give new meaning to the words “blue cheese.” This practice would also provide farmers who use raw milk inventory control some assurance that their dairy’s milk would not end up in a cheese sample sent to the Centers for Disease Control and Prevention Laboratory in Atlanta the next time an outbreak of (black market) cheese-borne illness occurred. Additionally, a system of milk vouchers could be instituted so dairy employees could obtain free pasteurized milk, but it would come from grocery stores, not from bulk tanks, or small on-farm pasteurizers could be provided for employee use. California’s dairy industry has developed a voluntary Dairy Quality Assurance Program. Part of their mission is to encourage science-based dairying practices which promote the health of the consumer, the environment and dairy livestock. The first module of the program addresses environmental stewardship through a series of workshops and short courses. When the module is developed for consumer health, control of bulk tank raw milk inventories and owner and employee food safety education should be essential elements of the program.

**CONCLUSION**

Hispanic community leaders need to provide licensed cheesemakers with information about consumer needs. In this way, marketing strategies could be changed to reach potential new customers in innovative ways and fulfill their taste and cultural expectations for Mexican-style cheeses. Food technologists also could conduct research to help cheesemakers develop products with all their taste and cultural expectations for Mexican-styles of cheese, a Spanish craft variety. Journal of Dairy Science Vol. 83, No. 12, 2000

ideas are supported not just in California, but internationally, as foodborne illness linked to raw milk products persists in spite of many years of research and education efforts (Keene, 1999; Rampling, 1996). There is still much progress to be made.

**REFERENCES**


California Milk Advisory Board. 1998. The Cheese is good when the cheese is safe. February 24, 1998. Media Advisory, CMAB, San Francisco, CA.


