Food Safety Systems Guide to Raw Milk Cheese Production

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Production of raw milk cheese requires careful attention to bacterial control in order to mitigate the risk of contaminations by pathogens. This guide can assist makers of raw milk cheese in developing procedures to reduce the risks posed by pathogens. Due to the complexity and diversity of production procedures and final products, it is difficult to identify a standard list of risk mitigation steps for the production of raw milk cheese. This guide has been developed based upon dozens of onsite visits with raw milk cheesemakers (along with literature review) and offers suggestions which may be customized to meet the needs of individual operations to identify and manage food safety risk. There is no 100% guarantee that a food will be safe, but if cheesemakers execute due diligence to assess their operation and manufacturing steps, food safety risk can be controlled to acceptable levels.

This guide offers 3 tools:

1. A **Flow Chart** showing key food safety steps in the manufacture of raw milk cheese.
2. **Top 10 Action Steps** intended to provide a quick and handy overview of Food Safety Management to manufacture raw milk cheese with suggested risk mitigation steps. (Note: cheesemakers must implement a range of strict controls to mitigate food safety risk).
3. A **Top Ten Action Steps Narrative** that provides specifics details for the Action Steps.

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1. Flow Chart

Supplier Control
How do we verify pathogen-free materials?

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Cheese Make Steps
How do we identify hurdles to mitigate microbiological Food Safety Risk?
For example: Control wet acid development to compete with undesirable bacteria.

Environmental Controls
Are your SSOP's (Sanitation Standard Operating Practices) in place and how do we control the environment to eliminate the potential for pathogenic bacteria?

Finish Product Evaluation
What are best practices (verification steps) to monitor finished product microbiological quality?

Education and Training
What resources are available for continued food safety education?

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2. Top 10 Action Steps

1. Develop a Supplier Control program for raw milk and ingredients.
2. Identify hurdles that use a kill step via process control and/or a recipe to control pathogenic contamination.
3. Set a target to monitor wet acid development during the make.
4. Create active Pest and Insect Control programs.
5. Implement Hygienic Zoning and Good Manufacturing Practices to mitigate cross contamination.
6. Verify documented cleaning procedures with a reputable sanitarian.
7. Conduct Environmental Monitoring and Product testing to verify effectiveness of sanitation and barrier control programs.
8. Assure a 60-day curing time at a minimum 35° F. prior to distribution.
9. Maintain a brine maintenance program (brined cheeses).
10. Identify opportunities for continuing education in Food Safety Management.

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3. Top 10 Action Steps Narrative

The narrative below expands on the Top 10 Action Steps and provides suggested controls covering these factors to address and mitigate food safety risk.

Consideration must be given to a number of factors, including raw milk testing, raw milk handling, storage and transportation; rate and degree of acidification achieved during cheesemaking; cheese aging and maturation; environmental monitoring and control of the cheese making environment; cleaning and sanitation; and good manufacturing practices (GMPs).

1. **Supplier Control Program on raw milk and ingredients:**

- Milk receiving and procurement (Bulk, can and or Farmstead)
    - Milk shall be received in accordance to applicable regulatory standards for either Grade A or Grade B milk. Microbiological safety of cheese made from unpasteurized milk is dictated by the safety of raw milk used for its production. Improving milk hygiene can be done through herd management, mastitis control, focus on feeding regimes, and sanitation during milking, storage and transportation to the cheese makers.
    - Receiving SOP for milk should also include microbiological sampling and testing for Listeria spp. and Salmonella. An option is to pull aseptic milk sample from cheese vat after a homogenous mix or utilize a disposable filter sock on the milk discharge pipe to the vat, after fill aseptically roll up and send to lab for Listeria and Salmonella testing.
    - Cheese made from raw milk shall be placed on 60 day hold and based upon microbiological milk test result be appropriately dispositioned (if positive reject if negative hold for 60 days (see step #8))
    - Recommend follow up program with the supply source of milk that test positive for pathogen. The goal is to maintain traceability (ensure lot # are maintained on milk supply to track sourcing) and correct the contamination problem or eliminate milk sources that do not take effective corrective action.
- Receiving ingredient:
    - Recommend development of a SOP for receiving ingredients.
    - Supplier conforms to all the Supplier Control SOP requirements.
    - Receiving procedure should include COA review and microbiological report on the COA. In addition, verify item is from an approved supplier, and verify the product is free of pathogens. (Would suggest box store purchases be avoided due to lack of a COA and other key documentation) unless buyer is willing to run own testing to create a COA or ingredient is low risk due to low water activity, low pH and or had undergone a kill step.
    - High risk ingredients shall require assurance from the supplier that they have taken action to mitigate potential pathogen risk i.e. spices and flavorings (Occasional internal testing is recommended on high risk ingredients to verify incoming COA reports) High Risk = history of recalls and supports pathogens due to high pH, high water activity and or has no kill step.

2. **Identify hurdles using kill step via process control and or recipe to control pathogenic contamination.**

- Thermalization of milk to ≥153.5°F for ≥16 seconds is considered to provide sufficient heat treatment to kill potential pathogenic bacteria such as Listeria. (1) Since this does not meet the threshold for legal pasteurization, the cheese can be labeled as raw milk cheese. Other hurdles may include cooking of the curd, salt level, moisture/water activity, (S/M Phase), acidification (see step #3) and cheese age/storage temperature (see step #8)

(1) Reference: Johnson et. Al., 1990 Thermalization

3. **Set target to monitor wet acid development during the make process**.

- Recommend a defined make procedure that includes monitoring culture activity for acid development.
- Active acid development by lactic acid bacteria can inhibit the growth of undesirable bacteria that may exist in raw milk used for cheese making.
- Slow or weak culture growth, especially at the start of the make process, can provide an environment for growth of undesirable microbes that may exist in the raw milk. i.e past studies have shown that it is important to develop normal acid during the early stages of cheesemaking. This indicates a normal growth of starter organisms which will inhibit the multiplication of any contaminating staphylococci. (2)
- Monitor wet acid development via TA or pH at key points during the make process.
    - Set TA or pH targets and acceptable ranges for the key points of the make
    - Key points may vary by type of cheese and make procedure and may be time related, or process step related (set, cut, stir out, whey draw, salting).
    - Suggest you work with "Culture" provider to develop acid development targets.
- Cheese not meeting acid development criteria, shall be placed on hold for pathogen testing prior to release for sale.
- Aseptically collect curd sample for E coli and Staphylococcus and Listeria testing

(2) Reference: J. Dairy Sci. "Relation of Acid Development During Cheesemaking to Development of Staphylococcal Enterotoxin A" Zehren and Zehren

4. **Active Pest and Insect control programs.**

- A prerequisite SOP for pest management is recommended.
- Presence of pest (especially rodents) and insects is not acceptable in a food process and storage facility. A Pest Control program is required.
- Pest management must be under the direction of licensed pest control person if handling insecticides/pesticides.
- Presence of pest and insects is evidence of lack of effective barrier control to keep them from entering the plant.
- Presence of pest and insects can also be evidence of filth, poor housekeeping, poor facility maintenance, poor sanitation, and lapses in GMP practices.
- Pest carry pathogens, and can be source of product contamination.

5. Implement Hygienic Zoning and Good Manufacturing Practices to mitigate cross contamination

- Develop a Hygienic Zoning and Good Manufacturing Practices SOP.
- Develop a diagram/map of the plant and identify areas such, make room, packaging area, hall way, storage areas, milk receiving and storage areas.
- On the plant map identify all types of traffic flow (foot traffic, pallet traffic, route to trash removal, etc.)
- On the map, identify where mitigations steps are needed to prevent cross contamination (foot baths, hand wash stations, etc.)
- Develop Good Manufacturing Practices documents (SOP) with training that comply with 21 CFR 117 Subpart B.

6. Verify documented cleaning procedures with reputable sanitarian.

- Recommend documentation of your sanitation program that identifies what has to be cleaned, frequency of cleaning, cleaning procedure, and the chemicals that are to be used.
- Recommend that a reputable sanitarian be consulted to review your sanitation program as well as procedures to verify the effectiveness.
- All cleaning and sanitizing chemicals shall be approved for use in a food plant. Household type cleaners are not generally for use in a food plant.
- Recommend training on cleaning and chemical safety be provided.

7. Conduct Environmental Monitoring (EM) and Product testing to verify effectiveness of sanitation and barrier control programs.

- EM program is a tool to monitor the effectiveness of GMPs, sanitation practices and barriers to prevent contaminates from the area where product is being produced and packaged.
- A robust EM program is recommended to be implemented to seek out potential pathogens sites and followed with corrective action to eliminate the source when pathogens are found. As a general guide, EM swabs are collected weekly at a rate of one swab per 1000 square feet of the production (RTE) area.
- Finished product testing is an additional tool to verify the effectiveness of all programs to mitigate pathogen risk. Positive pathogen test results on finished product is an indication of a system failure that need immediate attention and investigation of the root cause of the failure. (See step #8).

8. Maintain 60 day hold at minimum of 35 degrees F prior to distribution.

- Cheese made from milk that has not been pasteurized must be held for 60 days at ≥35°F before it can be released for sale.
- Recommend cheese that has been made from raw milk be tested for Listeria spp., E. coli (STEC) and Salmonella at 60-day age prior to release for distribution.
- If smear ripened suggest that additional test be conducted by scraping off some rind or swab the surface and test for Listeria ssp. (3)

(3) Smear ripen cheese may pose a higher risk for Listeria as studies have shown that the smear culture has no notable anti-listerial potential. Subsequently when removing the rind or portioning such smeared cheese loaves with a cutting device, a post pasteurization contamination of the core may occur.

Reference: Fate of Listeria innocua during production during ripening of smeared hard cheese made from raw milk. P. Hammer, W. Bockelmann, W. Hoffmann

9. If use of brine, maintain a brine maintenance program

- Brine can be potential source contamination as Listeria can survive in brines.
- Measures that can be used to maintain brine:
  - Maintain brine salinity, pH and temperature
  - Use of approved anti-microbial treatment in the brine
  - Drain brine vats and clean on a defined schedule
  - The use of good management practices, especially proper sanitation of the cheese plant environment, would seem to be a key in preventing brine contamination (recommend EM in the brine area)
  - Examples of a few maintenance activities to treat brine
    - Heat treat/pasteurize brine
    - Skim top layer of material that may float to the top of brine
    - Filter brine (Ultra filtration or other effective filtering system)
  - Test brine on a regular schedule for yeast/mold and Enterobacter.
  - Recommend the documentation of a brine SOP which covers the key elements controlling the brine make-up and monitoring activities.

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10. Identify continuing education for Food Safety Management

Many educational sources provide expert training:

- **University of Wisconsin Center for Dairy Research**
  https://www.cdr.wisc.edu/safety

- **Innovation Center for U.S. Dairy**
  www.usdairy.com/science-and-research/food-safety/dairy-plant-food-safety

- **Dairy Farmers of Wisconsin**
  http:// http://www.wisconsindairy.org/

- **American Cheese Society**
  http://www.cheesesociety.org/
  www.safecheesemaking.org

- **USDA Food Safety Education**
  http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education

Additional References:

Food Standards Scotland (Review of Controls or Pathogen Risks in Scottish Artisan Cheese Made from Unpasteurized Milk) December 2018 Catherine Donnelly

Food Standards Australia New Zealand (Guide to the requirements for raw milk cheese in Standard 4.2.4 – Primary Production and Processing Requirements for Raw Milk Cheese-Proposal P1022)