Validation of safety control measures and pathogen reduction steps for the safe production of traditional artisanal dairy products from the Mesoamerican region

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The opinions expressed here are those of the presenter and do not reflect those of the International Life Sciences Institute.
The project
3-year project (2017-2019)
Research, teaching & extension
Objective

Evaluate the adequacy of the currently applied control measures for three highly consumed traditional dairy products in the Mesoamerican Region, and to develop science-based and technical guidelines and educational materials for the safe processing of these products.
Justification
High consumption

Potentially hazardous products ($\text{pH}, \alpha_w$)

High nutritional value

Numerous artisanal producers

Lack of regulations

Raw milk

Lack of technical guidelines (Spanish & lay terms)

Lack of validations
Listeriosis & Pregnant Hispanic Women

Studies show that pregnant Hispanic women may have a higher incidence of listeriosis than pregnant non-Hispanic women. This is most likely because they might make and eat homemade soft cheese and other traditional foods made from unpasteurized milk. "Queso fresco" - a traditional homemade cheese, prepared from unpasteurized milk and widely consumed by Hispanics - has led to miscarriages, death of newborns, and premature delivery caused by L. monocytogenes.

To prevent the risk of listeriosis, Hispanic pregnant women should not eat homemade soft cheeses and other traditional foods made from unpasteurized milk. Like all other pregnant women, they should follow the food safety precautions outlined below.
Let’s pasteurize the milk!

The product changes

I’ve never done it and we’re fine

I don’t know how

I’m applying alternative treatments

Dry salting

Acidification + Heating

Fermentation
Culinary heritage
Productive practices
Education and training experience
Project stages
1. Product selection

2. GMPs and microbiological diagnostic
   (E. coli & L. monocytogenes)

3. Formulation and processing standardization
   (pilot plant scale)

4. Validation of safety control measures

5. Processing guidelines / educational material
   development and training
What have we done so far?
1 Product selection
1 Fermented milk
2 Dry-salted cheese
3 Pulled-curd cheese
GMPs and microbiological diagnostic (E. coli & L. monocytogenes)

- 15 processors (volunteers)
- 3 visits per processor
- GMPs (local regulation)
- 3 batches per product
- Formulation and processing
- Common GMPs deficiencies
- E. coli presence
- L. monocytogenes absence
Formulation and processing standardization (pilot plant scale)
Pulled-curd cheese

- Heat penetration (heating and cooling stages) for calculation of F-value during the curd-stretching step

- Potential of pathogen growth
  \( (L. \text{ monocytogenes}, \text{ Salmonella}, E. \text{ coli} \ O157:H7 \text{ and } S. \text{ aureus}) \) in the cheese (after molding)
  "Cheese Shelf Stability Predictor" from the University of Wisconsin-Madison
Lethalities obtained do not consistently ensure a greater than 5-log reduction of *Coxiella burnetii* (*z* value = 4.34°C) and other pathogens of concern. Thus, the curd-stretching step cannot substitute milk pasteurization.

Cheese pH and *a*<sub>w</sub> support the growth of pathogens of concern. Therefore, **GMPs and refrigeration are strictly required.**

### Table 1. Predicted log reductions for different pathogens caused by the curd stretching step in pulled-curd cheese manufactured by different processors (mean value ± standard deviation, *n*=3).

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Processor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Pilot plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. burnetii</em></td>
<td></td>
<td>2 ± 1</td>
<td>0.06 ± 0.08</td>
<td>0.2 ± 0.3</td>
<td>0.04 ± 0.05</td>
</tr>
<tr>
<td><em>E. coli O157:H7</em></td>
<td></td>
<td>38 ± 25</td>
<td>2 ± 2</td>
<td>3 ± 6</td>
<td>1 ± 1</td>
</tr>
<tr>
<td><em>L. monocytogenes</em></td>
<td></td>
<td>6 ± 2</td>
<td>1.0 ± 0.4</td>
<td>1.0 ± 0.8</td>
<td>0.7 ± 0.6</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td></td>
<td>41 ± 25</td>
<td>2 ± 2</td>
<td>4 ± 6</td>
<td>2 ± 2</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td></td>
<td>17 ± 2</td>
<td>5 ± 2</td>
<td>5 ± 2</td>
<td>3 ± 2</td>
</tr>
</tbody>
</table>
The effects of fermentation **temperature** (refrigeration, room temperature, and 37°C), **use of starter cultures**, and **milk pasteurization prior to fermentation** on the growth of lactic acid bacteria and milk acidification kinetics are under evaluation.
Figure 1. Acidification curves and population of lactic acid bacteria, at room temperature, during milk fermentation (mean value ± standard deviation, \( n=3 \)).
The effects of salting method (dry and moist), and cheese size (two sizes) on the pH, water activity, sodium content, and probability of pathogen growth (E. coli O157:H7, Salmonella, S. aureus and L. monocytogenes) are under investigation.
Figure 2. Representative curves for the $a_w$ and pH kinetics during cheese salting over time.
What’s next?
1. Development and transfer of science-based technical guidelines

2. Development of educational material

3. Training (processors and regulatory representatives)

4. Education of consumers (videos / social media)

5. Scientific publication
Impact and lessons learned
Science and society
THANK YOU!