

# Cheese Safety

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Describe a holistic approach to cheese safety based on risk analysis principles.



# The Concept of Risk

Risk = (probability of an adverse event such as falling off a ladder) x the severity of the consequences of the event.



# Cheese borne hazards: prevalence in raw milk

Food	Take Home Point		Prevalence:
<i>Cam</i>			12.3
<i>Shig</i>			3.8
<i>Liste mon</i>			12.6
<i>Salm</i>			8.9
<i>Stap</i>			
<i>Yers</i>			15.1
<i>Myc para</i>			
<i>Coxiella burnetii</i>	1 <a href="#">(Kim et al)</a>	>94% (U.S. Study)	

Cheese makers must assume that all raw milk received into their plant is contaminated with substantial numbers of one or more pathogenic microorganisms that must be eliminated during the cheese making process.

See also [Milk Facts](#)

# Cheese borne hazards: environmental

- *Listeria*: 7 – 28% of non food contact surfaces in cheese plants. Examples:
  - 17% of 243 noncontact surfaces (Menendez);

Take Home Point

Environmental contamination can shut down your plant.

product <http://www.foodsafetynews.com/>

- Survival demonstrated in cheese brine (5 days) and rennet extract (Ryser 1989)

# Some Cheese Borne Illnesses in North America

Year	Location	Details
2014	GA, NY, TN, TX	1 dead, 4 cases; Oasis Brand Latin American fresh cheese; <i>Listeria m.</i> , <a href="#">U.S. Centre for Disease Control</a>
2013	BC	No illnesses; Okanagan's Choice, Chipped Parmesan, <i>Listeria m.</i> , <a href="#">CFIA</a>
2011	Quebec	4 cases; <i>Listeria m.</i> several brands and varieties including Latin
2010	NJ	<a href="#">RGJ.com</a>
2010	AC	train of <i>E.</i>
2007	K	community
2008	Quebec	1 death; 87 cases; La Chaudiere brand Cheddar curd; Salmonella; <a href="#">CFIA</a>
2007	Ontario	24 cases; raw milk cheese; pathogen unknown; mobile cheese-maker; <a href="#">outbreak data base.</a>
2007	Ontario	1 infant HUS; mother ate raw milk cheese
2006	Ontario	9 year old girl hospitalized; raw milk Gouda cheese; <i>E. coli 0157:H7</i>
2002	Edmonton	13 cases (5 hospitalized, 2 HUS); raw milk gouda cheese

**Take Home Point**  
**Don't kid yourself. It can happen in any plant**

# Factors affecting growth and survival of pathogens

## Take Home Point

Pathogens can be controlled by a combination of 'hurdles' such as acidity, lack of accessible moisture, heat stress, salt, and competition from bacterial cultures.

activity

Mo

1.0

Few

0.90

Sor

No

an 0.85

Sor

Temperature history

less than 10°C, 10 – 45°C, 45 - 55°C, more than 55°C

Cultures: competition, acidity, inhibitors

Salt: less than 1%, 1 – 3%, more than 3%

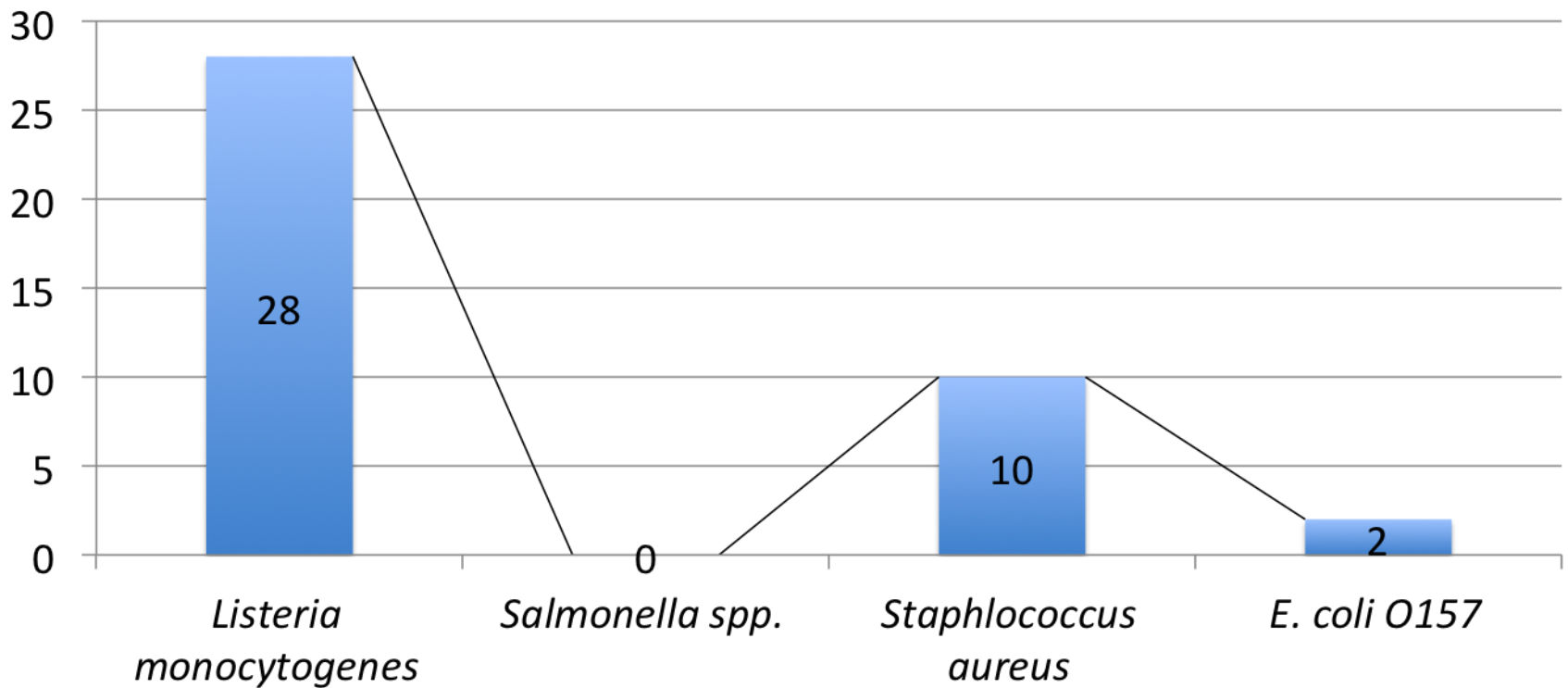
## Properties of pathogens associated with cheese

<b>Organism</b>	<b>Properties</b>
<i>Listeria monocytogenes</i> (30% mortality)	<ul style="list-style-type: none"><li>• Infectious, relatively high doses</li><li>• Cold, acid and salt tolerant</li><li>• Requires full pasteurization</li><li>• Ubiquitous in food environments</li></ul>
<i>Enteropathogenic E. Coli</i> (e.g., 0157 H7) “hamburger disease”	<ul style="list-style-type: none"><li>• Infectious, low doses</li><li>• Cold and acid tolerant</li><li>• In cheese, usually comes from milk</li></ul>
<i>Salmonella spp</i>	<ul style="list-style-type: none"><li>• Infectious at low doses</li></ul>
<i>Campylobacter jejuni</i>	<ul style="list-style-type: none"><li>• Infectious at low doses</li></ul>
<i>Yersina enterocolitica</i>	<ul style="list-style-type: none"><li>• Cold tolerant</li></ul>
<i>Staphylococci aureus</i>	<ul style="list-style-type: none"><li>• In cheese, usually from people contact</li></ul>



# Cheese Recall Summary

## Number of the CFIA Public Alerts Related to Cheeses: 2012-2015



Source: Complete listing of all recalls and allergy alerts: CFIA

# Cheese Recall Summary

## Pathogenic Bacteria vs Recall Incidents

	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016*</b>
<i>Listeria monocytogenes</i>	1/19 (5%)	9/25 (36%)	11/32 (34%)	7/35 (20%)	1/6 (17%)
<i>Staphylococcus aureus</i>	0/0	0/0	7/7 (100%)	3/6 (50%)	0/0
<i>E. coli</i> O157:H7	0/47	2/9 (22%)	0/9	0/0	0/0
<i>Salmonella</i> spp.	0/52	0/31	0/30	0/30	0/0

x/y: “x”: number of cheese recall, “y”: total food recall

\* First four month in 2016

Source: Complete listing of all recalls and allergy alerts: CFIA

Health Canada Policy on *Listeria monocytogenes* in ready-to-eat  
foods (Revised 2017)

## Take Home Point

Under the new policy for ready-to-eat  
foods most cheese varieties are

- categorized as high risk for survival  
and growth of *Listeria monocytogenes*.

- $\text{pH} < 5.5$  &  $A_w < 0.95$ , or
- Refrigerated for  $\leq 10$  days

- $\text{pH} < 5$  &  $A_w < 0.94$ , or
- **Refrigerated for  $\leq 5$  days**

## Pathogenic Hurdles in Cheese Making

### Take Home Point

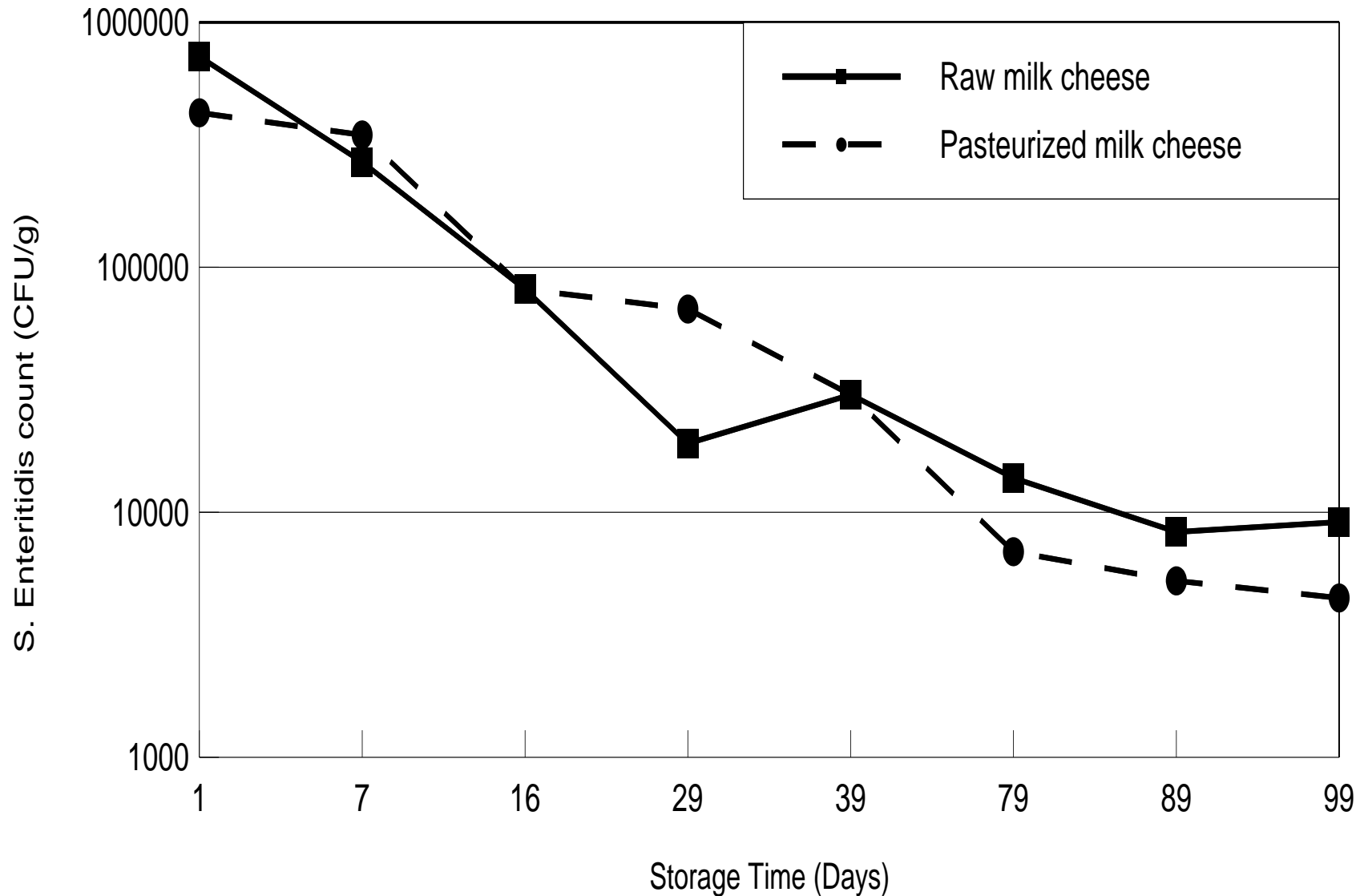
‘One size doesn’t fit all’. Effective cheese risk assessment and management is variety specific.

Cold	Pathogens
Remo	
Cultu	profile
Avai	
Temp	ically
	reduced in ‘cooked’ cheeses
Exposure history	<ul style="list-style-type: none"> <li>• Cheddar vs Parmigiano vs Ricotta</li> <li>• Latin white cheese versus lactic cheese</li> </ul>
Ripening time	Pathogens decline due to low pH (acidic), decreasing $a_w$ , antimicrobials, and low oxygen

# *Listeria* presence and survival in cheese

## Take Home Points

- 3 c
  - 1 P  
V  
S
  - 1 b  
la
  - Incidence on cheese appears independent of milk heat treatment (Data and citations in Rudolf, 2001)
- Lactic acid bacteria radically reduce pathogen growth *genes.*
- Soft ripened cheese higher risk for survival and growth of pathogens *aces:*
- Washed rinds higher risk but ecosystem probably inhibits growth *0;* with *of pathogens*



Survival of *Salmonella* Enteritidis in Cheddar cheese. Hirvi et al., 2001





CHAMPAGNE  
EXTRA DRY  
1998  
12.50  
1999  
12.50  
2000  
12.50

LE GRAND VIN DE JURE  
CHAMPAGNE  
EXTRA DRY  
1998  
1999  
2000  
Bouvier

LE GRAND VIN DE JURE  
CHAMPAGNE  
EXTRA DRY  
1998  
1999  
2000  
Bouvier

Comme elle  
mange de **COMTE**  
LE GRUYERE DE  
COMTE DE GRUYERE  
Comme elle  
veut notre  
Beauté, Force et Santé  
EXIGEZ  
CETTE MARQUE  
TRADE MARK  
COMTE DE GRUYERE



...and I thought 'cooked' cheese was safe?

**Health Hazard Alert -  
Certain Okanagan's Choice  
Cheese brand Chipped  
Parmesan Cheese may  
contain *Listeria  
monocytogenes***

Recall date: June 20, 2013

Reason: Listeria

Hazard classification: Class 1

Company: Castle Cheese

Distribution: BC, MB



# Cheese Risk Management priorities

While emphasizing the need for validation my list of highest to lowest risk management priorities is:

- Varieties with minimum or ripened pH > 5.6
- Intelligent inclusion of heat treatments in risk assessment and mitigation strategies
- Cross contamination in food service and retail stores
- Artisan manufacturers in new world countries
- Some traditional practices in old world countries.  
E.g. Inoculation via back slopping.

# Cases



# Safety of Unrefrigerated Cheese Curd

1993 Ontario Ministry of Health changed policy to allow sale of pasteurized Cheddar cheese curd at room temperature. Rationale:

- Culture inhibits more at room temperature, acidity and antimicrobials
- Salt inhibition
- 200 year tradition
- Considered (probably incorrectly) *S aureus* higher risk than LM because LM would be destroyed by pasteurization.

# Raw Milk Cheese

1997 attempt to change the 60 day national standard for raw milk cheese in Canada. Full pasteurization ( $72.5^{\circ}$  C, 16 s) unless:

1. Milk  $63^{\circ}$  C, 16 s; pH < 5.5;  $a_w$  < 0.95; ripen 60 d at  $>2^{\circ}$  C; retail label indicate date of manufacture; **Or,**
2. Inspection at 100% level (including imports)

Proposal withdrawn due to objections by raw milk cheese importers, producers & consumers.

# Raw Milk Camembert in Quebec

Exempt from 60 d, 2° C rule subject to:

- Water quality specs for producers and processors
- Special herd health program
- Milk: <24 h post milking; monthly *E. coli* < 500; monthly Staph aureus < 1000; tri-monthly *Listeria monocytogenes* and *Salmonella spp.* free;
- Records: herd health, milking and processing dates and times; make temperature and acidity.

## August 2008, Quebec

- Listeriosis: 22 cases, 1 death, 6 premature deliveries, 1 stillbirth; *Listeria m.* associated with cut and uncut mixed rind soft cheese from two Québec factories; 300 retailers via one distributor; cross- contamination assumed likely among pasteurized and raw milk cheese.
- [Ombudsman](#) criticized agencies for inconsistent recalls, for not distinguishing between soft and hard cheese, and for inconsistent risk assessments