

Raw Milk: Clarifying The Debate And Moving Towards Healthier Public Policy

Prabjit Barn, NCCEH
Tom Kosatsky, BC CDC
Sion Shyng, BC CDC
CIPHI National Conference
May 5, 2009



National Collaborating Centre
for Environmental Health
Centre de collaboration nationale
en santé environnementale



BC Centre for Disease Control
AN AGENCY OF THE PROVINCIAL HEALTH SERVICES AUTHORITY

Health Protection: Cornerstone of Public Health
Promotion et protection de la santé: Fondement de la santé publique

Outline

- Background
- Arguments for and against raw milk
- The evidence behind the arguments
- Approaches to moving forward
- Summary
- Questions/Discussion



Raw Milk

- “Straight from the cow” (or other animal)
- No formal processing



Pasteurized Milk

- Thermal processing
- Purpose:
 - To destroy pathogenic microorganisms present in raw milk
 - To increase shelf-life of milk & milk products



Pasteurization

- Different methods based on time and temperature
 - High temperature short time (HTST): ~ 72 °C at 15 seconds
 - Ultra high temperature (UHT): 2 step treatment method at high pressure
 - Higher heat shorter time (HHST): conditions between HTST and UHT
 - Holder method: longer heating period (~ 63 °C at 30 min)
- Specific requirements (time & temperature) may vary by province
- Pasteurization method will also depend on product



Regulations In Canada

- Raw milk sales prohibited since 1991
- Sale of raw milk cheeses allowed
 - However, Canadian-made cheeses must be aged for at least 60 days at 2 °C
 - Recent exception of Quebec (no required aging period)



Why Is It An Issue?

Raw milk is seen as a microbial risk from a public health perspective

BUT

Raw milk drinkers advocate it as a healthy food

- Popular among individuals wanting natural diets



Raw Milk Arguments

For

- Raw milk comes from healthier animals
- Raw milk confers unique health benefits
- Pasteurization destroys important qualities present in raw milk
- Consumption is a matter of choice

Against

- Raw milk carries disease-causing microorganisms
- Milk is not inherently sterile
- It is difficult to make raw milk “safe” without thermal treatment



For Raw Milk

Argument 1: Raw Milk Is Produced from Healthier Animals



Are Animals From Raw Milk Operations Healthier?

This argument is based on the assumption that raw milk operations are small-scale farms associated with:

- Lower animal density
- Better animal housing
- Natural animal diets
- No antibiotics or hormone use (rbST)

AND

- That these conditions are not present in large-scale operations where pasteurized milk is produced



Environmental Conditions & Milk Quality

- Animal diet, density and housing do play a role in milk quality
 - Certain types of bedding are associated with lower milk bacterial counts
 - Less crowding is associated with lower milk bacterial counts & lower incidence of mastitis
 - Pasture-based diets are associated with lower milk bacterial counts & higher fat-soluble vitamin content compared with grain-based diets
- ➔ But it is not clear how much these factors affect milk quality (microbial counts and nutrients) and to what degree these conditions are present in each type of operation



Milk Contamination Pathways

- Acute mastitis (infection of the udder) & sub-clinical mastitis are major sources of milk contamination
- Mastitis can occur from:
 1. contagious pathogens (shed from the milked animal)
 2. environmental pathogens (introduced through contact with the environment)
- More recently, environmental pathogens have been associated with the majority of mastitis cases within the dairy industry



Contamination Pathways (2)

- Environmental contamination pathways can be controlled (to a certain degree) through hygiene
- Small raw milk operations may be associated with a shorter distribution chain from producer to consumer
 - Can limit points at which contamination occurs as well as can reduce infective dose by allowing for less time for pathogen overgrowth



Antibiotic & Hormone Use

- Antibiotic use restricted in Canadian dairies
 - All milk used in processing must be free of antibiotics (testing occurs prior to processing)
 - Some limitations exist in testing (may be conducted only for one class of antibiotics)
- Use of recombinant bovine somatotropin (rbST) hormone officially banned in Canada as of 1999
 - rbST use is permitted in the US



For Raw Milk

Argument 2: Raw milk confers unique health benefits

- Asthma and Allergies
- Lactose Intolerance



Asthma and Allergies

- Some studies have investigated the relationship between raw milk consumption & health
- Study groups: children with farm exposures & children from rural & urban environments
- Have found raw milk consumption to be associated with decreased incidence of:
 - asthma, eczema, hay fever, rhinoconjunctivitis



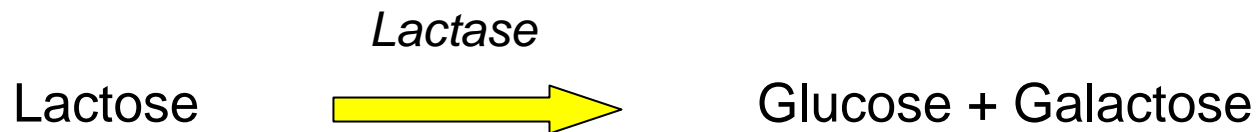
What's Not Clear From The Research:

- **Timing of exposure:**
 - What is the critical time window for raw milk exposure to be protective?
 - Exposure definition differs among studies (“consumption ever”, “consumption in the last year”)
- **Which exposures in particular? Are there confounding exposures?**
- **Do benefits outweigh risks?**



Can Raw Milk Aid in Lactose Digestion?

- Lactose is a sugar found in milk
- Lactose intolerance is due to **lactase** deficiency
 - Produced in small intestine
- Lactase aids in digestion through the following reaction:



- Without this breakdown, lactose continues on to the large intestines where fermentation by bacteria can lead to intestinal pain, flatulence, diarrhea



Lactose-Intolerance

- It is argued that raw milk contains bacteria which can help to breakdown lactose
 - β -galactosidase, a bacterial enzyme, can carry out same function as lactase
- Most of the research has focused on β -galactosidase activity in yogurt
 - Some evidence suggests that yogurt containing live bacteria is well tolerated among lactose-intolerant individuals
- Yogurt may have unique properties which prevent degradation of this enzyme along the digestive pathway
- No strong evidence to suggest this also applies to milk



For Raw Milk

Argument 3: Pasteurization Destroys Important Qualities in Milk

- Nutrients
- Anti-Microbial Properties



Nutrients

- **Vitamins**

- Most vitamins not affected by pasteurization
- Vitamin C is lost in largest amount but milk is not a significant source

- **Proteins**

- Casein proteins generally not affected by pasteurization
- Whey proteins denatured with heat treatment
 - ~ 10 % loss of whey proteins may occur with HTST pasteurization
 - up to 70 % loss can occur with ultra high temperature (UHT) treatment



Nutrients (2)

- Calcium

- No significant changes in calcium levels have been found between raw and pasteurized milk
- Pasteurization may produce a change in the type of calcium
 - Present in both soluble and colloidal forms
 - Degree of change is dependent on time & temperature conditions (smaller change with lower temperature and shorter time)
 - Change may be reversible over time
- Pasteurization does not appear to affect bioavailability of calcium



Anti-Microbial Properties

- Milk contains natural anti-microbial properties:
 - Lactoferrin
 - **The lactoperoxidase system**
- Lactoferrin
 - Higher concentrations in human milk compared with cow's milk
 - Cow's milk contains citrate, which competes with lactoferrin to bind iron, and therefore limits its ability to act as an anti-microbial



Anti-Microbial Properties (2)

- The lactoperoxidase (LP) system
 - Most effective anti-microbial system
 - Works by inactivating microbial enzymes & by damaging microbial membranes
- Is affected by heat-treatment
 - System severely limited by pasteurization at 80 °C for 15 seconds
 - At 72 °C for 15 seconds (common conditions of HTST), retains ~ 70 % of activity



For Raw Milk

Argument 4: Consumption is a Matter of Choice



A Matter of Choice

- Belief or feeling that government regulations infringe on personal rights
- Not something that can be argued with scientific evidence
- Question to consider:
Whose choice is it?
(e.g. minors)



Against Raw Milk



Against Raw Milk

1. Raw milk is associated with a number of disease causing pathogens
2. Raw milk is not inherently sterile



Argument 1: Milk Is A Carrier Of Pathogens

- Milk can be a carrier for many disease-causing pathogens
 - *Salmonella*
 - *Listeria monocytogenes*
 - *Campylobacter jejuni*
 - *Escherichia coli*
 - *Yersinia enterocolitica*
 - *Mycobacterium paratuberculosis*
 - *Staphylococcus*
- Raw milk has been associated with outbreaks of illness world-wide



Outbreaks of Illness

- **Outbreak data is important but is potentially misleading**
 - Not all outbreak incidences are reported
 - Among reported outbreaks, often the raw milk source (location of purchase or actual product) is difficult to ascertain
 - Raw milk may be implicated if consumption is a common factor among affected individuals
- **Difficult to get accurate numbers on illness related to raw milk in the population**



Argument 2: Raw Milk Is Not Inherently Sterile

- Routine testing cannot ensure that all milk is free of contamination
 - Detection may be difficult or impossible for all milk that is produced
 - Raw milk contains a large microflora & testing may not detect all organisms
- A number of contamination pathways exist
 - Difficult to control each of these pathways
- Pasteurization is an important (**essential?**) safeguard



What is the Evidence on Pasteurization Effectiveness?

- Pasteurization is effective against **most but not all** pathogens
- **Certain organisms are of concern when:**
 - Initial concentrations of organisms are high
 - Heat resistant endospores are present in milk supply
 - Post-pasteurization contamination occurs



Effectiveness of Pasteurization (2)

- Organisms can be associated with illness and/or product spoilage
- Examples:
 - *Mycobacterium paratuberculosis* (MAP)
 - *Listeria monocytogenes*
 - Spore forming *Bacillus spp.*
 - *Pseudomonas*



An Example: MAP

- MAP has been associated with Crohn's disease in humans
- Within Canada, cattle is assumed to be most important reservoir of MAP
- Several studies have found that pasteurization is ineffective against MAP



MAP (2)

- **These studies have been criticized:**
 - Spiked sample concentrations may not be representative of actual situations
 - Methodology differs significantly among studies making comparisons difficult
- **Evidence shows pasteurization is effective when:**
 - Raw milk contains low numbers of MAP
 - Pasteurization conditions are altered (e.g. increasing heating time)



Pasteurization Effectiveness

- Similarly for other organisms, evidence shows that pasteurization can be effective when:
 - Initial concentrations in raw milk are **low** & when **post-pasteurization contamination** does not occur

➔ **Both farm hygiene & processing hygiene are critical to reduce risk of microbial illness to consumers**



What Do Other Jurisdictions Do?

- **Sale of raw milk is legal in many US states**
 - Specific regulations differ widely from state to state
 - Range from allowing sales but not advertising of raw milk, only allowing sale of goat milk, only allowing on-farm sales & applying daily sales limits
- **Raw milk sales are legal around the world**
 - Some countries within Europe, Asia, Africa, South America



Incoherence in Public Policy

- Different regulations/restrictions world-wide
- Despite regulations in Canada, there are a number of ways to acquire raw milk
 - Sale of imported raw products within Canada
 - Allowances for raw milk across the US border
 - Loop-holes for production within Canada (cow shares currently being contested)

➔ **Can result in ambiguity in overall health messaging**



What Are Cow Shares?

- Individuals purchase a share of a cow & in turn pay a fee to a farmer for room & board for the animal
- Shareholders are entitled to milk from cow, without it being considered a purchase
 - Operate on the principle that this process involves a “service” rather than a “product” (agistment)



What Are Cow Shares? (2)

- Public health authorities have no jurisdiction
- It is up to the individual operation to decide on level of testing & monitoring
- Responsibility also on consumer to educate themselves about their milk
- Difficult to get information on numbers & locations of cow shares in Canada



To Summarize

- Raw milk & raw milk products are becoming increasingly popular
- Raw milk can be a carrier for disease-causing organisms
- Current regulations may not protect those at risk & current approaches need to be reviewed



What Can Be Done?

- Two approaches:
 1. Try to eliminate raw milk consumption among the public
 2. Produce “safer” raw milk
- Both approaches are associated with their own limitations



Eliminate Consumption

- Promoting replacement of raw milk products with pasteurized ones
 - Specific recipes that call for use of raw milk
- Targeted messaging for those most at risk
 - Children, pregnant women, elderly, immunocompromised individuals
- Stricter control of raw milk sources
 - Raw milk product imports, border allowances, cow shares



Eliminate Consumption (2)

- Individuals may be resistant to change their behavior
- This approach could fuel the notion that the government is infringing on personal freedom
- Individuals may continue to find ways to acquire raw milk



Make Raw Milk “Safer”

- Alternatives to pasteurization

- Ultraviolet (UV) irradiation not effective for milk
- Gamma irradiation may be effective for some products
- More research needed to show that this can work on a larger scale

➔ The majority of the raw milk consumers may not accept irradiated milk as a reasonable alternative



Make Raw Milk “Safer”(2)

- Certification of raw milk

- Raw milk from cow shares is not regulated in Canada but it is regulated in many US states
- Similar model could be implemented in Canada
- Such operations have been implicated/associated with outbreaks of illness

➔ Some raw milk consumers may not accept certified retail milk as a reasonable alternative (concern for big industry and government interference)



Make Raw Milk “Safer” (3)

- Raw milk consumers:
 - Individuals who purchase retail raw milk ✓
 - Individuals who want a direct relationship with the raw milk producer ✗
- Certification of **small** cow shares may be an option
- Education of risks associated with raw milk consumption is important



What Lessons Can Be Learned From The Debate?

- It is important to understand the basis for arguments made on both sides of the debate
- Lessons can be drawn from both sides in order to move forward, including:
 - The quality of raw milk is important for the safety of both raw milk & pasteurized milk
 - Environmental contamination pathways are important control points
- Pasteurization techniques have evolved and will continue to evolve, in part due to changing consumer demand



Summary

- Both sides of the raw milk debate offer arguments based on health, environmental, and political concerns
- Scientific evidence can help to clarify some aspects of the debate
- Raw milk consumption can pose a health risk to consumers
 - Some individuals are particularly susceptible to these risks (children, pregnant women, elderly, immuno-compromised individuals)
- Despite the risk, raw milk is becoming increasingly popular and the debate will continue to involve both the public and public health



National Collaborating Centre for Environmental Health

Working on a range of environmental health issues, primarily serving the public health community, including public health inspectors and medical officers of health

Visit our website at www.ncceh.ca to view a variety of documents and other products, such as:

- Course presentations
- Summaries of recent journal articles
- Environmental health legislation

