Unpasteurized Milk: A Growing Public Health Issue

Stacey Pettigrew

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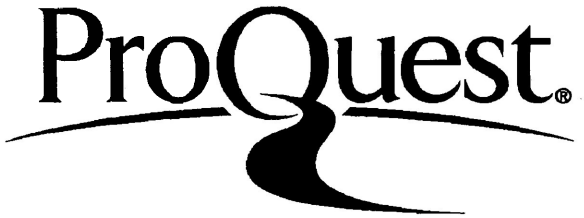
Lakehead University

Supervisor: Dr. Peter Brink



Abstract

The sale and distribution of unpasteurized/raw milk is illegal in Canada. Canadian federal and provincial legislation prohibit the sale and distribution of raw milk based on scientific evidence that unpasteurized milk poses a human health risk. The official position of the Canadian government is supported by domestic and foreign government agencies, public health professionals, and faculty at post-secondary educational institutions as well as physicians and veterinarian. The arguments made by groups that support pasteurization are further bolstered by studies published in peer-reviewed journals which cite epidemiological evidence and laboratory findings that unpasteurized milk is a vehicle for food-borne illness.

Some Canadian milk producers have found means of circumventing and contravening the current legislation in order to meet an increasing public demand for raw milk. Groups supporting consumption of unpasteurized milk often reinforce the statements made by other raw milk advocates; however their claims surrounding the purported benefits of unpasteurized milk and the alleged dangers of pasteurization have not been scientifically proven. Furthermore, the claims made by raw milk advocates are often contradicted by information provided by the previously mentioned groups who warn against the consumption of raw milk. Based on the credentials of the authors, and the scientific evidence provided to support their claims, the author has concluded that the argument supporting pasteurization and the ongoing ban on the sale and distribution of unpasteurized milk is the more persuasive.

Raw milk advocates argue that it is the right of the individual to decide what they consume in their quest for maintaining and improving their health and that the government does not have the right to infringe upon the private affairs of citizens. Autonomy is the basis for

western culture, and an integral component of a democratic society, however, autonomy must be exercised within the parameters of the law.

Many other countries support Canada's position and have also made the sale and distribution of unpasteurized milk illegal due to the potential for the product to carry pathogenic organisms. Some countries however, have legalized the sale and distribution of unpasteurized milk. These countries have implemented restrictions and precautions as a means of balancing the consumer's right to choose what they consume with reduction of the risk that consumption of the product poses.

Even though the claims made by raw milk advocates regarding the superiority of unpasteurized milk have not been scientifically proven, recent scientific studies have identified that early consumption of unpasteurized farm milk may reduce a child's risk of developing allergic disorders. Increased research is needed in order to determine what components of raw milk provide a protective effect on the development of allergic disorders in farm children. Once these components are identified, further research is needed in order to determine how to preserve these factors, while maintaining a pathogen-free product. While this research is being conducted, public health efforts should focus on the development and delivery of targeted educational campaigns that better inform farmers and the public of the risks of consuming raw milk and the scientific evidence surrounding pasteurized and unpasteurized milk.

Introduction

Issues surrounding unpasteurized milk, commonly known as raw milk, have been prevalent in the media in recent months (CBC, 2009; CBC, 2010; Toronto Star, 2010a). Even though consumption of unpasteurized milk is not a new phenomenon, the number of individuals choosing to drink raw milk is increasing, along with the public attention that positions on both sides of the argument are receiving (Oliver, Boor, Murphy, & Murinda, 2009).

It is illegal in Ontario, and throughout Canada, to sell or distribute unpasteurized milk (Health Canada, 2006). The sale and distribution of unpasteurized milk is prohibited due to the product having the potential to be a vehicle for the transmission of pathogenic organisms on to people (Health Canada, 2006). The consumption of raw milk, however, is not illegal in Canada and consumers and producers alike have found means to meet the public demand for the product through cow shares and underground illegal distribution of unpasteurized milk (Oliver et al., 2009).

Medical professionals and government agencies have supported the current legislation stating that unpasteurized milk constitutes a health hazard and that any purported benefits of drinking raw milk are far outweighed by the scientifically proven evidence that the consumption of unpasteurized milk is a threat to human health (Canadian Medical Association, 2007; Oliver et al., 2009; Haugh, 2010). It has been well documented through numerous scientific studies and reports that pathogenic organisms can be found in unpasteurized milk and that consumption of the products can result in human morbidity and mortality (Oliver et al., 2009; Potter, Kaufmann, Blake, & Feldman, 1984).

Raw milk advocates claim that the risk of contracting a food-borne disease as a result of drinking unpasteurized milk is minimal and that the health benefits of consuming raw milk far outweigh the risks (Oliver et al., 2009). Raw milk advocates also believe that it is the right of individuals to decide what they consume in their quest for maintaining and improving their health and that the government does not have the right to infringe upon the private affairs of citizens (Oliver et al., 2009).

In the current paper, a review of pertinent literature will be conducted in order to evaluate both the arguments put forward by raw milk proponents as well as the issues raised by individuals and groups who oppose the sale and distribution of unpasteurized milk.

Proven and Purported Risk and Benefits of Milk Consumption

Milk is defined under the Ontario Milk Act as "milk from cows or goats" (Government of Ontario, 2009b). The United States Food and Drug Administration states that " of all foods, none surpasses milk as a single source of those dietary elements needed for the maintenance of proper health, especially in children and older citizens" (United States Food and Drug Administration, 2009c). As consumption of milk is beneficial to human health, Canada's Food Guide recommends 2-4 servings of dairy products per day (Health Canada, 2007). Ingestion of the recommended daily servings of dairy products aids in the prevention of obesity, hypertension, osteoporosis and diabetes (Dieticians of Canada, 2007; LeJeune & Rajala-Schultz, 2009). Dairy products also provide a source of protein, vitamins, including A and D, as well as phosphorous and magnesium (Dieticians of Canada, 2007).

Even though milk is an important source of essential proteins, vitamins and minerals, milk has the potential to also be a source of pathogenic bacteria (Ontario Ministry of Health and Long-Term Care, 2008a). Two of the factors the make milk suitable for human consumption, high nutrient content and neutral pH, also make milk an ideal growth medium for bacteria (LeJeune & Rajala-Schultz, 2009).

Cows carry certain pathogenic bacteria as part of their natural flora (Ontario Ministry of Health and Long-Term Care, 2008a). These disease-causing bacteria can pass into milk during the secretion of milk within the mammary glands of the cow, from the udders during the milking process or through contamination by the milking equipment and surrounding environment (Ontario Ministry of Health and Long-Term Care, 2008; Sellers et al., 2008).

As a best practice, milk collected from clinically ill cows is discarded by the farmer prior to pooling with milk from clinically healthy cows; however, disease-causing bacteria may be present in the milk of asymptomatic cattle and would typically be pooled with milk from a number of other cows and placed into the milk distribution system (LeJeune & Rajala-Schultz, 2009). Clinically healthy cattle are often colonized with a number of pathogenic organisms including Campylobacter, Coliform, Salmonella, Staphylococcus, Streptococcus, Bacillus, Micrococcus, Listeria and Corynebacteriun species of bacteria, as well as *Coxiella burnetii* (the cause of Q fever) and *Mycobacterium avium* subspecies paratuberculosis (the cause of Johne disease which may be linked to Crohn's disease in humans) (LeJeune & Rajala-Schultz, 2009). Though rare in recent years, cows can also suffer from bovine tuberculosis (*Mycobacterium bovis*) and brucellosis (*Brucella abortus*) (LeJeune & Rajala-Schultz, 2009). Pathogenic bacteria found in unpasteurized milk can lead to serious and life-threatening disease in humans (Ontario Ministry of Health and Long-Term Care, 2008a).

Prior to the introduction of pasteurization in the early 1900's, many people suffered from food-borne diseases associated with the consumption of unpasteurized milk (Ontario Ministry of Health and Long-Term Care, 2008a). The process of pasteurization heats milk to high temperatures for specific periods of time in order to destroy pathogenic and spoilage bacteria (Ontario Ministry of Health and Long-Term Care, 2008a). Pasteurization is the single most effective means of reducing the bacterial load in milk (LeJeune & Rajala-Schultz, 2009).

It has been illegal to sell or distribute unpasteurized milk in Ontario since 1938 (Health Canada, 2006). According to the United States Food and Drug Administration, "in 1938, milkborne outbreaks constituted twenty-five percent (25%) of all disease outbreaks due to infected foods and contaminated water. Our most recent information reveals that milk and fluid

milk products continue to be associated with less than one percent (<1%) of such reported outbreaks" (United States Food and Drug Administration, 2009). Currently, the most common cause of pasteurized milk-borne outbreaks is post-pasteurization contamination (Oliver et al., 2009). These outbreaks emphasise the need for all parties involved in milk harvesting and processing to practice continued "vigilance at every stage of production, processing, pasteurization and distribution of milk and milk products" (United States Food and Drug Administration, 2009c).

Despite the known hazards of consuming unpasteurized milk, there are an increasing number of people who support the practice (Oliver et al., 2009). Individuals who choose to drink unpasteurized milk do so because of perceived health benefits of consuming raw milk (Ontario Ministry of Health and Long-Term Care, 2008c). In a California study conducted by Headrick et al., it was determined that raw milk drinkers tended to be younger than forty years of age, male and Hispanic and have less than a high school education (2001 as in Oliver et al., 2009). Oliver et al., speculated that the recent increase in raw milk consumption is associated with a desire to purchase locally produced, natural and unprocessed foods as well a belief that consumption of unpasteurized milk is beneficial to human health (2009).

Similar to Oliver et al, (2009), Nesbitt et al., (2009) also determined that raw milk drinkers were significantly more likely to have a lower level of education than pasteurized milk drinkers. Nesbitt et al., also found that rural residents were more likely to consume unpasteurized milk than were urban or sub-urban residents (2009). Rural residents were also found to be significantly more likely to have heard of the risks of consuming raw milk , but continued to consume the product despite being aware of the risks of doing so (Nesbitt et al., 2009). The increased prevalence of rural residents consuming unpasteurized milk suggests that farm families

may be more likely to consume raw milk (Nesbitt et al., 2009). This finding is supported by Oliver, Jayarao, & Almeida (2005). Farm families who choose to consume raw milk do so because of ease of access and reduced cost as well as traditional practice (Nesbitt et al, 2009). Nesbitt et al., speculated that farm families are more likely to consume unpasteurized milk even though they are aware of the risks of doing so out of confidence in the health of their herd and a belief in acquired immunity (2009).

Young et al., (2010) also found that rural residents were more likely to consume unpasteurized milk. Young et al., stated that 88% of dairy farmers surveyed reported that they or their families consume unpasteurized milk from the farm (2010). Thirty-six percent of respondents indicated that the public should also have the option to purchase unpasteurized milk (Young et al., 2010). Dairy farmers who had completed an on-farm food-safety program were less likely to support access to raw milk for the public and less likely to consume the product themselves (Young et al., 2010). However, organic producers, younger farmers and farmers with smaller herds tended to support legalizing raw milk in Canada (Young et al., 2010).

Raw milk advocates claim that the pasteurization process reduces both the quality and nutritional value of milk (Natural Milk, 2010; Sellers et al., 2008; Ontario Ministry of Health and Long-Term Care, 2008c, Oliver et al., 2009). Raw milk advocates allege that heat treatment of milk reduces the quality of the product as it produces "detectable off-flavours" (Natural Milk, 2010). These individuals also believe that raw milk is nutritionally superior to pasteurized milk as water soluble vitamins and proteins are damaged, reduced and destroyed during the pasteurization process (Natural Milk, 2010). Raw milk advocates claim that there is approximately a 10 percent loss in the vitamins B1, B6, B12 and folate and a 25 percent loss in vitamin C content in milk following pasteurization (Natural Milk, 2010).

Proponents of raw milk claim that the naturally occurring beneficial whey proteins in raw milk are denatured by the high temperatures used during pasteurization as well as though the homogenisation process (Natural Milk, 2010). These people believe that the heat treatment of whey results not only in denaturing the proteins but also in cross-linking proteins and that this "may be detrimental to the consumer, possibly via an effect on nutritional value and also perhaps by the increased potential to trigger some form of allergic reaction" (Natural Milk, 2010). Raw milk advocates believe that pasteurization, by denaturing proteins, destroys the ability of certain proteins to bind to folate and perhaps zinc and vitamin B12, thus reducing the ability of these vitamins and minerals to be absorbed by the human digestive system (Natural Milk, 2010). Raw milk advocates state that the heat-sensitive lactoferin protein, which improves absorption and utilization of iron and is believed to possess anti-cancer, anti-viral and anti-bacterial properties, is also rendered less effective as a result of being denatured during the pasteurization process (Raw Milk Facts, 2010). Raw milk advocates believe so strongly in the ill effects of pasteurization that they go so far as to imply a link between the consumption of denatured milk proteins and the development of atherosclerosis (Natural Milk, 2010).

Raw milk advocates claim that lactose-digesting Lactobacilli bacteria aid lactose intolerant individuals in digesting unpasteurized milk (Raw Milk Facts, 2010). However, this benefit is lost during the pasteurization process when these bacteria are damaged (Raw Milk Facts, 2010). Individuals who believe in the benefits of unpasteurized milk claim that the pasteurization process can make milk more harmful to individuals with milk allergies presenting in the form of atopic dermatitis (Raw Milk Facts, 2010). Their belief is that the protein β-lactoglobulin, which lowers the "allergy-causing reactivity" of raw milk, is destroyed by being exposed to heat (Natural Milk, 2010). Furthermore, proponents of unpasteurized milk claim that

pasteurization destroys the nutrients, enzymes and protective bacteria in raw milk, and thereby leads to allergies, arthritis and other diseases (Sellers et al., 2008).

Individuals who believe in the benefits of unpasteurized milk claim that unpasteurized milk contains sufficient anti-microbial qualities, in the forms of proteins and beneficial bacteria, to successfully inhibit the growth and virulence of pathogenic organisms (Natural Milk, 2010). Raw milk advocates believe that the anti-microbial qualities of unpasteurized milk are effective enough to overcome post-collection contamination and to suppress infection following ingestion (Natural Milk, 2010; Raw Milk Facts, 2010). These individuals go on to state that the anti-bacterial properties of the lysozyme and lactoperoxidase enzymes are diminished through the pasteurization process, leaving the milk susceptible to becoming a reservoir for unchecked bacterial growth should the product be subjected to post-pasteurization contamination (Natural Milk, 2010; Raw Milk Facts, 2010).

Raw milk advocates state that Ontario and Canada's legislation banning the sale and distribution of unpasteurized milk are remiss as there is no evidence that unpasteurized milk presents a health hazard (Natural Milk, 2010). Proponents of unpasteurized milk believe that the pasteurization process destroys the "special qualities" of milk and that the government only persists in banning the sale and distribution of unpasteurized milk out of corporate support for the Dairy Farmers of Canada and its provincial branches (Natural Milk, 2010; Sellers et al., 2008).

Even though there are several perceived health benefits to consuming unpasteurized milk, none of these alleged benefits have been scientifically proven (Ontario Ministry of Health and Long-Term Care, 2008c; Potter et al, 1984). Research has show that pasteurization does not

significantly change the nutritional content, flavour or quality of milk (Ontario Ministry of Agriculture, Food, & Rural Affairs, 2010; LeJeune & Rajala-Schultz, 2009; Ontario Ministry of Health and Long-Term Care, 2008c; United States Food and Drug Administration, 2010a). According to the Ontario Ministry of Health and Long-Term Care, "pasteurization does not affect the quality of calcium, protein, riboflavin, niacin, folic acid, vitamin B6, pantothenic acid and vitamin A present in milk" (Ontario Ministry of Health and Long-Term Care, 2008c). Pasteurized milk is a good source of phosphorous, thiamine and vitamin B12 (Ontario Ministry of Agriculture, Food, & Rural Affairs, 2010; Potter et al., 1984). Furthermore, vitamin D is added to all pasteurized milk in Canada in order to aid in the absorption of calcium (Ontario Ministry of Health and Long-Term Care, 2008c). Even though the vitamin C content in milk is reduced by approximately 20 percent as a result of the pasteurization process, this is of little consequence as milk is not a significant source of vitamin C (Ontario Ministry of Health and Long-Term Care, 2008c).

Pasteurization destroys some undesirable enzymes and spoilage bacteria, improving the quality of milk and extending the shelf-life of the product (University of Guelph, n.d.). The high temperature used as part of the pasteurization process denatures the major enzyme that degrades fats in milk, lipoprotein lipase (Cornell University, n.d.). Denaturing lipoprotein lipase improves the quality of milk by preventing the enzyme from degrading fat which can result in off-flavours (Cornell University, n.d.). Inactivation of lipase therefore increases the shelf life of milk (Cornell University, n.d.). Pasteurization also denatures some enzymes that degrade proteins in milk (Cornell University, n.d.). Degradation of proteins can also lead bitter off-flavours (Cornell University, n.d.).

The milk protein casein is relatively unaffected by pasteurization and whey proteins undergo only a barely perceptible modification as a result of exposure to heat (National Environmental Health Association, 2008). The proteins that cause allergic reactions to milk are present in both raw and pasteurized milk (United States Food and Drug Administration, 2010a). Lactose, the sugar that causes difficulties for individuals with lactose intolerance is present in the same concentration in raw and pasteurized milk (United States Food and Drug Administration, 2010a). Raw milk is no better tolerated by individuals with milk allergies and lactose intolerance than is pasteurized milk (United States Food and Drug Administration, 2010b). Furthermore, pasteurized milk does not cause either lactose intolerance or milk allergies (United States Food and Drug Administration, 2010b). Enzymes in milk do not aid significantly in the digestion of milk in humans; this function is accomplished by enzymes present in the human digestive tract (Cornell University, n.d.). No scientific evidence exists to support the claim that raw milk cures and prevents disease (Infectious Diseases Society of America, 2009).

Raw milk does not have the anti-microbial ability to destroy pathogenic organisms on its own (United States Food and Drug Administration, 2010b). Lactoperoxidase must be combined with hydrogen peroxide and thiocyanate, neither of which are naturally present in milk, in order to exhibit antibacterial properties (Cornell University, n.d.). Lysozyme does possess some antibacterial properties, however the amount of lysozyme present in milk is very small (Cornell University, n.d.).

Even though there may be some nutrient value loss as part of the pasteurization process, this loss is not significant and is far outweighed by the reduced risk of acquiring food borne illness (Ontario Ministry of Health and Long-Term Care, 2008c). Flavour changes can result from both pasteurization and failure to do so (Cornell University, n.d.).

It has been scientifically proven that the quality and nutritional value of milk is not significantly altered by the pasteurization process and that pasteurization is currently the most effective means of reducing the microbial load in milk (Ontario Ministry of Health and Long-Term Care, 2008c). Even though the claims made by raw milk advocates regarding the superiority of unpasteurized milk have not been scientifically proven, recent scientific studies have identified that early consumption of unpasteurized farm milk may reduce a child's risk of developing allergic disorders (Perkin, 2007). Numerous studies have identified up to a two-third reduction in the prevalence of allergic disorders in farming children compared to other rural and urban children (Perkin, 2007). It is believed that early exposure to a combination of factors including barns, stables and animals and as well as maternal exposure to these factors during pregnancy is the reason for this reduced prevalence (Perkin, 2007). A smaller number of studies support a hypothesis that consumption of unpasteurized milk also protects against allergic disorders (Perkin, 2007). Riedler et al., (2001) found that early consumption of unpasteurized milk was found to have an independent protective effect on asthma, wheezing, hay fever, rhinitis and atopic sensitization (as in Perkin, 2007). Other studies have not supported the independent protective effect, but rather, the combination of early consumption of unpasteurized milk with early exposure to animals and their stables and barns were linked with a reduced prevalence of allergic disorders (Perkin, 2007). Perkin (2007) found that unpasteurized milk consumption had a protective effect on eczema, atopy and seasonal allergenic rhinitis. Perkin acknowledged that unpasteurized milk contains far greater numbers and varieties of bacteria than does pasteurized milk (2007). Perkin implied that perhaps either the increased quantity or diversity of bacteria found in raw milk supports the development of a healthy immune system (2007). Perkin went on to state that endotoxins such as lipopolysaccharide (LPS) are another component of milk that

could explain the protective function of unpasteurized milk (2007). Endotoxins are structural components of bacteria (Perkin, 2007). Upon bacterial lysis during milk pasteurization, endotoxins are released and upon ingestion can trigger an allergic reaction (Perkin, 2007). However, Perkin followed by stating that the implementation of pasteurization in the dairy industry outdated the increased prevalence of allergic disorders by too great a time period in order to imply causality (2007). Perkin stated that a closer temporal relationship could be drawn for the introduction of homogenization (2007).

Homogenization involves forcing milk through narrow pipes at high pressure in order to break up the fat globules in milk as a means of preventing the cream layer from separating from the milk (Perkin, 2007). Perkin recommended that the effect of the homogenization process on milk, as well as the potential for the altered milk to trigger changes in the immune system, be further studied (Perkin, 2007). While Perkin acknowledged the hazards associated with consumption of unpasteurized milk, he also highlighted the duty of the medical and scientific communities in investigating the reason behind such a significant reduction in the prevalence of allergic disorders amongst children who consume unpasteurized milk (2007). Perkin (2007) goes on to state that "the key issue now is to determine what underlies this protective effect and whether it is possible to separate the protective from the potentially hazardous elements".

Perkin's findings support earlier work done by Riedler et al., (2001) which concluded that early exposure to a farming environment reduces the risk of development of allergic disorders such as asthma, hay fever and atopic sensitization (Riedler et al., 2001). The study comprised of a cross-sectional survey of 2618 parents of children aged 6-13 years, in addition, 901 children provided blood samples for analysis of IgE antibodies to common allergens (Riedler et al., 2001). The study found that children exposed to stables and who consumed

unpasteurized farm milk prior to one year of age had a lower incidence of asthma, hay fever and atopic sensitization than did children exposed to these factors between the ages of 1-5 years (Riedler et al., 2001). The lowest incidence of allergic disorders was found amongst children who were both exposed to stables and who consumed unpasteurized farm milk until the age of 5 (Riedler et al., 2001). The study concluded that "long-term and early-life exposure to stables and farm milk induces a strong protective effect against development of asthma, hay fever, and atopic sensitization" (Riedler et al., 2001). Dust collected from kitchen floors and children's mattresses in farming families contained a higher concentration of endotoxin (a component of the cell wall of gram-negative bacteria) than did dust collected from non-farming families (Riedler et al., 2001). The researchers provided suggestions as to why early and long-term exposure to a farm environment provided a protective effect (Riedler et al., 2001). Reidler et al., postulated that this protective effect could be the result of farm children being exposed to greater amounts of endotoxin-containing dust through inhalation and ingestions early in life, and that this aided their immune system in maturing properly (2001). Unpasteurized farm milk usually contains greater numbers of bacteria, including gram-negative bacteria and lipopolysaccharide than does processed milk (Riedler et al., 2001). The researchers speculated that "the protective factor associated with consumption of farm milk could be associated with ingestion of non-infectious microbial components, with resultant changes to the commensal gut flora, or both" (Riedler et al., 2001).

The study conducted by Waser et al., had similar findings, that children who consumed farm-fresh products including milk had a significantly lower prevalence of asthma and other allergic disorders when compared to children who consumed store-bought products (2006). Waser et al., recommended that additional research be conducted in order to determine what

components of farm milk provide this protective effect and determine a means of ensuring a safe product that still retains theses beneficial properties (2006).

In order to study the hypothesis that an early and long-term exposure to a farming environment has a preventative effect on of the development of allergic disorders, the GABRIEL project was initiated (Genomes, Asthma and Environments in Europe, 2005). The GABRIEL project is a multi-disciplinary study that is attempting to identify the genetic and environmental causes of asthma (Genomes, Asthma and Environments in Europe, 2005). Contact early in life with stables, barns, and the consumption of unpasteurized milk result in a greater than 70 percent reduction in the risk of developing asthma (Genomes, Asthma and Environments in Europe, 2005). GABRIEL project members have "begun to systematically study farming and rural environmental in order to identify the factors which are fundamental to protecting against disease" (Genomes, Asthma and Environments in Europe, 2005). The project proposes to analyse milk samples taken from homes of asthma cases as well as controls for various bacterial, parameters as well as lactoferin levels (Genomes, Asthma and Environments in Europe, 2005). Lactoferin is of interest as it is believed to have an effect on the immune system (Genomes, Asthma and Environments in Europe, 2005). The milk samples will also be tested for yeast and mould (Genomes, Asthma and Environments in Europe, 2005). The project will also analyse dust samples taken from homes of cases and controls as well as throat swabs taken from both groups (Genomes, Asthma and Environments in Europe, 2005).

The Risks of Unpasteurized milk

Even though the perceived health benefits of consuming raw milk have not been scientifically proven, the types of pathogenic organisms that can be found in unpasteurized milk have been clearly identified (Ontario Ministry of Health and Long-Term Care, 2008a).

Cows naturally carry disease-causing bacteria which may contaminate the milk that they produce (Ontario Ministry of Health and Long-Term Care, 2008a). Milk may also become contaminated during the milking process by the exterior of the cow or by the milking equipment or surrounding environment (LeJeune & Rajala-Schultz, 2009). Oliver et al., stated that "dairy cattle are considered a major reservoir of Salmonella, Campylobacter and STEC (2005). Studies have demonstrated that cattle likely become infected through contaminated food or water (Oliver et al., 2005). Oliver et al., state that pasteurization alone is not sufficient at ensuring that milk is free from pathogens (2005). The author goes on to state that good animal husbandry and safe food handling practices must be practiced at every stage of product preparation (Oliver et al., 2005).

Prior to the adoption of pasteurization in Canada, many food-borne outbreaks were linked to the consumption of milk (Ontario Ministry of Health and Long-Term Care, 2008c). While anyone may become ill from drinking unpasteurized milk, certain groups have a higher risk of infection and serious consequences (Ontario Ministry of Health and Long-Term Care, 2008a). Babies, young children, and people who are immune-suppressed due to advanced age, chronic condition or a weakened immune system are most at risk of suffering from serious disease and death as a result of infection with a milk-borne pathogen (Ontario Ministry of Health and Long-Term Care, 2008a). Babies and young children are at higher risk of suffering from severe illness

as their immune systems have not developed sufficiently to effectively fight infection (Ontario Ministry of Health and Long-Term Care, 2008a). Pregnant women are at risk for miscarriage when infected with some of the pathogenic organisms that may be present in unpasteurized milk (Ontario Ministry of Health and Long-Term Care, 2008a).

Pathogenic Organisms in Unpasteurized Milk

Pathogenic organisms in unpasteurized milk can lead to infections that cause severe cramps, diarrhoea, nausea, vomiting, dehydration, fever and headache (Ontario Ministry of Health and Long-Term Care, 2008a). Illness can result in kidney failure, meningitis, miscarriage and death (Ontario Ministry of Health and Long-Term Care, 2008a). The pathogenic organisms found in raw milk can cause the following infections (Ontario Ministry of Health and Long-Term Care, 2008a):

Campylobacteriosis

Infection with the bacteria of the genus *Campylobacter* can cause cramps, bloody diarrhoea, nausea, vomiting, and fever typically lasting for two to five days (United States Centres for Disease Control and Prevention, 2010b). Symptoms are usually self-limiting (United States Centres for Disease Control and Prevention, 2010b). However, the bacteria can spread to the blood stream in immune-compromised individuals causing, septicaemia a life-threatening infection (United States Centres for Disease Control and Prevention, 2010b). Long-term consequences of infection include development of arthritis and Guillain-Barre syndrome (United States Centres for Disease Control and Prevention, 2010b).

Salmonellosis

Most individuals infected with *Salmonella* species of bacteria experience cramps, diarrhoea and fever lasting from four to seven days (United States Centres for Disease Control and Prevention,

2009c). Symptoms are typically self-limiting (United States Centres for Disease Control and Prevention, 2009c). However, the bacteria can spread outside of the intestines to other parts of the body leading to Reiter's syndrome which can cause pain in the joints, eyes and urinary tract for months or years following infection and can lead to chronic arthritis (United States Centres for Disease Control and Prevention, 2009c).

Yersiniosis

Bacteria of the genus *Yersinia* cause fever, cramps and bloody diarrhoea that can last for one to three weeks or longer (United States Centres for Disease Control and Prevention, 2009d). Uncomplicated cases of yersiniosis are self-limiting (United States Centres for Disease Control and Prevention, 2009d). Long-term consequences include joint pain lasting up to six months following infection and a skin rash, erythema nodosum, which typically resolves within one month of infection (United States Centres for Disease Control and Prevention, 2009d).

Listeriosis

Infection with *Listeria monocytogenes* primarily affects pregnant women, babies, the elderly, and people who are immune-compromised (United States Centres for Disease Control and Prevention, 2009a). Symptoms typically include fever, muscle aches, nausea and diarrhoea (United States Centres for Disease Control and Prevention, 2009a). The bacteria has the ability to spread to the nervous system causing headaches, stiff neck, confusion, loss of balance and convulsions (United States Centres for Disease Control and Prevention, 2009a). Infection during pregnancy can cause pre-term labour, infection in the newborn, miscarriage and stillbirth (United States Centres for Disease Control and Prevention, 2009a). *Listeria monocytogenes* can cause septicaemia and meningitis, resulting in death (Ontario Ministry of Health and Long-Term Care, 2008c).

Tuberculosis

Infection with *Mycobacterium bovis* causes fever, weight loss and night sweats (New York City Department of Health and Mental Hygiene, 2010). The organism can cause various others symptoms depending on the area of the body infected (New York City Department of Health and Mental Hygiene, 2010). If the lungs are infected, a cough will develop (New York City Department of Health and Mental Hygiene, 2010). If the lymph nodes are infected, this will result in swelling in the neck (New York City Department of Health and Mental Hygiene, 2010). Infection of the gastrointestinal system will cause abdominal pain and swelling as well as diarrhoea (New York City Department of Health and Mental Hygiene, 2010). Death may occur if the individual does not receive proper antibiotic treatment (New York City Department of Health and Mental Hygiene, 2010).

Brucellosis

Infection with bacteria of the genus *Brucella* typically result in fever, sweats, headache, back pain, and weakness (United States Centres for Disease Control and Prevention, 2010a). However, infection can progress to endocarditis and infections of the central nervous system (United States Centres for Disease Control and Prevention, 2010a). Long-term consequences of infection include recurrent fever, joint pain and fatigue (United States Centres for Disease Control and Prevention, 2010a).

Staphylococcal food poisoning

Ingestion of the toxin produced by *Staphylococcus aureus* causes nausea, vomiting, cramps and diarrhoea (United States Centres for Disease Control and Prevention, 2010c). Symptoms are usually relatively mild and recovery is in one to three days, however some individuals experience more severe symptoms (United States Centres for Disease Control and Prevention, 2010c).

Streptococcal infections

Infection with *Streptococcus sp.* typically result in diarrhoea, cramps, nausea, vomiting, fever, chills and dizziness (United States Food and Drug Administration, 2009b). Illness is acute and self-limiting (United States Food and Drug Administration, 2009b).

Escherichia coli O157:H7 infection

Infection with Escherichia coli O157:H7 results in severe abdominal cramping and bloody diarrhoea which may be accompanied by vomiting and fever (United States Food and Drug Administration, 2009a). Illness is typically self-limiting and symptoms resolve within eight days (United States Food and Drug Administration, 2009a). Some individuals, young children in particular, are at risk of developing haemolytic uremic syndrome which can lead to permanent loss of kidney function (United States Food and Drug Administration, 2009a). Approximately 10 percent of people with E. coli 0157 develop haemolytic uremic syndrome which can lead to kidney failure and death (Ontario Ministry of Health and Long-Term Care, 2009).

The elderly may also suffer from haemolytic uremic syndrome in combination with fever and neurologic symptoms (United States Food and Drug Administration, 2009a). This combination of symptoms is labelled thrombotic thrombocytopenic pupura (United States Food and Drug Administration, 2009a). Development of thrombotic thrombocytopenic pupura is associated with a 50 percent mortality rate (United States Food and Drug Administration, 2009a).

Toxoplasmosis

Healthy men and non-pregnant women who become infected with *Toxoplasma gondii* may exhibit sore lymph nodes and muscle aches that are self-limiting and last for several weeks (United States Centres for Disease Control and Prevention, 2008). However, the parasite remains dormant in their system and reactivates should the individual become immune-suppressed at a

later date (United States Centres for Disease Control and Prevention, 2008). Babies of women who were previously infected and then become pregnant are usually protected due to the mother's immune system continuing to suppress the parasite (United States Centres for Disease Control and Prevention, 2008). However, if a pregnant woman becomes newly infected, or if she is infected immediately prior to becoming pregnant, congenital transmission can occur and the baby will become infected (United States Centres for Disease Control and Prevention, 2008). Congenital transmission can result in miscarriage, stillbirth and severe birth defects (United States Centres for Disease Control and Prevention, 2008). Individuals who were previously infected and suppressed the parasite but become immune-suppressed at a later date can develop reactivated *Toxoplasma* infection and experience nausea, headache, fever, confusion, seizures and poor coordination (United States Centres for Disease Control and Prevention, 2008).

Q Fever

Infection with the bacteria *Coxelliae burnettii* results in sudden onset of high fever, severe headache, malaise, muscle pain, confusion, sore throat, chills, sweats, cough, nausea, vomiting, diarrhoea, cramps, and chest pain (United States Centres for Disease Control and Prevention, 2009b). Symptoms can last from weeks to months (United States Centres for Disease Control and Prevention, 2009b). Long-term consequences include weight loss, pneumonia, hepatitis, and death (United States Centres for Disease Control and Prevention, 2009b). Infections that last for more than six months are termed Chronic Q Fever and can result in endocarditis (United States Centres for Disease Control and Prevention, 2009b). Chronic Q fever has a mortality rate of 65 percent and is most likely to occur in immune-suppressed individuals (United States Centres for Disease Control and Prevention, 2009b).

Individuals who become infected with a communicable pathogenic organism from drinking raw milk can then pass this organism on to other individuals through hand-to-mouth contact (Ontario Ministry of Health and Long-Term Care, 2008c). The infected individual can pass the infection on to others especially while they are ill with vomiting and diarrhoea (Ontario Ministry of Health and Long-Term Care, 2008c; Ontario Ministry of Health and Long-Term Care, 2009). Symptomatic individuals are most likely to transmit pathogenic organisms via the faecal-oral route if they are not practicing thorough hand washing and good personal hygiene (Ontario Ministry of Health and Long-Term Care, 2009). Close contacts and care-givers are at an increased risk of secondary infection (Ontario Ministry of Health and Long-Term Care, 2009). In some instances, cases may become asymptomatic carriers and pass the disease on to others showing signs of illness themselves. Ontario Ministry of Health and Long-Term Care, 2008c)

Unpasteurized Milk-Borne Outbreaks

The Ontario Ministry of Health and Long-Term Care reports that from 2005 to 2007, 92 cases of food borne illness have been caused in Ontario as a result of consumption of unpasteurized milk or cheese made from unpasteurized milk (Ontario Ministry of Health and Long-Term Care, 2008a). Campylobacteriosis represented 66 percent of these cases and caused at least two outbreaks (Ontario Ministry of Health and Long-Term Care, 2008a). Also included in the 92 cases of illness were six cases of E. coli O157: H7 (Ontario Ministry of Health and Long-Term Care, 2008a).

From 1880 to 1907, approximately 29 milk-borne outbreaks per year were reported in the United States of America (Chin, 1982 as in Oliver et al., 2009). In 1938, milk-borne outbreaks accounted for roughly 25 percent of all reported food or water related outbreaks (United States

Food and Drug Administration, 2007 Revision as in Olive ret al., 2009). Following the implementation of the United States Food and Drug Administration's Grade "A" Pasteurized Milk Ordinance in 1965, the incidence of outbreaks associated with milk decreased significantly in the United States (Oliver et al., 2009).

A 1995 study indicated that in all states within the United States of American where the sale of unpasteurized milk was legal, less than one percent of total milk production was sold as unpasteurized product (Headrick et al, 1998). The study collected data on milk-borne outbreaks that occurred between 1973 and 1992 (Headrick et al, 1998). The study identified that 40 of the 46 reported milk-borne outbreaks occurred in states where the sale of unpasteurized milk was legal at the time of the outbreak (Headrick et al, 1998). The United State of America implemented an interstate ban on the sale of raw milk in 1987 (Headrick et al, 1998). After 1987, only one reported outbreak occurred in a state in which the sale of raw milk was illegal (Headrick et al, 1998). Headrick et al., concluded that evidence supported that an intrastate ban on the sale of unpasteurized milk would further reduce the incidence of milk-related illness and outbreaks (1998).

From 1993 to 2006, 68 outbreaks, representing an average of 5.2 per year were associated with unpasteurized milk or milk products (Centres for Disease Control and Prevention (CDC), 2008, as in Oliver et at., 2009; Infectious Diseases Society of America, 2009 as in LeJeune & Rajala-Schiltz, 2009). From 1998 to 2008, the United Sates Centres for Disease Control and Prevention reported 85 outbreaks of human illness related to consumption of unpasteurized milk or milk products (United States Food and Drug Administration, 2010a). This represented 1, 614 cases of illness which resulted in 187 hospitalizations and two deaths (United States Food and Drug Administration, 2010a). As cases of food-borne illness are often not reported, this is likely

only a portion of the actual number of unpasteurized milk related outbreaks. In the majority of these outbreaks, the organism associated with the outbreak was isolated from samples of the consumed milk product or from subsequent batches made by the same dairy (Oliver et al., 2009). The Pulse Field Gel Electrophoresis (PFGE) pattern of organisms isolated from the stool of many of the cases matched the PFGE pattern of samples taken from milk products or environmental samples collected from the facility, "providing evidence of a causal association between the producer/processor, products, and illness (Oliver et al., 2009). Incidence of outbreaks associated with consumption of raw milk is considerably higher than those for pasteurized product (Oliver et al., 2009). During the same time period, two outbreaks associated with pasteurized milk, both linked to post-pasteurization contamination, were reported (Oliver et al., 2009). Pasteurization has been proven to reduce morbidity and mortality (Oliver et al., 2009). However, just like any ready-to-eat product, producers must remain vigilant in protecting the product from post-production contamination.

In November and December of 2005, an outbreak of Escherichia coli O157: H7 occurred and involved shareholders in a cow-share program in Washington and Oregon states (CDC Morbidity and Mortality Weekly Report, 2007). The sale of raw milk and cow-shares are legal in Washington, however, these must be licensed and meet established standards for production and processing as well as pass animal health and facility sanitation inspections by local departments of agriculture (CDC Morbidity and Mortality Weekly Report, 2007). The farm linked to the outbreak was not a licensed facility (CDC Morbidity and Mortality Weekly Report, 2007). The outbreak involved 18 cases, eight of which were laboratory confirmed (CDC Morbidity and Mortality Weekly Report, 2007). Five of the cases required hospitalization and four of these suffered from haemolytic uremic syndrome (CDC Morbidity and Mortality Weekly Report,

2007). Milk samples obtained from the farm as well as one shareholder tested positive for Escherichia coli O157: H7 (CDC Morbidity and Mortality Weekly Report, 2007). Environmental samples taken from the farm also tested positive for Escherichia coli O157:H7, however stool samples from the five cows tested negative (CDC Morbidity and Mortality Weekly Report, 2007).

In a 2002-2003 outbreak of *Salmonella* typhimurium, 62 people in Illinois, Indiana, Ohio and Tennessee became ill after consuming raw milk sold at a combination petting zoo-dairy-restaurant in Ohio (CDC Morbidity and Mortality Weekly Report, 2003). At the time of the outbreak, the implicated restaurant was the only food premises in Ohio that legally sold unpasteurized milk to the public (CDC Morbidity and Mortality Weekly Report, 2003). The 62 cases consisted of consumers and their household contacts as well as diary workers (CDC Morbidity and Mortality Weekly Report, 2003). Five samples of milk and milk products obtained from the restaurant tested positive for S. Typhimurium, however all stool samples collected from cows as well as environmental samples taken from the dairy equipment and storage sites tested negative (CDC Morbidity and Mortality Weekly Report, 2003). It was found that four barn workers had asymptomatic S. Typhimurium infection (CDC Morbidity and Mortality Weekly Report, 2003). These individuals were responsible for milking the cows, bottling the milk and making ice cream (CDC Morbidity and Mortality Weekly Report, 2003). Although the department of health could not determine the source of contamination, the investigation suggested that contamination may have occurred during the milking, bottling or capping of the product (CDC Morbidity and Mortality Weekly Report, 2003). As of October 1997, Ohio law did not permit the sale of unpasteurized milk, other than from dairies that had been in the practice of doing so prior to October 31, 1965 (CDC Morbidity and Mortality

Weekly Report, 2003). The dairy involved in this outbreak had been in operation since 1958 and was the only dairy in Ohio legally able to sell unpasteurized milk and milk products to the public (CDC Morbidity and Mortality Weekly Report, 2003). Following this outbreak, the diary voluntarily relinquished its licence and as a result, no businesses are currently able to legally sell unpasteurized milk in the state of Ohio (CDC Morbidity and Mortality Weekly Report, 2003).

In 2001, an outbreak of *Campylobacter jejuni* occurred involving a cow-leasing program in Wisconsin (CDC Morbidity and Mortality Weekly Report, 2002). Seventy-five individuals met the case definition in this outbreak, 28 of whom had submitted stool specimens that tested positive for *C. Jejui* (CDC Morbidity and Mortality Weekly Report, 2002). All cases had either drank unpasteurized milk, or been a household contact of a case (CDC Morbidity and Mortality Weekly Report, 2002). The dairy involved in the outbreak was a Grade A organic dairy farm with 36 cows (CDC Morbidity and Mortality Weekly Report, 2002). The operators provided milk to cow-share members as well as samples of milk to members of the public who visited the farm, including children from childcare facilities (CDC Morbidity and Mortality Weekly Report, 2002). It is illegal in Wisconsin to sell unpasteurized milk; the farm operators circumvented the legislation by initiating a cow-leasing program whereby consumers paid a fee to lease part of a cow and the farm operators cared for and milked the cows and stored the milk until such a time as consumers picked-up the product from the farm or the operators delivered the milk to the home of the consumer (CDC Morbidity and Mortality Weekly Report, 2002). Milk from all cows was pooled in a common tank at the farm (CDC Morbidity and Mortality Weekly Report, 2002). Milk samples collected from the milk tank tested positive for the strain of *C. jejuni* involved in the outbreak (CDC Morbidity and Mortality Weekly Report, 2002).

The United States Centres for Disease Control and Prevention has identified 35 human cases of *Mycobacterium bovis* between 2001 and 2004 in New York City (CDC Morbidity and Mortality Weekly Report, 2005). Of these cases, 26 needed to be admitted to the hospital and one 15 month-old boy died (CDC Morbidity and Mortality Weekly Report, 2005). Humans most commonly become infected with *M. Bovis* through the ingestion of unpasteurized milk and milk products (CDC Morbidity and Mortality Weekly Report, 2005). Investigators determined that unpasteurized cheese brought from Mexico was the likely cause of infection in this outbreak (CDC Morbidity and Mortality Weekly Report, 2005).

Two incidents have been reported in Massachusetts of individuals receiving rabies post-exposure prophylaxis as a result of consuming unpasteurized milk from a rabid cow (CDC Morbidity and Mortality Weekly Report, 1999). The most recent of the two incidents occurred in 1998 when rabies was confirmed in a 6-year-old dairy cow from a farm in Worcester County (CDC Morbidity and Mortality Weekly Report, 1999). The cow had been milked 12 times in the week prior to its death (CDC Morbidity and Mortality Weekly Report, 1999). The milk had been pooled with milk collected from other cows, a portion of which was distributed unpasteurized (CDC Morbidity and Mortality Weekly Report, 1999). The investigation revealed that 66 individuals had consumed the unpasteurized milk and all 66 individuals subsequently received rabies post-exposure prophylaxis (CDC Morbidity and Mortality Weekly Report, 1999).

A similar incident occurred in 1996 involving a rabid 14-year-old dairy cow from a different farm in the same county (CDC Morbidity and Mortality Weekly Report, 1999). The cow had been milked from one to two weeks prior to death and its unpasteurized milk was drunk by 14 individuals, all of whom received rabies post-exposure prophylaxis (CDC Morbidity and Mortality Weekly Report, 1999).

Rabies has a 100% fatality rate among humans if exposed individuals do not received rabies post-exposure prophylaxis within an acceptable period of time following exposure to the virus (CDC Morbidity and Mortality Weekly Report, 1999). Approximately 150 rabid cows have been reported to the United States Centres of Disease Control and Prevention every year since 1990 (CDC Morbidity and Mortality Weekly Report, 1999). The National Association of State Public Health Veterinarians advises against consuming uncooked or undercooked meat and unpasteurized milk from rabid animals (CDC Morbidity and Mortality Weekly Report, 1999). It is theoretically possible for the rabies virus to be transmitted though unpasteurized milk (CDC Morbidity and Mortality Weekly Report, 1999).

The most recent outbreak associated with consumption of unpasteurized milk occurred in Boulder Colorado (Boulder, 2010). Boulder County Public Health announced on Thursday, July 8, 2010, a second child had been hospitalized due to illness acquired from consuming unpasteurized goat's milk (Boulder, 2010). As of July 8, 2010, the outbreak consisted of 30 cases, including the two hospitalized children (Boulder, 2010). Laboratory tests have confirmed that the raw milk product supplied by a farm in Longmont, Colorado was responsible for all 30 cases of illness (Boulder, 2010). Samples of the milk tested positive for the same strains of Campylobacter and E. coli O157 identified in the cases (Boulder, 2010).

Even though it has been proven that pathogenic organisms in unpasteurized milk present a risk of infection with communicable disease-causing organisms, the theory that unpasteurized milk can lead to an increased risk of cancer has not been corroborated. Sellers (2008) conducted a study to investigate the findings of Buehring et al., 2003) that unpasteurized milk may increase the risk of cancer in humans (Buehring et al., 2003 as in Sellers et al., 2008). The study conducted by Sellers et al., relied on statistics gathered through the Iowa Women's Health Study,

which is a prospective cohort study of 41, 836 women aged 55-69 at the initiation of the study in 1986 (Sellers et al., 2008). Sellers et al., (2008) determined that the analysis of the data collected through the survey suggested that consumption of unpasteurized milk did not increase the risk of cancer.

Applicable Legislation

Section 13 of the *Health Protection and Promotion Act* states that:

> (1) A medical officer of health or a public health inspector, in the circumstances mentioned in subsection (2), by a written order may require a person to take or to refrain from taking any action that is specified in the order in respect of a health hazard
>
> (2) A medical officer of health or a public health inspector may make an order under this section where he or she is of the opinion, upon reasonable and probable grounds,
>
> a) that a health hazard exists in the health unit served by him or her; and
>
> b) that the requirements specified in the order are necessary in order to decrease the effect of or to eliminate the health hazard (Government of Ontario, 2009a).

Under section 100(1) of the *Health Protection and Promotion Act*, "any person who fails to obey an order made under this Act is guilty of an offence" (Government of Ontario, 2009a).

The *Health Protection and Promotion Act* defines a health hazard as:

> a) a condition of a premises,
>
> b) a substance, thing, plant or animal other than man, or
>
> c) a solid, liquid, gas or combination of any of them,
>
> that has or that is likely to have an adverse effect on the health of any person (Government of Ontario, 2009a).

Unpasteurized milk constitutes a health hazard due to the potential for the product to be a vehicle for the transmission of pathogenic organisms (Ontario Ministry of Health and Long-Term Care, 2008a). Pathogenic bacteria may enter milk from the cow or the surrounding environment during manufacturing, collection or processing (LeJeune & Rajala-Schultz, 2009). Once pathogenic bacteria are introduced, milk provides an opportune growth media for bacteria due to its neutral pH and high protein content (LeJeune & Rajala-Schultz, 2009).

Canada's *Food and Drug Regulations* require that all milk available for sale in Canada be pasteurized (Ontario Ministry of Health and Long-Term Care, 2008a). The Ontario *Health Protection and Promotion Act* requires that all milk that is sold or distributed in Ontario be pasteurized in a plant licensed under the Ontario *Milk Act* or in a plant located outside of Ontario that meets the standards for plants licensed under the *Milk Act* (Government of Ontario, 2009a).

Pasteurization is a process whereby milk is heated to high temperatures for set periods of time in order to kill pathogenic organisms (Ontario Ministry of Health and Long-Term Care, 2008a). Pasteurization is the single most effective means of reducing the bacterial load in milk (LeJeune & Rajala-Schultz, 2009).

In Ontario, the *Food Premises Regulation* requires that all milk be pasteurized by heating the milk to a temperature of at least 63 degrees Celsius for not less than 30 minutes or to a temperature of at least 72 degrees Celsius for not less than 16 seconds (Government of Ontario, 2008). In addition to these set times and temperatures, the *Food Premises Regulation* also permits pasteurization by other combinations of times and temperatures provided that the final result is the equivalent destruction of pathogenic organisms and the inactivation of the enzyme alkaline phosphatase (Government of Ontario, 2008).

Inactivation of alkaline phosphatase is used as an indicator of pasteurization under Section B.08.030 of the Canadian *Food and Drug Regulations (*Government of Canada, 2010). Alkaline phosphatase is an enzyme which is naturally found in all dairy products (Health Canada, 2002). Alkaline phosphatase has an inactivation temperature which is slightly higher than the temperature necessary to kill the most heat-resistant pathogenic organism found in milk, *Coxelliae burnettii (*Health Canada, 2002; University of Guelph, n.d.). Therefore, milk is deemed to be pasteurized if it tests negative for alkaline phosphatase (University of Guelph, n.d.).

The Case of Michael Schmidt

Michael Schmidt is the owner of Glencolton Farms, a dairy farm located in the township of Durham, Grey-Bruce County, Ontario (Ontario Court of Justice, 2010). Michael Schmidt is also a self-proclaimed raw milk advocate (Glencolton Farms, n.d.)

In February 1994, the Bruce-Grey-Owen Sound Health Unit (now the Grey Bruce Health Unit) issued an order under section 13 of the *Health Protection and Promotion Act* requiring Michael Schmidt to "cease the manufacturing, processing, preparation, storage, handling, display [sale, offering for sale and distribution] of unpasteurized milk and milk products" (Ontario Court of Justice, 2010).

Glencolton Farms was raided in 1994 by the Ministry officials and Michael Schmidt was subsequently found guilty of selling and distributing unpasteurized milk and was ordered to pay a fine of $3,500.00 and was placed on two years' probation (Ontario Court of Justice, 2010). Mr. Schmidt appealed the order to the Health Protection Appeal Board and his appeal was subsequently denied in September, 1994 (Ontario Court of Justice, 2010). In order to continue to

provide unpasteurized milk to his clients in a manner which he felt did not contravene the provincial or federal legislation, Michael Schmidt developed a cow share program and altered his milk processing operation in an attempt to have his farm no longer meet the definition of a milk plant under the *Milk Act* (Ontario Court of Justice, 2010).

On November 21, 2006, the Ministry of Natural Resources executed a search warrant at Glencolton Farms, seizing machinery, equipment and documents as well as large quantities of unpasteurized milk and milk products (Ontario Court of Justice, 2010). The Grey Bruce Health Unit charged Mr. Schmidt in October and November, 2006 with displaying and storing unpasteurized milk at Glencolton Farms (Ontario Court of Justice, 2010). The Ministry of Natural Resources charged Mr. Schmidt with operating a milk plant without a license and with selling and distributing unpasteurized milk and milk products on several occasions between August and November 2006 (Ontario Court of Justice, 2010). In total, the Grey Bruce Health Unit and the Ministry of Natural Resources jointly filed 17 charges with the Provincial Offences Office under the *Health Protection and Promotion Act* as well as three charges under the *Milk Act* (Ontario Court of Justice, 2010).

On December 5, 2006, York Region Public Health Services ordered Michael Schmidt, under section 13 of the Ontario *Health Protection and Promotion Act*, to immediately cease the sale and distribution of unpasteurized milk in York Region (Ontario Court of Justice, 2008a). In contravention of York Region Public Health Services' December 5, 2006 order, Michael Schmidt continued to distribute unpasteurized milk causing York Region to apply to the Ontario Superior Court of Justice for a restraining order (Ontario Court of Justice, 2008a). York Region Public Health Services was authorized to apply to the Ontario Superior Court of Justice under section 102 (1) of the *Health Protection and Promotion Act* (Government of Ontario, 2009a).

The restraining order was awarded by Justice Ferguson on May 17, 2007 and was subsequently served upon Mr. Schmidt by York Region Public Health Services (Ontario Court of Justice, 2008a). However, Mr. Schmidt continued to sell and distribute unpasteurized milk in contravention of Justice Ferguson's order (Ontario Court of Justice, 2008a). As a result, York Region Public Health Services brought Mr. Schmidt before Justice Boswell in September, 2008 (Ontario Court of Justice, 2008a).

Through the court proceedings, Justice Boswell found that York Region Public Health Services' investigation had been flawed as they had failed to seize any milk products or to test the milk that Mr. Schmidt had sold and distributed for the presence of alkaline phosphatase (Ontario Court of Justice, 2008a). York Region Public Health Services had gathered evidence to support their claim that Mr. Schmidt had sold and distributed unpasteurized milk by monitoring Michael Schmidt's Glencolton Farms website and by hiring a private investigator to videotape individuals coming and going from a blue bus stationed in a parking lot in Maple, Ontario which is located in York Region (Ontario Court of Justice, 2008a). On October 20, 2008, Justice Boswell found Michael Schmidt in contempt of Justice Fergusson's order (Ontario Court of Justice, 2008a). Justice Boswell based his ruling on evidence provided though the testimony of two cow shareholders and York Region's private investigator as well as statements that Michael Schmidt had made on his website and to a Toronto Sun reporter (Ontario Court of Justice, 2008a).

Penalties for individuals found in contempt of court in Ontario can range from monetary fines to imprisoned (Ontario Court of Justice, 2008a). As a penalty for Mr. Schmidt's contempt conviction, York Region advised the court that they sought a fine as well as recuperation of court costs (Ontario Court of Justice, 2008b). York Region's council indicated that York Region did

not seek the highest possible fine as this was Mr. Schmidt's first convicted contempt charge and that their intention was to have Mr. Schmidt comply with their order to cease the sale and distribution of raw milk (Ontario Court of Justice, 2008b). Mr. Schmidt argued that he should be punished at the harshest possible level and stated that he was of the likes of Gandhi and Martin Luther King in his attempt to bring about political and legal change (Ontario Court of Justice, 2008b). Justice Boswell ordered Mr. Schmidt to pay a fine of $5, 000.00 plus $50, 000.00 in costs and allowed Mr. Schmidt six months to pay (Ontario Court of Justice, 2008b).

From January 2009 to January 2010 Justice Kowarsky presided over the case addressing the 20 charges jointly field by the Grey Bruce Health and the Ministry of Natural Resources against Michael Schmidt (Ontario Court of Justice, 2010). During trial, the Ministry of Natural Resources withdrew one charge, reducing the total number of charges to 19 (Ontario Court of Justice, 2010).

During the course of the trial, Mr. Schmidt indicated that his intention was not to "circumvent the law. [His] concern was simply to work within the parameters of the statutes and Acts" (Ontario Court of Justice, 2010). As part of the documents submitted during the court proceedings was a search warrant statement in which Mr. Schmidt stated that he provides unpasteurized milk to cow share members only and not to the general public (Ontario Court of Justice, 2010). Mr. Schmidt described cow share members as individuals who bought a quarter or half cow for $300.00 for six years and who pay $2.00 to $2.50 per liter of milk for Mr. Schmidt's services of housing, feeding, cleaning and milking the cows as well as bottling, cooling and making milk products such as cheese (Ontario Court of Justice, 2010). Mr. Schmidt stated that he currently has 150 cow share members all of whom are aware that the milk that they are purchasing is unpasteurized (Ontario Court of Justice, 2010). Both Mr. Schmidt and the

crown lawyer agreed that there is no law in Ontario prohibiting the consumption of unpasteurized milk or milk products (Ontario Court of Justice, 2010).

In taking into consideration the arguments presented at the trial as well as other case law including the *Smoke Free Ontario Act* which protects the public from unwanted exposure to tobacco smoke, Justice Kowarsky found Mr. Schmidt not guilty on all 19 charges on January 21st, 2010 (Government of Ontario, 2010e; Ontario Court of Justice, 2010). The Ontario Government will be appealing Justice Kowarsky's decision to the Ontario Court of Justice (Fantauzzi, 2010).

Prior to the commencement of the trial over which Justice Kowarsky presided, Michael Schmidt brought forward a constitutional challenge alleging that the Ontario *Health Protection and Promotion Act* and the *Milk Act* infringed upon his rights under section 7 of the *Charter of Rights and Freedoms* (Ontario Court of Justice, 2010). Upon mutual agreement by both parties, Justice Kowarsky deferred the constitutional challenge until after his ruling on the case brought before him (Ontario Court of Justice, 2010). Michael Schmidt did not pursue the constitutional challenge once Justice Kowarsky found him not guilty on all charges; however, the Canadian Constitution Foundation advised that they would be representing Mr. Schmidt regarding the outstanding constitutional issues now that their client has been served with the notice of appeal (Fantauzzi, 2010). The Ontario Government filed a Notice of Appeal with the Ontario Court of Justice stating that Justice Kowarsky "erred in law" in ruling that Michael Schmidt and his cow-share members could be exempt from provincial and federal legislation "through a private contractual arrangement" (Toronto Star, 2010b).

The Case of Alice Jongerden

On July 9, 2008, the Fraser Health Authority, under the authority of the *Public Health Act*, ordered Alice Jongerden to cease and desist the distribution of raw milk for human consumption (Supreme Court of British Columbia, 2010). Alice Jongerden did not appeal the order and on December 18, 2009, it was determined that Alice Jongerden continued to operate her cow share in contravention of both the July 9, 2008 order and the *Public Health Act* (Supreme Court of British Columbia, 2010).

Alice Jongerden referred to Justice Kowarsky's ruling in Michael Schmidt's court case in her arguments to the court (Supreme Court of British Columbia, 2010). Under the British Columbia *Public Health Act*, it is illegal to sell or distribute unpasteurized milk for human consumption (Supreme Court of British Columbia, 2010). Furthermore, section 7 of the *Public Health Act Transitional Regulation* states that milk for human consumption which has not been pasteurized at a licensed dairy plant in accordance with the *Milk Industry Act*, is a health hazard (Supreme Court of British Columbia, 2010). Section 15 of the *Public Health Act* "prohibits a person from willingly causing a health hazard" (Supreme Court of British Columbia, 2010). On March 18, 2010, Justice Gropper found that Alice Jongerden was in contravention to the legislation and awarded the Fraser Health Authority with a permanent injunction to prevent Alice Jongerden of Home on the Range, a diary cow share operating in Chilliwack B.C, from selling and distributing unpasteurized milk for human consumption (Supreme Court of British Columbia, 2010).

Legislation in Other Jurisdictions

In Australia, as in Canada, the sale and distribution of unpasteurized milk is illegal (Ontario Ministry of Health and Long-Term Care, 2008a; Commonwealth of Australia, 2010). The United States bans the interstate trade of unpasteurized milk (Headrick et al, 1998). Some states, such as the State of Delaware, have adopted a similar approach to Ontario in that sale and distribution of unpasteurized milk is illegal (State of Delaware, 1999). However, 29 states in the United States have legalized the sale of raw milk for human consumption (National Association of State Departments of Agriculture (NASDA), 2008).

Jurisdictions that allow for the sale of unpasteurized milk have adopted a variety of approaches to balance the public demand for raw milk with the risk that consumption of the product poses. Of the 29 states that have legalized the sale of raw milk, 17 do not allow unpasteurized milk to be sold anywhere other than from the farm on which the milk was produced (NASDA, 2008). Nebraska State, for example, permits the sale of unpasteurized milk only by farmers at the farm directly to customers for direct consumption and not for resale at restaurants, grocery stores or other retail or food service establishments (State of Nebraska, 2007).

Seven states have placed some type of restriction over the sale of raw milk such as limiting sale only to raw goat's milk, by granting access only through the prescription from a physician (as is the practice in Kentucky), or by placing restrictions on farm size or on volume of milk sold (Oliver et al., 2009; State of Kentucky, 1988).

Thirteen states allow for retail sales of unpasteurized milk (Oliver et al., 2009). The Nevada State *Dairy Products and Substitutes Chapter 584 under the Public Health and Safety Act* permits the sale of unpasteurized cow and goat milk (State of Nevada, 2001). The Nevada *Public Health and Safety* Act does place requirements upon producers in order to allow for risk reduction (State of Nevada, 2001). The milk must be cooled to 45 degrees Fahrenheit or cooler immediately following milking and until such time as it is delivered to the consumer (State of Nevada, 2001). The Act also requires that at time of human ingestion, the milk contains 10 or fewer coliform bacteria per milliliter and less than 10,000 bacteria per milliliter (State of Nevada, 2001). The milk must also have been certified by the local county milk commission (State of Nevada, 2001). The Act requires that every individual coming into contact with the milk "maintains scrupulous cleanliness and is not afflicted with any communicable disease or in a condition to disseminate any disease which can be transmitted by milk" (State of Nevada, 2001). Furthermore, any food handlers coming into contact with the milk must undergo a physical examination prior to beginning employment and every 3 months thereafter in order to ensure that they are not infected with a communicable disease (State of Nevada, 2001). The Nevada State Dairy Commission inspects the cows and goats in order to ensure that the animals are in good health as well as the dairy farms for general sanitation (State of Nevada, 2001).

Washington State allows the retail sale and distribution of unpasteurized milk provided the container bares a warning label (Washington State, 2009). The milk must be bottled on the farm where it was produced and the milk must be clearly labeled as "raw" and contain the name of the producer on the label (Washington State, 2003).

The Washington state department of agriculture adopted the warning label requirement in order to "inform consumers about possible harm that may occur from consuming raw milk that

contains harmful microorganisms" (Washington State, 2003). The state's intention is to ensure that the public is aware of the health hazards associated with the consumption of raw milk so that they may make informed choices about buying unpasteurized milk and milk products (Washington State, 2003). The milk container must bear the following label in order to be sold at retail:

WARNING: This product has not been pasteurized and may contain harmful bacteria. Pregnant women, children, the elderly and persons with lowered resistance to disease have the highest risk of harm from use of this product (Washington State, 2003).

The warning label must meet minimum requirements for size and must be clear, conspicuous and prominently displayed on the milk bottle (Washington State, 2003).

The state of Oregon allows for farm gate sales of limited quantities of cow's milk as well as retail sale of unpasteurized goat's milk (Oliver et al., 2009). Some states allow for cow-share or cow-leasing programs, however, these types of operations have also been used in states that prohibit the sale of unpasteurized milk as a means of circumventing State legislation (Oliver et al., 2009). States that allow for the sale of raw milk vary in their bacteriological standards for raw milk (Oliver et al., 2009).

The sale and distribution of unpasteurized milk is also legal in England (United Kingdom, 2007). There are approximately 200 producers of unpasteurized or "Green Top" milk in England (United Kingdom, 2007). A special license is given to dairies which are permitted to sell unpasteurized milk in the United Kingdom (United Kingdom, 2007). England's *Food Act* requires that producers of unpasteurized milk adhere to stricter standards than dairies

manufacturing pasteurized milk (United Kingdom, 2007). Cows used for the production of milk that will not be pasteurized must be free from communicable disease (European Commission, 2008). Unpasteurized milk must also be routinely tested for tuberculosis and brucellosis (United Kingdom, 2007). Similar to Washington State, England has required that a warning label be placed on all unpasteurized milk containers (United Kingdom, 2007). The label must state "this product has not been heat-treated and may contain organisms harmful to health" (United Kingdom, 2007). Producers sell their milk either directly from the farm to the consumer or through farmers markets or delivery services (United Kingdom, 2007). It is however, illegal under the Food Safety Act to sell unpasteurized milk on "the High Street, via shops or supermarkets in England, Wales or Northern Ireland" (United Kingdom, 2007).

In a 1993 poll of 3, 999 residents living in states where the sale of unpasteurized milk was legal, 138 (3%) of the respondents reported drinking unpasteurized milk that same year (CDC Morbidity and Mortality Weekly Report, 2002). The small percentage of individuals who choose to consume unpasteurized milk has been increasing over recent years despite the known hazards of consuming the product (Oliver et al., 2009) A direct correlation has been found to occur between the incidence of outbreaks linked with consumption of raw milk and the legal sale of unpasteurized milk within a state (National Environmental Health Association (NEHA), 2008). That is, the rate of unpasteurized milk-related outbreaks was significantly higher in states that have legalized the sale of raw milk (NEHA, 2008).

Raw milk advocates choose to drink unpasteurized milk due to perceived health benefits of consuming the product (Oliver et al., 2009). The recent "eat local" movement and interest in consuming natural and unprocessed foods has further increased the demand for raw milk products (Oliver et al., 2009). But perhaps the raw milk argument most passionately defended

stems from the individual's freedom of choice and each person's right to consume what they feel is necessary in order to improve and maintain their personal health (Oliver et al., 2009).

Ethical Issues Surrounding Unpasteurized Milk

Canada is a democratic society (Parliament of Canada, 2010). The values central to a democratic society are freedom, tolerance, cooperation, and compromise (American Government, 2010). According to the United States government, "democracy rests upon the principles of majority rule and individual rights" (American Government, 2010). Furthermore, autonomy, or self-governance, is a basis for Western political and moral culture (Holland, 2007, p. 38).

Autonomy is defined as 'at a minimum, self-rule that is free from both controlling interference by others and from limitations, such as inadequate understanding, that prevent meaningful choice' (Beauchamp and Childress, 2001 as in Holland, 2007, p.26). Therefore, within a democratic society, personal autonomy, or self-governance, is carefully balanced with the best interests of the population at large. Autonomy is so strongly valued in our society that it is referenced in the Canadian Charter of Rights and Freedoms (Government of Canada, 1982). Section 7 of the Charter states that "everyone has the right to life, liberty and security of the person and the right not to be deprived thereof except in accordance with the principles of fundamental justice" (Government of Canada, 1982).

The recent increased interest in unpasteurized milk has stemmed not only from the "eat local" movement and the public's interest in consuming natural and unprocessed foods, but also in defence of the individual's freedom of choice in determining what they ingest (Oliver et al., 2009).

Throughout his court trails, Michael Schmidt argued that it is a personal choice to drink unpasteurized milk and that individuals should have the right to choose what they consume in

their pursuit for optimal health, that government should not infringe upon these rights or become involved in private affairs of citizens (Ontario Court of Justice, 2010). Prior to the commencement of the trial over which Justice Kowarsky presided, Michael Schmidt brought forward a constitutional challenge, in which he claimed that his rights under section 7 of the Canadian Charter of Rights and Freedoms had been infringed upon by the Health Protection and Promotion Act as well as the Milk Act (Ontario Court of Justice, 2010). The Canadian Constitution Foundation has stated that it will assist Mr. Schmidt with his Charter challenge (Canadian Constitution Foundation, 2010).

During the trial in which Justice Boswell presided, the Justice of the Peace acknowledged that he understood that Michael Schmidt was fighting for what he considered to be his fundamental rights (Ontario Court of Justice, 2008a). However, Justice Boswell went on to say that "it must be remembered that the preamble to the *Charter* itself confirms that Canada is founded on principles that recognize the rule of law" (Ontario Court of Justice, 2008a). Therefore, citizens cannot conduct illegal acts in an attempt to uphold their personal autonomy.

Parental autonomy is an extension of personal autonomy and is also a valued element of our culture. In our society, it is assumed that "parents are the most appropriate decision makers because they know their children well and are in the ideal position to decide what is in the child's best interest" (Lyren and Leonard, 2006 as in Holland, 2007, p. 143). According to this train of thought, parents who provide their children with unpasteurized milk, out of a genuine belief that it will benefit the child, are exercising their parental autonomy (Holland, 2007, p. 145).

It has proven that children are particularly at risk for serious infections from drinking raw milk as their immune systems are not yet fully developed and they are therefore less able to fight

off infection from pathogenic organisms found in unpasteurized milk (Ontario Ministry of Health and Long-Term Care, 2008c). If parents genuinely believe that unpasteurized milk is superior to pasteurized milk, it is unlikely that any amount of education on the part of medical practitioners or government organizations will be successful at encouraging them to serve their children only pasteurized milk (Ontario Ministry of Health and Long-Term Care, 2008c). In order to infringe upon parental autonomy though enacted legislation, there must be clear and unequivocal proof that certain parental choices are not in the best interest of the child or that these choices will adversely affect a third party (Holland, 2007, p. 143).

Several pieces of provincial legislation currently exist which infringe upon parental autonomy in cases where there is proof that certain parental behaviours are not in the best interest of the child. The Smoke- Free Ontario Act prohibits adults, including parents, from smoking in vehicles when children under 16 years of age present (Government of Ontario, 2010e). This legislation is ethically justified as it has been proven that exposure to second-hand smoke leads to both short and long-term illness in children (Physicians for a Smoke-Free Canada, 1999). This section of the Smoke- Free Ontario Act is enforced by Ontario police through their powers under the Highway Traffic Act (Government of Ontario, 2010a).

The Highway Traffic Act also requires the use of seat belts for all drivers and passengers in motorized vehicles (Government of Ontario, 2010a). Adults travelling in vehicles with children under the age of 16 years are directly responsible for ensuring that the children in their care are properly wearing a seatbelt or in an appropriately installed car seat (Government of Ontario, 2010a). This legislation is ethically justified as it has been proven that seat belts, when worn correctly, dramatically increase a person's chance of surviving a motor vehicle accident (Ontario Ministry of Transportation, 2010).

Liberalist theory argues that legislation prohibiting individuals from wilfully consuming unpasteurized milk is unethical as this type of government interference infringes upon the autonomy and personal liberties of individual citizens (Holland, 2007, p. 139). However, the Harm Principle states that "the only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others. His own good, whether physical or moral, is not a sufficient warrant (Mill, 1975 as in Holland, 2007, p139). Closely linked to the Harm Principle is the Principle of Beneficence, which states that we have a 'moral obligation to act for the benefit of others' (Beauchamp and Childress, 2001 as in Holland, 2001, p27). Supporting the Harm Principle and the Principle of Beneficence is the Principle of Non-maleficence which states that we have a moral 'obligation not to inflict harm on others' (Beauchamp & Childress (2001) as in Holland, 2007, p27).

Individuals who consume unpasteurized milk are at risk of infection with pathogenic organisms that are naturally found in the product (Ontario Ministry of Health and Long-Term Care, 2009). These individuals, once ill, can transmit disease-causing organisms by person-to-person spread via the faecal-oral route (Ontario Ministry of Health and Long-Term Care, 2009). Pathogenic organisms that are found in unpasteurized milk infect the host and are then excreted in their faces and spread to others who ingest these organisms either through food prepared by the infected individual or by coming into contact with surfaces that the infected individual has contaminated or by coming into direct contact with the infected individual and then not thoroughly washing their hands (Ontario Ministry of Health and Long-Term Care, 2009). Secondary person-to-person spread is especially concerning in institutional or child-care settings where there are a high concentrations of vulnerable, immune-compromised individuals and personal hygiene practices many not be ideal (Ontario Ministry of Health and Long-Term Care,

2008a). The very young, elderly, and immune-compromised individuals have a higher risk for serious long-term illness and death when they become infected with pathogenic organisms (Ontario Ministry of Health and Long-Term Care, 2008a).

Individuals who are exposed to pathogenic organisms via person-to-person spread may have made the conscious decision not to drink unpasteurized milk due to the known health risks of doing so; therefore, their own autonomy has been infringed upon by inadvertently being exposed to this risk. According to the harm principle, the government is justified, when the potential risk of harm to other is high, and there is a risk of serious disability or death to resort to legal compulsion in order to ensure compliance (Holland, 2007, p. 29; Holland, 2007, p.139).

Therefore, under the principles of Beneficence, Non-Maleficence and Harm Principles, citizens have a moral obligation not to consume unpasteurized milk. Under these same principles, the government is ethically justified in prohibiting the sale and distribution of unpasteurized milk. The infringement that current legislation places upon the autonomy of the public is far outweighed by the public health benefit that this same legislation affords.

Yet another ethical argument arises when considering the responsibilities that citizen have to the society in which they are a part of. That is, is it ethical for individuals within a society to choose personal behaviours that may cause a burden on society? Beauchamp & Childress define justice as 'fair, equitable and appropriate treatment in light of what is due or owed a person' (2001 as in Holland, 2007). The principle of justice can be applied to what is owed a person by society as well as the extent to which individuals are morally obligated to contribute towards the greater public good.

The Ontario Health Insurance Plan pays for medical care received by residents of Ontario should they become ill (Ontario Ministry of Health and Long-Term Care, 2008b). Provincial residents contribute to Medicare through tax dollars (Ontario Ministry of Finance, 2010). Under the Principle of Justice, it may be argued that individuals have a duty to society to not expose themselves unnecessarily to disease-causing organisms in order to ensure that they do not become an unnecessary burden on the health care system that society supports.

However, OHIP currently pays for the lifestyle choices of many citizens who make lifestyle choices that adversely affect their health. For example, long-term tobacco smokers who suffer from Chronic Obstructive Pulmonary Disease or cancer are not discriminated against in the health care system and have access to the same treatment as non-smokers. What is different between smokers and individuals who drink unpasteurized milk is that smokers are well aware that smoking is harmful to their health, while individuals who drink unpasteurized milk believe that by doing so, they are improving their health. The Principle of Justice also states that all individuals within a society must be treated fairly (Beauchamp & Childress 2001 as in Holland, 2007). Therefore, individuals who consume raw milk have just as much of a right to access medical services as would individuals who do not drink unpasteurized milk. However, people have a duty to the society to which they are a member to refrain from taking actions that would make them a burden on the system.

Furthermore, many substances that are known to cause disease in humans, including tobacco and alcohol are legal in Ontario (Government of Ontario, 2010b; Government of Ontario, 2010c; Government of Ontario, 2010d; Government of Ontario, 2010e). Restrictions are placed on where these products can be sold, to whom they can be sold to and where they can be used, however, they remain legal (2010b; Government of Ontario, 2010c; Government of

Ontario, 2010d; Government of Ontario, 2010e). It could be argued that it is unjust that individuals are given the freedom to choose to legally smoke tobacco or drink alcohol, which have known adverse effects on human health, however the government will not extend that liberty to individuals who wish to legally consume unpasteurized milk in an effort to improve their health.

Evaluation of Literature

Groups that support the pasteurization of milk and warn against the consumption of raw milk include the Ontario Ministry of Health and Long-Term, the Ontario Ministry of Agriculture, Food and Rural Affairs, and Health Canada. These agencies carry-out provincial and federal food safety and health mandates and enforce applicable legislation. Based on known illness associated with consumption of unpasteurized milk, the United States Food and Drug Administration, the United States Centres for Disease Control and Prevention, the Canadian and American Medical Associations, the American Academy of Paediatrics, the Ontario Public Health Association, the American Public Health Association, the American Veterinary Association, The International Association for Food Protection, and the World Health Association all recommend against the consumption of raw milk (Canadian Medical Association Journal, 2007; United States Food and Drug Administration, 2010b; Oliver et al., 2009; Ontario Public Health Association, 2010). Given their food safety and health mandates, these agencies would be expected to have a bias towards supporting pasteurization. However, this bias is supported by scientific evidence, such as repeated identification of pathogenic organisms in unpasteurized milk as well as numerous outbreaks that have been either epidemiologically linked to consumption of unpasteurized milk or that have been proven to be linked through laboratory analysis of samples. Furthermore, these agencies employ experts in the fields of medicine, public health, epidemiology, food safety, nutrition and control of infectious disease. Core competencies and work-related education are requirements for staff employed in these agencies.

The position of the above agencies is supported by the National Environmental Health Association (NEHA) in their position paper which highlighted the risks associated with consumption of unpasteurized milk. The paper was published in the Journal *of Environmental*

Health, which is a peer reviewed journal written for public health professionals. The paper cites government agency studies and investigations outlining the risks associated with unpasteurized milk. Given these qualities, the NEHA position paper is biased towards banning the sale and distribution of unpasteurized milk in the United States, however, this position is based in epidemiological studies and scientific knowledge. Potter et al., (1984) and Oliver et al., (2005; 2009) published articles in two peer-reviewed journals, the *Journal of the American Medical Association* and *Foodborne Pathogens and Disease*, respectively. These three articles support pasteurization and warn against consumption of raw milk. The authors of these articles are faculty at post-secondary educational institutions, physicians and veterinarians and as such are content experts.

The Ontario Ministry of Health and Long-Term Care provides information on the types of pathogenic organisms that have been identified in raw milk. This information is supported by the United States Centres for Disease Control and Prevention (CDC) as well as the United States Food and Drug Administration (FDA) and the New York City Department of Health and Mental Hygiene. The United States CDC falls under the Department of Health and Human Services and carries-out America's federal public health mandate. As part of their duties, CDC publishes the *Morbidity and Mortality Weekly Report* (MMWR) which is a scientific publication written for medical and public health professionals as a weekly update of disease outbreaks and trends. Qualified staff at local public health agencies, such as the New York City Department of Health and Mental Hygiene and Boulder County Public Health, carry-out outbreak investigations and communicate relevant findings.

These inventories of raw milk associated pathogenic organisms are supported by the Canadian Medical Association in *The Canadian Medical Association Journal* (2007), Lejeune

and Rajala-Schultz in their article published in the journal of *Clinical Infectious Diseases* as well as Headrick et al., in their article published in the *American Journal of Public Health* and Oliver et al., (2005 and 2009) in their articles published in *Foodborne Pathogens and Disease*. All of these journals are peer-reviewed journals which publish articles that are intended for an audience of medical and public health professionals. Authors of the article are doctors of veterinary medicine, hold masters in public health and/or are physicians. Due to their educational background and filed expertise, these individuals are well qualified to conduct a review of raw-milk associated outbreaks. The articles were written in a factual and scientific manner. Headrick et al., (1998) concluded that an in intra-state ban on the sale and distribution of unpasteurized milk in the United States of America is warranted based on the epidemiological evidence collected as part of their research.

Oliver et al., (2009) found that the number of individuals consuming raw milk is increasing. The authors then go on to provide strategies that may reduce the risk of exposure to pathogenic organisms in areas where the sale of raw milk is legal (Oliver et al., 2009). The authors are faculty at the University of Tennessee, Cornell University and California State Polytechnic University and the article is published in *Foodborne Pathogens and Disease* which is a peer-reviewed journal. The article was written in a professional and unbiased manner as it focuses on risk reduction rather than legislation banning the sale of raw milk.

Groups that advise that the nutritional content, flavour, or quality of milk are not significantly affected by the pasteurization process include the Ontario Ministry of Health and Long-Term Care, the Ontario Ministry of Agriculture, Food and Rural Affairs, as well as the United States Food and Drug Administration which holds the American mandate for nutrition and food safety. Statements made by these groups warning against consumption and

unpasteurized milk and advising that there is no significant difference in the nutritional value or quality of pasteurized versus raw milk, are supported by articles published in peer-reviewed journals such as the article written by LeJeune & Rajala-Schultz which was published in the journal of *Clinical Infectious Diseases*. The article written by Doctor LeJeune & Doctor Rajala-Schultz was scientifically written in an unbiased manner. The authors are employed at the Food Animal Health Research Program, Ohio Agricultural Research and Development Centre, and the Department of Veterinary Preventative Medicine, College of Veterinary Medicine, Columbus, Ohio and are content experts.

Internet sites written by raw milk advocates sound scientific and support statements made on other internet sites authored by similar groups; however, these groups not provide proof to back their claims. Many of the claims made on these websites are contradicted by the government publications and peer-reviewed journal articles listed above. The author of the Raw Milk Facts website lists himself as a Nutrition Consultant and states in a disclaimer on the website that he is not a medical professional and to take what you learn from the site with caution.

The Natural Milk website has posted a report from the Association of Unpasteurized Milk Producers & Consumers which is written by Dr. B. M. Pickard of the Department of Animal Physiology and Nutrition at the University of Leeds located in the United Kingdom. However the claims listed in this paper are contradicted by the government agencies and peer-reviewed journal articles listed above. Furthermore, peer-reviewed journal articles could not be located which supported any of Pickard's claims.

Sellers et al., (2008) found that there was no correlation between consumption of unpasteurized milk and subsequent development of cancer. The study was published in *Cancer Causes Control*, which is a peer-reviewed journal. A limitation of the work done by Sellers et al., (2008) was that the data used in the study, which was collected as part of the Iowa Women's Health Study, did not differentiate the species of animal from which the unpasteurized milk came from (Sellers et al., 2008). Another limitation was that self-reported consumption may have occurred as far as 50 years in the past, contamination of the consumed milk could not be confirmed (Sellers et al., 2008). One of the strengths of the study conducted by Sellers et al., was that it was based on data collected through a large prospective cohort study and that the self-reported consumption of unpasteurized milk was collected prior to a cancer diagnosis (Sellers et al., 2008). Data on other risk factors for cancer was also available enabling Sellers et al., (2008) to adjust for a large number of confounding variable (Sellers et al., 2008).

Perkin (2007), Reidler et al., (2001) and Waser et al., (2006) all found a protective effect of consumption of unpasteurized milk on allergic conditions. Perkin's study was written in an unbiased format and was published in *Clinical and Experimental Allergy* which is a peer reviewed journal. Dr. Perkin is a faculty member in the Division of Community Health Sciences at St. George's University of London and as such is a credible source for such information. A limitation of the study conducted by Reidler et al., (2001) is that the study could be subject to recall bias, as researchers gathered information on exposures during the first year of lift retrospectively (Riedler et al., 2001). Strengths of this article are that is was published in the *Lancet*, which is a peer reviewed journal. Researchers made efforts to account for confounding factors. Centrally-trained field staff conducted in-person interviews. Statistical analysis was performed on the data. A relatively large sample size was used. Researchers are all medical

doctors or faculty at post-secondary institutions and as such are credible sources for this information.

Waser et al., (2006), based their scientific study on large sample size and the article was written in an unbiased format. The article was published in *Clinical and Experimental Allergy*, which is a peer-reviewed journal. The authors are medical professionals and researchers suited to providing this type of information.

Perkin (2007) and Waser et al., (2006), recommended that additional research be conducted in order to determine what components of farm milk provide this protective effect and determine a means of ensuring a safe product that still retains theses beneficial properties.

Sources of Ontario provincial legislation including the *Health Protection and Promotion Act*, the *Food Premises Regulation*, the *Smoke-Free Ontario Act*, the *Highway Traffic Act*, and the *Milk Act* were obtained from Service Ontario e-Laws which is the official website site for Ontario's provincial legislation and therefore a credible sources for this information. Canada's *Food and Drug Regulations* were retrieved from the Department of Justice Canada Justice Laws web site which is a credible source for this information.

Information surrounding the legislation addressing the sale of unpasteurized milk in Australia and England was collected from the Commonwealth of Australia's and the United Kingdom's official websites. Information collected on the milk legislation of various states in the United States of America was retrieved from the respective state's official website (Nebraska, Kentucky, Nevada, Delaware, and Washington) which are reputable sources for this information.

Court manuscripts were taken from the Canadian Legal Information Institute (CanLII) website which is managed by the Federation of Law Societies of Canada. This site is supported by the Ontario Court of Justice as well as the Supreme Court of British Columbia.

Information regarding Canada and democracy and the Canadian Charter of Rights and Freedoms was taken from the Canadian and United States federal websites which are direct sources for such information.

Information regarding ethical principles was taken from Holland and supported by Mill, Beauchamp and Childress as well as Lyren and Leonard as cited in Holland (2007). Holland is the author of a published book used in post-secondary institutions. Holland has written articles for peer-reviewed journals such as *Public Health Ethics* and is a faculty member of the Department of Philosophy at the University of York in the United Kingdom. Holland would be considered to be a credible source for ethics-related information.

Nesbitt et al., (2009) found that raw milk drinkers tended to have less formal education and live in rural environments and that these individuals chose to consume the product despite having knowledge of the associated risks. Oliver et al., (2005) supported the findings of Nesbitt et al., (2009), in regards to education level of raw milk drinkers. Nesbitt et al., (2009) recommended that targeted education programs be given as a means of better educating the public and farmers about the true risks associated with drinking unpasteurized milk. The article by Nesbitt et al., (2009) was published in the *Journal of Food Protection*, which is a peer-reviewed journal. The article was written by staff from the Ontario Veterinary College, Public Health Agency of Canada, Faculty of Veterinary Medicine at the University of Calgary, region of Waterloo Public Health who are all qualified content experts. The authors admit that they did

rely on self-reported behaviours, and therefore reporting may have been biased towards socially desirable responses (Nesbitt et al., 2009).

The findings of Nesbitt et al., (2009) are supported by Young et al., (2010) who found that dairy farmers were more likely to support the consumption of unpasteurized milk, however support for pasteurization increased following food-safety education. All Canadian dairy farmers registered with dairy herd-improvement organizations were eligible to participate in the study (Nesbitt et al., 2009). This group represented approximately 75 percent of all dairy producers in Canada, with a response rate of 20.9% (Nesbitt et al., 2009). However, as only registered dairy farmers were included in the study, this could result in selection bias as farmers who would undergo voluntary registration in an organization that held them to a higher standard than was legislated may not represent the entire population of dairy farmers. Study was scientific in nature and the researchers conducted questionnaire validation and statistical analysis of findings. Young et al., published their article in *Preventive Veterinary Medicine*, a peer reviewed journal. The authors are faculty at post-secondary institutions including University of Guelph as well as Public Health Agency of Canada and are therefore content experts.

Conclusion

The raw milk debate has been ongoing for at least a century (Potter et al., 1984). In this time period the "theoretic health benefits of raw milk have never withstood careful scientific scrutiny" (Potter et al., 1984). However, scientific evidence has repeatedly proved that raw milk can be a vehicle for the transmission of pathogenic organisms on to humans (Canadian Medical Association, 2007; Haugh, 2010; Oliver et al., 2009; Potter et al., 1984). The United States Food and Drug Administration states that "raw milk, no matter how carefully produced, may be unsafe" (2010a). The United States Food and Drug Administration warns that "raw milk is inherently dangerous and it should not be consumed by anyone at any time for any purpose" (United States Food and Drug Administration, 2010a).

Raw milk advocates claim that "pasteurization is not the universal solution" to ensuring that milk is safe for public consumption (Natural Milk, 2010). They go on to state that unpasteurized milk can be as, if not more, safe than the pasteurized product and that rather than banning the sale of unpasteurized milk, the government should focus on reducing or eliminating disease in cattle and enabling milk producers to properly self-govern, thereby ensuring that bacterial levels in unpasteurized milk are low (Natural Milk, 2010). Raw milk advocates suggest that routine bacteriological testing of raw milk would ensure that the product is safe for human consumption (Oliver et al., 2009). However, bacteriological testing is expensive and it would be impractical from an operations standpoint to sample every batch of milk. In addition, testing can result in false negatives, as a negative sample does not ensure that the organism is not present in the larger batch (Oliver et al., 2009). Therefore, testing could not replace pasteurization as a means of ensuring product safety (Oliver et al., 2009).

Numerous outbreaks have demonstrated that raw milk collected using hygienic practices may still be contaminated with pathogenic organisms (CDC Morbidity and Mortality Weekly Report, 2007). Practices such as hand washing, maintaining equipment in a clean and sanitary manner, and maintaining a separate milking area, can reduced the potential that milk will become contaminated, however, regardless of how stringent there practices are, they will not eliminate the risk (CDC Morbidity and Mortality Weekly Report, 2007). Oliver et al., admit that further research is needed in order to identify on-farm factors that can lead to pre-harvest and post-harvest contamination and state that identification of risk factors and subsequent corrective action would be beneficial; however elimination of these risks would be difficult (2009). The Infectious Disease Society of America advises that "pasteurization remains the best way to reduce the unavoidable risk of contamination" (2009; Oliver et al., 2005). Oliver et al., state that the most essential component of reducing the risk associated with raw milk is education regarding the risks of consuming the product (Oliver et al., 2009).

It has been found that rural residents, particularly farm families, are the most likely drinkers of raw milk (Headrick et al., 1997; Nesbitt et al., 2009; Oliver et al., 2005). Rural residents have also been found to be highly aware of milk-borne pathogens (Nesbitt et el., 2009). Rural residents likely drink unpasteurized milk, despite being aware of the risks of doing so, due to accessibility, reduced cost, traditional practice, confidence in the health of their herd, and a belief in acquired immunity (Nesbitt et al., 2009; Oliver et al., 2005). It was also found that once dairy farmers were educated about food-safety and the true risks of consuming unpasteurized milk, that their support for pasteurization of milk increased (Young et al., 2010). Nesbitt et al., advised that in order for educational programs to be effective, that they had to target specific audiences (2009). Educational campaigns should target farm families and other rural families in

order to better inform drinkers of unpasteurized milk of the risks associated with the consumption of the product and to dispel any misconceptions associated with raw and pasteurized milk (Oliver et al., 2005). Dairy farmers and staff require education surrounding the risks and liabilities associated with the sale of unpasteurized milk (Oliver et al., 2009). Policy makers require education about the importance of uniform legislation (Oliver et al., 2009). A combination of all of these educational activities would reduce the risk associated with raw milk consumption; however it would not eliminate the risk (Oliver et al., 2009). Pasteurization is the single most effective means of reducing the bacterial load in milk (LeJeune & Rajala-Schultz, 2009).

The rationale behind banning the sale and distribution of raw milk in Ontario and in Canada is that unpasteurized milk is a known health hazard (Ontario Ministry of Health and Long-Term Care, 2008a). It could be argued that the *Health Protection and Promotion Act* and the *Milk Act* are unjust as many other substances, including tobacco, are known health hazards and are legal in this country. It should be considered however, that the *Smoke-Free Ontario Act* is increasingly placing tighter restrictions on the display and sale of tobacco products. Had the sale and distribution of tobacco products not been legalized years ago, it is questionable if tobacco would be legalized in the current political and legal environment.

Autonomy is defined as 'at a minimum, self-rule that is free from both controlling interference by others and from limitations, such as inadequate understanding, that prevent meaningful choice' (Beauchamp and Childress, 2001 as in Holland, 2007, p.26). Potter et al., (1984) state that arguments surrounding the legalization of the sale of raw milk are often based on freedom of choice; however a major feature of freedom of choice is informed consent. According to Potter et al., "incorrect information on the purported benefits of drinking raw milk

is so widespread that truly informed consent is difficult to achieve" (1984). Furthermore, children of raw milk advocates are exposed to the risks of raw milk without themselves having an understanding of the risks (Potter et al., 1984).

Autonomy is extremely important, however, given the proven risk that raw milk poses to the individual, their children and the public at large, our provincial and federal governments are ethically justified, under the principles of Beneficence and Non-Maleficence as well as the Harm Principle, in prohibiting the sale and distribution of raw milk.

Groups and individuals warning against the consumption of raw milk and who support the pasteurization of milk, include government agencies, public health professionals, faculty at post-secondary educational institutions, physicians and veterinarians. Proponents of raw milk tend to support one-another's claims; however, no scientific evidence is available to support their allegations. Furthermore, the claims made by raw milk advocates are often contradicted by information provided by the above noted groups who warn against the consumption of raw milk. Based on the credentials of the authors and the scientific evidence provided to support their claims, the argument supporting pasteurization and the ongoing ban on the sale and distribution of unpasteurized milk is more persuasive.

Public health efforts should focus on the development and delivery of targeted education campaigns that better inform farmers and the public of the risks of consuming raw milk and the scientific evidence surrounding pasteurized and unpasteurized milk. Increased research is needed in order to determine what components of raw milk provide for a protective effect in farm children. Once these components are identified, further research is needed in order to determine how to preserve these factors, while maintaining a pathogen-free product.

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