

Raw Milk FAQs

Mike Schutz, Extension Dairy Specialist, Department of Animal Sciences, Purdue University
Mike Ferree, Agriculture and Natural Resources Educator, Bartholomew County, Purdue University

Currently, Indiana is one of 20 states that does not allow the sale of raw milk for human consumption. The term “raw milk” means milk that has not been pasteurized.

The process of heating consumable liquids to reduce bacterial pathogens was developed 150 years ago in April 1862 by Louis Pasteur and Claude Bernard, who tested the process to increase the length of storage time. Eventually, this process became known as pasteurization. Today, pasteurization most often is recognized for its use with milk, a process first suggested by Franz von Soxhlet in 1886. No single process has done more to prevent tuberculosis and brucellosis transmission in humans; and pasteurization remains an effective method to reduce the risk of foodborne illness from dairy products.

All milk that is sold across state lines is governed by the Pasteurized Milk Ordinance (PMO) of the U.S. Food and Drug Administration. All milk sold through interstate commerce for fluid consumption must be produced under PMO Standards (2011 revision, FDA) and be pasteurized or delivered as raw milk to a plant where it will be pasteurized. Within states, legislatures may provide opportunities for sales to consumers within those states. Thirty states presently allow legal sales of unpasteurized milk to consumers, although the rules governing those sales are widely different.



Unpasteurized milk is acquired for personal use by some consumers in Indiana through obtaining milk from cows they “own,” or by purchasing milk that is designated only for use as animal or pet food. Some dairy cows are wholly or partly owned by consumers who have arranged “cow share” agreements with dairy producers to care for and milk cows for them. While cow share arrangements have not been tested in Indiana courts, the FDA views them as a murky legal area, because they are not included in the legal code in most states. In Indiana, farms selling unpasteurized milk or other processed dairy products as pet food or animal feed must be licensed by the Office of the Indiana State Chemist to produce animal feed. Milk produced for cow share purchasers or sold as animal feed has at least as high a risk of carrying pathogenic bacteria as raw milk intended for pasteurization.

During the 2012 session of the Indiana General Assembly, an amendment to Senate Bill 398 was introduced to allow the sale of milk in Indiana from any dairy farm with 20 or fewer cows. While the amendment passed in the Senate, the bill was withdrawn and replaced by House Bill 1129. As a result of the legislation, the Indiana Board of Animal Health is to study the issue of whether a program can be developed to decrease the risk of allowing consumers to purchase raw milk.

A report of their findings will be provided to Indiana legislators by Dec. 1, 2012.

Unpasteurized milk is being debated at the national level, too. During a U.S. Senate debate on the Farm Bill in the summer of 2012, Sen. Rand Paul, R-Ky, offered an amendment to the Federal Agriculture Reform and Risk Management Act (FARRM) to eliminate the “mandatory pasteurization for all milk and milk products in final package form intended for direct human consumption.” This would have discontinued requirement of pasteurization of all interstate milk shipments for sale directly to the consumer. The amendment was not included among those debated on the Senate floor and, thus, not in the final bill that was passed.

The purpose of this publication is to provide answers to some frequently asked questions on pasteurization and unpasteurized milk, and its safety.

1. What is pasteurization?

The process of pasteurization involves heating every particle of milk for a specific period of time to inactivate bacterial pathogens. Pasteurization dramatically reduces the number of pathogens, but does not sterilize the milk. A number of heat-tolerant (non-pathogenic) and spore-forming bacteria can survive pasteurization. The cooler the pasteurization temperature, the longer the milk must be held at that temperature to adequately inactivate bacterial pathogens. Vat or batch pasteurization requires milk to be raised to 145° Fahrenheit (F) for 30 minutes and agitated, to ensure uniform temperature of all milk in the vat. Batch pasteurization is common for small-scale dairy processors.



Vat pasteurization carries with it the additional challenge of rapidly cooling the milk again following pasteurization.

Most milk bottlers use high-temperature, short-time pasteurization, which requires every particle of milk be heated to 161°F and held at that temperature for no less than 15 seconds. This results in the destruction of most bacterial pathogens, while largely protecting milk proteins from degradation. Ultra-pasteurized refers to milk heated to at least 280°F for not less than two seconds. Ultra-pasteurized milk has been sold in the U.S. and Europe, and when combined with aseptic bottling can eliminate the need for refrigeration prior to opening the container. Common temperature and time combinations for pasteurization include:

Temperature	Time
145°F	30 minutes
161°F	15 seconds
191°F	1 second
194°F	0.5 second
210°F	0.1 second
204°F	0.05 second
212°F	0.01 second

2. Why is pasteurization used for milk?

While milk normally does not harbor harmful bacteria it can become contaminated, even under very hygienic conditions, particularly given the nature of dairy farms and processing equipment. Because milk is an excellent growth media, pathogens can multiply rapidly, especially if milk is not immediately or adequately cooled. Some zoonotic diseases (ones transmitted from animals to humans) can be transmitted into milk by ill cows. Other bacterial pathogens can contaminate the milk as it leaves the cow, from contaminated equipment, dirt or manure entering the milking equipment, or during storage. Pasteurization provides a critical step to ensure the safety of milk drinkers by drastically reducing the number of pathogenic bacteria present: *Mycobacterium tuberculosis* (tuberculosis), *Brucella melitensis* (brucellosis), *Coxiella rickettsia* (Q-fever), *Salmonella*, *Yersinia*, *Toxoplasma*, *E. coli* O157:H7, *Campylobacter*, *Listeria monocytogenes*, *Cryptosporidia*,

Staphylococcus and Streptococcus. Proper handling of milk and keeping it cold are critical to maintaining quality of milk, even when pasteurized.

3. Is milk altered by pasteurization?

In a word, yes. Milk must be heated to a temperature at which some changes to protein molecules begin to occur. This is expected, as the damage to proteins is necessary to inactivate harmful bacteria. Indeed, the degradation of an enzyme, alkaline phosphatase, that is present in all unpasteurized milk samples is one of the key measures of the effectiveness of pasteurization. However, research has proved that pasteurization does not degrade the healthful benefits of milk. Among the milk components are the following (adapted from Jeff LeJeune, DVM, Ph.D., Dipl. ACVM, Ohio Agricultural Research and Development Center):

- Bovine lactoferrin from pasteurized milk has similar antibacterial properties to that from unheated milk.
- Lactoperoxidase retains 70 percent activity when heated to 161°F for 15 seconds, with further decreases in activity as the temperature is increased.
- Lysozyme (bactericide) lysozyme will survive at 176°F for 15 seconds.
- Bovine immunoglobulin has no loss in activity when held for 30 minutes at 145°F, and retains more than 59 percent of activity after high-temperature, short-time pasteurization.
- Lactose (milk sugar) concentration is not changed by pasteurization.
- Caseins' and whey proteins' nutritive values are largely unaffected by pasteurization.
- Fat soluble vitamins A, D, E and K are not appreciably affected by pasteurization.
- Vitamin C, which is very low in cow's milk, may be reduced up to 10 percent by pasteurization.
- Bacteriocins are heat stable and remain active following pasteurization.
- Oligosaccharides are heat stable.



- Xanthine oxidase, an enzyme linked with flavor, retains enzymatic activity after 50 seconds at 176°F.

4. Does pasteurization kill milk?

Proponents of unpasteurized milk often claim that pasteurization “kills” milk. But obviously milk is not a living thing. What they are referring to is that pasteurization kills beneficial bacteria in milk. It is true that some bacteria are present in milk, such as *Lactobacillus* species, and that those bacteria may aid in the digestion of lactose. However, those bacteria are generally not present in cow's milk before it exits the udder. Thus, it arises from post-milking, unintentional contamination of the milk. If milk is contaminated by beneficial bacteria, it also may be contaminated by harmful bacteria. Beneficial bacteria can be added back to milk in cultured dairy products. For example, yogurt is produced through the culturing of milk with pure cultures of beneficial bacteria (e.g., *Lactobacillus delbrueckii* subspecies *bulgaricus* and *Streptococcus thermophilus*) and provides a safer source of bacteria with probiotic properties.

5. What risks are associated with drinking unpasteurized milk?

Clearly, the risks of unpasteurized milk consumption are in the possible contraction of the diseases mentioned above. Most of the time risks from consumption of unpasteurized milk are not great, but the health consequences if one contracts the disease can be very serious, or even fatal. There is no doubt that pasteurization reduces the risk. While there have been outbreaks of disease from pasteurized dairy products that were recontaminated or not properly pasteurized, the number of such occurrences is far, far less in proportion to the amount of milk consumed as pasteurized versus non-pasteurized. Furthermore, many environmental factors influence the risk that milk may be contaminated, and these vary greatly from farm to farm, and week to week on any given farm.

6. Can I continue to drink unpasteurized milk if I grew up on unpasteurized milk?

It is true that many dairy farm children drink unpasteurized milk at home. By and large, farm children who consume unpasteurized milk are exposed to similar risks as anyone else consuming unpasteurized milk. However, raw milk tends to be



consumed more quickly on the farm and therefore provides less incubation time for bacteria. It is possible that repeated exposure to low levels of some bacteria may build immunological resistance, but a sudden occurrence of new pathogenic bacteria may still result in disease, especially during times of reduced immunological health. In one 2012 E. coli O157:H7 outbreak in Oregon, among the 21 individuals who took ill were four children from the farm on which the milk was produced. As mentioned, it is typical that when milk is readily available on the farm, it is consumed very quickly — even the same day — limiting the opportunity for bacteria to multiply. Thus, the sale of milk to consumers carries more control points at which risks of bacterial contamination and growth can occur, compared to on-farm consumption. Moreover, many dairy farm families pasteurize the milk they consume at home.

7. What is the difference between pasteurization and homogenization?

Pasteurization is the process of heating milk briefly to eliminate bacterial pathogens, while homogenization is the process of forcing the milk

at high pressure through small holes to break up the fat globules so the fat is evenly dispersed in the milk and does not separate. In bottling plants, these steps usually are done in sequence, since the milk is warmed from pasteurization, making homogenization more efficient. It is possible for consumers to buy pasteurized, non-homogenized milk. Often this is referred to as “cream-line” milk, because of the layer of cream that rises to the surface when the milk stands in the refrigerator.

8. Can I make butter, cheese and ice cream with pasteurized milk?

Yes. A major part of the reason that it is difficult to make products at home from pasteurized milk is that pasteurization most often is accompanied by homogenization in purchased dairy products. The disruption of the fat globule that allows uniform dispersion of butterfat throughout the milk makes it very difficult to churn butter and make some kinds of cheese. However, most cheese, butter and other products available for purchase in stores are made with pasteurized milk and cream.

9. Can I buy any products made with unpasteurized milk?

Yes, certain kinds of unpasteurized milk cheese can be sold directly to consumers if it has been aged at least 60 days. This is allowed by FDA rules because if the cheese is properly cured, the bacteria arising from the cheese cultures in the presence of proper salinity and acidity will out-compete, and essentially eliminate, pathogenic bacteria such as *Listeria monocytogenes*, *Salmonella* and *E. coli*. Nevertheless, there have been recalls of unpasteurized milk aged cheese because of the presence of such bacteria as *Staphylococcus aureus* and *Listeria monocytogenes*.



10. Are there beneficial characteristics or properties of unpasteurized milk?

There have been many claims about healthful benefits of unpasteurized milk, but most are anecdotal and not backed by controlled studies. Recently, the European GABRIELA study deter-

mined that consumption of non-boiled farm milk by farm children resulted in fewer cases of asthma and hay fever than among those children who consumed boiled farm milk. The study concluded that a protective effect of unpasteurized milk might be associated with the whey protein fraction of the unpasteurized milk. It must be pointed out that the study was not designed to control for any other factors that might have affected development of allergies, such as the amount of animal or dairy cattle exposure. The study did not attempt to compare the relative reduction of allergy incidence — if any relationship is verified in subsequent properly controlled studies — versus the inherent risk of consuming unpasteurized milk. Furthermore, the vast majority of pasteurized milk consumed is pasteurized at temperatures well below boiling, and therefore subject to less protein degradation. At the very least, it remains unclear whether any possible benefits of unpasteurized milk consumption could outweigh the very real risks of contracting disease from its consumption.



11. Are greater risks associated with drinking unpasteurized milk?

Yes. From 1993 to 2006 in the U.S. there were 121 outbreaks of dairy-associated disease for which the pasteurization status was known. During that time there were 73 outbreaks (60 percent) from non-pasteurized products, resulting in 1,571 cases, 202 hospitalizations and two deaths. Of those outbreaks, 75 percent occurred in states that allowed sales of non-pasteurized milk. However, the number of outbreak-related illnesses was 150 times greater for non-pasteurized versus pasteurized products, and disproportionately affected persons under 20 years of age. States that restricted sales had fewer outbreaks and illnesses (*Emerging Infectious Diseases*, 2012). In the first four months of 2012 there have been six outbreaks of disease in the U.S. associated with raw milk, resulting in 152 illnesses, mostly involving *Campylobacter*.

12. Should Purdue Extension support legalizing unpasteurized milk sales in Indiana?

Purdue Extension is committed to doing all it can to promote the safety of milk and dairy products. At present, pasteurization remains the best way to ensure the safety of milk products. Pasteurization has been very successful in accomplishing this for decades. The rate of foodborne illness from unpasteurized milk and dairy is much higher than from pasteurized milk and dairy. If sales of unpasteurized milk are permitted in Indiana, renewed focus should be on educating consumers about pasteurization; the very real disease risks of consuming unpasteurized milk; and how to properly handle milk, whether pasteurized or not. Further, efforts to assist

sellers of unpasteurized milk to comply with regulations and understand their legal obligations and financial risks, also should be undertaken.

13. If sales of unpasteurized milk are permitted in Indiana, should they be allowed only at the farm on which the milk is produced?

The very short shelf life of unpasteurized milk does not lend itself well to the more lengthy period of transporting the product to a retail location and holding it there until it is sold. Therefore, if unpasteurized milk sales are permitted, despite the risks, sales of milk should be restricted to the farm on which the milk is produced. Restricting sales only to the farm premises 1) encourages the buyer to be aware of the general conditions under which the milk is produced; 2) reduces the number of individuals handling the milk and limits responsibility for its care to the producer and final consumer; 3) decreases the possibility that a consumer would purchase unpasteurized milk believing it to be pasteurized; 4) incentivizes farmers who sell unpasteurized milk to maintain high production standards for their visiting customers; and 5) supports the concept and practice of local food production.

14. What rules should be in place to safeguard the public if unpasteurized milk sales are legalized in Indiana?

While no rules will be able to ensure safety of consumers as well as pasteurization, there clearly is demand for unpasteurized milk by consumers in Indiana, as evidenced by the listing of cow share programs and availability of a wide range of dairy products sold as “pet food” at farmers markets. Some degree of third party oversight of dairy operations would provide improved assurance, compared to the present situation of no oversight of cow share and “animal feed” or “pet food” sales of unpasteurized milk. As a starting point, farms selling unpasteurized milk should exceed the safety standards for production of Grade A milk that is intended to be pasteurized. Among the goals should be rapid cooling of milk to 40 degrees or less; use of glass, impermeable plastic or stainless steel equipment; sanitizing of equipment; milk sold within 48 hours after milking; minimum standards for bottling and capping; specific labeling statements; standards for allowable single-use containers; standards for milk bacteria, coliform bacteria and somatic cell counts; routine animal health testing for Tuberculosis, Brucellosis, and Streptococcus infections; weekly testing of milk for Campylobacter, Salmonella, Listeria, and E. coli O157:H7; and, as with all milk, antibiotic residue testing of every batch and aflatoxin testing when needed. But even these steps cannot reach the measure of safety provided by pasteurization.

15. Given that cigarettes and alcohol are legal for adults and both contain considerable health risks, why shouldn't unpasteurized milk be legal as well?

This is not an apples to apples comparison. Milk is available for purchase and even home delivery.

With cigarettes and alcohol, there are many standards in place to help with consumer safety. These include requirement of licenses for alcohol sales, warning labels, cigarette filters, standards of nicotine and alcohol content, no sales to minors, legal limits for blood alcohol for driving, protection of individuals from second-hand smoke, banning of flavoring of cigarettes to allure first-time smokers, etc.

16. Are the risks of raw milk consumption equivalent for all population groups?

No. Those with weakened immune systems are at greatest risk. For instance, the young, old, ill, those on chemotherapy or certain kinds of medication, and those taking immunosuppressant drugs are generally at greater risk for bacterial infection. Unfortunately, with unpasteurized milk those with the weakest immune systems — the very young, elderly and those with health issues — often are not in a position to make their own informed decisions about consumption of unpasteurized milk. Milk enjoys a long reputation as a wholesome and healthful product, and any decision to dramatically increase the risk associated with a product currently considered safe should not be taken lightly.



17. If unpasteurized milk is legalized, should children be allowed to consume it?

A better question is “Is unpasteurized milk safe for children?” Keep in mind that young children often do not have a mature immune system and, therefore, often are most at risk for becoming severely ill from foodborne pathogens. Pasteurized milk is clearly safer for children to consume.

18. In the unpasteurized milk debate, which is the highest priority: personal liberty or public safety?

Both are important, and both must be considered during any discussion about measures to protect public safety. Ultimately, it will be left to the state legislature to decide whether permitted sales of unpasteurized milk will be made available to consumers in Indiana. A certification program with animal health, milk handling and sanitation standards can at best somewhat mitigate a known health risk that has been very effectively reduced by the time-tested process of pasteurization.

Links

The following links are provided as examples of information about unpasteurized milk available to the public online. Accuracy of information on these sites is not guaranteed by Purdue University Cooperative Extension Service.

Pasteurized Milk Ordinance:
www.fda.gov/downloads/Food/FoodSafety/Product-SpecificInformation/MilkSafety/NationalConferenceonInterstateMilkShipmentsNCIMSMoelDocuments/UCM291757.pdf

A Campaign for Real Milk (Weston A. Price Foundation) www.realmilk.com

Centers for Disease Control and Prevention; “Raw (Unpasteurized) Milk”:
www.cdc.gov/features/rawmilk

Real Raw Milk Facts www.realrawmilkfacts.com

Nov. 2012

It is the policy of the Purdue University Cooperative Extension Service that all persons have equal opportunity and access to its educational programs, services, activities, and facilities without regard to race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability or status as a veteran.

Purdue University is an Affirmative Action institution. This material may be available in alternative formats.