FSE-3-05

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Extension FactSheet

Food Science and Technology, 2015 Fyffe Road, Columbus, OH 43210-1007

Health Benefits, Risks, and Regulations of Raw and Pasteurized Milk

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Milk from healthy cows contains relatively few bacteria (10^2–10^3 /ml), and the health risk from drinking raw milk would be minimal. However, milk is a natural food that has no protection from external contamination and can be contaminated easily when it is separated from the cow (Rosenthal, 1991). Raw milk normally has a varied microflora arising from several sources, such as the exterior surfaces of the animal and the surfaces of milk handling equipment such as milking machines, pipeline, and containers (Burton, 1986). Therefore, milk is susceptible to contamination by many pathogenic microorganisms, which result in infection and threat to consumer's health. Additionally, there is the potential that disease of cows such as tuberculosis, brucellosis, typhoid, and listeriosis can be transmitted (Spreer, 1998). The average standard plate counts (SPC) for can and bulk milk are ~700,000 bacteria/mL and ~100,000 bacteria/mL respectively, depending on temperature and handling conditions. The microbial standards for grade "A" raw milk are 100,000 bacteria/mL, for individual producer milk, 300,000 bacteria/mL, as commingled milk, 75,000 cells/mL as somatic cell count (SCC) (PMO, 2001). These standards are the maximum allowed and most dairy producers provide milk with concentrations considerably below the maximum allowable limits. Another indicator of milk quality is the preliminary incubation count (PI) with a maximum allowable count of 100,000 bacteria/mL on load, storage tank, or individual producer samples, although results of 25,000 bacteria/mL or less are desirable (DPC, 1997). Milk can be classified as a potentially hazardous food if it is not properly processed, handled, or stored.

Raw milk has been, and continues to be, a staple in the epidemiological literature; it has been linked to campylobacteriosis, salmonellosis, tuberculosis, brucellosis, hemorrhagic colitis, Brainerd diarrhea, Q fever, listeriosis, yersiniosis, and toxoplasmosis to name a few (Plotter, 2002). Outbreaks associated with the consumption of raw milk routinely occur every year. In 1995, the Center for Food Safety and Applied Nutrition and the U.S. Food and Drug Administration published guidelines that established a list of pathogen organisms transmitted through raw milk and milk products, such as *Salmonella* spp., *Staphyloccocus aureus, Campylobacter jejuni, Yersina enterocolitica, Listeria monocytogenes, Escherichia coli* (both enterotoxic and enteropathic), *E. coli 0157: H7, Shigella* spp., *Streptococcus* spp., and Hepatitis A virus. Among the fifty states and Puerto Rico, twenty-four states, including Ohio, do not permit the sale of raw milk directly to the consumer. Twenty-seven states permit the sale of raw milk for human consumption either at the farm where produced, in retail outlets,

or through cow-share agreements. Twenty-nine states have recorded foodborne outbreaks traceable to raw milk consumption (NASDA, 2004).

Pasteurization is a thermal process widely used in the food and dairy industry with the objective of minimizing health hazards from pathogenic microorganisms and to prolong product shelf life. There are several temperature-time combinations to pasteurize milk that range from 63°C (145°F)/30 minutes or 72°C (161°F)/15 seconds to 100°C (212°F)/0.01 seconds. The bacteria standards for Grade "A" pasteurized milk are 20,000 bacteria/mL and <10 coliform/mL (PMO, 2001). Heat may denature milk proteins. This effect is not considered a disadvantage from the nutritional point of view because it only involves changes in the specific arrangement of the casein protein. There is no breakdown of peptide linkages; therefore, casein can be considered a thermal-resistant compound. Although α-lactoalbumin is relatively heat stable, other whey proteins can be denatured as a result of heating. These denatured proteins are more digestible than their naturally occurring form because the protein's structure is loosened and enzymes can act easier (Renner, 1986). Pasteurization does not impair the nutritional quality of milk fat, calcium, and phosphorus (Beddows and Blake, 1982). Pasteurization temperature does not affect fat-soluble vitamins (A, D, and E), as well as the B-complex vitamins riboflavin, pantothenic acid, biotin, and niacin. The losses of vitamins, such as thiamin (<3%), pyridoxine (0–8%), cobalamin (<10%), and folic acid (<10%) are considered lower than those that take place during the normal handling and preparation of foodstuffs at home (Lund, 1982). Most of the vitamin C is lost during handling, pasteurization, packaging, and oxidation of milk; about 70% of the remaining vitamin C and 90% of riboflavin can be destroyed by sunlight exposure during storage (Renner, 1986).

Scientific research has shown that the detrimental effects of pasteurization on the nutritional and physiological values of milk are negligible considering the safety benefits in regards to consumers' health.

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