International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
(A Peer Reviewed, Referred, Indexed and Open Access Journal)
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 9, Issue 6 -2022

Review Article

DOI: http://dx.doi.org/10.22192/ijarbs.2022.09.06.019

Risk of raw milk and benefit of pasteurized milk on human health and their foodborne pathogen – A Review

Kunjan Hirpara[1], Rukhsar Ansari[2]
[1,2] Department of Microbiology,
Bhagwan Mahavir College of Basic and Applied Sciences,
Bhagwan Mahavir University, India

Abstract

Milk, whether raw or processed, is a highly nutritious food that is high in proteins, minerals, and lipids, which are especially necessary for the developing newborn. Pasteurization is a legally necessary practice for handling made-from-milk products in the majority of nations. Milk and milk products have numerous nutritional benefits. A brief history of milk pasteurization development is presented and updated. However, raw milk, or unpasteurized milk, might contain hazardous microorganisms. The proportion of foodborne pathogens in raw cow milk fluctuates, but their presence has been established in numerous surveys, and foodborne infections caused by Campylobacter, Salmonella spp., and human pathogenic verocytotoxin-producing Escherichia coli have been routinely recorded. Milk-borne and milk product-borne illnesses account for 26% of bacterial foodborne outbreaks in developed nations.

Keywords: Food born pathogen, human health, pasteurization method, pasteurized milk, Raw milk

1. Introduction

Raw milk, also known as unpasteurized milk, is milk that has not been pasteurized, which is a method of heating liquid foods to kill microorganisms and improve storage period (Beecher *et al*., 2016). Pasteurization is a technique named after the scientist Louis Pasteur that uses heat to kill microorganisms in food. The phrases "pasteurization" and "pasteurization" are used in the dairy sector. Raw milk is milk that has not been pasteurized in order to destroy hazardous microorganisms. Dangerous bacteria and germs that can make us very ill or have detrimental effects can be found in raw milk. While foodborne infections can occur from a variety of sources, breast milk is one of the most dangerous identified, and the clinical network warns of excessive hazards, which include a better threat of infection (Smith *et al*., 2010). Pasteurization took place at a time when uncooked milk was the primary means by which tuberculosis, scarlet fever, typhoid fever, and other diseases spread, injuring or killing thousands of people. Thousands of lives have been preserved thanks to pasteurization.

1.1 History of raw milk and Pasturization:-

Following the arrival of agriculture in the course of the Neolithic Era or the arrival of agriculture, people first commenced to frequently drink the milk of different mammals. This evolution occurred independently in many parts of the world from as early as 9000-7000 BC in Mesopotamia (Bellwood *et al*., 2005). The first dairy animals to be domesticated in Mesopotamia were cattle, sheep, and goats, but domestic farm animals have occasionally evolved from populations of wild aurochs since then (Beja-Pereira *et al*., 2006). After extensive clinical studies led to the development of germ theory, pasteurization was implemented in the United States in the 1890s. This motion efficiently halted the unfold of extraordinarily risky bacterial infections which includes *E. coli* infection, bovine tuberculosis, and brucellosis (Olmstead *et al*., 2004). In the early years following the scientific discovery of bacteria, there was no way to determine whether or not a farmer's milk was safe or inflamed, so all milk was labelled as potentially contagious. Following the improvement of the primary tests, a few farmers took steps to maintain their diseased animals from being killed and eliminated from meal production (Olmstead, A. L., & Rhode 2007). Some international locations outright limit the acquisition of uncooked milk bought instantly from the farmer, at the same time as many do not. Raw milk may eventually be provided upon application from a customer who owns a portion of the dairy cow or herd and is thus legally consuming milk from their own animal (Walters *et al*., 2013). Milk is regularly unpasteurized in rural regions of Asia in which milk intake is prevalent. Raw milk, in particular from water buffalo, is not unusualplace in Asian towns. Most Asian international locations don't have any or few guidelines in opposition to the intake of uncooked milk. In Japan, milk labeled "uncooked" (nama) is available, however the type indicates its miles a hundred percentage uncooked entire milk earlier than pasteurization. Unpasteurized milk is extraordinarily uncommon at some point of Japan (Hsieh, W. C., 1963)

1.2 Risk of raw milk :-

Many scientific research has shown that raw milk can contain a range of germs that cause illness. These studies, as well as other foodborne outbreaks, clearly highlight the dangers of drinking raw milk. Consumers are becoming more interested in raw milk as they learn more about the good bacteria and other nutrients found in milk that are eliminated by pasteurization. Between 1998 and 2011, the Centers for Disease Control and Prevention received reports on 2,384 infections linked to Pre raw milk dairy products. There were 284 hospitalizations and two deaths as a result of these incidents. Unfortunately, even milk produced in facilities that test for bacteria and adhere to strict hygiene requirements can become contaminated and pose health hazards (Robinson, T. J., 2014). Vitamins, enzymes, and good bacteria in raw milk reduce the frequency of respiratory infections and fever in newborns and protect against asthma and allergies. Meanwhile, it is vulnerable to contamination from a variety of sources, including cow excrement, microbial infections, and illnesses (Baars, *et al*., 2013).

Raw milk is no more beneficial than pasteurized milk in bone health.

There is no scientific evidence to support the claims that pasteurized milk causes osteoporosis or that raw milk improves calcium deposition in bone. Pasteurization has been proven in studies to have no effect on calcium concentration or absorption (Rolls, B. A. 1973). In an animal experiments, Weeks and King (1985) found no change in calcium bioavailability between raw milk, homogenized HTST (high-temperature–short-time) milk, and homogenized UHT (Ultra-high temperature) milk. For six to eight weeks, weanling rats were fed the three varieties of milk, and calcium through milk was their sole source of calcium. There was no difference in intestinal calcium absorption or calcium deposition in long bones between rat groups that consumed the three types of milk (Williamson.S, E. Finucane, 1978).

Raw milk contains no helpful microorganisms for digestive health.

Raw milk bacteria are not probiotic. Non-pathogenic probiotic bacteria are required (Teitelbaum, J. E. and W. A. Walker. 2002). To mention a few, raw milk can harbor *E. coli O157:H7, Salmonella, Streptococcus spp., Yersinia enterocolitica, Campylobacter jejuni, Staphylococcus aureus, Listeria monocytogenes, Mycobacterium tuberculosis, and Coxiella burnetti*(Hayes, et al., 2001).Raw milk proponents refer to *Bifidobacteria* as the "good bugs" in raw milk. Microbiota are bacteria that are often found in the gastrointestinal tracts of humans and animals. They are part of the gut flora (Arunachalam, K. D. 1999). *Bifidobacteria* are present in bovine feces because they are found in the GI tract. *Bifidobacteria* should not be present in raw milk obtained with sufficient cleanliness. Contrarily, the presence of *Bifidobacteria* in raw milk suggests faecal contamination and inadequate farm sanitation (Beerens, *et al*., 2000).

Raw milk contains no immunoglobulins that increase the human immune system.

Bovine immunoglobulins are physiologically negligible to humans at this low amount when eaten immediately from milk (Hurley, W. L. 2003). IgG is the most abundant immunoglobulin component in cow milk (about 85-90 percent). IgG is relatively heat stable. In one investigation, LTLT (low temperature long-time pasteurization) pasteurization (63°C for 30 minutes) had no effect on IgG levels, while HTST pasteurization (72°C/15s) resulted in only 1% IgG denaturation (Fox, P. F. 2003).

Raw milk contains natural antibacterial components that keep milk safe.

Lactoferrin, lactoperoxidase, lysozyme, and xanthine oxidase are the principal antibacterial chemicals found naturally in milk. There is no scientific evidence to support the idea that the indigenous antibacterial chemicals found in raw milk fight germs and assure the safety of raw milk (Mainer, *et al*., 1997). Raw milk microbiota is complicated and unpredictable. Depending on the pathogenic species and strains involved, the antimicrobial components in milk can have bactericidal, bacteriostatic, or no impact at all (Naidu, A. S. 2000).

1.3 Raw milk consumption

Medical authorities strongly advise against consuming raw milk due to the presence of pathogenic germs, which pose a health risk. Consumption of raw cow's milk does not raise, but rather lowers the incidence of asthma, hay fever, and atopic sensitization, according to epidemiological studies. Braun-Fahrlander and von Mutius analyzed the components of unprocessed milk, potentially giving health protection, using epidemiological literature. They discussed the importance of bacteria in raw milk, the fatty acid profile, whey proteins, and allergies in milk. Currier and Widness examined newborn mortality from 1875 to 1925, taking into account the effect of milk cleanliness. Infants should drink pasteurized cow milk to ensure the safety of milk nutrients and to reduce newborn mortality caused by milk pathogens such as human and bovine tuberculosis, brucellosis, salmonellosis, streptococcal infections, diphtheria, and summer diarrhea (Currier, R.W. 1875).

1.4 Epidemiology of diseases caused by raw or unpasteurized milk and milk products

From 1993 to 2006, 121 dairy-associated foodborne illness outbreaks were detected in the United States, according to a second investigation. Of these, 73 (60%) were linked to unpasteurized dairy products, resulting in 1571 cases, 202 hospitalizations, and 2 fatalities; 60% of the patients were under the age of 20. Thirteen percent of patients engaged in raw milk or milk product foodborne illness outbreaks were hospitalized, compared to one percent of patients included in pasteurized product outbreaks. Furthermore, 55 (75%) of the 121 outbreaks occurred in 21 states that allowed the sale of unpasteurized dairy products (Langer AJ, Ayers T 1993- 2006). Another subgroup at risk of sickness from traditional dishes cooked with raw milk is immigrant communities (MacDonald PDM, *et al*., 2005)

2.1 Benefit of pasturized milk on human health

Brief history and safety of pasteurized milk:-

Pasteur was preceded by Gail Borden, who patented a method of heating and condensing milk under vacuum, followed by the addition of sugar for preservation. However, until Pasteur's discovery, the aspect of germ eradication achieved by the practice of heating milk was not recognized. Soxhlet, who pasteurized bottled milk administered to infants, may have been the first to use pasteurizing heat treatments on milk. As early as 1888, Gerber and Wieske pasteurized milk in bottles at 65°C for 1 hour (Gerber N. & Wieske P. 1903). In 1882, Germany produced the first commercial pasteurizer; by the mid-1880s, commercial pasteurization had become regular practice in Denmark and Sweden. In Bloomville, New York, the first commercially operated milk pasteurizer in the United States of America (USA) was erected in 1893. In the United States, there were strong opposition to widespread heat treatment of milk, and the controversy raged for many years, despite the fact that dairy processors recognized the approach as a means of enhancing the shelf-life of fluid milk. Early commercial pasteurization of milk was not widely recognized, but many enterprises had secretly used the procedure (Pegram T.R. 1991).

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2.3 Pasteurization Methods for Milk

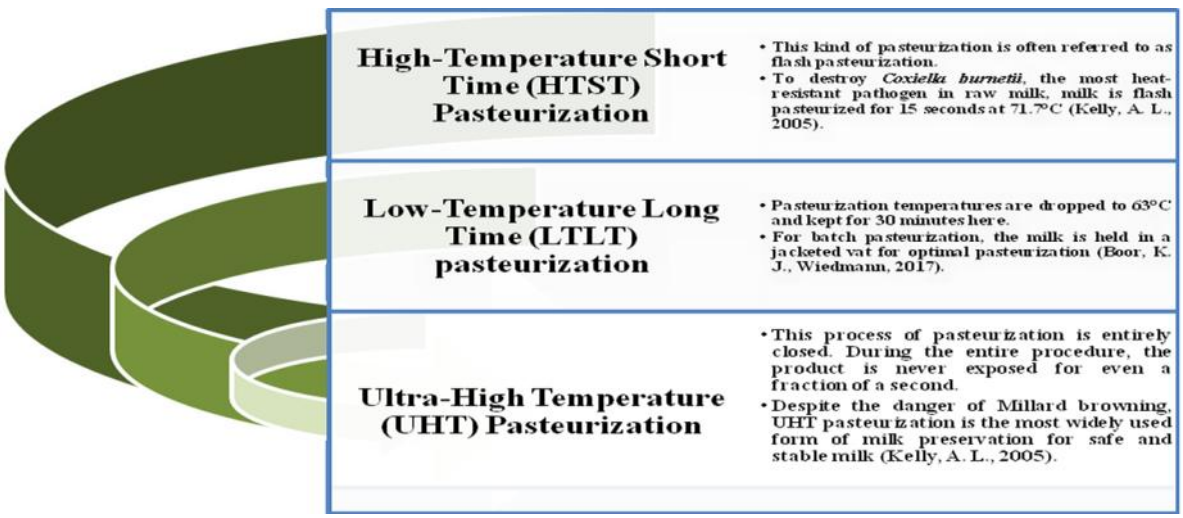

Figure- 1 Various Milk Pasteurization Techniques

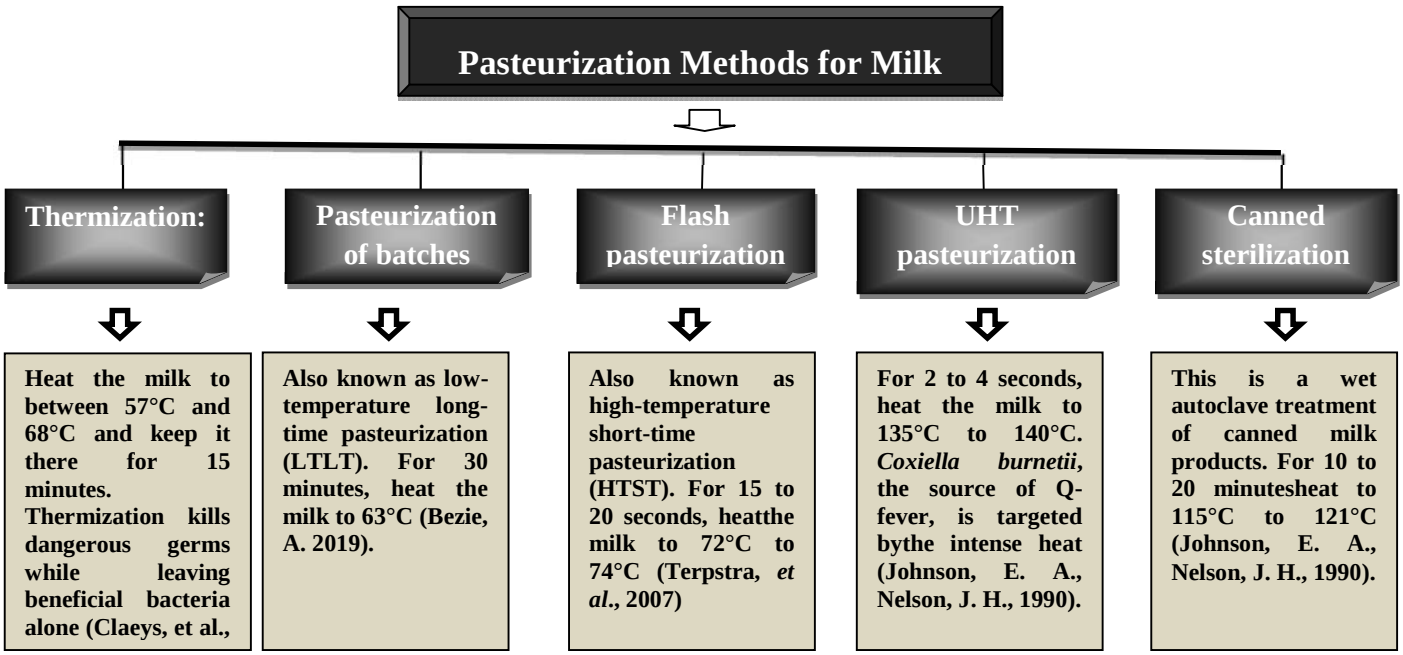

Figure- 2 Different Types of Thermal Processing Techniques

2.4 Consumption of pasteurized milk:-

Pasteurization, or heating milk to a specified temperature, renders milk safe for human consumption by lowering the amount of live pathogenic germs (Holsinger, et al., 1997). Scarlet fever, TB, brucellosis, and diphtheria are all diseases that can be avoided (Balarabe, et al., 2016). When compared to unpasteurized milk, it has a longer shelf life (Barbano, et al., 2006). The removal of strong aromatic molecules from specific foods. It should be noted that this is not always a benefit: many of these fragrances can be pleasant to customers (Schwab, et al., 2008). Despite the fact that the health benefits of pasteurization are well documented, some organizations lobbied for the marketing of raw milk as "nature's perfect diet." They argue that pasteurization kills essential vitamins, yet raw milk drinking can help prevent and treat allergies, cancer, and lactose intolerance(Macdonald, L.E. et al., 1814-1832).

2.5 Benefit of pasteurized milk:-

Pasteurized milk has lesser nutritional benefits than raw milk. Pasteurization eliminates all bacteria in milk, including those that are useful to the digestive and immune systems. According to a nutritional researcher and author of "Nourishing Traditions," pasteurization also alters milk's amino acids, promotes fatty acid food spoilage, destroys vitamins A, D, C, and B12, and reduces the minerals calcium, chloride, magnesium, phosphorus, sodium, and Sulphur, as well as many trace minerals. Furthermore, pasteurization destroys the enzymes in milk that aid in the digestion of minerals, especially calcium. Manufactured vitamins are commonly added back into pasteurized milk; however, in the absence of milk's natural enzymes, they are difficult to digest (Weerathilake, W. A. D. V., et al., 2014).

3.1 Food born pathogen in raw milk:-

Milk and products generated from dairy cow milk can house a wide range of microorganisms and serve as key sources of foodborne diseases. Foodborne pathogens in milk are present due to direct interaction with contaminated sources in the dairy farm environment and excretion from an affected animal's udder (Adesiyun, A.A., L.A. Webb, et al., 1998). More than 200 diseases are known to be spread by food by a range of agents such as bacteria, fungus, viruses, and parasites.

According to public health and food safety experts, foodborne bacteria cause millions of diseases in the United States and around the world each year. While the United States has one of the cleanest food supplies in the world, the Centers for Disease Control and Prevention (CDC, 2003, 2004) estimates that 76 million people get sick, more than 300,000 are hospitalized, and 5,000 die from foodborne illness each year. The danger of foodborne illness has increased steadily in the last 20 years, with roughly a quarter of the population being at heightened risk. As a result, preventing sickness and mortality from foodborne microorganisms remains a serious public health challenge. Furthermore, food safety is a worldwide issue, and an increase in food imports and exports could result in the introduction and establishment of new diseases in geographical areas that have never previously encountered foodborne pathogens (Tian Y, Sun P, et al., 2010).

3.2 Bacterial infections:-

Among the bacteria that can cause milk-borne diseases include Salmonella spp., *Campylobacter jejuni*,9 *Bacillus cereus*, higa toxin-producing *E. coli* (*E. coli* O157:H7), Salmonella spp., *Yersinia enterocolitica*, and particular strains of *Staphylococcus aureus* capable of releasing extremely heat-stable toxins. Staphylococcal enterotoxin gastroenteritis is caused by particular strains of *Staphylococcus aureus* producing a heat-stable enterotoxin (Tian Y, Sun P, et al., 2010). The most prevalent carriers of this bacteria, which causes mucosal or cutaneous illnesses such as impetigo and cattle mastitis, are humans and dairy cows. As a result, bacteria may be transferred to milk via the udder of cattle or the hands of milkers, and staphylococcal mastitis is still frequent in India today (Kumar R, et al., 2012).

3.3 Viral infections:-

Milk-borne illnesses can also be caused by a wide variety of viruses, particularly in underdeveloped countries with poor sanitation. Certain viruses may require heat inactivation temperatures slightly greater than those maintained during pasteurization, however in most developed countries, contamination appears to occur after pasteurization. Other agents that may contaminate milk include species hepatitis viruses, which are more commonly discovered in sheep and goat milk and less frequently in cow milk (Cisak E, Wojcik-Fatla A, et al., 2010).

3.4 Fungal infections:-

A variety of harmful fungus can infect the cow's udder and so be expelled in significant quantities in the milk. Nocardia asteroides has been linked to bovine mastitis (Cook JG, Holliman A. 2004).

Conclusion

Milk is a significant source of foodborne illnesses and can harbour a variety of microorganisms. Milk can become contaminated with foodborne pathogens through udder discharge from sick animals as well as direct contact with contaminated sources in the dairy farm environment. The dairy industry should be concerned about dairy food safety because: (1) outbreaks of disease in humans have been linked to the consumption of unpasteurized milk and have also been linked to the consumption of pasteurized milk; and (2) unpasteurized milk is consumed directly by dairy producers and their families, farm workers and their families, neighbors, and raw milk proponents. (3) Milk pasteurization might not completely eradicate all foodborne pathogens, and (4) mishandled pasteurization might not completely eradicate all pathogens.

Acknowledgments

The authors are very grateful to the Bhagwan Mahavir University, Surat, for providing a proper guideline for review preparation. https://acknowledgementworld.com/acknowledgement-for-research-paper/

References

1) Adesiyun, A.A., L.A. Webb, and H.T. Romain. 1998. Prevalence and characteristics of Staphylococcus aureus strains isolated from bulk and composite milk and cattle handlers. J. Food Prot. 61:629–632.
2) Arunachalam, K. D. 1999. Role of Bifidobacteria in nutrition, medicine and technology. *Nutrition Research*. 19:1559-1597.
3) Baars, T. "Milk consumption, raw and general, in the discussion on health or hazard." J. Nutritional Ecology Food Res. 2013, 1(2), 91-107.
4) Balarabe, S., Doma, U. D., Kalla, D. J. U., & Zahraddeen, D. (2016). Animal products and handling: A caution for consumers and entrepreneurs. *Nigerian Journal of Animal Science*, *18*(1), 266-274.
5) Beecher, C. (2016). Raw milk's 'explosive growth'comes with costs to the state. *Food Safety News*.
6) Beerens, H., H. B. de la Perriere, and F. Gravini. 2000. Evaluation of the hygienic quality of raw milk based on the presence of bifidobacteria: the cow as a source of faecal contamination. *International Journal of Food Microbiology*. 54:163-169.
7) Beja-Pereira, A., Caramelli, D., Lalueza-Fox, C., Vernesi, C., Ferrand, N., Casoli, A., ... & Bertorelle, G. (2006). The origin of European cattle: evidence from modern and ancient DNA. Proceedings of the National Academy of Sciences, 103(21), 8113-8118.
8) Bellwood, Peter (2005). "The Beginnings of Agriculture in Southwest Asia". First Farmers: the origins of agricultural societies. Malden, MA: Blackwell Publushing. pp. 44–68. ISBN 978-0-631-20566-1.
9) Bezie, A. (2019). The effect of different heat treatment on the nutritional value of milk and milk products and shelf-life of milk products. A review. *J. Dairy Vet. Sci*, *11*(5), 555822.
10) Braun-Fahrlander, C.; and von Mutius, E. "Can farm milk consumption prevent allergic diseases?" Clin Exp Allergy 2011, 41(1): 29-35.
11) CDC, 2007. *Escherichia coli* O157:H7 infection associated with drinking raw milk in Washington and Oregon, November −December 2005. *Morbidity and Mortality Weekly Report*. 56:165-167.
12) CDC, 2008. Escherichia coli 0157:H7 Infections in Children Associated with Raw Milk and Raw Colostrum From Cows --- California, 2006. *Morbidity and Mortality Weekly Report*. 57:625-628.
13) Centers for Disease Control and Prevention (CDC). Outbreak of listeriosis associated with homemade Mexican-style cheese—North Carolina, October 2000-January 2001. MMWR Morb Mortal Wkly Rep. 2001;50(26): 560–562
14) Centers for Disease Control and Prevention. How many outbreaks are related to raw milk? Available at: http://www.cdc.gov/foodsafety/rawmilk/raw-milk-questions-andanswers.html#related-outbreaks. Accessed November 12, 2013
15) Centers for Disease Control and Prevention. What is the history of the recommendation for pasteurization in the United States? Available at: http://www.cdc.gov/foodsafety/rawmilk/raw-milk-questionsand-answers.html#history. Accessed November 12, 2013
16) Cisak E, Wojcik-Fatla A, Zajac V, Sroka J, Buczek A, Dutkiewicz J. Prevalence of tick-borne encephalitis virus (TBEV) in samples of raw milk taken randomly from cows, goats and sheep in eastern Poland. Ann Agric Environ Med. 2010; 17(2): 283-6.
17) Claeys, W. L., Cardoen, S., Daube, G., De Block, J., Dewettinck, K., Dierick, K., ... & Herman, L. (2013). Raw or heated cow milk consumption: Review of risks and benefits. *Food control*, *31*(1), 251-262.

18) Cook JG, Holliman A. Mastitis due to Nocardia asteroides in a UK dairy herd following restocking after FMD. Vet Rec. 2004; 154(9): 267-8.Mastitis due to Nocardia asteroides in a UK dairy herd following restocking after FMD. Vet Rec. 2004; 154(9): 267-8.
19) Currier, R.W.; and Widness, J.A. "A Brief History of Milk Hygiene and Its Impact on Infant Mortality from 1875 to 1925 and Implications for Today: A Review." J. Food Prot 2018, 81(10): 1713-1722.
20) Hayes, M. C. and K. J. Boor. 2001. Raw milk and fluid milk products, p. 59-76. *In* J. L. Steele and E. H. Marth (ed.), Applied Dairy Microbiology, Marcel Decker, Inc., New York, NY.
21) Holsinger, V. H., Rajkowski, K. T., & Stabel, J. R. (1997). Milk pasteurisation and safety: a brief history and update. *Revue scientifique et technique-Office international des epizooties*, *16*(2), 441-466.
22) Hsieh, W. C., Wallace, C. K., Wang, S. P., & Rasmussen Jr, A. F. (1963). Inapparent Infection with Japanese Encephalitis of American Servicemen on Okinawa in 1960. *American Journal of Tropical Medicine and Hygiene*, *12*(3), 413-16.
23) Johnson, E. A., Nelson, J. H., & Johnson, M. (1990). Microbiological safety of cheese made from heat-treated milk, part II. microbiology. *Journal of Food Protection*, *53*(6), 519-540.
24) Kumar R, Yadav BR. Genetic variations in immunoglobulin G3 and association with staphylococcal intra-mammary infections in cattle and buffaloes. Mol Biol Rep. 2012; 39(7): 7599-607.
25) Langer AJ, Ayers T, Grass J, Lynch M, Angulo FJ, Mahon BE; Centers for Disease Control and Prevention. Nonpasteurized dairy products, disease outbreaks, and state lawsUnited States, 1993–2006. Emerg Infect Dis. 2012;18(3):385–391
26) MacDonald PDM, Whitwam RE, Boggs JD, et al. Outbreak of listeriosis among Mexican immigrants as a result of consumption of illicitly produced Mexican-style cheese. Clin Infect Dis. 2005;40(5):677–682
27) Macdonald, L.E. et al. "A systematic review and meta-analysis of the effects of pasteurization on milk vitamins, and evidence for raw milk consumption and other health-related outcomes." J. Food Prot 2011, 74(11): 1814-1832.
28) Mainer, G., L. Sanchez, J. M. Ena, and M. Calvo. 1997. Kinetic and thermodynamic parameters for heat denaturation of bovine milk IgG, IgA and IgM. *Journal of Food Science*. 62:1034-1038.
29) Naidu, A. S. 2000a. Overview. Natural food antimicrobial systems., p. 1-16. *In* A. S. Naidu (ed.), Natural Food Antimicrobial Systems, CRC Press, Boca Raton, Florida.
30) Olmstead, A. L., & Rhode, P. W. (2004). An impossible undertaking: the eradication of bovine tuberculosis in the United States. The Journal of Economic History, 64(3), 734-772.
31) Olmstead, A. L., & Rhode, P. W. (2007). Not on my farm! Resistance to bovine tuberculosis eradication in the United States. The Journal of Economic History, 67(3), 768-809.
32) Pegram T.R. (1991). - Public health and progressive dairying in Illinois. Agric. Hist., 65, 36-50.
33) Robinson, T. J., Scheftel, J. M., and Smith, K.E. "Raw milk consumption among patients with non-outbreak-related enteric infections, Minnesota, USA, 2001–2010." Emerging infectious diseases 2014, 20(1): 38.
34) Rolls, B. A. and J. W. G. Porter. 1973. Some effects of processing and storage on the nutritive value of milk and milk products. *The Proceedings of the Nutrition Society*. 32:9-15.
35) Schwab, W., Davidovich-Rikanati, R., & Lewinsohn, E. (2008). Biosynthesis of plant-derived flavor compounds. *The plant journal*, *54*(4), 712-732.
36) Smith, T. P. (2010). Got E. coli? Raw milk's appeal grows despite health risks. *Scientific American, Division of springer nature America, NC*.

37) Teitelbaum, J. E. and W. A. Walker. 2002. Nutritional impact of pre- and probiotics as protective gastrointestinal organisms. *Annual Review of Nutrition*. 22:107-138.
38) Terpstra, F. G., Rechtman, D. J., Lee, M. L., Hoeij, K. V., Berg, H., Engelenberg, F. A. V., & Wout, A. B. V. T. (2007). Antimicrobial and antiviral effect of high-temperature short-time (HTST) pasteurization applied to human milk. *Breastfeeding Medicine*, *2*(1), 27-33.
39) Tian Y, Sun P, Wu H, Bai N, Wang R, Zhu W, et al. Inactivation of Staphylococcus aureus and Enterococcus faecalis by a direct-current, cold atmospheric-pressure air plasma microjet. J Biomed Res. 2010; 24(4): 264-9.
40) Varnam, A., & Sutherland, J. P. (2001). *Milk and milk products: technology, chemistry and microbiology* (Vol. 1). Springer Science & Business Media.
41) Walters, E. (2013). The Food Safety Modernization Act's True Implications for Sustainable Agriculture. *Washington and Lee Journal of Energy, Climate, and the Environment*, *4*(2), 391.
42) Weerathilake, W. A. D. V., Rasika, D. M. D., Ruwanmali, J. K. U., & Munasinghe, M. A. D. D. (2014). The evolution, processing, varieties and health benefits of yogurt. *International Journal of Scientific and Research Publications*, *4*(4), 1-10.
43) Williamson.S, E. Finucane, H. Ellis, and H. R. Gamsu. 1978. Effect of heat treatment of human milk on absorption of nitrogen, fat, sodium, calcium, and phosphorus by preterm infants. *Archives of Disease in Childhood*. 53:555-563.

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How to cite this article:
Kunjan Hirpara, Rukhsar Ansari. (2022). Risk of raw milk and benefit of pasteurized milk on human health and their foodborne pathogen –A Review. Int. J. Adv. Res. Biol. Sci. 9(6): 158-166.
DOI: http://dx.doi.org/10.22192/ijarbs.2022.09.06.019