Research & Reviews: Journal of Dairy Science and Technology
ISSN: 2319-3409(online), ISSN: 2349-3704(print)
Volume 4, Issue 1
www.stmjournals.com

Food Borne Pathogens: A Threat to Dairy Industry

Vaghela Nileshkumar R., Subrota Hati*, Kunal Gawai, Sreeja V.
SMC College of Dairy Science, Anand Agricultural University, Anand, Gujarat, India

Abstract

Food borne diseases is the major concern along with malnutrition in developing countries and developed countries as well. Milk is rich source of nutrition with large number of pathogenic bacteria which are more susceptible to cause illness or death. Millions of people stuck with food borne outbreaks throughout the globe because of presence of pathogenic bacteria – disease causing microbiota like E. coli O157:H7, Salmonella, Shigella, Listeria, Campylobacter, S.aureus and Clostrida and their heat stable and heat labile toxins. The presence of food borne pathogens in milk and milk products is due to direct contact with contaminated sources in dairy farm environment and to excretion from infected udder of animal suffering from disease. Generally very few percentage (app. 1–2%) people of the globe consume raw milk and milk products while others use pasteurized one. But sometimes inadequate or faulty heat treatment and post processing contamination through infected supply chain may lead to major consequences related to outbreaks.

Keywords: *Food borne disease, milk and milk products, pathogens, contamination*

****Author for Correspondence*** E-mail: subrota_dt@yahoo.com

INTRODUCTION

There are more than 200 known diseases transmitted through different food stuff and environment by different variety of agents like bacteria, fungi, viruses, parasites and their toxins [1]. According to public health and food safety experts, every year millions of people stuck with illnesses in the United States and throughout the world which can be traced to food borne pathogen. The risk of food borne disease has increased markedly over last two decades with higher risk factor because of new emerging food borne pathogens. It's a major public health challenge in preventing of food borne outbreaks. Consequently food safety is global issue, with increase of import and export of food products provides new platform to emerging food borne pathogens. Foodborne disease can be defined as any disease of an infectious or toxic nature caused by or thought to be caused by the consumption of food or water [2]. The burden of food borne disease on globe is currently unknown but the World Health Organization (WHO) has responded to this data gap by launching a new initiative to provide better estimates. In 2005 it was reported that 1.8 million people died from diarrheal diseases largely due to consumption of contaminated food and water [3]. Milk is complete whole some food-rich in nutrition and mostly preferable in all age of people throughout the world. Also it's a good mediator vehicle for food borne pathogens. Raw milk and product prepared from raw milk (i.e., raw cheese) are rich source of pathogenic bacteria with wide range of species. This micro biota and their metabolites (i.e., toxic enzyme) are more susceptible to cause illness or death. Number of cases of illness reported due to consumption of raw milk directs from farm. Also sometimes post processing and cross contamination throughout the supply chain from farm to fork became victim for illness or death. To reduce the risk of food borne pathogen transmission, monitoring of food borne diseases and pathogen necessary within supply chain that has been implemented and, approach of farm to fork has been adopted to improve personal hygiene and also include food safety principles like HACCP (Hazard Analysis and Critical Control Point). Different standard hygiene programmes like GMP (Good Manufacturing Practices), GLP (Good Laboratory Practice), and GHP (Good Hygienic Practices) to be implemented in food processing plants to prevent the food borne organisms.

The main aim of this study is to estimate the contribution of milk and milk products borne

diseases among food borne diseases that were recorded in all over world from developed to developing countries and also to estimate the involvement of different type of milk and milk product in the same. Numbers of milk borne illness were reported in all over the world majorly associated with raw milk. Majority associated milk borne pathogens are *Listeria, Salmonella, Shigella, E. coli, Campylobacter, Clostridia, Bacillus, and S.aureus* etc.

FOOD BORNE DISEASE AND TYPES [4]

In the U.S., the federal regulatory agencies define a food borne disease as an outbreak when two or more people become sick with a similar illness (symptoms) from the consumption of the same food from the same source, and the epidemiological investigations implicate, either directly or indirectly, the same food from the same source as the cause of the illness. However, in the case of botulism and chemical poisoning, because of a high fatality rate, even when only one person has the illness, it is considered an outbreak.

Types of microbial food borne disease:

1. Intoxication (poisoning)
2. Infection
3. Toxicoinfection

INTOXICATION

Intoxication or poisoning is an illness occurs as a consequence of ingesting a preformed bacterial or mold toxins because of their growth in a food stuff throughout supply and a toxin has to be present in the contaminated food. There is no need of viable cells in food stuff during consumption of the food for illness or death to occur, once the microorganisms have grown and produced toxin in a food. Staph food poisoning is an example of intoxication caused by *Staphylococcus aureus*.

Some general characteristics of food poisoning/ intoxication are:

1. The toxin is produced by pathogenic bacteria while growing in a foodstuff during supply chain.
2. A toxin can be heat labile or heat stable.
3. After 30 min of food ingestion, it shows symptoms quickly.
4. Symptoms vary with type of toxin like enterotoxins produce gastric symptoms and neurotoxins produce neurological symptoms.

INFECTION

Infection is defined as an illness occurs upon consumption of contaminated water or food stuff containing enteropathogenic bacteria or viruses. The cell of enteropathogenic bacteria or viruses remains alive in food stuff or water during consumption. Presence of these viable cells in small numbers, have great potential to establish and multiply in digestive tract to cause adverse effect like illness and chronic diseases. Salmonellosis is an example of infection caused by Salmonella.

Some general characteristics of food borne infections:

i. Viable live cells of the enteric pathogens (bacteria and viruses) have to be consumed through foodstuff or water.
ii. The surviving enteric pathogenic bacteria cells (from gastric environment) penetrate through the membrane of intestine and establish in the epithelial cells of the intestines and produce toxins by metabolism.
iii. Generally symptoms occur after 24 h, after consumption of contaminated food which, depending on the nature of pathogen (enteric/nonenteric).
iv. An enteric symptom includes abdominal pain, diarrhoea, vomiting, nausea and fever. It includes bacteria like *Shigella*, *Salmonella*, Enteroinvasive *E. coli* (EIEC), *Vibrio parahaemolyticus*, *Campylobacter jejuni*, and *Y. enterocolitica*.
v. In non-enteric type internal organ and tissue affected due to passing of toxins through organ and tissue and also it cause fever. It includes *Listeria monocytogenes*, enterohemorrhagic *E. coli* (EHEC), *V. vulnificus*, and Hepatitis A virus.

TOXICOINFECTION

Toxicoinfection is defined as an illness occurs from ingesting a large number of viable cells of some pathogenic bacteria through contaminated food or water. Generally bacterial cells either sporulate or die and release toxins which are enough for causing symptoms of illness or diseases.

Gastroenteritis is an example of food borne toxicoinfection caused by *Clostridium perfringens*.

Some general characteristics of food borne toxicoinfection:

i. Large numbers of live vegetative cells ingestion is necessary for spore formers.
ii. Vegetative cells of spore formers do not multiply in the digestive tract, but sporulate and release toxins inside the tract to cause illness.
iii. Gram-negative cells can multiply rapidly in the digestive tract so the ingested gram –negative bacteria are moderate in number.
iv. Toxins of both groups (Gram positive and negative) produce the gastroenteritis symptoms and call illness.

In addition to the pathogenic microorganisms associated with food borne illnesses or diseases, some bacterial species and strains normally considered non-pathogenic which can cause gastroenteritis, especially in susceptible individuals. They are considered as opportunistic pathogens. They are normally required to be alive and present in large numbers when consumed through a contaminated foodstuff or water. Majorly causative food borne pathogen causing serious health hazard and their association with respective food is mentioned in Table 1.

Table 1: *Food Borne Major Outbreaks and their Causative Organism [5].*

Disease / Outbreak	Micro-organism	Associated food
Salmonellosis	*Salmonella* spp.	Poultry, **Raw milk**
Listeriosis	*Listeria monocytogenes*	**Raw milk and Dairy products, Soft Cheeses,** Turkey franks, Cold cut meats, Improperly cooked chicken
Gastroenteritis	EHEC (*E. Coli* O157:H7)	**Raw milk**, Ground beef, Contaminated Hamburgers, Apple cider, Some fruits, Uncooked sausages, Sprouts, Salad
Gastroenteritis	EIEC	Any food which is contaminated with Faecal source
Shigellosis (bacillary dysentery)	*Shigella* spp	Different types of salads (potato, tuna, shrimp, and chicken), Contaminated shellfish
Campylobacteriosis	*Campylobacter* spp	**Raw milk and Dairy products**, Raw meats (beef, lamb, pork, chicken, turkey), Eggs, Vegetables, Mushrooms, and Clams
Yersiniosis	*Yersinia enterocolitica*	**Raw and Pasteurized milk, Processed Dairy Products**, Raw and Improperly cooked meats, Fresh vegetables, and Improperly Chlorinated water
Gastroenteritis	*Vibrio* spp	Raw, improperly cooked, or post heat-contaminated sea foods like fish, crabs, oysters, shrimp, and lobster
Brucellosis	*Brucellaabortus, Br. Meletensis*	**Cheese and Raw milk**
Staphylococaalinfction	Group a *Streptococcus*	**Raw milk and Dairy products**, Potato salad
Q fever	*Coxiellaburnetii*	**Raw milk and Dairy product**, Meat

TRANSMISSION OF FOOD BORNE PATHOGENS AND TOXINS

Food may become contaminated during production and processing or during food preparation and handling. Also it can be contaminated during storage due to contaminated supply chain and handlers. Lack of awareness and unhygienic manufacturing practises by workers leads to increase in risk of food borne illness.

Food Production and Preparation

Fruits and vegetables gets contaminated if washed or irrigated water is contaminated with pathogens from animal or human faeces sources. Animals naturally harbour many food-borne bacteria in their intestines which can cause illness, but do not cause illness in the animals. During slaughter, meat and poultry carcasses contaminated due come in contact with or exposed to small amounts of intestinal contents. And these may lead to transmission of pathogenic bacteria to consumer through food.

Food Preparation and Handling

The faeces of infected person are rich source of pathogenic bacteria which can infect individuals and these pathogens can be transferred to others through food via the faecal-oral route. Bacteria present in infected lesions and normal nasal flora may also be

transmitted from an infected food-handler to ready-to-eat foods through supply chain. Cross-contamination also play an important role in transmission of pathogens from one food to other foods during food preparation if same cooking equipment and utensils are used without washing and disinfecting in between, especially in case of ready-to-eat foods. Inadequate cooking temperature along with insufficient cooking, pathogenic bacteria can multiply and produce heat stable toxins within the food which shows symptoms even after heating and cause illness.

Improper Storage

Food stored at warm (10–50^{o}C) temperature allows multiplication of pathogens and is an important cause of food borne outbreaks. A temperature fluctuation during supply chain from farm to fork leads to increase of microbial load in food and also risk of illness.

MILK BORNE DISEASES: GLOBAL SCENARIO

Raw milk contains a large number of micro-organisms and they can cause serious disease to consumer but with efficient thermal processing (pasteurization, sterilization) quality of milk can be improved. Many cases of illness and death occur throughout the world due to consumption of milk and products.

There are around a million cases of food borne illness in the UK each year, which results in 20,000 hospitalized and 500 deaths. Norovirus and Campylobacter are considered the most common cause of food borne illness among the five main pathogens monitor (*Campylobacte*r, *E. Coli* O157, *L. monocytogenes*, Salmonella and Norovirus) [6]. A biggest outbreak of food-borne infection caused, by contaminated low fat milk with Enterotoxin A produced by *S. aureus*, involved more than 13,000 patients, occurred in 2000 [7]. In 2000, major outbreak reported that 14700 persons infected by staphylococcal enterotoxinA in Japan due consumption of low fat milk and powdered skim milk. In 2001, around 202 people of school mainly students infected by *E. coli* O157:H7 in North California upon consumption of raw milk. Around 200 people affected in prison by *C. jejuni* in Colorado by consuming pasteurized milk in the year 2005. In 2006, app. 329 people get infected by Norovirus in Georgia upon consumption of cheese cake. In 2006, major outbreak reported that 1644 persons infected by *C. jejuni* serotype in California due consumption of pasteurized milk [8].

In 2006, Germany reported a *L. monocytogenes* outbreak affecting six persons. The source was a contaminated hard cheese with cheese samples containing 52,000–120,000 *L. monocytogenes* CFU/g. Also, in Czech Republic soft cheese was identified as the source of infection in three outbreaks with a total of 78 people affected; all were hospitalised and 13 persons died. An outbreak in Norway in the year 2007, 52 persons was infected by a soft cheese produced on a small dairy farm. Throughout the 1990s and up till today, majorly these three (Salmonella spp., *E. coli* and Campylobacter spp.) foodborne pathogens have been commanding the most research and attention to a large extent from governmental health agencies for awareness from the food industry. As per present scenario there has been growing and emerging concern about *L. monocytogenes*. This pathogen may cause adverse and severe illness. India is tropical country and number one in milk production but due to lack of clean milk production facilities and improper handling of raw milk with unorganized sector, microbial count is higher in milk and milk products. Most commonly present food borne pathogens and their percentage in Indian milk and milk product are shown in Tables 2 and 3. Also in developed country risk of food borne illness is higher and number of cases from last few years is shown in Tables 4 and 5. Number of food borne illness and death reported in USA since last 15 years caused by raw milk and milk products mentioned in Figure 1 and outbreaks in Australia reported in Figure 2 from 2000–2008.

Salmonella

Salmonella spp. colonise and contaminated to food product through come in contact with livestock species like poultry, cattle and fish which are rich and major source for the same. Majorly it causes salmonellosis and the outbreak of the same is observed and reported frequently. Generally it enables to grow in unprocessed food and also allow for

amplification in environment with long term survivability. These may provide opportunity for adaptation and evolution which can demonstrate by outbreaks reported in recent years by salmonellosis and associated agents. An increase in salmonellosis since last 10–15 years, it was clearly observed throughout the developed world majorly. This comprised *S. enteritidis* and *S. typhimurium*, which were epidemiologically and microbiologically associated with raw milk and other environmental conditions. In 2011, major outbreak of milk-borne illness by *Salmonella enteritidis* has been reported in which 37 people affected by consumption of Queso fresco cheese (unpasteurized) in California [8].

E.coli

E.coli is most commonly and highly prominent gut coloniser in may host species. Isolated *E.coli* strains from intestinal disease have been grouped into six different diarrhoeagenic *E. coli* (DEC) groups based on specific virulence factor and their phenotypes; which includes enteroaggregative *E. coli* (EAggEC), enteroinvasive *E. coli* (EIEC), enteropathogenic *E. coli* (EPEC), enterotoxigenic *E. coli* (ETEC), diffusely adherent *E. Coli* (DAEC), and Vero cytotoxin producing *E. coli* (VTEC) or Shiga toxin-producing *E. coli* (STEC). Foodborne outbreaks have been associated particularly with VTEC, while lesser with EPEC, ETEC, and EaggEC strains. Among the VTEC strains, *E. coil O157:H7* become most prominent and widely recognized as a very important cause of food borne illness especially milk-borne illness over the last two decades. With new-improved and rapid detection technology for pathogens it has become more clear that other than O157, other causes of food-borne infectious disease through the food in globe mainly due to O groups O26, O111, O145 and O103 of *E. coli* [9].In 1982, first case of *E. coli O157* was reported in outbreaks of severe bloody diarrhoea in North America. Number of outbreaks reported of food and milk borne illness due to this strain which contaminated through beef meat, raw milk its product and diseased animal. In 2001, an outbreak in school children in North Carolina (USA) reported caused by *E. coli O157:H7* involved 202 total illness and 11 of hospitalized due to consumption of raw milk [8]. On the basis of studies on VTEC information and knowledge on trends and persistence of food-borne *E. coli* infections is derived. In the early food-borne outbreaks the sources of TTEC were mostly found to be contaminated beef meat but with change in scenario any vehicle comes in contact with ruminant feces become potentially a source and it includes vegetables, fruits, sprouts, meat products, milk and juices (both pasteurized and unpasteurized).

Campylobacter

In European Union, *Campylobacter* spp. is the most commonly reported agent of acute bacterial food poisoning so it becomes major target for reduction of intestinal infectious diseases in public throughout the globe. Some European countries recorded data on campylobacteriosis while in the UK case reported since 1982. Infections by *campylobacter* increased year by year till 2000 after which there was a drop of about 20% until 2004. It is complex and unclear to explain the reasons for variations in incidence of infection caused by *campylobacter*. Since the early 1980s numerous efforts has gone to indentify and control the source of infection. *Campylobacter* contamination of poultry meat from colonised chickens is considered the major source. Intestine of infectious milch animal also act as source of *campylobacter* which increase the risk and severity of milk borne illness. *C.jejuni* can't grow and multiply outside the host. These food borne pathogens are effectively respond and adaptive to environmental stresses like antimicrobials, dehydration, temperature etc by exploiting genomic plasticity. This adaptive capacity used by campylobacter to survive under stressful conditions to become ubiquitous in the environment. Thus, change in physiology of organism results in variations in mechanisms which cause food-borne illness in human. A major milk-borne outbreak reported in 2006, that 1644 persons infected from the place of prison due to consumption of pasteurized milk contaminated by *campylobacter* jejuni serotype in California. In 2012, 148 cases reported of milk borne illness by unpasteurized whole milk contaminated by *C. jejuni* in Pensylvania [8].

L. monocytogenes

A number of pathogenic bacteria transmitted by food and water-borne routes and it causes infectious food-borne disease in humans. Health agencies and policy makers focus on those pathogens which are most predominant in causing food-borne outbreaks, severity of disease, and its prevalence of infections and/or customer perception. The importance of "minor food-borne" pathogens may change with time; it may become emerging food-borne pathogens. *L. monocytogenes*acts as an opportunistic pathogen affect rarely to immune compromised, unborn or newly delivered infants, pregnant women and elderly. It may cause listeriosis very rarely but fatality rate of infection is higher (20–30%). This pathogen is commonly found in surface water, plants, soil and food but it can also found in packaged ready-to-eat foods as it is able to grow at refrigeration temperature and cause infection. In 2012 food-borne outbreak reported of 23 cases due to *L. monocytogenes* infection through Ricotaslata cheese in multi states of USA [8].

Table 2: *Pathogenic Bacteria Isolated from Different Indian Foods [10].*

Sr. No.	Food	Pathogenic bacteria
1	Milk	*Listeria monocytogenes, Yersinia enterocolitica, B. cereus, E.coli, Streptococcus feacalis*
2	Dahi (yoghurt), Khoa	*E.coli, S. Newport, Salmonella enterlidis*, feacal coliform, *Enterobactoraerogen*
3	Butter milk	*Yersinia enterocolitica*

Table 3: *Common Milk Borne Pathogen and % Contamination in Indian Food [10].*

Sr. No.	Food	Pathogen	% contamination
1	Milk	*B.cereus*	16–50
		L.monocytogenes	6
		Yersinia	5–59
		Aeromonas	7
		Vibrio	8
2	Lassi	*B.cereus*	5
3	Khoa	*Staphylococcus spp.*	20–36
		Salmonella spp.	5
		E.coli	9

Table 4: *Food Borne Disease Outbreaks Reported Due to Milk and Milk Products in Different Countries.*

Sr. No.	Country	No. of years	Cases	Food	Reference
1	USA	13(2001–2013)	6340	Cheese, Raw and pasteurized milk, ice cream, butter, milk shake	[8]
2	Australia	9(2000–2008)	280	Raw milk, cheese, cream cake, feta cheese	[11]
3	Austria	2(2000–2001)	40	Raw milk	[12]
4	India	29(1980–2009)	175	Butter milk, Kheer	[10]

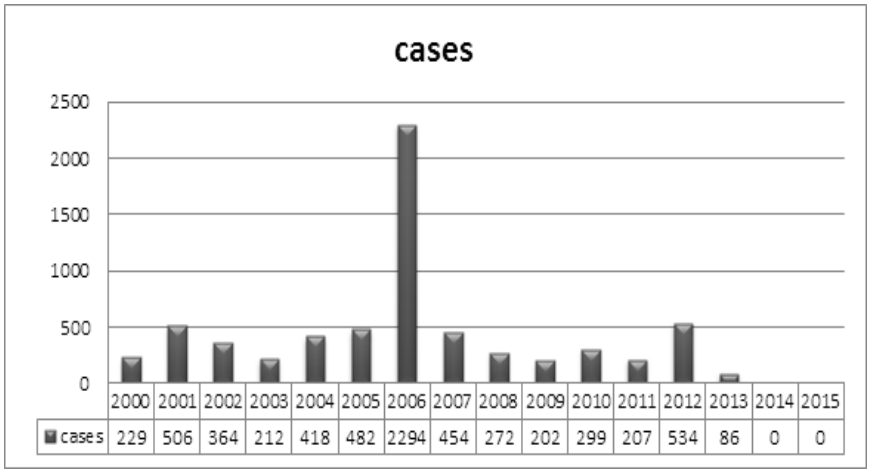

Fig. 1: *Number of Outbreaks Associated with Milk and Milk Product Borne Diseases in United States (2000–2015) (www.realrawmilkfacts.com) [8].*

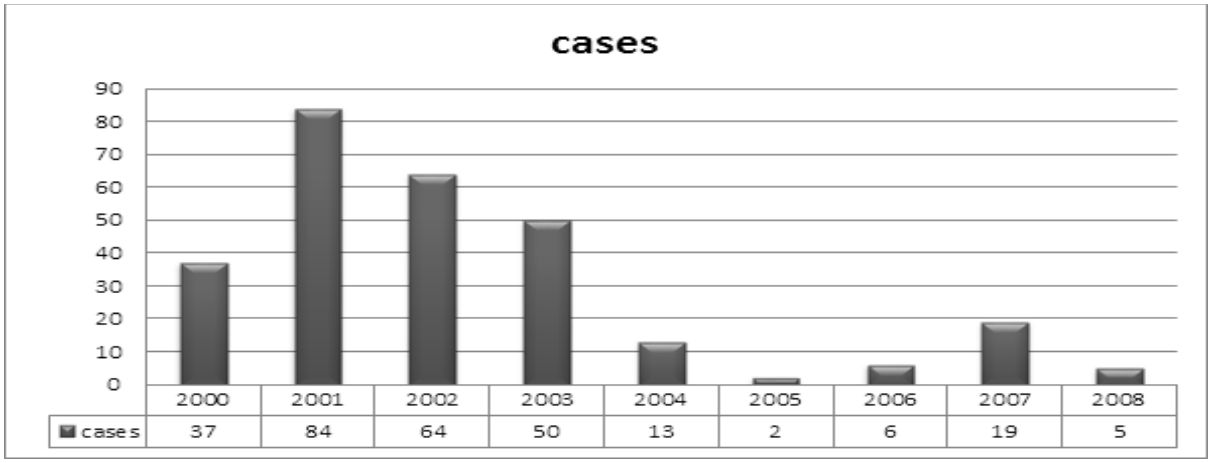

Fig. 2: *Number of Outbreaks Associated with Milk and Milk Product Borne Diseases in Australia (2000–2008) [11].*

Table 5: *Milk Borne Diseases in Other Countries [13–16].*

Sr. No.	Year	Food	Pathogen	Cases	Country
1	2000	Raw milk	*C.jejuni*	31	Germany
2	2000	Bottled pasteurized milk	*Yersinia enterocolitica*	10	VT,NH
3	2000	Raw milk	*Vero cytotoxin-producing Escherichia coli (VTEC) O157*	2	England and Wales
4	2000	Morbier cheese (unpasteurized)	*Salmonella typhimurium*	113	France
5	2002	Raw milk	*Campylobacter sp.*	28	Netherland
6	2002	Raw milk	*Campylobacter sp.*	3	UK
7	2003	Farmstead Gouda cheese	*E. coli O157:H7*	11	Alb., Can.
8	2003	Custard milk*	*C.jejuni*	81	Spain

**Possible contamination from raw chicken prepared in the same kitchen*

RECYCLING OF FOOD BORNE PATHOGENS IN THE DAIRY ENVIRONMENT

Dairy and cattle farms are an important and rich reservoir of food borne pathogens and their presence in milk is because of direct contact of contaminated sources in the environment of dairy farm. The presence of pathogens in bulk milk tank shows the direct link to faecal contamination occur during milk harvesting also mastitis leads to direct extraction of pathogen in milk. Amplification of pathogens taken place into infected milch animals and it comes in direct contact with environment via their faeces. The accumulation and spread on dairy farm or crop land increase the area of contamination which contaminates the crops and other things and these contaminated crops are generally feed to milch animals which increase the load of pathogens in milk during milking. Thus bulk tank milk also gets contaminated and their use in preparation of cheese and other milk product or direct consumption of raw milk becomes jeopardize to consumer. Thus from farm to fork many sources play an important role to increase the pathogenic bacteria load and risk of disease. Number of pathogens isolated and investigated from dairy farm during major outbreaks occurred [17].

FOOD SAFETY AND PUBLIC HEALTH CONCERNS

Pasteurization and sterilization are regarded as an effective method for eliminating and destroying food borne pathogens and other bacteria from the milk. But milk borne diseases reported due to consumption of pasteurized milk or ready to eat food show that pasteurization is not final solution for decrease the risk of milk borne disease. Number of outbreaks reported due consumption of milk or milk product contaminated with pathogenic bacteria like *Salmonella, Shigella, S.aures,*

Listeria, C.jejuni etc. Since last 10–15 years' multi state (California, Florida, Wisconsin, South dacota, Texas and others) food borne outbreaks reported due to presence of pathogenic bacteria (*C.jejuni, S.aureus, E.coli, B.cereus, L.monocytogenes*) associated with milk and milk products in school, prison, dairy farm, camp, restaurant, fair and multiple location. WHO recommended five keys to make food safer and decrease the risk of food borne illness 1) Keep clean, 2) Separate raw and cooked food, 3) Cook thoroughly, 4) Keep food at safe temperature, 5) Use safe water and raw materials [18]. GMP, GHP and personal hygiene is primary requirement to make food safe, also cleaning and sanitization of equipment is necessary. Avoid cross contamination by insects, pest and rodent to food material. Keep processed and raw food separately which prevents the transmission of bacteria from raw to cooked and decrease risk of illness and deterioration of food. Proper heat treatment with suitable time-temperature combination must be given to food and cook thoroughly to destroy the harmful pathogenic bacteria. Use of fresh and clean raw material with safe quality water protects the food from contamination and decrease the chance of milk borne illness.

CONCLUSION

This manuscript has been exhibited the trends over the last 10 years data on food borne diseases throughout the world. The dairy industry should be concerned about dairy food safety issues because a large segment of population of the world consumes milk, milk products and cheese products. So entry of milk borne pathogens via contaminated raw milk into dairy plant can lead to persistence of pathogens in bio films, and subsequent contamination of processed milk products and exposure of consumer to pathogenic bacteria. Pasteurization may not destroy all pathogenic bacteria in milk and it may increase the transmission rate of the same. However, this is a major challenge to provide a safe and nutritious food to the consumer. Safe and nutritious milk supply from farm to fork should be the goal of every milk producer in the world which decreases the risk of milk borne illness itself as well as to meet the demand of food quality.

REFERENCE

1. Acheson DW. Food Borne infections. *Curr Opin Gastroen*. 1999; 15: 538–545p.
2. Adams MR, Moss MO. Significance of Food Borne Diseases, *Food Microbiol*. 2003; 2(163): 160–164p.
3. Newell DG, Koopmans M, Verhoef L, *et al*. Food-borne Diseses- the Challanges of 20 Years ago Still Persist While New Ones Continue to Emerge. *Int J Food Microbiol*. 2010; 139(1): 3–15p.
4. Bibek Ray. Food Borne Infection. In: *Fundamental Food Microbiology*. 3rd ed. CRC Press LLC, Boca Raton, Florida; 2003.
5. Anon. Bacteria Associated with Foodborne Diseases. *Food Technol*. 2004; 58(7): 20–21p.
6. Anon. Annual Report of the Chief Scientist 2012/13- Safer Food for Nation. *Food Standards Agency*. 2013, food.gov.uk
7. ItsuroYamne. *Ann. N.Y. Acad. Sci*.2006; 1081: 30–38 p.
8. Foodborne Outbreaks Online Database (FOOD), Available from: http://wwwn.cdc.gov/foodborneoutbreaks/Default.aspx#,center for disease control and prevention; cited on 15th March, 2015. Available from: www.realrawmilkfacts.com
9. Jiménez M, Soler P, Venanzi JD, *et al*. An Outbreak of *Campylobacter jejuni* Enteritis in a School of Madrid, Spain. *Eurosurveillance Monthly*. 2005; 10: 9–10p.
10. Sudershan RV, Naveenkumar R, Polasa K. Foodborne Disease in India – A Review, *Brit Food J*. 2012; 114(5): 661–680p.
11. Anon. Food Safety Risk Assessment of NSW Food Safety Scheme. 2009. Available from: http://www.foodauthority.nsw.gov.au/_Documents/science/Food_Safety_Scheme_Risk_Assessment.pdf cited on 20th March, 2015
12. Anon. Microbiological Risk Assessment of Raw Cow Milk. Food standards Australia & New Zealand. 2009. Available from: http://www.foodstandards.gov.au/code/proposals/documents/P1007%20PPPS%20for%20raw%20milk%201AR%20SD1%20Cow%20milk%20Risk%20Assessment.pdf

13. Boor KJ, Zadoks RN. Dairy Foods Involved with Few Disease Outbreaks. *Hoard's Dairyman*. 2003; 769p.
14. Gillespie IA, Adak GK, O'brien SJ, *et al.* Milkborne General Outbreaks of Infectious Intestinal Disease, England and Wales, 1992–2000. *Epidemiol Infect.* 2003; 130: 461–468p.
15. Jiménez M, Soler P, Venanzi JD, *et al*. An Outbreak of *Campylobacter jejuni* Enteritis in a School of Madrid, Spain. *Eurosurveillance Monthly*. 2005; 10: 9–10p.
16. Van den Brandhof W, Wagenaar J, van den Kerkhof H. An Outbreak of Campylobacteriosis after Drinking Uppasteurized Milk, 2002, the Netherlands. *Int J Med Microbiol*. 2004; 293: 142p.
17. Oliver SP, Jayarao BM, Almeida RA. Review: Foodborne Pathogens in Milk and the Dairy Farm Environment: Food Safety and Public Health Implications. *Foodborne Patho Dis*. 2005; 2(2): 115–129p.
18. Anon. Food Borne Diseases.*CD Alert-Monthly Newsletter of National Centre for Disease Control*. Gov. of India. 2009; 13(4): 1–12p.

Cite this Article
Vaghela Nileshkumar R, Subrota Hati, Gawai K et al. Food Borne Pathogens: A Threat To Dairy Industry; *Research & Reviews: Journal of Dairy Science and Technology*. 2015; 4(1): 28–36p.

