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Review on Milk Safety with Emphasis on Its Public Health

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Abstract: Milk borne public health hazards can be classified as biological, chemical or Physical agents. Biological hazards can be posed by parasites, viruses or bacteria. The leading public health hazard from poor milk safety are microbial (Bacterial) followed by chemical milk contaminants. Young children, infants, pregnantwomen, elders and immunocompromised peoples are the primary groups at risk for milk safety problems. Even though pasteurization is considers as a perfect prevention method of biological milk safety hazards, there could be a hazard after all because of equipment, time and temperature frailer, lack of skill, some heat resistant bacterial toxin and spores and cross contamination. Chemical contaminants in milk can come from industrial and agricultural sources, from food processing or from the food itself. Toxic chemicals also come from biological sources such as molds and some bacterias. Foreign objects present in food could constitute a physical hazard to the consumer. A healthy animal's milk is usually sterile when secreted from the mammary gland. But Contamination may occur from Mastitis, systemic disease, (e.g., bovine tuberculosis), skin micro flora, environment (Feces, dirt, processing equipment), Vectors (Flies) and Human carriers. Contaminants in cow's milk and dairy products caused by accidents, carelessness and overzealous use of antibiotics. Chemical contamination cannot completely prevent, or eliminate from milk and dairy products. Because milk contains the persistent fat and lipophilic contaminants will find for some time. Further, when the enormous quantity of milk produced is considered, the potential health hazard posed by the residues is almost nonexistent. The use of food safety and quality assurance in farms and plants is very important to reduce chemical contaminants in milk and dairy products. The most contentious microbial and residues that occur in milk are bacteria and antimicrobial drugs respectively. Control measures based on the scientific analysis and good management practice (GMP), GHP principles are the better way with the scope to ensure problem prevention rather than to solve it after it has occurred.

Key words: Milk Safety Hazards · Public Health · Source of Milk Safety Hazards

INTRODUCTION

Milk is considered as nature's single most complete food and is definitely one of the most valuable and regularly consumed foods. But at the same time, it is highly vulnerable to bacterial contamination and hence is easily perishable. Moreover, in several countries; a milk safety problem is pretty common. Safety evaluation of milk is thus vital [1].

Consumers prefer wholesome and nutritious food produced and processed in a sound and sanitary manner such that it is free from pathogens and chemical contaminants. For fulfilling consumer's demand, production of quality milk is essential [1]. Quality milk is the milk of normal chemical composition, completely free from harmful bacteria and harmful toxic substances, free from sediment (Chemical residues) and extraneous substances, has lower degree of titratable acid, of good flavor, adequate in preserving quality and low in bacterial counts. In many parts of the world, milk is produced mostly in non-standardized way and is usually supplied to the consumers from the urban and rural areas by milkmen. Although there is little milk pockets specially milk vita and some established dairy farms where surplus milk is readily available, this perishable product has never received particular attention in hygienic distribution to the consumers. But milk is an excellent growth medium for bacteria and can easily be contaminated by many different sources including the udder and body of cows, dust from the air, litter, floor, flies, insects and rodents, water

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supply, hands and clothes of the milker, utensils, bottles, atmosphere etc. Thus milk and the dairy products can be important sources of food borne pathogens [2].

Even though microbial are the primary causes of milk safety hazards they can be destroyed through pasteurization of the milk. Pasteurization was originally designed to destroy pathogenic bacteria that caused tuberculosis, brucellosis, typhoid and Q-fever (Most heat resistant target organism), illnesses that were often associated with the consumption of raw milk. Milk pasteurization, coupled with improved animal husbandry procedures, has virtually eliminated most of these types of illnesses. Raw milk may also harbor other organisms associated with foodborne illness, including *Salmonella*, *Listeria*, *Campylobacter*, *Yersinia* and certain strains of *E. coli*. These organisms are also killed by pasteurization. However, cross-contamination of processed dairy products with raw milk and/or the direct consumption of raw milk have resulted in relatively recent outbreaks of foodborne illnesses involving these organisms. Pasteurized milk products can also be contaminated by poor processing and handling conditions and/or poor worker hygiene [3].

But milk is not only a potential carrier of microbial that affect milk safety, but also chemicals such as antimicrobials, pesticides, herbicides, hormones and heavy metals or adulterants from production to consumption presents hazards to public health. Safe milk implies milk hygiene or clean milk, being handled by clean people using clean equipments, working in clean environment & premises and protects the products, consumer & brand loyalty. Thus milk safety hazards can be due to biological, chemical and physical agents [4].

The codex Alimentarious Food Hygiene Committee defined a food safety hazard "as abiological, physical or chemical agent in, food with the potential to cause an adverse health effect [5]. Physical Hazards are material found in milk, which may cause illness or injury to the user. Chemical Hazards are of concern in two respects first, environmental contaminants such as Aflatoxins, Heavy Metals, Pesticides, Chemical fertilizers, radioactive substance, growth promoters and second, adulterants added in milk which may cause illness or adverse health effects [4].

So far, no enough Reviewed materials and paid attention on the public health problems with regard to milk safety. The objective of this review is to highlight the vital milk safety hazads (Biological, chemical and physical) with regads to public health and their control and prevention methods.

Milk Safety and its Public Health Significance: Milk safety, from milk Hygiene Practices points of view Milk safety can be endangered starting from farm to the mouth of consumers. Therefore, legal requirements for safety, quality and production conditions are currently enforced in many countries. European Union (EU) directives specify that raw milk must come from healthy animals and infectious diseases or foreign substances that are communicable to human beings through milk, should not endanger human health. Furthermore the equipment, tools and conditions under which milk is produced must fulfill certain minimum requirements. Milk's content must also meet specified hygienic standards in terms of bacterial and somatic cell numbers present [6].

Hygiene in Milk Production: Maintaining a high standard of hygiene is one of today's most important milk production objectives. The hygiene level directly influences the production's economical result and dairies are enforcing this by steadily raising their quality requirements for raw milk. More importantly though, consumers are concerned about the safety of dairy products and the conditions under which these are produced. It is therefore critically important to ensure high quality raw milk can be produced from healthy animals under good hygienic conditions and that control measures are applied to protect human health. Good hygienic practice is very important in the production of clean milk. Clean milk has the following characteristics Low bacterial count, Pleasant creamy smell and colour, No obnoxious odours, No dirt and extraneous matter and No residues of antibiotics, sanitizers or pesticides [7].

Sources of Milk Contamination: Raw milk may be contaminated by bacteria from several sources. These include: Udder and udder flanks, Milker, Milking environment, Milking equipment and Vessels used for milk storage and transportation [8].

Conditions for Clean Milk Production: Here are some important points to observe in order to produce clean milk: Milking should be carried out in a well-ventilated barn with adequate lighting, the floor of the milk barn must be durable and easy to clean, preferably made of concrete, after use milking vessels and equipment must be cleaned with potable water, sanitized and dried in the sun on a drying rack. Suitable disinfectants, such as hypochlorite solution, should be used at the recommended concentrations, milkers must be healthy and not suffering from contagious diseases or ulcers, only healthy cows should be milked. Cows suffering from mastitis should be milked last and their milk discarded. Milk from cows on antibiotic treatment should not be sold until the specified withdrawal period (Usually 72 hours or more) has elapsed; Colostrum (The milk produced in the first five days after calving) should not be mixed with normal milk. Calves must be allowed to suckle their dams and excess colostrum may be given to other calves or fed to pets (Cats and dogs) and during milking, the first strips of milk (Fore milk) should be milked into a separate, black-coated cup (Strip cup) to check for mastitis. The fore milk should then be discarded. Where possible, raw milk should be cooled using simple methods such as immersing milk cans in a trough of running cool water or evaporative [7].

Hygiene in Milk Transportation, Handling and Storage

Hygiene in Milk Transportation: For transporting fresh milk a cooler or ice chest is needed. It is helpful to have the family name on the inside and outside of the cooler. Several re-freezable blue gel packs or ice will be needed to cool empty bottles and to keep milk cold during the trip home. The milk needs to be kept at 40 degrees F (4 degree Celsius) or lower at all times [9].

Hygiene in Milk Handling: When handling milk, hand washing is the most effective way to prevent contamination for the consumer also. Washing and drying hands just before filling the milk jars is important. Check the temperature of the home refrigerator to find the coldest area for storing the milk. Use the door shelf only for the bottle in current use. It may be helpful to place a container of ice in plastic quart-sized bags or re-freezable gel packs in front of or next to the containers that will be stored the longest. With care, normally milk can be stored 7 to 14 days. It is important to keep the milk cold. Ideally milk should be held between 35 and 37 degrees F [6].

Hygiene in Milk Storage: Do not use glass containers for freezing. Use No. 1 plastic (Milk jugs) when freezing milk. Be sure to leave about one-inch of “head room” for expansion of the milk when it is frozen. Freeze as quickly as possible. To use frozen milk, thaw slowly at room temperature. Fast thawing will result in curdling and/or separation of the cream from milk. Whisking the milk may be needed to get rid of lumps of cream [10].

Public Health Significance of Milk Safety Hazards

Milk Safety Hazards (Raw and Pasteurized Milk): There is no generally accepted definition of ‘safe food’. One of the frequently used science-based definitions is that safe food is “food that is wholesome and that does not exceed an acceptable level of risk associated with pathogenic organisms or chemical and physical hazards” As the definition indicates, a number of hazards may cause food-borne illnesses. In the widely recognized Hazard Analysis Critical Control Point (HACCP) concept the term hazard refers to “a biological, chemical or physical agent in food with the potential to cause an adverse health effect”. This concept permits a systematic approach to the identification of hazards and an assessment of the likelihood of their occurrence during the production, distribution and use of a food product and defines measures for their control [11].

The Food and Drug authority (FDA) recently published an article (November 1, 2011),“Raw Milk Misconceptions (Mistaken thought, idea, or notion) and the Danger of Raw Milk Consumption, in which it argued that most claims made in favor of raw milk are false and that raw milk is unsafe to drink because it may contain pathogens and contribute to foodborne illness. The FDA categorically rejects any claims that raw milk may reduce the risk of certain health problems even though its potential to do so is currently an area of active research. It claims that pasteurized milk is just as nutritious as raw milk, but ignores changes that occur to the biological activity of milk nutrients during pasteurization. Finally, it claims that raw milk is unsafe because it may contain pathogens even though pasteurized milk is by the same logic also unsafe because it also may contain pathogens [12].

Pasteurization opponents say that raw milk contains bacteria beneficial to the human digestive system, but pasteurization is not selective and impacts all bacteria whether beneficial or infectious. These bacteria include species considered to be probiotics, such as *Lactobacillus acidophilus*, useful for the culturing of yogurt and cheese. Milk products with *L. acidophilus*, have been associated with decreased incidence of pediatric diarrhea, decreased levels of toxic amines in the blood of dialysis patients with small bowel bacterial overgrowth, aided lactose digestion in lactose-intolerant subjects and a reduction in coronary heart disease risks. However, food scientists and FDA officials maintain that such "good bacteria" can be found in pasteurized products, including yogurt and argue that the destruction of pathogens far outweighs any proposed benefit to keeping the "beneficial" microbes alive [13].

. Observational evidence suggests that raw milk may improve lactose tolerance, prevent the development of asthma and allergies and may be more digestible than pasteurized milk for people who have difficulty digesting fat. Pasteurization decreases the content of iron, copper, manganese and iodine in milk and may diminish the bioavailability of calcium and phosphorus. It causes major losses of biological activity for vitamin C and folate, substantial losses for vitamin B6 and may have similar effects for other vitamins. The available data for the prevalence of foodborne illnesses associated with specific foods are extremely poor in quality and rich in bias. Even taking these data at face value, however, raw milk may have the potential to protect millions of people from asthma and prevent hundreds of asthma-related deaths without causing major increases in the total burden of foodborne illness. These predictions need to be evaluated with high-quality, clinical research, which we will believe will proceed at a rapid pace only if the government abandons its antagonism to the producers and consumers of raw milk and instead encourages high quality scientific research and freedom of choice for consumers. We evaluate each issue individually below. In general, we follow the sequence and format of the FDA document, occasionally modifying it to eliminate redundancy [14].

Pasteurization is credited with dramatically reducing pathogens found in milk. This improves the shelf-life and safety of the processed milk. Advocates of drinking raw milk claim various health benefits they attribute to raw milk that are lost in the pasteurization process and claim that raw milk can be produced as hygienically as pasteurized milk. Raw milk advocates may go as far as to claim that untreated milk is a "miracle cure" for illnesses such as asthma or gastrointestinal disorders. A 2006 systematic review of infections associated with raw milk contends that pasteurized milk is substantially safer than raw milk and comparably nutritious to raw milk, therefore there is no scientific reason for choosing raw milk products [13]. Some people may say they have grown up drinking raw milk and never suffered ill effects. However, public health authorities have documented many cases of illnesses caused by drinking raw milk, which tell a far different story. While mandatory pasteurization of milk has virtually eliminated large outbreaks of milk borne disease in Canada, occasional cases still remind us of the hazards of raw milk consumption [12].

Pasteurization kills pathogenic bacteria which occasionally may be present in milk, including those causing tuberculosis (*Mycobacterium bovis*), listeriosis (*Listeria monocytogenes*), Q fever (*Coxiella burnetii*), brucellosis (*Brucella*), campylobacteriosis (*Campylobacter*), salmonellosis (*Salmonella*) and several other foodborne illnesses (e.g., *Escherichia coli* O157:H7). Pasteurization may not kill some resistant bacteria, which can eventually cause souring and spoilage of fresh milk. UHT pasteurization (Ultra High Temperature) is a more extreme form of pasteurization heating milk to a temperature high enough to kill spoilage organisms also. Pasteurization is widely accepted to improve the safety of milk products by reducing the exposure to pathogens. Opponents of pasteurization argue that unpasteurized milk has benefits associated with superior taste, nutritional qualities and certain health benefits over pasteurized milk. While pasteurization of milk kills off bacterial pathogens, other bacteria species with possible health benefits are also destroyed. A 2009 systematic review of the food safety of unpasteurized milk concluded that science-based data to substantiate claims of health benefits "are lacking or do not exist" and the risks associated with disease outbreaks as a result of raw milk consumption are "considerably higher [15].

Center for disease control and prevention (CDC) collects data on foodborne disease outbreaks voluntarily reported by the state, local, territorial, or tribal health departments. The health departments conduct most outbreak investigations reported to CDC. The data reported may change frequently as reporting agencies enter new records and modify or delete old ones. Among dairy product-associated outbreaks reported to CDC between 1973 and 2009 in which the investigators reported whether the product was pasteurized or raw, 82% were due to raw milk or cheese. From 1998 through 2009, 93 outbreaks due to consumption of raw milk or raw milk products were reported to CDC. These resulted in 1,837 illnesses, 195 hospitalizations and 2 deaths. Most of these illnesses were caused by Escherichia coli O157, Campylobacter, or Salmonella. It is important to note that a substantial proportion of the raw milk-associated disease burden falls on children; among the 93 raw dairy product outbreaks from 1998 to 2009, 79% involved at least one person less than 20 years old [16].

Biological Causes of Milk Safety Hazards: A biological entity that may cause an unacceptable risk to consumer health through illness. Primarily microbiological such as bacteria, viruses, fungi (Yeasts & molds) and protozoa [17].

Table 1: Pathogenic microorganisms detected in raw milk

Microorganism Enterobacteriaceae	Disease
Pathogenic Escherichia coli(eg EHEC, STEC)	Gastroenteritis, other complications involve Haemolytic uraemic syndrome (HUS) and Thrombotic thrombocytopenic purpura (TTP)
Salmonella	Gastroenteritis, typhoid fever
Shigella	Dysentery
Yersinia enterocolitica	Gastroenteritis
Vibrionaceae and Campylobacter	
Campylobacter jejuni	Gastroenteritis
Aeromonas hydrophila	Gastroenteritis
Other Gram-negatives	
Pseudomonas aeruginosa	Gastroenteritis
Brucella spp.	Brucellosis (Bang's Disease)
Gram-positive sporeformers	
Bacillus cereus	Gastroenteritis
Bacillus anthracis	Anthrax
Clostridium perfringens	Gastroenteritis
Clostridium botulinum	Botulism
Gram-positive cocci	
Staphylococcus aureus	Emetic intoxication
Streptococcus agalactiae	Sore throat
Streptococcus pyogenes	Scarlet fever/sore throat
Streptococcus zooepidemicus	Pharyngitis, nephritic sequelae
Miscellaneous Gram-positives	
Listeria monocytogenes	Listeriosis (various manifestations)
Corynebacterium spp.	Diphtheria
Mycobacterium bovis	Tuberculosis
Mycobacterium tuberculosis	Tuberculosis
Mycobacterium paratuberculosis	Johne's disease (ruminants)
	Crohn's disease (unproven in humans)
Rickettsia	
Coxiella burnetii	Q fever
Viral	
Enteroviruses, including polioviruses and Coxsackie virus, Rotaviruses	Enteric infection
Foot and mouth disease virus	Foot-and-mouth disease (not a human disease)
Hepatitis virus	Infectious hepatitis
Fungi	
Mould (and associated aflatoxins)	Mycotoxicoses
Protozoan parasites	
Cryptosporidium parvum	Cryptosporidiosis
Entamoeba histolytica	Amoebiasis
Giardia lamblia	Giardiasis
Toxoplasma gondii	Toxoplasmosis

Source: Boor [17].

The importance of milk in our diet is well established as it is considered as the best, ideal and complete food for all age groups. However, in spite of being so, milk can also serve as a potential vehicle for transmission of some diseases under certain circumstances. Moreover, by virtue of possessing almost all the essential nutritional factors, milk can also serve as an excellent source and protective medium for certain microorganisms, which may include potential pathogens capable of causing various health problems to the consumers [18].

In this way, milk may serve not only as a potential vehicle of transmission of disease causing organisms, but it can also allow these pathogens to grow, multiply and produce certain toxic metabolites, thereby making itself an extremely vulnerable commodity from the public health point of view[1].

A variety of pathogenic organisms may gain access into milk and milk products from different sources and cause different types of food-borne illnesses. Milk and milk products may carry organisms as such or their toxic metabolites (Poisons) called 'toxins' to the susceptible consumers. Ingestion of toxins already synthesized in the food i.e., pre-formed brings about poisoning syndromes in the consumers [19].

This is called 'food intoxication' and the toxins affecting the gastro-intestinal tract are called enterotoxins. Whereas the ingestion of viable pathogenic bacteria along with the food leads to their implantation and establishment in internal organs. This is called 'food infection'. There are yet other types of organisms, which can infect intestine when ingested along with the food and produce toxins in situ to bring about symptoms of poisoning. This situation is called 'toxi-infection' [20].

These three categories are better covered by the term food-borne infections and intoxications. Apart from these food-borne illnesses, a number of other types of diseases whose etiological agents may be bacteria, fungi, rickettsia and viruses can also be spread through milk and milk products. The microbiological health hazards arising from the consumption of contaminated high risk foods like milk has grown in recent years and has resulted in national and international intensification of food hygiene programs [19].

Although the occurrence of incidences of food-borne illnesses has been considerably reduced in most of the developed countries chiefly due to adoption of strict microbiological quality control and sanitary practices during the production, processing and distribution of milk and milk products, the situation continues to be grim in developing countries where such practices can not be followed. This problem is aggravated when heavy expansion of dairy industry in the third world countries and this increases the risk of milk-borne intoxications and other illnesses [2].

The pathogenic organisms may be derived chiefly from Dairy animals, Human handlers and Environment [2]. The health of dairy animals is a very important consideration because a number of diseases of cattle including Brucellosis, Q fever, Salmonellosis, Staphylococcal and Streptococcal infections and Foot and Mouth Disease (FMD) virus may be transmitted to man through the consumption of milk. The organisms of most of these diseases may be transmitted to milk either directly from the udder or indirectly through the infected body discharges, which may drop, splash or be blown into milk [21].

The diseased persons may transmit disease like typhoid fever, scarlet fever, diphtheria, septic sore throat and infantile diarrhea by contaminated hands or by coughing, sneezing and talking [20].

Dairy and farm environment may also introduce a variety of pathogens into milk and milk products at different stages of production and processing. Some common air-borne pathogens include Group A streptococci, Corynebacterium diphtheriae, Mycobacterium tuberculosis, Coxiella burnetti and some viruses of respiratory origin. Water, fodder and unhygienic conditions at farm and plant level may also contribute pathogens to milk [22].

Prevention of milk-borne diseases is one of the most important problems of public health. Success in controlling a disease can be maintained only by the constant vigilance over the health of the cow udder until it reaches the mouth of the consumers [23].

Bacterial Cause of Milk Safety Hazards: Bacterias are the leading and common microbial milk safety hazards. Raw milk is inherently dangerous. Raw milk may contain a whole host of pathogens, including: *enterotoxigenic Staphylococcus aureus, Campylobacter jejuni, Salmonella species, E. coli, Listeria monocytogenes, Mycobacterium tuberculosis, Mycobacterium bovis, Brucella species, Coxiella Burnetii and Yersinia enterocolitica.* This listing is not meant to be exhaustive. Illnesses caused by these bacteria can be especially problematic for infants, young children, the elderly, pregnant women and the immunocompromised. One complication that can arise as a result of infection with *E. coli* O157:H7 is hemolytic uremic syndrome (HUS), which can cause acute renal failure, especially in the very young or the elder. The common symptoms of food borne infection and intoxication in man are diarrhea, abdominal cramps, nausea, vomiting, headache, fever and chills [22].

Food and Drug authority (FDA) and other health agencies such as the Centers for Disease Control and Prevention organizations such as the American Academy of Pediatrics agree that raw milk is unsafe because it can contain disease-causing pathogens, Oliver *et al*. [2].

Other micro-organisms are emerging, capturing the attention of scientists and analysts. Research in dairy products often shows the detection of bacteria which before were never analysed, but very likely present also in the past. The development of modern analytical tools reveals the presence of an unexpected number of different biotypes of the same species. For several reasons micro-organisms change, become more virulent, more resistant to certain antibiotics, the number of people susceptible to being infected increases, etc. All this can contribute, together with the increased capacity of monitoring and keeping record of infections transmitted through dairy products, to an increased number of cases of foodborne diseases [23].

In developing countries, there are some reports on the presence, with an incidence ranging 10-20% of the samples, of harmful organisms such as *E. coli O157: H7, Brucella melitensis, Bacillus cereus, Yersinia enterocolitica, Aeromonas hydrophila, Pseudomonas pseudomallei, Lysteria monocytogenes, Staphylococcus aureus*, etc. Samples were isolated from products consumed directly and deriving from cow, sheep, goat, camel, buffalo milks. It is also clear that there is a high risk of contracting diseases by consumption of these products. However, we make this statement on the basis of our limited European experiences which were recorded in a totally different environment, on a different population with very different food consumption habits, in very different sanitary conditions, etc [2].

Another issue that would need special attention and discussion is the presence of aflatoxins, in particular aflatoxin M1.These toxins are quite often found in milk and milk products, as consequence of the growth of fungi on feed, a phenomenon facilitated by the environmental conditions in several developing countries. Due to the carcinogenic properties of some toxins the control of aflatoxins is highly advisable for the benefit of consumer health [24].

Brucella: Brucellosis is one of the classical examples of milk-borne zoonosis. The three principal species of Brucella (*B. abortus, B. melitensis and B. suis*) have been isolated from milk (Dairy animals) in various parts of the world. All of them can infect man and excreted in milk of dairy animals. In non-pregnant cows the organism is found in the secretory tissue of the udder. In man it causes systemic disease, usually with an insidious onset resembling flu and clinical diagnosis is usually difficult. (Pasteurization destroys this organism) [25].

Staphylococcus Aureus: Raw milk is recognized as the most likely source of contamination of dairy products with *S.aureus*. Of 344 goats and 63 ewe's milk samples 109 and 21 were positive for S. aureus respectively. Samples of cow and goat raw milk and raw milk products in Norway were examined for the presence of *S. aureus* and enterotoxin production. Of 220 cow milk/milk product samples and 213 goat milk/milk product samples 165 and 31 were positive for the organism respectively. SE production was evident in 22.1% and 57.3% of isolates from the cow milk/milk products and goat milk/milk products samples. Detection of *S. aureus* in 62% of samples of bulk tank milk in France gives an indication of the high prevalence of this organism in dairy operations. In man, pathogenic staphylococci are commonly associated with skin lesions, infected lacerations, boils and pustules that are common in farm workers. In cattle, staphylococcus is often found in older cows as a low grade, sub clinical mastitis or from small ulcers on the teats. (Pasteurization destroys this organism, but not the toxin) [26].

***E-coli*:** *E. coli* 0157:H7 is a newly recognized bacterial zoonosis that causes haemorrhagic colitis (HC) and haemolytic ureamic syndrome (HUS) in humans. The strain is found in gut and fecal material of affected cows and humans. Milk can get contaminated through contamination with cow faces or unhygienic handling. Dairy cattle in many countries have been shown to harbour *E. coli* 0157:H7 and to act as a source of contamination of milk (And other foods), water and the environment [27-29].

Cattle are the most important animal reservoir of shiga toxin-producing *Escherichia coli*(STEC), particularly O157:H7, however STEC has been isolated from other animals including sheep, goats, dogs, pigs, horses and flies. Carriage rates in cattle vary with a survey in the USA detecting the O157:H7 in 1% and 10% of healthy and ill cattle respectively. Several surveys have been conducted to determine the prevalence. The farm prevalence of O157:H7 in the USA is estimated to be between 22 and 50%, even higher if including other STEC serotypes, with the individual carriage rate ranging between 0.2% to 8.4% Overall approximately 4% of cattle in the USA and the UK are positive for STEC O157. Sheep are also known to harbour STEC. In Scotland a survey of 15 flocks near Aberdeen were tested for the presence of STEC O157, 6 were found to have the organism, with 6.5% of 676 faecal samples also testing positive. STEC O157:H7 were found in 30 of 68 samples of faeces from goats from farms in Florida, USA. Across 32 separate publications the total number of samples of bulk tank milk (bovine) was 20038, with 1275 positive samples for STEC, giving an overall prevalence of 6.36% [30].

E-coli is found naturally in the environment for example in soil, water and faeces/manure or in the digestive tract of humans and animals. It is an important indicator of poor hygiene practices or improper processing. Symptoms of contracting this organism are vomiting, fever, diarrhea and stomach cramps. (Pasteurization destroys this organism) [29].

***Mycobacterium Bovis* (Bovine Tuberculosis):** Cattle shed *M. bovis* in respiratory secretions, feces and milk and sometimes in the urine, vaginal secretions or semen. Large numbers of organisms may be shed in the late stages of infection. Asymptomatic and allergic carriers occur. In most cases, *M. bovis* is transmitted between cattle in aerosols during close contact. Some animals become infected when they ingest the organism; this route may be particularly important in calves that nurse from infected cows. Cutaneous, genital and congenital infections have been seen but are rare. All infected cattle may not transmit the disease. Ingestion appears to be the primary route of transmission in pigs, ferrets, cats and probably deer. In addition, cats can be infected by the respiratory route or via percutaneous transmission in bites and scratches. Nonhuman primates are usually infected by inhalation. Aerosol transmission also seems to be the main route of spread in badgers, but transmission in bite wounds can be significant. Badgers with advanced disease can shed *M. bovis* in the urine and organisms have been found in the feces. Due to behavioral changes, badgers and possums are most likely to transmit *M. bovis* to cattle during the late stages of disease [31].

*M. bovi*s can infect humans, primarily by the ingestion of unpasteurized dairy products but also in aerosols and through breaks in the skin. Raw or undercooked meat can also be a source of the organism. Person-to-person transmission is rare in immunocompetent individuals, but *M. bovis* has occasionally been transmitted within small clusters of people, particularly alcoholics or HIV-infected individuals. Rarely, humans have infected cattle via aerosols or in urine. Infected milk are the most important vehicle for the transmission of bovine tuberculosis in man and it would appear that the presence in man is dependent on the prevalence in cattle and the amount of raw milk consumed. (Pasteurization destroys this organism) [32].

Human tuberculosis due to *M. bovis* has become very rare in countries with pasteurized milk and bovine tuberculosis eradication programs. However, this disease continues to be reported from areas where bovine disease is poorly controlled. The incidence is higher in farmers, abattoir workers and others who work with cattle. In addition, humans can be infected by exposure to other species; documented infections have occurred from goats, seals, farmed elk and a rhinoceros. Wildlife may be a source of infection, particularly in countries where bush meat is eaten [33].

Some human infections are asymptomatic. In other cases, localized or disseminated disease can develop either soon after infection, or many years later when waning immunity allows the infection to reactivate. Localized disease can affect the lymph nodes, skin, bones and joints, genitourinary system, meninges or respiratory system. Cervical lymphadenopathy (Scrofula), which primarily affects the tonsillar and pre-auricular lymph nodes, was once a very common form of tuberculosis in children who drank infected milk. In some cases, these lymph nodes rupture and drain to the skin; chronic skin disease (Lupus vulgaris) may occasionally result. Humans infected through the skin can develop localized skin disease ("Butcher's wart"), a form usually thought to be benign and self-limiting. Pulmonary disease is more common in people with reactivated infections than initially; the symptoms may include fever, cough, chest pain, cavitations and hemoptysis. Genitourinary disease can result in kidney failure. Bovine tuberculosis can be treated successfully with antimicrobial drugs, but untreated infections may be fatal [34].

Streptococcus: Group A streptococci (Sore throat, scarlet fever and mastitis) originate from human carriers that in turn may affect the udder. Unpasteurized or inefficiently cooled milk can lead to a rapid multiplication. (Pasteurization destroys this organism) [35].

Salmonella: These are not natural pathogens of milk animals, but are readily transmitted by milk in those areas where pasteurization is not enforced. This is a common food poisoning organism due to poor hygiene or incorrect processing. Symptoms associated with contracting this organism are nausea, vomiting, abdominal pain, headache, chills and diarrhea. (Pasteurization destroys this organism) [36].

Shigella: Shigella infections in man are often associated with the ingestion of raw milk. It occurs worldwide and two thirds of the cases and most of the deaths are in children under the age of 10 years. This occurs commonly in population living under poor conditions-malnutrition, poor sanitation and crowding. Sources are hands of milkers, water and flies. (Pasteurization destroys this organism) [35].

Campylobacter Jejuni: Animals may also harbor *Campylobacter* either as a normal commensal organism or as subclinical infections, including cattle, wild birds; rodents and some insects carry the organism on the exoskeleton. Milk has been implicated in outbreaks; however, pasteurization will generally eliminate the organism from milk. It was not detected in sheep or goats milk in Switzerland. There are several published reports on the detection of *Campylobacter* in farm bulk tanks with large variations in the prevalence of the organism. Several papers reported the absence of *Campylobacter* in raw milk. This represents over 1000 samples across three countries. Conversely, the highest level reported give an estimated prevalence of over 80%. The majority of papers gave indicative prevalence levels less than 10%. In total 10931 samples from bulk tanks across more than eight countries, from 26 separate publications, gave an overall prevalence of *Campylobacter* of 1.84% [37].

This organism is found naturally in soil, water and farm waste and in the digestive tract of animals. In recent years there have been reports of severe outbreaks of enteritis in the UK attributed to Campylobacter jejuni. In all cases consumption of unpasteurized milk was implicated. Symptoms are profuse diarrhea (Sometimes bloody), stomach cramps, nausea, dizziness and fever. (Pasteurization destroys this organism) [38].

Helicobacter Pylori: This organism may be transmitted through contaminated milk. Infection with the organism is a powerful predisposing factor to the development of stomach cancer. Treatment of clinical cases is expensive and a correct diagnosis in humans requires a gastric biopsy. (Pasteurization destroys this organism) [35].

Listeria Monocytogenes: Of the identified hazards in Pathogen Combat relevant to dairy industry operations, *Listeria monocytogenes* has had the greatest attention placed surveillance. The organism's ability to grow at low temperatures means that strict temperature control is required to restrict potential growth. Nearly 50 papers and reports on the detection or surveillance for *Listeria monocytogenes* in bulk tank milk were collected. This represents over 66000 samples spanning 24 countries. A small portion of the papers examined showed absence of the organism in the samples collected (641 samples across five countries). One of the papers [39] detailed a long term study (23 years) in Denmark. This study collected an analysed 36199 samples and found 488 positive (Prevalence 1.2%) for *Listeria monocytogenes*. Due to the size and nature of this study, the overall prevalence of the organism in bulk milk in strongly influenced. Including this study, the global prevalence estimate result is 2.9%.However, excluding this study the estimated prevalence is 4.95%.The majority of the papers give detection rates between 1-6% [39]. This organism is found naturally in the environment. Consuming raw milk could lead to contracting this organism. It could cause symptoms like flu-like illnesses to meningitis. It may also cause abortion in pregnant women. It has a mortality rate of 30% of those who are infected. (Pasteurization destroys this organism) [40].

Bacillus Cereus in Liquid Milk: Raw milk is frequently contaminated with Bacillus spores, with the milk often contaminated at the farm. Sanitation of the teats prior to milking was able to reduce the incidence of B. cereus in raw milk. The presence of B. cereus in processed dairy product is often associated with the ability of the spores to survive pasteurization, which may then colonies pipes, tanks and filling machines [41].

Ryser and Marth [42] Examined the risk from *B. cereus* in pasteurized liquid milk in the Netherlands. The study estimated that up to 7% of pasteurized milk may contain *B. cereus*, with levels up to 105/mL. However, pasteurized milk has not figured as a cause of B. cereus food poisoning in Australia. One reason for this is the germination of B. cereus spores and its growth in pasteurized milk leads to the development of "off flavors" and an appearance discouraging consumption.

Viral Causes of Milk Safety Hazards: Viruses are the smallest of the microorganisms that can cause foodborne illness. One cannot look at a food to determine if viruses are present. Milk is contaminated by bacteria and viruses via unhealthy animals, people hands, milking utensils or water.Viruses are different from bacteria in that they do not grow in food. Viruses simply use food as a vehicle to get from one person to another. Therefore, viruses can contaminate any food. Water, salads, shellfish, iced drinks and other ready-to-eat foods are the most sources of viral foodborne illnesses. Some of the virus that contaminate milk and other food staffs are Entero viruses, Infectious hepatitis virus, Tick-borne Encephalitis Virus and Foot and Mouth Disease virus (FMD-virus).

Controlling Viruses: The best way to control viruses is to prevent them from getting into food in the first place. If viruses get into food, cooking might not destroy them. Therefore, as a food service manager you must: Promote good personal hygiene (Only allowing healthy workers to handle food). Have all workers frequently and properly wash their hands. Buy all food from an approved and safe source (Approved sources are regulated by the government are so are more likely to be safe).Use safe water for food preparation and cleaning -Safe water is drinking quality [43].

Chemical Causes of Milk Safety Hazards: The sources of chemical contaminants in raw materials of animal origin, mainly milk, are to a large extent comparable to those of raw materials originating from plants [44]. The most of chemical contaminants in milk and dairy products are veterinary drugs such as antimicrobials (Antibiotics and sulfonamides), hormones, anthelminthitic drugs, pesticides and etc.

Chemical Hazards are of concern in two respects first, environmental contaminants and second, adulterants added in milk which may cause illness or adverse health effects. There are several environmental contaminants that can affect the safety and quality of milk. Aflatoxins and other mycotoxins are reported to be mutagenic, carcinogenic, tetratogenic and hepatotoxic in most animals and man. Aflatoxins present in the cattle feed are excreted in milk are known as M1, M2 and M4, etc. These toxins can appear in milk within 48 hours of their intake through contaminated feed. It is important to have, regular monitoring for the presence of aflatoxins in milk. Heavy Metals for example lead; mercury, cadmium, arsenic, etc have been reported in milk. These contaminants are harmful / toxic if ingested in higher concentration than PFA norm. At world level, concerns are being expressed for their harmful effects and their prescribed limits are being lowered frequently in order to ensure safety of the food. Pesticides are commonly used for control of insects on plants and animals. The common insecticides which may be present in milk are DDT, BHC (Benzene hexachloride), their isomers and other chlorinated compounds such as aldrin, dieldrin, heptachlor etc. Radioactive Substances occur rarely in milk due to consumption of plants that are exposed to radiation produced by fission and fusion of nuclear material. Major radioactive substance are strontium 90 (90sr), Iodine 89(891)Barium140(140Ba).Chemical fertilizers and growth promoters (Such as Hormones) have been used extensively to boost up agricultural production [45].

Antimicrobial Residue: The most contentious residues that occur in milk are antimicrobial drugs. Much of the veterinary treatment of dairy cattle involves intra mammary infusion of antibiotics to control mastitis. Some drugs apply to control endoparasites, ectoparasites and several illnesses and to increase milk production [46]. The most commonly used antimicrobials in dairy cattle can group into five major classes. These include the beta-lactams (e.g, penicillins and cephalosporins), tetracyclines (e.g., Oxytetracycline, tetracycline and chlortetracycline), amino glycosides (e.g., streptomycine, neomycin and gentamycin), macrolides (e.g., erythromycin) and sulfanomides (e.g., sulfamethazines) [47]. These drugs are administered to animals by many routes such as injection routs, orally in the food and water, topically on the skin and by intra mammary and intrauterine infusions. Theoretically, all of these routes may lead to residues appearing in milk and dairy products. Whenever any route with an antibiotic treats a lactating cow, measurable levels of the antibiotic are usually detectable in the milk for a few days after the last. There are Maximum Residues Limits (MRLs) for some drugs in milk according European Union (EU) regulations that have shown in Table 2 [48].

Table 2: Maximum Residues Limits (MRLs) of some veterinary drugs in milk according to EU regulations

Drugs	Concentration ($\mu g\ kg^{-1}$)
Benzylpenicillin	4
Tetracyline	100-200
Oxytetracycline	100
Chortracyline	100
Trimethoprim	50
Ceftiofur	100
Streptomycin	200-100
Oxfendazole	10
Sulphonamides	100

Source: [48]. Maximum Residues Limits (MRLs) for some drugs in milk according EU regulations

Although antibiotic residues in foods can have a detrimental effect on the processing of cultured products such as cheese and are important in terms of consumer confidence, the public health significance of residue concentrations of some of these compounds in foods from animals appears to be low, based on substantial scientific assessment. Most of the antibiotic drugs currently used in animal agriculture are relatively non-toxic, even at high concentrations, but there are a few antibiotics which pose a small but significant threat to public health when present in sufficiently high concentrations in foods. Among these is chloramphenicol, which has been associated (In a non-dose related manner) with aplastic anaemia due to bone marrow depression in a small proportion of human patients to whom the drug was administered for therapeutic purposes. Some of the patients who survive the bone marrow depression have developed leukemia, which creates concerns about possible carcinogenicity. Based on animal bioassay data, nitrofurans and some anti-parasitic drugs, such as dimetridazole, also raise some concern of carcinogenicity. Other antibiotics have been associated with allergic reactions of varying severity in people. An estimated four to ten allergic reactions occur per 100,000 courses of penicillin treatment administered directly to people, but actual incidents of allergic reaction to penicillin residues in foods are few and poorly documented. Although sulfonamides and tetracyclines aclministered to people at therapeutic concentrations may have toxic and allergic consequences, there is little evidence that these occur at the concentrations at which residues are encountered in foods. Based on experimental evidence, however, there is concern that residue concentrations of antibiotics have the potential to encourage the development of antibiotic resistance in the microbial flora of people eating contaminated foods [49].

Exposure from veterinary drug residues rather most common as are directly injected or feed to the animals. The overuse of antimicrobials such as tetracyclines, sulfonamides, amino glycosides, â-lactam derivatives etc. in animal production or their residues in food system pose potential allergic reactions in sensitized individuals. But sub therapeutic and therapeutic levels may disturb human gut micro flora [50].

The National Research Council and Institute of Medicine have noted a link between the use of antibiotics in food animals and the development of bacterial resistance to these drugs causing human diseases. Similarly, scientist at Center for Disease Control and Prevention (CDC) began tracking a new type of *Salmonella* called Newport 9+ which is resistant to nine antibiotics including ceftriaxone, One of the few drugs that kill most bacteria and the drug of choice for children when *Salmonella* enter the blood stream the emergence of resistant bacteria within animals and the transfer of antibiotic resistance gene to human pathogens [51].

Hormone Residue

Steroid Hormones: Milk can also consider as a rich source of steroid hormones. The amounts of lipophilic hormones depend on the fat content of the milk and dairy products. Not only progesterone but also estrogen increases with fat content. Food processing does not seem to influence the amount and ratios of the hormones. Food processing, such as heating or churning, appears to have no effect on the hormones in milk and dairy products although cheese ripening does. In fresh cheese as well as in ripened cheese, testosterone was detected (0.1-0.5 mg kg^{-1}). Probably not only propionic acid bacteria but also other fermenting bacteria or clotting enzymes are responsible for the formation of testosterone during the fermentation process [52].

Bovine Growth Hormones: Bovine Growth Hormone (BGH) or Bovine Somatotropin (BST) is a genetically engineered protein hormone either identical or similar to the natural bovine pituitary product. Its primary function is to increase milk production dairy lactating cattle. Therefore, BST is a protein hormone that increases milk production in cows between 10 and 15%. An increase in milk yield typically occurs with 5 days after beginning of treatment. When BST-treated cows were consuming sufficient quantities of nutrients to meet the energy needs for additional milk synthesis, body lipid mobilization did not increase, but lipid synthesis was instead reduced. BGH increases activity and/or longevity of mammary secretary cells, probably via Insulin-like Growth Factor (IGF)-I produced by the liver and/or the mammary gland. IGF-I is a portion of the effects of BST on lactation in dairy cows. The raw milk and pasteurized milk could have been levels of IGF-I of 5.6 and 8.2 ng mL-1, respectively. The infant formula could have been only trace amounts of IGF-I of 0.7 ng mL-1. Therefore, IGF-I is not destroyed by the pasteurization process but the heating of milk for the preparation of infant formula denaturizes IGF-I and significantly, reduction (35-48%) levels of IGF-I compared to raw milk. BGH is probably stimulating immunological responses of animals and hence increasing the milk cell count. The US Food and Drug Administration (FDA) declared BGH officially "safe" in 1993, but it can cause to increase incidence of clinical mastitis in cows and sub clinical mastitis in ewes. This prompted concern that increased use of antibiotics to treat the mastitis might lead to increased residues of such drugs in milk. Therefore, the risk to human health comes not from BGH residues but from the possibility that residues from the antibiotics used to treat the udder infections could end up in the milk supply. There are many conventions about BST treated in cows. For example, an international meeting of scientists of the United States and Europe has concluded that beef raised with hormonal supplements has no adverse effect on humans and they are safe for cows and humans. However, in news of the World Trade Organization has partially accepted European Union (EU) contentions for prohibiting the use of growth-promoting hormones in cattle [53].

Pesticides and Insecticides Residue: Contamination of feeds arises in the field or store where treatment with pesticides occurs. Chlorinated pesticides and related compounds such as DDT, Polychlorinated biphenyls (PCBs) and Dioxins can enter milk and dairy products. The chlorinated hydrocarbons are extremely durable, persistent, endocrine-disrupting activities, bio-accumulating and widely distributed toxic compounds that find their way into the food chain usually through use in controlling environmental or animal pests [54]. As much as 20% of an ingested chlorinated hydrocarbon excretes in milk. Chlorinated hydrocarbons adhere to milk fat and butter contains a much higher proportion of these insecticides. DDT can accumulate in fatty tissues and can transfer into milk and dairy products. Organochlorine pesticides such as DDT and Hexachlorocyclohexane (HCH) have banned in China since 1983. Residues of such compounds may persist in the environment and cause contamination through the food chain Presented organochlorine pesticide residues (Owing to their use in sanitary actions) indicating a human exposure through milk and dairy products [55].

Mycotoxins Residue: Some of the moulds produce various toxic metabolites under appropriate temperature and moisture conditions. These metabolites, which may be hazardous for human health, are called mycotoxins. Aflatoxin M1 (AFM1) may be found in the milk of animals that are fed with Aflatoxin B1 (AFB1) containing feed. It can produce by moulds of feeds that have been harvested damp, have not adequately dried, or are improperly stored. These substances through the feedstuff can infect dairy cattle. The content of AFM1 in milk is entirely dependent on the presence of the precursor AFB1 in the ration of dairy cattle and it can numerically express as feed to milk ratio. The forming of AFM1, metabolite of AFB1, occurs in liver and it secrets into milk in the mammary gland of dairy cows. Many researchers reported that there was a linear relationship between the amount of AFM1 in milk and AFB1 in feed consumed by the animals. On the other hand, AFM1 levels in milk show a seasonal variation and the toxin amount have differences in the products, which are produced from the toxin containing milk. It reported that after uncovering of negative effects of aflatoxins on public health, various international foundations related with this subject paid attention and in 1993, International Agency for Research on Cancer (IARC) of WHO included AFB1 as primary and AFM1 as secondary groups of carcinogenic compoun. Many countries have carried out various control and inspection programs on this subject concerning about public health for many years. According to the results obtained, maximum aflatoxin levels were determined for food and feed by considering each country's conditions and finally regulations were established [56].

Heat treatments like pasteurization were not effective in the reduction of formation of AFM1 [57]. It has relatively increased in cheese samples because of its affinity to casein fraction in milk and due to the water solubility of this toxin lower level of AFM1 was found in cream and butter than that of bulk-tank milk. All of these findings indicated that AFM1 with different levels could be available in dairy products made from contaminated milk. Consequently, this subject is a serious problem for the public health since all the age groups including infants and children consume these products worldwide. For this reason, milk and dairy products have to be inspected continuously for AFM1 contamination at least twice a year. Beside this, it is important to have low levels of AFM1 in the feeds of dairy animals and in order to achieve this purpose, feeds of dairy cows should be kept away from contamination as much as possible [57].

Heavy Metals Residue: Heavy Metals for example lead, mercury, cadmium, arsenic, etc have been reported in milk. Heavy enter the human body mainly by the routes of inhalation and ingestion. With increasing environmental pollution, a heavy metal exposure assessment study is necessary Heavy metals produce toxic effects by replacing essential metal ions existing in the chelates present in body. The intake via ingestion depends upon food habits. It is well established that lead (Pb) and cadmium (Cd) are toxic for human and children are more sensitive to these metals than adults. The metals, namely copper (Cu) and zinc (Zn), are essential micronutrients and have a variety of biochemical functions in all living organisms. While Cu and Zn are essential, they can be toxic when taken in excess; both toxicity and necessity vary from element-to-element. Milk is the fundamental food for infants and the daily intake of the heavy metals Pb, Cd, Cu and Zncanb determine by different age groups of infants through different milks and baby foods. Heavy metals can enter to milk and dairy products and affect the health of people who have consumed contaminate milk and dairy products [58].

Public Health Concerns of Chemical Residues: The presence of chemical contaminants in milk are very important for consumers and it can be a matter of public health concern as well as many of unknown diseases in human because milk and dairy products are widely consumed by humans throughout the world. Primary concerns associated with antimicrobial residues in milk and dairy products do not express by the consumers. It expresses by the dairy processors who found that contaminated milk was inhibiting the starter cultures used in the production of cheeses, yoghurt and other fermented dairy products as well as influencing the results of the dye reduction tests used for milk quality at the time. An important concern of veterinary toxicology is the possible transmission of harmful substances from milk and dairy products to human population. This concerns primarily antibiotics in use as feed additives. They include tetracycline, nitrofuranes and sulfonamides [44]. There may be biologically active metabolites of antimicrobial in milk and dairy products that could result anaphylaxis and allergic shock in sensitized individuals such as penicillin. Penicillin is not inactivated by pasteurization or drying and levels as low as 0.03 IU mL-1 has caused skin rashes [59]. Overuse of antimicrobial in agriculture production cause to toxicity in human and animals. They can cause some disruptions like aplasia of the bone marrow (e.g., chloramphenicol) [48] and carcinogen (e.g., oxytetracycline and furazolidone). In addition, they can react with nitrite to yield (carcinogenic) nitrosamines (e.g., oxytetracycline) [48]. They have some effects on the human gut microbial populations, the emergence of resistant bacteria within animals and the transfer of antibiotic resistance genes(R-factor) from non- pathogenic bacteria to other bacteria or human pathogens that will lead to widespread resistance [59]. Therefore, the use of antibiotics in livestock species may accelerate the development of antibiotic-resistant strains of microbial pathogens, potentially complicating treatment for both animals and humans. Pesticides, e.g., Hexachlorocyclohexane (HCHs), can cause damages on central nervous system, reproductive and endocrine. Organochlorines are pesticides, which have neurotoxic and teratologic effects [60]. In general, organochlorine pesticides characterize by their high lipophilicity and long elimination half-lives. Disruption of the normal homeostasis of the endocrine functions can result in developmental, reproductive, neurotoxic, carcinogenic, immunotoxic and other adverse health effects. The mechanisms of endocrine disruptive actions of these chemicals have not well understood. It is not known as to whether these chemicals act directly as hormones or modify the endocrine systems by binding to endocrine receptor sites. Disruption of normal endocrine-regulated functions by these chemicals represents an important consideration in risk assessment [54]. Mycotoxins can also present in milk and dairy products and can create public health problems in humans. The consumption by humans of aflatoxin-containing edible-tissue, other than milk, from animals that have consumed aflatoxin contaminated feed, is necessarily a matter of concern. Aflatoxin M1 in milk is a carcinogenic metabolite of aflatoxin B1. Aflatoxin M1 in milk and dairy products led to increase the risk of cancer liver. Excretion of AFM1 into milk causes hepatocellular carcinoma in rat and rain trout. Due to the potent carcinogenicity of AFM1, most countries regulate both AFB1 in dairy cattle feed and the AFM1 in milk. The tolerance level for AFM1 in milk varies among countries from 0.05 μg kg-1 in Europe to 0.5 μg kg^{-1} in the United States [61, 62]. The tolerance level for AFM1 in milk and dairy products in Iran is also 0.05 to 0.5 μg kg^{-1} [57].

Physical Causes of Milk Safety Hazards: Physical Hazards are material found in milk, which may cause illness or injury to the user i.e. glass, wood, metal, pest, insulation, plastic, dirt etc. The probability of introducing physical hazards on-farm, which ends up in the final products is thought to be minimal. Any physical hazard contamination that may be introduced on farm should be removed at the farm level. Most dairy farms include a filter 'sock' through which the milk passes prior to entering into the farm vat. This filter will remove most gross physical contaminants [63].

The introduction of physical hazards at the processing level has occasionally happened in the past, with pieces of equipment ending up in a dairy product. The instances of this occurring are very rare and the preventative maintenance of equipment means the risk is very low [64].

Acceptable Levels of Hazards: The key reason of the complexity of defining 'safe food' is that the acceptable (Tolerable) levels of food safety hazards are difficult to set.

The Codex Alimentarius Commission (CAC) has set acceptable levels of chemical substances that are commonly recognized. For residues an Acceptable Daily Intake (ADI) has been established. For pesticides this limit is determined on the basis of the concept of a Maximum Residue Level (MRL), *i.e.* the maximum concentration of a pesticide residue resulting from the use of the pesticide according to good agricultural practice. MRLs are expressed in mg substance per kg food. In the case of veterinary medicines, determination of the limits is based directly upon the ADI. In other words, a hypothetical maximum diet has been composed containing product groups consumed daily and basically the ADI is distributed over these product groups. For environmental contaminants the term Tolerable Daily Intake (TDI) is often used. The ADI or TDI is the daily intake of chemicals to which consumers can be exposed daily without this having adverse effects on their health. This intake is usually expressed in mg single substance per kg body weight. However, in recent years, the validity of acceptable levels set for single substances has been doubted. Although the available studies on interactions between substances do not support this, there are a number of circumstances–e.g.in cases of structural analogues of substances where combined exposure should be taken into account as part of setting acceptable levels of chemical substances. This has been the approach adopted for food additives in the establishment of group ADIs and for some contaminants in the establishment of toxic equivalency factors for combining intakes of structural analogues.

As for microbiological hazards the establishment of acceptable levels is rather different. The approaches to food safety criteria that have been developed are based on end product testing and frequently differ among countries. Because of the non-uniform distribution of micro-organisms in the end product and possible recontamination during the production process these approaches do not guarantee total absence of pathogens. At the same time, microbiological inspection of all food is physically and financially impossible. In addition, it is impractical to apply end-product criteria for products that will have been distributed and probably consumed before examinations are completed [65].

A new risk-assessment based concept of 'Appropriate Level Of (Consumer) Protection' (ALOP) was introduced by the World Trade Organization/Sanitary and Phytosanitary Agreement in 1994. An example of an ALOP is that the incidence of human listeriosis related to ready-to-eat foods should not exceed 0.25 cases per 100,000 inhabitants per year. However, the Codex Alimentarius Commission has still to elaborate a procedure for translating such a general risk estimate into a specific microbiological criterion that can be used by producers or authorities. The International Commission on Microbial Specifications for Foods (ICMSF) has therefore proposed to use risk assessments for establishing 'Food Safety Objectives' (FSO). An FSO is "a statement of frequency or maximum concentration of a microbiological hazard in a food considered acceptable for consumer protection". An example of such an FSO could be that the level of *Listeria monocytogenes* in ready-to-eat foods should not exceed 100 colony-forming units per g food at the moment of consumption. An FSO may serve as an equivalent to the acceptable level of a hazard to be attained by control measures integrated into a quality and safety assurance plan that includes the General Principles of Food Hygiene and the HACCP. Some of these control measures are explicitly expressed as performance criteria, process criteria, or end-product criteria, which may be developed and adopted by producers to meet the FSO [66].

The concept of FSO is in principle applicable to chemical hazards as well, although for some substances, like dioxin, it is difficult to define an FSO. In contrast to generally acute symptoms of food-borne microbiological illnesses, chemicals usually cause continuous exposure over a lifetime. Moreover, as other factors may play a role in the occurrence of the illness, in many cases there is no unambiguous causal relationship between a particular hazard and human illness [65].

Control and Prevention of Milk Safety Hazards: To control milk safety hazards effectively, it is important to understand the nature of possible hazards. Not all substances or microorganisms are hazardous until they reach a certain level, so it is important to know and understand the significance of these levels. Possible hazards are always going to pose a risk to your health and company, so it is essential to know how to control these hazards. By using different methods such as destroying, removing, preventing, or reducing hazards to an acceptable level, contamination issues will be greatly reduced, for instance

Pasteurization is a sanitation process in which milk is heated briefly to a temperature high enough to kill pathogens, followed by rapid cooling. While different times and temperatures may be used by different processors, pasteurization is most commonly achieved with heating to 161 degrees Fahrenheit (72 degrees Celsius) for 15 seconds. Milk is tested following pasteurization to confirm that bacteria have been killed to an acceptable level [67].

One very useful program for chemical contaminants control in milk and dairy products is the using of the hazard analysis critical control points (HACCP) approaches in livestock, milk and dairy industries. The HACCP approach specifically develops for control in the food production industries. Its applications to date have focused mainly on microbiological hazards, although it also has potential application for chemical hazards [67, 68 and 69].

To control food hazards in general, you must have a system in place that maintains control points within the process (e.g HACCP).You must have knowledge of how to develop this system so that any change can be taken into account and managed correctly.

General Control Points for Biological Hazards: Product Specification: The implicated food must be specified in the first place, example milk and milk product such us cheese, butter, yoghurt etc. It is important to be aware of the presence and number of microorganisms in food. Many raw materials, therefore, have microbiological standards. It is common in the food industry to have specifications for the absence of microbiological contaminants [69].

Control Mechanisms: Physical and chemical control mechanisms significantly affect the survival and multiplication of microorganisms; for example, a reduction in pH by yoghurt formation can prevent microorganisms from multiplying [70].

Time and temperature are important control points since pasteurization and cooling (freezing) can prevent the growth of biological contaminants. Freezing usually stops the multiplication of microorganisms; however it does not kill them. Thermal processing will kill most biological hazards [71].

Cross-Contamination: Cross-contamination must be managed so that materials cannot contaminate others. Control systems should be in place and your staff made aware of their responsibility to prevent Cross-contamination. Your staff must also be aware of correct product handling and personal hygiene [69].

Cleaning and Disinfection: The equipment used for producing, processing and storing products should be sanitized on a regular basis. It is good practice to have a cleaning schedule in place [1].

The packing, storage and distribution must be controlled so that no biological hazard can contaminate or survive on food products. This process will entail suitable packaging for the product and temperature control in storage and distribution [70].

Conditions for Use: The directions you provide to the consumer are very important. Providing information on how to correctly store and heat treatment of the product can reduce the risks of biological hazards [69].

Controls of Chemical Hazards: Having a management system in place that indentifies sampling points and sampling levels is good practice to reduce the risk of chemical hazards [72].

Control points for chemical hazards must be identified during the process and storage of milk and milk products. Such can be done by using hazard analysis technique [67].

Preventing Physical Hazards: Preventive maintenance of equipment is extremely important to greatly reduce the risk of physical contamination [5].

Equipment failure or breakage can allow physical hazards to enter foods. This happens usually during the processing stage. Routine inspections and maintenance of the equipment is good practice [64].

Screens and filters used in liquid processing can identify problems in equipment upstream. By regularly inspecting the screens or filters, objects from equipment (broken machine parts or rubber seals, for example) can easily be seen and further contamination reduced [67].

CONCLUSION

Milk is highly vulnerable to bacterial contamination and hence is easily perishable. Not only bacterial but also chemical contaminants are the vital problems, especially in developing countries. So, in several countries of the world, a milk safety problem is very common. Therefore, a regulatory law implementation in milk and dairy industries, training of personnel, good manufacturing practices and monitoring by regular examination with economic penalties about chemical residues is required to do milk safety. Therefore providing 'on-farm food safety' programmers' (Good hygienic practice, GHP) which address the daily management of the production unit with regard to animal health and well-being, public health and environmental health must be a top priority for agriculturalists and veterinarians. Developing critical control point management (CCPM) procedures for animal and human health concerns is a viable approach to aid in alleviating public concerns about dairy products and the food supply in general. Implementation of these programmes will be essential in addressing milk safety concerns for the public health.

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