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Milk Borne zoonotic diseases

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Introduction

Contamination in milk, leading to spoilage and the presence of harmful microorganisms causing illnesses, can originate from various sources such as animals, handlers, the environment, water, equipment, air, and raw materials, exacerbated by poor sanitation practices. Understanding these sources is crucial for preventing or minimizing the impact of spoilage and pathogenic microbes in milk.

Milk serves as an effective carrier for disease-causing microorganisms, posing a significant challenge with the widespread collection and distribution of milk in industrialized nations. The potential for disease transmission through milk necessitates constant vigilance over the health of dairy animals and the implementation of stringent controls at every stage, from the moment the milk is extracted until it reaches the consumer. Regardless of the economic status of a country, the key to disease control lies in maintaining a meticulous approach to all aspects of the milk supply chain.

The challenges associated with ensuring a safe milk supply may vary between economically advanced and developing countries, but essential similarities persist. In both scenarios, whether employing a highly mechanized system with extensive distribution services from a centralized milk plant or facing different magnitudes of issues, any lapse in attention at critical points along the milk chain from the farm to the consumer can invite problems.

A shared factor between advanced and developing nations is the presence of disease-causing microbes. These microbial agents can be categorized into three main groups:

a) Communicable disease-causing microbes, encompassing viruses, rickettsiae, bacteria, protozoa, and other parasites, along with their associated toxins.

b) Specific and non-specific sensitizing agents.

c) Toxic chemicals, such as pesticides, preservatives, drugs, radionuclides, and various substances.

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Milk, being rich in nutritional components, can be an ideal medium for microbes, particularly pathogens. Bacteria can efficiently utilize various elements in milk to grow and proliferate. During this process, these microbes release various metabolites such as lactic and other organic acids, enzymes, gases, flavoring compounds, pigments, toxins, etc., which can have both beneficial and harmful effects on milk quality. Generally, these metabolites contribute to different forms of spoilage in milk products, rendering them unsuitable for consumption. Raw milk, in particular, poses inherent dangers and should be avoided by all individuals due to the potential health risks associated with consuming it. Despite the historical practice of consuming raw milk in northern parts of India, it may be attributed to a lack of awareness among consumers.

Food safety experts emphasize the life-saving benefits of pasteurization. The widespread adoption of pasteurization techniques in the early 1900s has significantly reduced milk-related foodborne illnesses from one-fourth to approximately 1 percent today. Although anyone can be susceptible to illnesses like E. coli or Salmonella poisoning from raw milk, children and individuals with weakened immune systems face a higher risk. The popularity of raw milk is on the rise, leading to an increase in infections as people take this health risk. Milk can act as a potential carrier for the transmission of diseases under certain conditions. Pathogens thrive in milk, producing toxic metabolites and turning it into a highly vulnerable commodity from a public health perspective. Microbiological health hazards associated with contaminated milk have escalated in recent times, prompting an intensified focus on global food hygiene programs. While developed countries have significantly reduced the incidence of foodborne illnesses through stringent microbiological quality control and sanitary practices in milk production, processing, and distribution, the situation remains challenging in developing countries like the Indian subcontinent where such practices are currently impractical.

Spoilage of milk is evident through a decline in aroma, flavor, texture, and nutritional value, and in severe cases, dairy products become entirely unpalatable. Moreover, certain microbes release toxins that can pose health risks to consumers.

Pathogens can enter milk through various sources, leading to different types of foodborne illnesses. Microbes or their toxic byproducts, known as toxins, may be present in milk and its products.

The health of dairy animals is a crucial factor, as diseases such as brucellosis, Q-fever, salmonellosis, staphylococcal and

streptococcal infections, and foot and mouth disease virus can be transmitted to humans through milk. These microbes may reach milk directly from the udder or indirectly through infected body discharges that might fall, splash, or be blown into the milk.

Handlers also play a significant role, as individuals with illnesses like typhoid fever, scarlet fever, diphtheria, septic sore throat, and infantile diarrhea can transmit diseases through contaminated hands or by coughing, sneezing, and talking during milking or subsequent milk handling at the farm.

The dairy farm environment itself can introduce pathogens at various stages of production and processing. Airborne pathogens, such as Group A Streptococci, Corynebacterium diphtheriae, Mycobacterium tuberculosis, Coxiella burnetii, and respiratory viruses, may be present. Contaminated water, fodder, unclean vessels, and containers used in milk handling, along with overall unhygienic conditions at the farm and processing plant, contribute significantly to the presence of pathogens and spoilage-causing microorganisms in milk.

Major milk borne disease

Tuberculosis

Mycobacterium tuberculosis is the causative microorganism for tuberculosis. German physician Robert Koch (1843-1910) identified this microorganism in contaminated raw milk, linking it to infant mortality. Koch also discovered that another strain, M. bovis, caused tuberculosis in cows, with a species-specific nature believed to spare humans. Tuberculosis linked to raw milk was often due to external contamination or lesions in cows suffering from bovine tuberculosis. The risk extended to milk buckets, easily contaminated by workers. Tuberculosis manifests in two forms: pulmonary and non-pulmonary. Pulmonary tuberculosis, affecting the respiratory tract, results from the human strain of the microorganism. M. bovis causes non-pulmonary tuberculosis in cattle, while the avian type may cause both forms.

- The tuberculosis-causing strains are as follows:
  - **Mycobacterium tuberculosis:** Human
  - **Mycobacterium bovis:** Cattle and human
  - **Mycobacterium avium:** Birds, swine, but rarely human

Human tuberculosis bacilli can enter milk through milkers and handlers, leading to human-type tuberculosis in cattle. This may not be immediately apparent and might yield a negative tuberculin test initially, becoming positive after 2-3 months. Suspected animals are usually observed and periodically tested. If the reaction disappears, they are reintegrated into the herd. Cattle may excrete bacilli in milk from seemingly normal udders.

Besides cattle, other milch animals, like buffaloes and goats, can be affected by tuberculosis, mainly of the bovine type. Although a significant proportion of cows may be infected, human infections are practically nonexistent, likely due to the common practice of boiling milk before consumption. Boiling or souring milk can eliminate human and bovine tuberculosis bacilli within 18 to 24 hours. Avian-type tuberculosis bacilli can also naturally infect cattle, but human infections with this type are exceedingly rare.

Symptoms: Tuberculosis manifests through the initiation of parenchymal pulmonary infiltration, which is identifiable through X-ray analysis, as well as pleurisy. This is succeeded by an advanced stage marked by symptoms such as cough, fever, fatigue, and weight loss. The incubation period spans 4 to 6 weeks, during which the infection progresses to the point of demonstrating a primary lesion.

Prevention and control: Animals should be subjected to tuberculin test. Animal suffering with tuberculosis should be isolated. Proper heat treatment of milk. The traditional habit of boiling every lot of milk before consumption in India is good, in combating the incidence of tuberculosis. Overcrowding of animals must be avoided and living conditions must be improved. Tuberculosis patients should be prohibited from handling cattle as well as milk. Proper disinfection should be followed.

Brucellosis

Brucellosis, also known as Bang's disease, Crimean fever, Gibraltar fever, Malta fever, Maltese fever, Mediterranean fever, rock fever, or undulant fever, stands out as one of the most prevalent milk-borne diseases. This highly contagious zoonotic illness is triggered by the consumption of unsterilized milk or meat from infected animals or close contact with their secretions. Brucella spp., characterized as small, Gram-negative, non-motile, non-spore-forming, rod-shaped bacteria (coccobacilli), operate as facultative intracellular parasites, leading to persistent, chronic disease.

Brucellosis encompass profuse sweating, joint pain, and muscle discomfort. The origins of Malta fever, now identified as brucellosis, trace back to the 1850s in Malta during the Crimean War. In the realm of cattle, this ailment is also recognized as contagious abortion and infectious abortion.

Symptoms: The primary symptoms of this condition manifest as muscular pain and sweating, and the duration of the illness may vary from a few weeks to several months or even years. In the initial stage, septicaemia occurs, giving rise to undulant fevers, sweating, and migratory arthralgia. Blood tests typically indicate leukopenia and anemia, with

positive results in Bengal Rose and Huddleston reactions. Melitococcemia, the presence of brucellae in the blood, can be reliably demonstrated through blood culture in tryptose medium during Malta fever episodes. If left untreated, the disease can progress to a chronic state. Brucellosis tends to focalize in bones and joints, and a distinct characteristic is spondylodiscitis of the lumbar spine, often accompanied by sacroiliitis.

Prevention and control: Segregation of infected herds to prevent cross-infection, with consideration for slaughtering infected animals. Proper vaccination of herds. Application of adequate heat treatment to milk to destroy causative microbial agents.

Q Fever

Q fever is caused by Coxiella burnetii, a bacterium known for its resilience. Raw milk is often implicated in transmitting the disease, as C. burnetii can withstand pasteurization if the specified temperature is not maintained, and it is more heat-resistant than Mycobacterium tuberculosis. The microbe can survive freezing temperatures and remains viable for up to 2 years at 20˚C, resisting 0.5% formalin and 1% phenol. Notably, it persists for 25 days in rennet cheese and 42 days in cottage cheese, but is eliminated in yogurt within 24 hours due to acidity. These characteristics make C. burnetii a microorganism of significant public health concern.

Individuals with frequent direct contact with animals, such as veterinarians, meat workers, and farmers, face a higher risk of Q fever. Transmission occurs through inhalation of contaminated air or dust from areas with a concentration of infected animals. Tissues from birthing animals pose a particular risk, and indirect transmission can occur through contaminated materials like wool and straw. The consumption of contaminated raw milk also carries a risk. Animals such as sheep, cattle, goats, cats, dogs, wild animals, birds, and ticks can carry the bacteria, with most infected animals showing no signs of illness. About half of those infected with C. burnetii show signs of illness, which initially resemble flu symptoms such as fever, chills, sweats, headache, and weakness. Q fever can progress to affect the liver, nervous system, or heart valve in rare cases. Diagnosis involves identifying the bacteria in tissues or through a blood test detecting antibodies. Treatment is usually unnecessary for those with mild, transient illness. Proper disposal of placenta, birth products, and aborted fetuses is crucial, and veterinary assistance should be sought for animals with reproductive or health issues. Human infection primarily occurs through inhalation of infected dust or fecal matter. Infected cattle continue to excrete the

microorganisms in milk for an extended period.

Symptoms: High fever, headache, weakness, malaise, severe sweating, and pneumonia resembling a viral infection.

Prevention and control measures include adequate heating of milk and cream, separating calving sheds from milking sheds, proper vaccination of animals, and conducting surveys to determine infection prevalence in an area.

Diphtheria

Diphtheria is primarily caused by toxigenic strains of Corynebacterium diphtheriae, although on rare occasions, a diphtheria-like illness may be instigated by toxigenic strains of C. ulcerans or C. pseudotuberculosis. C. diphtheriae exhibits three biotypes: gravis, intermedius, and mitis. The gravis biotype is linked to the most severe manifestations, yet any strain has the potential for toxigenicity. It is crucial to test all clinical isolates of C. diphtheriae for toxigenicity, as nontoxigenic strains can lead to various infections, including sore throat and invasive conditions like endocarditis.

Classic diphtheria manifests as an upper-respiratory tract infection, characterized by symptoms such as sore throat, low-grade fever, and the presence of an adherent pseudomembrane on the tonsils, pharynx, and/or nose. The infection can affect nearly any mucous membrane and is classified based on the site of infection:

Anterior nasal diphtheria: This form is marked by mucopurulent nasal discharge, possibly bloody, and a white pseudomembrane on the nasal septum.

Pharyngeal and tonsillar diphtheria: The most common form presents initially with malaise, sore throat, anorexia, and low-grade fever. A bluish-white pseudomembrane forms on one or both tonsils and can extend to surrounding areas. Severe cases may lead to edema of the anterior neck.

Laryngeal diphtheria: Involving the larynx, this form can present with fever, hoarseness, and a barking cough, potentially causing fatal airway obstruction.

Cutaneous diphtheria: Typically mild, it manifests as non-distinctive sores or shallow ulcers. Toxigenic or nontoxigenic strains may cause this form, with skin infections common in tropical climates.

Diphtheria is transmitted from person to person through respiratory droplets or, less commonly, contact with discharge from skin lesions. Historically, raw milk and fomites were known as vehicles for transmission. The incubation period ranges from 2 to 5 days, and individuals remain communicable for up to 4 days after initiating effective antibiotic treatment. Untreated individuals may shed

bacteria for 2-4 weeks, with a rare chronic carrier state lasting 6 months or more.

Preventive measures include proper vaccination, adequate heat treatment of milk, and avoiding unhygienic practices among dairy workers. Infected individuals should refrain from handling milk and milk products.