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Research Article

Review on *Listeriosis* in small ruminants and public health significance in Ethiopia

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Summary

Listeria monocytogenes is a bacterium mostly transmitted to man through food and it can cause mild gastroenteritis or severe infections of the bloodstream and/or the central nervous system, or abortion, depending on host susceptibility. Listeriosis is a serious illness caused by eating food contaminated with the bacterium *Listeria*, which is a Gram-positive psychotropic, facultatively anaerobic, none sporulating, motile, small rod. It displays characteristic tumbling motility that is facilitated by the presence of peritrichous flagella. Motility is temperature-dependent, showing high motility at 20-30°C when the flagellar expression is maximum. *L. monocytogenes* is ubiquitous in the environment and can be found in soil, water, feces, silage, effluent foods, and sewage. It has the ability to form biofilms which can contribute to its ability to colonize food processing facilities. The primary mode of transmission for *Listeria* is through soil contamination and ingestion of contaminated feed. Calves that develop the septicemic disease may acquire infection from contamination of the cow teat from the ingestion of milk containing the organism or from a cow with subclinical bacteremia, through the navel from the environment and also as congenital infection. Infection with *Listeria. monocytogenes* usually follow ingestion of contaminated feed and may result in septicemia, encephalitis, and abortion. There are few clinical features that are unique to *listeriosis*. Therefore, clinicians must consider a variety of potential causes of infection, including viral infections (influenza) and other bacterial infections that may cause sepsis or meningitis. Cook thoroughly raw food from animal sources, such as beef, pork, or poultry. Wash raw vegetables thoroughly before eating. Keep uncooked meats separate from vegetables and from cooked foods and ready-to-eat foods. Avoid raw (unpasteurized) milk or foods made from raw milk. Wash hands, knives, and cutting board and can contact with before and after handling cooked foods.

Introduction

Milk and milk products are an important source of many disease-producing microbes including Listeria monocytogenes, which is a Gram-positive, motile, also its principal cause of listeriosis in humans and in a wide variety of animals including birds. However, disease occurs in sporadic as well as epidemic forms, following the ingestion of food contaminated by this organism. In the world, it is becoming an important food-borne bacterial disease, with low incidence but high case fatality rate (Pal, et al. 2012a). Listeriosis is caused by several species *of Listeria*, bacterial organisms that live as saprophytes in the environment but occasionally cause disease in a wide range of vertebrates including mammals, marsupials, birds, and reptiles so that organisms are most often ingested in food, where they can proliferate even at refrigeration temperatures. Most illnesses are caused by *Listeria* monocytogenes, but *L. ivanovii* found occasionally rare reports of clinical cases caused by other species of *Listeria* [1]. *L. monocytogenes* has been recovered from dust, soil, water, sewage, decaying vegetation, at least 42 species of wild and domestic mammals, and 17 avian species, crustaceans, pond trout, ticks, and flies. Among food sources, milk and milk products, uncooked vegetables, fish and shellfish, ready-to-eat meat products, ground beef, and poultry have all been found to contain the organism [2].

Listeriosis affects all ages and sexes, but animals less than three years of age are more commonly prone to clinical disease than older animals and the bacterial disease can is seen clinically in animals as one of four forms and is more common during the winter \or spring month's also adult animals usually get the encephalitis form, while neonates often get the septicemic

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or visceral form of the disease (Adrea, 2005). However, Listeria monocytogenes is a bacterium mostly transmitted to man through food so it can cause mild gastroenteritis or severe infections of the bloodstream and/or the central nervous system, or abortion, depending on host susceptibility. The lethality (fatality rate) of severe listeriosis ranges from 20 to 30% (Buchanan, et al. 2004). Moreover, human infections are also foodborne it can be isolated transiently in the stool of 1-10% of the population. Cabbage fertilized by manure from sheep and subsequently stored at 4°C was implicated in one outbreak and other outbreaks have been associated with contaminated cheese and milk. Rarely, contact with infected cows has caused skin infections in veterinarians (Schleich WF 3rd, 1983).

The occurrence of *Listeria monocytogenes* within slaughterhouses and meat processing facilities has been associated with environmental colonization, because of its ability to adapt and survive even on 'clean' equipment and rooms. However, *L. monocytogenes* can enter through infected animals and raw meat or intermediate products processed by suppliers (Boerlin and Piffaretti, 1991). The most important species in the genus *Listeria* causes human health threats and spread worldwide with a specific host range even though *L .monocytogenes* is mostly responsible for human *Listeriosis* but occasionally infection with other species such as *L.seeligeri* and *L.ivanovii* has been reported. However, *L. monocytogenes* can cause a variety of diseases, including infections in pregnancy, ranging from a mild chill to a severe illness that may precipitate premature birth or miscarriage, and meningitis in newborn children. Septicemia and meningitis occur in adults, whose immunity to infection is impaired, such as those suffering from cancer or leukemia or transplant patients (Dieterich, et al. 2006).

Starting in the 1960s, as a result of the introduction and widespread use of refrigerators, processed foods and extended shelf life foods became more associated with listeriosis due to *L. monocytogenes*. Then, the disease primarily affects older adults, pregnant women, newborns, and adults with weakened immune systems. Today, listeriosis is regarded as a food-borne disease of serious public health concern (Swaminathan, et al. 2008).

Listeriosis monocytogenes are transmitted from animal to animal through fecal-oral routes, usually via manure contamination of the pasture or silage with the microorganism. Animal to human transmission is either directly through contact with infected animals or indirectly via milk, cheese, meat, eggs, or vegetables. It's inactivated with pasteurization; however, contamination of the pasteurized product with the raw product has been reported as a source of infection [3].

Several studies have reported that handling and consumption of contaminated raw broiler meat is an important risk factor for human infection. Because of the epidemiological importance of certain serotypes of *L. monocytogenes* to human health and the potential transmission of the pathogen from poultry to humans, accurate detection of *L. monocytogenes* followed by subtyping methods to identify the specific serotype or genotype involved in outbreaks is essential. This report describes an unusual presentation of *Listeriosis* in adult chickens and the systematic use of molecular tests performed to diagnose *Listeriosis* in this backyard poultry flock. Also, it stresses the importance of being aware of potentially zoonotic diseases. (Tappero, et al. 1995).

Direct transmission from animals to humans is possible especially among veterinarians performing gynecological interventions with aborted animals. Animals may be diseased or asymptomatic carriers of *L. Monocytogenes* shedding the organism in their feces. Even in Ethiopia the most problem of the disease due to indirect transmission occurs simply by consumption of food products from diseased animals reported that on-farm manufactured raw milk cheese made from cattle. Raw or contaminated milk, vegetables, and ready-to-eat meat have been implicated in overseas outbreaks. Contamination could be during preparation and it then multiplies during the storage process [4].

Literature review

Etiology

Listeriosis is a serious illness caused by eating food contaminated with the bacterium *Listeria*, which is a Gram-positive psychotropic, facultatively anaerobic, none sporulating, motile, small rod and it displays characteristic tumbling motility that is facilitated by the presence of peritrichous flagella. Motility is temperature-dependent, showing high motility at 20-30°C when the flagellar expression is maximum. There are 7 species of *Listeria L. monocytogenes, L. innocua, L. welshimeri, L. seeligeri, L. ivanovii, L. murrayi, and L. grayi*. *L. monocytogenes* is the only species of listeria that is pathogenic for both humans and animals [5].

The Genus *Listeria* contains seven species but one is most pathogenic for both animal and human beings. The most important species is *L. monocytogenes* a gram-positive facultatively anaerobic bacillus 0.5 to 2 microns long and 0.5 microns in diameter that is motile at temperatures between 20°C and 25°C also it is beta-hemolytic in blood agar and forms a narrow band of hemolysis around the colonies (unlike *L. ivanovii*, which forms a wide band). A noteworthy characteristic of *L.monocytogenes* is its ability to grow at low temperatures; at a pH between 6 and 9, [6].

Listeriosis is caused by members of the genus *Listeria*, a Gram-positive bacterial rod in the family *Listeriaceae*. *L.monocytogenes* is the primary pathogen in humans and animals, but *L.ivanovii* is found occasionally, and there are rare reports of clinical cases caused by *L. seeligeri*, *L. grayi* (which includes the former *L.murrayi*), and *L. innocua*. *Listeria* is a Gram-positive pathogen with the ability to adapt to a wide range of conditions such as refrigeration temperatures (2–4 °C) and acidic and high-salt conditions. *Listeria* cells are slow growers and may be rapidly outgrown by competitors (Kelly 2015).

Epidemiology

Geographical location: Although the organism is widespread

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in nature, clinical diseases in animals occur mainly in the northern and southern latitudes and are much less common in tropical and subtropical than in temperate climates. In the northern hemispheres, *Listeriosis* has a distinct seasonal occurrence, probably associated with seasonal feeding of silage, with the highest prevalence in the months of December [7].

Listeriosis monocytogenes are ubiquitous in the environment and can be found in soil, water, faeces, silage, affluent foods, and sewage. *L. monocytogenes* bacteria are widely distributed in nature, especially in the food chain. Most cases occur sporadically but foodborne and nosocomial outbreaks have been documented Foods associated with infection include unpasteurized milk, soft cheeses, processed meats, and contaminated vegetables. Newborns, the elderly, immunocompromised persons, and pregnant women are at greater risk of infection. About 30% of all cases occur in newborns within the first 3 weeks of life [8].

Therefore, it can survive in food processing environments and become persistent. Such persistence of *L. monocytogenes* has been shown, often for many years, at a larger scale and smaller artisan facilities of different production sectors. Because *L.monocytogenes* is ubiquitous in the environment and frequently present in the processing environment, it can contaminate foods including fish, mammals, crustaceans, poultry, ticks meat, soft cheeses, and ready-to-eat [9].

Listeria monocytogenes has been considered a widespread bacterium in nature, as it is part of the faecal flora of many mammals and it is a common foodborne source. It is believed that the main route of bacterial transmission occurs through the consumption of contaminated food such as meat (sausages, pate, ham, salami, and chicken), vegetables, ready-to-eat seafood (such as smoked fish or mussels), raw seafood, unpasteurized milk, soft-serve ice creams, and soft cheeses [10].

Listeriosis is not a reportable disease, but data from two active surveillance studies performed in 1980-1982 and 1986 by the Centers for Disease Control and Prevention (CDC) indicate annual infection rates of 7.4 cases per million populations, accounting for 1,850 cases per year in the United States and for 425 deaths (Gellin , et al. 1986).

Mode of transmission

Listeria monocytogenes was recognized as an animal pathogen over 80 years ago, the first outbreak confirming an indirect transmission from animals to humans was reported only in 1983, in Canada's Maritime Provinces. In that outbreak, cabbages, stored in the cold over the winter, were contaminated with *Listeria* through exposure to infected sheep manure [11].

The laboratory methods used to detect L. monocytogenes in food have improved in recent years and the organism has been found, but usually in small numbers, in many foods including raw fish, shellfish, and fish products; raw meat, poultry, and their products, including hot dogs and pate; raw and processed vegetables; ripened soft cheeses; ice cream; retail cook-chill meals; salads including coleslaw; raw and inadequately pasteurized milk as well as raw and liquid egg (Aureli, et al. 2000).

The primary mode of transmission for *Listeria* is through soil contamination and ingestion of contaminated feed. Calves that develop the septicemic disease may acquire infection from contamination of the cow teat from the ingestion of milk containing the organism or from a cow with subclinical bacteremia, through the navel from the environment and also as congenital infection [12].

After a short incubation, *L. monocytogenes* can spread systemically and cross the blood-brain barrier or the placenta and a recent analysis of several outbreaks found that gastrointestinal symptoms appeared within 24 h of ingestion and bacteremia occurred within 2 days (Goulet, et al. 2013). However, it took an average of 9 days for CNS symptoms to emerge, and much longer (17–67 days) for pregnancy-associated cases to be reported. Even with antibiotic treatment, the invasive form of *listeriosis* has a high mortality rate, particularly in immune-compromised individuals (Wing and Gregory, 2002).

In farm animals, Listeriosis is typically linked to the consumption of poor-quality silage that is contaminated with high levels of L. monocytogenes. Because improperly fermented silage or pockets of improper fermentation with a high pH (>6.0) allow for multiplication of *Listeria* and some poorly fermented silages have shown *Listeria* contamination in excess of 10 cfu/g wet weight of silage. The application of molecular subtyping methods has been used in a number of *Listeriosis* outbreaks in ruminants to characterize sources and transmission of L. monocytogenes. In many cases, matching L. monocytogenes sub-types have been found in silage and in diseased animals as well as in fecal samples from asymptomatic animals (Wiedmann, et al. 1996).

Contamination of foods by L. monocytogenes can occur at any point in the food chain, including on farms, in food processing plants, in retail establishments, and in the home, and L. monocytogenes can be detected in a wide range of foods, including both raw and processed foods. Many foods such as soft cheeses, hot dogs, and seafood have been implicated in listeriosis outbreaks, but *L. monocytogenes* also can be isolated from other foods such as beef, pork, fermented sausages, and fresh produce and fish products [13].

Inadequately pasteurized milk (or milk contaminated post-pasteurization), soft cheeses, ice cream, and other dairy products also are important sources of *L. monocytogenes*. Milk and milk products are considered risk foodstuffs for *L. monocytogenes* [14]. Pregnant women can transmit the infection to their unborn fetuses in utero (through hematogenous spread) or during birth (Siegman, et al. 2002).

Listeriosis is primarily a foodborne infection. So consuming contaminated food items has been identified as the source of infection in both sporadic and outbreak-associated cases. *Listeria* can be found in a variety of foods, including soft cheeses (e.g. Brie, Camembert, Mexican style fresh cheeses, Roquefort, Bleu), hot dogs and other ready-to-eat meats, smoked fish, lettuce, coleslaw, other salad items, ready-to-eat foods purchased from store delicatessens, and raw milk.

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Home-made raw milk soft cheeses are a particular risk. Cross-contamination of ready-to-eat foods may also play a role in transmission. *Listeria* contamination frequently causes food product recalls (CDC, 2010).

Pathogenesis

Infection with *L. monocytogenes* usually follows ingestion of contaminated feed and may result in septicemia, encephalitis, and abortion. Most *Listeria* species are destroyed by gastric acids. The use of antacids and H -blockers increases survival rate and is considered as H -blockers increase survival rate are considered as probably penetrate the M-cells in Payer's patches in the intestine and spread, occurs via lymph and blood to various tissues. An alternative route of entry has been proposed for central nervous system (CNS) infection through damaged oral, nasal or ocular mucosal surfaces via the neural sheath of peripheral nerve endings, particularly the trigeminal nerve [15].

Pathogenic *Listeria* enters the host primarily through the intestine. The liver is thought to be the first target organ after intestinal translocation. In the liver, *Listeria* actively multiplies until the infection is controlled by a cell-mediated immune response. This initial, subclinical step is thought to be common due to the frequent presence of *L. monocytogenes* in food (Werbrouck, et al. 2006).

It can debilitated and immunocompromised patients, the unrestricted proliferation of *Listeria* in the liver may result in prolonged low-level bacteremia, leading to invasion of the preferred secondary target organs (the brain and the gravid uterus) and to overt clinical disease (Longhi, et al. 2004).

At present, the pathogenesis of neuron Listeriosis is not entirely understood and importantly, the required infectious dose still remains unknown. Oral infection is a common feature for both, animals and humans. However, subsequent mechanisms to access the brain are likely to differ between host species. In humans, it is assumed that *L .monocytogenes* pass the gastrointestinal barrier and spreads hematogenous to the brain [16].

Once an organism is ingested then penetrates the intestinal mucosa and results in a clinically in-apparent infection with localization of bacteria in various organs or fatal septicemia. *Listeria* localizes itself in the uterus of pregnant animals and usually causes abortion if the infection takes place early in pregnancy. It is not known precisely how bacteria reach the brain in animals developing meningoencephalitis; however, they probably gain entrance through wounds in the mucosa of the oral cavity (Coetzer and Tustin 2007).

From the intestine, bacteria are then carried in macrophage cells to the liver and spleen, where most of them are destroyed by neutrophils acting in concert with Küpàer cells. Some of them can escape into the cytosol by employing the pore-forming protein *Listeriolysin* O. If the T cell-mediated immune response of the host is inadequate, *Listeria monocytogenes* can multiply in hepatocytes and macrophages freely [17].

The pathogenesis and genetics of *L. monocytogenes* have been explored extensively. For many decades, *L. monocytogenes* has been recognized as a model bacterial pathogen that induces T-cell-mediated cellular immunity. Studies on the cellular pathogenesis of listeriosis showed that L. monocytogenes is a facultative intracellular pathogen, which has a unique ability to use host cell proteins to spread from cell to cell. The ability of L. monocytogenes to directly spread from cell to cell (without contact with the extracellular milieu) provides a morphological explanation, of why cellular immunity plays a crucial role in the immune protection against listeriosis [18].

Clinical signs and symptom

Initial symptoms of infection include nonspecific flu-like symptoms, nausea, vomiting, cramps, diarrhea, and fever and there are few clinical features that are unique to *Listeriosis*. Therefore, clinicians must consider a variety of potential causes of infection, including viral infections (influenza) and other bacterial infections that may cause sepsis or meningitis. Symptoms can develop at any time from 2 to 70 days after eating contaminated food. Except for vertical mother–fetus transmission, most cases of *Listeriosis* begin with ingestion of the organism from a food source [19].

The CNS is frequently involved in both, animal and human cases, and accounts for the high mortality rate associated with *Listeriosis*. Occur as rhomb encephalitis Most commonly, *Listeria* CNS infections in ruminants, i.e. primarily affect the brainstem, and only exceptionally as meningitis or meningoencephalitis [20].

Septicemia is mainly seen in young ruminants or adults with metritis. Outbreaks of gastroenteritis with diarrhea have been described occasionally in sheep and cattle. Some of these animals can have extensive gastrointestinal hemorrhages, and sudden death is possible. Gastroenteritis may also precede or accompany septicemia. Kerato conjunctivitis can result from cranial nerve deficits that expose the cornea to rhombencephalitis, but it also occurs in animals with no other signs of *Listeriosis* [21].

The presentation of *Listeriosis* during pregnancy includes mild flu-like symptoms. In a series of 191 cases of *Listeriosis* in pregnancy, 32% of women had symptoms of a flu-like illness, 65% had a fever, and other symptoms included backache (21.5%) (Which may be mistaken for a urinary tract infection), headache (10.5%), vomiting/diarrhea (7%), muscle pains (4%) and sore throat (4%). Approximately 29% of the women were asymptomatic (Mylonakis, et al. 2002).

Pregnancy-associated *listeriosis* has generally been classified as an illness occurring in a pregnant woman or in an infant age ≤ 28 days. *Listeriosis* may result in pregnancy loss (fetal loss before 20 weeks gestation), intrauterine fetal demise (≥20 weeks gestation), pre-term labor, or neonatal infection while causing minimal or no systemic symptoms in the mother. Pregnancy loss and intrauterine fetal demise are considered to be maternal outcomes (CDC 2010).

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Neonatal *Listeriosis* commonly manifests as bacteremia, central nervous system infection, and pneumonia, and is associated with high fatality rates. Transmission of *Listeria* from mother to baby transplacentally or during delivery is almost always the source of early-onset neonatal infections (diagnosed between birth and 6 days), and the most likely source of late-onset neonatal listeriosis (diagnosed between 7–28 days) (Updated CSTE case definition 2019).

Diagnosis

Diagnosis is based on history, clinical signs, pathological lesions, and detection of the pathogen. Previous exposure to disease, feeding habits, grazing pasture, and observation of signs and symptoms are helpful for presumptive diagnosis. A definitive diagnosis can be made only after isolation and identification of the bacterium. Isolation of *Listeria* is not much cumbersome as it can be readily isolated. However, difficulty may occur while recovering this pathogen from birds showing the encephalitic form of the disease. The ubiquitous nature, wide distribution, and ability to survive for long periods outside the host's body present difficulty in concluding the source and spread of infection [21].

Conventional methods for isolation of *L. monocytogenes*, acceptable for international regulatory purposes, include the United States (FDA) method, the (AOAC) official method, the ISO 11290 Standards, the (USDA)-(FSIS) method, and the French Standards. The preferred clinical samples for identification of the organism in culture include the brain tissue, lumbar (CSF), blood, liver, spleen, heart, aborted placenta and fetus, meconium of newborns, faeces, vomitus, and food/feed material [22].

Doctors usually diagnose *Listeria* infections with a lab test called a bacterial culture, done on a sample of a body fluid, such as blood, spinal fluid, or the placenta. The earlier *Listeriosis* is detected and treated, the better, because it can cause a serious and life-threatening infection (Rebeccs L. 2017).

L. monocytogenes, its nucleic acids, and antigens may be detected in the placenta, fetus (e.g., fetal stomach contents), or uterine discharges after an abortion; in the blood of septicemic animals; in samples from sites of localization, such as (CSF) or ocular swabs; and in postmortem tissue samples such as the liver, kidneys, spleen, and brain [1].

Listeria grows on most conventional laboratory media, with small, round colonies observed on agar media after incubation for 1 to 2 days. It may be necessary to use selective media and cold enrichment (storage of the specimen in the refrigerator for a prolonged period) to detect *listeria* in specimens contaminated with rapidly growing bacteria. *Listeria* grows well on media such as 5% sheep blood agar on which it exhibits the characteristic small zone of hemolysis around and under colonies. β-Hemolysis on sheep blood agar media can serve to distinguish *Listeria* from morphologically similar bacteria; however, hemolysis is generally weak and may not be observed initially (Sagar Aryya, 2017).

A definitive diagnosis can only be made postmortem by histopathology of the Ponto medullary region of the brainstem and by bacterial culture. Usually, there are no gross lesions seen in the brain at necropsy. The characteristic microscopic lesions include multifocal asymmetrical microabscesses and mononuclear cell meningoencephalitis (thus, the name *L. monocytogenes*) in the brainstem, anterior spinal cord, and, occasionally, cerebellum. Peroxidase-anti peroxidase test, a more accurate diagnostic tool than histopathology, is used to detect degraded bacterial proteins as well as intact bacteria in formalin-fixed tissue [3].

Treatment

The majority of people with *Listeria* infections spontaneously clear the infection in about seven days. However, those patients at increased risk, especially pregnant women, usually require immediate IV antibiotic treatment to prevent, halt, or slow the development of more severe diseases. For example, early executive antibiotic treatment of pregnant females may be lifesaving for the fetus. In general, the length of antibiotic treatment increases with the severity of the infection [23].

The optimal antibiotic treatment for *Listeriosis* was penicillin, ampicillin, erythromycin rifampicin, chloramphenicol, tetracycline, and aminoglycosides, with the exception of cephalosporin are effective against *L. monocytogenes*. A combination of trimethoprim and tetracycline was more effectives [24].

Treatment involves administration of high doses of *procaine penicillin* every six hours for three to five days, then daily for an additional seven days. Forty-thousand IU per kg of body weight of procaine penicillin is needed to cross the blood-brain barrier and put sufficient amounts of the antibiotic into the tissue of the goat's central nervous system. Remember that one kilogram (kg) equals 2.2 pounds (Jolly 1999-2020).

The standard treatment for CNS *Listeriosis* in adults is an *Ampicillin* 2 g IV every 4 hours with or without gentamicin for synergy. It is usually a disease of younger animals (under three years), as it is associated with tooth eruption and the emergence of the permanent molar teeth throughout the environment (Best treatment for Listeria in sheep *2020*). For minor infections, medication might not be required [25].

The choice of treatment consists of a *β*-lactam antibiotic, normally *Ampicillin*. Because penicillin is bacteriostatic, some studies have attempted drug combinations. For example, the simultaneous use of *Ampicillin* and an aminoglycoside (usually gentamicin) is one of the most useful methods, especially in patients over age 50. The dose is important in the treatment of invasive disease, which requires a dose of 6 grams or higher [26].

In general, the length of antibiotic treatment increases with the severity of the infection. The treatment for meningitis lasts three weeks while brain abscess treatment lasts six weeks. The initial choice of antibiotics is usually IV ampicillin (Charles P.1996-2020).

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Prevention and control measure

Cook thoroughly raw food from animal sources, such as beef, pork, or poultry. Wash raw vegetables thoroughly before eating. Keep uncooked meats separate from vegetables and from cooked foods and ready-to-eat foods. Avoid raw (unpasteurized) milk or foods made from raw milk and Wash hands, knives, and cutting boards after handling uncooked foods (CDC 1992).

Plants must focus on preventing contamination of cooked products by *L. monocytogenes. L. monocytogenes* contamination of cooked meat products most frequently occurs when a product or food-contact surface is contaminated between the cooking and packaging steps. However, *L. monocytogenes* can also be introduced into the processing area from or by employees, equipment, animals, environmental reservoirs, or ingredients [27].

Food businesses are responsible for complying with the law. They demonstrate compliance by ensuring that the commodities and processes for which they are responsible meet regulatory requirements. If a written preventive control plan (PCP) is required, the food business develops a PCP with supporting documents, monitors and maintains evidence of its implementation, and verifies that all control measures are effective (Safe food for Canadians Regulation (SFCR2019)).

Extensive work has been done with the administration of antimicrobials in conventional food products and processing environments, most of which is applicable to poultry products as well as *Listeria spp*. contamination may be mitigated through staff training and production procedures. In RTE meats and poultry, Hazard Analysis and Critical Control Points (HACCP) plans are applied to reduce chemical and biological adulterants. In poultry slaughtering control, points can include the scalder, evisceration, final wash, chilling, and storage for further processing [28].

Employees, through their clothing, gloves, boots, or skin coming into direct contact with the product, improperly cleaned and sanitized equipment, the environment, through airborne bacteria or aerosol moisture droplets generated in other work areas *L. monocytogenes* can grow in cool, damp environments contamination, plants must assess their product flow and identify the most likely sites of contamination. A preprocessing checklist has been developed to help processors evaluate areas of high risk (Penn State Extension 2016).

Prevention and control are difficult at the farm level. The food industry has to cope with contaminated raw materials, resulting in the need to treat them as rapidly as possible by, for example, irradiation or lactic acid. When the parameters of food and its processing, in their relation to *Listeria* growth, are unknown, they should be investigated so that the "Hazard Analysis Critical Control Point" approach can be applied. It is necessary to investigate the vectors of contamination for the products at risk, and then apply the appropriate measures to avert contamination (Epiz 1987).

Disease status in Ethiopia

Listeriosis monocytogenes via contaminated food and/or water, or by a zoonotic infection, and in Ethiopia, a study has by a zoonotic infection. In Ethiopia, a study has and other *Listeria* species in a variety of raw and ready-to-eat food products in Addis Ababa prevalence of to-eat food products in Addis Ababa with the prevalence of raw meat and dairy products like raw milk, cottage cheese, and cream cake collected from the capital and five neighboring towns in Ethiopia. The serotypes of *Listeria monocytogenes* identified belonged to 1/2b, 4b, and 4e (Derra M. 2013).

Although foods of animal origin such as milk, cheese, meat, and poultry are consumed well in Ethiopia, published information on the status of food-borne *Listeriosis* caused by *L. monocytogenes* is very limited and incomplete in both the veterinary and public health sectors. In Ethiopia, a study has shown the presence and distribution of a variety of raw and ready-to-eat food products in Addis Ababa with a prevalence of 5.1% described with 4.1% of prevalence from raw meat and dairy products like raw milk, cheese, and cream cake collected from the capital and five neighboring towns in Ethiopia [29].

According to a research study, the overall prevalence of *Listeria* species was 28.4%, and specifically, that of *L. monocytogenes* was 5.6%. Taking the prevalence of *Listeria* species into consideration, cheese was found to be highly contaminated at 60%, followed by pasteurized milk samples (40%), raw milk (18.9%), and yogurt (5%) [30].

However, nowadays there are some reports on the prevalence of Listeria monocytogenes in different samples. For example, in Ethiopia (Addis Ababa) study conducted in 2004 showed an overall prevalence of 32.6% of *Listeria* species out of the total 316 examined samples with a high prevalence of *L. monocytogenes* in ice cream (19.6%) (Molla, et al. 2004). Also, of the samples examined (391) in Addis Ababa in 2010, 102 (26.1%) were found to be positive for *Listeria. L. monocytogenes* was detected in 5.4% of the samples analyzed. It was isolated mainly from raw milk (13%) (Gebretsadik, et al. 2010).

Public health significance

Listeria is an opportunistic intracellular pathogen that has become an important cause of human foodborne infections world wid. Although *L. monocytogenes* is infective to all human population groups, it has a propensity to cause especially severe problems in pregnant women, neonates, the elderly, and immunosuppressed individuals and direct transmission is possible especially among veterinarians performing gynecological interventions with aborted animals. Animals may be diseased or asymptomatic carriers of *L. Monocytogenes* shedding the organism in their feces [31].

Milk is supposed to constitute a complex ecosystem for various microorganisms including bacteria. Milk products like cheese, ice cream, and curd are widely consumed and the market for them has existed in many parts of the world for many generations. Raw milk and other dairy products are consumed by all age groups, including those populations at

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risk for contracting *Listeriosis* (Pal, et al. 2012a). The disease primarily affects older, pregnant women, newborns, and adults with weakened immune systems. However, rarely, persons without these risk factors can also be affected. Among the different species of the genus *Listeria*, *L. monocytogenes* has been known to cause *Listeriosis* in humans and animals [32,33].

Animals naturally harbor many food-borne bacteria in their intestines that can cause illness in humans, but often do not cause illness in animals. During slaughter, meat and poultry carcasses can become contaminated, if they are exposed to small amounts of intestinal contents (Pal, 2015; Pal and Mahendra 2015).

Food safety has emerged as an important global issue with international trade and public health implications. *Listeria monocytogenes* associated with outbreaks have been reported in a wide variety of foods (Pal 2013; Pal and Awel 2014). The bacterium has been isolated from meat, poultry, milk, cheese, other dairy products, and vegetables (Antunes, et al. 2002; Kumar 2011; Khan, et al. 2013; Pal and Awel 2014; Pal 2015).

The Public Health Agency of Canada convened an expert panel in August 2008 to provide information to health care professionals and the general public on the diagnosis and management of *Listeriosis* during the recent outbreak. The following information is based on the panel's discussion and addresses what should be done for patients who have eaten food items that are suspected of being contaminated with *Listeria* and who have symptoms of diarrhea with or without fever. For healthy adults and children with a normal immune system, no *Listeria*-specific investigation is required. Gastroenteritis due to *Listeria* infection has a short duration and is self-limited in this population [34].

Healthy adults and children occasionally get infected with *L. monocytogenes*, but they rarely become seriously ill. The body's defense against *L. monocytogenes* is called "cell-mediated immunity" because it depends on our cells, especially lymphocytes called "T-cells." Therefore, individuals whose cell-mediated immunity is suppressed are more susceptible to the devastating effects of *Listeriosis*. Pregnant women naturally have a depressed cell-mediated immune system. In addition, the systems of fetuses and newborns are very immature and are extremely susceptible to these types of infections (Richard , et al. 2008).

Many food-borne zoonoses are of serious public health concern with a long-term sequel to various organs. Among these, *Listeriosis* can cause severe and life-threatening complications. Owing to changes in food habits towards ready-to-eat products, food production systems, processing, and supply, refrigeration for food preservation, interest in organic and natural products, interest in free-range birds, and awareness towards better health, *Listeriosis* is now considered an emerging food-borne zoonosis of increased public health significance [35-48].

World Health Organization (WHO) defines zoonosis as those diseases and infections which are naturally transmitted between vertebrate animals and man. There are approximately 1415 Pathogens known to affect humans of which about 61% of all human pathogens are zoonotic. Nearly half of all human infectious diseases known today can be classified as Emerging and about 75% of emerging infectious diseases are caused by zoonotic pathogens [32].

The human population encounters animal diseases with varying frequency depending on their Occupation's geographical location and the prevailing culture of the country. Whether living in an urban or rural environment animals constantly may have close contact with a human on the farm (Food producing animals) at the area of residence (dogs, cats, cage birds) through leisure. Activities (horse, wildlife) or by virtue of the occupation of the individual as veterinarians or Animal nurses. This close contact can result in the occurrence and transmission of zoonotic Disease which is naturally transmitted between vertebrate animals and man (Erdogan 1998).

Conclusions and recommendations

Listeriosis has gained recognition as a global human and animal pathogen because of the increasing incidence, diagnosis of infections and also, it is widespread in nature and lives naturally in food contamination and soil environments, and has the potential to introduce food to animals and food plants. It can grow in a wide range of temperatures and pH. Milk and milk products are important vehicles of *Listeriosis*, regularly causing *Listeriosis* outbreaks in different countries of the world. Good manufacturing and hygiene practices, particularly maintaining the hygiene of processing machines, are the keys to preventing *Listeriosis* contamination. It is also equally important to notice that products, which may be subjected to post-processing contamination, should be properly reheated before consumption by highly immune-compromised persons in order to eliminate possible contamination.

- ✓ Based on the fact and information mentioned in the review the following recommendations are forwarded.
- ✓ There should be proper disposal of aborted fetuses and feces of an infected animal to avoid the spread of the disease.
- ✓ Public health learning through Mass-media, radio, and teaching livestock holders and people who are at risk of Listeria monocytogenes is important People susceptible to acquiring *Listeriosis* should not consume unpasteurized milk and milk products.
- ✓ Meat products should be treated with heat before consumption which can kill *Listeria* species or reduce them to a detectable level.

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