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REVIEW

Prevalence, Antimicrobial Resistance, and Characterization of Listeria Spp. Isolated from Various Sources in Ethiopia: A Comprehensive Review

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Abstract: Listeriosis is an important foodborne zoonotic disease affecting humans and animals in Ethiopia. This review aims to synthesize the epidemiology, prevalence, distribution, and antimicrobial resistance of Listeria species in the country. The literature reveals a widespread occurrence of Listeria infection in humans, animals, and food products, with an average prevalence of 21.6% for Listeria species and 6.9% for *L. monocytogenes*. Three sequence types (STs) of *L. monocytogenes* (2, 145, and 18) and twelve STs of *L. innocua* (1489, 1619, 603, 537, 1010, 3186, 492, 3007, 1087, 474, 1008, and 637) were reported from milk and dairy products. Contamination rates ranged from 4.1% to 42.9% across livestock, dairy, slaughterhouses, and processing facilities, indicating faults in production practices. Sporadic human listeriosis outbreaks have occurred since 1967, causing meningitis, perinatal infections, and deaths, with recent studies showing *L. monocytogenes* isolation in up to 10.4% of febrile patients, confirming foodborne transmission. Non-pathogenic Listeria species were also common on farms and in facilities. Ovine listeriosis poses a threat to Ethiopia's sheep and goat industries, with over 40% seroprevalence in some herds. Comprehensive control measures across the food chain are needed to curb contamination and protect public health. Isolates from various foods show antibiotic resistance to first-line agents but susceptibility to others like gentamicin and cephalosporins. In conclusion, this review synthesizes evidence on Listeria distribution in Ethiopia's food system and disease burden, highlighting the need for improved food safety policies and awareness.

Keywords: animals, listeriosis, foodborne, pregnancy, zoonotic

Introduction

Listeriosis is a serious foodborne disease that can cause severe illness and death in high-risk groups like pregnant women, newborns, the elderly and immunocompromised individuals.[1] The disease is caused by *Listeria* species, with *L. monocytogenes* being the main pathogenic species that affects both animals and humans.[2–4] *L. monocytogenes* is a gram-positive bacterium that grows intracellularly and produces virulence factors like listeriolysin O and hemolysin to evade host defenses.[2–4]

L. monocytogenes is primarily transmitted through contaminated food, including raw dairy and ready-to-eat meals.[1] Direct contact with infected livestock like cattle, sheep, and goats can also transfer *L. monocytogenes* to humans; especially agricultural workers.[5] In animals, the bacterium is shed in feces and secretions. In humans, *L. monocytogenes typically* causes flu-like symptoms but can also lead to severe invasive diseases like septicemia, meningitis, encephalitis and miscarriage or newborn sepsis.[5,6]

Listeria contamination rates in Ethiopian foods range from 14.3% to 62% in raw meats, dairy products, and vegetables.[7] The highest Listeria prevalence was found in raw beef (62%) and ice cream (43%) samples.[8] Sporadic human listeriosis cases and outbreaks have been reported from Addis Ababa and central Ethiopian towns.[9,10]

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Antibiotics like ampicillin, penicillin, gentamicin, trimethoprim-sulfamethoxazole, and chloramphenicol can effectively treat listeriosis.[11] However, the emergence of multidrug resistant *L. monocytogenes* strains has raised public health concerns globally.[12] In Ethiopia, there is limited data on current antimicrobial resistance trends and molecular subtyping of Listeria strains from humans and animals.

Listeria is widespread in the environment.[13] Most infections are acquired by ingestion, but *Listeria* can also be transmitted through inhalation or direct contact. In sheep, listeriosis often occurs after eating contaminated silage.[14] Contaminated foods that can infect humans include raw meat, seafood, unpasteurized dairy, and uncooked vegetables.[14] In newborn infants and ruminants, vertical transmission from mother to baby during pregnancy or birth is the most common source of infection.[15] Humans can also become infected from direct contact with sick animals during birthing or necropsies.[15] Sheep and goat feces, human waste, farm slurries, sewage, water troughs, surface water, plants, animal feed, and barn walls are primary sources.[16] While *L. monocytogenes* is ubiquitous on farms, its growth is limited during food preparation.

In their 2024 study, Wei et al[17] investigated Listeria isolates from Ethiopia. They identified three sequence types (STs) of *Listeria monocytogenes* (2, 145, and 18) and twelve STs of *Listeria innocua* (1489, 1619, 603, 537, 1010, 3186, 492, 3007, 1087, 474, 1008, and 637). Some of these STs exhibited region-specific occurrence, while others were widely distributed across regions. Through high-quality single nucleotide polymorphism (SNP) analysis, they found that among the 13 *L. monocytogenes* isolates of ST2, 11 were highly similar, differing by only 1 to 10 SNPs, suggesting potential selection in the dairy food supply chain. The *L. innocua* isolates also exhibited low intra-ST genetic variation (0–10 SNP differences), except for ST1619, which displayed greater diversity.

Overall, listeriosis remains an underdiagnosed and underreported disease in Ethiopia due to lack of routine surveillance, reporting, and laboratory infrastructure in healthcare and veterinary sectors. Enhanced surveillance, diagnostics, antimicrobial susceptibility testing, and molecular characterization of Listeria strains circulating across Ethiopia are warranted to determine the public health impact of foodborne listeriosis. Findings can inform evidence-based control strategies to prevent listeriosis in high-risk groups and livestock production. The objective of this paper is to comprehensively review the epidemiology, prevalence, distribution, and antimicrobial resistance patterns of *Listeria monocytogenes and other Listeria spp* in Animals and Food products in Ethiopia.

Materials and Methods

A comprehensive search for relevant studies was performed using several major scientific databases, including PubMed, Web of Science, EMBASE, Google Scholar and the Cochrane Library. The search focused on identifying published observational studies that reported on the prevalence of Listeria species isolated from various sources in Ethiopia, including animal- and plant-based food products as well as human clinical samples (Figure 1). Strict inclusion and exclusion criteria were developed and applied to select the most pertinent articles. After removing duplicate reports, 37 studies met the predetermined inclusion criteria and were selected for review. This comprehensive search and screening process aimed to identify the most relevant published studies on *Listeria* spp, *Listeria monocytogenes*, prevalence, distributions in animal, human, food and feed reported in Ethiopia (Figure 2).

Results

Multiple studies in Ethiopia have found *Listeria* contamination in animal feed and human foods, though comprehensive nationwide data is lacking (Figure 1). A wide range of sample types were tested, including bovine, poultry, pork, fish, dairy products, eggs, farm environments and human clinical samples for detection of *Listeria monocytogenes* and other *Listeria spp*. The total number of samples analysed was 5144 across all the studies. The overall prevalence of any *Listeria* species ranged from 4.1% to 42.9%, with an average prevalence of 21.6% across the studies. This indicates widespread *Listeria* contamination of livestock, animal products, produce and the farm environment in the country. Bovine sources and raw dairy products showed some of the highest rates of contamination. The prevalence specifically for the pathogenic species *L. monocytogenes* averaged 6.9% across the studies, ranging from 1.2% to 32.6% based on the sample type. Key food sources showing *L. monocytogenes* contamination included raw milk, meat, eggs and fish. Human clinical samples also tested positive, confirming human listeriosis cases. Several non-pathogenic *Listeria* species were

Figure 1 Map of *Listeria spp* reported area.

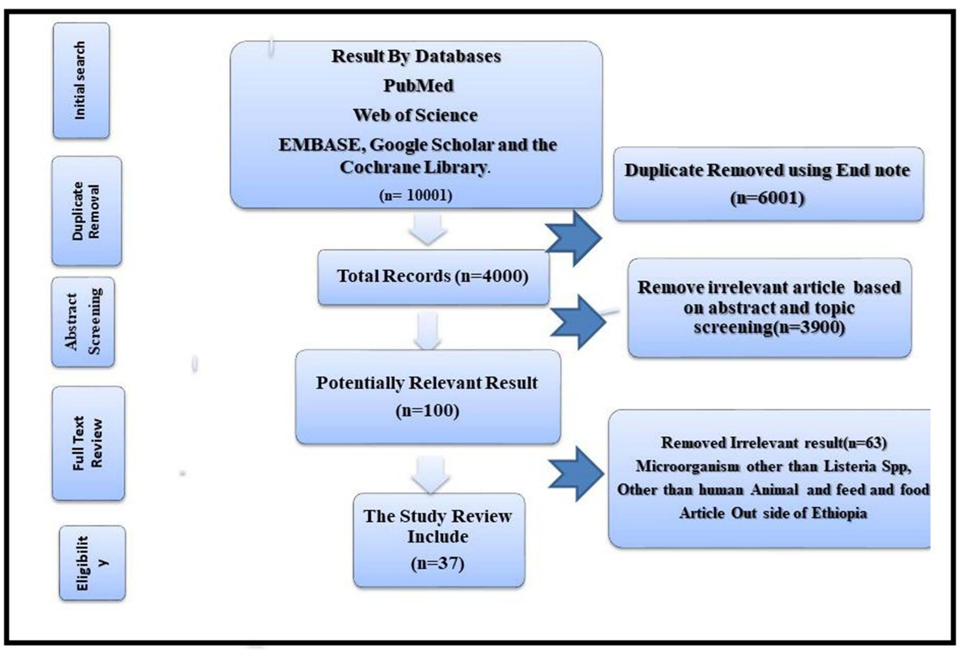

Figure 2 Strategy of Searching and Selection of Published Article.

isolated from the various sources, including *L. innocua, L. ivanovii, L. seeligeri, L. welshimeri, L. grayi* and *L. murrayi*. These species are generally saprophytes but can cause opportunistic infections. Their presence also indicates faults in food handling and processing (Table 1)

Table 1 Listeria Spp Isolated and Identified from Various Source in Ethiopia

Host	Sample type	Sample Number	Positive Sample	Over all *Listeria* Spp Prevalence	*Prevalence ofL. monocytogenes*	Other *Listeria* spp	Study Area	Citation
Bovine, poultryFish	Pork Beef Cheese Fish Chicken	316	103	32.6%	5.1%	*L. innocua* *L. ivanovii*, *L. seeligeri*, *L. welshimeri* *L. grayi and*, *L. murrayi*	Addis Ababa	[7]
Bovine Poultry	Cheese Raw beef Raw milk Egg	391	102	26.1%	5.4%	*L. innocua* *L. ivanovii* *L. seeligeri* *L. welshimeri* *L. grayi* *L. murrayi*	Addis Ababa	[18]
Bovine Poultry	Egg, meat milk, Pork	711	189	26.6%	4.7%	Other Spp	Addis Ababa	[19]
Bovine	Silage,water, barn, MilkEquipment	200	40	20%	5.5%	*L. innocua* *L. gray*, *L. ivanovii* *L. seeligeri* *L. welshimeri*	Haramaya University	[20]
Bovine	Milk and milk product	200	60	30%	5%	*L. innocua*, *L. welshimeri* *L. seeligeri*, *L. ivanovii*, *L. grayi*	Bishoftu and Dukem	[21]
Bovine	Milk	247	106	42.9%	1.2%	*Listeria Spp*	Arsi and E/ Shawa	[22]
Bovine	Milk, Cheese, IceCream, Yoghurt	200	13	6.5%	4%	*L. innocua*, *L. seeligeri*	Jimma Town	[23]
Bovine	Beef meat, milk	384	96	25%	6.25%	*L. ivanovii*, *L. innocua L. seeligeri*, *L. welshimeri, L. grayi L. murrayi*	Gondar	[24]
Ovine	Swab samples	873	36	4.1%	4.1%		Addis Ababa	[25]
Human	Blood	141	12	8.5%	8.5%	*L. monocytogenes*	Mekele	[26]
Bovine	Dairy Milk	407	85	20.88%	8.8%	*L. innocua* *L. seeligeri* *L. welshimeri* *L. grayi* *L. murrayi*	Debre – Birhan	[27]
Bovine	Beef meat	450	128	28.4	4.4%	*L. ivanovii L.seeligeri* *L. welshimeri* *L. innocua* *L. grayi*	Ambo Holeta	[28]
Human	Blood	144	8	5.56%	5.56%		Jima	[29]
Bovine	Milk	240	69	28.75%	7.08%	*Listeria spp*	Ambo Holeta	[30]
Polled Average		5144	1113	21.6	6.9%			

In Addis Ababa, Listeria was isolated from 26.1% of 391 samples including raw milk, beef, cheese, and eggs. *L. monocytogenes, L. innocua, L. ivanovii, L. seeligeri, L. welshimeri, L. grayi*, and *L. murrayi* were identified.[18] In Debre-Birhan, 20.88% of 407 dairy milk samples tested positive for *L. monocytogenes, L. innocua, L. seeligeri, L. welshimeri, L. grayi, and L. murrayi*.[27] In Gondar town, 27% of 711 raw milk, beef, pork, and egg samples were positive, with isolation of *L. monocytogenes* and other species.[19] Another Gondar study found 25% of 384 raw milk and beef samples positive, with isolation of multiple *Listeria* species.[31] In Ambo and Holeta, 28.4% of 450 beef samples were positive, with isolation of *L. monocytogenes, L. ivanovii, L. seeligeri, L. welshimeri, L. innocua, and L. grayi*.[28]

Listeria species were isolated from 27.4% of food samples in Addis Ababa, with *L. monocytogenes* specifically in 5.4%.[6] Another Addis Ababa study *isolated L. monocytogenes* and other *Listeria* from various raw and ready-to-eat foods at 5.1% frequency.[32] Identified *L. monocytogenes* serotypes belonged to serogroups 1/2b, 4b and 4e.[18] Listeria was found in 20% of samples from silage, water, cow barns, cows, and milking at Haramaya University.[20] *L. monocytogenes* was isolated from 20.88% of raw bovine milk in Debre-Birhan,[24] High contamination was reported in foods of animal origin from Bishoftu and Dukem at 30%.[21,23] In Arsi, East Shewa, and the central highlands, prevalence was 42.9% and 28.4% in raw milk and dairy, respectively.[22] Other studies found Listeria rates of 25% in animal foods in Gondar,[31] 24.2% in milk and dairy in North Shewa[33] 14% in meats and dairy in Jimma[19] and 4.1% in sheep meat from Addis Ababa.[25] Contamination ranging from 3.8% to 42.9% indicates Listeria is common in animal-derived foods across Ethiopia.

Sporadic cases and outbreaks of human listeriosis have also been reported in Ethiopia. The first documented case was in 1967 in a diabetic patient.[34] *L. monocytogenes* was isolated from 16 cases of meningitis from 1983 to 1984.[35] An outbreak occurred in 1988 with 16 perinatal infections and 2 maternal deaths linked to *L. monocytogenes* contamination in a hospital.[36] More recent studies have reported *L. monocytogenes* isolation rates of 10.4% from febrile patients, 31.7% from spinal fluid cultures, and 5.6% from cases of abortion in pregnant women.[29,34] Overall, human listeriosis appears to be an endemic yet underdiagnosed condition in Ethiopia, warranting improved food safety measures and education on prevention.

The highest prevalence has been reported from the central highlands of Ethiopia. A study by[25] conducted on 4 farms near Addis Ababa found *L. monocytogenes* in 7.6% of sheep and 4.8% of goats sampled. This indicates ovine listeriosis may be more common in certain agro-ecological zones of Ethiopia. The variable prevalence rates across different regions highlight the need for further epidemiological studies to determine the distribution and associated risk factors for ovine listeriosis in Ethiopia. Overall, the available studies indicate ovine listeriosis is an endemic problem in the Ethiopian small ruminant population. Prevalence of Listeria in animal feed and human food in Ethiopia is indicated in Table 1.

Studies across various regions of Ethiopia have reported a significant prevalence of *Listeria monocytogene*s contamination in food sources of animal origin as well as human clinical samples. The prevalence ranges from 1.2% in bovine bulk milk samples from Arsi and East Shewa zones[22] to 8.8% in dairy milk from Debre-Birhan.[27] In meat and milk products, a 4% prevalence was found in bovine milk, cheese, ice cream and yoghurt samples in Jimma Town,[23] while a 6.25% prevalence was detected in beef meat and milk samples in Gondar.[24] Clinical samples also showed contamination, with 8.5% prevalence in human blood samples from Mekele[26] and 5.56% in human blood samples from Jimma.[29] The pooled average prevalence across the various studies was 6.9%, highlighting the need for improved food safety practices to reduce *L. monocytogenes* contamination.

In raw cow milk samples, *L. monocytogenes* exhibited complete resistance (100%) to nalidixic acid, while also showing high resistance to erythromycin (88%), ampicillin (23.5%), chloramphenicol (17.65%), streptomycin (11.76%), and cefotaxime (5.88%).[30] Isolates from milk and milk products displayed 100% resistance to oxacillin, followed by 90.91% resistance to amoxicillin and 54.5% resistance to nalidixic acid.[37] In sheep meat samples, high resistance levels were observed against ampicillin (88.9%), chloramphenicol (88.9%), and penicillin (66.7%), while lower resistance was seen against sulfamethoxazole-trimethoprim (66.7%) and tetracycline (22.2%).[25] *Listeria* from raw milk exhibited 30.5% resistance to nalidixic acid, 25% to tetracycline, 22.2% to chloramphenicol, and 11.1% to streptomycin.[27] Clinical isolates from pregnant women's blood showed the highest resistance to penicillin G (66.7%), clindamycin (66.7%), amoxicillin (50%), and vancomycin (50%).[26]

Research showed *L. monocytogenes* isolates from raw cow milk samples had higher susceptibility to antibiotics like vancomycin, gentamicin, and sulfamethoxazole. Studies on milk products demonstrated retained sensitivity to gentamycin, norfloxacin, chloramphenicol, nitrofurantoin, and tetracycline. Analysis of *L. monocytogenes* from sheep meat samples found higher susceptibility rates to vancomycin, co-trimethazole, amoxyclav, gentamycin, and streptomycin. Investigations of isolates in raw milk indicated continued efficacy of cephalothin, kanamycin, vancomycin, ampicillin, and gentamicin against *L. monocytogenes*.(Table 2)

Table 2 Antimicrobial Resistance Profiles of Listeria Monocytogenes Isolated from Various Sample

Type of Sample	*L. monocytogene* Resistance%		*L. monocytogene* Susceptible %		Citation
Pregnant Women Blood	Penicillin G	66.7	Ciprofloxacin	75	[26]
	Clindamycin	66.7	Erythromycin	75	
	Amoxicillin	50	Trimethoprim	66.7	
	Vancomycin	50	Chloramphenicol	60%	
Raw Cow Milk Samples	Nalidixic Acid	100	Vancomycin	100	[30]
	Erythromycin,	88.	Gentamicin	100	
	Ampicillin,	23.5	Sulfamethoxazole	100	
	Chloramphenicol,	17.65			
	Streptomycin,	11.76			
	Cefotaxime	5.88			
Milk And Milk Products	Oxacillin	100	Gentamycin	100	[37]
	Amoxicillin	90.91	Norfloxacin	100	
	Vancomycin	81.82	Chloramphenicol	72.73	
	Ampicillin	72.7	Nitrofurantoin	63.64	
	Nalidixic Acid	54.5	Tetracycline	63.64	
Sheep Meat	Ampicillin	88.9	Tetracycline	77.8	[25]
	Chloramphenicol	88.9			
	Ciprofloxacin	77.8			
	Penicillin	66.7			
	Vancomycin	94.4			
	Co-trimoxazole	94.4			
	Sulfamethrimethoprim	66.7			
	Amoxyclav	100			
	Oxacillin	77			
	Gentamycin	97.2			
	Streptomycin	83.3			
Raw Milk	Nalidixic acid	30.5	Cephalothin	100	[27]
	Tetracycline	25	Chloramphenicol	50%	
	Chloramphenicol	22.2	Kanamycin	100	
	Streptomycin	11.1	Vancomycin	100	
			Ampicillin	100	
			Gentamicin	80	

(*Continued*)

Table 2 (Continued).

Type of Sample	*L. monocytogene* Resistance%		*L. monocytogene* Susceptible %		Citation
Blood (Women)	Penicillin a	100	Ampicillin	100	[29]
	Meropenem	100			

Conclusion

In conclusion, this review highlights that listeriosis remains an underdiagnosed and underreported disease in Ethiopia, warranting strengthened nationwide surveillance, diagnostics, antimicrobial susceptibility testing, and molecular characterization of Listeria strains circulating in livestock, foods, and humans across diverse agro-ecological zones. Reported contamination rates of Listeria species in Ethiopian foods ranging from 3.8% to 42.9% indicate it is a common foodborne hazard needing improved farm biosafety and food hygiene practices for control. Sporadic human cases and outbreaks also showcase listeriosis as an endemic yet overlooked public health issue in Ethiopia. However, its true distribution and burden across high-risk groups like pregnant women and neonates are unknown due to limited systematic monitoring, reporting, and laboratory infrastructure. Thus, enhanced surveillance and epidemiological studies are recommended to determine the prevalence, incidence, and impacts of listeriosis in vulnerable populations nationwide. Routine screening, outbreak reporting, advanced diagnostic testing, antimicrobial resistance profiling, and molecular subtyping of Listeria strains in veterinary and public health laboratories would help elucidate the public health risks. Evidence-based control strategies should be implemented, including education programmes on food hygiene and safety targeted at farmers, processors, and consumers. Livestock vaccination if available, sanitation protocols in food production facilities, and restrictions on the distribution of high-risk products are also advised. Further research can identify predominant Listeria strains, transmission routes, and risk factors in diverse regions to support tailored prevention approaches to control listeriosis across Ethiopia. Overall, this review summarizes current knowledge on ovine and human listeriosis in Ethiopia while underscoring critical needs for improved monitoring, diagnostics, molecular characterization, risk factor research, and the implementation of food safety practices and policies to combat this major zoonotic disease.

Disclosure

The author reports no conflicts of interest in this work.

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