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Review article

Animal listeriosis in Türkiye: a descriptive and comparative study of a One Health relevant disease

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Abstract

Listeriosis is a significant zoonotic disease affecting ruminants and causing substantial economic losses in livestock production. Although numerous regional studies have been conducted in Türkiye, a comprehensive synthesis of available data has been lacking. The current study aimed to evaluate the epidemiology, clinical forms, diagnostic approaches, and regional distribution of animal listeriosis in Türkiye. Studies reporting clinical listeriosis in animals in Türkiye between 1980 and 2024 were included. Due to methodological heterogeneity, a descriptive-analytic approach was adopted. A total of 26 studies were included. Most studies were conducted in Eastern and Central Anatolia, regions with intensive ruminant farming and widespread silage use. Sample sizes ranged from 18 to 3,760 animals. The most frequently investigated species were sheep (n=13 studies) and cattle (n=9 studies), followed by goats, dogs, and horses. Molecular and culture-based studies generally reported low positivity rates (0–7.29%), whereas serological studies showed a substantially wider range (17–86.69%), suggesting past exposure rather than active infection. An exceptionally high culture positivity rate (66.6%) was reported in a small-scale investigation of an encephalitic outbreak, whereas 100% seropositivity was observed in limited farm-based screenings of horses and dogs. Both findings likely reflect context-specific findings from small samples rather than population-level prevalence. Clinically, encephalitic and abortive forms were predominant in small ruminants, whereas subclinical infections were frequently reported in cattle through serological surveillance. The available evidence indicates that contaminated silage is a major epidemiological risk factor, particularly in regions with prolonged winter feeding. Notably, national surveillance data remain scarce, and most studies were cross-sectional or case-based. In conclusion, animal listeriosis remains a significant health concern in Türkiye, particularly in ruminant-dense regions. Strengthening surveillance and expanding molecular diagnostics in primary animal production farms, along with integration within a One Health framework, are essential to better define the disease burden and reduce zoonotic risk.

Keywords: Abortion, Encephalitis, *Listeria monocytogenes*, Listeriosis, Türkiye

Introduction

The genus *Listeria* (*L.*) comprises Gram-positive, facultative anaerobic bacteria capable of intracellular survival and notable for their high resistance to environmental conditions. Listeriosis in humans and animals is caused mainly by *L. monocytogenes* and *L. ivanovii* [1]. *L. monocytogenes* is a major foodborne pathogen that poses a serious concern for public health and the food industry. Human infections may result in severe clinical manifestations, including gastroenteritis, septicemia, meningitis, and encephalitis, and can also cause pregnancy-associated complications, including stillbirths and spontaneous abortions [2]. The ability of *L. monocytogenes* to multiply at low temperatures, tolerate high salt concentrations, and survive across a wide pH range allows this pathogen to remain viable for extended periods in environmental sources, including silage, soil, water, and feed. This environmental resilience is considered a key factor in the persistence of infection, particularly in ruminant operations [3].

Listeriosis in animals is associated with severe clinical conditions, particularly in ruminants, resulting in significant economic losses. The most commonly observed forms are encephalitic, abortive, and septicemic, while subclinical infections also contribute to the silent spread of the pathogen within herds [4]. The encephalitic form is more frequent in sheep and goats and is characterized by neurological signs known as “Circling disease” and high mortality. The abortive form occurs primarily in cattle during late pregnancy, resulting in substantial calf losses at the herd level. The septicemic form is more common in young animals and is associated with sudden death. Direct animal losses, decreased milk yield, treatment costs, and reduced reproductive performance related to these clinical presentations collectively contribute to the substantial economic burden of listeriosis [1, 5, 6, 7].

Türkiye is among the countries with widespread sheep and cattle farming, with the Central, Eastern, and South-eastern Anatolia regions being particularly notable for their high ruminant densities. The widespread use of silage feeding during the winter months in these regions represents a significant risk factor for animal listeriosis. Improper silage fermentation, insufficient pH reduction, and improper storage conditions allow *L. monocytogenes* to proliferate in silage. Recent studies in Türkiye indicate that a substantial proportion of animal listeriosis cases are associated with the consumption of contaminated silage [8]. Regional livestock management, housing, and hygiene practices play a critical role in shaping the geographic

distribution of animal listeriosis [9]. Despite ongoing studies on animal listeriosis in Türkiye, most studies employ heterogeneous methods due to regional variation and small sample sizes. The lack of a comprehensive national-level review assessing prevalence, epidemiology, clinical manifestations, and diagnostic methods leaves a notable gap in the existing literature. Consequently, compiling and synthesizing current scientific data on animal listeriosis in Türkiye is crucial for improving veterinary practice and zoonotic risk evaluation. This report aims to provide a thorough overview of the prevalence, spatiotemporal distribution, epidemiological features, clinical presentations, and diagnostic techniques of animal listeriosis in Türkiye.

Materials and methods

Search strategy

In this study, information on animal listeriosis in Türkiye was collected through manual searches of PubMed, Web of Science, Scopus, and TR Dizin (A national citation and indexing system that indexes academic journals published in Türkiye). The search employed various combinations of the keywords: "*Listeria monocytogenes*," "*L. monocytogenes*," "listeriosis," "animals," "Türkiye," "ruminant," "abort," "sheep," and "cattle". The analysis was restricted to articles published between 1980 and 2024, with particular emphasis on studies published after 2020. Only studies conducted in Türkiye that addressed *Listeria* spp. or *L. monocytogenes* in animals, based on clinical cases, screening, or abortion material, were included. Human listeriosis, food safety-focused studies, and *in vitro* experimental studies were excluded.

Study selection process

Two independent researchers performed title and abstract screening, and the full texts of eligible studies were evaluated. Studies meeting the inclusion criteria were included in the report. Data on animal species, sample type, diagnostic method, region where the study was conducted, and year of publication were extracted from each study using a standardized data form.

Data synthesis

Due to significant methodological heterogeneity among the studies, a quantitative meta-analysis was not performed; instead, findings were examined using a descriptive and comparative approach. The included studies varied widely in sample type and size, diagnostic methods, and study design. Some studies focused solely on clinical cases, while others included herd-based screening data. Furthermore, the use of different combinations of culture, PCR, and serological methods limited the pooling of quantitative data. Therefore, the findings were evaluated using a descriptive and comparative approach.

Results

The current analysis included 26 studies from Türkiye on animal-derived listeriosis that met the predefined inclusion criteria. The studies spanned the period from 1987 to 2024, with sample sizes ranging from 18 to 3,760 animals. While most investigations focused on sheep, cattle, and goats, other animal species, including horses and dogs, were also tested, highlighting the broader host range of *L. monocytogenes*.

The most frequently examined clinical materials were abortion specimens (foetal tissues, placenta, abomasal contents, and vaginal swabs) and blood samples. Among diagnostic methods, culture, PCR, real-time PCR (RT-PCR), and serological tests (e.g., ELISA) were most commonly employed. Positivity rates reported in molecular and culture-based studies generally ranged from 0% to 7.29%, whereas serological studies showed a wider range, from 17% to 86.69%, reflecting past exposure rather than active infection. Notably, a study conducted in the Kars Province reported a culture-based positivity rate of 66.6%; however, this finding is exceptional due to the small sample size and the inclusion of clinically symptomatic animals. The detailed findings of the listeriosis studies included in this analysis are summarized in Table 1.

Research on listeriosis in horses is limited. For instance, a study in Van Province found that of 203 animals tested, 176 (86.69%) were positive [10]. In a serological screening conducted in Ankara Province, 100% positivity was reported in three horses and a dog on a single farm, representing an exceptional case [11]. Additionally, a study from Van Province examined brain tissue from animals with encephalitis symptoms and aborted sheep samples. The analysis showed that *Listeria* spp. was absent from the abortion samples, but two positive cases were identified in the brain tissue [9]. This pattern has been attributed to limited silage consumption by small ruminants in the region. In a commercial livestock enterprise near Akyurt (Ankara), serological analysis of blood samples from 50 goats, 3 horses, 1 dog, and 6 animal handlers revealed antibodies against *L. monocytogenes*. These findings indicate that listeriosis can occur across multiple animal species and in humans, underscoring the need for a coordinated approach involving both veterinary professionals and public health authorities for the surveillance and control of this infection [11]. Table 2 provides an overview of the number of studies, primary sample types, and methods employed, categorized by animal species.

Table 1: Studies on animal listeriosis in Türkiye between 1980 and 2024, arranged according to the method of diagnosis used in each study.

Methods	Year and reference	Geographical region	Period of sampling	Animal hosts	Materials tested	Total sample	Positive sample (%)	Clinical forms
Culturing	1987 [50]	Central Anatolian region	1980-1986	Sheep, goats	Aborted foetuses	3,760	10 (0.25)	Abortive form
Culturing	1999 [51]	Eastern Anatolian (Elazığ)	1995-1996	Sheep, goats	Aborted foetuses	110	1 (0.9)	Abortive form
Culturing	2006 [52]	Eastern Anatolian (Kars)	2004	Sheep	Liver and lungs	120	5 (4.17)	Abortive form
Culturing	2021 [31]	Eastern Anatolian (Kars)	2021	Sheep, cattle	Brain and liver tissues	18	12 (66.6)	Encephalitis form
Culturing, PCR	2022 [14]	Eastern Anatolian (Kars)	2016-2019	Sheep	Vaginal swabs, milk, and foetal abomasum contents	538	8 (1.48)	Abortive form
Immuno-peroxidase	2013 [53]	Eastern Anatolian (Kars)	2008	Cattle	Vaginal swab	96	7 (7.29)	Abortive form
PCR	2021 [54]	Türkiye	2019	Sheep, cattle, goats	Foetal abomasum contents	250	0	Abortive form
PCR, Histopathology	2022 [55]	Central Anatolian Region (Konya)	2018	Sheep	Aborted foetuses	52	0	Abortive form
RT-PCR	2023 [12]	Eastern Anatolian (Van)	2017-2019	Sheep	Aborted foetuses, vaginal swabs, and placenta	130	1 (0,77)	Abortive form
PCR	2024 [13]	Mediterranean region (Isparta, Burdur, Antalya), Aegean region (Afyonkarahisar), Central Anatolian, region (Niğde, Aksaray, Karaman, Konya	2012-2017	Sheep, goats	Aborted foetuses	1,226	28 (2.4)	Abortive form
PCR	2025 [32]	Aegean region, the Mediterranean region, and the Central Anatolian region	2015-2017	Cattle	Aborted foetuses	125	0	Abortive form
PCR	2024 [9]	Eastern Anatolian (Van)	2020-2022	Sheep	Abortion material and brain	41	2 (4.87)	Encephalitis form
PCR	2024 [56]	Türkiye	2022	Sheep, cattle	Vaginal swabs and foetal abomasum contents	179	0	Abortive form
Serology	1999 [38]	Eastern Anatolian (Kars) (Ardahan)	1999	Cattle	Blood	462	374 (81)	Subclinical form
Serology	2002 [10]	Eastern Anatolian (Van)	2002	Horses	Blood	203	176 (86.7)	Subclinical form
Serology	2003 [57]	Aegean region (Aydın)	2002	Sheep	Blood	100	35 (35)	Subclinical form
Serology	2006 [37]	Marmara region (Bursa)	2005	Cattle	Blood	209	101 (48.3)	Subclinical form
Serology	2006 [11]	Central Anatolian region (Ankara)	2006	Goats	Blood	50	23 (43)	Subclinical form
				Horses	Blood	3	3 (100)	
				Dogs	Blood	1	1 (100)	
Serology	2007 [46]	Eastern Anatolian (Van)	2007	Goats	Blood	98	34 (34.7)	Subclinical form
Serology	2008 [45]	Central Anatolian (Kırıkkale)	2005-2006	Cattle	Blood	100	37 (37)	Subclinical form
Serology	2009 [23]	Central Anatolian (Ankara)	2008	Sheep, goats	Blood	137	80 (58.4)	Subclinical form
Serology	2009 [59]	Kırıkkale, İzmir, Tokat	2009	Cattle	Blood	378	162 (42.85)	Subclinical form
Serology	2010 [48]	Eastern Anatolian (Erzurum)	2009	Dogs	Blood	72	19 (26.3)	Subclinical form
Serology	2010 [47]	Southeastern Anatolian (Diyarbakır)	2009	Dogs	Blood	100	17 (17)	Subclinical form
Serology	2010 [58]	Eastern Anatolian (Kars)	2010	Dogs	Blood	179	40 (22.3)	Subclinical form
Serology	2014 [60]	Mediterranean region (Adana)	2008	Cattle	Blood	132	54 (40.9)	Subclinical form

Spatiotemporal distribution and characteristics of included studies

Examining the temporal distribution of studies on animal listeriosis in Türkiye shows a marked increase after 2020, largely attributable to the broader adoption of molecular diagnostic methods in veterinary microbiology laboratories [9, 12, 13]. Studies published between 2020 and 2024 focused on the molecular characterization, clinical forms, and epidemiological features of *L. monocytogenes* [14]. Following the COVID-19 pandemic, heightened interest in zoonotic diseases has prompted more systematic investigations of animal-derived pathogens, including listeriosis [15]. Overall, the findings indicate that studies on animal listeriosis in Türkiye are regionally concentrated and that reported prevalence rates vary considerably by diagnostic method. High positivity rates in serological studies can be explained by the detection of antibodies reflecting both past and current infections.

A substantial proportion of the included studies were conducted in Eastern Anatolia, particularly in the Provinces of Kars and Van, reflecting the high density of ruminant populations in this region. Overall, Eastern and Central Anatolia accounted for the most studies among the regions. The higher occurrence of the disease in these areas may be associated with the widespread practice of sheep and cattle breeding, as well as the intensive use of silage, both of which are recognized as important risk factors for listeriosis [1, 9]. Studies in the Marmara region have reported subclinical infections and isolation of *Listeria* spp. from milk and fecal samples, primarily on intensive cattle farms [16]. The limited number of studies in the Black Sea and Southeastern Anatolia regions makes it difficult to determine the true prevalence of the disease in these areas [17]. The vast majority of studies published in Türkiye since 2020 have been cross-sectional studies and clinical case series. These studies generally involve isolation and molecular identification methods based on abortion material, brain tissue, and silage samples. Long-term surveillance studies and national-level epidemiological monitoring programs have been found to be limited. Table 3 presents the number of studies on listeriosis conducted in Türkiye by year, region, and study type.

Table 2: The number of studies, materials used, and research methods were categorized by animal species.

Animal species	Number of studies	Main specimens	Common diagnostic methods
Sheep	6	Abortion material, foetal abomasum contents, vaginal swab, and blood	PCR, RT-PCR, culture, serology
Cattle	7	Blood, abortion material, vaginal swab, brain, and liver	Serology (ELISA), PCR, culture,
Goat	1	Blood and abortion material	Serology, PCR, culture
Dog	3	Blood	Serology
Horse	1	Blood	Serology
Multiple species (sheep-cattle-goat)	8	Abortion material, foetal abomasum contents, and vaginal swab.	PCR

Table 3: Spatiotemporal distribution of listeriosis studies conducted on animals in Türkiye by year, region, and study type.

Criteria	Information	Number of studies
Temporal distribution	1980-1999	3
	2000-2004	2
	2005-2009	6
	2010-2014	4
	2015-2019	4
	2020–2024	7
Spatial distribution	Eastern Anatolia	12
	Central Anatolia	6
	Mediterranean	1
	Marmara	1
	South-eastern Anatolia	1
	Aegean	0
	Black Sea	0
	Unknown	2
	Multi-Location	3
Type of study	Seroprevalence study	13
	Molecular prevalence study	6
	Bacteriological isolation study	4
	Immunohistochemical and immunoperoxidase study	1
	Combined methodology study	2

Discussion

This study synthesizes data from all published studies on animal listeriosis in Türkiye, providing a comprehensive overview of its epidemiology, clinical manifestations, diagnostic methods, and regional patterns. The results demonstrate that listeriosis continues to be a significant animal health concern in Türkiye, especially in areas with intensive ruminant farming [18]. A similar trend has been reported in European countries, underscoring the need for parallel monitoring of animal and human listeriosis cases [19].

In Türkiye, the vast majority of listeriosis cases in cattle are abortive. *L. monocytogenes* has been widely isolated from foetal tissues and placental samples obtained from abortions, particularly in the last trimester of pregnancy [12, 13]. This pattern is explained by the tropism of *L. monocytogenes* for placental tissues [20]. Recent studies suggest that cattle may be subclinical carriers and contribute to the persistence of infection within the herd [1]. These findings are important for cattle farms with respect to both animal health and zoonotic risk [4]. Listeriosis in sheep is the most commonly reported form of animal listeriosis in Türkiye. The disease primarily manifests as encephalitis, with isolates from the brainstem and medulla oblongata showing high positivity rates. Recent studies report that encephalitic cases in sheep are largely associated with consumption of contaminated silage [21]. Clinically, ataxia, head tilt, and facial paralysis are the most commonly reported findings [22]. In goats, studies on listeriosis in Türkiye are limited. Available data indicate that the infection predominantly occurs in encephalitic and septicemic forms [21, 23]. The septicemic form has been reported to be fatal, especially in young goats [24]. There are no studies on the presence of *Listeria* spp. in live poultry and wild animals. However, studies on poultry in Türkiye have focused on the food industry and were therefore excluded from our study. In the aforementioned study, subclinical carriage was reported in poultry, and the authors noted that these animals may contribute to environmental contamination [25].

When evaluating the distribution of animal listeriosis in Türkiye by clinical form, encephalitis is one of the main manifestations. Identifying this form is challenging because clinical signs are typically nonspecific, misdiagnosed with other diseases, and often leading to diagnosis at advanced stages [21, 26, 27]. In contrast, the abortive form can be detected earlier; however, many cases are reported without confirmation of the causative agent. The abortive form is most commonly observed in cattle, while the septicemic form is reported mainly in calves and lambs [28]. Subclinical infections also play a critical role in sustaining herd-level transmission [29, 30]. This review highlights the presence of subclinical cases, which contribute to the silent spread of listeriosis within herds and elevate the associated zoonotic risk [19].

To date, the existing literature in Türkiye indicates that the highest isolation rates for *Listeria* diagnosis are obtained from brain tissue and abortion materials [9, 12, 31, 32]. Listeriosis is among several bacterial infections frequently associated with the consumption of contaminated silage [33]. Isolations from silage samples support the importance of feed-borne transmission [8, 34]. Similarly, studies conducted in Europe have reported that silage use is a major risk factor for listeriosis [35, 36]. Subclinical infections have been reported to be predominant in the Marmara region [37]. Isolation of *Listeria* from fecal and milk samples is considered an indicator of subclinical carriage and a potential public health threat [38, 39]. However, in this study, subclinical forms were detected in blood samples using serologic assays, including ELISA. In regional epidemiological assessments in Türkiye, encephalitic cases are reported more frequently in the Eastern Anatolia region, while abortive cases are reported more frequently in the Central Anatolia region. This situation can be explained by the prevalence of ruminant livestock farming, the long winter season, and the intensive use of silage in these regions [8, 9].

Culture and PCR methods are widely used for detecting *Listeria* worldwide. In Türkiye, detection rates in cattle range from 0% to 7.29%, and in sheep from 0% to 4.87%. Similarly, a study in Tunisia reported rates of 5.7% in cattle and 10.2% in sheep [40]. In Sweden, *Listeria* was detected in 4.3% of autopsy samples from various animals [41]. In contrast, a study on goats in India reported a much higher rate of 55.6%, which may be attributed to the small sample size [42]. In the United States, detection rates were 24.4% in cattle and 32.9% in small ruminants [30]. The relatively high detection rates in some studies are likely due to the types of samples analyzed, such as feces, soil, and water.

Seroprevalence studies of animal listeriosis have been conducted in countries such as Nigeria and Ethiopia, revealing substantial variation across species and regions. In Nigeria, the highest seroprevalence was reported in horses (68.4%), followed by pigs (36.1%) and cattle (20.8%) [43]. In Ethiopia, average prevalence rates were 21.6% for *Listeria* spp. and 6.9% for *L. monocytogenes*, with some sheep and goat herds showing seroprevalence above 40% [44]. Similarly, in Türkiye, horses exhibit the highest serological rate at 86.69%, while cattle show prevalence between 37% and 81%, sheep and goats range from 34.69% to 58.39%, and dogs range from 17% to 26.3% [10, 23, 38, 45, 46, 47, 48].

Listeriosis is a significant infectious disease not only for veterinary health but also for public health. The presence of subclinical carriers in Türkiye increases the risk of

human infection through raw milk and dairy products [49]. Reports from the European Union suggest that animal and human listeriosis cases may be epidemiologically linked, highlighting the importance of a One Health approach [19]. In this context, strengthening surveillance systems for animal listeriosis in Türkiye is essential to better understand animal–human–environment interactions.

This review has some limitations. Most studies on listeriosis in Türkiye are regional, involve small sample sizes, and display methodological heterogeneity. Additionally, the lack of national-level, long-term surveillance studies hinders accurate assessment of the disease's true prevalence.

Conclusion

This study demonstrates that animal listeriosis remains a significant animal health problem in Türkiye, particularly in regions with intensive ruminant farming. Current evidence indicates that *L. monocytogenes* is the primary causative agent, and infections typically manifest as encephalitic or abortive forms. The findings highlight silage as a key risk factor in listeriosis epidemiology, as consumption of improperly fermented or poorly stored silage facilitates the spread of *L. monocytogenes* within herds. This underscores the importance of feed hygiene and silage quality control in disease prevention.

An integrated approach is essential for effective control of animal listeriosis in Türkiye. Key strategies include improving silage and feed hygiene, promoting molecular diagnostic methods for early detection, and implementing One Health-based surveillance programs that encompass animal–human–environment interactions. Future research should focus on multicenter epidemiological studies across Türkiye and encourage the use of advanced techniques such as molecular characterization and whole-genome sequencing. Integrated monitoring of both animal and human listeriosis cases will further enhance the management of associated zoonotic risks.

Declarations and supplementary information

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