OPEN ACCESS Freely available online

ISSN: 2576-389X
Journal of Infectious Diseases and Diagnosis

Mini Review

Infectious Disease Challenges in Korean Native Black Goats (KNBGs): Current Status, Control Needs and Strategic Approaches

Gyeong-Seo Park, Woo Ju Kwon, Byoung-Joo Seo*, Chonghan Kim*

Vaccine Lab, WOOGENE B&G Co., Ltd., Seoul 07299, Republic of Korea

ABSTRACT

The Korean Native Black Goats (KNBGs) industry has observed remarkable growth over the past decade in Korea. From 2012 to 2021, the KNBG population increased by 72.2% and also, their market value increased from 75.8 billion KRW in 2015 to 177.5 billion KRW (South Korean Won) in 2021. This growth has been driven by a steady rise in consumer demand for black goat meat, fueled by shifting dietary preferences and a growing interest in alternative protein sources. Additionally, the prohibition of dog meat consumption has further encouraged a shift toward ethically acceptable livestock products in Korea. Despite this situation, the industry faces important challenges, particularly the lack of organized herd management systems and specialized veterinarian and veterinary pharmaceuticals. These challenges have led to the sustained occurrence of infectious diseases, posing a significant threat to disease control and productivity in the KNBGs industry. One of the most challenging diseases is Caseous Lymphadenitis (CLA), a chronic infectious disease caused by *Corynebacterium pseudotuberculosis*. The CLA induced abscess formation, reduced productivity of meat and increased culling rates. Since its initial identification in South Korea in 2014, CLA has shown a continuous increase, with recent reports indicating that approximately 50% of farms were infected in 2023. In addition to CLA, KNBG herds are susceptible to respiratory and digestive diseases; enterotoxaemia caused by *Clostridium perfringens* types C and D, *colibacillosis* associated with *Escherichia coli* and Q fever caused by *Coxiella burnetii*. However, the method or policy about disease control has not been constructed yet. This review emphasizes the necessity of a multifaceted approach. Routine disease surveillance, stringent biosecurity measures and the development of effective, species-specific pharmaceuticals are essential to improving herd management and ensuring the sustainable growth of the KNBG industry in Korea.

Keywords: *Clostridium perfringens*; Colibacillosis; *E. coli*; Q-fever; *Coxiella burnetii*; Control strategies

INTRODUCTION

The black goat industry has experienced remarkable growth in recent years, driven by the increasing demand for black goat meat. Data from the Ministry for Food, Agriculture, Forestry and Fisheries (MAFRA) in Korea indicate a steady rise in the black goat population, which grew by 72.2%, from 257,262 in 2012 to 443,094 in 2021. During the same period, the industry's production value also increased from 75.8 billion KRW in 2015 to 177.5 billion KRW in 2021.

Despite the market growth, KNBGs are still classified as minor livestock under South Korea's livestock law. As a result, KNBG farms do not receive the same support as major livestock

Correspondence to: Byoung-Joo Seo, Vaccine Lab, WOOGENE B&G Co., Ltd., Seoul 07299, Republic of Korea, E-mail: byoungjooseo@gmail.com
Chonghan Kim, Vaccine Lab, WOOGENE B&G Co., Ltd., Seoul 07299, Republic of Korea, E-mail: chonghan2004@naver.com

Received: 19-Dec-2024, Manuscript No. JIDD-24-27846; **Editor assigned:** 23-Dec-2024, PreQC No. JIDD-24-27846 (PQ); **Reviewed:** 06-Jan-2025, QC No. JIDD-24-27846; **Revised:** 13-Jan-2025, Manuscript No. JIDD-24-27846 (R); **Published:** 20-Jan-2025, DOI: 10.35248/2576-389X.25.10.308

Citation: Park GS, Kwon WJ, Seo BJ, Kim C (2025). Infectious Disease Challenges in Korean Native Black Goats (KNBGs): Current Status, Control Needs and Strategic Approaches. J Infect Dis Diagn. 10:308.

operations leading to their exclusion from essential government programs and contributing to the continued decline in farm condition [1,2].

LITERATURE REVIEW

Characteristics of black goat bred in Korea

KNBGs occupy a unique position as the only goat breed from South Korea listed in the Domestic Animal Diversity Information System (DAD-IS) under the Food and Agriculture Organization (FAO). Despite this distinction, research on their phenotypic characteristics, genetic diversity and phylogenetic relationships remains limited [3-5]. This lack of comprehensive evaluation presents challenges for the effective management and conservation of this breed.

The KNBG breed is further divided into several distinct regional lines. Recent genetic studies suggest that, while KNBGs show minimal genetic divergence from international goat breeds they can be classified into specific regional lines, such as those from Dangjin, Tongyeong and Jangsu [6,7]. Additionally, the introduction of crossbred lines through hybridization with Boer goats has led to increased genetic variation within the KNBG population. Combined with the lack of specialized pharmaceuticals and farm management strategies, these characteristics have contributed to the widespread prevalence of various diseases among KNBGs [8].

Caseous Lymphadenitis (CLA): A major contagious disease of KNBGs

Among the infectious diseases affecting KNBGs, Caseous Lymphadenitis (CLA) is a major concern due to its significant impact on goat meat productivity. Caused by *Corynebacterium pseudotuberculosis*, CLA typically occurs with lymph node enlargement and edema and may involve other organs such as the lungs, liver and kidneys and is classified as an acute and chronic infection [9]. In the case of chronic infection, it can lead to severe reductions in productivity and, in more advanced stages, result in sudden death in goats [10,11]. CLA was first reported in South Korea in 2014 and its prevalence has continuously increased [12]. As of 2023, approximately 50% of goats were infected across various regions in the country [8,13]. Additionally, the seasonal variations in the incidence of CLA in KNBGs have also been documented, with increased cases observed during specific times of the year, further highlighting the growing impact of the disease [8]. Despite the recognized importance of controlling Caseous Lymphadenitis (CLA) in goat farming, South Korea currently lacks continuous disease surveillance programs to monitor its prevalence and economic impact. Moreover, the absence of veterinarians specializing in goats and the unavailability of goat-specific pharmaceuticals significantly inhibit accurate assessment of the disease.

These limitations underscore a pressing need for comprehensive strategies, including nationwide disease monitoring initiatives, targeted pharmaceutical development and specialized veterinary training. Addressing these gaps will be important to mitigating the health and economic challenges posed by CLA in KNBGs and ensuring the sustainable growth of the black goat industry.

Major respiratory and digestive infectious diseases in KNBGs

KNBGs are susceptible to several other infectious diseases that significantly impact their health and productivity. Among these, infections caused by *Clostridium perfringens*, *Colibacillosis* and *Coxiella burnetii* (the causative agent of Q fever) are particularly noteworthy.

Enterotoxaemia (*C. perfringens*): Digestive infectious diseases

Clostridium perfringens is a key pathogen responsible for enterotoxaemia, commonly referred to as "pulpy kidney disease," in goats [14,15]. The disease is typically associated with poor nutritional management, abrupt dietary changes, or stress, which promote the overgrowth of the bacterium in the gastrointestinal tract [16]. *Clostridium perfringens* is classified into four types (A, B, C and D) based on the production of four major toxins; α (Alpha), β (Beta), ε (Epsilon) and ι (Iota), it is also known to produce at least 16 virulence factors [17-19]. The pathogenicity exhibits variability, which is dependent on the specific toxins; however, relatively little is known about the pathogen's mechanisms in goats compared to other animal species [20-22]. Generally, *C. perfringens* toxins are associated with bacterial enteritis and diarrhea [20]. Notably, the α (alpha) and β (beta) toxins produced by *C. perfringens* type C have been linked to severe conditions, including small intestinal ulcers, necrotizing enteritis and hemorrhagic enteritis [20,23]. In South Korea, outbreaks of *C. perfringens* have been documented sporadically, but systematic prevalence studies are lacking [24,25]. In addition, while studies on the pathogenicity and clinical manifestations of *C. perfringens* type D have been conducted internationally, research on this toxin type in goats remains scarce in South Korea, underscoring the need for domestic investigations to better understand its role in Enterotoxaemia [26,27]. In South Korea, research on clostridial diseases caused by *C. perfringens* type D has primarily focused on analyzing antibiotic resistance, with limited recent studies addressing prevalence or pathogenicity.

As a result, the extent to which these diseases persist on farms and their overall impact remains unclear. This lack of data might have induced significant challenges not only in assessing the scale of the problem but also in implementing effective disease control measures, leaving farmers with limited options for managing outbreaks.

Colibacillosis (*E. coli*): Digestive infectious diseases

Escherichia coli is another significant pathogen responsible for gastrointestinal diseases in KNBGs, particularly affecting neonates and kids [28,29]. Diarrhea caused by pathogenic *E. coli* strains, including Enterotoxigenic *E. coli* (ETEC) and Shiga Toxin-producing *E. coli* (STEC), can result in dehydration, weight loss and, sudden death [29-31]. While research on the pathogenic strains of *E. coli* in goats in South Korea is limited,

there have been occasional field reports documenting outbreaks of diarrhea in goat kids [32]. Previous study, examined the prevalence of *E. coli* in South Korean goats by analyzing 49 fecal samples from various farms and identified approximately a 10% positivity rate [32].

Despite the detection of *E. coli* antigens in a considerable portion of samples, follow-up research on the prevalence and pathogenicity of *E. coli*-induced diarrhea in goats in South Korea remains lacking. The lack of sustained and comprehensive research on this disease is concerning in that we are unable to identify trends and characteristics of the disease in Korea. These research gaps are believed to hinder the development of effective diagnostics and the systematization of disease management strategies and the overuse of broad-spectrum antibiotics on farms has led to growing concerns about antibiotic resistance. Therefore, a more exhaustive investigation of the epidemiology and pathogenic mechanisms of *E. coli* in KNBG is urgently needed.

Q-fever (*Coxiella burnetii*): Emerging respiratory infectious diseases

Q fever, caused by *Coxiella burnetii*, is a zoonotic disease with serious implications for both animal and public health [33,34]. This disease is a significant concern in veterinary medicine due to its potential to be transmitted to humans, particularly through inhalation of contaminated aerosols, contact with infected animal products, or ingesting unpasteurized milk [35,36]. In contrast, the transmission of *Coxiella burnetii* between animals is known to occur through arthropods such as ticks [33]. In ruminants such as cattle, sheep and goats, Q fever infection has been reported to primarily cause reproductive failures, including late-term abortions, premature births, stillbirths and the delivery of weak-born [37,38]. In South Korea, Q fever is classified as a notifiable infectious disease under strict governmental management. According to the KDCA, the number of human cases increased from 81 in 2016 to 162 in 2019, demonstrating a significant upward trend [39]. In addition, Q fever is designated as a Type 2 notifiable livestock infectious disease, with reports from the Animal and Plant Quarantine Agency (APQA) indicating a continuous increase in livestock (Ruminants) infections, from 24 cases in 2017 to 144 cases in 2019 [40,41]. Most studies on Q fever have focused on analyzing domestic prevalence and seropositivity rates and overall, the prevalence of Q fever in goats is reported to be around 11% [1]. In addition, a nationwide survey of 60 goat farms in five provinces with goat herd sizes exceeding 100 goats from 2009 to 2011 found an average seropositivity rate of 19%. When subdivided by region, the seropositivity rate was 43% in Gyeongnam, 24% in Jeonbuk and 19% in Jeonnam, indicating clear regional differences in outbreak characteristics [42-44]. Subsequent studies have confirmed the presence of Q fever in South Korea, with a nationwide seropositivity rate of approximately 15%, with regional variations trending in line with previous studies [42]. In addition to regional differences, a seasonal pattern emerged, with higher seropositivity rates in summer (approximately 33%) and fall (approximately 28%). This confirms that Q-fever has unique regional and seasonal infection and transmission characteristics in Korea [40].

Despite these preliminary findings, few recent studies (since 2020) have been conducted on the prevalence, seropositivity, or pathogenicity of Q fever in goats. In the absence of further research, it is difficult to determine the prevalence and current trends of Q-fever in goat farms. As with the aforementioned diseases, there is an urgent need for systematic monitoring and preventive measures due to the lack of routine surveillance and disease management programs. Given the zoonotic potential of Q fever, especially for farm workers and veterinarians, rapid diagnostic techniques and response options should be considered.

DISCUSSION

KNBGs continue to face considerable challenges from infectious diseases, with systemic shortcomings impeding efforts to mitigate these issues:

Absence of goat-specific pharmaceuticals, vaccines and veterinarians

The absence of pharmaceuticals specifically designed for goats remains a major obstacle. Farmers often misuse and abuse bovine-based medicines to treat diseases in goats. Furthermore, the lack of veterinarians who specialize in goats makes it difficult to accurately diagnose, prevent and treat diseases.

Deficiencies in surveillance and diagnostic tools

Currently, there is a lack of comprehensive data on the prevalence of the disease and how it manifests in KNBG, largely due to the lack of continuous disease surveillance. This absence of routine surveillance programs makes early detection of outbreaks difficult. In addition, limited diagnostics for goat disease prevent accurate disease identification, which prevents active biosecurity.

Poor farm management

Overcrowded housing, poor animal hygiene and inadequate biosecurity measures on many farms create conditions for pathogens to spread rapidly. The lack of national policies, training and investment in farmer training and modernized husbandry, sanitation and biosecurity protocols leaves them vulnerable to both endemic and emerging infectious diseases.

To address these pressing issues, a multi-faceted approach is required, encompassing the development of targeted pharmaceuticals and vaccines tailored to goats, the establishment of comprehensive disease monitoring systems and the dissemination of evidence-based best practices to KNBG farmers. Implementing these measures is imperative to safeguarding the health of KNBG populations and ensuring the long-term viability and sustainability of the native black goat industry in South Korea.

CONCLUSION

The health and sustainability of the KNBG industry are undermined by persistent infectious diseases, exacerbated by systemic challenges such as the absence of goat-specific vaccines and therapeutics, inadequate surveillance programs and poor farm management practices. Addressing these issues requires a coordinated and proactive approach. The development of goat-specific pharmaceuticals, implementation of effective disease monitoring systems and adoption of improved biosecurity measures are essential to mitigate disease impacts. Additionally, fostering research on the prevalence, pathogenicity and transmission dynamics of key infectious agents like *Corynebacterium pseudotuberculosis*, *Clostridium perfringens*, colibacillosis and *Coxiella burnetii* will inform targeted interventions. Ensuring government support for KNBG farmers through education, financial assistance and policy inclusion is important to overcoming these challenges. To achieve these changes, it is essential for research institutions in academia, industry and government to maintain a continuous focus on the Korean goat industry and to dedicate collaborative efforts across these sectors.

REFERENCES

1. Kim H, Kim S, Kim K, Kim B, Chang B, Choe NH. Prevalence of bovine tuberculosis, brucellosis and Q fever in Korean black goats. Korean J Vet Res. 2016;56(4):249-254.
2. Choi SH. Korean black goat industry status, problems and improvements. National Institute of Animal Science, Wanju. 2009.
3. Kim JH, Cho CY, Choi SB, Cho YM, Yeon SH, Yang BS. mtDNA diversity and phylogenetic analysis of Korean native goats. J Life Sci. 2011;21(9):1329-1335.
4. Kim JH, Byun MJ, Ko YG, Kim SW, Kim SW, Do YJ, Kim MJ, Yoon SH, Choi SB. Phylogenetic analysis of Korean native goats based on the mitochondrial cytochrome b gene. J Anim Sci Technol. 2012;54(4):241-246.
5. Suh S, Byun M, Kim YS, Kim MJ, Choi SB, Ko YG, et al. Analysis of genetic diversity and relationships of Korean native goat populations by microsatellite markers. J Life Sci. 2012;22(11): 1493-1499.
6. Kim G, Lee E, Kim K, Kim D, Kim S, Jin D, et al. Mitochondrial genomes of Korean native black goats reveal shared phylogeographic patterns and demographic history. Animals. 2024;14(20):2949.
7. Lee SH, Lee J, Jeon D, Kim S, Kim KW. Morphological characteristics and growth performance of Korean native black goats. JKAIS (Journal of the Korea Academia-Industrial Cooperation Society). 2019;20(8):149-155.
8. Park GS, Lee S, Jeong MA, Lee SY, Cho DG, Cho W, et al. First trial of a novel Caseous lymphadenitis inactivated vaccine in south Korea: Experimental evaluation across various animal models. Pathogens. 2024;13(9):729.
9. Taylor DJ. Miscellaneous bacterial infections. Diseases of Swine. 2006;9:817-843.
10. Baird GJ, Fontaine MC. *Corynebacterium pseudotuberculosis* and its role in ovine Caseous lymphadenitis. J Comp Pathol. 2007;137(4): 179-210.
11. Fontaine MC, Baird GJ. Caseous lymphadenitis. Small Rumin Res. 2008;76(1-2):42-48.
12. Pathirana HN, Cho HS, Cho YI, Kim CL, Wimalasena SH, Rajapaksha LG, et al. Molecular characterization and antimicrobial susceptibility of *Corynebacterium pseudotuberculosis* isolated from skin abscesses of native Korean goats (Capra hircus coreanae). J Appl Microbiol. 2022;133(3):2074-2082.
13. Pioquinto JM, Aftabuzzaman M, Valete EJ, Espiritu H, Kim SH, Jin SJ, et al. Pilot study on risk factors associated with Caseous lymphadenitis and its seasonal prevalence in the Korean native goat. Korean J Vet Serv. 2023;46(4):255-262.
14. Jemal D, Shifa M, Kebede B. Review on pulpy kidney disease. J Vet Sci Technol. 2016;7(5):361.
15. Sasikala M, Selvaraj J, Ahamad DB, Prasath NB. Pulpy Kidney Disease in Sheep and Goats. Indian Vet J. 2016;93(02):83-84.
16. Uzal FA, Vidal JE, McClane BA, Gurjar AA. *Clostridium perfringens* toxins involved in mammalian veterinary diseases. Open Toxinology J. 2010;2:24-42.
17. McDonel JL. *Clostridium perfringens* toxins (type A, B, C, D, E). Pharmacol Ther. 1980;10(3):617-655.
18. Nakano V, Ignacio A, Llanco L, Bueris V, Sircili MP, Ávila-Campos MJ. Multilocus sequence typing analyses of *Clostridium perfringens* type A strains harboring tpeL and netB genes. Anaerobe. 2017;44:99-105.
19. Coursodon CF, Glock RD, Moore KL, Cooper KK, Songer JG. TpeL-producing strains of *Clostridium perfringens* type A are highly virulent for broiler chicks. Anaerobe. 2012;18(1):117-121.
20. Chen J, Ma M, Uzal FA, McClane BA. Host cell-induced signaling causes *Clostridium perfringens* to upregulate production of toxins important for intestinal infections. Gut Microbes. 2014;5(1): 96-107.
21. Uzal FA, Freedman JC, Shrestha A, Theoret JR, Garcia J, Awad MM, et al. Towards an understanding of the role of *Clostridium perfringens* toxins in human and animal disease. Future Microbiol. 2014;9(3):361-377.
22. Mehdizadeh Gohari I, A. Navarro M, Li J, Shrestha A, Uzal F, A. McClane B. Pathogenicity and virulence of *Clostridium perfringens*. Virulence. 2021;12(1):723-753.
23. Nagahama M, Ochi S, Oda M, Miyamoto K, Takehara M, Kobayashi K. Recent insights into *Clostridium perfringens* beta-toxin. Toxins. 2015;7(2):396-406.
24. Kim JH, Kim YH, Cho KH, Nam SY, Lee HJ, Lee BJ. Antibiotic susceptibility of *Clostridium perfringens* type D isolated from feces of goats. J Prev Vet Med. 2018;42(4):148-156.]
25. Yoo HS, Lee SU, Park KY, Park YH. Molecular typing and epidemiological survey of prevalence of *Clostridium perfringens* types by multiplex PCR. J Clin Microbiol. 1997;35(1):228-232.
26. Morrell EL, Navarro MA, Garcia JP, Beingesser J, Uzal FA. Intestinal pathology in goats challenged with *Clostridium perfringens* type D strain CN1020 wild-type and its genetically modified derivatives. Vet Pathol. 2024:03009858241273122.
27. Uzal FA, Giannitti F, Finnie JW, García JP. Diseases produced by *Clostridium perfringens* type D. Clostridial Diseases of Animals; Wiley Blackwell: Ames, IA, USA. 2016:157-172.
28. Hanlon KE, Miller MF, Guillen LM, Echeverry A, Dormedy E, Cemo B, et al. Presence of *Salmonella* and *Escherichia coli* O157 on the hide, and presence of *Salmonella*, *Escherichia coli* O157 and *Campylobacter* in feces from small-ruminant (goat and lamb) samples collected in the United States, Bahamas and Mexico. Meat Sci. 2018;135:1-5.
29. Yañez-Villa A, Martínez-Flores RI, Díaz-Aparicio E, Carrillo-Casas EM, Morales-Espinosa R, Delgado G, et al. *Escherichia coli* virulence genes and clonality in strains from diarrhoea in goat kids. Small Rumin Res. 2023;220:106906.

30. Alvarez-Suarez ME, Otero A, Garcia-Lopez ML, Dahbi G, Blanco M, Mora A, et al. Genetic characterization of Shiga toxin-producing *Escherichia coli* (STEC) and atypical enteropathogenic *Escherichia coli* (EPEC) isolates from goat's milk and goat farm environment. Int J Food Microbiol. 2016;236:148-154.

31. Kritas SK, Burriel AR, Tzivara AH, Govaris A, Kyriakis SC, Karatzias H, et al. Prevention of scours in neonatal kids after modification of management and experimental vaccination against *Escherichia coli*. Small Rumin Res. 2003;50(1-2):51-56.

32. Chang-Yong, Dong-Soo, Sun-Ho, Tae-Yeong, Yeong-Hun, Seok-Jin, et al. Investigation of the major pathogens in black goat farms. Anim Resour Res. 2012;23(1):33-38.

33. Maurin M, Raoult DF. Q fever. Clin Microbiol Rev. 1999;12(4): 518-553.

34. Hatchette T, Campbell N, Hudson R, Raoult D, Marrie TJ. Natural history of Q fever in goats. Vector Borne Zoonotic Dis. 2003;3(1):11-15.

35. Woldehiwet Z. Q fever (coxiellosis): Epidemiology and pathogenesis. Research in veterinary science. 2004;77(2):93-100.

36. Norlander L. Q fever epidemiology and pathogenesis. Microbes Infect. 2000;2(4):417-424.

37. Berri M, Rousset E, Champion JL, Russo P, Rodolakis A. Goats may experience reproductive failures and shed *Coxiella burnetii* at two successive parturitions after a Q fever infection. Res Vet Sci. 2007;83(1):47-52.

38. Roest HJ, van Gelderen B, Dinkla A, Frangoulidis D, van Zijderveld F, Rebel J, et al. Q fever in pregnant goats: Pathogenesis and excretion of *Coxiella burnetii*. PloS One. 2012;7(11):e48949.

39. Kwak W, Chu H, Hwang S, Park JH, Hwang KJ, Gwack J, et al. Epidemiological characteristics of serologically confirmed q Fever cases in South Korea, 2006-2011. Osong Public Health Res Perspect. 2013;4(1):34-38.

40. Seong Min-ho, Park Jong-sik, Yoon Do-kyung, Kim Hyeong-su, Ko Byeong-hyo, Ham Jeong-min, et al. Survey on the positivity rate of Q-fever antibodies in goats raised in Gyeongnam region. Korean J Vet Sci. 2020;43(4):211-216.

41. Byeon HS, Jeon BY, Jeong HW, Kim CS, Jang RH, Kang SS, et al. Massive human Q fever outbreak from a goat farm in Korea. J Biomed Transl Res. 2020;21(4):200-206.

42. Jung BY, Seo MG, Lee SH, Byun JW, Oem JK, Kwak D. Molecular and serologic detection of *Coxiella burnetii* in native Korean goats (Capra hircus coreanae). Vete Microbiol. 2014;173(1-2):152-155.

43. Kim SG, Cho JC, Lee MG, Kim SS, Lee SH, Kwak DM. Seroprevalence of *Coxiella burnetii* in native Korean goats (Capra hircus coreanae) in Gyeongbuk province, Korea. Korean J Vet Srev. 2014;37(4):241-246.

44. Gang SJ, Jeong JM, Kim HK, Lee JW, Shon KR, Park TW. Prevalence of *Coxiella burnetii* in native Korean goat in Jeonbuk province. Korean J Vet Srev. 2016;39(4):239-246.