



## Prevalence of Pathogenic *Escherichia coli* 0157:H7 in Livestock and Poultry in Market and Abattoirs in Zaria, Kaduna State, Nigeria: A Short Communication

<sup>1</sup>Yusuf Wada, <sup>2</sup>Suwaiba Ladan Muhammad, <sup>1</sup>Nasir Ademola Adeyemi, <sup>1</sup>Oyebola Yusrah Bolakojo, <sup>1</sup>Mubarak Jimoh Ibrahim, <sup>1</sup>Hannatu Jimba J, <sup>1</sup>Mariam Adeola Salu, <sup>1</sup>Abdulkareem Auwal Aliyu, <sup>1</sup>Halimat Oyiza Tijani, <sup>3</sup>Mustapha Wada, <sup>1</sup>Franca Maiture Galion, <sup>1</sup>Olive Blessing Daniel, <sup>1</sup>Rosemary Funto Boboye

<sup>1</sup>Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria Nigeria

<sup>2</sup>Department of Chemical Sciences, Federal University of Kashere, Gombe, Gombe state,

<sup>3</sup>Department of Veterinary Physiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria Nigeria

### ABSTRACT

Pathogenic *Escherichia coli* 0157:H7 poses significant risks to both human and animal health. This research aimed to detect its presence in various livestock and poultry samples collected from different markets and abattoirs in Zaria, Kaduna State, Nigeria. The samples were tested and confirmed using Eosin-Methylene Blue (EMB) agar, biochemical characterization, and serology. In slaughtered cattle from Zango Abattoir, Samaru, Zaria, 34% (17/50) of rectal swab samples tested positive for *E. coli*, with 47.06% (8/17) of these samples identified as pathogenic *E. coli* 0157:H7. Similarly, in sheep and goat samples from Ganga Uku Abattoir Samaru, 28% (14/50) and 18% (9/50) tested positive for *E. coli*, with 92.8% (13/14) and 55.5% (5/9) respectively of these being pathogenic *E. coli* 0157:H7. For poultry, 54% (27/50) of samples from various sources in Samaru market and abattoir tested positive for *E. coli*, with 48.1% (13/27) identified as pathogenic *E. coli* 0157:H7. In addition, the pathogenic *E. coli* 0157:H7 does not show any significant association ( $p=0.1138$ ) with cattle, sheep, goat and poultry birds. Notably, samples from sheep and poultry birds showed the highest prevalence. These findings emphasize the importance of implementing good practices and proper hygiene measures to mitigate the risk of *E. coli* contamination in livestock and poultry products. Additionally, further research using molecular tools such as PCR is recommended for more accurate detection and confirmation of pathogenic *E. coli* 0157:H7.

### ARTICLE INFO

#### Article History

Received: November, 2024

Received in revised form: December, 2024

Accepted: January, 2025

Published online: March, 2025

### KEYWORDS

*E. coli* 0157:H7, Prevalence, Livestock, Poultry Birds

### INTRODUCTION

*Escherichia coli* (*E. coli*) are groups of bacteria that inhabits the gastrointestinal tracts of mammals as a non-pathogenic commensal of humans and animals [1]. However, there exist pathogenic forms of *E. coli* that causes intestinal and extra-intestinal infection and are developed from the inter-strain exchange of virulence factors encoded in their genetic elements. Among the intestinal pathogens, there are three well-described categories namely the: enteropathogenic *E. coli* (EPEC),

enterohaemorrhagic *E. coli* (EHEC) and enterotoxigenic *E. coli* (ETEC) that can cause disease in animals using many of the same virulence factors that are present in human strains and unique colonization factors that are not found in human strains [2, 3].

Enterohemorrhagic *E. coli* (EHEC) is often classified as Shiga toxin-producing *E. coli* (STEC) strains that cause human illnesses, such as bloody diarrhea and hemolytic uremic syndrome [4, 5]. The main STEC serogroups include *E. coli* O26, O45, O91, O103, O111,

Corresponding author: Yusuf Wada

✉ [wadayusuf34@gmail.com](mailto:wadayusuf34@gmail.com)

Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria Nigeria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

O113, O121, O128, O145, and O157, and they are all capable of producing one or both types of Shiga toxins which acts by inhibiting protein synthesis in endothelial and other cells; primarily causing damage to vascular endothelium thereby leading to thrombotic lesions and disseminated intravascular coagulation [6, 7].

The detection of the EHEC serotype O157:H7 strains is important because they have a low infectious dose and an ability to survive in extra-intestinal environments alongside the outbreaks and sporadic cases of bloody diarrhoea and life-threatening hemolytic uremic syndrome [8, 9]. This serotype is characterized by the EHEC-associated virulence genes, and the expression of the H7 antigen (encoded by *fliCH7*) [10]. Typically, healthy cattle serve as the primary reservoir for *E. coli* O157:H7, but they are also carried by sheep, chicken, and goats [11]. Human infections with *E. coli* O157:H7 are often attributed to the consumption of contaminated food of animal origins, including raw or undercooked meat, meat products, raw milk, and unpasteurized dairy products [12]. These foods can become contaminated by contact with animal faeces during harvesting, processing, or storage or by cross-contamination with other foods or utensils. During meat production, improper evisceration procedures or inadequate sanitation allow faeces

from the gastrointestinal tract to come in direct contact with carcasses, resulting in their contamination [13, 14].

It is mandatory to examine animals that could serve as reservoir for pathogenic bacteria at the lowest level of local region; therefore, this study specifically investigated the presence of pathogenic *E. coli* O157:H7 in specimens taken from the rectum cattle in Zango abattoir, rectum of sheep and goat in Ganga uku abattoir and caecum of poultry birds in the Samaru market and abattoir in Zaria region of Kaduna State, Nigeria.

## METHODOLOGY

### Study Area

The sampling was carried out in the city of Zaria, located in the North of Kaduna state, along the Kaduna-Kano highway. Zaria comprises two Local Government Areas, namely Zaria and Sabon Gari, with the latter being the study area. Zaria urban area is composed of four districts, namely Tudun Wada, Sabon Gari, Samaru and Zaria City, (Figure 1). The study area is characterized by a natural and stable ecosystem in the Northern Guinea Savannah zone, with a discontinuous layer of sparsely distributed short trees followed by relatively continuous layers of tall, medium and short grasses.

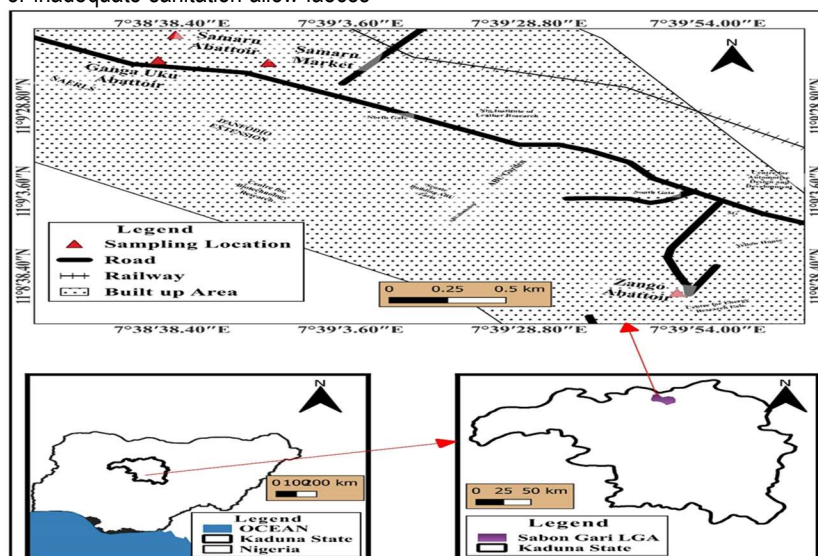


Fig 1.0: Map of Kaduna state of Nigeria showing Sabon/Gari Local Government.

Corresponding author: Yusuf Wada

✉ [wadayusuf34@gmail.com](mailto:wadayusuf34@gmail.com)

Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria Nigeria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

### Sampling technique and sample collection

Four different sampling points was considered for the study: faecal samples from cattle in Zango abattoir (Latitude 11° 8' 33.47592" N, and longitude 7° 39' 49.66992" E), sheep and goat in Ganga uku abattoir (Latitude 11° 9' 42.3738" N and Longitude 7° 38' 36.429" E) Samaru, Zaria and faecal samples from poultry birds in Samaru Abattoir (Latitude 11° 09' 49.90068"N Longitude 7° 38' 38.87016"E) and Samaru central market (Latitude 11° 9' 41.6628"N Longitude 7° 38' 52"E), Zaria all in Sabon Gari Local Government Area of Kaduna State. Fifty (50) samples were collected each for each group of animals randomly sampled making a total of 200 faecal samples collected for this study. The faecal samples were collected with the use of cotton wool from cattle, sheep, goat's rectum and poultry bird's cloaca. Ten (10) samples were collected each for five (5) days for the different groups of animals for four (4) weeks.

### Isolation and identification of *E. coli*

The sterilized Brain Heart Infusion (BHI) medium (5 ml) was inoculated with the faecal sample and incubated at 37°C for 24 hours. A loopful of the positive BHI culture was streaked onto Eosin Methylene Blue (EMB) agar using the streak plate method. The EMB plate was incubated at 37°C for 24 hours. The EMB agar was observed for colonies with metallic green sheen which was considered as *E. coli*. Samples with colony resembling *E. coli* was picked up from the EMB plates and biochemically confirmed using established methods [15].

### Serotyping test for *E. coli* O157:H7

Table 1: Result of the *E. coli* isolation on EMB agar and Biochemical test

Sampling point	Animals	Number of samples examined	Number of positive samples for EMB	Number of positive samples for biochemical test
Zango Abattoir	Cattle	50	33 (66)	17 (51)
Ganga uku abattoir	Sheep	50	18 (72)	14 (48.3)
Samaru market	Goat	50	11 (44)	9 (31)
	Poultry	25	15 (60)	15 (100)
Samaru abattoir	Poultry	25	12 (48)	12 (100)

The serotyping test procedure for *E. coli* O157:H7 followed [16, 17]. All cultures that have been isolated and identified as *E. coli* bacteria from the biochemical test [18] were then identified by agglutination using monospecific O157:H7 antiserum for identification as *E. coli* O157:H7. Two drops of overnight broth and two drops of *E. coli* antiserum were placed on a clean slide, emulsified, and shake gently. The appearance of particles shows presence of pathogenic *E. coli* O157:H7.

### Data Analysis

The prevalence rate for cattle, sheep, goat and poultry birds were expressed in percentages of the total number of *E. coli* that was sampled. Chi-square was used to test for significant association between the pathogenic *E. coli* O157:H7 and the sampled cattle, sheep, goat and poultry birds. The value of  $p < 0.05$  was considered significant and the analysis was done using R version 4.2.1.

## RESULTS

### Overall prevalence of *E. coli*

The prevalence of *E. coli* isolated and tested in EMB agar and the different biochemical approach is illustrated in Table 1.0. Fifty (50) faecal samples of the animals were examined each in EMB agar and 33, 18, 11, 27 were positive for cattle, sheep, goat and poultry respectively. The number of individual samples positive from the faecal samples of cattle, sheep, goat and poultry for the biochemical test were 17 (51), 14 (48.3), 9 (31), 27 (100) respectively.

Corresponding author: Yusuf Wada

✉ [wadayusuf34@gmail.com](mailto:wadayusuf34@gmail.com)

Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria Nigeria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

### Definitive test for *E. coli* O157:H7

The colony positive for *E. coli* in the biochemical test was subjected to further agglutination test and the result is presented in Table 2. The number of colonies examined for cattle, sheep, goat, and poultry birds were 17, 14,

9, and 27 respectively. The observed prevalence of *E. coli* O157:H7 were 8 (47.06), 13 (92.8), 5 (55.5), 13 (48.14) for cattle, sheep, goat and poultry birds respectively.

Table 2: Result for Definitive test for Pathogenic *E. coli* O157:H7 by Serology

Sampling point	Animals	Number of samples biochemical examined	Number positive for test	Number positive for agglutination	p-value
Zango Abattoir	Cattle	17		8 (47.06)	0.1138
Ganga uku abattoir	Sheep	14		13 (92.8)	
	Goat	9		5 (55.5)	
Samaru market	Poultry	15		6 (40)	
Samaru abattoir	Poultry	12		7 (58.3)	

Note: A significant association between *E. coli* O157:H7 and vegetables, fruits and milk was set at  $p < 0.05$

### DISCUSSION OF FINDINGS

*Escherichia coli* is an enteric bacterium typically found in humans and animals' gastrointestinal tracts, with a lifestyle ranging from commensal to obligate pathogen [19, 20]. As a pathogen, it is associated with bacteremia, wound infections, urinary and gastrointestinal tract infections [21]. Both commensal and pathogenic *E. coli* have also been implicated in transferring resistance genes to other bacteria, including pathogenic ones [22]. Animals have been identified as important reservoir of different strains of *E. coli* which they ingest from food, water and other component of the environment [23, 24, 25]. This study revealed that slaughtered cattle from Zango Abattoir, Samaru, Zaria had 34% (17/50) of rectal swab samples that tested positive for *E. coli*. Sheep and goat samples from Ganga Uku Abattoir Samaru, had 28% (14/50) and 18% (9/50) of rectal swab samples that tested positive for *E. coli* respectively. Also, the of poultry birds from Samaru abattoir and market had 54 % (27/50) cloacal swab that tested positive for *E. coli* for the biochemical test.

*E. coli* O157:H7 is one of the most dangerous foodborne pathogens as it can cause grievous illnesses such as inflammation,

abdominal pain, diarrhea, hemolytic uremic syndrome, hemorrhagic colitis, and even death, especially in young, old and immunocompromised individuals [26]. The outbreaks of foodborne diseases induced by *E. coli* O157:H7 are related to the consumption of contaminated foods and water [27]. Shiga toxin-producing *Escherichia coli* (STEC) strains have been detected in a wide diversity of mammals, birds, fish, and several insects. Carriage by most animals is asymptomatic, thus allowing for dissemination of the bacterium in the environment without detection. Replication of the organism may occur in the gastrointestinal tract of some animals, notably ruminants [28].

The prevalence of *E. coli* O157:H7 in sheep's rectum and poultry bird's cloacal sample were the highest when compared to cattle and goat. For poultry birds, 48.1% (13/27) of samples from various sources in Samaru market and abattoir identified as pathogenic *E. coli* O157:H7 and the sheep had 92.8% (13/14). These indicate that poultry birds and sheep may be more suitable reservoir of *E. coli* O157:H7. Moreover, the pathogenic *E. coli* O157:H7 does not show any significant association ( $p=0.1138$ ) with cattle, sheep, goat and poultry birds. In support, several

Corresponding author: Yusuf Wada

[wadayusuf34@gmail.com](mailto:wadayusuf34@gmail.com)

Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria Nigeria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved



studies revealed poultry birds and sheep as potentially important reservoir of pathogenic *E. coli* O157:H7 [29, 30, 31]. This study therefore highlights the advantages of adopting implementing hygiene practice during slaughtering and evisceration of livestock and poultry products. Further studies should utilise advanced molecular tools with appropriate precision to detect and confirm pathogenic *E. coli* O157:H7.

## CONCLUSION

Studies have shown the contamination of food products with *E. coli* and this study chose to reveal the occurrence of a member of the Shiga toxin-producing *E. coli* (*E. coli* O157:H7) faecal samples of cattle, sheep, goat and poultry and the findings suggest that all groups of animals served as reservoir for the pathogenic bacteria.

## REFERENCES

1. Quinn, P.J.; Markey, B.K.; Leonard, F.C.; FitzPatrick, E.S.; Fanning, S.; Hartigan, P.J. Enterobacteriaceae. In *Veterinary Microbiology and Microbial Diseases*, 2nd ed.; Wiley & Blackwell: Hoboken, NJ, USA, 2011; pp. 263–286.
2. Kaper, J. B., Nataro, J. P., & Mobley, H. L. (2004). Pathogenic escherichia coli. *Nature reviews microbiology*, 2(2), 123-140.
3. Gu, X., Wu, Q., Chai, Y., Huang, X., Zhou, X., Han, M., ... & Zhong, F. (2025). Epidemiological and molecular characteristics of extraintestinal pathogenic escherichia coli isolated from diseased cattle and sheep in Xinjiang, China from 2015 to 2019. *BMC Veterinary Research*, 21(1), 42.
4. Collins, J.; Tack, D.; Pindyck, T.; Griffin, P. *Escherichia coli*, Diarrheagenic. Centre for Disease Control and Prevention. Available online: <https://wwwnc.cdc.gov/travel/yellowbook/2024/infections-diseases/escherichia-coli-diarrheagenic> (accessed on 20 December 2024).
5. Lee, W.; Kim, M.-H.; Sung, S.; Kim, E.; An, E.S.; Kim, S.H.; Kim, S.H.; Kim, H.-Y. Genome-Based Characterization of Hybrid Shiga Toxin-Producing and Enterotoxigenic *Escherichia coli* (STEC/ETEC) Strains Isolated in South Korea, 2016–2020. *Microorganisms* 2023, 11, 1285
6. Melton-Celsa, A.R. Shiga toxin (Stx) classification, structure, and function. *Microbiol. Spectr.* 2014, 2, 10–1128. [CrossRef]
7. Sandvig, K. Pathways Followed by Ricin and Shiga Toxin into Cells. *Histochem. Cell Biol.* 2002, 117, 131–141. [CrossRef]
8. Nataro, J.P.; Kaper, J.B. Diarrheagenic *Escherichia coli*. *Clin. Microbiol. Rev.* 1998, 11, 142–201. [CrossRef]
9. Karch, H.; Tarr, P.I.; Bielaszewska, M. Enterohaemorrhagic *Escherichia coli* in human medicine. *Int. J. Med. Microbiol.* 2005, 295, 405–418. [CrossRef] [PubMed]
10. Iguchi, A.; Shirai, H.; Seto, K.; Ooka, T.; Ogura, Y.; Hayashi, T.; Osawa, R. Wide distribution of O157-antigen biosynthesis gene clusters in *Escherichia coli*. *PLoS ONE* 2011, 6, e23250.
11. Goulart, D.B.; Mellata, M. *Escherichia coli* Mastitis in Dairy Cattle: Etiology, Diagnosis, and Treatment Challenges. *Front. Microbiol.* 2022, 13, 928346. [CrossRef]
12. Rangel, J.M.; Sparling, P.H.; Crowe, C.; Griffin, P.M.; Swerdlow, D.L. Epidemiology of *Escherichia coli* O157 Outbreaks, United States, 1982–2002. *Emerg. Infect. Dis.* 2005, 11, 603–609. [CrossRef]
13. Albuqami, S.A.; Dawoud, T.M.; Moussa, I.M.; Elbehiry, A.; Alsubki, R.A.; Hemeg, H.A.; Alhaji, J.H. The Molecular Detection and Antimicrobial Profiles of Selected Bacterial Pathogens in Slaughterhouses in Riyadh City, Saudi Arabia. *Appl. Sci.* 2023, 13, 13037. [CrossRef]
14. Niyonzima, E.; Ongol, M.P.; Kimonyo, A.; Sindic, M. Risk Factors and Control Measures for Bacterial Contamination in the Bovine Meat Chain: A Review on Salmonella and Pathogenic *E. coli*. *J. Food Res.* 2015, 4, 98. [CrossRef]
15. Barrow, G.I.; Feltham, R.K.A. *Cowan and Steel's Manual for Identification of Medical Bacteria*, 3rd ed.; Cambridge University Press: London, UK, 1993.
16. Supar, Hirst RG and Patten BE 1988 *Proc. of 6th Congress Federation of Asian Vet. Ass. (FAVA)* (Denpasar:Bali-Indonesia)
17. Ariyanti, T., Rachmawati, F., & Noor, S. M. (2022, December). Contamination of *Escherichia coli* O157: H7 in milk and its dairy products in Depok, Cianjur, Sukabumi and Bandung. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1107, No. 1, p. 012047). IOP Publishing.

Corresponding author: Yusuf Wada

✉ [wadayusuf34@gmail.com](mailto:wadayusuf34@gmail.com)

Department of Zoology, Faculty of Life Sciences, Ahmadu Bello University, Zaria Nigeria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved



18. Kabiru, L. M., Bello, M., Kabir, J., Grande, L., & Morabito, S. (2015). Detection of pathogenic *Escherichia coli* in samples collected at an abattoir in Zaria, Nigeria and at different points in the surrounding environment.
19. Frommel, U.; Lehmann, W.; Rodiger, S.; Bohm, A.; Nitschke, J.; Weinreich, J.; Gross, J.; Roggenbuck, D.; Zinke, O.; Ansorge, H.; et al. Adhesion of human and animal *Escherichia coli* strains in association with their virulence-associated genes and phylogenetic origins. *Appl. Environ. Microbiol.* 2013, 79, 5814–5829. [CrossRef] [PubMed]
20. Abraham, S.; Gordon, D.M.; Chin, J.; Brouwers, H.J.; Njuguna, P.; Groves, M.D.; Zhang, R.; Chapman, T.A. Molecular characterization of commensal *Escherichia coli* adapted to different compartments of the porcine gastrointestinal tract. *Appl. Environ. Microbiol.* 2012, 78, 6799–6803. [CrossRef] [PubMed]
21. Tadesse, D.A.; Zhao, S.; Tong, E.; Ayers, S.; Singh, A.; Bartholomew, M.J.; McDermott, P.F. Antimicrobial drug resistance in *Escherichia coli* from humans and food animals, United States, 1950–2002. *Emerg. Infect. Dis.* 2012, 18, 741–749. [CrossRef] [PubMed]
22. Adenipekun, E.O.; Jackson, C.R.; Oluwadun, A.; Iwalokun, B.A.; Frye, J.G.; Barrett, J.B.; Hiott, L.M.; Woodley, T.A. Prevalence and antimicrobial resistance in *Escherichia coli* from food animals in Lagos, Nigeria. *Microb. Drug Resist.* 2015, 21, 358–365.
23. Cui, L., Zhao, X., Li, R., Han, Y., Hao, G., Wang, G., & Sun, S. (2022). Companion animals as potential reservoirs of antibiotic resistant diarrheagenic *Escherichia coli* in Shandong, China. *Antibiotics*, 11(6), 828.
24. Cui, L., Zhao, X., Li, R., Han, Y., Hao, G., Wang, G., & Sun, S. (2022). Companion animals as potential reservoirs of antibiotic resistant diarrheagenic *Escherichia coli* in Shandong, China. *Antibiotics*, 11(6), 828.
25. Abdalla, S. E., Abia, A. L., Amoako, D. G., Perrett, K., Bester, L. A., & Essack, S. Y. (2022). Food animals as reservoirs and potential sources of multidrug-resistant diarrheagenic *E. coli* pathotypes: Focus on intensive pig farming in South Africa. *Onderstepoort Journal of Veterinary Research*, 89(1), 1963.
26. Saxena, T., Kaushik, P., & Mohan, M. K. (2015). Prevalence of *E. coli* O157: H7 in water sources: an overview on associated diseases, outbreaks and detection methods. *Diagnostic microbiology and infectious disease*, 82(3), 249–264.
27. Silva, D. M., & Domingues, L. (2015). On the track for an efficient detection of *Escherichia coli* in water: A review on PCR-based methods. *Ecotoxicology and Environmental Safety*, 113, 400–411.
28. Persad, A. K., & Lejeune, J. T. (2015). Animal reservoirs of Shiga toxin-producing *Escherichia coli*. *Enterohemorrhagic Escherichia coli and other Shiga toxin-producing E. coli*, 211–230.
29. Fuh, N. J., Christiana, O. M., Yami, A. L., Uteh, U. P., Ekpiken, E. S., & Ogechi, U. M. (2018). Prevalence and antibiotic resistance of *Escherichia coli* O157: H7 serotype from chicken droppings produced by free-ranged and poultry birds in cross river, Nigeria. *American Journal of Biomedical and Life Sciences*, 6(3), 51–55.
30. Gencay, Y. E. (2014). Sheep as an important source of *E. coli* O157/O157: H7 in Turkey. *Veterinary Microbiology*, 172(3–4), 590–595.
31. Franco, A., Lovari, S., Cordaro, G., Di Matteo, P., Sorbara, L., Iurescia, M., ... & Battisti, A. (2009). Prevalence and concentration of verotoxigenic *Escherichia coli* O157: H7 in adult sheep at slaughter from Italy. *Zoonoses and Public Health*, 56(5), 215–220.