Open Veterinary Journal, (2025), Vol. 15(11): 6076-6080
Short Communication
DOI: *10.5455/OVJ.2025.v15.i11.64*

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Submitted: 01/08/2025 Revised: 01/10/2025 Accepted: 08/10/2025 Published: 30/11/2025

Prevalence of *Escherichia coli* 0157: H7 in chicken livers

Khalid Dahmani[1], Abdulgader Dhawi[2], Mohamed Saad[1], Saadadin Bealeed[1], Omar Elhenshir[1] and Mohamed Elemam[3]*

[1]*Department of Bacteriology, Libyan Biotechnology Research Center, Tripoli, Libya*
[2]*Department of Microbiology and Parasitology, Faculty of Veterinary Medicine, University of Tripoli, Tripoli, Libya*
[3]*Department of Microbiology, Faculty of Dentistry, University of Tripoli, Tripoli, Libya*

ABSTRACT

Background: Meat and meat products are vital sources of nutrition, but are also associated with foodborne illnesses worldwide. *Escherichia coli* O157:H7 is a pathogenic strain known to cause severe conditions, such as hemorrhagic colitis, hemolytic-uremic syndrome, and diarrhea. This strain is particularly dangerous due to its very low infectious dose and can be transmitted to humans through contaminated meat.

Aim: This study aimed to investigate the prevalence of *E. coli* O157:H7 infection in chicken liver samples sold in butcher shops and supermarkets in Tripoli, Libya, and to highlight the associated public health risk.

Methods: A total of 175 chicken liver samples were collected and analyzed. The presence of *E. coli* was determined using classical culture techniques and the analytical profile index 20E system. The specific strain of *E. coli* O157:H7 was confirmed using a latex agglutination test with specific antisera.

Results: Of the 175 samples, 81 (46.3%) were positive for *E. coli* strains. Of these positive samples, 14 (17.3%) were confirmed to be *E. coli* O157:H7.

Conclusion: Chicken liver may serve as a significant vehicle for *E. coli* O157:H7 transmission, posing a considerable public health risk. The findings underscore the need for effective control and preventive measures to ensure the safety of meat and meat products throughout the entire meat supply chain.

Keywords: Chicken livers; *Escherichia coli*; Latex agglutination test; Pathogenic bacteria.

Introduction

Consuming foods from animals can be risky if they are not prepared and handled hygienically, despite their high nutritional value. Therefore, strict food safety standards are needed to protect consumers (Amalia *et al.*, 2020). Meat and meat products constitute an essential part of the human diet, serving as significant sources of high-quality proteins, essential amino acids, vitamins, such as vitamin B complex, and iron and zinc. However, they are also considered potential vehicles for contamination and infection due to the presence of pathogenic microorganisms. This is particularly evident in developing countries, where animals are frequently slaughtered in small-scale or unregulated slaughterhouses that often lack proper food safety and hygiene practices. Consequently, the risk of cross-contamination with pathogenic bacteria is considered high. Among these pathogens, *Escherichia coli* O157: H7 has been identified as a significant global public health concern. This strain of *E. coli* can colonize the ceca of poultry, making chickens a possible reservoir of the bacterium, although cattle are considered the primary source (Gugsa *et al.*, 2022). *Escherichia coli* O157:H7 was first recognized as a pathogen and linked to foodborne outbreaks of hemorrhagic colitis in 1982 (Rangel *et al.*, 2005).

Foodborne diseases remain a significant global public health concern and a leading cause of morbidity and mortality in humans. According to estimates by the World Health Organization's Foodborne Disease Burden Epidemiology Reference Group, foodborne illnesses were responsible for approximately 600 million cases of illness, 420,000 deaths, and 33 million disability-adjusted life years (DALYs) in 2010. The highest burden has been reported in the African region (WHO, 2015).

Food consumption is a major bacterial contamination pathway. The key contributing factors include unhygienic conditions at abattoirs, improper transportation of carcasses, and inadequate butcher hygiene practices (Niyonzima *et al.*, 2015a,b). Particular attention should be paid to the cleanliness of utensils, equipment, and storage conditions in butcher shops.

Escherichia coli O157:H7 is a well-documented foodborne pathogen that is frequently associated with

***Corresponding Author:** Mohamed Elemam. Department of Microbiology, Faculty of Dentistry, University of Tripoli, Tripoli, Libya. Email: *m.elemam@uot.edu.ly*

ground beef and meat products. Routine surveillance for *E. coli* O157:H7 in beef products is essential due to its strong association with HCC and other GI illnesses (Jay *et al.*, 2005; Fletcher *et al.*, 2013).

Infections acquired through the consumption of under cooked, contaminated beef have led to multiple outbreaks of bloody diarrhea and serious complications. In 1999, the Centers for Disease Control and Prevention estimated that *E. coli* O157:H7 was responsible for approximately 73,000 illnesses annually in the United States, leading to approximately 2,000 hospitalizations and 60 deaths (Mead *et al.*, 1999). The severity of *E. coli* O157:H7 and its complications, including hemolytic uremic syndrome, make it a critical pathogen of concern. Cattle are considered the primary reservoir for *E. coli* O157:H7, although the bacterium has also been isolated from the intestines of chickens, deer, sheep, goats, and pigs. Notably, these animals do not exhibit symptoms of illness and instead act as asymptomatic carriers (Singha *et al.*, 2023).

Although most infected individuals recover without complications, approximately 5%–10% may develop life-threatening conditions, particularly children and the older adults (Armstrong *et al.*, 1996; Kaper *et al.*, 2004). The rising awareness of health risks associated with contaminated meat has emphasized the need for strict hygienic practices during meat processing.

The microbiological quality of minced meat, whether concerning spoilage organisms or foodborne pathogens, depends heavily on the sanitary conditions of the processing environment, the source and quality of raw meat, and the temperature and duration of storage (Khalafalla *et al.*, 1993a and 1993b).

The present study aimed to isolate and identify *E. coli* O157:H7 from chicken liver samples, considering the potential of poultry as a reservoir for this pathogen.

Materials and Methods

Samples

A total of 175 chicken liver samples were collected from various supermarkets and butcher shops in Tripoli, Libya. Tripoli, which is situated in the northwestern region of the country, has an estimated population of approximately 1.5 million. Each sample was aseptically transferred into a sterile plastic bag, which was immediately sealed to prevent contamination. To ensure sample integrity, samples were transported to the laboratory in insulated containers with cooling elements and processed within 2 hours of collection.

Microbiological analysis

To detect the presence of *E. coli* O157:H7, 25 g of each liver sample was aseptically weighed and pre-enriched in modified EC broth supplemented with novobiocin (mEC+n; Merck 14582, Berlin, Germany). The enrichment broth was incubated at 37°C for 24 hours. Following incubation, a sterile swab was used to inoculate on SMAC plates, which were then incubated at 42°C for 24 hours.

After incubation, up to 5 sorbitol-negative colonies per sample were selected for further analysis (March and Ratnam, 1986). These presumptive colonies were subjected to Gram staining and biochemical tests, such as indole, methyl red, Voges–Proskauer, and citrate, for preliminary identification. Colonies exhibiting typical *E. coli* characteristics were further confirmed using the analytical profile index (API 20E; bioMérieux, France). Confirmed *E. coli* isolates were subsequently tested for the presence of the O157:H7 serotype using a latex agglutination assay (Oxoid, UK), following the manufacturer's instructions (March and Ratnam, 1989; Cebiroglu and Nazli, 1999). A portion of a freshly grown overnight colony was emulsified in a drop of saline and mixed with a drop of test latex reagent on a clean glass slide. The slide was gently rocked for 60–90 seconds and examined for visible agglutination. Positive results were verified by repeating the test using a control latex reagent to eliminate agglutination.

Ethical approval

Not needed for this study.

Results and Discussion

Foodborne illnesses are a major and increasing public health problem worldwide. They encompass a wide variety of health conditions caused by consuming contaminated food, which can be tainted by various microorganisms or chemical hazards (Tegegne *et al.*, 2024).

In this study, modified EC broth supplemented with novobiocin (mEC+n) was used to isolate *Escherichia coli* O157:H7 from chicken liver samples. Of the 175 samples analyzed, 81 (46.3%) samples contained *E. coli* strains, whereas 14 *(*17.3% of *E. coli*-positive samples) were confirmed as *E. coli* O157:H7 using latex agglutination with specific antisera (Table 1). The latex agglutination test utilizes polystyrene latex particles coated with antibodies specific to the *E. coli* O157:H7 serotype and has demonstrated both sensitivity and specificity, showing rapid and complete agglutination with positive isolates (Fig. 1).

Isolates were identified using the Analytical Profile Index (API 20E), a standardized biochemical panel for members of the Enterobacteriaceae family.

The prevalence rate observed in this study is high compared with that in previous reports. For instance, a study in Nigeria found a significant prevalence of *E. coli* O157:H7 in poultry. The researchers analyzed 180 poultry fecal samples, and 58.33% of them tested positive for *E. coli*. Further investigation using a latex agglutination test confirmed that 14.44% of the total samples, which amounted to 26 individual isolates, were specific strains of O157:H7. This finding highlights the presence of this potentially harmful bacterium in the region's poultry (Sandra Okoye *et al.*, 2025).

In contrast, Bosilevac *et al.* (2015) investigated the prevalence of *E. coli* O157:H7, finding that it was nearly zero in all samples collected during June and

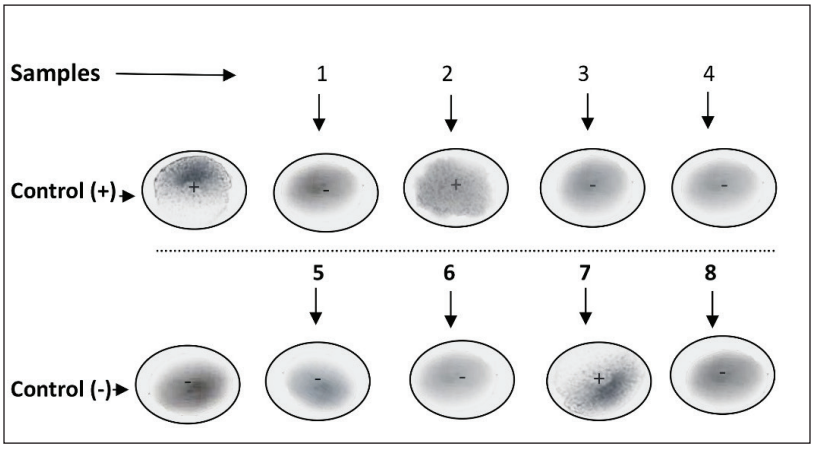

Fig. 1. Serological test results for *E. coli* O157:H7.

Table 1. Prevalence of E. coli 0157: H7 detection results.

Category	Number of samples	Percentage
Total samples	175	100%
Samples containing *E. coli*	81	46.3%
E. coli O157: H7-positive samples	14	17.3%

July. These results constitute the first comprehensive study of *E. coli* O157:H7 prevalence in Saudi Arabian meat animals at harvest, possibly due to methodological differences or limitations. Another study aimed to assess the bacteriological quality of RTE foods sampled from night markets and street stalls. However, no *E. coli* O157: H7 was reported in this study (Arkappan *et al.*, 2025).

This discrepancy may be attributed to variability in sampling protocols, enrichment methods, or regional differences in pathogen prevalence. Another study screened all samples for *E. coli*, with a particular focus on the *E. coli* O157:H7 pathogenic strain. The presence of *E. coli* was significant in the tested food products and stool samples. Chicken frozen fillet, 7 out of 25 samples (28%) were positive for *E. coli*. Chicken frozen leg, 9 out of 25 samples (36%) were positive for *E. coli*. Minced frozen beef, 7 out of 25 samples (28%) were positive for *E. coli*. Children's stool, 2 out of 28 samples (7.14%) were positive for *E. coli*. While *E. coli* was common, the specific O157:H7 strain was less prevalent. It was detected in two samples, one from the frozen chicken fillet group and one from the frozen chicken leg group. The strain was not found in any of the minced frozen beef or stool samples from children (Hassan *et al.*, 2010). Our findings are more consistent with those of Abebe *et al.* (2023), who reported overall prevalence rates of 54.7% and 6.5% for *E. coli* O157:H7, respectively. The highest prevalence rates of *E. coli* (79.6%) and *E. coli* O157:H7 (16.7%) were found in carcass swabs and milk tank samples, respectively. Conversely, Hunduma *et al.* (2024) reported a much lower prevalence of *E. coli* O157:H7. Bacteria were present in the feces of 3.9% cows and 0.6% camels. It was also detected in 2.6% of the composite milk samples.

Escherichia coli can be categorized based on the toxins they produce. Strains that produce Shiga toxins (Stx1 and Stx2) are known as Shigatoxigenic *E. coli*. Meanwhile, strains that produce Shiga-like toxins (also called verotoxins) are referred to as verotoxigenic *E. coli* (Alhadlaq *et al.*, 2023).

The results highlight the effectiveness of the latex agglutination test as a rapid and reliable diagnostic tool for identifying *E. coli* O157:H7. Given the relatively high prevalence observed, chicken liver may represent a significant public health concern.

Improper hygiene during the slaughtering or processing of cattle is the main way the *E. coli* O157:H7 bacterium enters the food supply, causing both health risks and significant financial losses. Therefore, public education regarding proper storage, handling, and thorough cooking of poultry products is essential to reduce the risk of foodborne illness caused by *E. coli* O157:H7. (Guo *et al.,* 2024 and Jaradat *et al.*, 2024).

Conclusion

This study highlights the need for stringent control measures throughout all stages of the poultry production chain, including farming, handling, slaughtering, and processing, to minimize the risk of contamination and safeguard public health. The latex agglutination test targeting the *E. coli* O157:H7 serotype proved to be a simple, rapid, and highly reliable diagnostic tool, demonstrating near 100% sensitivity and specificity. Further research is warranted to characterize the genetic profiles of the detected strains using molecular techniques such as PCR. Additionally, an investigation into the antimicrobial susceptibility patterns of *E. coli*

O157:H7 is necessary to inform treatment strategies and monitor resistance trends. Expanding surveillance to include other types of food, particularly those of animal origin, would provide a broader understanding of the pathogen's prevalence and distribution in the food supply.

Acknowledgments

The authors wish to express their gratitude to the Libyan Biotechnology Research Center for the valuable support provided during this research, and especially, thankful for the use of the laboratory facilities and equipment, which were instrumental in carrying out the experiments described in this paper.

Conflict of interest

The authors declare that there is no conflict of interest.

Funding

This research was supported by the Libyan Biotechnology Research Center, which provided essential funding, laboratory facilities, and equipment.

Authors' contribution

Authors' contributions. This work was carried out in collaboration with all authors. Authors: Mohamed Elemam and Khalid Dahmani designed the study, wrote the protocol, and wrote the first draft of the manuscript. Authors Abdulgader Dhawi and Omar Elhenshi managed the literature searches and analyses of the study. Authors Khalid Dahmani, Mohamed Saad, Saadadin Bealeed, and Mohamed Elemam supervised the laboratory work. All authors have read and approved the final version of the manuscript.

Data availability

The datasets generated and analyzed in the current study are available within the article.

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