



ULST Timisoara
**Multidisciplinary Conference on
Sustainable Development**
21-22 May 2026



Forest to Fork: Assessing Pre- and Post-Harvest Factors Affecting the Safety of Game Meat

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Abstract:

The rising global demand for wild game meat, notably from wild boar (*Sus scrofa*) and cervids, reflects a consumer shift toward sustainable protein sources but introduces multifaceted public health challenges. Unlike conventional livestock, wild ungulates are harvested in unmonitored environments, rendering the "forest to fork" supply chain vulnerable to diverse microbiological and chemical hazards. This review evaluates the multifactorial pre- and post-harvest determinants affecting game meat safety. Following PRISMA guidelines, a comprehensive literature search was conducted across the Web of Science and Scopus databases. The findings demonstrate that while wildlife act as natural reservoirs for zoonotic pathogens such as *Trichinella* spp., STEC, and *Salmonella* spp., the final safety profile is primarily governed by human-mediated factors. Physiological stress from chase-based hunting critically alters muscle biochemistry, leading to dark, firm, and dry (DFD) characteristics that promote microbial proliferation. Furthermore, field-handling practices, particularly delayed evisceration, and breaches in cold chain logistics significantly increase bacterial contamination. Chemical risks, including heavy metal bioaccumulation from ammunition and persistent organic pollutants, present chronic exposure risks, especially regarding offal consumption. Ensuring the safety of the game meat industry requires a holistic 'One Health' approach. While intrinsic environmental hazards are inevitable, targeted interventions, such as mandatory hunter training in field dressing, the adoption of non-lead ammunition, and strict maintenance of the cold chain, serve as vital critical control points to mitigate foodborne risks and protect public health.

Introduction

The rising global demand for sustainable wild game meat (specifically wild boars and cervids) highlights unique food safety challenges, as these animals are harvested in uncontrolled environments without standard abattoir oversight. This lack of standardization exposes the meat to complex "forest to fork" risks, including pre-harvest hazards like zoonotic pathogens, chemical contaminants, and hunting-induced stress, alongside post-harvest handling vulnerabilities. This review systematically evaluates these multifactorial influences, emphasizing that while intrinsic ecological factors establish a baseline risk, prompt human interventions—specifically precise shot placement, rapid field evisceration, and strict cold-chain implementation—are the decisive factors in mitigating contamination and ensuring game meat safety.

Material and method

This systematic review was conducted in accordance with PRISMA guidelines to ensure methodological transparency and reproducibility. A comprehensive literature search was performed across the Web of Science and Scopus databases for peer-reviewed, English-language articles published between 2010 and early 2026. The search strategy utilized targeted keywords and Boolean operators to capture studies focusing on game meat alongside its pre- and post-harvest supply chain dynamics. To minimize bias, multiple independent reviewers executed a rigorous two-stage screening process—initially assessing titles and abstracts, followed by comprehensive full-text evaluations—based on predefined inclusion and exclusion criteria. The final selection of eligible studies, strictly relevant to wild game meat safety and handling, underwent systematic data extraction and qualitative synthesis, with the entire screening workflow visually documented in a standard PRISMA flow diagram.

Results

This comprehensive analysis reveals a significant, region-specific prevalence of zoonotic pathogens—notably *Salmonella*, *Yersinia enterocolitica*, and STEC—alongside persistent chemical contaminants like Lead (Pb) and Cadmium (Cd), which frequently exceed regulatory safety thresholds in wildlife from industrialized and legacy mining areas. This baseline risk is heavily amplified at the wildlife-livestock interface, where fragmented landscapes and anthropogenic pressures facilitate bidirectional pathogen spillover. During the pre-harvest phase, hunting practices serve as a critical determinant of both safety and quality; chase-driven methods induce severe physiological stress, evidenced by elevated cortisol and altered ultimate pH, which directly increases the incidence of microbial-prone DFD (Dark, Firm, Dry) meat. Furthermore, delayed or unhygienic field evisceration exponentially elevates surface microbial loads, especially when ambient temperatures exceed 20°C. In the post-harvest continuum, mitigating these amplified risks relies absolutely on strict cold chain management, requiring carcasses to be chilled below 4°C within 4 hours to inhibit spoilage organisms. Finally, synergizing rigorous abattoir hygiene with advanced packaging technologies (Vacuum, MAP, and bioactive films) and digital supply chain traceability proves highly effective; these combined interventions not only reduce cross-contamination events by up to 40% but also extend the shelf life of game meat by up to 10 days while improving recall efficiency by 30%.

Conclusions

The safety of wild game meat depends on the critical interplay between natural ecological risks and human interventions. While wild animals serve as natural reservoirs for pathogens and contaminants, this baseline risk is severely amplified by chase-driven hunting (which induces microbial-prone DFD meat), delayed evisceration, and unhygienic handling. To safeguard public health, a holistic 'One Health' approach is essential. By enforcing mandatory hunter training, rapid cold-chain implementation, and advanced packaging technologies, the inherent environmental hazards of wild game can be effectively mitigated to ensure safe consumption.



forest
to fork

