

**Original Article**

Prevalence and Public Health Implications of Isolation of *Listeria monocytogenes* from Fresh Raw Milk Sold in Ilorin, Nigeria

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ABSTRACT

Introduction: Milk is a nutritious fluid secreted by female mammals to nourish their young. Milk-borne pathogens remain a major public health concern in Nigeria, where raw cow milk is widely consumed without pasteurization. This study was conducted to determine the prevalence of *Listeria monocytogenes* and other potential pathogens in raw cow milk sold in Ilorin, Kwara State, Nigeria.

Methods: A total of 240 raw milk samples were randomly collected from vendors across three major markets in Ilorin. The samples were analyzed using standard microbiological techniques involving culture on *Listeria*-specific selective medium and biochemical identification tests.

Results: Out of the 240 samples examined, 28 (11.7%) were positive for *Listeria* spp. presumptive *L. monocytogenes*. Other potential bacterial pathogens isolated were *Staphylococcus aureus* and *Escherichia coli*. The association between sample source and the presence of *L. monocytogenes* was not statistically significant ($p = 0.851$), suggesting that contamination was widespread across different milk sources rather than limited to specific locations. The health implications of these findings are considerable, as listeriosis can result in septicemia, meningitis, miscarriage, stillbirth, particularly in pregnant women, neonates and the elderly. These findings underscore critical gaps in milk hygiene, storage, and food safety surveillance in Nigeria.

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Conclusion: The presence of *Listeria* spp. presumptive *L. monocytogenes* and other potential pathogens in raw cow milk sold in Ilorin highlight a possible serious health hazard to citizens consuming this product and a pressing public health concern that requires immediate attention.

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Introduction

Milk is an essential part of a daily diet, particularly for expectant mothers and growing children (Szyller *et al.*, 2024). Milk and milk products are considered ideal foods for people of all ages, both in rural and urban areas worldwide (Kavaz *et al.*, 2022). Raw cow milk is defined as milk obtained directly from the udder of healthy cows without undergoing any heat treatment or other sterilization processes (Oliveira *et al.*, 2021). It is a complex biological fluid that contains a balanced mixture of water, carbohydrates (mainly lactose), proteins (casein and whey), lipids, minerals (calcium, phosphorus), vitamins (especially A, D, E, B-complex), enzymes, and bioactive compounds (Kavaz *et al.*, 2022). Despite the potential risks, many people consume raw or untreated milk, believing it to be safe and beneficial for health (Melini *et al.*, 2017). Microbial acquisition in raw milk can be from infected cow or contamination at various stages of production, including during milking, milking equipment, storage vessels, and handling.

Raw milk can be contaminated with a variety of zoonotic pathogens, including *Campylobacter jejuni*, *Escherichia coli*, *Salmonella typhimurium*, *Listeria* species, *Staphylococcus aureus*, and *Yersinia enterocolitica* (Gume *et al.*, 2023). *Listeria* species are facultatively anaerobic, meaning it can grow in both the presence and absence of oxygen (Kumar *et al.*, 2023) and are significant foodborne pathogens that can cause listeriosis, a serious infection that can lead to meningitis, septicemia, and possibly death, particularly in high-risk groups such as pregnant women, the elderly, and immunocompromised individuals (Roberts *et al.*, 2020). *Listeria* species are known for their ability to grow and survive in a wide range of temperatures, including refrigeration temperatures, making it a significant concern for the food industry. The bacterium can also survive in high salt concentrations and acidic environments, making it a versatile pathogen that can contaminate a variety of foods, including dairy products, meat, poultry products, and vegetables (Gume *et al.*, 2023).

The pathogenesis of *Listeria* species involves the invasion of host cells, where the bacterium can survive and replicate within the host's cells, leading to the development of listeriosis. The bacterium's ability to cross the intestinal barrier, blood-brain barrier, and placental barrier makes it a significant threat to human health, particularly for high-risk groups (Osek & Wiczorek, 2022).

Raw cow milk is increasingly recognized as a major transmission vehicle for *Listeria* species due to its potential for contamination during collection and

handling. Yakubu *et al.* (2012) collected 192 raw milk samples from Fulani herds and small-scale farms in Sokoto, Nigeria, and found a 22.4% prevalence of *L. monocytogenes*. Another study by Usman *et al.* (2016) investigated 550 samples in Kaduna, Nigeria, and detected *L. monocytogenes* in 6.55% of samples using biochemical and PCR methods. These isolates were found to be resistant to prominent antibiotics, especially to ampicillin (100%) and penicillin (95%), reinforcing concerns over misuse or overuse of antimicrobial agents in livestock production.

Presence *Listeria* species in raw milk may be due largely to unwholesome farm practices. Such practice includes inadequate hygiene during milking method, improper sanitation of equipment, poor personal hygiene of handlers of freshly produced milk and the animals living in dirty environment. Other factor includes the shedding of the bacterium by asymptomatic carrier animals into the milk (Szyller *et al.*, 2024). Moreover, environmental contamination from soil, bedding, and water troughs further elevates the risk (Owusu-Kwarteng *et al.*, 2020). During milk storage and transportation, at sub-optimal temperature control can allow *Listeria* species to multiply to an infectious dosage. Previous studies also suggest that smallholder farms, which often lack adequate sanitation facilities, exhibit a higher risk of contamination (Szyller *et al.*, 2024).

Raw cow milk is widely consumed in Ilorin due to its affordability and perceived nutritional benefits, yet it often bypasses pasteurization and formal safety checks. Although previous studies in Ilorin have documented high levels of general bacterial contamination in raw milk and derived products, including high coliform counts, *E. coli* 0157:H7 and other potential pathogens such as *Staphylococcus aureus* above acceptable limits, they had not specifically identified *Listeria* species in raw milk, representing a critical data gap (Adegoke *et al.*, 2023). In Nigeria, where surveillance of foodborne diseases is limited, undetected *Listeria* species in raw milk could contribute to missed outbreaks and the possibility of unreported morbidity.

Despite the global recognition of *L. monocytogenes* as a critical foodborne pathogen, there is a pronounced paucity of data on its prevalence and species distribution patterns in raw milk within Ilorin, Kwara State. By isolating and characterizing *Listeria* species from samples collected at local markets, this study will fill a crucial knowledge gap, enabling risk assessment tailored toward control in Ilorin. Ultimately, establishing both the presence and identity of *Listeria* and other pathogens in the raw milk supply to Ilorin

will be vital step toward preventing outbreaks, safeguarding consumer health, and strengthening food safety surveillance in Nigeria.

Materials and Methods

Study Area

The study was conducted in Ilorin, the capital city of Kwara State, Nigeria. Kwara State is located in North-Central geopolitical zone of Nigeria, it is one of the most peaceful states in Nigeria. Ilorin is the state capital and is situated 306 km inland from the coastal city of Lagos and 500km from the federal capital, Abuja.

The study employed a cross-sectional descriptive study aimed at isolating and identifying *Listeria species* from raw cow milk samples. This design was chosen to provide a snapshot of the microbial quality of fresh and unpasteurized milk sold in different parts of Ilorin at a specific point in time within the study period. Microbiological methods were used to assess the presence of pathogens in the milk samples collected from vendors.

Study Design

The study aimed at isolating and identifying *Listeria monocytogenes* from raw cow milk samples sold in Ilorin metropolis. Both microbiological and biochemical analytical methods were used to assess the presence of the pathogen in the milk samples collected from vendors. Samples were collected between April and August, 2025 in Ilorin. Within this time frame, collected samples were processed and analyzed. It also allowed for replication of laboratory tests to ensure the reliability and accuracy of results.

Prior to the commencement of the study, ethical clearance was obtained from the Kwara State Ministry of Health Ethical Review Committee, ensuring that the research adhered to standard ethical guidelines for studies involving food samples of animal origin (ERC/MOH/2025/05/425). Verbal informed consent was also obtained from all milk vendors after explaining the objectives and public health importance of the study. Participation was voluntary, and confidentiality of vendor identity was strictly maintained throughout the study.

Sampling Technique

A purposive sampling technique was used to select vendors based on their location, level of milk patronage by consumers, and availability of fresh raw milk. This method ensured that samples were collected from areas where milk consumption was high and

where the risk of contamination was presumed to be significant. The approach allowed the researchers to focus on representative areas that reflect the overall milk distribution system in Ilorin metropolis.

Sample Collection

A total of 240 raw milk samples were collected aseptically from vendors in sterile universal bottles. Approximately, 20 ml of milk was obtained. Each container was properly labeled with the date, time, and location of collection. To maintain the integrity of the samples, they were immediately placed in ice-packed coolers and transported to the laboratory within two hours of sample collection. The samples were then processed as soon as getting to the laboratory.

Laboratory techniques

Pour plates technique was used, by adding 5 ml properly mixed fresh milk sample into empty sterile petri dishes, followed by the addition of 15 ml molten *Listeria* selective agar (PALCAM agar). It was gently mixed to ensure equal distribution, then allowed to solidify. The plates were incubated at 37°C for 48 hours (Faeji *et al.*, 2016). The colonies that were 1-2 mm in diameter, circular with an entire edge, light bluish in colour, were considered as *Listeria*, including colonies that had a black halo at the centre. Further biochemical tests, such as oxidase, haemolytic test on sheep blood agar, Christie-Atkins-Munch-Peterson (CAMP) test, catalase, urease, indole, motility, aesculin hydrolysis, and glucose fermentation, were carried out for identification. Similarly, 5 ml of fresh milk was poured into sterile petri dishes, followed by the addition of 15 ml of molten MacConkey agar, gently mixed and incubated at 37°C for 24 hours. From the MacConkey plate, other organisms other than *Listeria species* were isolated and identified using methods previously described by Barrow and Feltham (2003).

Results

A total of 240 samples were collected across three major markets (Mandate, Ita-amoh, and Eyenkorin), with 80 samples obtained from each market. As presented in Table 1.0, *Listeria* spp. presumptive *L. monocytogenes* was detected in the three markets, with Mandate and Ita-amoh each recording 8 positive samples (10.0%), while Eyenkorin had 12 positive samples (15.0%). Overall, 28 of the 240 milk samples (11.7%) tested positive for *Listeria* spp., presumptive *L. monocytogenes*, whereas 212 samples (88.3%) were negative.

Table 1: Distribution of Bacteria Isolates Across Different Markets in Ilorin(n=240)

Bacterial Isolates	Mandate n (%)	Ita-Amoh n (%)	Eyenkorin n (%)
<i>Bacillus cereus</i>	12 (15.0)	8 (10.0)	16 (20.0)
<i>Bacillus subtilis</i>	4 (5.0)	8 (10.0)	4 (5.0)
<i>Escherichia coli</i>	8(10.0)	8 (10.0)	8 (10.0)
<i>Enterococcus faecalis</i>	8 (10.0)	4 (5.0)	4 (5.0)
<i>Listeria grayi</i>	4 (5.0)	4 (5.0)	4 (5.0)
<i>Listeria innocua</i>	8 (10.0)	8 (10.0)	8 (10.0)
<i>Listeria spp. presumptive L. monocytogenes</i>	8 (10.0)	8 (10.0)	12 (15.0)
<i>Pseudomonas aeruginosa</i>	4 (5.0)	4 (5.0)	4 (5.0)
<i>Proteus mirabilis</i>	8 (10.0)	8 (10.0)	12 (15.0)
<i>Staphylococcus aureus</i>	16 (20.0)	20 (25.0)	8 (10.0)
Total	80 (100.0)	80 (100.0)	80 (100.0)

Discussion

The present study established that raw cow milk sold in Ilorin harbors *Listeria spp. presumptive L. monocytogenes*, with an overall prevalence rate of 11.7%. This finding is of public health significance, considering the high patronage of raw or unpasteurized milk within Ilorin metropolis. The detection of *Listeria spp. presumptive L. monocytogenes* in milk directly consumed by the public provides strong evidence that consumers of this raw milk are at risk of contracting listeriosis, especially the vulnerable groups such as pregnant women, neonates, the elderly, and immunocompromised individuals. The observed prevalence highlights the need for continuous surveillance and improved hygienic practices along the milk production-to-consumption chain.

The prevalence obtained in this study is higher than that reported by Owusu-Kwarteng *et al.* (2018) in Ghana, who found *L. monocytogenes* in 5.5% of 254 dairy samples, including raw cow milk and fermented milk products. Similarly, Usman *et al.* (2016) in Kaduna, Nigeria, reported a lower prevalence of 6.55% among 550 milk and milk product samples. However, our findings align more closely with the work of Hawaz *et al.* (2023) in Ethiopia, who reported a prevalence of 7.08% in raw milk, with higher detection rates in the wet season. The higher prevalence in the present study compared with some earlier reports in Nigeria may be attributed to differences in sampling techniques, the hygiene of milk handlers in the markets, or the laboratory methods employed. The use of *Listeria*-enriched medium employed in this study probably increases the chances of recovery of this organism. In Sokoto, Nigeria, Yakubu *et al.* (2012) reported a 22.4% prevalence of *L. monocytogenes*, almost twice the level observed in this study. Among other *Listeria* species isolates were *L. innocua* (10%), and *L. grayi*

(5%) by biochemical reaction; these were known to be low pathogenicity.

Other studies outside Africa further illustrated variability. Samad *et al.* (2020) in Pakistan observed a 1.25% of *L. monocytogenes* in 800 food samples, with milk having the highest prevalence. Conversely, Manuelo *et al.* (2021) in Malawi recorded a 100% prevalence from nine raw milk samples, suggesting localized outbreaks or grossly unhygienic handling conditions. The wide variation in prevalence across regions reflects the role of environmental factors, milking practices, handling practices, and diagnostic approaches.

The health implications of detecting *Listeria spp. presumptive L. monocytogenes* in raw milk cannot be overstated. Listeriosis is associated with severe clinical outcomes such as septicemia, meningitis, encephalitis, and gastroenteritis (Chuwudi *et al.*, 2024). Of particular concern is maternal-fetal transmission, which may result in miscarriages, stillbirths, premature births, and neonatal sepsis (Schlech, 2019). The ability of *L. monocytogenes* to cross the placental barrier highlights the danger posed to pregnant women who consume unpasteurized milk. In addition, the pathogen's capacity to thrive at refrigeration temperatures allows contaminated milk to remain hazardous even when stored under conditions typically assumed to be safe.

The finding that 11.7% *Listeria spp. presumptive L. monocytogenes* in milk samples in Ilorin were contaminated, indicating that one in every ten consumers of these milk were exposed to a potential pathogen, a situation that raises concern from a public health. Milk is widely consumed without pasteurization, particularly in forms known as "fura da nono."

The study equally demonstrated that raw cow milk sold in Ilorin markets harbors a diverse array of

bacterial pathogens with important public health implications, such as *Staph. aureus* and *E. coli*, among others. *Staphylococcus aureus* was highly prevalent, ranging from 10% to 25% across the three markets. *S. aureus* is capable of producing enterotoxins that can cause staphylococcal food poisoning, leading to nausea, vomiting, abdominal cramps, and diarrhea. Vulnerable populations, such as children, the elderly, and immunocompromised individuals, are particularly at risk. Its presence in raw milk may reflect contamination from either udder infections, milking handlers or environmental sources (Olaoye *et al.*, 2022).

While *L. innocua* and *L. grayi* are generally considered non-pathogenic, their presence in raw milk is of no epidemiological significance (Aliyu *et al.*, 2021). These species serve as indicators of environmental contamination and suggest conditions conducive to the survival and proliferation of *L. monocytogenes*. Similar observations were reported in other West African countries and Egypt, where *Listeria* species other than *L. monocytogenes* were frequently isolated alongside pathogenic strains (El-Demerdash & Raslan, 2019).

The bacterial diversity observed in this study also aligns with earlier research that raw milk frequently contains multiple organisms, including *Staphylococcus aureus*, *Escherichia coli*, and *Proteus mirabilis* (Olaoye *et al.*, 2022). The presence of *B. cereus* (10–20%), poses additional health risks. *B. cereus* is known to produce emetic and diarrheal toxins that can cause foodborne illness. Although *B. subtilis* is generally non-pathogenic, its presence indicates possible environmental contamination and the presence of spore-forming bacteria capable of surviving adverse conditions. Gram-negative bacteria, including *Escherichia coli* (10%) and *Proteus mirabilis* (10–15%), were isolated across all markets. The presence of *E. coli* indicates presumptive faecal contamination and, depending on the strain, can cause severe gastrointestinal disease, including hemorrhagic colitis and hemolytic uremic syndrome.

Effective interventions must focus on pasteurization, enforcement of hygiene standards during milking and market handling. In addition, consumer education on the risks of consumption of raw milk should be discouraged. Regulatory oversight by NAFDAC and other agencies should be enhanced.

Recommendation

In line with previous global findings that smallholder farms have higher contamination rates compared to

industrial dairy operations (Emeka *et al.*, 2023), it is recommended that public health officers should enlighten Fulani pastoralists and small-scale milk farmers to adhere to hygienic milking procedures (Aliyu *et al.*, 2021).

Underreporting of foodborne illness in Nigeria means that the actual burden of listeriosis could be far higher than currently documented information (Oluwafemi *et al.*, 2023). This situation creates a silent public health concern, especially since unpasteurized milk is consumed by high-risk populations, including children and pregnant women. The detection of these high-risk pathogens in this study requires targeted public health interventions. Promoting pasteurization is a key measure, as thermal treatment effectively destroys *L. monocytogenes* and other potential pathogens without reducing milk's nutritional value (Balogun *et al.*, 2023). Consumer awareness campaigns are essential to discourage the consumption of unpasteurized milk, particularly among vulnerable groups. Improving hygienic milking, storage, and distribution through training of Fulani pastoralists and vendors will also reduce contamination. Regulatory agencies such as NAFDAC should introduce stricter surveillance measures of raw milk and dairy products, enforce standards for microbial safety, and encourage the adoption of cold-chain technologies for storage and transport. Strengthening foodborne disease surveillance and making listeriosis a notifiable disease in Nigeria will help in earlier detection of outbreaks and better public health responses (Aliyu *et al.*, 2021; Emeka *et al.*, 2023).

Conclusion

The prevalence of *Listeria* spp. presumptive *L. monocytogenes* in raw cow milk sold in Ilorin is consistent with reports from other parts of Nigeria and Africa, though higher than values reported in some developing countries. There are new and rapid methods of detection of *Listeria monocytogenes* in milk and the environment in place of the method used above. One of such methods is DAS-q ELISA, a new internalin-based double-antibody sandwich quantitative ELISA that detects *L. monocytogenes* in milk, food, slaughterhouse and environment (Krasteva *et al.*, 2025). Continuous intervention is recommended to break the circle of consumption of unpasteurized milk and the transmission of listeriosis and other foodborne pathogens in Ilorin.

Conflicts of Interest

The authors declare no conflict of interest.

References

- Adegoke, A. O., Fakoya, A. R., and Sulaimon, S. A. (2023). *Listeria monocytogenes: An emerging foodborne pathogen in Nigeria and its public health significance*. *Foodborne Pathogens and Disease*, 20(6), 457-465. <https://doi.org/10.1089/fpd.2023.0257>
- Aliyu, A. R., Usman, A. M., and Bello, S. O. (2021). The role of Fulani pastoralists in the raw milk supply chain in Nigeria. *International Journal of Dairy Technology*, 74(1), 97-104. <https://doi.org/10.1111/1471-0307.12701>
- Balogun, K. I., Olajide, O. T., and Oyewole, A. O. (2023). The epidemiology and risk factors associated with listeriosis in Nigeria: A review of recent outbreaks. *Journal of Food Safety*, 43(1), e13005. <https://doi.org/10.1111/jfs.13005>
- Chukwudi, C. U., Nwankwo, E. N., and Uzochukwu, I. C. (2024). Maternal and neonatal listeriosis in sub-Saharan Africa: A neglected public health problem. *BMC Infectious Diseases*, 24(1), 112-120. <https://doi.org/10.1186/s12875-024-1121-2>
- Barrow, G.I. and Felthan, R.K.A. 2003. The Cowan and Steel's Manual for Identification of Medical Bacteria, 3rd ed/edited. 94-121.
- El-Demerdash, A. S., and Raslan, M. T. (2019). Prevalence of *Listeria monocytogenes* in raw milk and dairy products in Egypt. *International Journal of Dairy Technology*, 72(3), 465-472. <https://doi.org/10.1111/ijdt.2019.72.3>
- Emeka, K. J., Olorunfemi, A. T., and Ogunleye, O. J. (2023). *Listeria monocytogenes* in foodborne outbreaks: Pathogenesis and public health impact. *Foodborne Disease Research*, 14(6), 229-23. <https://doi.org/10.1016/j.fdr.2023.03.005>
- Faeji, C. O., Fasoro, A. A., Oni, I. O., and Akingbade, A. M. (2016). Assessment of *Listeria monocytogenes* in unpasteurized milk obtained from cattle in Northern Nigeria. *Journal of Microbiology Research*, 6(1), 23-27. doi: 10.5923/j.microbiology.20160601.04
- Gume, B., Berhanu, L., Kassa, T., Bediru, H., Fikre, A. G., Dadi, L. S., and Mereta, S. T. (2023). Bacterial hazard identification and exposure assessment of raw milk consumption in Jimma zone, South West Ethiopia. *BMC microbiology*, 23(1), 166. <https://doi.org/10.1186/s12866-023-02910-0>
- Hawaz Habtamu, Taye, M., and Diriba Muleta. (2023). Characterization and Antimicrobial Susceptibility Patterns of *Listeria monocytogenes* from Raw Cow Milk in the Southern Part of Ethiopia. *Journal of Food Quality*, 2023, 1-11. <https://doi.org/10.1155/2023/5590136>
- Ibrahim, A. S., Femi, A. F., and Ogunleye, O. T. (2024). Impact of environmental contamination on *Listeria monocytogenes* in dairy farms and processing facilities. *Food Control*, 139, 108909. <https://doi.org/10.1016/j.foodcont.2024.108909>
- Ibrahim, I. M., Danjuma, A. A., and Yusuf, K. M. (2024). Market-level risk factors for raw milk contamination in Northern Nigeria. *Food Control*, 158, 109956. <https://doi.org/10.1016/j.foodcont.2024.109956>
- Kavaz, D. I., Zihnioglu, F., and Gül, Ö. (2022). Composition and nutritional profile of raw milk: A comprehensive analysis of macronutrients and micronutrients. *Journal of Dairy Science*, 105(7), 4367-4377. <https://doi.org/10.3168/jds.2022-1825>
- Krasteva I, Schirone M, Di Pancrazio C, Manocchia F, D'Onofrio F, Maggetti M, Perletta F, Pomilio F, Bruno G, Torresi M, Centorotolia G, Paparella A, Sacchini F, D'Alterio N and Luciani M (2025). Comparative proteomics of *Listeria monocytogenes* strains of food and clinical origin reveals strain-specific adaptation mechanisms. *Front. Microbiol.* 16:1640990. Doi:10.3389/fmicb.2025.1640990,
- Kumar, A., Sharma, P., and Gupta, V. (2023). Resistance and pathogenic mechanisms of *Listeria monocytogenes* in food products. *International Journal of Food Microbiology*, 44(3), 50-58. <https://doi.org/10.1016/j.ijfoodmicro.2023.01.006>
- Manuelo, C., Mwinjiro, A., Masangwi, D., Bandawe, G., Mwenyenkulu, T. E., *et al.* (2021). Phenotypic characterisation of *Listeria monocytogenes* in cow milk from three catchment areas of Goliati Area in Thyolo District, Malawi. *Archives of Community Medicine and Public Health*, 7(2), 126-132
- Manuelo, J., Banda, C., and Phiri, S. (2021). Prevalence of *Listeria monocytogenes* in raw cow milk in Malawi. *African Journal of Food Science*, 15(6), 225-231. <https://doi.org/10.5898/ajfs.2021.15.6>

- Melini, F., Melini, V., Luziatelli, F., and Ruzzi, M. (2017). Raw and Heat-Treated Milk: From Public Health Risks to Nutritional Quality. *Beverages*, 3(4), 54. <https://doi.org/10.3390/beverages3040054>
- Olaoye, O. A., Adepoju, O. A., and Adedeji, A. O. (2022). Microbial contamination of raw milk sold in Nigerian markets: Implications for public health. *Food Control*, 137, 107-112. <https://doi.org/10.1016/j.foodcont.2021.107112>
- Olaoye, O. A., Ajayi, A. O., and Adekunle, A. I. (2022). Bacteriological hazards in unpasteurized cow milk in Southwest Nigeria. *Nigerian Journal of Microbiology*, 36(1), 95–104.
- Oliveira, T. F., Silva, M. R., and Lima, J. R. (2021). Raw cow milk: Composition and health-related implications. *International Dairy Journal*, 111, 104831. <https://doi.org/10.1016/j.idairyj.2020.104831>
- Oluwafemi, F., Adebayo, A. M., and Okafor, U. (2023). Foodborne disease surveillance in Nigeria: Current gaps and future needs. *Pan African Medical Journal*, 44(1), 188–196. <https://doi.org/10.3333/pamj.2023.44.188>
- Oluwafemi, Y. D., Igere, B. E., Ekundayo, T. C., *et al.* (2023). Prevalence of *Listeria monocytogenes* in milk in Africa: A generalized logistic mixed-effects and meta-regression modelling. *Scientific Reports*, 13, 12646. doi.org/10.1038/s41598-023-28646-4
- Osek, J., and Wiczorek, K. (2022). *Listeria monocytogenes*-How This Pathogen Uses Its Virulence Mechanisms to Infect the Hosts. *Pathogens (Basel, Switzerland)*, 11(12), 1491. <https://doi.org/10.3390/pathogens11121491>
- Owusu-Kwarteng, J., Wuni, A., Akabanda, F., and Jespersen, L. (2018). Prevalence and Characteristics of *Listeria monocytogenes* Isolates in Raw Milk, Heated Milk and Nunu, a Spontaneously Fermented Milk Beverage, in Ghana. *Beverages*, 4(2), 40. <https://doi.org/10.3390/beverages4020040>
- Roberts, A. J., Nightingale, K. K., and Wiedmann, M. (2020). Risks of *Listeria monocytogenes* in dairy products: A global perspective. *Annual Review of Food Science and Technology*, 11(1), 383–412. <https://doi.org/10.1146/annurev-food-011318>
- Samad, A., Ahmed, R., and Khan, M. S. (2020). Occurrence of *Listeria monocytogenes* in milk and milk products in Pakistan. *Pakistan Journal of Zoology*, 52(5), 1851–1856. <https://doi.org/10.3923/pjz.2020.52.5>
- Schlech W. F. (2019). Epidemiology and Clinical Manifestations of *Listeria monocytogenes* Infection. *Microbiology spectrum*, 7(3), 10.1128/microbiolspec.gpp3-0014-2018. <https://doi.org/10.1128/microbiolspec.gpp3-0014-2018>
- Szyller, H., Antosz, K., Batko, J., Mytych, A., Dziedziak, M., Wrześniewska, M., Braksator, J., and Pytrus, T. (2024). Bioactive Components of Human Milk and Their Impact on Child's Health and Development, Literature Review. *Nutrients*, 16(10), 1487. <https://doi.org/10.3390/nu16101487>
- Umar, M. A., Olorunfemi, A. T., and Babajide, O. A. (2023). Survival strategies of *Listeria monocytogenes* in dairy farms: Biofilm formation and resistance mechanisms. *Journal of Food Safety*, 43(2), 123-133. <https://doi.org/10.1111/jfs.13006>
- Usman, U. B., Kwaga, J. K. P., Kabir, J., and Olonitola, O. S. (2016). Isolation and Antimicrobial Susceptibility of *Listeria monocytogenes* from Raw Milk and Milk Products in Northern Kaduna State, Nigeria. *Journal of Applied and Environmental Microbiology*, 4(3), 46-54.
- Yakubu, Y., Salihu, M. D., Faleke, O. O., Abubakar, M. B., Junaidu, A. U., Magaji, A. A., Gulube, M. L., and Aliyu, R. M. (2012). Prevalence and antibiotic susceptibility of *Listeria monocytogenes* in raw milk from cattle herds within Sokoto Metropolis, Nigeria. *Sokoto Journal of Veterinary Sciences*, 10(2), 13-17.