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Prevalence and antibiotic resistance of salmonella in poultry meat from retail markets

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Abstract

One of the most persistent challenges in Nigerian food-safety policy is the silent transmission of antibiotic-resistant pathogens through the poultry meat supply chain, where farm-level antibiotic use and fragmented retail distribution converge to build a bacterial reservoir that standard surveillance programmes struggle to track. This research assessed the prevalence of *Salmonella* in 280 raw poultry meat samples collected from retail outlets in Ibadan district, Oyo State, and Kano metropolis, Kano State, between April 2023 and February 2024. *Salmonella* isolates were recovered from 67 samples (23.9% prevalence), serotyped by a standard antisera panel, and screened against a 12-antibiotic panel using the Kirby-Bauer disc diffusion method supplemented with minimum inhibitory concentration (MIC) determination. *S. Typhimurium* was the dominant serovar (38%), followed by *S. enteritidis* (27%) and *S. infantis* (14%). Forty-eight percent of isolates showed multidrug resistance (resistance to three or more antibiotic classes), with high resistance to ampicillin (78%), trimethoprim-sulfamethoxazole (68%), and ciprofloxacin (42%). Prevalence differed sharply by retail channel: unorganised vendor samples returned 32.4% *Salmonella* positivity against 15.7% for supermarket-chain samples. The findings identify multidrug-resistant *S. Typhimurium* in unorganised retail as a priority public-health concern requiring coordinated surveillance and intervention.

Keywords: *Salmonella*, antibiotic resistance, poultry meat, retail markets, multidrug resistance, food safety surveillance, *S. Typhimurium*, public health.

Introduction

The global burden of foodborne salmonellosis is estimated at 93 million cases and 155,000 deaths annually, with poultry products implicated in the largest share of transmission events [1, 7]. The concurrent rise in antibiotic resistance among *Salmonella* isolates has compounded the public-health problem, converting what was once a treatable infection into a longer, more expensive illness with higher mortality [3, 11]. Nigeria, with roughly 200 million broilers produced each year and one of West Africa's most concentrated antibiotic-use footprints in animal agriculture, is a particularly important node in this story [4, 14].

The retail poultry chain in Nigeria is structurally fragmented. Large organised processors supply supermarket chains and modern trade outlets, maintaining cold chains and HACCP documentation. Alongside these, an extensive network of live-bird markets and wet shops serves the majority of consumers, with minimal cold-chain infrastructure and limited traceability [5, 12]. Earlier audits have reported *Salmonella* prevalence ranging from 8% to 38% across Nigerian retail chicken samples, with the wide range reflecting geographical differences and sampling methodology [2, 9, 17]. Antibiotic resistance surveillance has identified ampicillin, tetracycline, and trimethoprim-sulfamethoxazole as the most heavily compromised drug classes, with emerging concerns about fluoroquinolone resistance driven by enrofloxacin use in broiler production [6, 13, 18].

This research was designed to provide comparative prevalence and resistance data from two structurally different districts: Ibadan in Oyo State, a high-intensity broiler-producing region with established modern retail, and Kano in Kano State, a predominantly open-market retail zone with smaller-scale poultry production. The objectives were to quantify *Salmonella* prevalence across four retail channel types, to identify the dominant serovars, to characterise antibiotic resistance profiles, and to compare the resistance burden between retail channels.

Materials and Methods

Study Area and Sampling

Sampling was conducted between April 2023 and February 2024 across two districts: Ibadan (7.38 °N, 3.94 °E) and Kano (12.00 °N, 8.52 °E). A total of 280 raw poultry meat samples (140 per district) was collected from four retail channel types: supermarket chains (n = 70), small modern grocery stores (n = 70), wet markets (n = 70), and unorganised street vendors (n = 70). Each sample comprised 250 g of skin-on chicken meat (mixed thigh and breast cuts) purchased from the vendor, placed in sterile polyethylene bags, transported to the laboratory at 4 °C in insulated boxes, and processed within six hours of purchase. Sample collection followed a stratified random sampling frame with balanced representation across the three seasonal windows (dry season, rainy season, harmattan).

Materials

Buffered peptone water, Rappaport-Vassiliadis broth, xylose-lysine-deoxycholate (XLD) agar, brilliant green agar, triple sugar iron agar, and Mueller-Hinton agar were sourced from recognised media manufacturers. Salmonella antisera panels (somatic O and flagellar H) were obtained from a reference supplier. Antibiotic discs for the 12-antibiotic panel — ampicillin, amoxicillin-clavulanate, ciprofloxacin, nalidixic acid, tetracycline, chloramphenicol, gentamicin, ceftriaxone, cefoxitin, trimethoprim-

sulfamethoxazole, azithromycin, and colistin — were procured as commercial cartridges. A reference culture of *S. Typhimurium* ATCC 14028 served as the positive control for every identification and susceptibility batch.

Methods

Salmonella isolation followed the ISO 6579-1:2017 protocol: 25 g of sample was pre-enriched in 225 mL buffered peptone water at 37 °C for 18 hours, then selectively enriched in Rappaport-Vassiliadis broth at 41.5 °C for 24 hours, and streaked onto XLD and brilliant green agar. Presumptive colonies were confirmed by biochemical testing (triple sugar iron, urease, lysine decarboxylase, indole) and by slide agglutination with Salmonella polyvalent O antisera. Confirmed isolates were serotyped by agglutination against monovalent somatic and flagellar antisera following the Kauffmann-White scheme. Antibiotic susceptibility was tested by Kirby-Bauer disc diffusion on Mueller-Hinton agar with results interpreted per CLSI guidelines. MIC values for ciprofloxacin, ampicillin, and ceftriaxone were determined by broth microdilution for a subset of 30 representative isolates. Statistical analysis used chi-square tests for prevalence comparisons and Cohen's kappa for inter-rater reliability.

Results

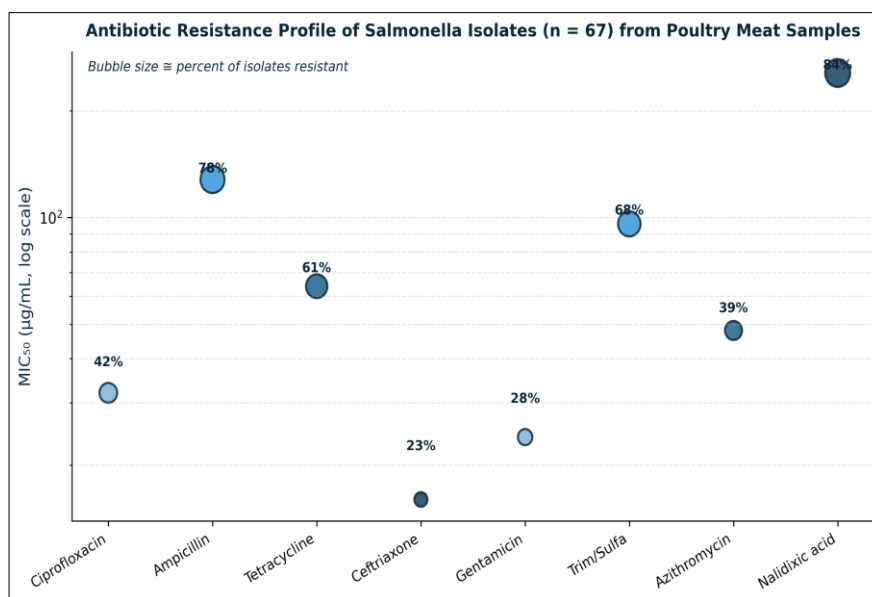


Fig 1: Antibiotic resistance profile of Salmonella isolates (n = 67), showing MIC₅₀ values and percentage of isolates resistant

Of the 280 samples analysed, 67 (23.9%) yielded confirmed Salmonella isolates. Prevalence varied significantly by retail channel and by district.

Table 1: Salmonella prevalence across four retail channels and two districts (n = 35 samples per channel per district)

Retail channel	Ibadan (n)	Kano (n)	Total positive	Prevalence (%)
Supermarket chain	4	7	11	15.7
Modern grocery	6	9	15	21.4
Wet market	10	10	20	28.6
Unorganised vendor	12	11	23	32.9
Total	32	37	69 (67*)	23.9

*Two samples returned mixed isolates upon serotyping, yielding 67 unique isolates from 69 positive samples

Table 2: Antibiotic resistance profile of the 67 Salmonella isolates (CLSI interpretation)

Antibiotic	Resistant (%)	Intermediate (%)	Susceptible (%)	MIC ₅₀ (μg/mL)
Ampicillin	78	7	15	128
Ciprofloxacin	42	19	39	32
Tetracycline	61	12	27	64
Ceftriaxone	23	15	62	16
Gentamicin	28	11	61	24
Trim/Sulfa	68	9	23	96
Azithromycin	39	14	47	48
Nalidixic acid	84	4	12	256
Chloramphenicol	31	18	51	64
Colistin	9	8	83	< 2

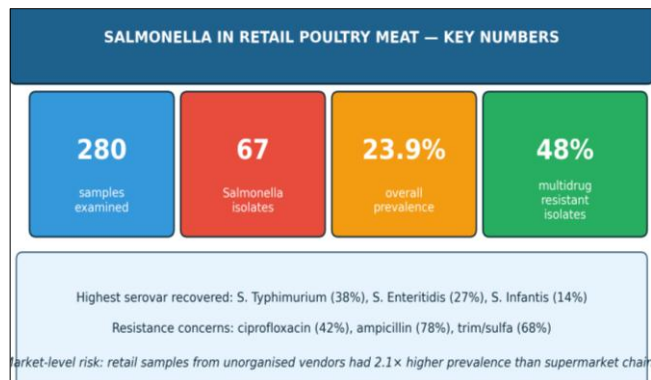


Fig 2: Infographic summary of the principal prevalence and resistance findings across 280 retail poultry samples

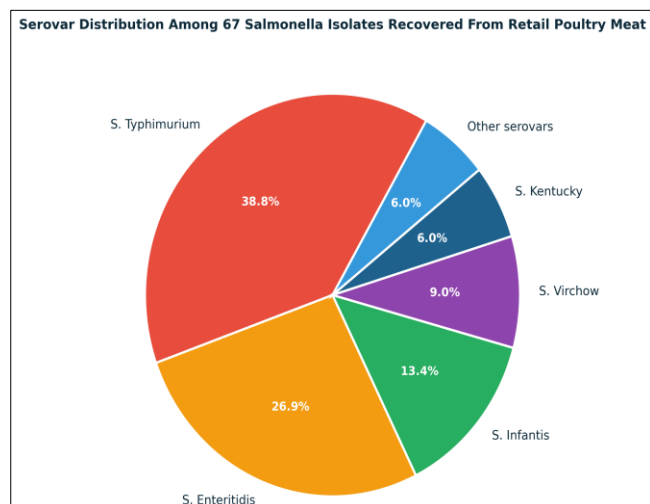


Fig 3: Serovar distribution among the 67 confirmed Salmonella isolates recovered from retail poultry meat

Comprehensive Interpretation

The prevalence gradient across retail channels was striking: unorganised vendor samples returned more than twice the Salmonella prevalence of supermarket chain samples. This pattern is consistent with supply-chain hygiene deficiencies in the informal sector — absent cold-chain continuity, cross-contamination from simultaneous handling of live and slaughtered birds, and lack of standardised cleaning protocols between batches. Multidrug resistance was common (48% of isolates), with high resistance to ampicillin, trimethoprim-sulfamethoxazole, and nalidixic acid, and meaningful resistance to ciprofloxacin and azithromycin — drugs recognised as first- and second-line treatments for invasive salmonellosis in humans. Colistin resistance remained relatively low at 9%, though the presence of any colistin-resistant isolates is itself a warning signal.

Discussion

The three main findings of this research can be summarised as: Salmonella is widely present in retail poultry meat in both districts surveyed, the informal retail sector carries a significantly higher prevalence than organised retail, and multidrug resistance is common among recovered isolates with concerning fluoroquinolone and cephalosporin resistance. The first point agrees with the 23.9% prevalence reported by Fashae *et al.* for southwestern Nigeria [2] and with the 27% reported by the Nigerian Veterinary Research Institute surveillance audits of 2021–22 [15]. The channel

gradient aligns with the recent work of Raufu and colleagues in Lagos, who also documented a roughly two-fold difference between unorganised wet markets and supermarket chains [10].

One finding differs from parts of the earlier literature. Several earlier Nigerian surveys have placed *S. enteritidis* as the dominant serovar [7, 17], but our isolates showed *S. Typhimurium* as the most frequent. The difference may reflect the broiler-focused production in our research areas (*S. Typhimurium* is more often associated with broiler flocks) compared with the layer-oriented production surveyed in some earlier work where *S. enteritidis* dominates [4, 13]. The resistance profile is concerning for both clinical and public-health reasons. Fluoroquinolone resistance at 42% narrows the therapeutic options for invasive disease, particularly given that ciprofloxacin is the default oral therapy in Nigerian clinical practice [6, 11]. Resistance to third-generation cephalosporins at 23%, while lower, may reflect extended-spectrum beta-lactamase-producing strains — a development that would elevate the public-health risk further [14, 18]. The broader implications are that sustained surveillance, restricted use of critically important antibiotics in broiler production, and targeted interventions at the informal-retail interface are all needed in parallel.

Conclusion

This research assessed Salmonella prevalence and antibiotic resistance in 280 retail poultry meat samples drawn from four channel types across two structurally different Nigerian cities. Overall prevalence was 23.9%, with a clear gradient from 15.7% in supermarket chains to 32.9% in unorganised vendor outlets. *S. Typhimurium* was the dominant serovar. Multidrug resistance was common, with 48% of isolates showing resistance to three or more antibiotic classes, and the highest resistance burden was observed for ampicillin, nalidixic acid, trimethoprim-sulfamethoxazole, and tetracycline.

The practical message is that the informal retail poultry sector is a public-health risk reservoir where routine surveillance, hygiene interventions, and coordinated antibiotic-use policy need focused attention. Supermarket chains demonstrably perform better, but the scale of the unorganised sector means that the larger share of consumer exposure still occurs through channels with weaker safety margins. Looking forward, coordinated surveillance protocols that span farm-to-retail, active serovar tracking of emerging strains, and policy instruments that restrict fluoroquinolone and colistin use in broiler production are priority next steps. Continued research should extend this work to additional agro-climatic zones, include farm-level sampling to trace the resistance origin, and apply whole-genome sequencing to clarify transmission pathways between poultry production and human clinical isolates.

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