



## DEMOGRAPHIC AND BIOSECURITY IMPACTS OF ANTIBIOTIC RESISTANT *SALMONELLA* SPECIES IN SOME SELECTED BROILER BREEDER FARMS AND HATCHERIES

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### Summary

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Prevalent antimicrobial resistant *Salmonella* serovars are aided by inadequate demography and biosecurity in several broiler breeder farms and hatcheries, with the possibility of Salmonellosis outbreak. This study evaluates the demographics and biosecurity impacts of antibiotic resistant *Salmonella* species in selected broiler breeder farms and hatcheries in southwest Nigeria. Among the selected broiler breeder farms and hatcheries in southwest Nigeria, caecal droppings (n=250) and cloacal swabs (n=250) were collected and analysed using microbiological methods. Isolated *Salmonella* were biotyped and evaluated for antimicrobial susceptibility using disc diffusion methods. The biosecurity and hygiene practices of the farms were estimated using structured questionnaires. Sociodemographic data of the poultry workers showed ages, gender, educational status and time spent on the job were significantly associated with *Salmonella* spread (P<0.05). More than 50% of the selected broiler breeder farms maintain biosecurity, while all farmers use one or more antibiotic type treatment only (15%) and prophylaxis (85%), with 70% practising self-prescriptions. Caecal contents (13.6%) and cloacal swabs (7.6%) were positive for *Salmonella*, including *Salmonella* Arizonae subsp. 3A, *Salmonella* subsp 1 and *Salmonella* Gallinarum with over 35% prevalence rates of *Salmonella* in breeder farms at major towns. High resistance rates (100%) to doxycycline, tetracycline, and colistin, and more than 70% resistance to amoxicillin, gentamycin, chloramphenicol, ciprofloxacin, and enrofloxacin were observed among the *Salmonella* strains that were resistant to at least 3 out of the 6 classes of antibiotics. Prevalence of antimicrobial *Salmonella* serovars in broiler breeder farms and hatcheries is a threat to poultry farming. Effective biosecurity practices are highly needed to prevent a possible outbreak of salmonellosis.

**Key words:** *Salmonella* serovars, antimicrobial resistance, poultry, breeder farms, hatcheries

## INTRODUCTION

Poultry and associated poultry products have undoubtedly played a major role in the provision of animal protein, mostly for the Nigerian population for decades (Udoh, 2025). To ensure the safety and the health of consumers, high level hygiene throughout the production chain is very important to prevent contamination with the *Salmonella* strain (Betiku *et al.*, 2025). *Salmonella* infection (salmonellosis) is of particular interest in poultry and to public health because of previous reports of high morbidity and mortality (Kumar *et al.*, 2025; Nazir *et al.*, 2025). Salmonellosis is a zoonotic disease with a growing global concern of predominant *Salmonella* serovars associated with human infections (Yue & Groves, 2025). Being one of the most studied food-borne pathogens, *Salmonella* easily spreads during the trade and processing of poultry products, specifically non-processed and non-heat treated poultry products (Souillard *et al.*, 2025). This spread has been facilitated by industrialization and the growing international trade in animal feed, live animals, and food (Yue & Groves, 2025). Inadequate biosecurity of breeder farms and hatcheries further aids the spread of *Salmonella* infection in poultry, leading to outbreaks in industrialized economies and mostly reported in underdeveloped economies (Tsogtbayar *et al.*, 2025). Evidences support transmission of *Salmonella* strains from contaminated eggs to humans following consumption and by direct or indirect contact (Ehuwa *et al.*, 2021; Souillard *et al.*, 2025). Most studies have identified handling raw poultry and eating poorly prepared poultry products as important risk factors, and these account for a variable percentage of cases (Tsogtbayar *et al.*, 2025). Trade of infected animals has also facilitated the

global spread of zoonotic *Salmonella* serovars at different breeder farms and hatcheries (Adem *et al.*, 2022; Nazir *et al.*, 2025).

The spread of antimicrobial resistant *Salmonella* in poultry is a major health concern and is largely facilitated by the widespread use of antibiotics in poultry production (Lei *et al.*, 2025). Indiscriminate use of antimicrobial agents in commercial and subsistence poultry production systems in Nigeria exacerbates the acquisition of antimicrobial resistance genes and the development of antimicrobial-resistant *Salmonella* colonizing breeder birds in Nigeria (Lamichhane *et al.*, 2024). There are limited studies on the demographic and biosecurity impact of the prevalence antibiotic-resistant *Salmonella* in broiler breeders, mostly in southwest Nigeria. Assessment of the biosecurity status of the farms as well as the hygiene and safety status of the workers, is very important. There is a need to fully study the *Salmonella* serovars circulating presently within the broiler breeder farms, determine their antibiotic resistance for improved epidemiological surveillance and monitoring. Therefore, the study aims to evaluate the demographic and biosecurity impacts of antibiotic resistant *Salmonella* species in selected broiler breeder farms and hatcheries in southwest Nigeria.

## MATERIALS AND METHODS

### *Sampling location*

The study was conducted from August 2023 to March 2024 at three geographical zones in southwest Nigeria, which lies between latitude 7° 23' 47" North and longitude 3° 55' 0" East at an elevation of 750 feet, with an area of 3,080 square

kilometres and a population of 3,500,000 (Awe *et al.*, 2025). At the onset of the study, the College of Veterinary Medicine Research and Ethical committee confirmed the study while the informed consent was obtained from the farmers and approval for the sample collection for the study was received from the farm managements. These selected sites are prominent transit points between the coastal and Northern region of Nigeria, harbouring several poultry farms and hatcheries that supply day-old chicks to other zones and farms in the country. The study was a cross-sectional survey to determine the presence of *Salmonellae* and biosecurity impact in selected twenty broiler breeder farms and hatcheries that supply day old chicks to other zones and farms in the country. The sample size calculation as described by Thrusfield (2007), included 500 samples of caecal droppings (n=250) and cloacal swabs (n=250) collected from 20 broiler breeder farms. The sampling was conducted in three geographical zones in Oyo State at the major operational broiler breeder farms that met the national regulations and guidelines for poultry management in Nigeria. Only laying (female) broiler breeders with the youngest age of 30 weeks and oldest age of 90 weeks were sampled. The sample size distribution ranged between 16 samples for the farm with the smallest flock size and 60 samples for the farm with the largest flock size. Briefly, a total of 500 samples were collected from Ido zone (n=137; including 68 caecal droppings and 69 cloacal swabs), Ibadan municipal zone (n=275, including 138 caecal droppings and 137 cloacal swabs) and Ibadan central zone (n=88, including 44 caecal droppings and 44 cloacal swabs). All the sampled breeder farms practiced battery cage management system and cloacal

swabs were aseptically collected from individual birds from cage lines, and caecal droppings were collected randomly from the body of the cage or dry floor areas of the other cage line with the use of a sterile 150-mm polypropylene spatula. All samples were collected aseptically, labelled and transported on ice to the Veterinary Public Health Laboratory of the College of Veterinary Medicine, Federal University of Agriculture, Abeokuta, Ogun State, for immediate bacteriological analysis. Poor assess to some broiler breeder farms in some zones as at the time of this study limit sampling while unregistered farms were excluded. Structured questionnaires were distributed to minimum of 20 respondents from each farm with personal interview while filling the questionnaires to obtain information on their personal data (demography), farm details, disease management, farm biosecurity, hygiene of personnel and safety status

#### *Biotyping*

All collected swabs were immediately dipped into Buffered Peptone Water Medium for pre-enrichment and incubated at 37 °C for 18 hours. One millilitre of the pre-enrichment broth (Buffered Peptone Water Medium) was transferred into Rappaport Vassiliadis medium and incubated at 42 °C for 48 hours. A loop of the turbid blue coloured medium of inoculated Rappaport Vassiliadis was sub-cultured onto Xylose Lysine Deoxycholate Agar and incubated at 37 °C for 18 hours as previously described (Gorski *et al.*, 2024; Amer *et al.*, 2025). After incubation, suspected *Salmonella* colonies with a black centre and transparent zone of reddish colouration were purified on MacConkey agar without sodium chloride (Oxoid, UK) to prevent further contamination and

incubated at 37 °C for 24 hours. Presumptive *Salmonella* isolates showing pale colonies were sub-cultured on nutrient agar and further examined by their colonial morphology and characterised with biochemical tests using Oxoid Microbact Gram Negative Bacteria 24E ID Kit with standardised identification system for *Enterobacteriaceae* while oxidase and motility tests were also performed. The reactions were observed and interpreted according to the manufacturer's interpretation guide. For serotyping, suspected biotyped *Salmonella* isolates were serotyped by slide agglutination using monovalent and polyvalent antisera (Microgen, UK), following the Kauffmann White Le Minor Scheme (Grimont and Weill, 2007).

#### *Phenotypic antibiogram*

Different classes of commonly used antibiotics in poultry were tested against the *Salmonella* isolates using Kirby Bauer disc diffusion method (Mohammed *et al.*, 2022; Mwambene *et al.*, 2025). The antibiotic discs (Oxoid, UK) included ciprofloxacin (5 µg), enrofloxacin (5 µg), colistin (10 µg), tetracycline (30 µg), neomycin (30 µg), amoxicillin (10 µg), doxycycline (30 µg), chloramphenicol (30 µg), gentamicin (10 µg), and ceftriaxone (30 µg). Overnight broth cultures of *Salmonella* isolates were diluted with sterile 0.9% NaCl solution to match 0.5 McFarland concentration (an approximate 10<sup>8</sup> colony-forming units) taken with a sterile cotton swab dipped into the adjusted broth and streaked to make a smooth spread over Mueller-Hinton agar plates. The plates were then allowed to dry at room temperature. Each antibiotic disc was placed on the inoculated agar and incubated at 37 °C for 24 hours. The inhibition zone of each antibiotic was measured using a graduated meter rule

and interpreted as sensitive or resistant according to the CLSI guidelines (CLSI, 2018; Cesana *et al.*, 2025).

#### *Biosecurity status of the farms and hygiene safety status of workers*

The biosecurity practices of the farms were scored on a total point of 11, based on the questions asked in the questionnaire. Points obtained were based on the choice of answers, where negative answers=0, and positive answers=1. Scoring <6 points was rated poor biosecurity practices, and scoring ≥6 points was rated good biosecurity practices. The hygiene and safety status of the workers were also scored, points obtained for each choice of answers ranged from 0 to 3, from negative answers to positive answers respectively, and a maximum of 15 obtainable points. Scoring <7 points was rated poor hygiene/safety practices, and scoring ≥7 points was rated good hygiene/safety practices as previously described (Alarcón, 2025).

#### *Data analysis*

Categorical data were analysed using Chi-square (Pearson and Fisher's exact test) to determine the significance of the socio-demographic, antibiotic use, biosecurity level and hygiene practise at selected breeder farms and hatcheries with the *Salmonella* spread, taking p value at 0.05. Odds ratios were calculated at 95% confidence interval to determine the likelihood of *Salmonella* infection based on variables obtained from the selected broiler breeder farms and hatcheries. Descriptive statistics was used to describe the prevalence analysis and all the data were analysed using SPSS v20.

RESULTS

*Implication of sociodemographic factors of poultry workers, antibiotic use, biosecurity and hygiene practice on prevalent Salmonella (enterica) species*

Sociodemographic information about the poultry workers shows that age differences, gender, marital status, religion, educational status and time spent on the

job were significantly associated with *Salmonella* spread (P<0.05). All the workers have spent more than a year on the job. The duration of years spent on the job and flock sizes of were associated with the *Salmonella* distribution (P<0.05) as shown in Table 1. *Salmonella* spread were significantly associated with age of the farm, flock size, the age of birds at the time of the study and the use of paper and plastic types of crates for egg collection

**Table 1.** Socio-demographic factor influencing *Salmonella* species (*enterica*) distribution in selected broiler breeder farms

Items	Items	Percentage (%)	OR (95% CI)	P value
Age (years)	20–30	10	7.45 (2.01–10.36)	0.001
	31–40	50		
	41–50	40		
Gender	Female	15	6.05 (3.27–8.91)	0.001
	Male	85		
Marital status	Married	95	8.45 (5.27–13.51)	0.001
	Single	5		
Religion	Christian	60	0.56 (0.21–1.32)	0.651
	Muslim	40		
	None	0		
Educational status	Secondary	20	4.15 (1.82–7.35)	0.045
	Tertiary	80		
Position	Manager	60	8.09 (4.06–11.65)	0.064
	Supervisor	40		
Time spent on the job (years)	1–5	55	10.9 (7.11–2.04)	0.001
	6–10	25		
	10–above	20		
Ages of farm	0– 5	20	6.67 (4.01–11.76)	0.001
	6–10	50		
	11–15	20		
	16–20	5		
	20–above	5		
Flock size	1000–1999	45	1.05 (0.45–3.92)	0.068
	2000–3999	45		
	4000–5999	10		
Ages of birds at the time of the study	0–30	10	5.49 (2.01–8.03)	0.02
	31–60	60		
	61–90	30		
	90–120	0		
The types of crates used in egg collection	Paper	36	9.56 (5.64–12.87)	0.02
	Plastic	60		
	Both	5		

**Table 2.** Antibiotics, biosecurity status, hygiene and safety status of workers in broiler breeder farms

Variables	Items	Percentage (%)	OR (95% CI)	P value
Use of antibiotics	Yes	100		
	No	0		
Reason(s) for the use of antibiotics	Prevention only	0	9.34 (3.94–15.54)	0.001
	Treatment only	15		
	Both	85		
Source of antibiotic prescription	Veterinarian	30	8.46 (2.01–12.62)	0.001
	Non-vet	0		
	Self	70		
Administration of antibiotics to day old chicks	Yes	100		
	No	0.0		
Length of time for antibiotic medication of day old chicks	3 days	5	1.32 (0.32–3.92)	0.025
	5 days	10		
	7 days	40		
	>7 days	45		
Is your farm fenced	Yes	55	1.29 (5.03–7.56)	0.063
	No	45		
Where are dead birds disposed of	On-farm	50		
	Off-farm	50		
Where do you dispose poultry waste of	On-farm	65	5.20 (2.51–8.46)	0.045
	Off-farm	35		
Do you have a rodent control program	Yes	10	8.59 (2.61–13.49)	0.001
	No	90		
Do you have other livestock in the farm	Yes	10	5.93 (2.84–10.51)	0.001
	No	90		
Presence of other poultry farms within 1km radius	Yes	65	8.32(3.12–14.03)	0.048
	No	35		
Presence of wild birds within the farm	Yes	60	4.18(1.42–6.30)	0.058
	No	40		
Are workers assigned to work in specific units of the farm	Yes	10	8.43(3.42–13.51)	0.001
	No	90		
Are foot dips and wash hand basins provided at the entrance of pens	Yes	70	7.45 (3.45–10.41)	0.001
	No	30		
Do you clean, disinfect or fumigate	Yes	80	2.54 (0.26–1.38)	0.001
	No	20		
Do you have designated vehicle for egg transfer	Yes	0	2.62 (1.04–4.72)	
	No	100		

(OR; 95%CI = 9.56; 5.64–12.87) with high likelihood of *Salmonella* infection.

Considering the antibiotic usage pattern of the selected broiler breeder farms, all farmers used one or more antibiotic type for treatment only (15%) and prophylaxis (85%) with 70% practising self-prescriptions of antibiotics as shown in Table 2. Biosecurity practice indicated that 50% of the farms disposed dead birds on the farm, 65% also disposed poultry wastes on the farm and 90% of the farms

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did not have a rodent control programme (OR; 95%CI: 8.59; 2.61–13.49) indicating possible risk of *Salmonella* spread. Many farm do not have other livestock in their farm (90%), 65% of the farm had presence of other farms within 1 km radius and 60% has presence of wild birds within their farm with 90% of the workers had no specific units of job assignment. Many of the farms (70%) had foot dips and wash hand basins at the entrance of the pens and 80% of the farms cleaned, disinfected and fumigated hatcheries and 100% had designated vehicle for egg transfer (Table 2).

The hygiene practice and safety of workers provided level of biosecurity in the selected farms and it was observed that breeder farmers were not provided with specific protective clothing and foot wear (75%), while 62% of the workers washed their protective wears at least

once in 2 weeks with 6.12-fold higher risk of *Salmonella* infection (OR; 95%CI: 6.12; 2.56–10.21). Only 55% were not aware of occupational exposure to zoonotic diseases and 75% were not aware of non-occupational exposure to zoonotic disease. Majority (100%) of the workers bath after work period, and 90% had hand washing after contact with birds and poultry faeces while 65% ate during the working hours and 100% eat within the poultry (Table 3).

*Prevalence of Salmonella species and antimicrobial pattern in selected broiler breeder farms*

Among the collected faecal samples (including caecal contents; 250 and cloacal swabs; 250 samples) from the surveyed farms, caecal contents (13.6%) and cloacal swabs (7.6%) were positive for *Sal-*

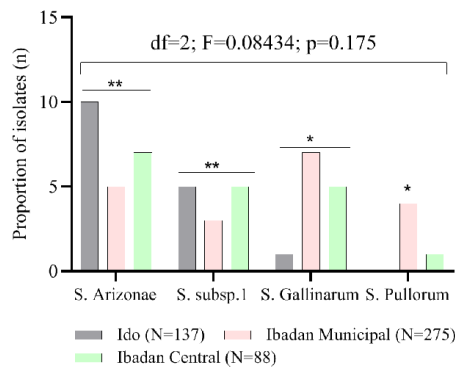
**Table 3.** Hygiene status and safety of workers in the selected broiler breeder farms

Items	Items	Percentage (%)	OR (95% CI)	P value
Wearing of specific protective clothing	Yes	25	2.18 (0.449–3.34)	0.001
	No	75		
Wearing of specific protective foot wears	Yes	25	1.92 (1.04–2.46)	0.001
	No	75		
Number of times protective wears are washed	Once in 2 weeks	62	6.12 (2.56–10.21)	0.001
	Once a month	38		
	Never	0		
Awareness of occupational exposure to zoonotic diseases	Yes	45	5.62 (2.93–8.26)	0.064
	No	55		
Awareness of non-occupational exposure to zoonotic disease	Yes	25	8.02 (4.61–12.76)	0.045
	No	75		
Bathing before work period	Yes	0	3.65 (1.65–8.63)	0.001
	No	100		
Bathing after work period	Yes	100	6.04 (2.12–9.20)	0.001
	No	0		
Hand washing after contact with birds and poultry faeces	Yes	90	4.03 (1.62–6.76)	0.001
	No	10		
Eating during work periods	Yes	36	4.21 (1.78–8.75)	0.02
	No	65		
Eating within the poultry house	Yes	0	5.92 (3.54–7.58)	0.001
	No	100		

**Table 4.** Prevalence of *Salmonella* serovars

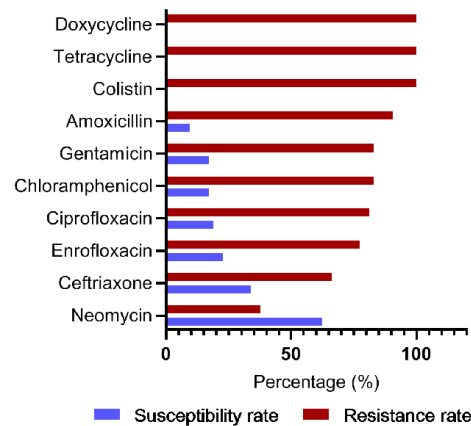
Samples	<i>S. arizonae</i> subsp 3A	<i>S. subsp 1</i>	<i>S. gallinarum</i>	<i>S. pullorum</i>	Prevalence n (%; 95% CI)	P value
Caecal droppings (N=250)	13	9	8	4	34 (13.6; 9.61–18.48)	0.069
Cloacal swabs (N=250)	9	4	5	1	19 (7.6; 4.64–11.61)	
Total positive (N=500)	22	13	13	5	53 (10.6; 8.04–13.64)	
Overall prevalence (%)	4.4	2.6	2.6	1		

*monella* respectively. Over 35% prevalence rates of *Salmonella* were recorded in breeder farms at major towns with prevalence rates of *Salmonella* Arizonae subsp. 3A (41.5%), *Salmonella* Arizona subsp 1 and *Salmonella* Gallinarum (24.3%). Significant proportion of serovars of *Salmonella* Arizonae subsp. 3A, *Salmonella* subsp 1, *Salmonella* Gallinarum and *Salmonella* Pullorum were found in breeder farms at major towns (Fig. 1). Prevalence of *Salmonella* serovars with caecal droppings (OR; 95% CI: 13.6%; 9.61–18.48) and cloacal swabs samples (OR; 95% CI: 7.6%; 4.64–11.61) is significantly associated (P=0.069) (Table 4).



**Fig. 1.** Distribution of the *Salmonella* isolates.

The assessment of the antibiotic resistance profile of the 53 isolates to 10 commonly used antimicrobial agents showed highest resistance rates (100%) to doxycycline, tetracycline, colistin, followed by amoxicillin (90.57%), gentamicin (83.02%), chloramphenicol (83.02%), ciprofloxacin (81.13%), enrofloxacin (77.36%), ceftriaxone (66.04%) and neomycin (37.74%) (Fig. 2). Antibiotic resistance pattern of *Salmonella* isolates in the selected broiler breeder farms were resistant to at least 3 out of the 6 classes of antibiotics tested (Table 5).



**Fig. 2.** Antibiotic resistance pattern of the isolated *Salmonella* strains.

**Table 5.** Multi-drug resistance pattern of *Salmonella* isolates in selected broiler breeder farms

Resistance pattern	Number of antibiotics	Number of classes	Number of resistant isolates	% resistant isolates
CT, TE, DO, CN	4	3	1	1.89
CT, TE, N, DO, CRO	5	4	1	1.89
CIP, ENR, CT, TE, DO	5	3	1	1.89
ENR, CT, TE, AML, DO, C	6	5	1	1.89
ENR, CT, TE, AML, DO, CN	6	5	1	1.89
CIP, CT, TE, AML, DO, C, CN	7	6	2	3.77
CT, TE, AML, DO, C, CN, CRO	7	5	3	5.67
CIP, ENR, CT, TE, DO, C, CRO	7	5	1	1.89
CT, TE, N, AML, DO, CN, CRO	7	4	1	1.89
CIP, CT, TE, AML, DO, C, CRO	7	6	2	3.77
CIP, ENR, CT, TE, AML, DO, CN	7	5	1	1.89
CIP, ENR, CT, TE, N, AML, DO, C	8	5	1	1.89
CIP, CT, TE, AML, DO, C, CN, CRO	8	6	3	3.77
CIP, ENR, CT, TE, AML, DO, C, CN	8	5	9	17.01
ENR, CT, TE, AML, DO, C, CN, CRO	8	6	2	3.77
CIP, ENR, CT, TE, AML, DO, C, CRO	8	5	3	5.67
CIP, ENR, CT, TE, AML, DO, CN, CRO	8	5	1	1.89
CIP, ENR, CT, TE, N, AML, DO, C, CN	9	6	1	1.89
CIP, ENR, CT, TE, AML, DO, C, CN, CRO	9	6	11	20.79
CIP, ENR, CT, TE, N, AML, DO, CN, CRO	9	5	1	1.89
CIP, ENR, CT, TE, N, AML, DO, C, CN, CRO	10	6	6	11.34

CIP – ciprofloxacin, ENR – enrofloxacin, CT – colistin, TE – tetracycline, N – neomycin, AML – amoxicillin, DO – doxycycline, C – chloramphenicol, CN – gentamicin, CRO – ceftriaxone.

## DISCUSSION

Prevalence of poultry salmonellosis in breeder chickens and hatching eggs are important health concern and sources of environmental contamination and human infection (Onyeke & Bahman, 2025). In the present study, the prevalence of *Salmonella* recorded in these localities suggest continuous spread which is aided by lack of adequate regulation and strict enforcement of laws on certified poultry (particularly breeders) and poultry products, poor rodent and reptile control programmes in many broiler breeder farms with confirmation of the presence of wild birds in the farm premises. Most of the workers in the broiler breeder farms are not provided with personal protective equipment. This might indicate a possible risk of exposure of workers to zoonotic agents and other related health hazards (Assefa, 2025). Although most farms have foot dips and hand washing facilities, and also disinfect and fumigate hatching eggs before transfer, there is need to step up biosecurity of the poultry to prevent possible outbreak. Provision of adequate farm sanitation, rodent and reptile control will aid prevention of horizontal transmission of *Salmonella* in the broiler breeder farms. Poor knowledge of occupational and non-occupational exposures of poultry workers to zoonotic infection implies high risk of work related hazards especially with infectious agents. There is need for awareness and education on various types of exposure to zoonotic diseases. The worse socio-demographic status of several poultry workers influence the spread of *Salmonella* in poultry production particularly the farm size, flock age, and the battery cage management system being popularly used in several breeders farms.

Highly prevalent *Salmonella* strains including *Salmonella* Gallinarum and *Sal-*

*monella* Pullorum are host adapted (poultry) and are of serious economic importance (Akter *et al.*, 2025). *Salmonella* enterica serovar Gallinarum biovar Pullorum is recognised worldwide, but is still important in flocks in developing countries (Azam *et al.*, 2025). Similarly, *Salmonella* Gallinarum was previously reported in Nigeria, and was responsible for outbreaks of fowl typhoid (Sann *et al.*, 2022; Aliyu *et al.*, 2024), with serious economic significance (Gonçalves *et al.*, 2025). Despite vaccination against *Salmonella* with live *Salmonella* Gallinarum 9R (SG9R) strain, and a combination of killed *Salmonella* Enteritidis and *Salmonella* Typhimurium (SE + ST) vaccines in most farms, there are reported prevalence rates in few farms (Joaquim *et al.*, 2024). Previous studies have shown that vaccination against *Salmonella* reduce both horizontal and vertical transmission of *Salmonellae* in breeders (Isah *et al.*, 2024). There is limited cross protection between serotypes belonging to different subgroups (Onyeke & Bahman, 2025) although there is a higher prevalence of *Salmonella* in caecal droppings compared to cloacal swabs. *Salmonella* has an affinity to invade the epithelial cells throughout the intestinal tract, ceca and ileocaecal junction leading to caecal colonisation and excretion (Deng & Wang, 2024). Faecal excretion of *Salmonella* is intermittent, and the main site of colonisation for *Salmonella* within the intestines of chicken is the caecum, which allows caeca to act as blind sacs with low content flow rate (Acharya, 2017). Adhesion of *Salmonella* to the caecal wall serves as a source of continuous contamination of fresh materials coming into the caecum after intermittent ejection of stale caecal content (Wagner & Hensel, 2011; Tan *et al.*, 2016). Most infected adult birds excrete

*Salmonella* for a variable period of time, but some become lifelong carriers and higher titres in the caecum and bursa of Fabricius of infected chickens persist longer (Wigley, 2024).

The threat of antimicrobial resistance is growing at an alarming pace, perhaps more rapidly in poultry (Salam *et al.*, 2023). The observed multiple drug resistance to more than three of the six classes of the antimicrobial agents mostly tetracycline, colistin and fluoroquinolones, is a significant indication of persistent dissemination of resistant *Salmonella* strains that enhance mortality and limited therapeutic options. The resistance to fluoroquinolones is a health concern given to possible outbreak of resistant *Salmonella* infection with little or no choice for broad spectrum antibiotics. The percentage resistance to tetracycline observed in this study is higher than in previously reported studies in southwest Nigeria (Sati *et al.*, 2024; Adetunji *et al.*, 2025; Souillard *et al.*, 2025), showing an increasing resistance rates within the same geographical location. High resistance to enrofloxacin, tetracycline, amoxicillin, colistin and gentamicin which are commonly used antibiotic in the study area (Suswati *et al.*, 2025), could have resulted from the indiscriminate use in poultry production for treatment and prophylaxis (Kumar *et al.*, 2019). The observed multi-drug resistant *Salmonella* showed that poultry could be a major reservoir for resistant strains with high transmission potential to humans. This calls for antibiotic regulation in broiler breeder farms and proper guide in administration for therapy or prophylaxis. Transfer of day old chicks and poultry products from and into southwest Nigeria and other parts of the country require adequate microbiological monitoring. Adequate and periodic monitoring of anti-

microbial resistance trend in broiler breeder farms and hatcheries are necessary to inform public policy regarding the appropriate use of antimicrobial agents in poultry.

The observed poor hygiene practice and inadequate safety items (including specific protective clothing and foot wear) for many workers enhance low level biosecurity and cross contamination of poultry products. Some identified resistant *Salmonella* strains from surveyed breeder farms could have emanated from poor biosecurity either through transportation of *Salmonella*-contaminated eggs or day-old-chick from breeder farms (Zamil *et al.*, 2021; Souillard *et al.*, 2025). Periodic training and awareness on *Salmonella* dissemination among farmers and importance of biosecurity are needed to reduce the spread of resistant *Salmonella* infection and improve profitability. Spread of AMR-*Salmonella* in breeder farms is a major health concern as it affect productivity but detecting resistant strains is important for managing possible *Salmonella* outbreaks and guiding the development of effective prevention strategies.

## CONCLUSIONS

Socio-demography of several poultry farmers, poor understanding of AMR and low level biosecurity compliance are factor that could aid spread of resistant *Salmonella* strains. Prevalence of *Salmonella* subsp.1, *Salmonella* Galinarum, *Salmonella* Pullorum and *Salmonella* Arizonae 3A in caecal droppings and cloacal swabs serve as reservoir for horizontal and vertical infection transfer and possible outbreak. Regular biosecurity assessments and enforcement of compliance in breeder farms would reduce spread of resistant *Salmonella* in poultry products and risk to

the health of poultry workers and potential consumers. Therefore, biosecurity practices in broiler breeder farms and hatcheries should be improved for effective control and prevention of salmonellosis.

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