Research Article

Occurrence of Antimicrobial-Resistant *Campylobacter* Species from Small Ruminants in Gwagwalada Area Council of Federal Capital Territory–Nigeria: A potential Zoonosis

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Abstract | Campylobacter species have been recognized as bacteria pathogens with considerable zoonotic potentials. This study was undertaken to determine the prevalence and antimicrobial susceptibility profile of Campylobacter species from rectal swabs of small ruminants in Gwagwalada Area Council of FCT, Abuja Nigeria. A total of 100 samples were collected from sheep (n = 50) and goats (n = 50) from September to October 2024. Campylobacter species were isolated using Campy blood-free selective agar (Oxoid, UK), incorporated with CCDR selective supplement SR155 (Oxoid, UK) and phenotypically characterized based on Gram staining and standard biochemical methods. Antimicrobial susceptibility of isolates was evaluated against 10 antimicrobial agents using the Kirby-Bauer disc diffusion method and in accordance with Clinical and Laboratory Standard Institute. Of the 100 samples analyzed, 67 were positive for Campylobacter species giving an overall prevalence of 67 %. The isolation rate was higher in goats with 38 % prevalence than in sheep having 29 % prevalence. The AST results showed susceptibility of Campylobacter isolates to Ofloxacin (100 %) and Ciprofloxacin (87 %) but completely resistant to Amoxicillin, Augmentin, Gentamicin, Chloramphenicol and Streptomycin. This study documents the occurrence of multidrug-resistant Campylobacter specie from small ruminants in the study area, an important foodborne pathogen. The findings of this study underscore the importance of surveillance and periodic antimicrobial susceptibility of zoonotic bacteria for effective monitoring of antimicrobial resistance in food animals.

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Introduction

Within the family *Campylobacteraceae*, the genus *Campylobacter* is a curved slender-shaped, micro-aerophilic Gram-negative bacteria found in the alimentary and reproductive tracts of animals and humans. There are 39 species and 16 subspecies of the genus *Campylobacter*, only few are pathogenic and clinically significant based on their ability to grow between 42 to 45°C temperature (Lynch, 2022). *Campylobacter* species are emerging zoonotic bacteria pathogens incriminated in several cases of foodborne infections, with an estimated 96 million cases of foodborne illness annually (Choudhary *et al*., 2024). Foodborne pathogens, such as Campylobacter, pose a significant public health concern worldwide, causing illnesses ranging from mild gastrointestinal discomfort to severe disease and death (Asmat and Khan, 2020). Substantial economic considerations are attached to the global burden of Campylobacteriosis, (Kaakoush *et al*., 2015).

Ruminants and chickens are the major food-animals in Nigeria (Echioda-Ogbole *et al*., 2025). These food-animals have been reported to be the major cause of bacterial foodborne illness (Del Collo *et al*., 2017). Studies by Wagenaar *et al*. (2023) reported sheep as major reservoirs of diverse *Campylobacter* species, they shed the organism in their feaces into the environment, thus contaminating the environment. *Campylobacter* can be transmitted mainly though the fecal-oral route (Hansson *et al*., 2018), and through direct contacts between humans and colonized animals (Kaakoush *et al*., 2015; Westermark, 2016). The close contact between humans and domestic animals facilitates the zoonotic transmission of various pathogens including Campylobacter (Acke, 2018).

Campylobacter fetus subsp *venerealis* (*cfv*) and C. *fetus* subsp *fetus* (*cff*) are the major veterinary pathogens, associated with reproductive issues such as abortion, stillbirth, and infertility in ruminants (Wheelhouse *et al*., 2018), adenomitis in swine, gastroenteritis and abortion in dogs (Adak *et al*., 2005). The main sources of human *Campylobacter* infections have been reported to be undercooked meat, especially chicken flesh, caused by human enteric *Campylobacter* species such as *C. coli, C. jejuni , C. jejuni subsp jejuni (Cjj), C. jejuni subsp doyley (Cjd) and C.fetus* (Sibanda *et al*., 2018). *C. jejuni* is the most pathogenic Campylobacter specie for humans (Ugarte-Ruiz *et al*., 2016). *Campylobacter*iosis usually results in gastrointestinal symptoms such as fever, nausea, vomiting, abdominal pain, and acute diarrhea, which may be bloody (Allos *et al*., 2011). The illness typically goes away in a week, severe cases can result in extra-gastrointestinal complications like reactive arthritis, Guillain-Barré syndrome, an autoimmune disorder that affects the nervous system (Scallan *et al* 2015), sequelae and Miller-Fisher syndrome (Skarp *et al*., 2016).

Diagnosis of campylobacteriosis is based on cultural isolation and identification of the Gram negative, slender, spirally curved (0.2–0.8 μm × 0.5–5 μm) bacteria in stool/ fecal samples of infected individuals and animals using selective media such as Campy blood free selective agar, CHROMagar™ Campylobacter, modified charcoal cefoperazone deoxycholate agar, campy-Line agar (CLA), Blood Agar with Skirrow's Supplement, and campy-cefex agar (CCA), as well as other culture media that can support the growth of the micro-aerophilic organism. Molecular techniques are better alternatives with high throughputs (Soto-Beltra etal., 2023). Currently, there are no other better treatment alternatives for campylobacteriosis other than antibiotics, however, Campylobacter isolates from both animals and humans are reported to becoming increasingly resistant to clinically important antimicrobials over the years (Shen *et al*., 2018). Antimicrobial resistance in animals could be attributed to both misuse and environmental exposure to antimicrobial agents. This study was undertaken to determine the prevalence and antimicrobial profile of Campylobacter species in small ruminants in Gwagwalada area council of the Federal Capital Territory, Nigeria.

Materials and Methods

Study area

Gwagwalada is one of the six Area Councils of the Federal Capital Territory (FCT) of Nigeria, alongside Kwali, Kuje, Bwari, Abaji and Abuja Municipal Area Council. Gwagwalada is on the geographical coordinates of 8 degrees 56'29 North 7 degrees 5'31 East, located approximately 40 kilometers Southwest of Abuja, the Capital City of Nigeria. Gwagwalada area council has several wards and villages including Gwagwalada town, Tungan-Maje, Anagada, Tipper garage, Zuba, Dobi and Iku.

Sample collection and handling

Sterile swab sticks were used to randomly collect rectal swabs from goats (n = 50) and sheep (n = 50) in three livestock markets namely Tungan-Maje, Anagada and Tipper garage within Gwagwalada area council of the Federal Capital territory from September to October 2025. All samples collected were placed in a flask with cold ice packs and immediately transported to the Department of Veterinary Microbiology laboratory, Faculty of Veterinary Medicine, University of Abuja for processing.

Isolation and identification of campylobacter species

Campylobacter blood-free selective agar (Oxoid, Basingstoke, Hampshire, UK) was prepared according to manufacturers' instructions. The CCDA Selective Supplement SR155 (Oxoid, Basingstoke, Hampshire, UK) was added for selective isolation of *Campylobacter* species. Each sample collected were analyzed individually by direct plating on the prepared plates of the *Campylobacter* blood-free selective agar supplemented with CCDA Selective Supplement SR155. All inoculated plates were placed in an anaerobic gas jar with the lid properly closed, and then transferred into the incubator for incubation at 42°C for 24-48 hrs. Following incubation, the plates were examined for typical colonies of *Campylobacter* which appeared as flat, smooth, glossy and grayish colonies as described by Teufel (2002). Distinct colonies were then sub cultured on prepared plates of Nutrient agar (Oxoid, Basingstoke, Hampshire, UK), incubated at 37 °C for 18-24 hours. Afterwards, presumptive isolates were characterized phenotypically based on microscopic appearance of Gram negative, short, curved-slender rods with single polar flagellum. and standard biochemical characterizations as described by Cheesbrough (2016).

Antibiotic susceptibility testing

Antibiotic susceptibility testing of isolates was determined using the Kirby-Bauer disc diffusion method and in accordance with the Clinical Laboratory Standard Institute (CLSI, 2018) guidelines. The antibiotics agents evaluated include: Chloramphenicol (30 µg), Amoxicillin (30 µg), Augmentin (10 µg), Gentamicin (30 µg), Septrin (30 µg), Pefloxacin (30 µg), Streptomycin (30 µg), Ciprofloxacin (30 µg), Ofloxacin (10 µg) and Sparfloxacin (10 µg). A transparent ruler was used to measure growth inhibition zone diameters, and the results were interpretated based on the breakpoints for each antimicrobial agents in accordance with the Clinical and Laboratory Standards Institute guidelines (CLSI, 2018).

Results

Of the hundred (100) samples analyzed in this study, 68 samples yielded growth for Campylobacter-on-Campylobacter blood-free selective agar supplemented with CCDA Selective Supplement SR155. Sixty-seven of the isolates were phenotypically confirmed Campylobacter species giving an overall prevalence of 67%. Thirty-eight (38 %) of the isolates were recovered from goats, while 29 were gotten from sheep (Table 1).

Table 1: *Prevalence of Campylobacter isolates based on animal specie.*

Animal species	Number of samples	Number positive	Percentage positive
Sheep	50	29	29
Goats	50	38	38
Total	100	67	67

Anagada had the highest number of isolation rate with 32 %, followed by Gwagwalada with 19 % while Tunga-mage had the least isolation rate of 17 % (Table 2).

Table 2: *Prevalence of Campylobacter based on sampling location.*

Location	Number of samples	Number positive	Percentage positive (%)
Anagada	60	31	31
Tungan-maje	20	17	17
Gwagwalada	20	19	19
Total	100	67	67

The result of the antibiotic susceptibility testing showed that the Campylobacter isolates in this study were only sensitive to Ofloxacin (100 %) and Ciprofloxacin (87 %) but completely resistant to Amoxicillin, Augmentin, Gentamicin and Streptomycin as shown in Figure 1.

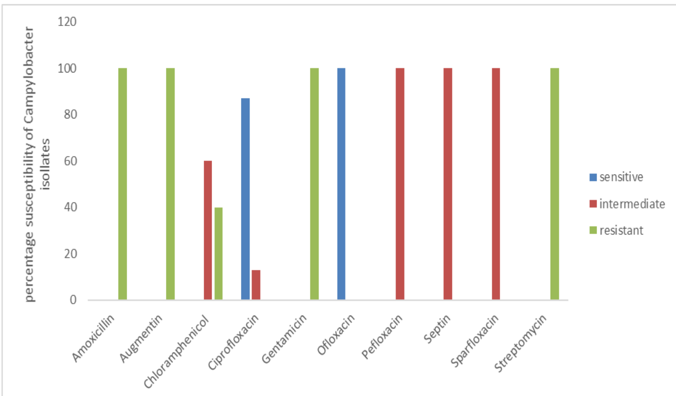

Figure 1: *Animicrpbial susceptibility of campylobacter isolates from sheep and goats.*

Discussion

Previously known as pathogen of animals, the organism Campylobacter has gain interest in recent years due to its zoonotic importance as a human enteric pathogen, considered as one of the most common cause of bacteria foodborne illnesses globally. The high prevalence of Campylobacter species recorded in sheep and goats in this study underscore the significance of small ruminants as reservoirs of the organism and potential sources of Campylobacter to humans considering the close contact shared, which can facilitate the transmission and increase colonization by Campylobacter species (Chen *et al*., 2021). The 67 5% prevalence recorded in this study is higher than the 20.1 % and 34 % reported by Salihu *et al*. (2014) and a Mpalang *et al*. (2014), but similar to previous reports (Ngulukun *et al*., 2011; Lazou *et al*., 2014; Olabode *et al*., 2017), thus accentuating small ruminants as reservoirs of the zoonotic bacteria. The isolation rate of Campylobacter in this study differs in the three different locations, with Anagada having the highest prevalence of 31%. This is consistent with previous studies, which reported varying isolation rates in different locations, which could be attributed to variation in sample size and age of the animals sampled (Altekuese *et al*., 2016).

The antimicrobial susceptibility of Campylobacter from sheep and goats in this study indicates that ofloxacin and ciprofloxacin are the most effective drugs against isolates in this study. The high susceptibility to fluoroquinolone is noteworthy, which showed that the animals are not exposed to the agents. Fluoroquinolone is one of the antibiotic classes indicated for the treatment of Campylobacter infections, the antibiotic inhibits the bacteria DNA by targeting DNA gyrase enzyme and topoisomerase IV (Hooper and Jacoby, 2016). Isolates in this study were found to be highly resistant to most of the antimicrobial agents tested, and this could be attributed to direct exposure of the animals to the antimicrobial agents or indirectly acquired from the environment during grazing. Antibiotic resistance in *Campylobacter* has become a significant public health concern. Overuse of antibiotics either for treatment or prophylaxis in both human and veterinary medicine has contributed to the increase trend in antimicrobial resistance (Shen *et al*., 2018). Several reports have shown that *Campylobacter* species have the ability to survive and thrive in the presence of an antimicrobial agents which they were once susceptible to due to diverse mechanisms of resistance such as point mutations, efflux pumps and the acquisition of resistance genes through horizontal gene transfer. For instance, point mutations in target genes such as gyrA contribute to fluoroquinolone resistance and 23S rRNA confers macrolide resistance (Hooper and Jacoby, 2016). While efflux pumps permit the efflux of antibiotic agents from bacterial cells therefore reducing intracellular drug concentrations and preventing access of the drug to target sites thus leading to resistance (Gaurav *et al*., 2024). The coexistence between humans and small ruminants can also facilitate the transfer of resistance genes by mobile genetic elements such as plasmids and phages. The phenotypic resistance exhibited by the isolates in this study was not confirmed genotypically, as financial constraint could not permit molecular characterization of the isolates in this study.

Conclusion

This study reports high prevalence of Campylobacter species in small ruminants which underscore sheep and goats as reservoirs and potential source of Campylobacter to humans. The occurrence of antimicrobial resistant Campylobacter species in sheep and goats is of great public concerned considering the close contact that exist between humans and ruminants.

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Author's Contribution

MEO: Conceptualization, methodology, investigation, formal analysis and writing of manuscript.
JAA, SM, OHKO: Supervision.
BMJ, OH, ICC: Methodology.
KA: Investigation.

Generative AI and AI-assisted technology statement
The authors declare that no Genrative AI was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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