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Environmental and Behavioral Drivers of Bacterial Contamination in Smoked Bushmeat from Southwestern Nigeria: Implications for Food Safety and Public Health

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Abstract

Bushmeat, especially smoked bushmeat, plays a vital role in food security and livelihoods across Africa, including Nigeria, due to its affordability, cultural significance, and extended shelf life. However, the trade and consumption of bushmeat raise significant public health concerns. This study assessed bacterial contamination and vendor hygiene practices associated with smoked bushmeat sold in selected markets of Southwestern Nigeria. Samples of smoked carcasses of Grasscutter (*Thryonomys swinderianus)* and Maxwelli Duiker (*Philantomba maxwellii*) were analyzed for bacterial load, species diversity, and antibiotic susceptibility profiles to quantify microbial contamination and characterize potential public health risks. Concurrently, knowledge, attitudes, and hygiene practices of bushmeat vendors were evaluated to identify behavioral and environmental contributors to contamination. Results revealed significant bacterial loads, with *Escherichia coli* 24 (22.2%) being the predominant organism followed by *Klebsiella pneumoniae* 18 (16.7%) and *Staphylococcus aureus* 17 (15.7%), while *Salmonella spp*. 2 (1.9%) was the least occurring. All bacterial isolates exhibited multidrug resistance. Despite vendors' good knowledge (78.7%) and positive attitudes (69.4%) towards food safety, hygiene practices were predominantly poor (66.7%), characterized by inadequate utensil sanitation, unsafe processing and handling of bushmeat for sale, and absence of effective environmental health monitoring. These findings expose a critical gap between awareness and practice, compounded by unsanitary market conditions that facilitated microbial contamination. The study emphasizes the need for integrated interventions targeting microbial hazards and behavioral factors to improve food safety and public health outcomes. This work links microbiological data with environmental and behavioral insights, offering a comprehensive perspective on bushmeat safety, providing evidence for effective risk assessment and control strategies.

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Keywords: Bushmeat safety, vendor practices, multidrug resistance, bacterial contamination and public health risk.

1. Introduction

Bushmeat refers to the meat of wild, non-domesticated animals and continues to serve as a vital protein source supporting household nutrition across Sub-Saharan Africa. In Nigeria, it remains popular because of its affordability, cultural relevance, and extended shelf life (Ogunjinmi *et al.*, 2022). Many consumers perceive it as a healthier, more natural alternative to farmed meat, a belief deeply embedded in traditional food practices. The trade and consumption of bushmeat have expanded from rural origins to urban centres, increasing both its economic importance and public health significance. Despite its nutritional benefits, bushmeat processing and sale pose serious food safety concerns.

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These practices are often linked with foodborne diseases and zoonotic infections capable of affecting handlers and consumers alike (van Vliet *et al.,* 2022; Muhinda *et al.,* 2025). Studies have repeatedly detected pathogenic and multidrug-resistant bacteria, including *Escherichia coli*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*, in smoked bushmeat from Nigerian markets, underscoring a notable risk to consumer safety (Abdulahi *et al.,* 2020; Olodu and Olisaka, 2025). While some vendors demonstrate awareness of food safety guidelines, this knowledge rarely translates into consistent hygienic practices. Poor sanitation, ineffective waste disposal, and insufficient regulatory monitoring are typical in many markets, promoting microbial contamination (Ovuru *et al.,* 2024). These risks are compounded by the rising prevalence of antimicrobial resistance among foodborne pathogens, which complicates treatment and amplifies health hazards (Ezechukwu *et al.,* 2024). Bushmeat markets are now recognized as potential hotspots for emerging infectious diseases (Friant *et al.,* 2020). The World Health Organization has linked zoonotic outbreaks such as Ebola and COVID-19 to wildlife handling and trade (Dharmarajan *et al.,* 2022). Given these threats, understanding the environmental and behavioral factors driving bacterial contamination in bushmeat markets is essential for designing preventive interventions that safeguard vendors and consumers.

This study aims to examine the environmental and behavioral influences on bacterial contamination in smoked bushmeat sold in Southwestern Nigeria and assess their implications for food safety and public health. The specific objectives are to: identify bacterial species contaminating bushmeat, determine their antibiotic resistance profiles, and evaluate vendors' knowledge, attitudes, and hygiene practices contributing to microbial contamination.

2. Materials and Method

2.1. *Study Area*

The research was carried out in three major markets in Southwestern Nigeria, each recognized for active bushmeat trade. These locations serve as primary distribution points within urban supply networks that provide bushmeat to diverse consumers (Figure 1).

2.2. *Study Design*

A cross-sectional descriptive approach was used to evaluate bacterial contamination, antimicrobial resistance profiles, and vendor hygiene behavior that may influence contamination levels.

2.3. *Sample Collection*

Samples of smoked carcasses of Grasscutter (*Thryonomys swinderianus)* and Maxwelli Duiker (*Philantomba maxwellii*) were aseptically obtained from various vendors across markets using a factorial sampling design, resulting in 108 samples. Each sample was stored in sterile containers and promptly transported to the laboratory for analysis.

2.4. *Microbiological Analysis*

Samples were processed according to standard microbiological techniques. Bacteria were cultured on selective and differential media such as MacConkey, Eosin Methylene Blue, Salmonella-Shigella, and Mannitol Salt agar. Incubation was performed at 37°C for 24–48 hours. Colonies with distinct morphological characteristics were purified and subjected to Gram staining and biochemical tests for identification. Bacterial load was determined using the pour plate method.

2.5. *Antibiotic Susceptibility Testing*

Antibiotic resistance was assessed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar following Clinical and Laboratory Standards Institute (CLSI) protocols. The antibiotics tested included Augmentin, Ofloxacin, Gentamycin, Cefuroxime, Cefixime, Ceftazidime, and Ceftriaxone. Following incubation, inhibition zones were measured (mm) and interpreted as sensitive, intermediate, or resistant according to CLSI criteria.

2.6. Survey of Bushmeat Vendors

A structured questionnaire was administered to vendors in the study markets to assess their food safety knowledge, attitudes, and hygiene practices. The survey covered demographics, food handling training, personal hygiene, sanitation access, and risk perceptions regarding bacterial contamination. Responses complemented microbiological findings by revealing behavioral and environmental drivers of bushmeat safety.

2.7. Grading and Scoring System

A structured scoring system was used to assess their knowledge, attitudes, and hygiene practices related to food safety (Muhinda *et al.,* 2025). Knowledge was assessed through questions pertaining to vendors understanding of health risks and

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microbial quality in bushmeat. Each correct response was assigned 3 points, incorrect response 2 points, and an indecisive response 1 point. The total score was obtained by summing all responses, with a maximum attainable score of 18 points (100%). Cumulative scores were categorized as follows: good knowledge (13–18 points) and poor knowledge (0–12 points). Attitudes were assessed using a similar approach, where each positive attitude received 3 points, a negative attitude received 2 points, and an indecisive attitude received 1 point. The maximum possible score was 15 points (100%). Vendors scoring 11–15 points were classified as having a positive attitude, while those scoring 0–10 points were considered to have a negative attitude. Practices were assessed based on adherence to safe handling and hygiene procedures during bushmeat processing. Each correct or hygienic practice was awarded 1 point, while an incorrect or unsafe practice received 0 points. The maximum practice score was 16 points, with scores ranging from 0–9 points categorized as poor practice and higher scores indicating better hygiene performance.

2.8. *Data Analysis*

SPSS Version-21 software was used for data analysis. Descriptive statistics was used to describe different characteristics of study participants as appropriate. Inferential statistics was used to determine associations between variables. Level of significance was set at 5% ($p<0.05$).

2.9. *Ethical Considerations*

Participants were fully informed of the study purpose, and verbal consent was obtained prior to participation. Data confidentiality was maintained, and participation was voluntary.

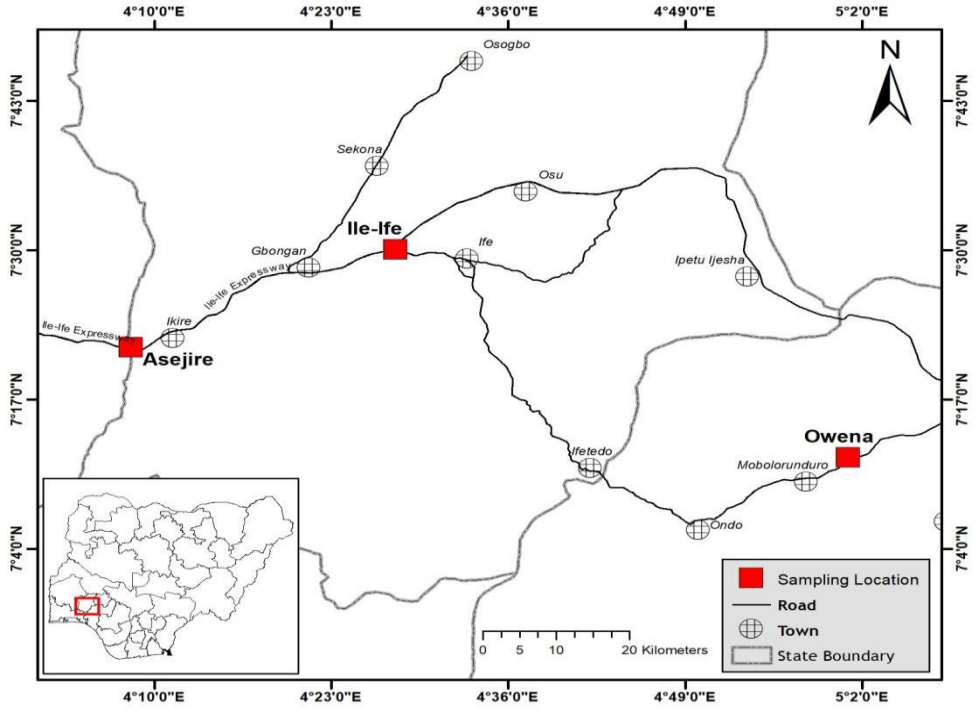


Figure 1: Map of the Study Area

3. Results and Discussion

3.1. *Prevalence of Bacterial Isolates*

A total of 108 bacterial isolates were recovered from smoked bushmeat samples. Table 1 presents the distribution of the isolates by bacterial species. *Escherichia coli* was most frequent (22.2%), followed by *Klebsiella pneumoniae* (16.7%) and *Staphylococcus aureus* (15.7%). Others included *Proteus mirabilis*, *Bacillus spp.*, *Proteus vulgaris*, *Citrobacter freundii*, *Enterobacter aerogenes*, and *Salmonella spp.* The predominance of *E. coli* aligns with earlier findings describing it as a fecal contamination indicator and a leading cause of foodborne disease in meat (Odo *et al.*, 2021;

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Bashiru *et al.*, 2022). Its presence suggests inadequate hygiene during processing and exposure of meat to contaminated water, tools, or handlers. The presence of *K. pneumoniae* and *S. aureus* underscores significant public health risk due to their infection potential and resistance traits (Ifedinezi *et al.*, 2024; Pal *et al.*, 2020). *Proteus* and *Bacillus* species point to environmental contamination during handling and display (Amposah *et al.*, 2024; Katani *et al.*, 2021). These bacteria can persist in soil, dust, and contaminated surfaces, thereby increasing the likelihood of cross-contamination. Although less common, *C. freundii*, *E. aerogenes*, and *Salmonella spp.* remain of concern as established foodborne pathogens (Abebe *et al.*, 2020). Overall, findings highlight hygiene deficiencies within the meat chain and emphasize the need for stricter inspection and sanitation enforcement to reduce microbial hazards.

Table 1: Percentage Distribution of the Isolated Bacteria

Isolated Bacteria	Frequency (n)	Percentage (%)
Escherichia coli	24	22.2
Klebsiella pneumoniae	18	16.7
Staphylococcus aureus	17	15.7
Proteus mirabilis	14	13.0
Bacillus spp	13	12.0
Proteus vulgaris	9	8.3
Citrobacter freudii	7	6.5
Enterobacter aerogena	2	3.7
Salmonella spp	4	1.9
Total	108	100

Escherichia coli (22.2%) had the highest number of isolates from bushmeat sampled, while *Salmonella spp* had the least 1.9%.

3.2. *Mean Bacterial Count Across Markets*

Mean bacterial counts from the three markets— Ife, Asejire, and Owena as presented in Figure 2 showed that Ife had the highest bacterial load (12.80 cfu/g), followed by Asejire (8.51 cfu/g), and Owena the lowest (7.70 cfu/g). Elevated counts in Ife may stem from poor sanitation, overcrowding, and waste accumulation that promote microbial growth (Ovuru *et al.*, 2024). Markets with inadequate drainage and limited clean water access often harbour bacteria due to organic waste build-up (Uzoho, 2024). On the other hand, the lower counts in Owena may reflect better hygiene and management practices (Olatunji *et al.*, 2023). This pattern reinforces the role of environmental cleanliness in minimizing contamination, consistent with prior studies noting higher bacterial loads in open markets exposed to dust, flies, and frequent handling (Igbinosa *et al.*, 2024; Ugbo *et al.*, 2017).

3.3. *Antibiotic Resistance Profiles of Bacterial Isolates*

Resistance to Augmentin (85–100%) and Gentamycin (56–79%) was widespread among isolates (Table 2). Ceftriaxone and Cefuroxime resistance varied but reached 75% in some cases. Ofloxacin showed the least resistance (24%), while Ciprofloxacin and Nitrofurantoin showed moderate levels. *S. aureus* isolates were fully resistant to Erythromycin (100%) and highly resistant to Clarithromycin (82%). The widespread resistance to multiple antibiotics suggests possible public health implications, as resistant bacteria can be transmitted through the food chain (Ifedineze *et al.*, 2020). Variation in resistance levels among bacterial species may be attributed to both intrinsic and acquired mechanisms, reflecting the complexity of antimicrobial resistance (Belay *et al.*, 2024). Although fluoroquinolones such as Ofloxacin and Ciprofloxacin still show relatively low resistance, increasing global reports of reduced susceptibility underscore the need for ongoing surveillance and prudent antibiotic use (Thakur *et al.*, 2025). Resistance to critical drugs like Ceftriaxone, often used in severe infections, further narrows treatment options and represents a growing therapeutic challenge (Tewabe *et al.*, 2021). The complete resistance of *S. aureus* to macrolides reinforces the urgency of implementing effective antimicrobial stewardship strategies.

3.4. *Socio-Demographic Characteristics of Bushmeat Vendors*

Table 3 presents the socio-demographic characteristics of bushmeat vendors involved in this study. The largest proportion of vendors were aged 30–39 years (42.6%), followed by those within 40–49 years (30.6%). About 19.4% fell within the 20–29 years group, while 7.4% were aged 50–59 years. Most vendors were married (82.4%), with smaller percentages

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being separated (8.3%), single (6.5%), or divorced (2.8%). All vendors had some level of formal education; 60.2% completed secondary school, 28.7% attained post-secondary education, and 11.1% had only primary education. Females constituted the majority (79.6%), while males accounted for 20.4%.

Table 2: Antibiotic Resistance Profiles of Bacterial Isolates

Antibiotic	*E. Coli* (n=24)	*Klebsiella pneumoniae* (n=19)	*Citrobacter freundii* (n=7)	*Enterobacter aerogenes* (N=4)	*Salmonella spp.* (n=2)	*Proteus vulgaris* (n=9)	*Proteus mirabilis* (n=14)	*Staphylococcus aureus* (n=17)	Overall Resistance (%)
Ofloxacin	41.7	0	0	25	0	55.6	35.7	11.8	24.2
Augmentin	95.8	100	100	100	100	88.9	85.7	94.1	94.7
Ceftazidime	25	77.8	71.4	25	50	44.4	28.6	76.4	50.5
Ceftriaxone	62.5	50	71.4	25	0	44.4	57.1	16	60
Gentamicin	66.7	55.6	57.1	75	100	77.8	78.6	70.6	68.4
Nitrofurantoin	45.8	66.7	28.6	50	0	55.6	64.3	-	52.5
Ciprofloxacin	8.3	72.2	14.3	75	50	55.6	28.6	-	53.8
Cefuroxime	41.7	44.4	85.7	75	0	33.3	57.1	-	50
Ceftriaxone	-	-	-	-	-	-	-	70.6	70.6
Erythromycin	-	-	-	-	-	-	-	100	100
Clarithromycin	-	-	-	-	-	-	-	82.4	82.4

Table 3: Socio-Dermoghraphic Characteristics of Bushmeat Vendors

Variable	Frequency	Percentage
Age		
20-29	21	19.4
30-39	46	42.6
40-49	33	30.6
50-59	8	7.4
Marital Status		
Single	7	6.5
Married	89	82.4
Separated	9	8.3
Divorced	3	2.8
Education		
None	0	0
Primary	12	11.1
Secondary	65	60.2
Postsecondary	31	28.7
Sex		
Male	22	20.4
Female	86	79.6
Total	108	100

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This demographic composition suggests that middle-aged women in their reproductive stage dominate the bushmeat trade and forms the active labour force. This is consistent with prior studies where middle-aged adults dominated informal trade activities (Ojo *et al.*, 2025). The high number of married vendors may indicate social stability that influences occupational health and safety awareness.

3.5. *Vendors' Knowledge of Health Risks and Microbial Contamination of Bushmeat*

Table 4 shows that most vendors (74.1%) were unaware that bushmeat could transmit diseases during hunting, processing, or consumption, while 22.2% were aware and 3.7% were unsure. However, 68.5% had received information on foodborne infections, and 62.0% were informed about preventive measures against bacterial contamination. Regarding hygiene, 67.6% agreed that an unclean environment reduces meat quality, 50.9% recognized the effect of handling materials, and only 41.7% reported the presence of Environmental Health Officers (*Wole wole*) in their area. Overall, vendors demonstrated good knowledge levels (Figure. 3). Although many had been exposed to public health information, awareness of zoonotic transmission remained low. Similar trends were reported among bushmeat traders in Nigeria (Ozioko *et al.*, 2018; Muhinda *et al.*, 2025). Limited knowledge may encourage unsafe practices that foster diseases such as Lassa fever and Ebola. The moderate awareness of hygiene precautions suggests that existing health education efforts are insufficient to drive behavioral change (Iorfa *et al.*, 2020), while weak regulatory supervision still hampers effective hygiene enforcement.

3.6. *Vendors' Attitude towards Health Risks and Microbial Contamination of Bushmeat*

As presented in Table 5, only 39.8% of bushmeat vendors recognized that certain occupations could expose individuals to zoonotic infections such as Ebola, while 57.4% disagreed and 2.8% were uncertain. Concerning protective materials like gloves and insect repellents, 43.5% acknowledged their importance, whereas 52.8% disagreed and 3.8% were unsure. About one-quarter (25.0%) believed they were more at risk of zoonotic diseases than others, while 69.4% disagreed and 5.6% were uncertain. In terms of health-seeking behavior, 61.1% reported consulting medical personnel when ill due to animal-related infections, compared with 31.5% who did not and 7.4% who were unsure. Only 5.6% were aware that hunting and trading wild game could pose health risks, while 63.9% disagreed and 30.6% had no knowledge of such risks. Overall, the vendors' attitude score was rated as good (Figure 4). These findings point to notable deficiencies in vendors' understanding and perception of zoonotic disease risks. The limited awareness of occupational exposure aligns with previous studies that reported poor zoonotic knowledge in informal bushmeat markets (Ozioko *et al.*, 2018; Muhinda *et al.*, 2025). The inconsistent use of protective materials suggests barriers to behavior change, possibly linked to low awareness, financial limitations, or inadequate health education (Ezeaka and Bartholomew, 2025). Furthermore, the lack of recognition of the dangers associated with hunting and marketing wild game underscores weak risk communication (Alhaji *et al.*, 2022). Collectively, these gaps emphasize the need for targeted public health education and stronger interventions to minimize zoonotic disease transmission among bushmeat handlers.

3.7. *Hygiene Conditions of Bushmeat Vendors*

Table 6 summarizes environmental and behavioral drivers of bacterial contamination of bushmeat. About 69.4% reported that at least one household member had weekly physical contact with bushmeat, while 30.6% did not. Only 7.4% had received hygiene training from Environmental Health Officers (EHOs), though 75.0% indicated that EHOs occasionally inspected their premises. In practice, 77.8% claimed to observe basic hygiene such as washing hands and using clean tools during processing, and 94.4% reported regular handwashing, particularly after using the toilet. However, only 38.9% avoided contact with blood and body fluids, and 32.4% avoided contact with faeces. Most vendors kept utensils clean (83.3%), used clean water for meat preparation (76.9%), and maintained clean transport (63.0%). About 56.5% washed carcasses after evisceration, and 23.1% used separate aprons or cloths during preparation. Although 74.1% displayed meat on clean tables, 88.0% admitted exposure to sunlight and dust. Routine inspection by EHOs was rare (1.9%), and only 23.1% had received any education on zoonotic diseases. Overall, hygiene practices were rated poor (Figure 5). While most vendors practiced basic personal hygiene, overall compliance with sanitary standards remained inadequate.

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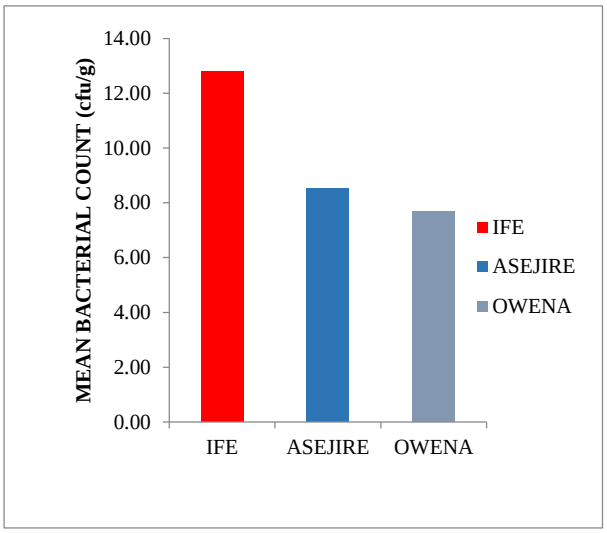


Figure 2: Mean Bacteria Count across Selected Markets

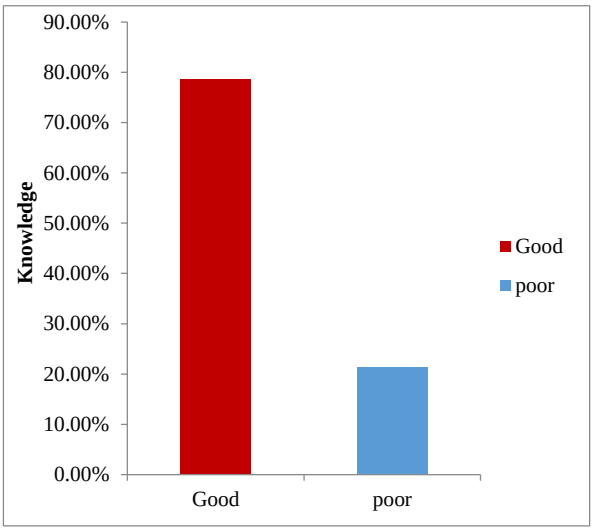


Figure 3: Overall Knowledge of Health Risk and Microbial Quality in Bushmeat

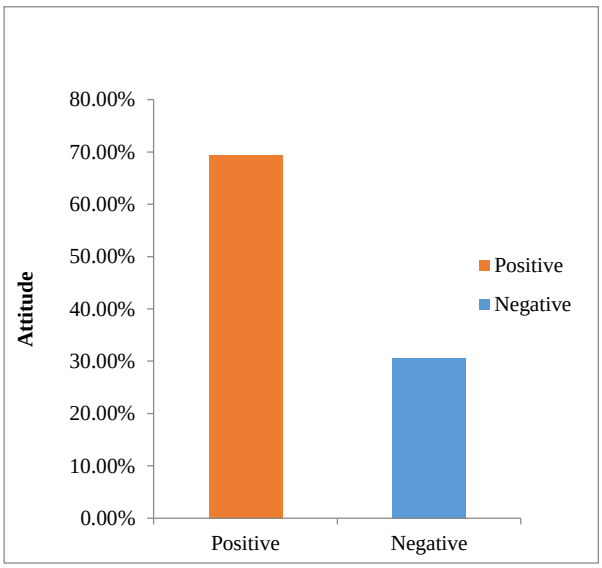


Figure 4: Overall Attitude of Health Risk and Microbial Quality In Bushmeat

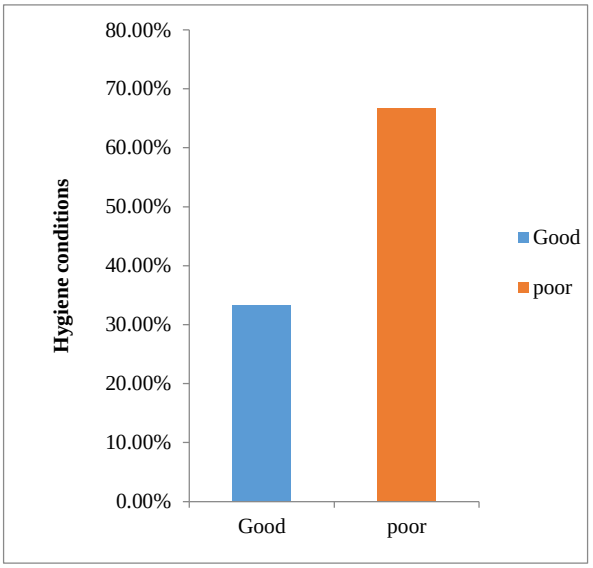


Figure 5: Overall Hygiene Conditions of Bushmeat Vendors

The low proportion (7.4%) who received hygiene training reflects minimal institutional involvement in bushmeat safety education, consistent with earlier reports of weak enforcement and irregular inspections in local markets (Adesokan *et al.*, 2020; Nwoye *et al.*, 2022). Although frequent handwashing was common, critical safety measures—such as avoiding contact with blood and faeces—were poorly observed, exposing vendors to occupational risks. Similar patterns of unsafe practices have been documented among bushmeat handlers in Nigeria and Cameroon (Alhaji *et al.*, 2022; Muhinda et al., 2025).

Exposure of meat to sunlight and dust, and evisceration on bare ground, further indicate poor hygiene, which has been linked to increased bacterial contamination in market meat (van Vliet *et al.*, 2022; Adenuga and Montowka, 2023; Ovuru *et al.*, 2024). The absence of regular inspection and limited public health education by EHOs highlight

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serious gaps in monitoring and control. Strengthening hygiene training, inspection frequency, and enforcement mechanisms is therefore essential to reduce microbial contamination and minimize zoonotic disease risks in the bushmeat trade.

Table 4: Vendors' Knowledge of Health Risk and Microbial Contamination In Bushmeat

Variable	Frequency (n)	Percentage (%)
Animals traded for food can make one sick (hunting, processing and eating of bushmeat)		
Yes	24	22.2
No	80	74.1
Donot know	4	3.7
Received information from any source about food borne diseases that you can get from contamination of bushmeat		
Yes	74	68.5
No	30	27.8
Donot know	4	3.7
Received information on precautions to take with bushmeat to reduce the risk of disease/bacterial contamination		
Yes	67	62.0
No	31	28.7
Donot know	10	9.3
Dirty environment contributes to the quality of meat during handling and processing		
Yes	73	67.6
No	29	26.9
Donot know	6	5.6
Different materials used in meat preparation and handling also contribute to the quality of meat sold.		
Yes	55	50.9
No	50	46.3
Donot know	3	2.8
Environmental health officers (*Wole wole*) are in your area		
Yes	45	41.7
No	54	50.0
Donot know	9	8.3

Table 5: Vendors' Attitude of Health Risk and Microbial Quality in Bushmeat

Variable	Frequency (n)	Percentage (%)
Some certain occupation exposes one to diseases that are transmitted from animals to man e.g. Ebola virus		
Yes	43	39.8
No	62	57.4
Do not know	3	2.8
It is important to use protective materials such as insect repellent, hand gloves and other protective measures		
Yes	47	43.5
No	57	52.8

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Do not know	4	3.8
As a seller of bushmeat, I am not exposed to diseases that are transmitted from animals to man than others		
Yes	27	25.0
No	75	69.4
Do not know	6	5.6
I seek medical advise concerning diseases that are transmitted from animals to man when you are sick		
Yes	66	61.1
No	34	31.5
Do not know	8	7.4
Hunting game in the wild and bringing such to our environment for consumption can pose a health hazard to the environment and consumers.		
Yes	6	5.6
No	69	63.9
Do not know	33	30.6

Table 6: Hygiene Conditions of Bushmeat Vendors

Variable	Frequency (n)	Percentage (%)
Does anyone in your household regularly (at least weekly) have physical contact with bushmeat apart from you		
Yes	75	69.4
No	33	30.6
Have you been trained on hygiene practices on handling and dressing of meat carcass by environmental health officers		
Yes	8	7.4
No	100	92.6
Do environmental health officers come from time to time to inspect the meat, environment in which it is prepared and your personal hygiene?		
Yes	81	75.0
No	27	25.0
Do you take precautionary measures like washing of hands after using the toilet, not coughing or sneezing, using clean materials during processing of bushmeat for sale?		
Yes	84	77.8
No	24	22.2
Frequent hand washing habit especially after using the toilet		
Yes	102	94.4
No	6	5.6
Avoid contact with blood and fluids during processing		
Yes	42	38.9
No	66	61.1
Avoid contact with faeces		
Yes	35	32.4
No	73	67.6
Keep food preparation utensils washed and clean		
Yes	90	83.3
No	18	16.7

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Use clean water for meat preparation		
Yes	83	76.9
No	25	23.1
Use clean means of transportation		
Yes	68	63.0
No	40	37.0
Wash the skin and meat carcass after evisceration		
Yes	61	56.5
No	47	43.4
Do you make use of an isolated cloth or apron or cover cloth for preparing meat?		
Yes	25	23.1
No	83	76.9
Bushmeat is usually displayed on clean tables		
Yes	80	74.1
No	28	25.9
Bushmeat is exposed to sunlight and dust		
Yes	95	88.0
No	13	12.0
Do environmental health officers inspect the bushmeat regularly		
Yes	2	1.9
No	106	98.1
Do environmental health officers educate you or get you aware of diseases that are transmitted from animals to man?		
Yes	25	23.1
No	83	76.9
Do you ensure the freshness of meat		
Yes	84	77.8
No	24	22.2
Which evisceration technique did you carry out?		
Lying on the ground	67	62.0
On a clean table	41	38.0

Table 7: Association between Vendors' Knowledge, Attitude, and Hygiene Practices

		Hygiene		Total	X^2	p-value
		Good	**Poor**			
Knowledge	Good	25	60	85	2.76	0.096
	Poor	11	12	23		
Atittude	Positive	25	50	75	0.78	0.38
	Negative	11	22	33		

3.8. *Association between Knowledge, Attitude, and Hygiene Conditions of Vendors*

The chi-square analysis conducted to assess the association between vendors' knowledge, attitude, and hygiene practices (Table 7) revealed no statistically significant relationships between knowledge and hygiene ($X^2 = 2.76$, $p = 0.096$) or between attitude and hygiene ($X^2 = 0.78$, $p = 0.38$). Despite the evidence that most vendors possessed adequate knowledge and a positive attitude towards safe meat handling, these factors did not correspond with improved hygiene practices.

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This indicates that awareness and favourable perceptions alone may be insufficient to elicit behavioral change. This trend corroborates findings from previous studies among meat handlers and bushmeat trade in Nigeria (Nwoye *et al.*, 2022; Alhaji *et al.*, 2022; Muhinda *et al.*, 2025). Furthermore, it aligns with broader sanitation literature emphasizing the neccessity of enabling environments and regulatory enforcement to effect meaningful improvement in hygiene behaviors (Ezeaka and Bartholomew, 2025).

4.0. Conclusion

Smoked bushmeat samples were contaminated with antibiotic-resistant bacteria, posing significant potential public health risks through food-borne transmission. Poor sanitation, limited awareness, and weak regulatory enforcement contribute to promote microbial contamination and increase the likelihood of zoonotic diseases spread within the bushmeat trade.

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