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A Cross-Sectional Survey of Consumers' Risk Perception and Hygiene of Retail Meat: A Nigerian Study

ABSTRACT

Consumers' perception of food safety risk could influence their food consumption habits. This questionnaire-based (n = 327) cross-sectional study assessed consumers' attitudes about and perception of retail meat risk. Also, the hygiene of meat display tables (n = 105) and retail meat (n = 107) sold to consumers was determined using total aerobic plate count and total coliform count. Most respondents were single (82.6%) and had tertiary educational status (89.3%). Most of the respondents preferred beef (60.9%) over other meat types and made purchases from retailers (71.3%). Overall, the risk perception score on retail meat safety reported by respondents was above average (56%, n = 83), although consumers (53.8%, n = 176) declared that meat consumption is worth the risk. Meat source (χ^2 = 16.65, P = 0.034) and processed meat products (χ^2 = 28.22, P = 0.005) were associated with food safety risk. Respondents opined that meat processors (weighted mean = 3.85%) could influence food safety. The freshness of meat (weighted mean = 2.54%) was the main criterion used by consumers to determine retail meat safety. Sampled meat and meat display tables had high total aerobic counts (>8 log) and total coliform counts (>5 log). These results are indicators of consumers' risk perception and preferences; the observed microbial loads highlight the need for improved hygiene practices associated with meat sold to consumers in Nigeria.

INTRODUCTION

Food safety is an important component of the "farm-to-fork" continuum, the steps by which foods such as meat are produced: from the farm, through primary and secondary processing, and final preparation. Retail meat is produced at the secondary processing step; failure in hygiene at this step could affect consumers' health. Globally, there is a growing concern in tracking and tracing food production along the complete food chain (25). A compromise in any part of the food chain can cause foodborne illnesses that endanger public health through morbidity and mortality, marked economic loss, and reduction in quality of life and productivity (48). In 2010 alone, 31 foodborne hazards

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resulted in 600 million (95% uncertainty interval 420 to 960 million) foodborne illnesses and 420,000 (95% uncertainty interval 310,000 to 600,000) deaths globally, with a higher burden observed among persons in the world's low-income territories (26, 48). Meat in its raw form is shelf unstable because it is rich in several nutrients that promote microbial growth (51). Nonadherence to standard hygiene protocols, improper processing and storage of meat, poor modes of transportation, and poor methods of meat sales have important safety implications for retail meat. Undoubtedly, raw meats can transmit pathogens carried by food animals slaughtered for consumption. Foodborne illnesses are usually underreported, especially in developing countries where the trace-back mechanism is extremely poor. Beef sold through retail channels in developing countries such as Nigeria suffers significant physical handling and contact with numerous pathogens (46). Biological contamination of meat, especially by pathogenic bacteria, is the main cause of foodborne diseases (48). This results in immediate consumer and public health burdens of varying degrees of severity and sometimes leads to chronic disease (43).

Consumer risk perception of meat safety reflects the uncertainty a consumer has when purchasing a particular product. Consumers' ethical concerns and preferences for certain food products and production methods can affect risk perceptions and impact their choice of products (42). Also, consumer food safety risk perception is an essential indicator of the food quality management system (38). Risk perception may vary among individuals because it is guided by an array of important considerations, for example, culture, traditions, customs, taste, nutrition, product attributes, safety, and price. These play significant roles and are crucial determinants of meat preferences among consumers globally (22, 23, 37). Thus, consumers' habits and attitudes toward food safety should be taken into consideration in food safety. With the increasing concerns about food safety, consumers tend to shift to foods with less perceived risk, causing needless precautions and loss of reliance on some food products (19).

Recently, consumers' needs, awareness, and expectations in developing economies are increasing owing to a rise in population and urbanization and to an increase in preferences for different meat types. Thus, the demand for wholesome meat and meat products is growing, making meat safety an important issue among consumers and the public (36). Despite the dwindling of consumer confidence in food products, research in Nigeria has focused mainly on bacteriological contamination of retail meat (4, 6, 12) and has not examined consumers' perception of meat safety. Note that there has been little or no scientific research to investigate consumers' meat consumption habits and risk perception in the face of growing consumer concern about retail meat safety. Therefore, this study surveys consumers' attitudes and risk perception of retail meat safety; it also evaluates the hygiene practices associated with retail meat sold to consumers within the Ilorin metropolis in Nigeria.

MATERIAL AND METHODS
Study area
This investigation was carried out at various randomly selected major retail meat outlets ($n = 7$) located within the Ilorin metropolis. Ilorin—latitude 8.4799°N, 4.5418°E, 320 m above sea level—is in the north central region of Nigeria. Ilorin, a nodal metropolis with approximately 814,192 inhabitants, is the 11th most populous capital in Nigeria (50). An average of 225 cattle are processed daily in the slaughterhouses within the Ilorin metropolis (29). The metropolis also has a high number of retail meat outlets, and a significant number of consumers have ready access to these retail meat locations during meat purchases.

Assessment of consumers' attitude and risk perception of retail meat safety in Ilorin
Study design and sample size

A questionnaire-based cross-sectional survey targeted at meat consumers (respondents) from March 2019 to June 2019 was carried out. In this survey, we defined meat consumers as adult permanent residents who purchased and consumed meat at retail outlets within the city in the last 3 months. Nonresidents and vegetarians were excluded from this study. The formula, $n = 1.96^2 \cdot \Pr (1 - \Pr)/d^2$, was used to approximate the sample size with the aid of Open Source Epidemiologic Statistics for Public Health (OpenEpi) 2.3.1 software (13), where n is the calculated sample size and Pr (expected proportion) was taken as 50%. The d (absolute precision) was set at 6%. Therefore, at least 267 targeted respondents were to be sampled across the Ilorin metropolis. The Pr was set at 50% because, to our knowledge, there has been no previous report on the proportion of meat consumers expressing their perception about retail meat safety.

Questionnaire design, implementation, and data collection

The questionnaire was designed after a review of the literature (1, 5, 8, 15, 17, 18, 31, 41). Close-ended questions were utilized to reduce variations and disparity, to achieve better precision, and to ease the rigor of data processing. These questions were grouped into four sections: (i) demographic information comprising variables such as age, gender, religion, geopolitical zone of origin, minimum household income, and current education status; (ii) consumers' meat consumption habits, which included questions about consumption frequency, type of meat preferred, meat products preferred, and so on; and (iii) consumers' risk perception, attitude, and reliance level, which included 15 questions (Likert-type scale) about perceptions on the safety of meat, foodborne illness from meat, risk of meat consumption, drug residues in meat, safety along the processing chain, and consumers' reliance on meat products.

The questionnaire was pretested on 10 meat purchasers at a retail outlet for clarity and precision of questions, and the feedback received was used before final administration (45).

Three trained questionnaire administrators were involved. Respondents gave informed consent before participating in the survey. To recruit the respondents, seven of the 15 major meat retail outlets receiving supplies from the abattoirs within the metropolis were randomly identified. During 4 months, at least 40 meat purchasers (who also consume meat) were approached at each of the seven major retail meat outlets. A total of 327 respondents completed the questionnaire.

Ethical consideration

The confidentiality of the respondents was maintained. All data and responses received were strictly treated as classified. Respondents were allowed to opt out voluntarily at any point during the questionnaire administration without prejudice following stipulated ethical conduct of research *(49)*. The Ethical Review Committee of the Faculty of Veterinary Medicine, University of Ilorin, ratified and endorsed the research (approval reference no. FVER/008/2019).

Evaluation of the hygiene of retail meat and meat display tables

Sample collection

We used a total of 212 samples (meat, $n = 107$; table swabs, $n = 105$), with at least 13 samples collected per week from the randomly selected retail meat outlets ($n = 7$) across the Ilorin metropolis. A meat display table is a board on which a meat retailer exhibits meat for purchasers to view and buy from. Usually, the table is constructed in a manner that allows for meat handling, including cutting and weighing. Sometimes, the meat displayed is also handled or palpated by the purchasers for personal assessment and satisfaction. The table swabs were collected using sterile swab sticks (Puritan Medical Products, Guilford, ME); each sterile swab stick was swabbed on an approximately 25-cm² area of the meat table surface *(30)*. The swabbed portion of the stick was then cut into a sterile bijou bottle containing sterile peptone water (Oxoid, Basingstoke, UK) solution. Similarly, each meat sample (approximately 25 g) was put into a sterile bijou bottle containing sterile peptone water solution and mixed thoroughly. The collected samples were conveyed in the cold chain to the laboratory and analyzed in <8 h after collection *(21)* at the Food Safety Laboratory, Department of Veterinary Public Health and Preventive Medicine, University of Ilorin.

Sample analysis: Bacterial contamination of meat and meat tables

To determine the level of bacterial contamination of the meat and meat table swab samples, the aerobic plate count (APC) and total coliform count (TCC) were carried out as previously described *(27)* using plate count agar (Oxoid) and MacConkey agar (Oxoid), respectively. Briefly, both the meat and table swab samples were mixed vigorously for 2 min before a sixfold serial dilution was performed in sterile peptone water (Oxoid). Aliquots (0.1 mL) from the final dilution level were inoculated in replicates on the prepared agar plates and incubated at 30°C for 24 to 48 h. All media used for bacterial enumeration were prepared according to the manufacturers' instructions. Bacterial counts were calculated as log CFU/g and log CFU/cm² for the meat and table swab samples, respectively.

Validity and reliability

Cronbach's alpha coefficient test was used to determine the internal reliability of the questionnaire. The Cronbach's alpha coefficient found in this study was 0.749, which is above the recommended 0.7 and within the satisfactory bound of reliability *(39, 44)*.

Data management and statistical analysis

Data obtained from the responses to the questionnaire were summarized using Microsoft Excel version 2016 (Microsoft Corporation, Redmond, WA) and analyzed using SPSS version 16 (IBM Corporation, Armonk, NY). Descriptive statistics were carried out using frequency and percentages. Also, a numeric scoring system was developed *(28)* to compute the outcome variable: consumers' risk perception. Scores for risk perception by respondents ranged from 0 to 13 (5.23 ± 2.66) and were further categorized as low (0 to 5), moderate (6 to 9), and high (10 to 13). Consumers' risk perception was used to determine their willingness to buy and consume meat products and their preference for types of meat and meat products. Chi-square (cross-tabulation) analysis was used to test the association among the outcome variables and demographic factors, source of meat, and processed meat products at the 95% confidence interval (a value of $P < 0.05$ was considered significant). Consumers' level of reliance on product attributes in assessing food safety and on the ability of stakeholders involved in the food chain to assure and influence food safety were computed into weighted means (%) to determine the specific variables that the respondents considered to be of importance among other variables. Data obtained about bacterial contamination of meat and meat tables were summarized as mean ± standard deviation for the various retail meat outlets sampled.

RESULTS

Demographic profile of respondents

Table 1 presents the demographic features of the surveyed respondents. A total of 327 respondents completed the questionnaire. The majority of the respondents (63.0%) were below the age of 25 years. A high percentage—82.6 and 74.3%—of the respondents were single and of the Islamic faith, respectively. Most respondents were indigenes of the northcentral (42.5%) and southwestern (35.2%) geopolitical zones of Nigeria. Over half (119, 60.9%) of the respondents earn below N100,000 (US$ 325.77) monthly.

TABLE 1. Demographical distribution of the meat consumers participating in the survey

Characteristics/categories	Frequency (*n*)	Percentage (%)
Gender		
Male	175	53.5
Female	152	46.5
Age		
Under 25	206	63.0
25–34	91	27.8
35–44	20	6.1
45–54	3	0.9
55–64	5	1.5
Over 64	2	0.6
Marital status		
Single	270	82.6
Married	57	17.4
Current educational status		
Secondary	5	1.5
Tertiary	292	89.3
Graduate	19	5.8
Postgraduate	11	3.4
North West	1	0.3
North East	2	0.6
North Central	139	42.5
South West	115	35.2
South East	59	18.0
South	11	3.4
Religion		
Islam	243	74.3
Christianity	84	25.4
Minimum household income		
≤ N20,000	102	31.2
N20,000 – N 50,000	55	16.8
N50,000 – N100,000	42	12.8
N100,000 – N150,000	40	12.2
≥ N150,000	88	26.9

Note: In October 2019, 1 U.S. dollar = N 306.96 Inter-bank Foreign Exchange Market, Central Bank of Nigeria. https://www.cbn.gov.ng/rates/exrate.asp?year=2019.
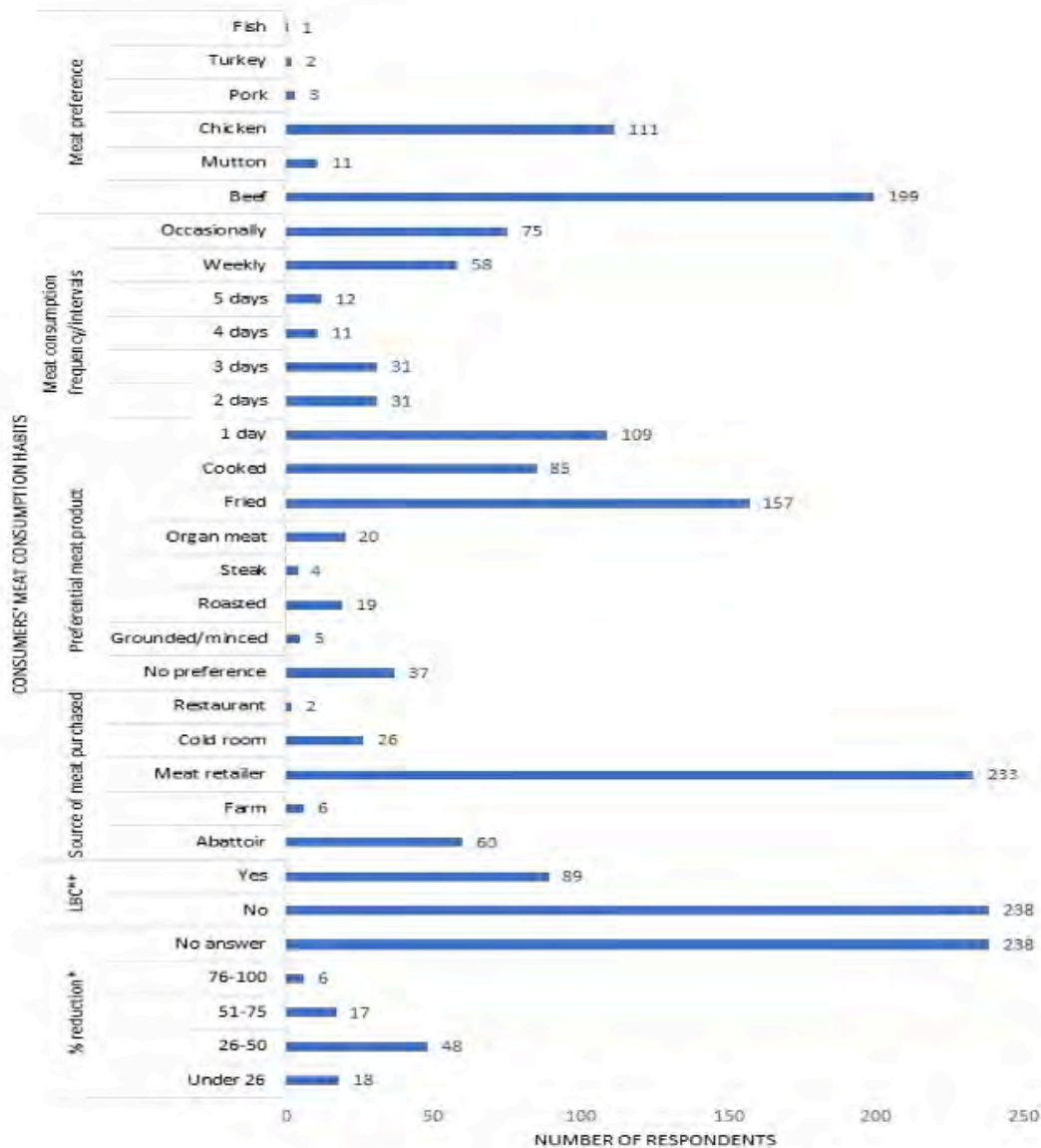
FIGURE 1. Meat consumption habits of retail consumers.
LBC, lowered beef consumption; *, percentage reduction of beef intake by consumers; **, responses provided by only 89 respondents.

Consumers' meat consumption habits

Most of the respondents (60.9%) preferred beef above other meat types and habitually consumed meat daily (33.3%) (Fig. 1). Approximately 40% of the respondents usually consumed chicken. These respondents reported a high preference for fried meat compared to other processed meat types. Most respondents (71.3%) reported usually purchasing meat from retailers. Due to food safety concerns, about a quarter of respondents (27.2%) reported having reduced their meat intake (most of them up to 50%) within the last 5 years.

Consumers' attitude, reliance, and perception of food safety risk

Respondents to this survey expressed various concerns about the food safety risk of various meat types (Fig. 2). Most respondents (46.2%) were indifferent about the safety perception of beef. Interestingly, a large proportion of the respondents (189 of 327) thought chicken was unsafe. Over half of the respondents (194, 59.3%) believed that meat consumption might expose them to clinical diseases or illness; 204 (64.2%) believed that drug residues could be found in meat; 258 (78.9%) believed that drug-resistant pathogens and infections could be acquired from
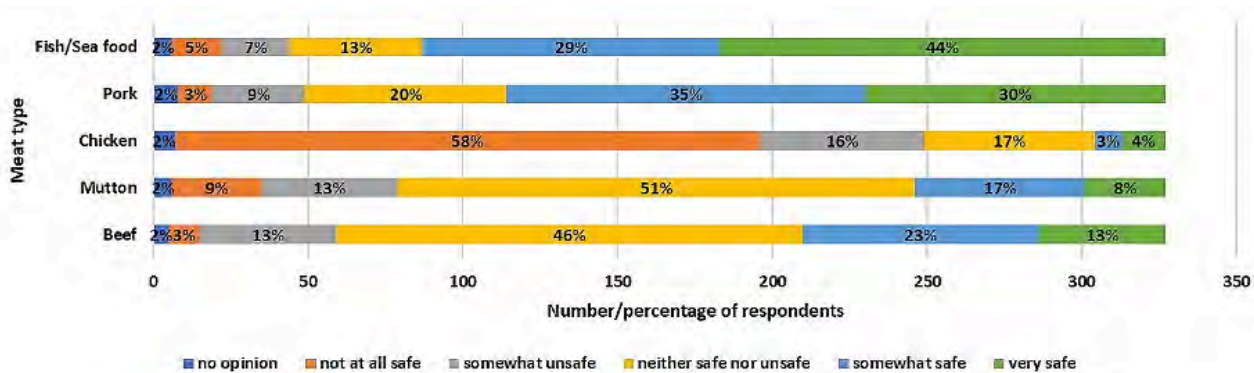
FIGURE 2. Consumers' perception of food safety risk of meat types.

TABLE 2. The ability of stakeholders in the meat industry to influence and assure beef food safety

Parameters	Very high n (%)	High n (%)	Moderate n (%)	Low n (%)	Very low n (%)	No opinion n (%)	Weighted mean (%)
Meat producers	134 (41.0)	63 (19.3)	70 (21.4)	39 (11.9)	16 (4.9)	5 (1.5)	3.75
Meat processors	142 (43.4)	67 (20.5)	70 (21.4)	29 (8.9)	13 (4.0)	6 (1.8)	3.85*
Retail meat vendors	127 (38.8)	65 (19.9)	74 (22.6)	34 (10.4)	19 (5.8)	8 (2.4)	3.68
Food restaurants	126 (38.5)	81 (24.8)	69 (21.1)	27 (8.3)	16 (4.9)	8 (2.4)	3.77
Homemade food	147 (45.0)	55 (16.8)	56 (17.1)	32 (9.8)	31 (9.5)	6 (1.8)	3.73
Government inspectors/regulators	146 (44.6)	57 (17.4)	60 (18.3)	30 (9.2)	30 (9.2)	4 (1.2)	3.75

*, Highest weighted mean.
The weighted mean (%), using percentage values, was calculated on a scale of 5; respondents reporting "no opinion" to "very high" options were scored "0" to "5" consecutively.

contaminated meat; 196 (59.9%) believed that drug residues in meat could contribute to antimicrobial resistance in humans; 176 (53.8%) believed that meat consumption was worth the risk; and 265 (81.0%) were aware of foodborne diseases. At bivariate analysis, meat source ($\chi^2 = 16.65$, df = 8, $P = 0.034$) and processed meat products ($\chi^2 = 28.22$, df = 8, $P = 0.005$) were associated with the risk of food safety. None of the demographic parameters was significantly ($P > 0.05$) associated with the risk of food safety.

The majority of the respondents ($\geq 60\%$) stated that meat producers, meat processors, retail meat vendors, restaurants, homemade food processors, and government inspectors and regulators have an important role in assuring meat safety (Table 2). The results of the computed weighted means show that respondents to the questionnaire opined that food meat processors (3.85%) have more ability than others to influence and assure beef food safety (Table 2).

Respondents were surveyed to assess how product attributes influenced their level of confidence in meat safety (Table 3); 49.5% expressed skepticism about price level, 41.3% about brand name or type, 36.5% about reputable source, 42.8% about country of origin, 35.2% about government-inspected products, 30.6% about meat freshness, and 32.4% about labeling traceable to source. The majority of respondents used the freshness of meat (weighted mean = 2.54%) as a major criterion to determine the safety of retail meat compared to other variables.

Bacterial contamination of meat and meat tables

High APC and TCC values were found for meat samples from the seven locations; they ranged from 7.60 ± 2.30 to 8.90 ± 0.26 log CFU/g and 4.54 ± 3.83 to 8.67 ± 0.49 log CFU/g, respectively (Table 4). Counts were mostly greater than 8 log for APC but less than 6 log for TCC across the

TABLE 3. Consumers' level of reliance on product attributes in evaluating meat safety

Product attributes	Extremely reliable n (%)	Very reliable n (%)	Somewhat reliable n (%)	Not very reliable n (%)	Not at all reliable n (%)	Weighted mean (%)
Price level	24 (7.3)	58 (17.7)	162 (49.5)	53 (16.2)	30 (9.2)	1.98
Brand name/type	27 (8.3)	82 (25.1)	135 (41.3)	46 (14.1)	37 (11.3)	2.05
Reputable source	64 (19.6)	90 (27.5)	119 (36.5)	38 (11.6)	16 (4.9)	2.46
Country of origin	44 (13.5)	57 (17.4)	140 (42.8)	51 (15.6)	35 (10.7)	2.07
Government inspected products	56 (17.1)	66 (20.2)	115 (35.2)	54 (16.5)	36 (11.0)	2.15
Freshness of meat	84 (25.7)	84 (25.7)	100 (30.6)	43 (13.1)	16 (4.9)	2.54*
Labeled traceable to source	64 (19.6)	76 (23.2)	106 (32.4)	43 (13.1)	38 (11.6)	2.26

*, Highest weighted mean.

The weighted mean (%), using percentage values, was calculated on a scale of 4; respondents reporting "not at all reliable" to "extremely reliable" options were scored "0" to "5" consecutively.

TABLE 4. Mean total aerobic plate and coliform counts of retail meat and meat tables in major retail sections in Ilorin

Locations	Meat (log CFU/g)			Table (log CFU/cm²)		
	n	APC	TCC	n	APC	TCC
A	26	7.60 ± 2.30	5.32 ± 3.68	26	8.30 ± 0.30	4.31 ± 3.79
B	26	8.80 ± 0.36	8.73 ± 0.36	26	8.10 ± 0.57	7.36 ± 3.21
C	30	8.50 ± 0.27	6.30 ± 2.90	18	8.30 ± 0.46	3.80 ± 3.95
D	20	8.10 ± 0.47	4.54 ± 3.83	24	8.40 ± 0.56	2.90 ± 3.86
E	28	8.70 ± 0.17	5.88 ± 3.51	32	8.70 ± 0.34	5.05 ± 4.30
F	52	8.90 ± 0.25	5.91 ± 3.84	52	9.00 ± 0.31	4.67 ± 3.93
G	32	8.90 ± 0.26	8.67 ± 0.49	32	8.80 ± 0.24	7.63 ± 2.59

APC, aerobic plate count; TCC, total coliform count; n, number of samples.

retail meat locations. As observed in the meat samples, the TCCs were lower than APCs on tables *(Table 4)*. The highest TCC was 7.63 ± 2.59 log CFU/cm²; however, a TCC as low as 2.90 ± 3.86 log CFU/cm² was found in samples obtained from a retail outlet. The APCs were high and ranged from 8.10 ± 0.57 to 9.00 ± 0.31 log CFU/cm².

DISCUSSION

This is the first report in Nigeria, to our knowledge, to determine consumers' risk perception, reliance on product attributes, and attitudes about food safety of retail meat. We found that the majority of meat consumers have a high

preference for beef purchased at retail; such meat received average scores on risk perception despite the perception that meat consumption has several food safety concerns. We also noted that, although respondents indicated that meat processors had more ability to influence and assure beef food safety, consumers use the freshness of meat as a major criterion in determining the safety of retail meat. A low level of hygiene practice was observed associated with the sale of retail meat to consumers.

Across the world, meat is regarded as part of an essential diet because it contains nutritious and valuable elements useful for the human body *(18, 47)*. The high percentage of

consumers who prefer beef to other types of meat and who may consume it daily indicates that retail beef has higher consumer acceptability—irrespective of beliefs, culture, educational status, and household income level—than other meat types consumed in the study area. In studies conducted in major parts of southwestern Nigeria, beef was the most preferred meat type among consumers (1, 31). Meat dietary consumption is affected by a complex interaction of several of these factors associated with consumers' lifestyles (7, 17). This finding is similar to that in other neighboring African countries, like Ghana (36). Usually, beef is preferred by purchasers and consumers because it is cheaper and more readily available at retail compared to other common meat types. Consumers prefer to purchase meat from retail outlets, which are close to residential areas, rather than from abattoirs and farms. The finding that about a quarter of respondents reported a reduction of meat intake in response to food safety concerns in the last 5 years was expected. Concern over beef safety, in addition to changing consumer lifestyles, the presence of antimicrobial residues in meat and meat products, poor meat processing, and poor meat quality have contributed to the declining intake of meat (14, 22). Consumers have also reduced meat intake because of its high price and its fat content (8, 15).

Because consumers are becoming better educated and demanding better-processed meats, an above-average number of respondents expressed concerns about meat safety due to the perceived risk of exposure to clinical disease, drug residues, and drug-resistant pathogens and infections; this calls for concern. Previous studies have highlighted meat contamination with pathogens, the presence of drug residues in meat, and the spread of antimicrobial-resistant pathogens in meat processing environments and at retail in Nigeria (24, 30, 32, 33, 35). In developed countries such as the United States, several recalls have been recorded as a result (9–11, 52). Our results agree with a previous finding that the current practices observed from slaughter to sales of meat fall below expected quality standards and hygiene levels, which exposes consumers to food contamination and foodborne illnesses (34). Based on these findings, interventions are needed to reduce the perceived risk of meat safety; these interventions should target sources where consumers purchase retail meat and also processed meat products.

The majority of respondents reported that meat producers, meat processors, retail meat vendors, restaurants, homemade food processors, and government inspectors and regulators have important roles to play in assuring meat safety. With the highest weighted mean score (3.85%), meat processors in the food service industry are seen to occupy a key position in ensuring that consumers are exposed to minimal food safety risks in the meat food chain. A failure of the meat processor to fill this crucial gap could have a negative effect on consumers' risk perception and attitudes toward meat consumption.

Nigeria, like most developing countries, does not have official grades or standards for beef in the retail meat market; this affects how consumers determine meat quality and safety. Our findings showed that, in determining meat safety, respondents considered the freshness of meat most important and price least important. In Kumasi metropolis of Ghana, consumers placed a higher emphasis on adherence to good hygiene practices in the shopping environment, packaging, low-fat beef, and product certification for safety and quality purposes more than on other attributes such as price (36). Jabbar and Admassu (20) in Ethiopia found that consumers consider freshness, more than price, a crucial attribute for meat quality. The same is observed in many European countries (40). Elsewhere in Ethiopia, respondents rated poor hygiene as a greater factor in meat consumption decisions than product price or consumer income status (5). This supports the observations that consumer awareness is growing about the need to consume good quality, safe meat and that the freshness of meat is a major factor that could influence consumer meat consumption patterns. However, it was observed that poor consumers in resource poor countries patronize the informal retail markets because the meat is inexpensive and available within the rural localities (21).

Bacterial counts are useful tools in determining contamination and hygiene of meat meant for consumption. Our study obtained APCs and TCCs for meat samples from seven major retail outlets of at least 8 and 5 log, respectively. The APCs for the meat display table were similar to those observed in the meat samples, whereas TCCs on meat display tables were at least 3 log. The APCs and TCCs for the meat samples and meat display tables were high and exceeded existing set standards (16). For instance, APC in meat should not be above 5 log/g. We found generally unsatisfactory hygiene levels in beef displayed for sale in Ilorin. Most meat retailers display meat unwrapped on the display tables, which exposes the product to dust and other contaminants. This disruption in hygiene and good processing practices at a crucial point along the meat production chain could easily lead to meat spoilage and affect the shelf life of the retail meat, which would have a negative effect on consumer perception of the food safety risk of the retail meat. Elsewhere in the country, lower APCs and TCCs were recorded for beef (6, 12). However, these counts were higher in a previous study (4). Comparably, a previous study outside Nigeria indicated APCs above acceptable international limits (21). Several factors may contribute to the high microbial counts observed in the retail meat and meat display table samples in Ilorin: poor hygiene practices in meat handling and processing, transport, and trade procedures that lead to poor-quality finished meat and meat products (2, 3). Consumers are exposed to foodborne diseases and other health risks and hazards if retail meats are not well prepared before consumption. Interestingly, the common way of cooking meat in Nigeria is rigorous, and it renders the meat microbiologically safe for consumption. The meat is usually

subjected to high temperatures during boiling, frying, and cooking that are sufficient to reduce microbial contaminants to safe levels.

A major limitation observed in this study is the possibility of response bias associated with the use of a questionnaire. To eliminate this bias, the questionnaire was pretested and close-ended questions were asked. Based on the pretest, several response biases were removed. The services of trained questionnaire administrators with adequate knowledge of food safety were used.

In conclusion, this study found moderate perceived food risk among consumers of retail meat in Ilorin. Although these consumers indicated that meat processors are important in assuring beef food safety, freshness of meat remained the major means they used to ascertain the safety of meat at retail. These results are important indicators of consumers' risk perception and preferences and could be used to influence consumers' preference for meat in Nigeria and other developing countries. Developing official grades and standards with consumer participation would be a useful way to lessen consumer perception of food safety risk. Based on microbial counts, the level of hygiene practice in meat preparation was severely deficient, which is a potential cause of consumers' negative perception of food safety at the retail meat level. Consumers' perception of meat safety and risk should be regarded as a key concern for policy formulation in Nigeria and other developing economies where food production and safety systems are stressed, poorly structured, and underdeveloped. Continuous education and training on good hygiene and manufacturing processes are essential for meat producers and processors, especially for those involved in the retail meat sector.

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DISCLOSURE STATEMENT

The authors declare no conflict of interest.

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