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Research Article

Antimicrobial Resistance and Molecular Detection of Extended-Spectrum Beta-Lacatamase Resistance in Eshcherichia Coli from Road-Side "Suya" Meat Sold in Nasarawa North, Nigeria State, Nigeria

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Abstract

Escherichia coli (E. coli) are common etiological agents of food borne diseases. A study on antimicrobial resistance and molecular detection of Extended-Spectrum β-lactamase resistance (ESBL) in E. coli from road-side suya meat was carried out. Suya meat (50 each from Akwanga, Nasarawa Eggon and Wamba) were collected; and E. coli was isolated and identified using cultural, morphological and biochemical characteristics. Antimicrobial susceptibility testing was carried out using disc diffusion method and interpreted as described by the Clinical and Laboratory Standards Institute. The phenotypic detection of ESBL production in multi-drug resistant isolates was carried using double disc synergy test. Screening for ESBL genes namely bla_{TEM}, bla_{SHV} and bla_{CTX-M} was carried out using polymerase chain reaction (PCR) method. The overall percentage occurrence of the isolates was 11(7.3%), being highest in wamba (10.0%), and lowest in Nasarawa Eggon (4.0%). The isolates were more resistant to amoxicillin/clavulanic acid, cefotaxime, and ceftazidine (54.5%). Percentage occurrence of ESBL producing isolates was 4(36.4%). Multidrug resistance (MDR) isolates (63.6%) occurred more than extensive drug resistance (XDR) (36.4%). The percentage occurrence of ESBL genes namely: bla_{SHV} and bla_{TEM} were 3 (75.0%). The Beta-lactam antibiotics such as amoxicillin/clavulanic acid, ceftazidime and cefotaxime were effective against the isolates and most of the isolates were ESBL resistant.

Key Words: escherichia coli; antimicrobial resistance; extended-spectrum beta-lactamase; suya

Introduction

Suya (roasted meat) is a popular traditionally processed ready to eat meat that is usually prepared from boneless of animals such as mutton, beef or goat. This meat product are usually sold along streets, in club houses, at pinics, parties, restaurant and within institution mostly Nigeria (Amaezi et al., 2016).

Suya, when being sold, are usually packaged in leftover newspaper and sometimes in cellophane or nylon bags (Amaezi et al., 2016). Most of the stages of preparation of this meat product, the materials used, packaging, the handlers and the surrounding environment can serve as a source of contamination of this product especially by members of Enterobactericeae mainly Escherichia coli (E. coli) which was reported by many researchers as the most common bacteria isolated from ready to eat suya in different part of Nigeria. This organism is also known as one of the most common cause of food borne disease both in developed and developing countries though the inhabit the intestinal tract of both human and animals. The pathotypes of diarrhgenic E. coli such as Enteropathogenic E. coli (EPEC), enteroinvasive E. coli (EIEC), Shiga toxin producing E. coli (STEC), Enterohemorrhagic E. coli (EHEC), enteroaggregative E. coli (EAEC), enterotoxigenic E. coli (ETEC) and diffusely adherent E. coli (DAEC) are the most strains causing food borne diseases in humans and commonly isolated from food sources (Abimiku et al., 2016).

Great attention has been paid to antibiotic resistance in Enterobactericeae in both human and animal population for adverse impact on the mortality and morbidity cause from this disease by this organism that result high

cost of treatment using antibiotics (Abimiku et al., 2019). Antimicrobial use in production animals has been shown to lead to the emergence of resistant Enterobactericeae throughout the food chain (Aworh et al., 2020). Most likely, the use of low doses of antibiotics by the modern food animal industry as growth-promoting substances in farm animals to promote animal growth and to prevent infections rather than cure infections is responsible for drug-resistant bacteria emerging on farms which reach the general population through human or animal carriers, and through the food consumers eat (Omer et al., 2021). So, the misuse and overuse of broad-spectrum antibiotics, mainly cephalosporins, must be contributing to selection and spread of ESBL-producing Enterobacteriaceae in animals (Aworh et al., 2020).

Extended spectrum beta-lactamase (ESBL) producing E. coli, which is zoonotic in nature, is one of the commonest resistant pathogens causing human infections (Aworh et al., 2020). It has been reported in several studies that antimicrobial resistance among E. coli isolates has increased globally mainly as a result of the high prevalence of ESBL producing bacteria (Abayneh et al., 2019; Aworh et al., 2020; Omer et al., 2021). This high prevalence of ESBL producing E. coli has resulted from growing reservoirs in animals especially their product that is commonly consumed and the use of antimicrobials (Adenaike et al., 2013; Aworh et al., 2020). The ESBL-encoding genes are often carried on plasmids, which can easily be transferred between isolates, bearing additional resistance determinants for other classes of antimicrobial agents, mainly fluoroquinolones, aminoglycosides and sulfonamides, contributing to the multidrug-resistant phenotype (Nafarnda et al., 2012; Legesse et al., 2015; Abimiku et al., 2019). This study however aimed at antimicrobial resistance profile and detection of ESBL resistance genes in E. coli isolated from road-side suya meat sold in Nasarawa North, Nasarawa State, Nigeria.

Materials

Media

Bacteriological media that were used in this study include: MacConkey Agar (MCA), Mueller-Hinton Agar (MHA), Nutrient agar (NA), Luria-Bertani (LB) broth, Eosine Methylene Blue (EMB) Agar and Tryptone Soy Broth (TSB). All the media were sourced from Oxoid Ltd. (U.K.).

Primers

The Primers and target genes with amplicon sizes for extended spectrum beta-lactamase gene in Escherichia coli is as shown in Table 1.

S/N	Tareget genes	Sequence	Amplicon size	References
1	bla_{TEM}	5´-TCGGGGAAATGTGCGCG-3´ 5´-TGCTTAATCAGTGAGGCACC-3´	972	Feizabadi et al., 2010
2	bla_{SHV}	5´-GGGTTATTCTTATTTGTCGC-3´ 5´-TTAGCGTTGCCAGTGCTC-3	615	Feizabadi et al., 2010
3	bla_{CTX-M}	5´-ACGCTGTTGTTAGGAAGTG-3´ 5´-TTGAGGCTGGGTGAAGT-3´	857	Feizabadiet al., 2010

Table 1: *Primers and target genes with amplicon sizes for extended spectrum beta-lactamase gene in Escherichia coli*

Antibiotic Discs

Antibiotic discs (and potency) that were used in this study include: Amoxicillin-Clavulanic acid (AMC: 30 µg), Cefotaxime (CTX: 30 µg), Ceftazidime (CAZ: 30 µg), Levofloxacin (LEV: 5µg), Ceftriaxone (CRO: 30 µg), Ciprofloxacin (CIP: 5 µg), Sulphamethoxazole/Trimethoprim (SXT: 25 µg), Gentamicin (CN: 10 µg), Ofloxacin (OF: 5 µg) and Streptomycin (S: 10 µg). All the discs were products of Oxoid Ltd (U.K.).

Methods

Study Area and Study Design

The study was carried out in the three Local Government Areas in the Nasarawa North Senatorial Zone of Nasarawa State, Nigeria, namely: Akwanga, Nassarawa Eggon and Wamba. This study was a descriptive survey of antimicrobial resistance and molecular detection of ESBL resistance genes in Escherichia coli from road-site suya meat sold in Nasarawa North Senatorial Zone of Nasarawa State, Nigeria.

Sample Collection

A total of 150 (50 from each Local Government Area of Senatorial Zone) road-side suya meat samples were randomly collected within the period of three months using sterile container and transported to Microbiology Laboratory, Nasarawa State University, Keffi, for analysis.

Isolation of Escherichia coli

Escherichia coli were isolated from suya samples as earlier described by Ngwai et al. (2014). Briefly, 1.0 g of the suya sample was inoculated into 9 ml of sterile Tryptone Soy Broth and incubated at 37°C for 24 h and a loopful of the 24 h TSB will be streaked on MacConkey agar plates and incubated at 37°C for 24 h. Pinkish colonies that grown on MCA plates were further streaked on Eosine methylene blue agar (EMBA: Oxoid Ltd, UK) agar plates and incubated at 37°C for 24 h. Greenish metallic sheen colonies that grown EMB agar plates after 24 h were selected as suspected E. coli isolates.

Identification of Escherichia coli

Gram-Staining

The Gram staining of the suspected E. coli will be carried out as earlier described by Cheesbrough (2006). Briefly, a smear of three (3) pure colonies of suspected organismwere made on a drop of normal saline placed on a clean grease-free glass slide and allowed to air dry. The slide was passed twice through the flame to heat fix and flooded with crystal violet solution for 30 sec and rinsed under slow running tap water and briefly decolorized with acetone and immediately rinsed under slow running tap water and counter stained with Safranin solution for 60 sec and again rinsed under slow running tap water and then allowed to air dry and was examine using x100 oil immersion objective.

Commercial Biochemical Kit (KB003 H125TM) Identification of Escherichia coli

The presumptive E. coli isolates that were Gram negative, rod shape, indole-positive, methyl red-positive, citrate-negative and Voges-Proskauer-negative were confirmed using KB003 H125^{TM} Kit following the manufacturer's instruction as follows. Following purification, 2 pure colonies of suspected isolates from NA plate were transfer to 5 ml of sterile normal saline in a tube to prepare a suspension and the turbidity of

the suspension was adjusted to the turbidity equivalent to the turbidity of 0.5 McFarland standards.

The kit was aseptically open by sealing off the sealing foil and 50 µl of the adjusted suspension was inoculated into each wells of the kit and the kit was seal back using the sealing foil and incubated at 37°C for 24 h. After incubation, 3 drops of reagent R036 and 1 drop of reagent R015 was added to well No 5; 2 drops of reagent R009 was added to well No. 6; 3 drops of reagent R029 and 1 drop of reagent R030 was added to well No. 9; 1 drops of reagent 1007 was added to well No. 10 and finally 1 drops of reagent R008 was added to well No. 11. The results were read and interpreted as per the standard given in the identification index.

Antimicrobial Susceptibility Testing

The antimicrobial susceptibility testing of the E. coli isolates was carried out as earlier described by Clinical and Laboratory Standards Institute (CLSI, 2018). Briefly, three (3) pure colonies of the isolates were inoculated in to 5 ml sterile 0.85% (w/v) NaCl (normal saline) and the turbidity of the bacteria suspension was adjusted to the turbidity equivalent to 0.5 McFarland's standard. The McFarland's standard was prepared as follows: 0.5 ml of 1.172% (w/v) $BaCl_2.2H_2O$ was added into 99.5 ml of 1% (w/v) H_2SO_4.

A sterile swab stick was soaked in standardized bacteria suspension and streaked on Mueller-Hinton agar plates and the antibiotic discs were aseptically placed at the center of the plates and allowed to stand for 1 h for pre-diffusion. The plates were incubated at 37°C for 24 h. The diameter zone of inhibition in millimeter was measured and the result was interpreted in accordance with the susceptibility break point earlier described by Clinical and Laboratory Standards Institute (CLSI, 2018).

Determination of Multiple Antibiotic Resistance (MAR) Index

The MAR index of the isolates was determined using the formula (Ngwai et al., 2014):

$$\text{MAR Index} = \frac{\text{Number of antibiotics isolate was resistant to}}{\text{Number of antibiotics tested}}$$

Classification of Antibiotic Resistance

Antibiotic resistance in the isolates were classified into: multidrug resistance (MDR: non-susceptible to ≥1 agent in ≥3 antimicrobial categories); extensive drug resistance (XDR: non-susceptible to ≥1 agent in all but ≤2 antimicrobial categories); pan drug resistance (PDR: non-susceptible to all antimicrobial listed) (Magiorakos et al., 2012).

Phenotypic of Extended Spectrum β-Lactamase Production

The phenotypic confirmatory test for ESBL production by isolates jointly resistant to both third generation cephalosporins (ceftazidime and cefotaxime) and ciprofloxacin was carried out using Double-Disc Synergy Test (DDST) method as described by Jarlier et al. (1988). Briefly, 10^5cfu/ml bacterial suspensionswere streaked on sterile Mueller-Hinton agar plates and amoxicillin-clavulanic acid (30 µg) disc was placed at the centre of the plate. Cefotaxime (30 µg) and ceftazidime (30 µg) discs were then placed 15 mm (edge-to-edge) from the centre disc. Enhancement of zone of inhibition in the area between the amoxicillin-clavulanic acid disc and any one of the β-lactam discs compared with the zone of inhibition on the far side of the drug disc was interpreted as indicative of the presence of an ESBL in the tested isolates.

Molecular Detection of Extended-Spectrum Beta-Lactamase Resistance

DNA Extraction

The DNA was extracted from ESBL producing isolates using boiling method as described by Abimiku et al. (2016). Briefly following, 1 pure colony of ESBL producing isolate, was inoculated into 2 ml of LB broth and incubated at 37ºC for 8 h and 200 µl of LB culture was transfer into Eppendorf tube and centrifuge in micro centrifuge as 3200 rpm for 2 min at room temperature and the supernatant was discard living the cells and the cells were wash twice with washing buffer. About 0.5ml of sterile phosphate buffer was added to the pellet and vortex for 5 sec after which it was heated at 90ºC for 10 min and rapid coiling was done by transferring the tubes into freeze for 10 min and thereafter it was centrifuge at 3200 rpm for 1 min to separate the DNA and the cell containing the DNA debris and 300 µl of supernatant, was transferred into 2 ml Eppendorf tube and stored at -10ºC until use.

DNA Amplification of Extended Spectrum β-Lactamase Genes

Simplex Polymerase Chain Reaction (PCR) was performed in order to amplify the ESBL genes present in the isolates. The presence of bla_{CTX-M}, bla_{SHV} and bla_{TEM} genes were tested for using previously published primer sets and conditions. The primer sequences and expected amplicon size for each gene are listed in Table 1.

The reactions were carried out in 20 µl reaction volume made up of 10 µl of Mastermix (Qiagen), 0.32 µl of primers (0.16 µl each of forward and reverse primers), 3 µl of DNA and 6.68 µl of nuclease free water. The primer concentration stood at 0.2 M. The reaction tubes were placed in the holes of the thermal cycler and the door of the machine was closed. Conditions during the reactions were set as: 3 minutes of initial denaturation at 95°C, followed by 35 amplification cycles of denaturation at 95°C for 30 sec, annealing at 56°C for 40 sec, initial extension at 72°C for 50 sec, final extension at 72°C for 3 min and a hold at 4°C infinitely.

Results

Occurrence of Escherichia coli

The occurrence of E.coli isolates from road side suya meat in nasarawa north, Nigeria is as shown in tale 2. Out of 150 suya meat samples obtained, the occurrence of the isolates in relation to this particular zone shows that the occurrence was high in wamba (10.0%) and akwanga (8.0%) but low in Nasarawa/Eggon(4.0%).

Antimicrobial Resistance of Eschericia coli

The antimicrobial resistance of the isolates from road side suya meat sold in Nasarawa North Nigeria is as shown in Table 3. The isolates were more resistant to amoxicillin/clavulani acid, cefotaxime and ceftazidime (54.5%) but less resistance tosulphamethoxazole/trimethoprim (36.4%), streptomycin and ceftriaxone (9.1%) but none was resistance to ofloxacin, levofloxacin, gentamicin and ciprofloxacin.

Antimicrobial Phenotypes of Escherichia coli

The E.coli isolates from road side suya meatin Nasarawa North, Nigeria were distributed into different antimicrobial phenotypes and the most common phenotypes were; CTX, CAZ and AMC,SXT,CTX,CAZ with percentage occurrence of 18.2% as shown in Table 4.

Multiple Antimicrobial Resistance (MAR) Index

The isolates from road side suya meat sold in Nasarawa North, Nigeria were distributed in to different MAR index and the most common MAR index was 0.4(36.4%) as shown in Table 5. The most common MAR index in Wamba and Nasarawa/Eggon were 0.4 with percentage occurrence of 40.0% and 100.0% respectively while in Akwanga metropolis, the most common MAR index was 0.5(50.0%).

Classification of Antimicrobial Resistance

The distribution of antibiotic resistant E. coli isolates from road-side suya meat sold in Nasarawa North, Nigeria into different classes of antibiotics namely: Multi Drug Resistance (MDR), Extensive Drug Resistance

(XDR) and Pandrug Resistance (PDR) are as shown in Table 6. The occurrence of MDR isolates (63.6%) was highest while the occurrence of XDR isolates (36.4%) was lowest. The occurrence of MDR and XDR isolates in Akwanga metropolis were 50.0% while the occurrence of occurrence of MDR and XDR isolates in Wamba metropolis was 100.0% respectively. The occurrence of MDR and XDR isolates in Nasarawa Eggon metropolis were (60.0%) and 40.0%.

Extended-Spectrum Beta-Lactamase Production

The occurrence of ESBL producing isolates from Nasarawa North, Nigeria is as shown in Table 7. The occurrence of ESBL producing isolates (36.4%) was low while the occurrence of Non-ESBL producing isolates (63.7%) was highest. The occurrence of ESBL producing isolates was highest in Akwanga metropolis (75.0%) and lowest in Wamba metropolis (20.0%).

Occurrence ofExtended-Spectrum Beta-Lactamase Resistance Genes

The occurrence of ESBL resistance genes in ESBL producing isolates from suya in Nasarawa North, Nasarawa State, Nigeria is as shown in Figure 5. Out 4 ESBL producing isolates, the occurrence of bla_{TEM} and bla_{SHV} was 75.0% while none of the isolates were bla_{CTX-M} positive.

Cultural Characteristics	Morphological Characteristics		Biochemical Characteristics												Inference
	Gram stain	Morphology	ONPG	Ornithine	UR	LYS	NT	H_2S	CT	TDA	VP	MR	IND	MAL	
Pinkish colony on MCA and greenish metallic sheen colony EMB agar	-	rod	+	+	-	+	+	-	-	-	-	+	+	_	E. coli

MCA= MacConkey agar; EMB= Eosin methylene blue; UR= Urease; LYS= Lysine; H_2S= Hydrogen Sulphide; CT= Citrate; TDA= Phenylalanine deaminase; VP=Voges-Proskauer; IND= Indole; MAL= Malonate; -= Negative; += Positive

Table 1: *Cultural, Morphological and Biochemical characteristics Escherichiacoli from Road-side Suya Meat Sold in Nasarawa North, Nasarawa State, Nigeria*

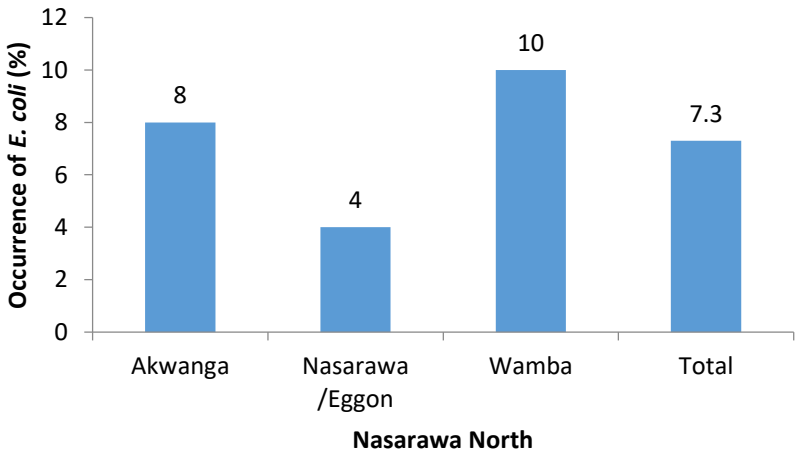

Figure 1: *Occurrence of Escherichia coli from road-side Suya meat sold in Nasarawa North, Nasarawa State, Nigeria*

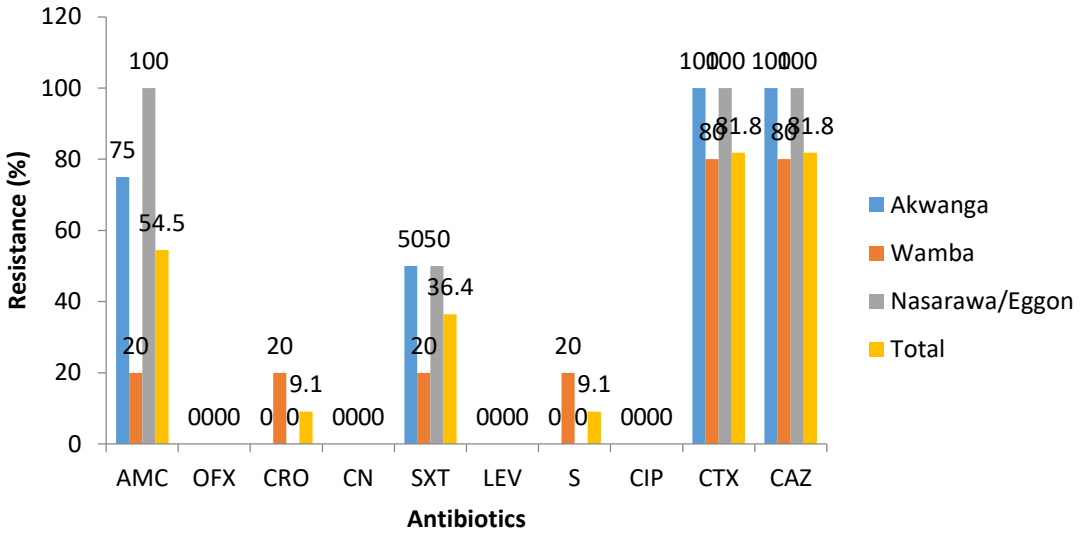

Figure 2: *Antimicrobial Resistance of Escherichia coli from road-side Suya meat sold in Nasarawa North, Nasarawa State, Nigeria*

Phenotypes	AK	WA	NE	Frequency (%)
CTX,CAZ	0(0.0)	2(40.0)	0(0.0)	2(18.2)
AMC,SXT,CTX	1(25.0)	0(0.0)	0(0.0)	1(9.1)
AMC,CTX,CAZ	1(25.0)	0(0.0)	0(0.0)	1(9.1)
AMC,CIP,CTX,CAZ	0(0.0)	0(0.0)	1(50.0)	1(9.1)
CTR,S,CTX,CAZ	0(0.0)	1(20.0)	0(0.0)	1(9.1)
AMC,SXT,CTX,CAZ	0(0.0)	1(20.0)	1(50.0)	2(18.2)
AMC,SXT,CIP,CTX,CAZ	1(25.0)	1(20.0)	0(0.0)	1(9.1)
CTR,SXT,LEV,CTX,CAZ	1(25.0)	0(0.0)	0(0.0)	1(9.1)

Table 2: *Antimicrobial Phenotypes of Escherichia coli from Road-side Suya Meat Sold in Nasarawa North, Nasarawa State, Nigeria*

No of antibiotics resistant (a)	No of antibiotics tested (b)	MAR index (a/b)	Frequency (%)			Total (%) (n=11)
			AK	WA	NE	
10	10	1.0	0(0.0)	0(0.0)	0(0.0)	0(0.0)
9	10	0.9	0(0.0)	0(0.0)	0(0.0)	0(0.0)
8	10	0.8	0(0.0)	0(0.0)	0(0.0)	0(0.0)
7	10	0.7	0(0.0)	0(0.0)	0(0.0)	0(0.0)
6	10	0.6	0(0.0)	0(0.0)	0(0.0)	0(0.0)
5	10	0.5	2(50.0)	0(0.0)	0(0.0)	2(18.2)
4	10	0.4	0(0.0)	2(40.0)	2(100)	4(36.4)
3	10	0.3	2(50.0)	0(0.0)	0(0.0)	2(18.2)
2	10	0.2	0(0.0)	2(20.0)	0(0.0)	2(18.2)
1	10	0.1	1(25.0)	0(0.0)	0(0.0)	1(9.1)

Table 3: *Multiple Antimicrobial Resistance (MAR) Index of Escherichia coli from Road-side Suya Meat Sold in Nasarawa North, Nasarawa State, Nigeria*

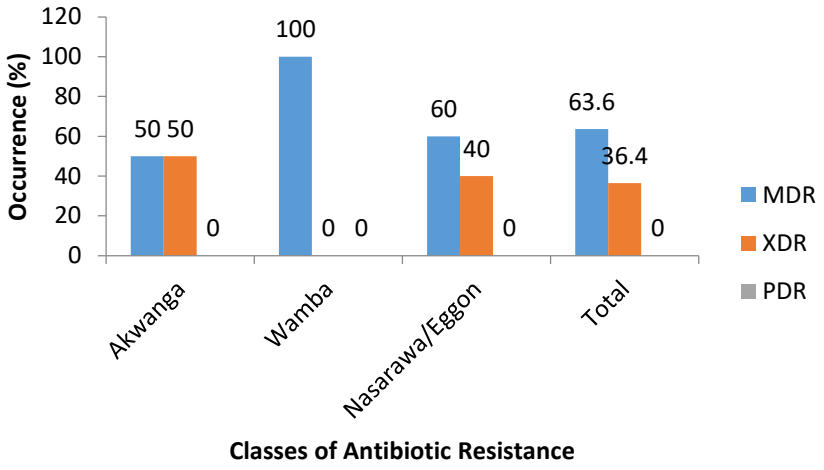

Figure 3: *Classes of Antibiotic Resistance in Antimicrobial Resistant Escherichia coli from Road-side Suya Meat Sold in Nasarawa North, Nasarawa State, Nigeria*

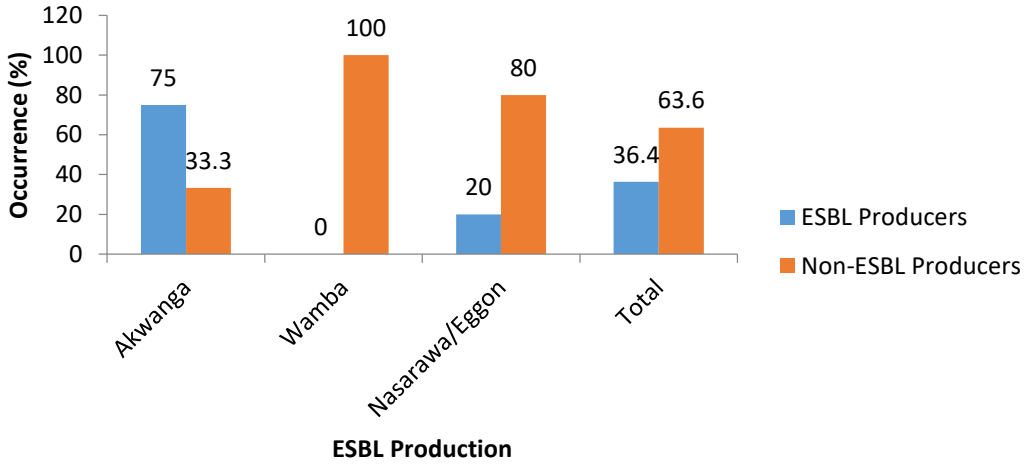

Figure 4: *Occurrence of Extended-Spectrum Beta-Lactamase Production in Antibiotic Resistant Escherichia coli from Road-side Suya Meat Sold in Nasarawa North, Nasarawa State, Nigeria*

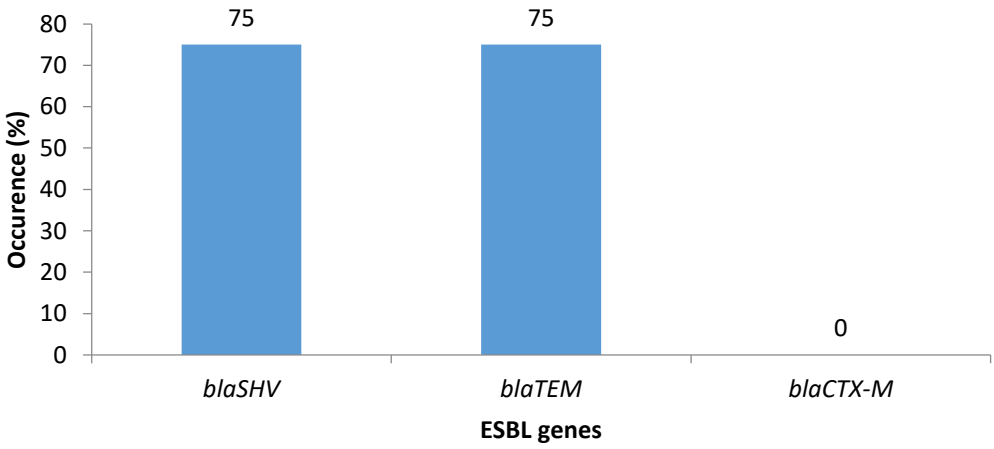

Figure 5: *Occurrence of Extended-Spectrum Beta-Lactamase Resistance Genes in Escherichia coli from Road-side Suya Meat Sold in Nasarawa North, Nasarawa State, Nigeria*

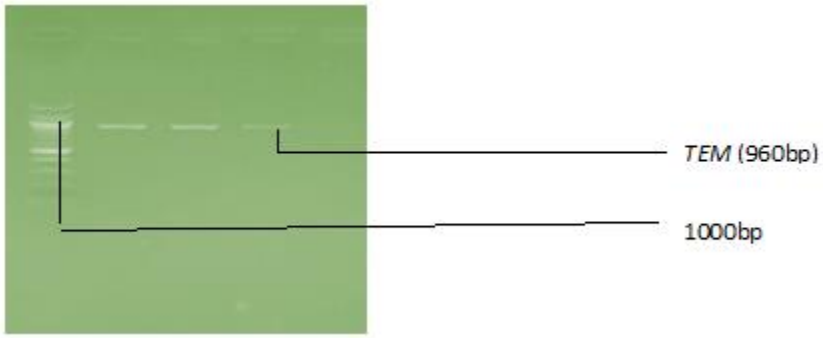

Plate 1: *Agarose gel electrophoresis of the amplified TEM gene from the E. coli isolates. Lanes 1, 2 and 3 represent the TEM bands, Lane M represents the 1500bp molecular ladder, while lane 4 show no band*

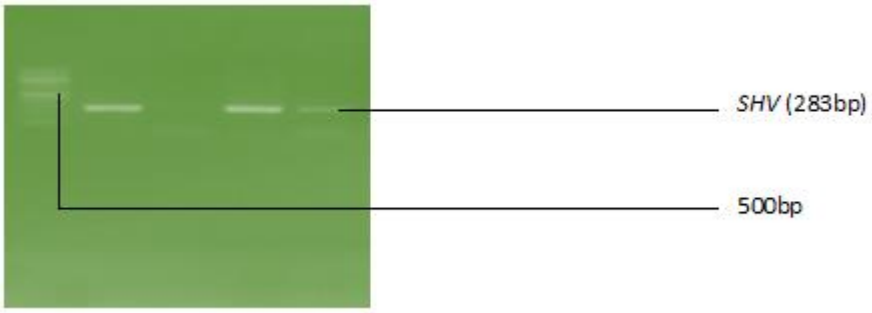

Plate 2: *Agarose gel electrophoresis of the amplified SHV gene from the E. coli isolates. Lanes 1, 3, and 4 represent the SHV bands, Lane M represents the 1500bp molecular ladder, while lane 2 show no band.*

Discussion

Suya meat is a traditionally processed meat usually sold along streets, in club houses, at pinics, parties, and restaurant and within institution mostly in Nigeria (Amaezi et al., 2016). Foodborne disease associated with contaminated meat products is a major public health issue and factors such as poor sanitation exercise, weak or poor safety laws, and regulatory system enforcements, lack of enlightenment, and infection awareness are reasons for outbreak of foodborne diseases in developing countries (Uzeh et al., 2021).

The isolation of E. coli from road-side suya meat in this study is an indication of faecal contamination of the product during processing. Escherichia coli is widely known as a common agent responsible for food borne disease and their occurrence in the meat product observed in this study may have public health problem. The percentage occurrence of the isolates from this study was higher than 5.0% in the study conducted by Falegan et al. (2019) but less than 13.0%, 13.0%, 15.78%, 21.9%, 23.0%, 50.0% and 63.33% in the study reported by Jesumirhewe et al. (2020), Datok et al. (2021), Uzeh et al. (2021), Abayneh et al. (2019), Azitey et al. (2021) and Omer et al. (2021) respectively.

The E. coli isolates from this study were less resistanceto antibiotics such as gentamicin, ceftriaxone, ciprofloxacin and ofloxacinand this finding is agreement with the study earlier described by Adzitey et al. (20121) were who reported 10.0% resistance of the isolates ceftriaxone and ciprofloxacin The low resistance of the isolates to gentamicin, ceftriaxone, ciprofloxacin and ofloxacin suggest that such antibiotics may not have been abused or misused in the study area and hence may be useful for treatment of infection caused by E. coli. The percentage resistance of the isolates to gentamicin, ceftriaxone, ciprofloxacin and ofloxacin in our findings was less than the 64.29%, 82.86%, 74.29% and 62.86% resistance to gentamicin, ceftriaxone, ciprofloxacin and ofloxacin in a study conducted by Ifenyinwa et al. (2019).

The high resistance of E. coli isolates to antibiotics such as amoxicillin/clavulanic acid, cefotaxime and ceftazidime in this study may be due to several reasons like; in appropriate prescriptions, inclusion of antibiotics in animal feed at sub-growth concentration, abuse and inability of the drug to get to the target site. The resistance of the isolates to antibiotic mentioned is an indication that the antibiotics may not be effective for treatment of infection caused by E. coli. The percentage resistance of the isolates to cefotaxime and ceftazidime in our study was higher than 5.3% resistance as earlier described by Omer et al. (2021). The occurrence of MDR isolates in suya meat product in this study was not different from the study reported by Datok et al. (2021) who reported 97.5% and this is uncalled for considering the fact that MDR bacteria widely known to cause infection that are difficult to be treated using antibiotics and may lead to high morbidity, mortality and high cost of treatment. Our finding also shows that most beta-lactam resistant isolates were ESBL producers and this suggest that the enzymes produced by the isolates may be responsible for cefotaxime and ceftazidime resistance.The occurrence of ESBL producing isolates in this study was slightly similar 35.0% reported by Ifenyinwa et al. (2019) but less than 45.0% reported by Adainake et al. (2013). The occurrence of bla_{TEM} and bla_{SHV} genes in ESBL producing isolates is an indication of the genes may be responsible for the expression of the ESBL enzymes responsible for resistance to cefotaxime and andceftazidime in this study. The detection of ESBL resistant isolates in road side suya meat sold in the study location may also have public health implication since ESBL resistant isolates carrying the ESBL resistance genes can easily be spread.

Conclusion

The occurrence of the isolates from road-side suya meat sold in study area was low and all beta-lactam antibiotics tested except ceftriaxone were not effective against the isolates and most of the isolates were MDR and

ESBL producers and bla_{TEM} and bla_{SHV} were the ESBL gene detected in beta-lactam resistant isolates.

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