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DISTRIBUTIONS OF POTENTIALLY PATHOGENIC *E. COLI* O157:H7 ISOLATED FROM FOOD SAMPLES AND THEIR SUSCEPTIBILITY TO DIFFERENT ANTIMICROBIAL AGENTS IN MAIDUGURI METROPOLITAN, NIGERIA

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Abstract

Food-borne diseases often follow the consumption of contaminated food-stuffs especially from animal products such as meat from infected animals contaminated with pathogenic bacteria. The objectives of the study is to determine the distributions of potentially pathogenic E. coli O157:H7 isolated from food samples and their susceptibility to different antimicrobial agents in Maiduguri Metropolitan, Nigeria. A total of 150 different samples was collected and screened for the presence of pathogenic E. coli. Sampling and screening was done between July, 2018 and December, 2018, in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. There was a

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KEYWORDS: *E. coli O157:H7, Food Samples, Antimicrobial Agents, Pathogenic, Contaminated, Maiduguri*

significant increase ($p < 0.05$) in the susceptibility of E. coli O157:H7 to AX in B ward compared to A and C wards. There was no significant difference ($p > 0.05$) in the susceptibility of E. coli O157:H7 to ST in A, B and C wards. There was a significant increase ($p < 0.05$) in the susceptibility of E. coli O157:H7 to N in C ward compared to A and B wards. There was no significant difference ($p > 0.05$) in the susceptibility of E. coli O157:H7 to GN in A, B and C wards. The distribution of E. coli serotype O157:H7 in the different wards in Maiduguri Metropolitan is with varying susceptibility pattern. Therefore, there is the need for vigorous antibiotic survey, detection and treatment of E. coli associated diseases.

Introduction

Microbial food-borne illness still remains a global concern despite the extensive scientific progress and technological developments achieved in recent years in developed countries (Mersha et al., 2010). Food-borne disease also occur commonly in developing countries particularly in Africa because of the prevailing poor food handling and sanitation practices, inadequate food safety laws, weak regulatory system, lack of financial resources to invest in safer equipment and lack of education for food-handlers (Haileselassie et al., 2013). Food-borne diseases often follow the consumption of contaminated food-stuffs especially from animal products such as meat from infected animals contaminated with pathogenic bacteria (Nouichi and Hamdi, 2009; Miajlovic and Smith, 2014). One of the most significant food-borne pathogens that have gained increased attention in recent years is E. coli O157:H7. It is an enterohemorrhagic strain of the bacterium *Escherichia coli* (*E. coli*), a cause of food borne illness (Miajlovic and Smith, 2014). Typical illness as a result of an *E. coli* O157:H7 infection can be life threatening, and susceptible individuals show a range of symptoms including haemolytic colitis, hemolytic-uremic syndrome, and thrombotic thrombocytopenia purpura (Arthur et al., 2014; Chileshe and Ateba, 2013).

Domestic and wild animals are the sources of *E. coli* O157, but the major animal carriers are healthy domesticated ruminants, primarily cattle and, to lesser extent, sheep, and possibly goat (Arthur et al., 2014; Kiranmayi et al., 2010; Rahimi et al., 2012). Transmission of *E. coli* O157:H7 to humans is principally via contamination of food by animal faeces, with cattle considered to be the primary reservoir (Rahimi et al., 2012). Sporadic cases and outbreaks of human diseases caused by *E. coli* O157 have been linked to ground beef, raw milk, meat and dairy products, vegetables, unpasteurized fruit juices and water (Arthur et al., 2014). There are also traceable links between human infection and ruminant faeces via water or direct contact (Ogden et al., 2005), and evidence that contact with animal faeces is a strong risk factor for sporadic *E. coli* O157:H7 infection (Locking et al., 2001). Antimicrobial resistance has emerged in the past few years as a major problem and many programs have been set up for its surveillance in human and veterinary medicine. These programs are aimed mainly at human pathogens, agents of zoonosis importance, and indicator bacteria of the normal intestinal flora from animals (Lanz et al., 2003). However, little attention has been paid to the resistance in specific animal pathogens (Lanz et al., 2003). Limited studies on the ecology of *E. coli* O157:H7 has been reported, particularly from developing countries (Rahimi and Nayebpour, 2012).

The magnitude of the public health burden due to resistant food borne pathogens is complex and is influenced by a number of variables such as antimicrobial use practices in farming, process control at slaughter, storage and distribution systems, the availability of clean water, and proper cooking and home hygiene, among others (WHO, 2000). The major concern on the public health threat of food borne illness is infection by antimicrobial resistant strains that lead to more intractable and severe disease (Martin et al., 2004).

This situation is further complicated by the potential of resistant bacteria to transfer their resistance determinants to resident constituents of the human microflora and other pathogenic bacteria (Olatoye et al., 2012). Several studies have suggested that foods might be a source of human acquired antimicrobial-resistant *E. coli*. The food supply is an established vehicle for certain other antimicrobial resistant and/or pathogenic bacteria including *E. coli* O157:H7 (Lanz et al., 2003; Ntuli, et al., 2016; Rahimi and Nayebpour, 2012). Therefore, the current study aims to evaluate the distributions of potentially pathogenic *E. coli* O157:h7 isolated from food samples and their susceptibility to different antimicrobial agents in Maiduguri Metropolitan, Nigeria.

METHODOLOGY

STUDY AREA

The study was carried out in Maiduguri Borno State, situated in the North-Eastern part of Nigeria which lies between latitude 10°N and 13°E. The state occupies the greater part of the Chad Basin in the North- Eastern part of the country and shares international borders with the Republic of Niger to the North, Chad to the North-East and Cameroun to the East. Most important to the country is the state's strategic location as a gate way to East and Central Africa. Internally, the state share borders with the neighboring states of Adamawa to the South, Yobe to the West and Kano to the north-west and Gombe to the South-West. The state has an area of 69,435 square kilometres, about 7.69% of the total land area of the country. Base on the 2006 census figure, the population density of approximately 60 inhabitants per square kilometre (NPC, 2006).

COLLECTION OF SAMPLES

A total of 150 different samples was collected and screened for the presence of pathogenic *E. coli*. Sampling and screening was done between July, 2018 and December, 2018,in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. The samples were collected in duplicates in sterile plastic containers, labelled and transported to the laboratory for immediate analysis. All the samples were screened initially for *E. coli* from which all positive isolates were further screened for *E. coli* O157:H7.

ISOLATION AND IDENTIFICATION OF E. COLI ISOLATES

Each of the food samples was homogenized in a sterile mortar and 1 g of the homogenate food sample was suspended in 9 ml buffered peptone water. Serial dilutions of up to 10- was then made and 1 ml of each will be plated on

Eosin methylene blue (EMB) agar. They were then incubated at 37°C for 24 h. pure cultures of all colonies exhibiting typical dark to purple red colonies with metallic sheen which is characteristic of *E. coli* on EMB was made in readiness for biochemical tests. Biochemical tests to confirm E. coli was done using the API 20E test strips and in accordance with the method described by Holt et al. (1994).

IDENTIFICATION OF E. COLI 0157:H7

Pure cultures of all positive E. coli was cultured on cefixim tellurite sorbitol-MacConkey (CT-SMAC) agar using the recommended method of Vernozy-Rozand (1997) and incubated at 37°C for 18 - 24 h. suspected colonies of *E coli* O157:H7 was confirmed using slide (Latex) agglutination test. Presence of toxic produced by O157;H7 was confirm using vetotoxin detection kit.

RESULTS SECTION

Figure 1 (a, and b) showed the susceptibility of *E. coli* O157:H7 to AX (Amoxicillin) and ST (Streptomycin) in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. There was a significant increase ($p < 0.05$) in the susceptibility of *E. coli* O157:H7 to AX in Bward compared to A and C wards. There was no significant difference ($p > 0.05$) in the susceptibility of *E. coli* O157:H7 to ST in A, B and C wards.

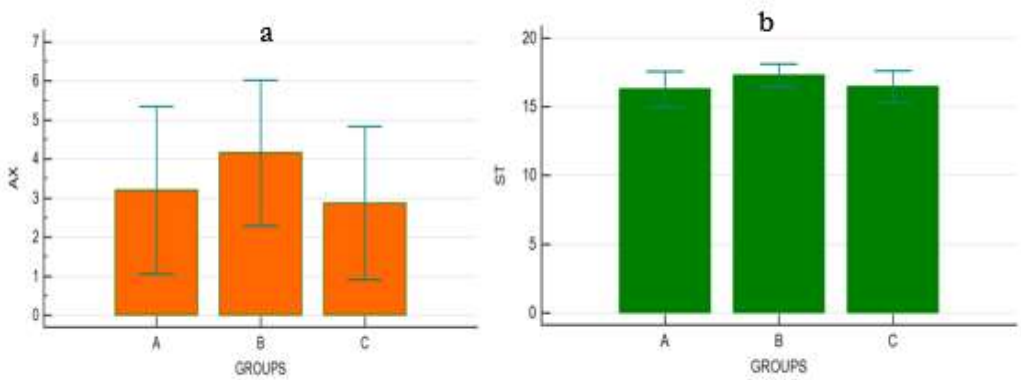

Figure 1 [a, b]: Susceptibility of *E. coli* O157:H7 to AX and ST in the various wards of A, B and C in Maiduguri Metropolitan

Figure 2 (a, and b) showed the susceptibility of *E. coli* O157:H7 to N (Nitrofurantoin) and GN (Gentamycin) in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. There was a significant increase ($p < 0.05$) in the susceptibility of *E. coli* O157:H7 to N in C ward compared to A and B wards. There was no significant differences ($p > 0.05$) in the susceptibility of *E. coli* O157:H7 to GN in A, B and C wards.

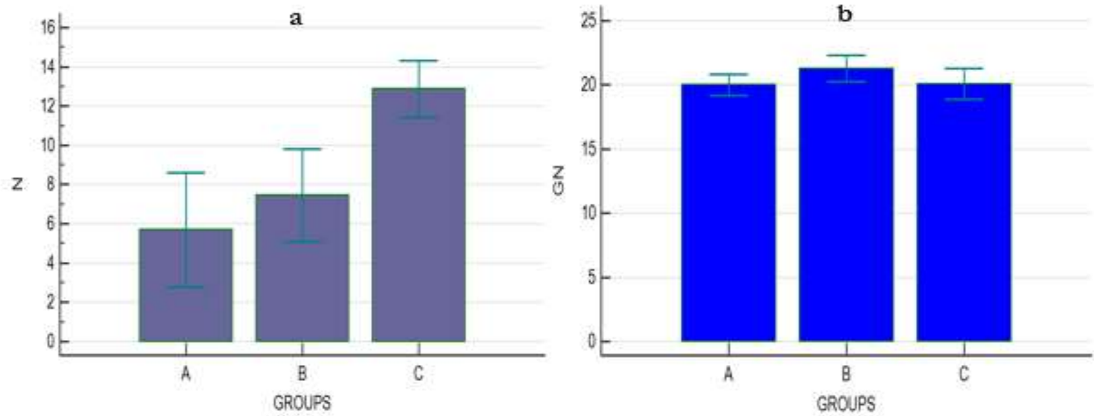

Figure 2 [a, b]: Susceptibility of *E. coli* O157:H7 to N and GN in the various wards of A, B and C in Maiduguri Metropolitan

Figure 3 (a, and b) showed the susceptibility of *E. coli* O157:H7 to CP (Ciprofloxacin) and C (Chloramphenicol) in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. There was a significant decrease ($p < 0.05$) in the susceptibility of *E. coli* O157:H7 to CP in C compared to A and B. There wasa significant increase ($p < 0.05$) in the susceptibility of *E. coli* O157:H7 to C in C compared to A and B wards.

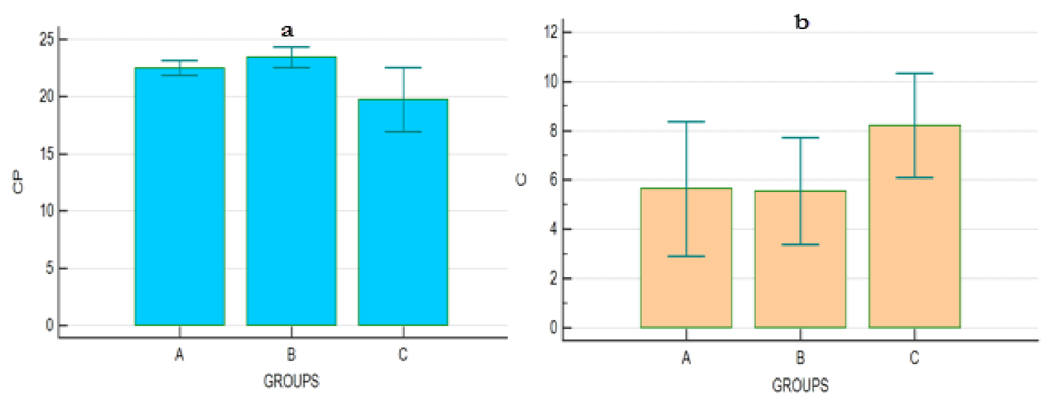

Figure 3 [a, b]: Susceptibility of *E. coli* O157:H7 to CP and C in the various wards of A, B and C in Maiduguri Metropolitan

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Figure 4 (a, and b) showed the susceptibility of *E. coli* O157:H7 to OF (Oflaxacin) and CF (Cefuroxime) in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. There was no significant differences (p >0.05) in the susceptibility of *E. coli* O157:H7 to OFamongstA, B and C wards. There was a significant increase (p < 0.05) in the susceptibility of *E. coli* O157:H7 to CF in C ward compared to A and B wards.

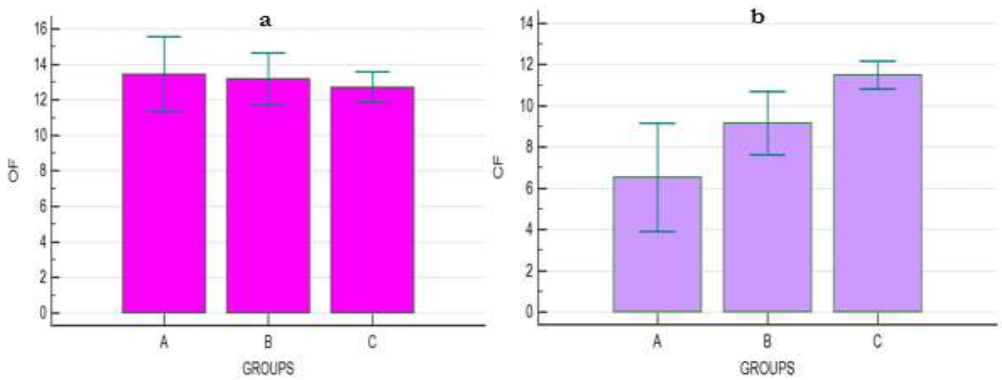

Figure 4 [a, b]: Susceptibility of *E. coli* O157:H7 to OF and CF in the various wards of A, B and C in Maiduguri Metropolitan

Figure 5 (a, and b) showed the susceptibility of *E. coli* O157:H7 to PF (Pefloxacin) and CT (Cetriaxone) in the various wards of ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area) in Maiduguri metropolitan, Borno State. There was a significant increase (p < 0.05) in the susceptibility of *E. coli* O157:H7 to PF in C ward Compared to A and B wards. There was a significant increase (p < 0.05) in the susceptibility of *E. coli* O157:H7 to CT in B ward compared to A and C wards.

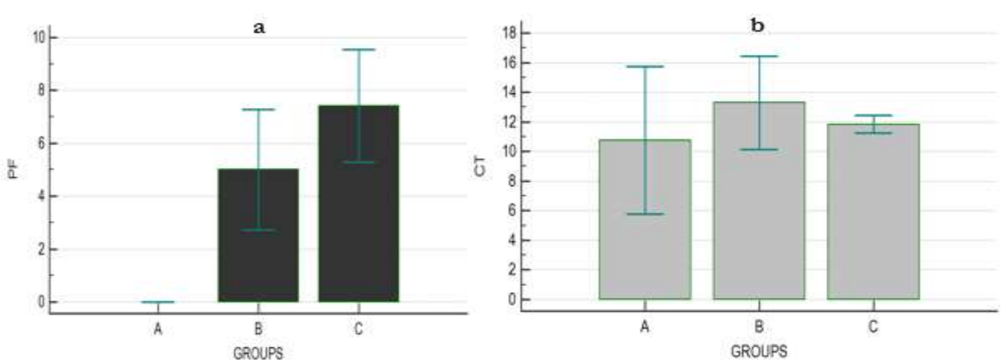

Figure 5 [a, b]: Susceptibility of *E. coli* O157:H7 to PF and CT in the various wards of A, B and C in Maiduguri Metropolitan

Figure 6 showed the contour distribution of *E. coli* in areas A, B and C of Maiduguri Metropolitan in Borno State, Nigeria. The distribution of *E. coli* is extensively distributed in area C compared to areas A and B.

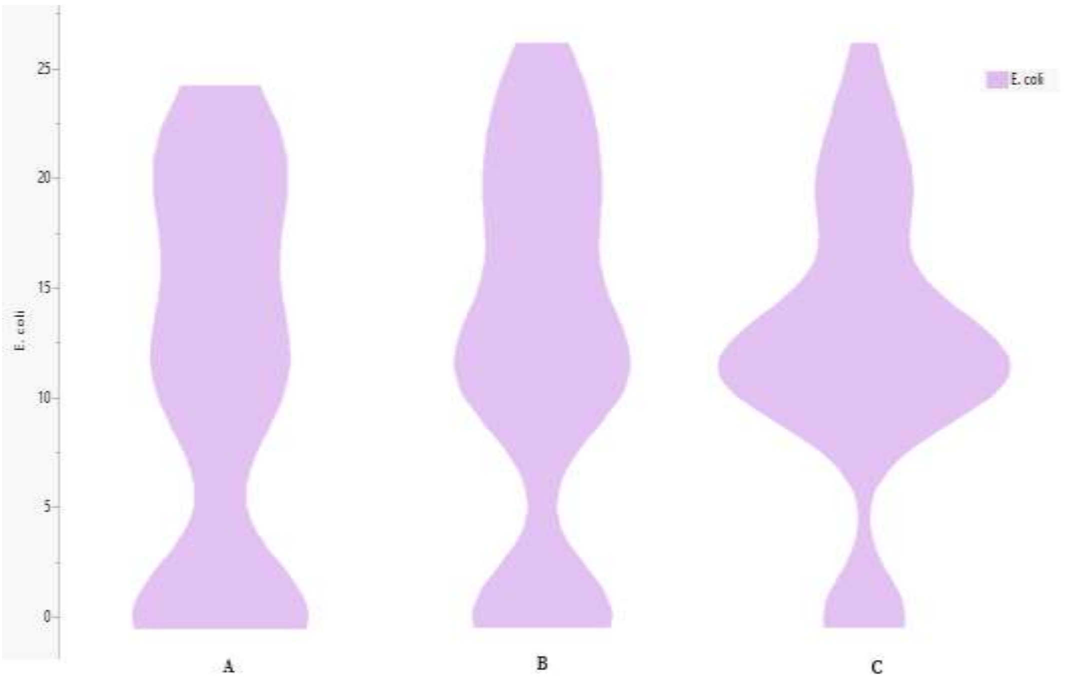

Figure 6: Contour representation of the distribution of *E. coli* O157:H7 in the various wards A, B and C of Maiduguri metropolitan, Borno State, Nigeria. ([A], University of Maiduguri/Tashan Bama area; [B], Custom/Gomboru area; [C], Tashan Baga area)

DISCUSSION

The study provides an evidence of the distributions of potentially pathogenic *E. coli* O157: H7 isolated from food samples and their susceptibility to different antimicrobial agents in Maiduguri Metropolitan, Nigeria.

Among the pathogenic *E. coli*, the EHEC serotype O157:H7 is of utmost importance due to its serious implications in humans and the increasing reported occurrence in many regions around the globe (Dundas et al., 2001; Effler et al., 2001). Thus, most studies on *E. coli* carried in Nigeria, focused mainly on the serotype O157:H7. In Nigeria, the food-borne bacteria *E. coli,* were isolated from animal and animal products (Adzitey et al., 2015).

Food borne contaminations are the foremost health issues in developing nationsas well as Nigeria. Evidence on the distribution of these contaminations and their susceptibility to antimicrobials helps policy makers to advancesuitableplans in terms of prevention, treatment and control.

In the current study, there was a significant increase in the susceptibility of *E. coli* O157:H7 to AX in B ward compared to A and C wards. There was no significant differences in the susceptibility of *E. coli* O157:H7 to ST in A, B and C wards.In the present study, the isolates were variablysusceptible to the antimicrobial agents. Despite the fact previous studies from Ethiopia and other countries described resistance to streptomycin and/or amoxicillin, the variable susceptibility observed against chloramphenicol in the present study is in divergence to the previous accounts of 100% susceptibility to this antibiotic (Dulo et al., 2015; Mersha et al., 2010).

Hiko et al., (2008) inspected meat samples whereas we tested for the presence of *E. coli* on foods samples. Likewise, Mersha et al., (2010)established at an export abattoir in central Ethiopia with an *E. coli* prevalence of 8.1%in sheep and goats before washing and 8.7% contamination by *E. coli* O157:H7 after washing. Also, the distribution of *E. coli* O157 in the foods obtained in the currentstudy was largely distributed centrally in ward C as compared to wards A and B, this finding is similar to reports from eastern Ethiopiain beef carcass at Haramaya University slaughter house (Taye et al., 2013)and from Turkey in beef carcass at two commercial abattoirs in Samsun Province (Inat and Siriken, 2010).

In the current study areas, there were fluctuations in the susceptibilities of *E. coli* to the varieties of antimicrobial agents used. This could be as a result of the enormousness of the public health burden due to resistant food borne pathogens which is complex and is influenced by a number of variables such as antimicrobial use practices in farming, process control at slaughter, storage and distribution systems, the availability of clean water, and proper cooking and home hygiene, among others as insinuated by WHO, (2000). Similarly, theforemostapprehension on the public health threat of food borne illness is infection by antimicrobial resistant strains that lead to more intractable and severe disease as documented by (Martin et al., 2004).

The changes in the susceptibilities of *E. coli* to the dissimilar antimicrobial agents in the study areas was further complicated by the potential of resistant bacteria to transfer their resistance determinants to resident constituents of the human microflora and other pathogenic bacteria, these findings were in accord to the statement of (Olatoye et al., 2012). Furthermore, several studies have proposed that foods might be a source of human acquired antimicrobial-resistant *E. coli.*Relatively, the food supply is an established vehicle for certain other antimicrobial resistant pathogenic bacteria including *E. coli* O157:H7 as stipulated by (Lanz et al., 2003; Rahimi and Nayebpour, 2012).

CONCLUSION

We concluded that the distribution of *E. coli* serotype O157:H7 in the different wards in Maiduguri Metropolitan is with varying susceptibility pattern. This calls for strong antibiotic reconnaissance for the detection and treatment of *E. coli* associated diseases as this recognised serotype has been connected in numerous deaths around the globe. Furthermore, reinforcement of good hygiene practices to prevent food borne outbreaks of diseases is encouraged.

CONFLICT OF INTEREST

Nothing to declare.

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REFERENCES

Adzitey, F. (2015). Prevalence of *Escherichia coli* and Salmonella spp. in beef samples sold at Tamale Metropolis, Ghana.

Arthur, T. M., Bono, J. L andKalchayanand, N. (2014). Characterization of *Escherichia coli* O157: H7 strains from contaminated raw beef trim during “High Event Periods”. Appl. Environ. Microbiol., 80(2), 506-514.

Chileshe J. and Ateba C.N (2013). Molecular identification of *Escherichia coli* O145:H28 from beef in the North West Province, South Africa. Life Science Journal, 10: 1171-1176.

Dulo F, Feleke A, Szonyi B, Fries R, Baumann MP, Grace D. Isolation of multidrug resistant *Escherichia coli* O157 from goats in the Somali region of Ethiopia: across-sectional, Abattoir-based study. Plos One. 2015; 10(11):e0142905.

Haileselassie, M., Taddele, H., Adhana, K andKalayou, S. (2013). Food safety knowledge and practices of abattoir and butchery shops and the microbial profile of meat in Mekelle City, Ethiopia. Asian Pacific journal of tropical biomedicine, 3(5), 407-412.

Hiko, A., Asrat, D., and Zewde, G. (2008). Occurrence of Escherichia coli O157: H7 in retail raw meat products in Ethiopia. The Journal of Infection in Developing Countries, 2(05), 389-393.

Inat G, Siriken B. Detection of *Escherichia coli* O157 and *Escherichia coli* O157:H7 by the immunomagnetic separation technique and stx1 and stx2 genes by multiplex PCR in slaughtered cattle in Samsun Province, Turkey. J Vet Sci. 2010; 11(4):321–6.

Kiranmayi, C., Krishnaiah, N and Mallika, E. N. (2010). *Escherichia coli* O157: H7-An Emerging Pathogen in foods of Animal Origin. Veterinary World, 3(8).

Lanz, R., Kuhnert, P and Boerlin, P. (2003). Antimicrobial resistance and resistance gene determinants in clinical *Escherichia coli* from different animal species in Switzerland. Veterinary microbiology, 91(1), 73-84.

Locking, M. E., O'Brien, S. J., Reilly, W. J., Wright, E. M., Campbell, D. M., Coia, J. E and Ramsay, C. N. (2001). Risk factors for sporadic cases of *Escherichia coli* O157 infection: the importance of contact with animal excreta. Epidemiology and Infection, 127(2), 215-220.

Martin, H. M., Campbell, B. J., Hart, C. A., Mpofu, C., Nayar, M., Singh, R and Rhodes, J. M. (2004). Enhanced *Escherichia coli* adherence and invasion in Crohn’s disease and colon cancer. Gastroenterology, 127(1), 80-93.

INTERNATIONAL JOURNAL – MBP
VOL. 10 NO.3 DEC-2019 ISSN: 1999-5650

Mersha G, Asrat D, Zewde BM, Kyule M. Occurrence of *Escherichia coli* O157: H7 in faeces, skin and carcasses from sheep and goats in Ethiopia. Lett ApplMicrobiol. 2010; 50(1):71–6.

Miajlovic, H andSmith, S. G. (2014). Bacterial self-defence: how *Escherichia coli* evades serum killing. FEMS microbiology letters, 354(1), 1-9.

Nouichi, S andHamdi, T. M. (2009). Superficial bacterial contamination of ovine and bovine carcasses at El-Harrach slaughterhouse (Algeria). Eur J Sci Res, 38(3), 474-85.

Ntuli, V., Njage, P. M. K., and Buys, E. M. (2016). Characterization of *Escherichia coli* and other Enterobacteriaceae in producer-distributor bulk milk. Journal of dairy science, 99(12), 9534-9549.

Ogden, I. D., MacRae, M and Strachan, N. J. C. (2005). Concentration and prevalence of *Escherichia coli* O157 in sheep faeces at pasture in Scotland. Journal of Applied Microbiology, 98(3), 646-651.

Olatoye I.O., Amosun E.A. and Ogundipe G.A. (2012). Multidrug resistant *Escherichia coli* O157 contamination of beef and chicken in municipal abattoirs of Southwest Nigeria. Nature and Science, 10:125-32.

Rahimi, E and Nayebpour, F. (2012). Antimicrobial resistance of *Escherichia coli* O 157: H7/NM isolated from feaces of ruminant animals in Iran. Journal of cell and animal Biology, 6(6), 104-108.

Rahimi, E., Kazemeini, H. R and Salajegheh, M. (2012). *Escherichia coli* O157: H7/NM prevalence in raw beef, camel, sheep, goat, and water buffalo meat in Fars and Khuzestan provinces, Iran. In Veterinary Research Forum (Vol. 3, No. 1, p. 15). Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.

Taye M, Berhanu T, Berhanu Y, Tamiru F, Terefe D. Study on carcass contaminating *E coli* in apparently healthy slaughtered cattle in Haramaya University slaughter house with special emphasis on *E. coli* O157:H7. J Vet Sci Technol. 2013; 4:132.

WHO 2000 - *E. coli* O157 in Canada, 30 May 2000