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PREVALENCE OF E. COLI AND E. COLI O157:H7 IN CATTLE CARCASS AND SWAB SAMPLES OF VARIOUS CONTACT SURFACES AT KANO CENTRAL ABATTOIR (KARA), KANO STATE, NIGERIA

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ABSTRACT

Kano Central Abattoir is a major supplier of meat and meat products in Kano State, yet its operations are conducted under poor hygienic conditions, with limited awareness among workers regarding *Escherichia coli* O157:H7. This study aimed to assess the prevalence of *E. coli* and *E. coli* O157:H7 in different samples collected from the abattoir, including meat, caecal contents, butcher's hands, and various contact surfaces such as wastewater, cutting boards, and evisceration knives. The isolation and identification processes passed through enrichment of samples with modified tryptone soy broth (mTSB) and nutrient broth, streaked onto Eosine methylene blue agar and Cefixime-tellurite sorbitol MacConkey agar, biochemical testing such as indole, Methyl red, Voges Proskauer and Citrate (IMVIC), followed by latex agglutination testing. A total of 160 samples were analysed, revealing *E. coli* contamination in 70 (43.75%) samples and *E. coli* O157:H7 in 23 (14.38%) samples. The highest prevalence of *E. coli* was observed in caecal content (55%), followed by evisceration knives (50%) and butchers' hands (45%), indicating significant cross-contamination risks. Similarly, the presence of *E. coli* O157:H7 in cutting boards (20%) and wastewater (20%) suggests inadequate sanitation practices. Sample collection, isolation, and identification were performed following standard microbiological protocols, including cultural, morphological, and biochemical testing. Statistical analysis revealed a significant association between contamination and sample type ($P < 0.05$). These findings highlight the urgent need for improved hygiene practices, enhanced awareness programs, and stricter regulatory measures to minimize public health risks associated with meat consumption from the abattoir.

KEYWORDS: Prevalence, Cattle carcass, *E. coli* O157:H7, Swab samples, Cross-contamination

INTRODUCTION

E. coli O157:H7 is a zoonotic pathogen that is an important cause of human foodborne and waterborne disease, with a spectrum of illness ranging from asymptomatic carriage and diarrhoea to the sometimes-fatal haemolytic uremic syndrome (Lupindu,2018). The incidence of infections caused by *E. coli* O157-H7 has become a major global public health challenge which affects both developed and developing countries (Uzeh and Agunlanna,2019). Outbreak of *E. coli* O157:H7 disease are often associated with undercooked beef and is transmitted to humans primarily through consumption of contaminated foods, such as raw or undercooked ground meat products and raw milk (Sebsibe and Asfaw,2020). Faecal contamination of water and other foods, as well as cross-contamination during food preparation (with beef and other meat products, contaminated surfaces, and kitchen utensils), will also lead to infection (WHO, 2018). These illnesses cause a decrease in manpower, which invariably results in considerable economic loss. Ground beef is responsible for 75% of *E. coli* O157:H7 outbreaks as such cattle faeces can directly contaminate dairy products and undercooked minced beef during the milking and slaughtering processes (Adamu MT *et al*, 2021).

In developing countries, animals are commonly slaughtered and dressed under unhygienic conditions and these further compromises the microbiological quality and safety of the meat obtained from the animals (Bello *et al.*,2013). Abattoir workers are one of the main groups at risk for contracting occupational zoonosis (such as *E. coli* O157:H7)due to their close contact with animals during slaughtering and processing and their inappropriate hygienic practices which often lead to cross contamination of the cattle carcasses (Adamu MT *et al*, 2016). Other sources associated with meat contamination include using contaminated water for washing carcasses, air particles in the dressing, cooling, and cutting rooms or tables and the environment. Thus, preharvest control of this pathogen in cattle production should have a large impact on reducing the risk of human foodborne illness (Bello *et al.*,2013). Therefore, poor slaughter processes, particularly poor hygienic practices during slaughtering, transport and display of meat play a largerole in increasing meat contamination. Hygienic management of animal and their food products, especially during slaughtering and display of meat for sale remains a better option in the control of *E. coli* O157:H7 transmission (Dong *et al.*,2024). Despite the danger of the infection pose on human population, a lot of people including cattle and beef handlers in Kano Central Abattoir are not aware of its mode of transmission due to lack of public awareness and minimum research conducted. Therefore, his study was conducted to determine the prevalence of *E.coli* O157:H7 from cattle carcasses, caecal content, and various contact surfaces at Kano Central abattoir, kano state, Nigeria.

METHODOLOGY

Study Design and Sampling

A cross-sectional study was conducted and apparently healthy slaughtered cattle in Kano Central abattoir were selected randomly. Samples were collected over a period of four (4) weeks included meat swabs (n= 60) and caecal contents of slaughtered animals (n= 20), swabs from abattoir environments, evisceration's knife (n= 20), butcher's hands (n= 20), cutting boards (n= 20), wastewater (n= 20) respectively.

Sample collection and processing

Swab samples were collected aseptically using systematic random sampling technique from the carcasses of daily slaughtered animals and contact surfaces at the abattoir using simple random sampling techniqueusing methods

adopted by (Sebsibe and Asfaw,2020).Selected carcasses were swabbed using the method described byTizeta *et al.* (2014) thereby placing sterile template (10 x 10 cm) on specific sites of a carcass. A sterile cotton tipped swab, (2X3 cm) fitted with shaft, was first soaked in an approximately 10 ml of buffered peptone water (Oxoid Ltd., Hampshire, England) rubbed first horizontally and then vertically several times on the selected carcasses part, the abdomen or body surface (flank), thorax (lateral surface) and breast or udder (lateral); Caecal content, Butchers' hand, evisceration knives, cutting boards and wastewater which are sites with the highest rate of contamination Tizeta *et al.* (2014) were chosen for sampling using the same swab over all the sites. On completion of the rubbing process, the shaft was broken by pressing it against the inner wall of the test tube and disposed leaving the cotton swab in the test tube. Finally, the samples were transported to the Microbiology Laboratory of Bayero University Kano using ice box in cold chain for microbiological analysis. Upon arrival, the samples will be stored in refrigerator at 4°C for 24 hrs until being processed for isolation as adopted by Tizeta *et al.* (2014)

Isolation and Identification/Enrichment Processes

All swab samples and 1 g of caecal contents from the slaughtered cattle was homogenized in 9mL of mTSB and Nutrient broth and was incubated at 37°C for 24 hours (USDA,2013).

Identification of the Isolates

After enriching the samples with prepared nutrient broth (NB), the overnight broth cultures were streaked ontoEosine Methylene Blue (EMB) agar (Oxoid) plates and incubated for 24-48 hours at 37°C. Colonies that produced green metallic sheen which is characteristic of *E. coli*were screened by colony morphology including Gram's staining, colour production (lactose fermenting colonies) and identified as *E. coli* by relevant biochemical tests, such as indole, methyl red, Voges Proskauer and citrate (IMVIC). Pure cultures of both were obtained by repeated sub culturing and stored on slants at 4°C.The isolated *E. coli* were thensub-cultured on sorbitol-McConkey agar (Oxoid Ltd., Hampshire, UK) supplemented with 0.05 mg/l Cefixime- 2.5 mg/l potassium tellurite and incubated at 37oC for 24 hours in order to distinguish between *E. coli* O157:H7 which are non-sorbitol fermenters that appeared pale cream in colour and other non O157:H7 strains of *E. coli* which fermented sorbitol to produce pink colonies(Dulo *et al.*,2015). Three to five non- sorbitol fermenters, colourless with a small, round, weak pale brownish appearance *E. coli* O157:H7 suspect colonies were identified through Cultural, morphological, biochemical tests, and confirmed using the slideagglutination test.

Statistical analysis

Sigma stat 3.5 software (Core *et al.*, 2017) was used for data analysis. The prevalence of *E. coli* O157:H7 in carcass swab, caecal contents and environmental samples was determined by dividing the number of positive samples by the total number of samples examined. Significant association between *E. coli* O157 carriage and type of sample (carcass vs caecal content) was assessed using Fisher's exact test. Differences were considered significant at P<0.05.

RESULTS AND DISCUSSION

The prevalence of *E. coli* and *E. coli* O157: H7 from different samples collected and examined at Kano Central Abattoir (Kara) shows that, out of the 160 samples examined, 70 (43.75%) were positive for *E. coli*, and 23 (14.38%) for *E. coli* O157:H7 (Table 1). The distribution of *E. coli* and *E. coli* O157: H7 in various Samples Collected from

Kano Central Abattoir (Kara) (Table 2). In wastewater, out of the 20 samples examined, 12 (60%) and 4 (20%) were positive for *E. coli* and *E. coli O157:H7*, followed by Caecal content 11(55%) *E. coli* and 6 (30%) *E. coli O157:H7* respectively. Udder and body surface swabs revealed similar rate with 7 (35%) *E. coli* and 2 (10%) *E. coli O157:H7* and *E. coli*, 7 (35%) *E. coli O157:H7*, 1 (5%). The remaining parts/ surfaces also showed various contamination rates with *E. coli* and *E. coli O157:H7* 6 (30%) and 1 (5%) from Lateral Surface, 8 (40%) and 4 (20%) from Cutting Board and finally Evisceration Knife with 10 (50%) *E. Coli* and 3 (15%) *E. coli O157:H7* respectively.

Kano central abattoir produces large share of meat and meat products that is being consumed in kano state, and the working procedure is performed in a below recommended hygienic condition, and the abattoir workers have little or no idea about *E. coli O157:H7* due to limited research and poor public awareness programs. In this study, different samples such as cattle carcass swabs, caecal content of slaughtered animals, swab samples taken from hands of meat handlers, and different surfaces that have contact with meat such as wastewater, cutting boards and evisceration knives were tested for the presence of *E. coli* and *E. coli O157:H7* in Kano Central Abattoir (Kara). Accordingly, *E. coli* was detected in 70 (43.75%) of the total 160 samples tested, whereas *E. coli O157:H7* were detected in 23 (14.38%) of the samples.

The presence of *E. coli* in 43.75% of the tested samples highlights significant contamination, which aligns with previous studies that have reported similar bacterial prevalence in abattoirs and meat-processing environments (Dulo *et al.*, 2015; Raji *et al.*, 2017). Comparatively, the 14.38% of *E. coli O157:H7* is lower than 53% prevalence reported by Dahiru *et al.* (2008) in fresh beef meat in Kano City, Nigeria. The prevalence of *E. coli O157:H7* in carcass swabs (3.9 %) is consistent with the earlier findings of Dulo *et al.* (2015), Enabulele and Ndaka (2009), which indicated a prevalence of 3.2 and 2.32 % in Ethiopian and Nigerian beef samples, respectively. Regarding sample types, the highest prevalence of *E. coli* was observed in caecal content (55%), followed by evisceration knives (50%) and butchers' hands (45%). The high bacterial load in caecal content is expected, as the intestines harbor diverse microbial populations, including pathogenic *E. coli* strains (Ferens & Hovde, 2011). Improper handling during evisceration can lead to cross-contamination, which explains the high contamination on evisceration knives. This finding is consistent with previous research, which found that slaughterhouse equipment is a major reservoir for *E. coli* contamination (Van Ba *et al.*, 2018).

However, the significant prevalence rate of *E. coli O157:H7* in cutting boards (20%), and wastewater (20%) suggests a potential risk of contamination through direct contact with faecal material and inadequate sanitation practices, which have been previously documented as key factors in bacterial persistence in abattoir environments (Gerba & Smith, 2020). Similarly, the presence of *E. coli* on butchers' hands (45%) and (10%) for *E. coli O157:H7* highlights the potential role of human handlers in spreading bacterial contamination. The presence of *E. coli* and *E. coli O157:H7* in meat samples, cecal content and swab samples were also reported in different studies (Mohammed *et al.*, 2014; Dulo *et al.*, 2015; Anattie *et al.*, 2017; Bersisa *et al.*, 2019 and Sebsibe and Asfaw, 2020) respectively. Many reasons might be contributed for cross- contaminations of meat and surface contacts with cecal contents and other sources. Previous work in cattle suggests that the prevalence of *E. coli O157:H7* in the faeces is correlated to the prevalence on the hide and carcasses of animals at slaughter (Mekonnen *et al.*, 2013).

In the present study, poor hygienic practices of the abattoir house and butchers' workers observed were found to be risky for contamination of meat with *E. coli* and *E. coli O157:H7*. This condition is riskier in our situation, because of the widespread practice of raw meat consumption throughout the country. Studies concluded that, raw meat can harbour harmful pathogenic *E. coli O157:H7* causing diarrhoea and systemic manifestations such as haemorrhagic colitis, haemolytic uremic syndrome (HUS) (Spickler AR, 2016; Jacob ME 2010; Sethulekshmet *et al.*,

2016). Studies have shown that proper hand hygiene and the use of gloves can significantly reduce the transmission of foodborne pathogens (Todd *et al.*, 2010).

Table 1: Prevalence of *E. coli* and *E. coli* O157: H7 in Samples Collected from Kano Central Abattoir (Kara)

Samples source		No. of Sample examined	No. of Positive Sample (%)	
			<i>E. coli</i>	<i>E. coli</i> O157:H7
Kano	Central Abattoir	160	70 (43.75)	23 (14.38)

Table 2: Distribution of *E. coli* and *E. coli* O157: H7 in various Swab Samples Collected from Kano Central Abattoir (Kara)

Samples Type	No. of Sample Type Tested	No. of Positive Sample (%)	
		<i>E. coli</i>	<i>E. coli</i> O157:H7
Udder	20	7 (35)	2 (10)
Body surface	20	7 (35)	1 (5)
Lateral surface	20	6 (30)	1 (5)
Evisceration knife	20	10 (50)	3 (15)
Butchers' hand	20	9 (45)	2 (10)
Caecal content	20	11 (55)	6 (30)
Cutting board	20	8 (40)	4 (20)
Wastewater	20	12(60)	4 (20)
Total	160	70 (43.75)	23 (14.38)

Key: No. Number, n, Number of processed samples, %, Percentage

CONCLUSION

The findings of this study confirm that *E. coli* and *E. coli* O157:H7 contamination is prevalent in various points of contact within the Kano Central Abattoir, posing a risk to both meat safety and public health. Similar patterns of contamination have been observed in other developing countries, highlighting the need for comprehensive food safety measures. Implementing proper public awareness, training of abattoir workers, hygiene and sanitation protocols can significantly reduce the risk of bacterial transmission, ultimately ensuring safer meat products for consumers.

RECOMMENDATIONS

To mitigate the risks associated with *E. coli*O157:H7 prevalence and cross-contamination at Kano Central abattoir, several interventions should be considered:

1. Improved Hygiene Practices: Butchers and meat handlers should adhere to strict handwashing protocols, use gloves, and ensure proper cleaning of knives and cutting boards.
2. Enhanced Sanitation Measures: Regular disinfection of surfaces, equipment, and abattoir floors should be implemented to minimize bacterial persistence.
3. Proper Wastewater Treatment: Effective treatment of abattoir wastewater is crucial to prevent environmental contamination and reduce the risk of waterborne disease outbreaks.
4. Routine Surveillance and Monitoring: Regular microbial testing should be conducted to assess contamination levels and evaluate the effectiveness of control measures.
5. Robust Public awareness programs and regular training of abattoir workers on food safety and hygiene practice will go a long way in mitigating the menace of the *E. Coli O157:H7*.

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