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Pathogenic Bacteria Profiles in Street Cooked and Raw Meat from Selected Markets in Entebbe Municipality, Uganda

Patricia Nagingo [a,b*], Denis Omara [b], Joel Philip Mwesigwa [a] and Fortunate Lujjimbirwa [a]

[a] *Department of Microbiology, Faculty of Health Sciences, University of Kisubi, Uganda.*
[b] *Department of Pathogen Genomics and Phenotype Immunity Program, Medical Research Council/Uganda Virus Research Institute and London School of Hygiene and Tropical Medicine (MRC/UVRI and LSHTM), Uganda Research Unit, Uganda.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Background: Microbial contaminations and their toxins have a lead role in food-borne outbreaks (FBOs) through food poisoning, spoilage, and intoxications. In Africa, it's approximated that 92 million people fall ill from consuming contaminated foods, resulting in 137,000 deaths each year. And yet, food safety does not seem to be a major concern within many countries in this continent. This study aimed at isolating pathogenic bacteria from street-cooked and raw meat from selected markets in Entebbe municipality, Uganda.
Methodology: This was a descriptive randomized cross-sectional study. Samples were in two clusters that is cooked and raw meat (chicken and beef). All of them were analyzed in the microbiology laboratory uniformly. A sample size of 40 was used. Selective media and bio-chemicals were used in the bacterial species isolation and identification respectively.
Results: A total of 11 isolates of bacteria were isolated and identified. These included gram-positive cocci: *Staphylococcus spp* (23.5%), and *Enterococcus spp* (12.3%); gram-positive rods: *Corynebacterium spp* (23.5%), and *Mycobacterium spp* (3.7%); and gram-negative rods: *Serratia*

**Corresponding author: E-mail: nagingopatriciaedanah@gmail.com;*

spp (1.2%), *Citrobacter spp* (9.9%), *E. coli spp* (1.2%), *Salmonella spp* (1.2%), and *Shigella spp* (1.2%).

Conclusion: There are significant levels of microbial contamination associated with street foods and these accounts for food-borne illnesses.

Keywords: Pathogenic bacteria; street meat; contamination; food borne diseases.

1. INTRODUCTION

Meat microbiological quality has recently turned out to be a very important concern in public health [1] despite it being a good source of proteins, zinc, iron, selenium, and phosphorus followed by vitamin A and B-complex vitamins A and humans have consumed it throughout history because of meat's sustenance qualities [2]. The poor standards of handling have contributed to the contamination of meat with pathogenic and spoilage bacteria which are a contributing factor for food borne infections and intoxication.

These microbial changes are favored by various conditions such as the pre-existing micro flora on the surface and in the digestive tract of animals; the killing techniques used, and hygienic conditions provided during gutting; the temperature, duration, and hygiene during transportation to the cooling point; and technical and sanitary conditions during skinning and butchering of the animals [2]. Other factors, such as the chemical composition of meat, gaseous environment, and nutrient availability, as well as competition from other bacteria, also affect how any particular bacteria may grow in this matrix of the meat [3]. Elsharawy (2018) emphasizes that the abattoir is an important step in the production of meat; and presents some of the preferable opportunities for contamination [1].

Microbial contamination and their toxins are a lead role to foodborne outbreaks through food poisoning, spoilage, and intoxications [4]. All is characterized by vomiting, diarrhea, nausea, stomach pain, cramping, fever, headache, weakness [5] and hospitalization under severe conditions. Food poisonings, most cases are caused by a variety of pathogenic bacteria including *Staphylococcus spp., Salmonella spp., Shigella spp., campylobacter spp., Pseudomonas spp.*, *Proteus spp. and Escherichia coli* among others; viruses, or parasites, all of which contaminate food [6].

Analysis shows that each year worldwide, unsafe food causes 600 million cases of foodborne diseases and 420,000 deaths, 30% of foodborne deaths occurring among children under 5 years of age [7]. It is estimated that 33 million years of healthy lives are lost due to eating unsafe food globally each year. In Africa, it's approximated that 92 million people fall ill from consuming contaminated foods, resulting in 137,000 deaths each year. And yet, food safety does not seem to be a major concern within many countries in this continent [8,9] like Ghana, Mali, Kenya, and Uganda. The popularity of street foods is increasing, and trading has become an enterprise; activities of the vendors are not regulated providing ample room for unwholesome practice which imposes risks to the health and safety of practitioners along the value chain. Thus, the study was designed to evaluate the microbial status including foodborne pathogen and spoilage bacteria in street sold meat (beef and chicken) in some selected markets in Entebbe Municipality, Uganda.

2. METHODOLOGY

2.1 Study Design

A descriptive cross-sectional study was conducted within five markets of Entebbe municipality, Uganda during October 2021 to January 2022.

2.2 Study Area

Street samples of meat were collected from vendors in randomly selected markets i.e., Namulanda, Kawuku, Kasatiro, Baita and Katabi market centers in Entebbe municipal, Uganda.

2.3 Sampling

A sample size of 40 was collected randomly from vendors, i.e., 20 were beef and 20 other chicken meats. Of these, 10 of each type of meat were cooked and the other 10 were raw. The cooked meat samples were defined as the portion of chicken or beef that had been subjected to deep frying or roasting. The fresh samples were collected in an aseptic way, whereby sterile collection bags were used and transported in sterile cool box from the markets to the microbiology laboratory and processed within 30 minutes of arrival.

2.4 Laboratory Analysis

The samples were analyzed in the microbiology laboratory, identified through laboratory ID numbers, from which small pieces were cut randomly and immersed into sterile containers with sterile distilled water and incubated in a shaking incubator for an overnight (12hrs). After 12hrs of incubation, the suspension was inoculated on selective growth media; MacConkey with salt agar (cat. DM141D, Gentaur), Xylose Lysine Deoxycholate (XLD) agar (cat. M031, HiMedia Laboratories), Bile Aesculin (BEA) Agar (cat. 3564184, BioRad) and Mannitol salt (MSA) agar (cat no M352, Sigma Aldrich) and incubated overnight.

Gram staining was performed on the colonies formed, and then confirmatory biochemical tests including catalase (Cat. H1009, Sigma Aldrich), coagulase (Cat. 74226, Sigma Aldrich), ZN staining (Cat 1.09215, Sigma Aldrich), TSI agar (Cat. no DM224D, Gentaur), Citrate (Cat. 211620, McKesson), and SIM agar (Cat. 1514, Sigma Aldrich) were done to identify the bacterial species isolated.

2.5 Data Analysis

Quantitative data was obtained. MS-Excel application software was used to analyze the data and render graphs for visualization purpose.

3. RESULTS

3.1 Isolated Bacterial Species in Both Cooked and Raw Meat from All the Selected Markets

In total of 40 samples, 11 isolates were identified. These included gram-positive cocci: *Staphylococcus spp.* (23.5%), and *Enterococcus spp.* (12.3%); gram-positive rods: *Corynebacterium spp.* (23.5%), and *Mycobacterium spp.* (3.7%); and gram-negative rods: *Serratia spp.* (1.2%), *Citrobacter spp.* (9.9%), *E. coli spp.* (1.2%), *Salmonella spp.* (1.2%), and *Shigella spp.* (1.2%) (Fig. 1).

3.2 Frequencies of the Bacterial Species Isolated

Corynebacterium spp. isolates (31.8%) were highest in cooked meat and *Staphylococcus spp.* (21.1%) were highest in the raw meat. *Serratia spp.* (4.5%), *E. coli* (4.5%), *Salmonella* spp. (4.5%) and *Shigella spp.* isolates (4.5%) were isolated in only cooked meat (Fig. 2).

3.3 Prevalence in the Markets

There were isolates identified from each of all the five markets. Namulanda and Kisubi market had the highest percentage of isolates (23.5%) and (24%) respectively, followed by Kawuku (19.8%) and Abayita (17.3%) then Katabi (16.0%) that had least isolates (Fig. 3).

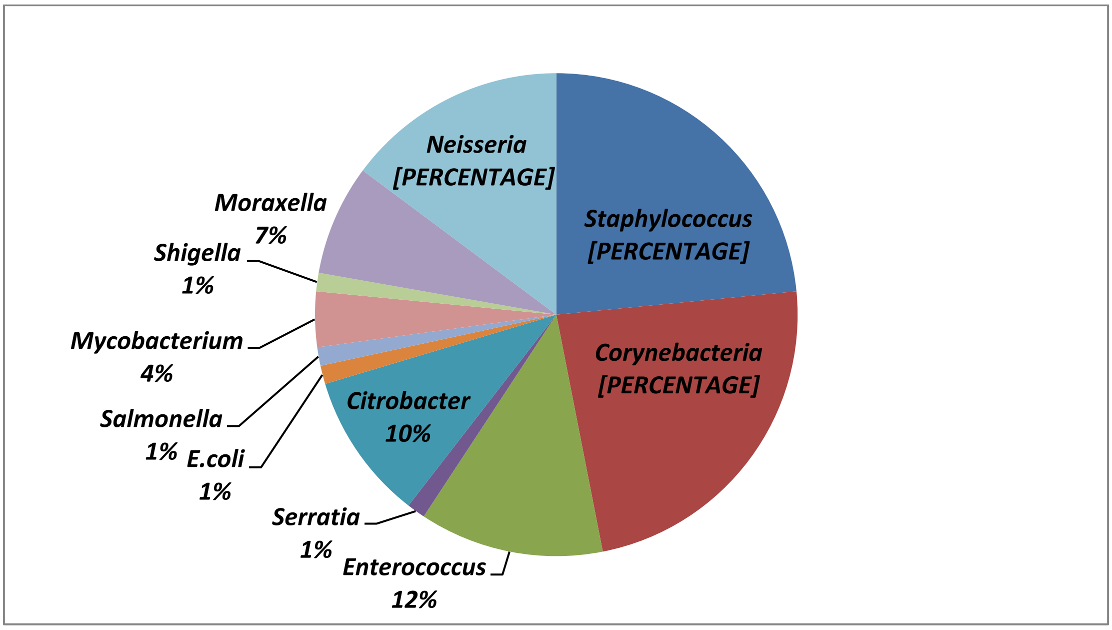

Fig. 1. Percentage of bacteria isolated

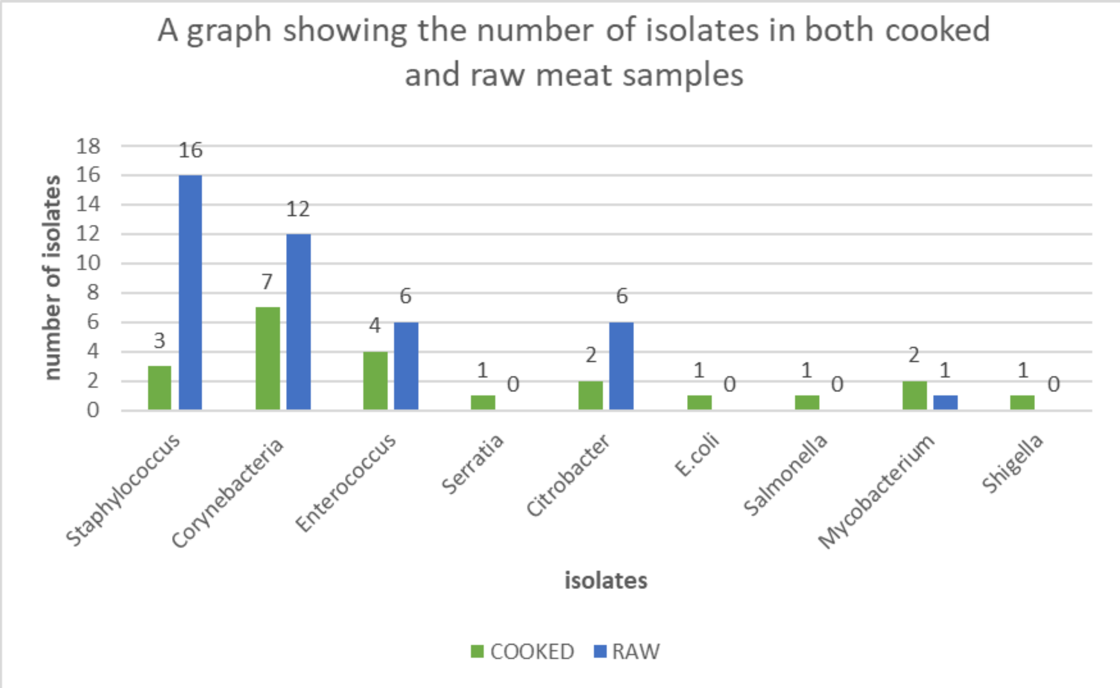

Fig. 2. A bar graph showing the bacteria present in both cooked and raw meat

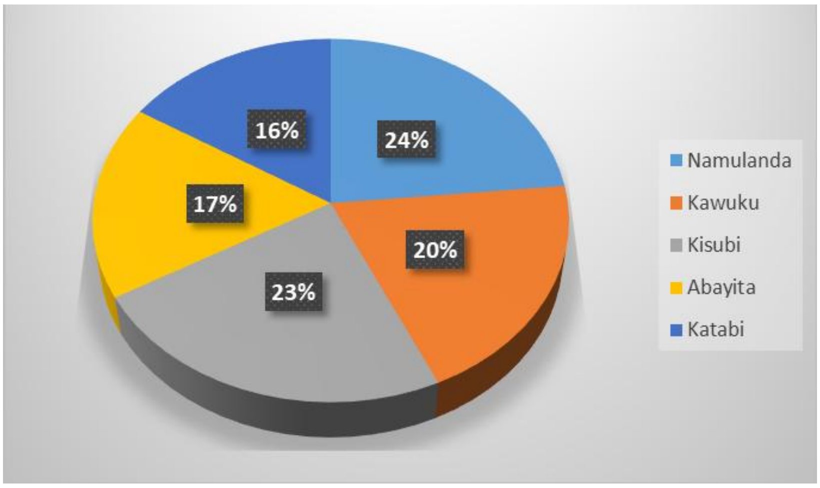

Fig. 3. A pie chart showing the percentage of total isolates per market

4. DISCUSSION

The presence of *Serratia spp., E. coli, Salmonella spp., Shigella spp.* in only cooked meat was indicative of fecal contamination of food during the preparation and handling stages. Enterobacteriaceae like *E. coli, Salmonella spp., Shigella spp.* among others have been reported to be some of the key indicators of fecal contamination in food [10,11]. The bacteria species that were present in both the raw and cooked meat i.e., *Staphylococcus spp., Corynebacterium spp., Enterococcus spp. and Citrobacter spp.* exhibit the undercooking of the meat since they were able to thrive the temperatures at which they were exposed [12-14]. Islam et al 2015 conducted a similar study in Dhaka, Bangladesh and found out that undercooking of food is one of the causes of food contamination with pathogenic microbes [15,16]. The presence of pathogenic microbes in the cooked meet could also be due to cross contamination by the vendors as a result of poor handling and improper vending practices [16].

Some bacteria spp. identified produce heat stable toxins. These include *Staphylococcus* spp. [17], *Enterococcus* spp. [18], *Corynebacterium* spp. [19,20] and *Citrobacter* [21]; some have been identified to cause bacterial nosocomial infections [22-24] and acute infectious disease that affect the upper respiratory tract and occasionally the skin; *Corynebacterium* spp. [25] and others have severe effects among the immune compromised population [26].

The presence of more isolates in some markets than in others portrays the poor hygiene and food handling techniques within these particular sites. This calls for the local government in search localities to provide sanitary facilities like toilets, waste bins, clean water, drainage systems among others to boost the hygiene. The high level of food contamination in some of these markets could also be due to the large proportion of Entebbe residents being ignorant about environmental sanitation as reported by Wandera et al. [27]. Therefore, food vendors in these markets should be sensitized about good hygiene as one of the elements of primary health care.

Recently, there have been several sporadic outbreaks of food borne diseases in urban areas of Uganda [28]. Therefore, the findings of this study add to the urge of conduction of a country wide surveillance on the food borne diseases to understand their causes so that appropriate interventions can be put in place to combat the diseases. In addition to surveillance, the resistance of pathogens identified in this study to the commonly used antibiotics in this area should be researched on to assess the effectiveness of the available interventions in case of any foodborne disease outbreak due to food contamination.

5. CONCLUSION

This study confirmed considerable levels of contamination derived from handling practices and preparation methods. The identified foodborne pathogenic bacteria isolates could pose a public health problem in the locality. Regular inspection, health education and training of vendors on food handling and safety practices are recommended and colony forming units (CFU) should be further researched regarding contamination levels. Food poisoning or intoxication can be prevented by adopting good hygienic practice with proper methods and conditions of food handling, storage, and preservation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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