Presence of Pathogenic Bacteria in Butchering Tables, Slaughtering Pavements and Meat Samples Collected from Slaughterhouses in Ogun State (Western Region), Nigeria

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Abstract: Aim: Bacterial assessment of slaughterhouses (abattoir) in Ogun state: Kara (Berger) and Odo-eran (Abeokuta) was conducted. Methods and result: Swabs of butchering tables, slaughtering pavements and meat samples were obtained from both sites over a period of three months, and examined for their bacterial contents. Both slaughterhouses were found to contain suspected pathogenic bacteria as well as spoilage organisms. The microbial load from samples obtained from Kara abattoir were generally higher than that obtained from Odo-eran abattoir however, pathogenic bacteria isolated from both abattoirs were species of Enterobacter, Staphylococcus, Klebsiella, Pseudomonas, Bacillus, Streptococcus, Salmonella, Proteus, Clostridium, Shigella and Escherichia coli. Conclusion: These findings pose health concerns to meat consumers in Ogun state. However, proper cooking of the meat would destroy most of these pathogens. Significance of Study: This study reflects the need for the Ogun state government's intervention in the rehabilitation of these abattoirs and ensuring that butchers follow already designed international guidelines of slaughtering animals, which would have a significant positive effect on the microbial population and load of meat and meat products obtained from these abattoirs.

Keywords: Abattoirs; pathogenic bacteria in meat; foodborne diseases; butchering tables; slaughtering pavements.

1. Introduction

According to the Oxford dictionary (2007), a slaughterhouse (also called an abattoir) is a facility where animals are killed and processed into meat for food. The animals commonly slaughtered for food are cattle (for beef and veal), sheep (for lamb and mutton), pig (for pork), horse (for horsemeat), goat (for chevon) and fowl, largely chickens, turkeys, and ducks, for poultry meat (USDA, 2000). In the United States, around ten billion animals are slaughtered every year in 5,700 slaughterhouses and processing plants employing 527,000 workers (Williams et al. 2007). In 2007, 28.1 billion pounds of beef were consumed in the U.S. alone (Torres, 2007). In Canada, 650 million of animals are killed for meat annually (Torres, 2007). In the European Union, the annual figure of animals killed for meat is 300 million cattle, sheep, pigs, and 4 billion chickens (Global Action Network, 2008). In Nigeria (as in many developing countries), the discharge of untreated wastewater from slaughterhouses is still a major problem. Wastewaters from abattoirs contain a variety of pathogenic microorganisms, and are directly introduced into neighboring water bodies (streams, ponds and rivers). These water bodies are used by local communities for domestic activities such as cooking, washing and bathing (Adeyemo, 2003). It is as a result of this pollution that environmental pollution and related diseases (especially zoonotic diseases) are caused and transferred (Salama, 1998). Furthermore, the consumption of meat containing various pathogens has shown to be problematic (Jay, 2005; William and Dennis, 2008). These pathogens not only cause various foodborne diseases but also cause spoilage of meat provided the intrinsic and extrinsic conditions are favorable.

Many of these pathogenic bacteria isolated from meat samples are highly pathogenic and cause various diseases. For instance, *Clostridium perfringens* is a common cause of gas gangrene, food poisoning as well as the bowel disease called necrotizing colitis (Loir et al. 2003). It is also known to cause sporadic diarrhea in children aged five years and below (Efutoye and Adetosoye, 2004). Also, *Vibrio* species such as *Vibrio cholerae* causes cholera in humans. Other *Vibrios* causes sepsis or enteritis (Brooks et al. 2004). Also *Salmonella* species are known to cause enteric fevers...
(typhoid and paratyphoid), which are caused by *Salmonella typhi* and *Salmonella paratyphi* respectively and septicaemia which is caused by *Salmonella choleræsus* (Brooks et al. 2004). *Listeria monocytogenes* may cause meningoencephalitis with or without bacteræmia in humans (Brooks et al. 2004). In this study, the presence of these pathogenic microorganisms was screened for in samples obtained from slaughterhouses in Ogun state using conventional microbiological techniques.

### 2. Materials and Method

#### 2.1 Materials

All materials and chemicals used in this investigation were of analytical grade and purchased from Hi-Media Pvt. Ltd, Mumbai, India.

#### 2.2 Selection of Slaughterhouses

Two slaughterhouses were used in this study. These were Kara abattoir (Berger, Lagos, Nigeria) and Odo-eran abattoir (Abeokuta, Ogun, Nigeria). The choice of these slaughterhouses was majorly due to their high patronage by meat consumers (i.e., high commercial activities), and their close proximity to the laboratory (Redeemers’ University, Ogun, Nigeria). Furthermore, the differences in the construction of these abattoirs played a crucial part to their eventual selection. Both abattoirs were local abattoirs as slaughtering of animals was done manually (not mechanically) on slaughtering pavements however, Odo-eran abattoir had tarred road unlike Kara abattoir which was covered with bare soil.

#### 2.3 Collection of samples

Butchering tables and slaughtering pavements swabs, as well meat samples were aseptically collected from slaughterhouses. Sterile cotton swabs (Hi-Media Pvt. Ltd, PW009) were used to aseptically swab both tables and pavements after which the cotton swabs were placed into sample bottles (McCartney bottles) containing 10.0ml of pre-enrichment broth (peptone water)(Hi-Media, Pvt. Ltd, M028). Small cuts of meat were aseptically transferred into sample bottles as well. Samples were collected over a period of three (3) months, at an interval of 27days from each abattoir, and labeled appropriately. Samples were collected in duplicates.

#### 2.4 Isolation of Bacteria

Samples were serially diluted according to standard protocol given by Atlas et al. (1995). Culture media used in this research work were Nutrient Agar (NA)-for isolating aerobic mesophilic bacteria (Hi-Media Pvt. Ltd, M1210), Violet red bile Agar (VRBA)-for enteric bacteria (Hi-Media Pvt. Ltd, M049A), Eosin-methylene blue Agar (EMBA)-for confirming *E.coli* (Hi-Media Pvt. Ltd, M317) and *Salmonella-Shigellosis* (SSA)-for isolating *Salmonella* and *Shigella* (Hi-Media Pvt. Ltd, M108) and were prepared and sterilized according to their respective manufacturers instructions. Inoculation was done by spread plate method (Atlas et al. 1995). Incubation of samples was done at appropriate temperatures and duration (2-5days); NA-30°C (Ercolini et al. 2009), VRBA-37°C (Sawant et al. 2007) and SSA-43°C (Kafel and Bryan, 1977). For anaerobic cultures anaerobic bags (Hi-media, Pvt. Ltd, LE008) were used. Sub-culturing of distinct colonies was done to obtain pure cultures.

#### 2.5 Identification of pure cultures

Identification of bacteria pure cultures was based on colony morphology examination, cellular morphology examination (by gram staining) (Atlas et al. 1995) and biochemical tests. Biochemical tests such as coagulase test, urease activity test, oxidase test, carbohydrate fermentation (sugar fermentation), catalase test, indole production test and citrate utilization test were all performed following the standard protocol given by Atlas et al. 1995.

### 3. Results and Discussion

The abattoirs in Ogun state, Nigeria were examined for the presence of pathogenic bacteria from slaughtered animals (meat) and the environment (Butchering tables and slaughtering pavements). Generally, the microbial load obtained from samples of Kara abattoir was higher than that of Odo-eran abattoir (Table 1 and Table 2). A total of 76 pure isolates were obtained from Kara abattoir while a total of 38 pure cultures were obtained from Odo-eran abattoir. Biochemical tests carried out on all pure cultures obtained from samples gotten from both abattoirs resulted in the identification of suspected species of *Enterobacter*, *Staphylococcus*, *Klebsiella*, *Streptococcus*, *Escherichia coli*, *Clostridium*, *Bacillus*, *Salmonella*, *Shigella*, *Proteus*, and *Pseudomonas*. Table 3 shows the summarized results of biochemical tests used in identifying these bacteria. From Kara abattoir, suspected species of *Enterobacter*, *Staphylococcus*, *Klebsiella*, *Streptococcus*, *Escherichia coli*, *Clostridium*, *Bacillus*, *Salmonella*, *Pseudomonas*, *Shigella* and *Proteus* were all isolated and identified while from samples collected from Odo-eran abattoir species of *Klebsiella*, *Streptococcus*, *Enterobacter*, *Pseudomonas*, *Escherichia coli*, *Proteus* and *Salmonella* were isolated and identified. In Kara abattoir, it was observed that of the 76 pure isolates obtained, *Escherichia coli* had the highest frequency of 16. This was followed by *Staphylococcus sp.*, *Enterobacter sp.*, and *Klebsiella sp.* which had frequencies of 12, 11 and 9 respectively. *Pseudomonas sp.* had a frequency of 7 while *Salmonella sp.*, *Bacillus sp.*, and *Streptococcus sp.* all had a frequency of 5 respectively. Furthermore, *Clostridium sp.*, *Shigella sp.*, and *Proteus sp.* had the lowest frequencies of occurrence of 2 respectively. In Odo-Eran abattoir, it was observed that of the 38 pure isolates obtained, *Klebsiella sp.* had the highest frequency of occurrence of 9. *Streptococcus sp.*, *Enterobacter sp.* and *Pseudomonas sp.* had frequencies of 6, 5 and 5 respectively. *Escherichia coli* and *Proteus sp.* had frequencies of occurrence of 4 while *Shigella sp.* had 3. Finally, *Salmonella sp.* had the lowest frequency of 2.
In this study, the predominant bacteria isolated were *Escherichia coli*, *Salmonella sp.*, *Proteus sp.*, *Pseudomonas sp.*, *Enterobacter sp.*, *Streptococcus sp.*, *Shigella sp.*, *Staphylococcus aureus*, *Klebsiella sp.*, *Clostridium sp.*. This is similar to that reported by Itah et al. (2005), where they observed in Uyo abattoir (Nigeria), that *Staphylococcus aureus*, *Escherichia coli*, *Bacillus cereus*, *Staphylococcus epidermidis*, *Micrococcus roseus*, *Bacillus subtilis*, and species of *Streptococcus*, *Klebsiella*, *Pseudomonas* and *Salmonella* were isolated from meat samples. Also, Adesemoye et al. (2006) had earlier reported that *Bacillus sp.*, *Clostridium sp.*, and *Pseudomonas aeruginosa* were predominant in some Nigerian abattoirs.

Six of the bacteria isolated from both abattoirs were members of the family *Enterobacteriacea* (Escherichia coli, Enterobacter sp., Salmonella sp., Klebsiella sp., Shigella sp. and Proteus sp.). This is not surprising as they are enteric organisms and would have come from the intestinal tract and fecal matters of the slaughtered animals (Jay, 2005). They are also likely to be present in the wash waters as reported by Adesemoye et al. (2006). Several studies have shown the pathogenic effect of most of these enteric microorganisms especially when consumed with poorly cooked meat such as barbequed meat (Loir et al. 2003). Thus the presence of these pathogenic microorganisms in samples obtained from these abattoirs pose a great threat to consumers of meat from these abattoirs in situations of undercooked meat. The ability of some of these pathogens such as *E.coli* to produce heat stable toxins is of great concern as it increases the possibility of consumers suffering from food poisoning. However, individuals who consume properly cooked meats are less likely to suffer from foodborne diseases associated with the presence of these pathogens (Jay, 2005). *Pseudomonas sp.* is a versatile microorganism, having varieties of enzymes that enable it to decompose a variety of compounds found in nature. *Pseudomonas sp.* are generally regarded as part of the microbiota of the soil (however, they are ubiquitous in nature), and its presence in meat samples as well as butchering table and slaughtering pavement indicates contaminations by soil. Although, *Pseudomonas sp.* are generally not known to cause any foodborne diseases, their presence in these samples from both abattoirs however, is...
undesirable as it causes spoilage of meat and serve as an indication of soil contamination and as a result, possible contamination with known human pathogen present in the soil. Examples of such soil dwelling pathogens are *Clostridium sp.* and *Bacillus sp.* both of which were isolated in this study. *Clostridium sp.* is a common cause of gas gangrene and food poisoning as well as the bowel disease called necrotizing colitis (Loir et al. 2003). It is also known to cause sporadic diarrhea in children aged 5 years and below (Efuntoye and Adetosoye, 2004). *Bacillus sp.* is also known to cause food poisoning (*Bacillus cereus*) (Loir et al. 2003). It is however important to note that both of these soil dwelling pathogens were only isolated from Kara abattoir and not Odo-Eran abattoir. The possible reason for this is most likely due to the construction design of these abattoirs. Unlike Odo-eran abattoir where roads were properly tarred and proper drainage systems were constructed, Kara abattoir was un-tarred, lacking proper drainage and as a result, the animals, butchering equipments, wash water were all directly exposed to the soil thus it is most likely that these pathogens were from the soil, or slaughtering equipment (which must have come in contact with the soil), rather than the meat (slaughtered animal).

Food poisoning caused by *Staphylococcus* species is one of the most common causes of foodborne illness due to the widespread occurrence of *S. aureus* and the ability of many strains to produce enterotoxins (Jay, 2005). The presence of *S. aureus* in food and other food products usually indicates contamination by food handlers and in this case animal butchers that may be hosting the pathogen and releasing it to the meat through skin lesions containing *S. aureus*, or releasing the pathogen into the meat either by sneezing or by coughing (Jay, 2005).

*Salmonella* sp. and *Shigella* sp. are known pathogen of humans usually caused when food contaminated with the appropriate strain (in significant numbers) is ingested resulting in food poisoning called Salmonellosis and Shigellosis (Jay, 2005). It has been established that eggs, poultry, meat and meat products are the most common food vehicles of Salmonellosis to humans (Jay, 2005) thus the presence of *Salmonella sp.* in samples obtained from both abattoirs is of great health concern. Foodborne shigellosis is a common foodborne disease and perhaps second only to those caused by *Staphylococcus* and *Salmonella* (Jay, 2005). The ability of some species of this pathogen to produce heat stable enterotoxins (Shigga toxins) has also led to numerous reported cases of food poisoning, especially when meat is poorly cooked or undercooked (Jay, 2005). Consequently, consumption of meat from these abattoirs, in undercooked form is hazardous. Furthermore, the presence of spoilage organisms isolated from meat samples of both abattoirs is also of great concern. In this study, known meat spoilers such as *Klebsiella sp.*, *Bacillus sp.*, *Pseudomonas sp.*, *Clostridium sp.*, and *Proteus sp.* were isolated from meat samples obtained from both abattoirs. It has been reported that species of *Pseudomonas* and *Bacillus* can cause surface slime; aerobic meat spoilage (Williams and Dennis, 2008). Furthermore, species of *Clostridium* has been seen to cause souring of meat (Williams and Dennis, 2008). Putrefaction which is an anaerobic decomposition of protein with the production of foul-smelling compounds such as H₂S can be caused by species of *Clostridium*, *Pseudomonas* and *Proteus* (Williams and Dennis, 2008).

4.Future Scope of Present Study

The present study is one with a major limitation as antimicrobial susceptibility of the pathogens isolated using known antibiotics, was not done due to time and financial constraints. Had this step been done, the information obtained would have shed more light on the possible risk of consuming antibiotic resistant pathogens in meat obtained from these abattoirs and with the advent of multi-drug resistance in various known human pathogens, the importance of this step in subsequent investigations of this manner is important.

5.Acknowledgement

My sincere appreciation goes to the Department of Microbiology, Redeemers’ University, Ogun state, Nigeria, for providing a suitable laboratory where this investigation was conducted.

References


