academicJournals

Vol. 7(12), pp. 441-445, December 2013
DOI: 10.5897/AJFS2013.1108
ISSN 1996-0794 ©2013 Academic Journals
http://www.academicjournals.org/AJFS

African Journal of Food Science

Full Length Research Paper

Assessment of bacteriological quality of cooked pork meat sold along the commercial streets of Nkwen through Bambili Metropolis, Cameroon

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Accepted 19 November, 2013

This study aimed to analyze the bacteriological profile of commercially prepared pork sold along commercial streets of Nkwen through Bambili in Cameroon. A total of 11 duplicate randomly collected pork samples were analyzed microbiologically for bacteria. All the pork meat samples analyzed confirmed the presence of bacterial pathogens, indicating the need for strict implementation of food sanitation practices to reduce the possible risk of transmission of infection on consumption of these prepared pork. The mean microbial load on the cooked pork meat ranged between 1.9×10^4 - 3.8×10^4 cfu/g and total coliform count between 1.1×10^3-3.0×10^3 cfu/g. The bacterial isolated includes: *Staphyloccocus aureus* (81.8%) which was the most predominant, followed by *Klebsiella pneumoniae* (72.7%), *Escherichia coli* (54.4%), *Salmonella* spp. (45.4%), *Proteus vulgaris* (27%) and *Shigella* spp. (9%). The presence of these organisms in cooked pork meat foods should receive particular attention, because their presence indicate public health hazard and give warning signal for the possible occurrence of food borne intoxication.

Key words: Nkwen/Bambili, *Escherichia coli*, pork meat, total coliforms, bacteria.

INTRODUCTION

Pork which is obtained from swine serves as food. It is a major source of protein and fats, and also an important source of vitamins for most people in many parts of the world. In the developing world, food borne infection leads to the death of many children and the resulting diarrheal disease can have long-term effects on children's growth as well as on their physical and cognitive development (Adak et al., 2005). Food borne diseases are diseases resulting from ingestion of bacteria, toxins and cells produced by microorganisms present in food. Pork meat (meat generally) is the most perishable of all important foods since it contains sufficient nutrient needed to support the growth of microorganisms (Magnus, 1981). In most cases, during slaughter, dressing and cutting, microorganisms came chiefly from the exterior of the animal and its intestinal tract but more came from knives, cloths, air, and equipment in general. Food borne microbiologic hazards may be responsible for many cases of illness as possible each year and are thus an important food safety challenge. It has been reported that Gram negative bacteria account for approximately 69% of the cases of bacterial food borne disease (Clarence et al., 2009). Members of the gram negative bacteria e.g. *E. coli* are widely distributed in the environment and are spread through contaminated food and water. The possible sources of these bacteria are likely to come from the skin of the animal from which the meat was obtained. Other potential sources of microbial contaminations are the equipment used for each operation that is performed until the final product is eaten, the clothing and hands of

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personnel and the physical facilities themselves (Rombouts and Nout, 1994). Retail cut could also result in greater microbial load because of the large amount of exposed surface area, more readily available water, nutrient and greater oxygen penetration available (Forest et al., 1985). But there is limited information on the health challenges from food borne diseases from cooked pork meat retailed within a highly commercial community. It was on this basis that it became necessary and essential to give useful information about the bacterial loads in most cooked pork meat sold in the commercial streets of Nkwen through Bambili in Cameroon, which is an indication of the sanitary condition in such area. Although contamination does not necessarily mean food-borne transmission, the possibility of these organisms being a food borne pathogen should be investigated. This current study therefore, focused on assessing, isolating and identifying bacteria in cooked pork meat sold along the commercial streets of Nkwen through Bambili metropolis, Cameroon, with a view to highlight the public health risk and implications of consuming such contaminated pork meat and provide useful information where necessary to the general public and potential approaches for improving the quality assurance and creates awareness among the consumers.

MATERIALS AND METHODS

Study area

The study area was the commercial streets of Nkwen through Bambili metropolis, North West Region, Cameroon. It is one of the most commercial areas in the North West Region due her numerous educational institutions (both secondary and higher institutions).

Sample collection

Eleven duplicates samples of different portions of cooked pork meat were purchased along the commercial streets of Nkwen through Bambili metropolis, Cameroon. The samples were aseptically collected in a clean polyethylene bag and transferred immediately to the laboratory for further bacteriological analysis.

Sample preparations

Ten grams (10 g) of each meat sample was weighed out and homogenized into 90 ml of sterile distilled deionized water using a sterile warring blender. Ten folds dilutions of the homogenates were made using sterile pipettes as described by the methods of Fawole and Oso (2001).

Culturing, enumeration and isolation

Media used in this study included: Nutrient Agar (NA) and Peptone Water (PW) as general and enriched media. Other media with selective and differential characteristics used were Mac Conkey agar (MCA), Eosin M ethylene Blue (EMB), and Kligler Iron Agar (KIA). All media were prepared according to the manufacturer's specification and sterilized at 121°C for 15 min. From the 10-fold dilutions of the well blended sample, 0.1 ml of 10^{-2}, $10^{-3}$and 10^{-4} dilutions of the homogenate was plated on different media (in duplicates), using pour plate method. The plates were then incubated at 37°C for 24 - 48 h. Mac Conkey agar was used for coliform enumeration while Nutrient agar in combination with the catalase and the coagulase test was used for the isolation of *Staphylococcus aureus*. Total viable aerobic bacteria count was performed on Nutrient Agar. At end of the incubation periods, colonies were counted. The counts were expressed as colony forming unit of the suspension (cfu/g).

Identification of isolates

Colonies identified on Eosin Methylene Blue (EMB) agar were carefully examined macroscopically for cultural characteristics such as the shape, color, size and consistency. Bacterial isolates were characterized based on microscopic appearance and colonial morphology. For example, *Esherichia coli* produced colonies with a green metallic sheen on the EMB plates.

Klebsiella produced mucoid colonies, while the swarming growth of *Proteus mirabilis* was exhibited on Mac Conkey agar plates. Gram staining reactions as well as appropriate biochemical tests were performed. Sub cultures on Klinger Iron agar (KIA) showed distinctive charac-teristics on the butt, slope and hydrogen sulphite gas production.

RESULTS

Eleven (11) samples of cooked pork meat along the commercial streets of Nkwen through Bambili metropolis, Cameroon**,** were analyzed microbiologically for the presence of bacteria. Table 1 shows the estimation of the total viable bacterial counts and total coliform counts in pork meat on Nutrient agar and MacConkey agar. The mean total viable count ranged from 1.9×10^4- 3.8×10^4, while total coliform count ranged from 1.1×10^3-3.0×10^3 as shown in Table 1

The isolates were identified as *S. aureus, Klebsiella pneumoniae*, *E. coli*, *Salmonella* spp., *Proteus mirabilis* and *Shigella* spp. by comparing their morphological and biochemical characteristics. *E. coli* produced green methalic sheen on EMB, *Klebsiella* spp. produced mucoid colonies on EMB and also showed distinctive characteristics on the KIA medium. *Salmonella* spp. also showed distinctive characteristics on the KIA medium, producing the black pigments as a result of hydrogen sulphite gas production. *Proteus* spp. exhibited a swarming growth on Mac Conkey agar. *Shigella* spp. showed no mortility, *S. aureus* was catalase and coagulase positive.

Table 2 shows the distribution of bacterial pathogens isolated from cooked pork meat along the commercial streets of Nkwen through Bambili metropolis. It showed that *S. aureus* (81.8%) was the most predominant pathogens. This was followed by *K. pneumoniae* (72.7%), *E. coli* (54.4%), *Salmonella* spp. (45.4%), *P. vulgaris* (27%), and *Shigella* spp. (9%) was less predominant (Figure 1).

Table 1. Total viable bacterial count and total coliform count in cooked pork meat along the commercial streets of Nkwen through Bambili metropolis, Cameroon.

Pork meat samples (PMS)	Mean total bacterial count (CFU/g)	Mean total coliform count (CFU/g)
PMS1	1.9×10^4	1.1×10^3
PMS 2	2.0×10^4	1.2×10^3
PMS 3	2.1×10^4	1.3×10^3
PMS 4	2.2×10^4	1.4×10^3
PMS 5	2.3×10^4	1.5×10^3
PMS 6	2.4×10^4	2.0×10^3
PMS 7	2.5×10^4	2.3×10^3
PMS 8	3.2×10^4	2.6×10^3
PMS 9	3.4×10^4	2.9×10^3
PMS 10	3.8×10^4	3.0×10^3
PMS 11	2.1×10^4	1.5×10^3

Table 2. Distribution of bacterial pathogens in cooked pork meat along the commercial streets of Nkwen through Bambili metropolis, Cameroon.

Pork meat samples (PMS)	Identified isolates
PMS1	*Salmonella* species *Klebsiella* species *Escherichia coli* *Staphylococcus aureus*
PMS 2	*Klebsiella* species *Staphylococcus aureus*
PMS 3	*Klebsiella* species *Escherichia coli* *Salmonella* species
PMS 4	*Klebsiella* species *Escherichia coli* *Proteus mirabilis* *Staphylococcus aureus*
PMS 5	*Klebsiella* species *Salmonella* species
PMS 6	*Proteus mirabilis* *Salmonella* species *Staphylococcus aureus*
PMS 7	*Shigella* species *Staphylococcus aureus*
PMS 8	*Klebsiella* species *Enterobacter* species *Staphylococcus aureus*
PMS 9	*Proteus mirabilis* *Escherichia coli* *Staphylococcus aureus*
PMS 10	*Escherichia coli* *Klebsiella* species *Staphylococcus aureus*

Table 2. Contd.

PMS 11	*Klebsiella* species
	Escherichia coli
	Staphylococcus aureus
	Salmonella species

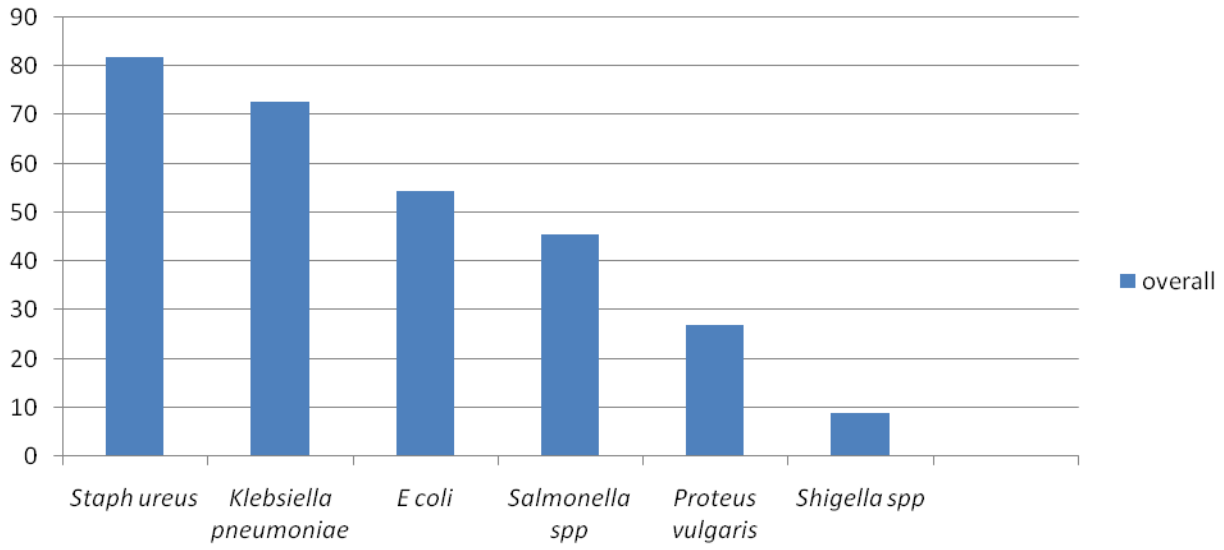

Figure 1. The overall percentage distribution of bacterial pathogens in cooked pork meat along the commercial streets of Nkwen through Bambili metropolis, Cameroon.

DISCUSSION

Pork meat basically contains all the nutrients necessary for microbial growth and metabolism, making it susceptible to microbial contamination. In view of the microbial quality of pork, proper hygiene must be ascertained to ensure safety from infection after consumption of such products and to promote quality assurance. The high total viable counts recorded in this study showed the microbial diversity (differences in form or species) in this area. On comparing the bacterial contamination between the various pork meet samples, the result obtained is on the high side. This is an indication of recontamination in food handling and hygiene techniques (Clarence et al., 2009). The bacteria isolates were identified as *S. aureus, K. pneumoniae, E. coli, Salmonella* spp., *Shigella* spp. *and P. mirabilis* by comparing their morphological and biochemical characteristics.

The presence of these organisms in cooked pork meats depicts a deplorable state of poor hygienic and sanitary practices employed in the slaughtering, processing and packaging of pork meats. The presence of *S. aureus* (81.8%) and *E. coli* (54.4%) in this cooked pork meat samples is an indication of faecal contamination of the pork meats. This might be due to possible contamination of pork meats or meat products itself during sales or unhygienic handling of the pork meats right from the slaughtering, butchering and processing or due to contamination from the skin, mouth or nose of the handlers which can be introduced directly into foods by process line workers, with contaminated hands and arms coming into contact with the food, or by coughing and sneezing.

The isolation of *Salmonella* spp. in this study is of practical impact. This organism might have contaminated the pork meats as a result of handling by pork meat sellers. *Salmonella* species such as *Salmonella typhi* is a bacterium that causes typhoid fever (enteric fever), an acute, life-threatening febrile illness (Centers for Disease Control and Prevention, 2008). The disease is a cause for concern and a major public health problem in developing countries (Asia, Africa) (Ibekwe et al., 2008). It is mainly transmitted through food or drink or water, contaminated with urine or faeces of infected people or a chronic carrier (Centers for Disease Control and Prevention, 2008; Ibekwe et al., 2008).

Conclusion

The findings of this study reveal that cooked pork meat

sold at commercial streets of Nkwen through Bambili, Cameroon is contaminated with bacteria pathogens. The possible source of contaminants, are the unhygienic manner of handling meat from the slaughters to the markets. This also implies that these meats are viable source of various diseases. Some of these diseases could spread and acquire epidemic status which poses serious health hazards. Since improper handling and improper hygiene might lead to the contamination of pork meats and this might eventually affects the health of the consumers. It is therefore suggested that pork meat processors and sellers should be educated on the adverse effect of contamination. However, the processors/-handlers/sellers should observe strict hygienic measures so that they may not serve as source of chance inoculation of microorganisms and fecal contamination of pork meats and other meat products. The need for microbial assessment of pork meats and other meat products processed and packaged for human consumption is therefore emphasized and recommended to reduce possible contamination. Irrespective of the presence of these organisms in cooked pork meat analyzed, it is believed that cooking processes and hygiene could greatly reduce the microbial load to harmless levels.

Thorough cooking as well as good hygiene is in order to prevent contamination of food. It is therefore necessary that we also make the following recommendations from the findings of this study:

1. Meat handlers and sellers should be educated on the adverse effect of lack of proper personal and environmental hygiene and sanitation;
2. Veterinary doctors should inspect the animals to be slaughter before the meat is sold to the general public;
3. Good manufacturing practices should be adhered to strictly by butchers and those selling the meat, the water used in washing the meat should be sterile, also the equipment must be washed properly before use;
4. Further regulatory and educational efforts are needed to improve the safety of produce items (Schroeder et al., 2000).

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