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Microbiological Quality Assessment of Cooked Meat Sold At Garkawa Market of Mikang Local Government of Plateau State, Nigeria

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Abstract: Microbial assessment of mutton, dog and pork meat sold in Garkawa market was carried out in August, 2022. General hygiene during processing, handling and quality measures to minimize bacterial contamination of products sold as test for coliform reflected that dog meat (1.70 x 10 3 CFU/g) had higher total coliform count (TCC) followed by pork (1.04 x 10 3 CFU/g) and mutton (0.44 x 10 3 CFU/g) had the lowest TCC. The organisms isolated from different meat types are: Mutton (Bacillus pumillus, Staphylococcus epidermidis and Klebsiella aerogens); Pork (Staphylococcus epidermidis, Bacillus spp and Bacillus megaterium); Dog (Escherichia coli, Staphylococcus aureus, Klebsiella aerogens and Bacillus spp).The results obtained from the study showed the presence of microorganisms in various levels in meat types collected would might be cable of causing food poisoning. Microbial loads of 2.65 – 3.14 x 10 3 CFU/g are safe for human consumption. High total coliform count in dog meat visualizes mal evisceration processes and insufficient hand washing. To protect public health and strengthen consumer confidence meat vendors should be trained by Nigeria Institute of Animal Science on food safety program.

Key words: Microbial, loads, assessment, meat, contamination

I. Introduction

Meat is exposed to a high risk of microbial contamination at the time of their production, processing, storage and distribution because they contains all nutrients required for the growth of bacteria, yeasts, and molds (Falegan and Oluwaniyi., 2015). Bacteria are seen as the singular most important agents capable of causing spoilage of meat, which is enhanced by a number of intrinsic and extrinsic factors during slaughtering, processing, and storage (Bersisa *et al*., 2019).

Food borne diseases remain an important public health problem worldwide associated with foods from animals' origin. Excessive degree of *Klebsiella pneumonia, Enterobacter sp, Pseudomonas aeruginosa, E. coli,*

Salmonella sp, Serratia marcescens and Proteus vulgaris, Staphylococcus aureus and Bacillus sp has been reported in literature (Okonko, 2010). The presence of fecal coliforms is indicative of fecal infection capable of causing enteric pathogens in particular bacterial pathogens (Anon, 2003).

Micro-organisms in meat and meat products responsible for food borne illness are: *Bacillus sp, Clostridium* sp, *Escherichia coli*, *Salmonella* sp, *Shigella sp, Staphylococcus aureus, Streptococcus pyogenes, Proteus* sp, *Pseudomonas aeruginosa, Leuconostoc* sp, *Lactobacillus* sp, *Micrococcus, Mycobacterium* sp, *Vibrio* sp (Ribah, *et al.*, 2018; *Okoli, et al*., 2018).

The study aimed at isolating food borne diseases, total aerobic bacterial count and total coliform count in mutton, pork and dog meat sold in Garkawa market of Mikang Local Government Area of Plateau State.

II. MATERIALS AND METHODS

Sample collection and Study area

A total of 42 samples of roasted or cooked mutton (14), pork (14) and dogs meats (14) were collected randomly around 2 – 3 pm from meat vendors at Garkawa Market into a sterile polythene bag in August, 2022. It was thereafter transported to the Microbiology Laboratory of National Veterinary Research Institute Vom, Plateau State, Nigeria for microbiological analysis.

Bacterial Load Count

Eight (8) test tubes were arranged and labeled 10^1, 10^2, 10^3 ... 10^8 and 9ml of distilled water was added to each test tube and 1ml of the meat sample was added to the 1st test tube and subsequently 1ml drawn from the 1st test tube into the 2nd and then 1ml was picked from the 2nd into the 3rd up to the 8^{th} test tube after which 1ml was discarded from the 8^{th} test tube. 1ml from the 8th test tube was then picked and poured into sterile nutrient agar, was spread and allowed to soak before incubating at 37^0C for 24 hours. The plate was counted using Stuart colony counter after incubation was completed.

Colony forming unit (CFU/ml)

Colony forming units (CFU/ml) was calculated as numbers of colonies multiply by dilution factor divided by volume of culture plate (International Commission on Microbiological Specifications for Foods, 1996).

Microbiological analysis

Total aerobic bacteria count CFU/g (TABC), total coliform count CFU/g (TCC) and Escherichia coli count CFU/g (ECC) as hygiene indicators was carried out as reported in the microbiological guidelines specified in the Process Criteria and Ingredient Standard of Livestock Products (QIA, 2013).

Experimental Treatment and Design

Three meat types: mutton, pork and dog were used as treatments 1, 2, and 3 respectively. Each treatment was collected from eight different meat retailers to serve as replicates. Completely randomized design (CRD), one way analysis of variance was used for investigation.

Statistical Analysis

Data collected on total aerobic bacterial count CFU/g (TaBC) and total coliform count CFU/g (TCC) were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) as packaged in SPSS 21.0 computer software programme. The means were separated using Duncan's Multiple Range Test option of the same software package (SPSS, 2012). Data collected on bacteria isolates were reported using percentage occurrences.

III. RESULTS AND DISCUSION

Table 4.1: Microbial count loads of animals' meat sold at Garkawa market.

Microbial loads in CFU/g	Meat types			SEM	P.value
	Mutton	Dog	Pork		
TABC	2.65×10^{3b}	3.06×10^{3ab}	3.14×10^{3a}	0.15	0.01
TCC	0.44×10^{3b}	1.70×10^{3a}	1.04×10^{3ab}	0.17	0.00

*a, b Means on the same row with different superscripts are significantly different (P< 0.05), SEM = Standard error of mean, TAPC = Total aerobic bacterial count, TCC = total coliform count

Microbial count loads of mutton, dog and pork meat sold at Garkawa market is presented in Table 1. Total aerobic bacterial count and total coliform counts were significantly (P<0.05) different between meat types. Total aerobic bacteria count (TaBC) of pork meat (3.14×10^{3a}) was significantly (P<0.05) higher followed by dog meat (3.06×10^{3ab}) and mutton (2.65×10^{3b}) though statistically similar. Higher total aerobic bacteria count in pork meat may suggest estimation of bacterial population due to poor hygiene but no specific information from a particular organism can be garnered from TaBC. TaBC is use as an indicator in assessing microorganism in meat. But Total aerobic bacteria count of $2.65 – 3.14 \times 10^3$ reported in this study was less than standard plate count of pork reported by Anachinaba *et al.* (2015) as $2.5 \times 10^4 – 6.2 \times 10^6$ CFU/g and the recommended limit of bacterial counts of 10^5 CFU/g of the International Standards for Micro-organisms in Foods (ICMSF, 2011). However, total aerobic bacteria counts higher than recommended standard may render meat unsafe for consumption.

However, higher total bacteria count of pork might be connected to practice of inadequate hygiene, mal handling and unhygienic working equipment by sellers. This finding was in consonant with the inquiry of Upadhyaya *et al.* (2012) that reported excessive handling of carcasses by too many people, by keeping more than two kinds of meats in a shop without proper separation. Total aerobic bacteria count reported in this study will provide useful information on general quality and shelf-life of meat sold in Garkawa market.

Testing for coliform count in meat sold in Garkawa market serve as a reflection of general hygiene during processing, handling and quality measures to minimize bacterial contamination of products sold reflected that dog meat (1.70×10^3) had higher total coliform count (TCC) followed by pork (1.04×10^{3ab}) and mutton (0.44×10^3) had the lowest TCC. High total coliform count in dog meat visualizes mal evisceration processes and insufficient hand washing. Contaminated water used in washing slaughtered meat may be view as main drivers for the presence of disease causing organisms on meat sold in Garkawa market. Total coliform counts in this study is used as pointer for hygiene of meat sold, although total coliform bacteria themselves do not necessarily cause harmful illnesses, but their presence in meat sold indicates that water used in washing and cooking will likely contain other additional destructive pathogens. The microbial load of 10^3 reported in this study is below 10^5 microbial guide lines for meat (Gilbert *et al*., 2000). ICMSF (1996) reported less than 10^2 per g as acceptable coliform counts.

Table 4.2: Percentage occurrence of isolates from mutton, pork and dog meat

Meat types	Identified isolates	Frequency	Percentage
Mutton			
	Bacillus pumillus	8	44.44
	Staphylococcus epidermidis	8	44.44
	Klebsiella aerogens	2	11.11
Pork			
	Staphylococcus epidermidis	4	40.00
	Bacillus spp	4	40.00
	Bacillus megaterium	2	20.00
Dog			
	Escherichia coli	8	50.00
	Staphylococcus aureus	4	25.00
	Klebsiella aerogens	2	12.50
	Bacillus spp	2	12.50

Percentage occurrence of bacteria isolated from mutton, pork and dog meat is as presented in Table 4.2. The presence of *Staphylococcus epidermidis* was noted in mutton and pork meat with the highest percentage occurrence of 44.44% and 40.00% respectively, this might be a potential source of wound infection as consumption of contaminated food is a major route for the transmission of this organism. Presence of *Klebsiela aerogens* in mutton (11.11%) and dog meat (12.50%), this might predict end users to likely suffer from urinary tract, pneumonia and blood stream infections. Amongst the sample size *Bacillus spp* had 40.00% and 12.5% respectively for pork and dog meat. This suggested that *Bacillus spp* had the possibility of causing gastrointestinal illness emetic syndrome. *Bacillus megaterium* (20.0%) a non pathogenic bacterium was found in dog meat. It is an insignificant contaminant. In mutton, *Bacillus pumillus* which is associated to food borne disease and *Staphylococcus epidermidis* an opportunistic pathogen that cause wound infections had the highest percentage occurrence while *Klebsiella aerogene* a pathogenic bacterium that cause infection in the lungs, bladder and liver had the least percentage occurrence. *Bacillus pumillus*, *Staphylococcus epidermidis* and *Klebsiella aerogene* are important opportunistic pathogens, primarily causing health care-associated infections to the consumers of mutton. Their presence if invades the human body via consumption ready to eat food might be poisonous.

Escherichia coli reported in this study via dog meat have the possibility of predisposing meat to contamination with pathogenic Escherichia coli because of biochemical composition of meat that makes it ideal for rapid proliferation of bacteria once contaminated.

IV. Conclusion

Bacterial contaminations of 2.65 – 3.14 x 10^3 CFU/g are safe for human consumption since they are less than the bacterial count limit of 10^5 recommended by International Standards for Micro-organisms in Foods (2011). On general notes meat sold in Garkawa market were exposed to flies that could serve as sources of contaminations.

Bacillus pumillus, *Staphylococcus epidermidis* and *Klebsiella aerogene* were identified as important opportunistic pathogens, primarily causing health care-associated infections to the consumers of mutton. Improper food handling practices and consumption of undercooked meat is likely one of the major cause of meat-borne outbreak. Food - borne diseases encompass a wide spectrum of illness and are growing public health problem worldwide.

V. Recommendation

Meat handlers in Garkawa market should be educated on the unhelpful effect of lack of proper personal, environmental hygiene and sanitation. The best solution to reduce microbial growth and contamination of vendors food (meats) is by setting up food safety program (use of safe water and equipment, separate raw meat from cooked, cook thoroughly and keep meat in netting environment) to protect public health and strengthen consumer confidence. All meat sellers and handlers should be trained by Nigeria Institute of Animal Science on food safety program.

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