

Microbial quality of beef sold on selected markets in the Tamale Metropolis in the Northern Region of Ghana

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Abstract

The microbial quality of beef sold in five most popular meat shops in the Tamale Metropolis was assessed in order to ascertain its safety. The meat shops were selected from Aboabo, Central (external), Central (internal), Nyohini, and Sakasaka markets. The total bacterial count was used as index of quality. A total of 100 beef samples were collected in two successive visits. The samples were stored under 4 °C for transportation to the laboratory. Microbiological analysis was carried out immediately upon arrival in the laboratory under aseptic conditions.

Beef samples from Sakasaka had the highest mean total bacterial count of 1.67×10^6 cfu/cm², followed by Aboabo (5.75×10^5 cfu/cm²), Central Market (internal) (4.325×10^5 cfu/cm²), Nyohini (3.875×10^5 cfu/cm²) and Central Market (internal) (4.325×10^5 cfu/cm²). While their mean log counts were 6.22, 5.76, 5.64, 5.59 and 5.57 for Sakasaka, Aboabo, Central Market (internal), Nyohini and Central Market (internal), respectively. Bacterial species isolated from the beef samples were *Escherichia coli*, *Streptococcus* species, *Salmonella* species and *Staphylococcus* species.

Keywords: beef, meat shops, microbiological quality and safety

Introduction

Cattle are found almost everywhere in Ghana, however, concentrations of cattle rearing can be found in the coastal, transitional and guinea savannah zones, where tsetse-fly infestation is reasonably less. Cattle rearing in the Northern Region plays an important role in the livelihood of most Ghanaians especially those originating from the North. They serve as a source of employment and income to those who rear them. They are also regarded as family's property to rely on in times of financial difficulties and payment of dowry. They are a source of food in the form of beef and contribute significantly to the protein intake of most Ghanaians. Generally, cattle are kept more by small to medium scale farmers for beef production, milk and as draught animals using communal lands for grazing (MOFA 2002).

Despite the roles cattle rearing plays in the livelihood of most Ghanaians and the contribution to the daily protein intake, beef can be a source of food-borne illnesses especially under the condition in which animals are handled, slaughtered, transported and sold on Ghanaian markets. Prescott et al (2002) shown that food items especially meat, are not only of high nutritional value to those who consume them but often are ideal culture media for microbial growth. Meat is one of the most

perishable foods, and its composition is ideal for the growth of a wide range of spoilage bacteria (Mayr et al 2003). Mukhopadhyay et al (2009) also reported that fresh raw meat like beef have been implicated for a number of meat borne infections and intoxications in several countries. This is because both pathogenic and non-pathogenic organisms live in the gastro-intestinal tract of cattle which can be transferred onto the meat under faulty and poor processing conditions.

In Ghana, a number of abattoirs and meat processing units are under standard and operated without adequate quality control systems. Meats are normally transported to the markets either in meat vans, taxi's, motor cycle and bicycles. Furthermore meats are sold in the open markets sometimes in sieves or without sieves, and on tables that are not well maintained or cleaned after work. This exposes the meat to a number of pathogens some of which may be pathogenic or non-pathogenic.

In order to ascertain this, the present study was undertaken to evaluate the microbial quality of beef sold in some selected market in the Tamale Metropolis of Ghana and to identify the possible sources of contamination.

Materials and method

Study area

This study was carried out in five markets selected from the Tamale Metropolis, the capital town of the Northern Region of Ghana. Tamale Metropolis covers an area of 930 km² with a population of about 300,000 and growth rate of 2.5% (Ansah et al 2009). The dominant ethnic group is Dagomba with Dagbani being the widely spoken local language.

Sources of beef samples

A total of five major meat shops where most people prefer to buy beef were selected for this study. The meat shops selected were at Sakasaka, Nyohini, Central market (external), Central market (internal) and Aboabo.

A total of 100 beef samples were collected in two successive visits. The samples were collected into sterile plastic bags and transported under 4 °C in a Coleman box filled with ice to prevent further contamination. The samples were analyzed immediately upon arrival in the laboratory.

Microbial analysis

Microbiological analysis was carried out in the Spanish laboratory of the University for Development Studies, Tamale, Ghana. Total bacterial count was determined using the pour plate method. Beef surfaces were swabbed with cotton swabs and pooled swabs were inoculated into 10 ml 0.1 % peptone water and homogenized for 2 minutes. Decimal serial dilutions were made by transferring 1 ml homogenized samples into 9 ml 0.1 % peptone water. 0.1 ml of each homogenized serial diluted sample was pipetted into empty petri dish and about 12- 15 ml of molten plate count agar (PCA) at 45 ±1°C was poured on it. This was then mixed thoroughly by rotating the petri dish gently. The agar was allowed to solidified and then incubated at 37 °C for 24 hours. After incubation the colonies were counted to determine the colony forming unit per centimeter square cfu/cm².

Identification and isolation of bacteria species was done according to the method employed by Ansah et al (2009). Bacteria colonies were further identified and confirmed using gram staining and biochemical tests such as catalase, oxidase, lysine iron agar and triple sugar iron.

Observation

The general sanitation in the handling and sale of beef at retail points within the Tamale Metropolis was assessed. Also, the hygienic condition of the environment at the retail point was observed and recorded.

Results and discussion

The quality of beef samples were determined using total viable count and the identification of bacteria such as *Escherichia coli*, *Streptococcus* species, *Salmonella* species and *Staphylococcus* species. Table 1 shows the mean total aerobic bacteria counts and their log obtained from the various markets.

Table 1. Total aerobic bacteria counts obtained from the various meat shops in the selected markets

Meat shop	Mean bacterial count, cfu/cm ²	Mean log
Sakasaka	1.67×10^6	6.22
Aboabo	5.75×10^5	5.76
Central Market (internal)	4.325×10^5	5.64
Nyohini	3.875×10^5	5.59
Central Market (external)	3.725×10^5	5.57

Table 2 shows the general of bacteria isolated from the various markets.

Table 2. Genera of bacteria found on beef surfaces from the various markets

Meat Shop	Bacteria identified
Nyohini	<i>Streptococcus</i> spp., <i>Salmonella</i> spp.
Central Market (external)	<i>Streptococcus</i> spp., <i>Salmonella</i> spp., <i>Escherichia coli</i>
Central Market (internal)	<i>Streptococcus</i> spp., <i>Salmonella</i> spp.
Sakasaka	<i>Staphylococcus</i> spp., <i>Streptococcus</i> spp., <i>Salmonella</i> spp.
Aboabo	<i>Salmonella</i> spp., <i>Streptococcus</i> spp., <i>Escherichia coli</i> , <i>Staphylococcus</i> spp.

Sakasaka

This area had the highest mean bacteria count of 1.67×10^6 cfu/cm². Even though the highest number of aerobic bacteria was enumerated from this market, the count was below 10^7 - 10^8 for which spoilage of meat is apparent (Warriss 2001; Teye and Okutu 2009). Nevertheless meats sold on Sakasaka market can be said to be near spoilage.

The genera of microbes isolated were *Staphylococcus* spp., *Streptococcus* spp. and *Salmonella* spp. which are disease causing organisms.

It was observed that, Sakasaka had no exact area where beef were sold and as such the butchers/meat sellers were scattered on the streets. These butchers/meat sellers advertise their meats on wooden tables which were not neat, the environment was littered with bones and the butchers themselves appeared dirty. It was also realised that some of the butchers/meat sellers here were illegally slaughtering cattle on their own without any inspection by a qualified inspector.

Aboabo

Aboabo had a mean bacterial count of 5.75×10^5 cfu/cm², the second highest after Sakasaka. The microbial load recorded was relatively better than that of Sakasaka.

However all the genera of microbes isolated thus *Streptococcus* spp., *Staphylococcus* spp., *Escherichia coli* and *Salmonella* spp. which are known to be disease causing organisms (James et al 2000) were found in this market.

This area has a big market where the butchers shop was located just by the road side. Meat contamination may be from the dust from the road side, flies, cross contamination from the chopping tables and the way the meat is transported from the abattoir to the shop.

Central market (internal)

This place had an average microbial count of 4.325×10^5 cfu/cm² which is less than 10^6 cfu/cm² to cause spoilage (Warriss, 2001). The genera of microbes isolated were *Streptococcus* spp. and *Salmonella* spp.

In the central market, the meat shops are located within a long block building housing numerous butchers with their meat displayed on tables and mortar – like structures. The building is well aerated with wire mesh covered windows. This seems to reduce the number of flies within the building. The meats sold here are obtained from the Tamale abattoir. The main sources of contamination may be the unsterilized tables and the handling of the meat with unsterilized instruments such as knives.

Nyohini

The mean viable count for this area was 4.3×10^5 cfu/cm² and the genera of bacteria isolated were *Salmonella* spp. and *Streptococcus* spp. In this market, a small building close to the road side was being used as a slaughter slab and at the same time as a meat shop.

The meat here is placed on tables which are not well cleaned after a day's work and in the open with houseflies hovering around beef. The shop is located next to a busy street with vehicles blowing dust with all sorts of contaminants on the meat. The butchers themselves pay little concern on their personal hygiene and serve the meats with dirty hands, and clothing. There were no storage facilities located within the vicinity. Leftover meat is smeared with blood to make it look fresh and sold to unsuspecting customers.

Central market (external)

This area had the least mean microbial count of 3.725×10^5 cfu/cm². Even though their numbers were below the spoilage causing limit, the meat could be unwholesome if not properly cooked. The genera

of microbes isolated here were *Streptococcus* spp., *Salmonella* spp. and *Escherichia coli*.

Meat shops here were located nearer to the main central market. Beef were displayed in small kiosks built with wood and covered with wire mesh. The butchers here were better clothed and meat is handled with care. Nonetheless, their clothes were still untidy, tables and chopping boards looked like they have not been cleaned for a long time. Weighing scales are occasionally wiped with the same dirty cloth.

The sources of contamination here may come from the slaughter process, through meat handling and transportation to the market. Cross contamination from tables, knives and weighing scale to other beefs is also possible.

The muscle tissues of healthy animals are free of microorganisms. However the muscle tissues are easily contaminated with both pathogenic and non-pathogenic microorganisms at the time of slaughter under poor processing conditions. In addition the high nutritive value of meat makes it an ideal medium for bacterial growth (Prescott et al 2002).

It was evident from the study that beef sold is contaminated with various genera of bacteria with *Salmonella* spp. and *Streptococcus* spp. being the most abundant probably due to the poor handling by butchers, storage and environmental conditions. The mean viable count found on the beef showed that all the beef from the meat shops was not spoiled since counts were 10^6 cfu/cm² or less. Nevertheless the isolation of pathogenic organisms like *Salmonellas* which are important food-borne pathogen is of public health concern. Consumers are therefore at risk of consuming beef from the various meat shops around Tamale Metropolis although adequate cooking (cooking to an internal temperature of 75 °C for 15 minutes) will kill these pathogens.

Possible sources of contaminations may come from the cutting knives, intestinal contents, chopping boards, hides, meat handlers, containers, vehicle for transportation carcasses and the meat selling environment. In the Tamale Metropolis of Ghana, Sulley (2006), reported that the vehicles and trucks for transporting carcasses are inadequate, compelling others to use motor-bikes and bicycles as a means of transport. The same researcher reported that the few transports are not properly cleaned and thus contained high microbial loads. Ansah et al (2009) found various levels and numbers of total bacteria count, *Streptococcus* spp., *Staphylococcus* spp., *Bacillus* spp., *Escherichia coli*, *Micrococcus* spp., *Diplococci* spp. and *Corynebacteria* spp. on eggs sold in the Tamale Metropolis.

Cattle and carcass handling coupled with microbial contamination of beef samples have also been reported in other developing countries. In Ethiopia, Kumar et al (2010) found a high total aerobic plate (APC) count of 75.91 % in beefs produced and marketed in some parts of Tigray region. They also reported that a high percentage of samples (varying from 38.56 % – 84.34 %) were of unsatisfactory quality. Sharma et al (1993) identified different organisms like *Staphylococcus aureus*, *Escherichia coli*, *Bacillus* spp. etc. from beef carcasses in Pondicherry, India. In Oja-gboro, Nigeria, Raji (2006) reported a total bacterial count of 3.5×10^4 cfu/g, Enterobacteriaceae count of 2.9×10^4 cfu/g, *Staphylococcus aureus* count of 2.05×10^4 cfu/g and *Escherichia coli* count of 3.8×10^1 cfu/g on dried sliced beef locally called 'Kilishi'

Conclusion

- The high bacteria count and diversity of bacterial isolates from the samples tested is an indication of its low bacteriological quality, and this can make it a potential source of food infection.
- The general sanitary conditions at the meat shops in addition to poor hygienic practices by the butchers are probable contributors to the microbial contamination on the beef.
- Standard hygienic practices are therefore recommended at both pre- and post-production stages
- Ensuring good hygienic standard at the various meat shops in the metropolis should be a shared responsibility between government, consumers and retailers

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