



## Microbial quality of chevon and mutton sold in Tamale Metropolis of Northern Ghana

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**ABSTRACT:** The microbial quality of 80 meat samples made up of 40 chevon and 40 mutton were collected from the Aboabo, Central-internal, Central-external, and Sakasaka meat shops in Tamale Metropolis and assessed in order to ascertain its safety. Chevon from Aboabo and mutton from the Central market-internal had the highest mean total aerobic bacterial count of  $3.9 \times 10^6$  cfu/cm<sup>2</sup> and  $3.7 \times 10^6$  cfu/cm<sup>2</sup>, respectively. The lowest total aerobic count in chevon was found in the Central-internal ( $6.0 \times 10^5$  cfu/cm<sup>2</sup>) and that of mutton was found in Sakasaka market meat shop ( $6.0 \times 10^5$  cfu/cm<sup>2</sup>). Bacteria isolated from the samples were *Escherichia coli*, *Streptococcus* species, *Salmonella* species, *Enterococcus* species, and *Staphylococcus* species, some of which harbor human pathogens of public health concern. The isolation of various bacteria in chevon and mutton sold in the Tamale Metropolis indicates that, lower standard of operating systems in the slaughtering, processing and sale of meats are adhered to. The Government of Ghana, Ministry of Health and Ministry of Food and Agriculture should enforce the laws that prohibit the illegal slaughtering of animals without veterinary inspection, unstandardized methods of handling animals, slaughtering and selling of meats on the open market. @JASEM

Small ruminants (sheep and goats) are reared all over Ghana. Their production plays an important role in creating employment, generating income and providing food (chevon and mutton). Teye and Salifu (2006) reported that sheep and goats are slaughtered mostly during Christmas, Islamic festivals and months prior to the farming season. Chevon and mutton are therefore popular meats in Ghana, which are cherished by most Ghanaians. These meats are normally cut into pieces, weighed in pounds and then sold in the open market to consumers.

Although chevon and mutton play a significant role in the livelihood of most Ghanaians, they can be important source of food-borne human pathogens and subsequently food-borne diseases due to the poor handling conditions of meat in most Ghanaian markets. In addition meat which is rich in protein is a good medium for growth of microbes. For instance, Mayr *et al.* (2003) showed that meat provides an ideal condition for the growth of different spoilage bacteria thus making meat very perishable.

Consumer awareness for food that is microbiologically safe is increasing tremendously in developed countries, which is not the case observed in most developing Africa countries. Therefore there is the need to produce meats that are of better quality and disease free especially in most developing Africa countries.

This study was therefore undertaken to assess the level of microbial contamination in chevon and mutton sold in four most popular meat sale points in the Tamale Metropolis in the Northern Region of Ghana.

### MATERIALS AND METHODS

**Sampling:** Chevon and mutton were purchased from four well known and most popular meat selling points in the Tamale Metropolis namely: Aboabo, Central-internal, Central-external, and Sakasaka markets. The

samples were collected into sterile plastic bags, stored under 4 °C in a cool man box filled with ice and transported to the laboratory immediately after collection. Microbial analysis was also carried out immediately upon arrival in the laboratory.

**Total aerobic plate count:** For the total bacterial counts, carcass swabs (pooled swabs) of meat sample were added to 10 ml of 0.1 % peptone water and homogenised for 2 minutes. Subsequently, decimal serial dilutions from  $10^{-1}$  to  $10^{-7}$  were made in 9 ml 0.1 % peptone water using 1 ml aliquot. Plating was done on plate count agar and incubated aerobically at 37 °C for 24 hours before colonies were counted and reported as colony forming unit per cm<sup>2</sup> (cfu/cm<sup>2</sup>). Number of colony forming unit per cm<sup>2</sup> was calculated using

Formula:  $N = \Sigma C / [1 * n_1 + (0.1 * n_2)] * (d)$   
where  $N$  = Number of colonies per cm<sup>2</sup>;  $\Sigma C$  = Sum of all colonies on all plates counted;  
 $n_1$  = Number of plates in first dilution counted;  $n_2$  = Number of plates in second dilution counted;  $d$  = Dilution from which the first counts were obtained.

**Salmonella species:** For the isolation of *Salmonella* species, the samples were pre-enriched in buffered peptone water (incubated aerobically at 37 °C for 24 hours), followed by enrichment in rappaport and vassiliadis broth (incubated aerobically at 42 °C for 24 hours) and plating onto xylose lysine deoxycholate agar (incubated aerobically at 37 °C for 24 hours).

**E. coli:** 1 ml aliquots of  $10^{-1}$  to  $10^{-2}$  were also spread on McConkey agar. Plates were incubated at 37 °C for 24 hours under aerobic conditions. Presumptive *E. coli* were confirmed using Gram staining and appropriate biochemical tests.

**Staphylococcus, Streptococcus and Enterococcus species:** For the *Staphylococcus*, *Streptococcus* and *Enterococcus* species, bacteria colonies with different

morphology (based on their appearance) on plate count agar were picked and purified on nutrient agar. They were then confirmed using Gram staining and required biochemical tests.

**Identification and confirmation of bacterial isolates:** The bacteria colonies obtained were purified on nutrient agar. They were then identified and confirmed using Gram staining and biochemical tests such as motility, catalase, coagulase, indole, citrate utilisation, MR-VP, oxidase, urease, gelatin hydrolysis and sugar fermentation.

## RESULTS AND DISCUSSION

The total aerobic bacterial count varied with place of collection and from sample to sample. Table 1 shows the total aerobic count for the various markets. The total bacterial count for chevon ranged from  $6.0 \times 10^5$  to  $3.9 \times 10^6$  cfu/cm<sup>2</sup> and that of mutton was  $6.0 \times 10^5$  to  $3.7 \times 10^6$  cfu/cm<sup>2</sup>. Chevon from Aboabo meat shop had the highest total aerobic bacteria count of  $3.9 \times 10^6$  cfu/cm<sup>2</sup> followed by mutton from the Central market-internal with  $3.7 \times 10^6$  cfu/cm<sup>2</sup>. Chevon and mutton from Central market-internal and Sakasaka respectively, had the lowest aerobic bacterial count of  $6.0 \times 10^5$  cfu/cm<sup>2</sup>.

**Table 1:** Total aerobic count of Chevon and mutton from the various meat shops

Meat Shop	Mean Bacterial Count (cfu/cm <sup>2</sup> )	
	Chevon	Mutton
Central Market (internal)	$6.0 \times 10^5$	$3.7 \times 10^6$
Central Market (external)	$3.2 \times 10^6$	$6.5 \times 10^5$
Aboabo	$3.9 \times 10^6$	$3.3 \times 10^6$
Sakasaka	$7.5 \times 10^5$	$6.0 \times 10^5$

The meat samples had microbial contamination from different genera. The genera are *Streptococcus* spp., *Staphylococcus* spp., *Enterococcus* spp., *Salmonella* spp. and *Escherichia coli*. Table 2 shows the genera of bacteria isolated from the various samples from the different meat shops. *Salmonella* species were isolated from all the chevon samples sold at the various markets. In mutton, *Salmonella* species were

isolated from all the market except Central market-internal. *Escherichia coli* were also isolated from three of markets except the central market-external.

*Enterococcus* was only identified in mutton sold in the Central market-internal. It has been showed that the meat tissue surfaces carry heterogeneous microbes with different load and composition (Jay, 1996; Upmann *et al.*, 2000).

The bacterial counts for the meat samples were generally high although they were below  $10^7$  where spoilage of meat occur (Warriss, 2001). Thus meats sold in the Tamale Metropolis are not spoiled. Nevertheless the isolation of *Salmonella* spp., *Staphylococcus* spp., *Streptococcus* spp. and *E. coli* can be worrying because certain strain of these bacteria causes food-borne infections. *Salmonella*, *Staphylococcus*, *Streptococcus* spp. and *E. coli* infections can be contracted through consumption of contaminated chevon and mutton. *Salmonellas* are important causes of gastroenteritis. Symptoms of *Salmonella* infection in healthy human beings include fever, diarrhoea, abdominal pain, and sometimes vomiting. *Staphylococcus* spp. can be part of normal flora on the skin of humans and animals which can be transmitted from person to product through unhygienic practices (Postgate, 2000). *Staphylococcus* spp. cause infections such as arthritis, black pox, boil, bronchitis, bumble foot, carbuncle, cystitis, endocarditis, meningitis, osteomyelitis, pneumonia, and scalded skin (Stuart, 2005). Others cause food poisoning resulting in severe vomiting and diarrhea. Some *Streptococcus* spp. cause sore throat, scarlet fever and in its most virulent form necrotizing fasciitis (Warriss, 2001). *Escherichia coli* causes illness ranging from gastrointestinal tract-related complications such as diarrhea, dysentery, urinary tract infection, pneumonia and even meningitis (Johnson *et al.*, 2006), although majority of the *Escherichia coli* strains are non-pathogenic and exists in the intestinal tract of humans and animals.

**Table 2:** The genera of bacteria isolated from the chevon and mutton meat samples

Meat Shop	Bacteria Identified	
	Chevon	Mutton
Central Market (internal)	<i>Staphylococcus</i> spp., <i>Salmonella</i> spp.	<i>Escherichia coli</i> , <i>Enterococcus</i> spp.
Central Market (external)	<i>Escherichia coli</i> , <i>Salmonella</i> spp.	<i>Staphylococcus</i> spp., <i>Salmonella</i> spp.
Aboabo	<i>Salmonella</i> spp., <i>Staphylococcus</i> spp.	<i>Escherichia coli</i> , <i>Salmonella</i> spp., <i>Streptococcus</i> spp.
Sakasaka	<i>Streptococcus</i> spp., <i>Salmonella</i> spp.	<i>Escherichia coli</i> , <i>Salmonella</i> spp., <i>Streptococcus</i> spp.

The presence of the isolated bacteria can be traced back to the handling and processing methods of meat in the Tamale Metropolis. Animals are slaughtered in abattoirs and sometimes in backyards without observing strict hygienic

practices. It is also a common practise to see people carrying carcasses just after dressing on their bare shoulders. Meats are normally transported to the markets either in meat vans (not be well maintained), taxi's, motor

cycle and bicycles. 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. Butchers and meat sellers pay little attention to their personal hygiene and serve meats with dirty hands and clothings.

Ansah *et al.* (2006) found various levels and numbers of total bacteria counts, *Streptococcus* spp., *Staphylococcus* spp., *Bacillus* spp., *Escherichia coli*, *Micrococcus* spp., *Diplococci* spp. and *Corynebacteria* spp. on eggs sold in the Tamale Metropolis. A work on milk, raw cheese and fried cheese by Iddrisu (2007) in the Tamale metropolis also indicated the presence of *Escherichia coli*, *Streptococcus* spp. and *Staphylococcus* spp. on the sample. Kutah (2010) also found *Escherichia coli*, *Streptococcus* spp., *Salmonella* spp. and *Staphylococcus* spp. in beef sold in the Tamale Metropolis.

Chevon and Mutton contamination by various microorganisms have also been reported in other countries by different authors. In Chennai City, India, Selvan *et al.* (2007) found that the mean total viable count was significantly greater in mutton products than all other products (chicken, pork and beef) studied. In Australia, Millard and Rockliff (2000) reported a prevalence of 22.2 %, 0.0 %, 0.0 % and 0.0 % for *E. coli*, *Salmonella* sp., *L. monocytogenes* and *Campylobacter* sp. respectively in Mutton. Mukhopadhyay *et al.* (2009) tested 23 chevon samples, out of which five samples (21.74%) yielded *Staphylococcus aureus*. They did not isolate any *Salmonella*, *Vibrio* and *Clostridium* species. In addition, they isolated *Corynebacterium* sp. from 2 chevon and 1 beef samples. Sharma *et al.* (1993) and Mukhopadhyay *et al.* (1998) also identified *Staphylococcus aureus*, *E.coli*, *Bacillus* sp. from chevon and beef carcasses.

To reduce microbiological load on meat carcasses sold in the Tamale Metropolis, standard operating methods should be practised. Such methods include screening of butchers, meat sellers and all who handle meat on regular basis on their health status. In addition well maintained meat vane, selling tables covered with nets, thoroughly cleaned and regularly sterilized knives, aprons and all equipments meats come into contact with should be used. Apart from these, meats cooked to an internal temperature of 70 °C for 15 minutes will help in killing all bacteria before consumption.

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