

# Microbial quality of table eggs sold on selected markets in the Tamale municipality in the Northern Region of Ghana

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## Abstract

A study to assess the microbial quality of table eggs sold in the Tamale Metropolis was carried out in four selected markets. The markets were Kuku Tamale central, Lamashegu and Aboabo markets. A total of three hundred eggs were randomly and aseptically collected. The pour plate method was used in culturing the egg content and shell.

A total of 482 microbes were isolated and it comprised 384 bacteria and 98 fungi. The bacteria isolates belong to seven (7) genera, among them are *streptococcus*, *staphylococcus*, *bacillus*, *micrococcus*, *cornyebacteria* and *diplococcus*. Two genera of fungi were also isolated these were *Mucor* and *Aspergillus*. The mean log viable count ranged from 7.26-7.56, 6.54-6.93, 7.18-7.36 and 6.9-7.3 for Kuku, Lamashegu, Aboabo and Tamale central respectively.

**Keywords:** Bacterial, egg content, egg shell and fungi

## Introduction

Ghana's economy is agricultural based and about 80% of the population is dependent on subsistence economy (World Health Report 2001). In this sector animal rearing especially commercial poultry plays, an important role in the creation of jobs and generating income and also provide food in the form of meat and eggs. In Ghana, animal protein constitutes about 5% of average daily diet (FAO 1993), and its consumption per person per day is 13.7g compared with the world average of 24.5g (FAO 1998).

The use of eggs in human diet includes pastries, stews and beverages. (Osei-Somuah et al 2003). Eggs have been considered to be highly nutritious containing high levels of vitamins and minerals. Applegate (2000) reported that eggs contribute only 1.3% of the total calories in the American diet but substantial amount of high quality protein, foliate and riboflavin as well as number of other nutrients in excess of the caloric contribution. It was reported that among egg consumers, eggs contributed 10% to 20% of dietary folate and 20% - 30% of Vitamins A, E, and B-12. (Applegate 2000)

Unfortunately the positive nutritional value of eggs was reduced with the discovery that they are a source of dietary cholesterol. Though eggs are considered as complete food for growth and sustenance, a lot of work done indicated that micro-organisms often contaminate eggs (Osei-Somuah et al 2003). Several factors have been implicated in egg contamination. Among these are faeces of the birds, litter material, egg crates, packing and storage. Others are cloths and hands of poultry workers, dust, the environment, weather conditions, transporting and marketing. Among the

common contaminant organisms pathogenic to human beings are *Salmonella* spp, *Staphylococcus* spp, *Gram positive Bacillus*, *Mucor*, *Corynebacteria*, *Aspergillus*, *Escherichia coli* and *Diplococci* (Osei-Somuah et al 2003).

In Ghana, the environmental conditions combined with the poor hygiene that characterize poultry or egg production favour the survival and proliferation of micro-organisms.

Increase consumption of table eggs in the urban centre demand investigation into egg contamination. Thus the main objective of the study is to isolate and identify microorganisms of table eggs sold in selected markets in the Tamale Metropolis.

## **Materials and methods**

### **Study area**

The study was carried out in the Tamale Metropolis, which is the capital of the Northern Region of Ghana. The population of Tamale city is about 300,000 with a growth rate of 2.5% (Ghana Statistical Service 2002).

Tamale lies in the Guinea-savanna belt with only one rainy season from April to September, followed by a prolonged dry season which lasts usually from November to March. Maximum day temperatures range from 33°C - 42°C while minimum night temperatures range from 20°C - 22°C. Average relative humidity is 89% during the day and 94% in the night. Apparently due to the unfavorable weather condition commercial poultry production is not extensively practiced with most of the eggs consumed in the metropolis coming from Brong Ahafo Region (Dufie 2003).

### **Source and collection of table eggs**

Four major markets in the Tamale Metropolis namely Aboabo, Lamashegu, Kukuo, and Tamale central market were selected for the study. Three hundred (300) eggs were randomly selected from five retailers in each market, fifteen eggs from each of retailer. Sampled eggs were collected during the month of February and May 2007. The mean temperature and humidity values during the study period were 38.5.1°C and 90% respectively (SARI, Nyankpala 2007). The sampled eggs were sent to the Central Veterinary Laboratory at Pong-Tamale and the University for Development Studies (UDS) Bacteriology laboratory where the various bacteria and fungi were isolated and identified.

### **Preparation of sample**

Ten (10) eggs were randomly sampled from the total eggs collected from each market. Swabs were taken from each egg on the shell using sterile cotton swab soaked in 0.1% peptone and was moistened in the nutrient broth medium and spread on each of the media. For the egg content, one (1) ml of homogenized egg (yolk and white) content was added to each of four media thus, nutrient agar, blood agar, nutrient broth, and McCartney agar. All the media were prepared following the manufacturers instruction and sterilized by autoclaving at 121°C for 20 minutes.

### **Cultures from the surface of eggs**

For the culture of bacteria on the surfaces of the eggs, cotton wool swab, on each occasion was moistened in the nutrient broth medium and used to rub the surface of the eggs, after which the material swabbed is transferred into each of the four media. After streaking out on each of the plates,

they were then incubated at 37°C overnight. The choice of the eggs to be cultured was randomly done.

### **Cultures from egg content**

In the culture of the contents of the eggs, surface of each of the eggs was first disinfected with 70% ethanol. With a sterilized hammer or hard object, each of the eggs to be cultured was broken and the content of the egg thoroughly mixed. A sterilized cotton wool was then introduced into the content, mixed well and transferred onto each of the four media plates. Two plates were used for each egg. Thus, duplicated samples were prepared.

For total viable counts, PCA plates showing colonies between 30-300 were selected and counted using electronic colony counter. Impure colonies on primary culture were sub-cultured onto fresh media for purification. Mix culture on McCartney and blood agar were sub-cultured to enhance identification.

### **Identification of organisms**

After incubation and culturing, the morphology of organisms was studied for size, shape, outline, color, and changes on various media. Standard microbiological techniques including cellular morphology and staining, among others, were used to identify the organism isolated. Bacteria were stained using Gram stain and examined for Gram reaction using light microscope of X100 with oil immersion. Fungi were identified by colonial and cellular morphology using lacto cotton blue staining technique.

### **Determination of total viable count (TVC)**

For total viable count, the pour plate method was used. One (1) ml each of the neat sample from the shell and content was serially diluted by ten (10) fold into four other McCartney bottles each containing 9ml of sterile 0.1% blank peptone water. Different pipettes were used for the various dilutions. One (1) ml of each dilution was aseptically transferred into McCartney bottle each containing 10ml of molten plate count Agar (PCA) kept in a water bath at 50°C (Collins et al 1989). This was mixed by rotation and poured into sterile Petri dishes to set.

## **Results and discussion**

### **Micro-organisms present on eggs**

All the forty (40) groups of eggs sampled had microbes from different genera on the shell; however, there were only a few growths when the egg contents were cultured. These growths were isolated from eggs from all the markets. The bacteria genera included *Streptococcus*, *Staphylococcus*, *Escherichia coli*, *Corynebacteria*, *Gram-positive bacilli*, *Micrococcus* and *Diplococci*. There were fungi growths on some of the media, the genera included, *Aspergillus* and *Mucor*.

It was noted that all the forty (40) groups of eggs sampled and cultured had microbial growths producing a total 482 isolates. These were made up of 384 bacteria and 98 fungi belonging to 7 and 2 genera of bacteria and fungi respectively. The bacteria genera included *Streptococcus*, *Staphylococcus*, *Bacillus*, *Escherichia*, *Micrococcus*, *Diplococci* and *Corynebacteria* (Table. 1).

**Table 1.** Genera of bacteria and fungi found on egg shell and egg contents

Markets	Isolates	
	Shell surface	Shell content
Kukuo	Staphylococcus	Escherichia coli
	Streptococcus	Aspergillus
	Bacillus	
	Aspergillus	
Lamashegu	Staphylococcus	Corynebacteria
	Streptococcus	Mucor
	Bacillus	
	Aspergillus	
	Mucor	
Aboabo	Staphylococcus	Streptococcus
	Streptococcus	Escherichia coli
	Escherichia coli	
	Aspergillus	
Tamale central	Staphylococcus	Escherichia coli
	Streptococcus	Aspergillus
	Escherichia coli	
	Aspergillus	
	Diplococci	

The fungi isolated were *Aspergillus* and *Mucor* (Table1). The distribution of the 384 bacteria isolates was Tamale central 60, Kukuo 191, Aboabo 88 and Lamashegu 45. For 98 fungi, the distribution was as follows: Tamale central 16, Kukuo 49, Aboabo 22 and Lamashegu 11.

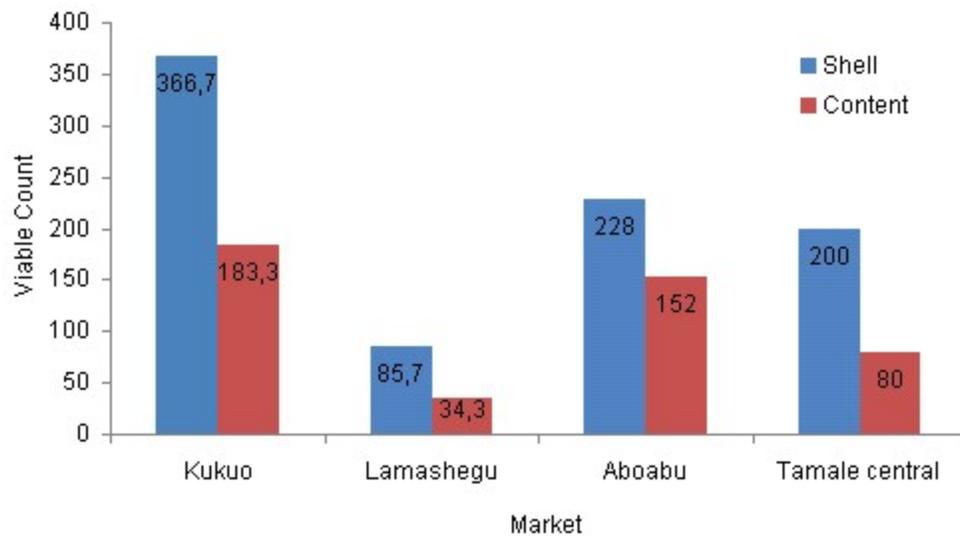
### Microbial isolates from the various markets

#### *Kukuo market*

The result obtained showed microbial growth on all the samples. The microbes isolated include, *Streptococcus*, *Staphylococcus*, *Escherichia coli*, *Bacillus* and *Aspergillus*. All the microbes isolated and identified are pathogenic to man and they can persist on and in the egg for a longer period under harsh conditions.

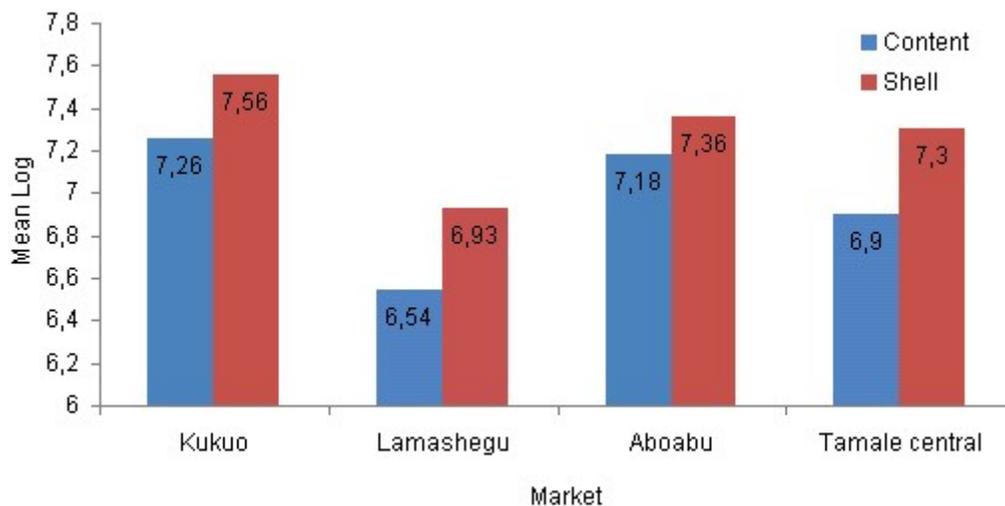
Four genera of bacteria and a genus of fungi, namely, *Aspergillus*, *Escherichia coli*, *Streptococcus* and *Staphylococcus* were isolated. *Aspergillus* and *Escherichia coli* were isolated from the content but *Aspergillus* was isolated from both the shell and the content. This agrees with the report of USDA (2006), that, microorganisms can be found on the outside of egg shell. This may be due to the fact that the egg emerges from the hens body through the same passageway feces is excreted, Microorganisms inside an un-cracked or whole egg may be due to the presence of pathogens within the hen's ovary or oviduct before the shell forms around the yolk and albumin. Fecal contamination could also occur through the pores on the shell after they are laid.

The mean total viable count for the content and shell were higher than the accepted  $10 \times 10^5$  gm/cfu (Figure 1) as recommended by the International Commission on the Microbiological Specification for Food (ICMSF) (1998).



**Figure 1.** Mean total viable count for microbes isolated

The contamination could be attributed to the unplanned and unhygienic conditions in the market. The high mean log of 7.26 (Figure 2) recorded for the isolate of egg content and 7.56 (Figure 2) for the egg shell is above the ICMSF value of 6.00.



**Figure 2.** Mean Log of Total Viable Count for Microorganisms Isolated

The absence of standard structures and drainage system in the market and the relatively high humidity could have contributed to the high microbial growth. It was also found out that most retailers do not store eggs in refrigerators, thus the eggs are exposed to weather conditions, resulting in their contamination. The isolated microbes could cause severe health problems like, diarrhoea, nausea and abdominal pain, since they are pathenogenic.

Osei-Somuah, (2003), also isolated and identified similar microorganism from the southern part of the country confirming that these organisms can survive under different conditions i.e. 4 °C and 60° C. However, *Salmonella* was not isolated and this suggested that all the eggs were *Salmonella* free. This may be attributed to the fact that poultry farmers practice strict medication and care, (Dufie 2003).

### **Lamashegu market**

Microorganisms that were isolated and identified from the sampled eggs from Lamashegu market include *Staphylococcus*, *Streptococcus*, *Bacillus*, *Corynebacteria*, *Mucor* and *Aspergillus*. (Table 1). *Mucor* was found on both the shell and in the content. This may be due to the fact that the eggs were improperly stored for a long time. Etches (1992), reported that, as eggs stay longer, their resistance reduced enabling these organisms to penetrate into the egg content. Warm and moist litters, poor condition in the farmhouses and retail outlets were reported to be sources of fungi growth and sporulation (Arthur and Osei-Somnah 2001).

Lamashegu market had the least mean total viable count of  $34.3 \times 10^5$  gm/cfu from the egg contents and  $85.7 \times 10^5$  gm/cfu from the shell (Figure 1). However, the mean log of total viable count ranged from 6.54 to 6.93 (Figure 2) for egg content and shell respectively which were above the recommended ICMSF value.

Sanitation is very poor as all sorts of animals enter and leave the market freely. Retailers store eggs in an open room without any standard storage facilities. These conditions favour microbial growth because microbes grow within a range of 4°C and 60°C.

The *Staphylococcus*, *Streptococcus* and *Corynebacteria* which were isolated from the samples are often implicated with fecal contamination. These could be of great health concern since species of these bacteria cause diarrhoea and fever, in the hosts (Arthur and Osei-Somuah 2001 and Riley et al 1979). *Bacilli species* are known to be a causative agent for food-borne gastroenteritis, emetic and diarrhea syndrome (Kramer and Gilbert 1989). *Mucor* is also known to cause metastasis lesion in the viscera (Stewart and Beswick 1971).

### **Aboabo market**

Aboabo market is the largest market in the metropolis with poor facilities and high population density. The market is enclosed, with poor sanitation and structures which do not allow conducive buying and selling.

The mean viable count  $152 \times 10^5$  gm/cfu from the content and  $228 \times 10^5$  gm/cfu (Figure 1) from the shell which exceeds the ICMSF of  $10 \times 10^5$  gm/cfu this means that eggs from the market are highly contaminated with microbes like *Streptococcus*, *Escherichia coli*, *Staphylococcus*, *Micrococcus* and *Aspergillus*.

*Escherichia coli* is known to contaminate the surface of egg while mechanical process can spread the bacteria through eggs and meat. Contamination with the pathogen while in the field, occur through improperly decomposed manure, contaminated water and poor hygienic practices of the farm workers. *Escherichia coli* causes mastitis, urinary tract infection, meningitis, pneumonia and peritonitis (Johnson et al 2006).

The mean log of the total viable count of 7.18 from the content and 7.38 (Figure 2) from the shell exceeds the standard of 6.00, which makes eggs from the market unsafe for human consumption.

### **Tamale central market**

The market is located at the central business center of Tamale. The structures are clustered and enclosed with poor sanitation.

The microbes isolated and identified include, *Staphylococcus*, *Streptococcus*, *Escherichia coli*, *Aspergillus* and *Diplococcus*. *Escherichia coli* were from the egg content and shell as reported by Etchers (1992).

Most retailers from the metropolis buy their eggs from this market, which has become the center of distribution. The mean total viable count for both shell  $200 \times 10^5$  gm/cfu and content  $80 \times 10^5$  gm/cfu (Figure 1 2) and mean log of total viable count both exceeded the recommended levels of  $10 \times 10^5$ , and 6.00 respectively, which suggest that eggs from the market must be consumed with caution. Due to the poor sanitation coupled with enclosed nature of the market, eggs have the tendency to absorb any bad odor and dangerous gasses from the market.

Retailers display eggs on unclean tables which can be a source of infection. It was also noted that eggs are transported to the metropolis by no standard transporting system which can be a source of infection and retailers store eggs in an open rooms without any refrigerators.

## Conclusion

- Findings from this study showed that eggs sold are highly contaminated partly due to handling by retailers, storage and environmental conditions.
- The mean total viable count and mean log were higher than the acceptable limits of  $10 \times 10^5$  and 6.00 as set by the International Commission on the Microbiological Specification for Food (ICMSF), showing a hazardous implication on the health of egg consumers as well as the unacceptable standard of egg production which falls below FAO/WHO standards.
- Since most of the organisms isolated are pathogenic to human, consumers are at a high risk of infection
- Though the eggs were highly contaminated, the absence of *Salmonella organisms*, which is a major concern in the poultry industry, is reassuring.

## Recommendations

- Ensuring good hygienic standard at the various markets and farmhouses in the metropolis is a shared responsibility between stakeholders, government, consumers and retailers.
- Retailers in particular should be impressed upon to endeavor to store and retail their eggs under refrigerated or good sanitary condition to reduce microbial contaminations.
- Consumption of raw eggs and half cooked eggs should be discouraged to reduce infection in consumers.

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