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Effects of time of meat purchase on the level of microbial contamination of beef from retail points in Samaru market, Zaria-Nigeria

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Abstract
The meat retail selling points are the major places where people usually purchase meat from morning through to evening at retail points in Samaru, Zaria. A total of 100 meat samples were collected from five different retail meat selling points in Samaru market Zaria, Kaduna state. Twenty samples were obtained from each retail point (10 samples in the morning and 10 in the evening). The meat samples were tested for total aerobic and coliform plate counts to determine the effect of time on the level of microbial contamination. The result of the study shows that there was a statistically significant difference ($P<0.05$) between the aerobic plate counts of samples obtained in the morning and those of samples obtained in the evening. Similarly, there was a statistically significant difference ($P<0.05$) between the total coliform counts of the morning and evening samples. This suggests that there were increases in both total aerobic and coliform plates counts from the morning samples compared to evening samples. The minimum aerobic plate counts (6.0 $\log_{10}$ CFU/g) obtained exceeded the permissible value of (5.7$\log_{10}$ CFU/g) while minimum coliform counts (4.7 $\log_{10}$ CFU/g) exceeded the permissible value of (2.7 $\log_{10}$ CFU/g). This is of serious public health concern. It was concluded that there were increases in level of total aerobic and coliform counts in the meat samples obtained in the evening compared to those obtained in the morning and the minimum counts of both aerobic and coliform counts in morning and evening samples exceeded the minimum acceptable level in all the five retail points. The study demonstrated that it is better to purchase meat from retail points in the morning than evening because of the observed increase in microbial loads in the evening samples which increases the chances of meat-borne infection to consumers.

Keywords: Aerobic, coliform counts, meat, retail points.

Introduction

Contaminated meat may be responsible for several meat-borne diseases in humans (Umoh, 2002). Meat contamination may originate from animal sources (Addo & Diallo, 1981), food contact surfaces such as tables, utensils and equipment (Bello & Son, 2009) and environmental conditions where animals are processed (Olanike, 2002). In beef carcass processing, bacterial organisms such as *Escherichia coli* increases or decreases during processing depending on level of fecal contamination of live cattle, efficiency of evisceration (Rigobelo *et al*., 2006), and hygienic practices in the abattoir (Rigobelo *et al*., 2006). Other organisms commonly encountered in meat contamination are *Salmonella spp.*, *E. coli* O157:H7 and *Listeria spp.* (Addo & Diallo., 1981; Mc Envoy *et al*., 2003; Declan *et al*., 2004). Public health concerns in meat safety with regards to consumer health have resulted in recall of contaminated products from market-places associated with microbial and especially bacterial pathogens (Sofos, 2003). To ensure safe and wholesome meat to consumer at all the stages of processing, good hygiene practice and standard operating procedures must be instituted up to the methods of packaging, distribution and marketing of the meat and meat products. Meat must be free from bacterial cross contamination and extrinsic contaminants such as toxin, chemical residues that will be injurious to human (Olugasa *et al*., 2000).

Raw beef sold at retail outlets in Nigeria undergo a considerable amount of handling and contact with microbes of different sources (Umoh *et al*., 2002). Keeping meat at ambient temperature for a longtime which is commonly done by meat retailers in the market may allow multiplication of pathogenic

bacteria (Umoh *et al.*, 2002). Detection of total coliform and *E. coli* as bio- marker organisms in food is widely applied in many food control laboratories (Enne de Boer, 1998). Meat can be assessed with respect to microbiological safety by estimation of the growth of *E. coli* (Greer *et al.*, 1994).

The objective of this study is to determine level of total coliform and aerobic plate count at different periods of the day from meat sold at retail points in Samaru market, Zaria Nigeria and to enumerate generic *E. coli* from the meat as indicator organism.

Materials and methods:

Study area: The study was conducted in Samaru, Zaria Kaduna state. Ten different meat retail points were identified and simple random sampling technique by balloting with replacement were used to select five retail points and are tagged as points A, B, C, D and E.

Description of retail points

The meat retail point is an open space in the market where meat is sold on wooden table under aluminum roof shade. The meat is not covered.

Sample collection

About 100g of meat sample was collected from each retail point in the morning and evening. A total of 100 samples were collected, 20 from each retail point. If a sample was collected from retail point in the morning, another sample was collected from the same point on the same day in the evening making total of 10 samples in the morning and a total of 10 samples in the evening. The meat samples were collected on every other day for period of 20 days. The time of sample collection in the morning was 7:00am to 11:00am and evening was 4:00pm to 6:00pm. Samples were collected in sterile polythene bags and were labeled as A, B, C, D and E according to the retail point identification and were transported to the laboratory immediately for total aerobic, coliform plate counts and *E. coli* isolation.

Laboratory procedure

A portion of 10 grams from each sample was collected using a weighing balance and homogenized with 90ml of 0.1% sterile peptone water in sterile transparent polythene bags using a stomacher (Stomacher L.B 400 U.K). A 10 fold serial dilution was carried out using 1ml of the homogenate and 9ml of sterile physiological saline solution (pss). About 0.1 ml of 10^5 dilution factor was inoculated into nutrient agar plate (Oxoid) and dilution of 10^3 was inoculated into MacConkey agar plate (Oxoid) for total aerobic plate counts and total coliform counts respectively. The plates were incubated at 37^0C for 24 hours. Colonies on nutrient agar plate were enumerated and expressed in $\log_{10}$ colony forming unit per/gram (CFU/g) of meat sample ($\log_{10}$ CFU/g). Colonies that appeared pinkish on MacConkey agar plate were considered to be members of coliform organisms and were enumerated and the counts expressed in $\log_{10}$ colony forming unit per/gram of meat sample ($\log_{10}$ CFU/g) Dilution of 10^3 was also inoculated into eosin methylene blue (EMB) agar plate and incubated at 37^0C for 24hours. For isolation of generic *E. coli*, colonies that appeared bluish with green metallic sheen were considered as *E. coli* (Grant *et al.*, 1996) and were then further characterized biochemically based on methods of Barrow & Feltham (1993).

Statistical analysis

All microbial counts obtained from both morning and evening samples were transformed to $\log_{10}$ values for subsequent data analysis. Descriptive statistics was used to analyze data obtained to find means, standard deviation and range. Using Microsoft office excel (2007), the total coliform and aerobic plate counts were subjected to t-test for paired samples to compare means for significant difference between the morning and evening samples.

Results

From the 50 samples collected in all five points, the mean of total aerobic plate counts enumerated in the morning was 7.6 log10 CFU/g and in the evening was 7.9 log10 CFU/g. For coliform, the mean total counts from all the five points in the morning were 5.4 log10 CFU/g and in the evening is 7.6 log10 CFU/g. The minimum value obtained for total aerobic plate counts in the morning samples was 6.0 $\log_{10}$ CFU/g and maximum value 8.5 $\log_{10}$ CFU/g. For the evening samples minimum value was 7.0 $\log_{10}$ CFU/g and maximum value was 8.7$\log_{10}$ CFU/g. For total coliform counts minimum value obtained in the morning was 4.7 $\log_{10}$ CFU/g and maximum values was 6.4$\log_{10}$ CFU/g while the evening samples the minimum value enumerated was 5.1$\log_{10}$ CFU/g and maximum values was 7.0 $\log_{10}$ CFU/g. The frequency of isolation rates of generic *E. coli* from the meat samples shows the highest of 17(85%) from retail point E and lowest is 12 (60%) from retail point B (Table 3). The total aerobic and coliform plates counts both in the morning and evening samples was high and there was statistically significant difference when compared the morning samples and corresponding evening samples ($P<0.05$) (Table 1 and 2).

Table 1: Mean total aerobic plate counts in the morning and evening samples from five different retail points.

Retail points	Total aerobic plate counts Log_{10} cfu/g Mean ± SD	
	Morning	Evening
A	7.69 ± 0.53	8.12 ± 0.35
B	7.13 ± 0.28	7.69 ± 0.39
C	7.51 ± 0.23	8.02 ± 0.49
D	7.86 ± 0.52	8.06 ± 0.43
E	7.66 ± 0.39	7.98 ± 0.43

t- Test paired two sample ($p<0.05$) was considered significant

Table 2: Mean total coliform plate counts in the morning and evening samples from five different retail points.

Retail points	Total coliform plate counts Log_{10} cfu/g Mean ± SD	
	Morning	Evening
A	5.39 ± 0.37	6.08 ± 0.35
B	5.49 ± 0.34	6.17 ± 0.41
C	5.70 ± 0.37	5.88 ± 0.53
D	5.27 ± 0.31	5.62 ± 0.35
E	5.22 ± 0.26	6.07 ± 0.22

t- Test paired two sample ($p<0.05$) was considered significant.

Table 3: Isolation rates of *Escherichia coli* from five different points for the both morning and evening samples.

Retail points	Number of samples	No of samples positive for *E. coli* (%)
A	20	15 (75)
B	20	12 (60)
C	20	16 (80)
D	20	14 (70)
E	20	17 (85)
Total	100	74 (74)

Discussion

The meat processed in the abattoir before transporting to market or retail points has considerable number of microbes (Ajogi *et al*., 2005), these microbes can multiply during transportation or at the retail point depending on the nature of transportation or how it was handled and kept at retail points. The result of this study reveals that there was significant difference in total aerobic and coliform plate counts between the morning and evening samples which suggest there was significant increase from the morning counts. This increase of microbial counts may be attributed to the manner in which the meat is being transported and considerable amount of handling and contact with equipment at retail points similarly keeping meat at ambient temperature for a longtime which is commonly done by meat retailer in the mark*et al*low multiplication of bacteria since the meat is good source of nutrient and also it already contains small number of microbes on it. This demonstrates that it is better to purchase meat from retail points in the morning than in the evening because of the effect of increase in level of microbial counts in the evening. However, there was high total aerobic and coliform plate counts with minimum value of 6.0 log_{10} CFU/g, maximum value of 8.7 log_{10} CFU/g, minimum value of 4.7log_{10} CFU/g and maximum value of 7.0 log_{10} CFU/g respectively. The minimum value of total aerobic plate count has exceeded the permissible value of 5.7 log_{10} CFU/g (Ajogi *et al*., 2005). Similarly the minimum value for total coliform counts exceeded permissible value of 2.7 log_{10} CFU/g (Ajogi *et al*., 2005). Presence of high coliform counts and high isolation rate of *E. coli* (Table 1) from the meat samples indicates poor hygienic practice, possible faecal contamination and poor handling of meat at meat retail points and possible potential presence of highly pathogenic microorganism such as *Salmonella*, *Listeria* and *E. coli* O157:H7 and this is of public health concern.

It was concluded that there were increased in level of total aerobic and coliform counts in the meat samples obtained in the evening compared to those obtained in the morning and the minimum counts of both aerobic and coliform counts in morning and evening samples has exceeded the minimum

level in all the five retail points. Finally the study demonstrated that it is better to purchase meat from retail points in the morning than evening because of the observed increase in microbial loads in the evening samples which increases the chances of meat-borne infection to humans.

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