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Pattern of microbial contamination of meat during meat display at the Bodija meat market, Ibadan, Nigeria

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Abstract

The pattern of microbial contamination of meat carcasses on display on wooden tables over a period of 90 minutes at the Bodija meat market was studied. This is to understudy the role of meat display methods on meat contamination. Swab samples were taken from four wooden meat display tables and meat carcasses on them at intervals of 30 minutes for a period of 1 hour 30 minutes and cultured on nutrient agar and Macconkey agar to determine the total aerobic counts (TAC) and coliform counts (TCC) over time. The result showed that the mean log TAC and TCC increased significantly ($P<0.05$) on the wooden meat display tables by 0.11 and 0.30 log CFU/cm^2 respectively and on the meat carcasses by 0.29 log CFU/cm^2 each over the 1 hour 30 minutes period. There is a direct relationship ($r = + 1$) in the pattern of microbial growth (TAC and TCC) on the wooden meat display tables and meat carcasses on display with time. This is suggestive of a common extraneous source of contamination of both the meat display tables and meat displayed on them. It is therefore recommended that meat carcasses should be hygienically displayed by preventing direct exposure to air and other environmental conditions so as to minimize contamination.

Keywords: Wooden Display Table, Meat Carcasses, Microbial Contamination, Nigeria

Introduction

Meat is a freshly dressed or treated tissue, mainly skeletal muscles from warm blooded animals, suitable for use as food. Safe meat is defined as the meat that is free from any substance which may be harmful to man and such substance would include both infectious agents and toxic substances of either endogenous or exogenous, while wholesome meat is defined as the meat which is free from defects, endogenous diseases or exogenous non microbial contamination and adulterations conducive to general well being and acceptable to the consumer as part of the diet (Alonge, 2001).

Meat quality control is a system that regulates the measure of extrinsic materials such as chemical residues, toxins, pathogenic microorganisms and putrefied tissues, which could be present in meat and are deleterious to human health (Olugasa et al., 2000). Globally, millions of people suffer from different types of illness due to meat contamination every year (Nortje et al., 1989). In the tropics, market sanitation and meat inspection are of relative more importance than development of preservation and processing techniques as most meat is consumed fresh (Adebona, 1978). In Nigeria, efforts are being made by the veterinary authority at the State level to ensure that safe and wholesome meat is available for public consumption. Among such efforts is the ante-mortem and post-mortem examination of meat animals presented for slaughter at the State abattoir. Despite these efforts, Onah and Chiejina (1995), reported that as many as 8.6% of hospitalized patients in southeastern Nigeria were attributed to meat contamination. The effects of surface contamination and effectiveness of work surface cleaning on the shelf life of meat and bacteria isolates from meat markets have been highlighted (Nortje et al., 1989). Positive correlation between the size of market and microbial load on meat display tables as well as isolation, identification and counts of bacterial and fungal contaminants on table scrapings from meat stalls in markets in Ibadan metropolis have been determined (Fasanmi et al., 2010). The hygienic handling of meat carcasses from the abattoir to the meat market till its consumption is important to minimizing contamination. At the Bodija meat market, meat are often displayed on wooden tables and exposed to air. Therefore, this study was undertaken to determine the pattern of microbial contamination of meat during display at the Bodija meat market in Ibadan, with the aim of developing effective ways of mitigating meat contamination during display.

Materials and Methods

The study area was Bodija meat market in Ibadan North local government, Oyo State – which is an inland state in South Western Nigeria. Bodija meat market is located on Latitude 07°25' 975'' N and on Longitude 03°54' 877'' E (Geographical positioning system, etrex, Garmin, Taiwan). The population of central Ibadan is 2,550,593 (National Census, 2006). Meats on sale at the Bodija meat market are from the major abattoir in Bodija, Ibadan.

Four meat display tables with the meat carcasses on them were simple randomly selected from twelve tables and used for this study. Swab samples were collected from the same spots (1cm^2 areas) on each table at 0 minute, 30 minutes, 60 minutes and 90 minutes. Swab samples were taken also from same spots (1cm^2 areas) on the meat carcass surfaces on each of the wooden tables at the same time intervals. The swab samples were put in ice packs and transported to the Food and Meat Hygiene Laboratory Department of Veterinary Public Health and Preventive Medicine, University of Ibadan for microbial analysis.

Sterile swabs used in sample collection were each vortexed in 9mls of sterile 0.1 % peptone water (Fishers scientific, UK) to ease count. The dilution continued until a ten fold dilution was attained. 0.1ml of each tenth fold dilution was surface plated on Nutrient agar (Fluka 7014, Germany) for total aerobic plate count and MacConkey agar (Fishers scientific, UK) for coliform counts. The plates were incubated aerobically at 37^{o}C for 24hrs. At the end of incubation a digital colony counter (Lapiz. 0671M.JG.058, Mumbai, India) was used in counting discrete colonies. Counts were expressed in colony forming unit per cm^2 area (CFU/ cm^2) and later converted to the $\log_{10}$ CFU/cm^2 values (Speck, 1986).

Statistical Analysis

The mean and standard deviation of the data collected from the display tables and meat carcasses on display were calculated using Microsoft Excel 2003. The level of statistical significance (between the means of the carcass and table samples at same intervals) was determined by using the student't' test for two different means. The level of significance was at 95% confidence interval. Analysis of variance (ANOVA) was used to determine the level of statistical significance in microbial counts over time, an alpha value of less than 0.05 ($\alpha < 0.05$) is considered as significant. Correlation analysis was used to determine relationship between the microbial load (TAC and TCC) on the wooden meat display tables and meat carcasses.

Results

The mean TAC on the wooden display table increased significantly by 22% from 219.8±20.3 to 282.0 ± 19.6 CFU/cm^2; while the TCC also increased significantly by 50% from 78.8±26.3 to 159.5 ± 13.2 CFU/cm^2 within 90 minutes ($\alpha < 0.05$). The mean TAC on the meat carcass on display increased significantly by 48.4% from 121.3±20.5 to 235.0 ± 51.6 CFU/cm^2; while the TCC also increased significantly by 48.9% from 67.0±26.3 to 131.0 ± 26.1 CFU/cm^2 ($\alpha<0.05$). The mean TAC and TCC of the meat display table increased by 0.11 and 0.30 log CFU/cm^2 respectively; while the mean TAC and TCC of the meat carcasses on display both increased by 0.29 log CFU/cm^2 respectively within 90 minutes (table 1) . There was statistical significant difference ($P<0.05$) between mean values of TAC and TCC on the wooden display table and the meat carcass displayed on it. There is a positive correlation ($r = +1$) between time interval and increases in both TAC and TCC in both wooden display table and the meat carcasses on display (Figure 1 and 2).

Table 1: Comparison of the mean TAC and TCC (log CFU/cm^2) of meat carcass on display and wooden meat display table over time

TIME (minutes)	Mean log total aerobic counts (log CFU/cm^2)		Mean log coliform counts (log CFU/ cm^2)	
	Meat carcasses Mean ± SD	Wooden meat display tables Mean ± SD	Meat carcasses Mean ± SD	Wooden meat display tables Mean ± SD
0	12.08 ± 0.07$^{(**)}$	12.34 ± 0.04$^{(**)(*)}$	11.83 ± 0.1$^{(6**)}$	11.90 ± 0.13$^{(**)}$
30	12.22 ± 0.10	12.37 ± 0.04$^{(*)}$	11.99 ± 0.09	12.12 ± 0.03$^{(*)}$
60	12.34 ± 0.10	12.43 ± 0.03	12.06 ± 0.10	12.17 ± 0.05
90	12.37 ± 0.11	12.45 ± 0.03	12.12 ± 0.70	12.20 ± 0.04

SD – Standard deviation

Values with single asterisk (*) are statistically significant at 95% confidence interval ($P<0.05$). Values with double asterisks (**) are statistically significant at 95% confidence limit ($\alpha< 0.05$)

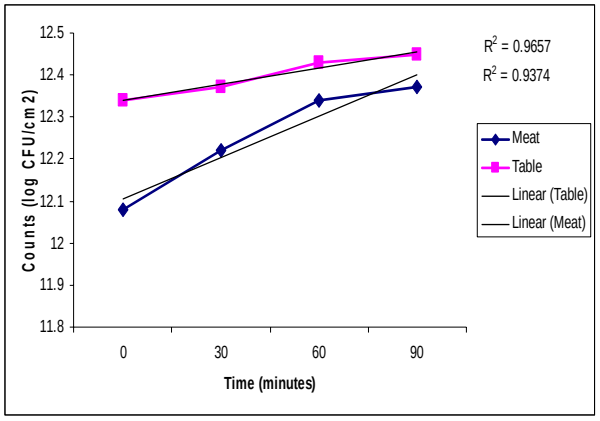

Fig. 1: Positive association in rise of mean log CFU/cm^2 of TAC in meat carcass and meat display tables for a period of 90 minutes

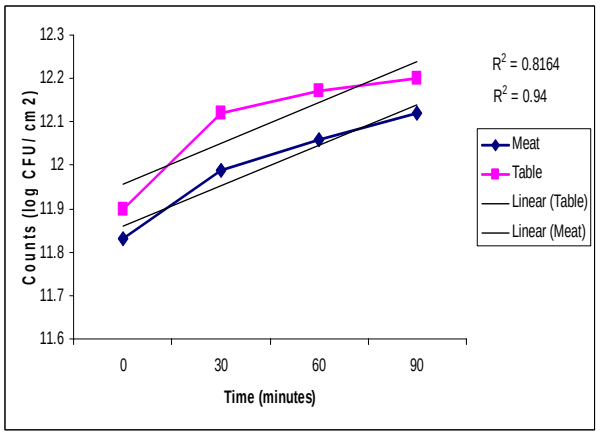

Fig. 2: Positive association in rise of mean log CFU/cm^2 of TCC in meat carcass and meat display tables for a period of 90 minutes

Discussion

The mean values of the TAC and TCC (log CFU/cm^2) for meat carcass surfaces at 0 minute were 12.08 ± 0.07 and 11.83 ± 0.16 respectively; these values are higher than the TAC (7.19) and TCC (5.50) reported by Nortje et al. (1989). The TAC on meat carcass in this study is significantly higher than that (5.25±0.07 log cfu/g) reported by Ruban and Nadeem (2011) in poultry meat from non sophisticated processing plants; TAC of 6.48 ± 0.27 log CFU/cm^2 reported by Sudhakar et al. (2007) in sheep and goat meat from traditional meat shops in India; and TAC of 1.81 log CFU/cm^2 reported by Sumner et al, 2003 in beef from very small plant in South Australia. The high mean TAC and TCC (log CFU/cm^2) obtained in this study is an indication of prior exposure of the meat carcass to contamination before display at the meat market. These high values may be due to diseased animals which spuriously escaped ante-mortem and postmortem examinations and found their way to the meat market. Such diseased animals harbor pathogenic microbes which are retained in tissues and muscles from such animals after processing (Adeyemo, 2002). The bacteria load may increase if there are adequate temperature, pH, and adequate time needed for the pathogenic microbes to grow (Norman et al., 2006). The initial high values of microbe in the meat carcass could have arisen also from use of contaminated water, poor and unhygienic means of transporting the meat from the abattoir to the market, use of contaminated meat display tables and poor personal hygiene.

The 0 minute mean TAC value of the wooden meat display tables (12.34±0.04 log CFU/cm^2) was higher than the normal mean (log CFU/cm^2) TAC for working surfaces which is 3.0 as reported by Nortje et al, 1989. Fasanmi et al. (2010), in a similar study on microbial load from table scrapings used for meat display in Ibadan, Nigeria, reported TAC of 5.54 log CFU/ml. The high mean values of TAC and TCC recorded for the wooden meat display tables in this study may be due to the prior contamination of the wooden meat display tables before meat display arising from lack of or inadequate cleaning of the wooden meat display tables or . More so, it could be due to use of non potable water containing coliform bacteria (Olugasa et al., 2000).

The mean values of the TAC and TCC (log CFU/cm^2) on the meat carcass after 30 minutes were 12.22±0.10 and 11.99±0.09 respectively. There were increases of about 27% and 32% in the TAC and TCC respectively within the first 30 minutes. The reason for the percentage increase in the mean TAC and TCC (log CFU/cm^2) on the meat carcass surfaces within the first 30 minutes of meat displayed may be due to the fact that there was availability of favourable conditions (temperature, pH, water, oxygen tension) for microbial growth at the meat market and initial high microbial load with adequate medium (the contaminated meat carcasses) which favoured rapid growth of microbes (Adebona., 1978). This might have been occassioned by the method of meat display at the meat market, since meat carcasses are directly exposed to environmental conditions. More so, handling of meat carcasses with contaminated hands by both meat sellers and customers, contact of meat carcasses with dirty surfaces and aprons or clothing, use of unsterilized knife in cutting meats, and activities of filth flies in the environment could also contribute to the increase in the microbial load (Nmorsi et al., 2007).

The mean values of the TAC and TCC (log CFU/cm^2) on the wooden meat display tables after 30 minutes were 12.37±0.04 and 12.12±0.03 respectively.

The mean TAC and TCC on the table increased by 6.7% and 39.8% respectively within the fisrt 30

minutes. The increase could be adduced to the bad practice of pouring water mixed with blood on meat carcasses already displayed on tables by the meat sellers in other to maintain the meat moisture.

After 60 minutes the mean TAC and TCC (log CFU/cm^2) on the meat carcass increased to 12.34±0.10 and 12.06±0.10 respectively. There was 23.3% and 14% increases in the mean TAC and TCC within the next 30 minutes i.e 30 to 60 minutes. These increases were not as high as the increases observed within the first 30 minutes, probably due to reduced conducive condition for more rapid microbial growth. On the meat display table, the mean values of the TAC and TCC (log CFU/cm^2) were 12.43±0.03 and 12.17±0.05 respectively after 60 minutes. There was 11.5% and 12% increases in mean TAC and TCC within this period. The TAC on the tables increased at a percentage more than the first thirty minutes, however the TCC further declined in growth. The percentage increases on the meat carcass are higher than that of the display table by this time probably because the meat carcass it self is a better medium for microbial growth than wooden display table. However, the longer the meat carcass stay on the display table the more the TAC and TCC obtained.

At the end of the 90 minutes, the mean TAC and TCC (log CFU/cm^2) on the meat carcass were 12.37±0.11 and 12.12±0.70 respectively; while that on the meat display table were 12.4 ±0.03 and 12.20±0.04. The percentage increase in TAC and TCC both on the meat carcass and on the display table within 60 to 90 minutes was lower than within 30 to 60 minutes. The trend revealed a decline in the rate at which the microbes were multiplying; may be as a result of dessication on the surfaces of the meat and table arising from rise in the environmental temperatures and other conditions. Overall, there was 48.4% and 48.9% increases on the meat carcass; and 22% and 50% increases on the display table in the TAC and TCC respectively. There was a positive correlation between time and increases in TAC and TCC in both meat carcass and meat display table. This is suggestive of a common extraneous source of exposure of the meat and table to contamination. It underscores the role of exposure of meat carcass to direct environmental condition as a source of contamination aside other possible innate factors that could contribute to meat carcass contamination.

The finding of this study is relevant to the meat industry especially in countries where meat carcasses are displayed on tables in open air thus directly exposing the meat to contaminants in the environment. It is recommended that the hygiene level both at the abattoir and meat stalls should be improved.

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