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Full Length Research Paper

Microbial studies of table scrapings from meat stalls in Ibadan Metropolis, Nigeria: Implications on meat hygiene

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Tables used to display meat for sale in nine different markets in Ibadan Metropolis were microbiologically examined for their implication on meat hygiene. Twenty seven strains of bacteria and eight strains of fungi were isolated and identified. They were identified on the basis of metabolic and physiological features while simple crystal violet staining was used for observing cell size and shape. The samples were placed on trypticase-soya –agar (TSA), for trophic bacteria and Sabouraud-glucose-agar (SGA) supplemented with chloramphenicol for fungi. Petri dishes were incubated at 37ºC for 48 - 72 h while the cultures were observed daily under a stereoscopic microscope for presence of bacterial colonies and or fungal mycelium. The mean value of bacterial count was 2.78 × 10^5 CFU/ml while that of the fungal count was 0.72 × 10^5 CFU/ml with a significant difference ($p < 0.05$). There was also a strong positive correlation between the sizes of the markets and the microbial load encountered in the samples. This was attributed to poor hygiene level resulting from inadequate facilities. The findings of this study indicate that meat hygiene is being compromised in the city, a situation that calls for public health concern.

Key words: Microbial load, meat hygiene, table scrapings, food contamination.

INTRODUCTION

Meat is every edible part of any slaughtered animal, whether the same is in its natural state or has been subjected to freezing, chilling, salting, canning or other preservative processes (OYSGN, 1978). The source of water for abattoir activities is very paramount to meat hygiene as water is needed in maintaining cleanliness of the abattoir environment and for washing off blood from the meat. Meat contamination in abattoirs and meat stalls could result from contaminated water, unhygienic practices like poor handling, use of contaminated tables to display meat meant for sale and the use of contaminated knives in cutting operations. Contamination of meat and meat products occur when raw meat is exposed or makes contact with pathogenic microbes (such as) which are ubiquitous in nature (WHO, 1982).

Microbial contamination of meat and meat products must not exceed levels which could adversely affect the shelf life of the product, if it does it renders the meat unwholesome and hence not fit for human consumption (Fasanmi and Sansi, 2008). Reduction of risk for human illness associated with raw produce can be better achieved through controlling points of potential contamination in the field, during harvesting, during processing or distribution, or in retail markets, food-service facilities, or the home (Scates et al., 2003; FDA, 2007).

Various *Salmonella* species have long been isolated from the outside of egg shells. *Salmonella enteritidis* has been implicated in several infections arising from the consumption of egg and other poultry products. This and other information strongly suggest vertical transmission, that is, deposition of the organism in the yolk by an

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Table 1. Mean values of microbial load of table scrapings.

Markets	Bacterial count (CFU/ml)	Fungal count (CFU/ml)	Total microbial count (CFU/ml)
Molete	1.16×10^5	0.54×10^5	1.70×10^5
Sabo	1.06×10^5	0.44×10^5	1.50×10^5
Odo Ona	1.64×10^5	1.22×10^5	2.86×10^5
Dugbe	1.23×10^5	0.45×10^5	1.68 x 105
Orita-Merin	1.96×10^5	0.70×10^5	2.66×10^5
Beere	1.14×10^5	0.56×10^5	1.70×10^5
Apata	1.06×10^5	0.60×10^5	1.66×10^5
Challenge	1.22×10^5	0.44×10^5	1.66×10^5
Bodija	2.00×10^5	1.08×10^5	3.08×10^5
Total	25.05×10^5	6.49×10^5	31.54×10^5
Mean	2.78×10^5	0.72×10^5	3.50×10^5

infected layer hen prior to shell deposition. Foods other than eggs have also caused outbreaks of *S. enteritidis* disease. Raw meats, poultry, eggs, milk and dairy products, fish, shrimp, frog legs, yeast, coconut, sauces and salad dressing, cake mixes, cream-filled desserts and toppings, dried gelatin, peanut butter, cocoa and chocolate have been implicated in harbouring pathogenic micro-organisms (FDA, 2007).

Food security is a complex issue, which is influenced by a number of factors. Increasing national agricultural production alone cannot improve food security. The Food and Agricultural Organization (FAO) of the United Nations and the World Health Organization (WHO) state that illness due to contaminated food is perhaps the most widespread health problem in the contemporary world and an important cause of reduced economic productivity (Edema et al., 2005). In Nigeria, there are a number of public slaughters houses and a few private meat processing plants distributed along the country, where the public buy their meat daily. Serious consequences relating to national productivity and development can arise from lack of hygiene and sanitation in such abattoirs and meat stalls. Nearly 90% of diarrheal-related deaths have been attributed to unsafe or inadequate water supplies and sanitation (Younes and Bartram, 2001; WHO, 2004) conditions affecting a large part of the world's population (Hughes and Koplan, 2005). An estimated 1.1 billion persons (one sixth of the world's population) lack access to clean water and 2.6 billion to adequate sanitation (Hughes and Koplan, 2005).

This study aimed at isolating, identifying and counting bacterial and fungal contaminants on table scrapings from meat stalls in nine different markets in Ibadan metropolis in Nigeria.

MATERIALS AND METHODS

Sample collection

Fifty (50) samples of table scrapings were collected from nine (9) different markets in Ibadan metropolis. They include Sabo, Beere, Dugbe, Bodija, Odo-Ona, Challenge, Orita-Merin, Apata and Molete markets. The bottles used for sample collection in the study first were sterilized using hot air oven to ensure that they were not contaminated by any micro-organisms before being used for sample collection. The knives used for scrapping the table samples were also sterilized using cotton wool and methylated spirit before and after use. This procedure was repeated for all the samples collected on different occasions in all the nine markets. These samples were taken to the laboratory for microbiological studies within 6 h (of collection). The samples were analyzed for microbial quality as described by FAO (2007) at the Department of Microbiology, Institute of Agricultural Research and Training (I.A.R.&T.), Apata, Ibadan.

Microbial counts

The samples were placed on trypticase-soya –agar (TSA), for trophic bacteria and Sabouraud-glucose-agar (SGA) supplemented with chloramphenicol for fungi. Petri dishes were incubated at 37ºC for 48 - 72 h while the cultures were observed daily under a stereoscopic microscope for presence of bacterial colonies and or fungal mycelium. The media used were weighed out and prepared according to the manufacturer's specification, with respect to the given instructions and directions. The serial dilution method was used for total microbial counts (Table 1).

Identification of microbes

Pure isolates of resulting growth were identified using morphological and biochemical methods as described by Lennette et al. (1985) and Jolt et al. (1994). The number of occurrence of each identified bacterium and fungus was recorded with its percentage occurrence (Tables 2 and 3). The sterility of each batch of test medium was confirmed by incubating one or two uninoculated tubes or plates along with the inoculated tests. The uninoculated tubes or plates were always examined to show no evidence of bacterial growth.

Statistical analysis

All data were subjected to analysis of variance (ANOVA) according to the standard procedure described by Steel and Torrie (1980). Duncan multiple range test was used to compare means found to be statistically significant ($p < 0.05$) as described by Obi (1990).

Table 2. Number of individual bacterium encountered in the samples.

Bacterium	Number of occurrence	%
1. *A. aerogenes*	7	1.98
2. *B. aureus*	26	7.34
3. *B. cerens*	33	9.32
4. *B. macerans*	19	5.37
5. *B. subtilis*	6	1.69
6. *E. coli*	46	12.99
7. *K. aerogenes*	12	3.39
8. *M. acidiumulus*	1	0.28
9. *M. acideophilus*	9	2.54
10. *M. luteus*	16	4.52
11. *M. viridians*	7	1.98
12. *P. mirabilis*	14	3.95
13. *P. morganii*	7	1.98
14. *P. vulgaris*	19	5.37
15. *P. aureginosa*	35	9.88
16. *P. florescence*	6	1.69
17. *P. fragii*	3	0.85
18. *P. nigrifriscenes*	7	1.98
19. *S. enteritidis*	2	0.56
20. *S. typhinurium*	4	1.13
21. *Se. macenses*	9	2.54
22. *S. aureus*	11	3.12
23. *S. faecalis*	4	1.13
24. *S. faecum*	36	10.17
25. *S. lactis*	4	1.13
26. *S. pyogenes*	4	1.14
27. *S. zymogenes*	7	1.98
Total	**354**	

RESULTS

The mean value of the bacterial count from all the sample was 2.78 x 10^5 CFU/ml while the mean value for fungal count was 0.72 x 10^5 CFU/ml with a significant difference ($P < 0.05$). The mean total microbial count for all the 50 samples was 3.5 × 10^5 CFU/ml (Table 1). The highest and lowest microbial counts were observed in Bodija and Sabo Markets respectively.

A total of 27 strains of bacteria were isolated from all the samples with *Escherichia coli* being the most frequent occurring as it accounted for 13% of the bacterial count in the study (Table 2). This was followed by *Streptococcus faecum* and *Bacillus cereus* accounting for 10 and 9%, respectively, of the total bacterial count observed in the study. The least encountered bacterium in the study was *Micrococcus acidiumulus* being 0.28% of the total bacterial count (Table 2). *Salmonella* species accounted for approximately 2% of the total bacterial count in the study.

A total of eight strains of fungi were isolated from the samples with *Sacchromyces* species being the most frequently occurring fungi accounting for approximately 38% of the total fungal count followed by the *Aspergillus* species 34% (Table 3). The least frequently occurring fungi in the study was *Panicum oxalicum* accounting for approximately 2.6% of the total fungal count in the study (Table 3).

DISCUSSION

The microbes isolated and identified were the following species: *Aerobacter*, *Bacillus, Escherichia, Klebsiella, Micrococcus, Proteus, Pseudomonas*, *Salmonella, Staphylococcus, Streptococcus, Aspergillus, Fusarum, Panicum, Rhizopus* and *Sacchromyces* (Tables 2 and 3). *E. coli* was the highest occurring bacterium in the study as it accounted for approximately 13% of the total bacterial count (Table 2). This is in conformity with earlier reports that *E. coli* is a major meat contaminant (Fasnmi and Sansi, 2008). The presence of these microbes in the table scrapings is an indication that meat placed on such tables could have been contaminated in the process. Nevertheless, other factors such as unhygienic practices may also account for the contamination of the tables after the daily normal sales. These findings were similar to the reports of Edema et al. (2005) on the microbial safety and quality of ready-to-eat foods in Nigeria. The pathogens isolated in this present study were similar to the microorganisms reported by Olawale et al. (2005), where nine bacterial genera including *S. auerus*, *A. aerogenes*, *S. faecalis* and *E. coli* (and two fungi) among other organisms were isolated from food samples in public

Table 3. Number of individual fungus encountered in all the samples.

Fungus	Number of occurrence	Percentage of total number (%)
Aspergillus niger	36	31.03
Aspergillus tamanis	4	3.45
Fusarum compacticum	1	0.86
Fusarum oxysporum	14	12.07
Panicum oxalicum	3	2.59
Rhizopus nignicans	15	12.93
Sacchromyces cerensiae	41	35.34
Sacchromyces parasiticum	2	1.72
Total	**116**	

canteens in Osun State, Nigeria. The presence of *Bacillus* species, *Salmonella* spieces, *Micrococcus* species, *E. coli*, *Rhizopus* species, *Staphylococcus* species, *Pseudomonas* species, *Aspergilus* species *and Sacchromyces* species reported in this study is also in agreement with the findings of Adesokan et al. (2005) who reported the presence of *Bacillus* species and *E. coli* among other organisms in selected brands of beer in Nigeria.

Also, the findings of this work are also in conformity with that of Bankole et al. (2005) who reported the presence of *S. auerus, Bacillus* species, *E. coli, Pseudomonas* species, *Sacchromyces* species, *Rhizopus* species and *Aspergillus* species in the palms of food vendors in Abeokuta Metropolis, Ogun State, Nigeria. Biological contaminants such as bacteria, viruses, fungi, protozoa and helminthes constitute the major cause of food-borne diseases with varying degrees of severity, ranging from mild indisposition to chronic or life-threatening illness, or both. In developing countries, such contaminants are responsible for food borne diseases such as cholera, campylobacteriosis, *E. coil* gastroenteritis, salmonellosis, shigellosis, brucellosis, amoebiasis and poilomyletis (Edema et al., 2005).

The total microbial counts observed in this study ranged between 1.50 x 10^5 and 3.08 x 10^5 CFU/ml. These values exceed the FAO/WHO standard limit of 1 .0 x 10 CFU/ml for food products and water. This poses a serious public health concern to the consumers of these meats and is an indicator of the level of hygienic practices at the various meat stalls in Ibadan metropolis. The findings of this present study confirms that a wide variety of foods including meats, milk, vegetables and fish have been associated with the diarrheal type food poisoning resulting from *Bacillus* species. The vomiting-type outbreaks have generally been associated with rice products; however, other starchy foods such as potato, pasta and cheese products have also been implicated. Food mixtures such as sauces, puddings, soups, casseroles, pastries and salads have frequently been incriminated in food poisoning outbreaks (FSRI, 2003; FDA, 2007). The microbiological safety of food is achieved by as far as possibly ensuring the absence of pathogenic microorganisms and by all means preventing their multiplication (Okonko et al., 2008). The Hazard Analysis Critical Control Point (HACCP) concept is used to identify microbiological vulnerable points in the food production process and processing, and to determine the most appropriate methods of control to be applied. Usually such methods include improved handling techniques, monitoring of temperature and more intensive supervision (Edema and Omemu, 2004).

The presence of the most frequently isolated index of water quality and indicators of faecal contamination such as *E. coli* and *S. faecalis*, in the samples is an indication of faecal contamination of meat through water and or hands and or unhygienic handling of meat right from the slaughter slabs to the various meat stalls. This is in consonant with the findings of Edema et al. (2001), on the microbial analysis of different sources of drinking water in Abeokuta, Nigeria. Also, the unhygienic condition of the tables on which the meats are disposed for sale might account for additional sources of meat contamination. Often, the knives and cutlasses used in cutting meat are also important contaminants of meat since they are rarely sterilized. Lack of facilities for sterilization of tools at the slaughter houses and meat stalls can be a major cause of this. Also, the indiscriminate use of these tools in the cutting of offals like the intestines constitute another possible source of meat contamination as the gut contents can easily be spread to the table and the entire meat to be sold.

Bodija Market having the highest microbial count in the study is the largest municipal abattoir in Ibadan metropolis while Sabo Market ranks amongst the smallest meat markets in Ibadan. The facilities available at Bodija Market are by far lower to the operational activities of the market, hence, a compromise of hygienic practices. The Bodija Abattoir often experience scarcity of water especially during the dry season of the year. This condition is further worsened by the absence of enough water storage facilities thereby contributing to the difficulty of maintaining hygienic practices in the abattoir. Unhygenic practices in abattoirs resulting from poor water supply encourage the growth of microbes within abattoir environment. Olukole and Ohore (2007) reported that the

Bodija Municipal Abattoir had a very high prevalence of metastrongylosis. The high level of microbes encountered in the study further confirms the findings of Olukole (2008) on the low enforcement of veterinary legislations in Oyo State of which Ibadan is the capital city. This could be attributed to the number of veterinary officers, animal health officers, law enforcement agencies and control post officers available in the state among factors like the inadequacy of necessary facilities (Olukole, 2008). The presence of *S. auerus* and *Streptococcus* species, pathogenic organisms of public health concern and significance in the table samples might have resulted from improper handling of meat and poor hygienic practices by butchers and meat vendors.

In order to improve on the level of hygiene at the various abattoirs and meat stalls in Ibadan Metropolis, there is the need to further enforce veterinary legislations. Hence, stakeholders in animal health and production may need to consider the setting up of a paramilitary body that would be saddled with the primary role of ensuring strict enforcement of Veterinary legislations and the non-politicized arrest and appropriate prosecution of defaulters (Olukole, 2006). Also, there is the need to educate butchers and meat vendors on the adverse effects of meat contamination on public health. However, the meat vendors/retailers should observe strict hygienic measures such as daily washing of their tables before and after sales. This should be followed by a consistent sterilization of all knives and cutlasses used in the cutting of meat meant for public consumption. Nevertheless, the public must be enlightened on the need to properly cook meat before eating them.

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