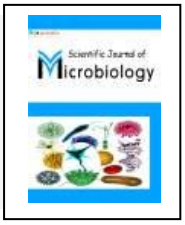
Sjournals
Scientific Journals
Scientific Journal of Microbiology (2013) 2(7) 134-139
ISSN 2322-2948

Contents lists available at Sjournals
Scientific Journal of Microbiology
Journal homepage: www.Sjournals.com



Original article

Bacteriological quality of raw meat displayed for sale at Sokoto, Sokoto state, Nigeria

M.D. Salihu[a,*], A.A. Magaji[a], B. Garba[a], B. Saidu[b], M. Aliyu[c], N. Sulieman[b], B.S. Wurno[a]

[a]*Department of Veterinary Public Health and Preventive Medicine, Usmanu Danfodiyo University, Sokoto, Nigeria.*
[b]*Department of Veterinary Physiology and Biochemistry, Usmanu Danfodiyo University, Sokoto, Nigeria.*
[c]*Department of Parasitology and Entomology, Usmanu Danfodiyo University, Sokoto, Nigeria.*

[*]Corresponding author; Department of Veterinary Public Health and Preventive Medicine, Usmanu Danfodiyo University, Sokoto, Nigeria; Tel: +2348035950593.

ARTICLE INFO

Article history:
Received 12 July 2013
Accepted 25 July 2013
Available online 30 July 2013

Keywords:
Bacteria
Coliform counts
Meat
Quality

ABSTRACT

This study was conducted to determine the bacteriological quality of raw meat on sale at the Sokoto Fish and Meat market. 120 samples each of meat and 1cm^2 table top surface swab were collected and analyzed microbiologically for total viable count (TAC) and total coliform (TCC). The mean viable count for meat samples was 4.52x10^6 cfu/cm^2 and the mean coliform count was 2.34x10^6 cfu/cm^2. The mean viable count for meat table surface was 4.21x10^6 cfu/cm^2, while the mean coliform was 2.17 x10^6 cfu/cm^2. A total of 10 different bacterial isolates from both the raw meat and table top swabs were obtained, these isolates include *Escherichia coli* [49(25.3%)] and [21(19.0%)] which was the most predominant, followed by *Enterobacter spp* [31(16.0%)] and [15(13.5%)], *Bacillus spp* [27(14.0%)] and [24(21.6%)], *Staphylococcus aureus* [26(13.4%)] and [29(26.1%)], *Salmonella spp* [16(8.2%)] and [6(5.4%)], *Klebsiella spp* [13(6.7%)] and [0(0.0%)], *Proteus vulgaris* [12(6.2%)] and [6(5.4%)], *Shigella spp* [9(4.6%)] and [3(2.7%)], *Streptococcus spp* [8(4.1%)] and [7(6.3%)], *Citrobacter spp* [3(1.5%)] and [0(0.0%)] which was less predominant. This study reveals that raw meat displayed for sale at the open market are often contaminated with bacteria. The presence of higher number of pathogenic *Escherichia coli, Enterobacter spp, Bacillus spp*, and *Salmonella* among others, encountered in raw meat from conventional beef is alarming. The

presence of these organisms in meat foods and table surface should receive particular attention, because their presence indicate public health hazard and give warning signal for the possible occurrence of food borne intoxication.

1. Introduction

Food born infections and illness is a serious worldwide health problem associated with colossal economic losses. In developing countries, food borne infection has caused death of many children and the associated diarrheal condition can cause long-term effects on children's growth and development (Adak et al., 2006). Although the intensity of signs and symptoms may vary, depending on the quantity of contaminated food ingested, and susceptibility of the individual to the toxins (Clarence et al., 2009).

Meat is considered as an important source of proteins to man and is the most perishable of all important foods because of its rich nutrients that supports microbial growth (Magnus, 1981; Ukut et al., 2010). The water content of meat corresponds to water activity approximately 0.99 which is suitable for microbial growth (Ruo et al., 2009) the microbiological contamination of carcasses occurs mostly during flaying, evisceration, storage and distribution at slaughter houses and retailed outlets (Abdalla et al., 2009). Fecal materials are major source of contamination via direct deposition and indirect contact through contaminated equipments, tools, vehicles and even workers (Borch and Arinder, 2002).

Due to the high demand for fresh meat, a lot of small farmers slaughter their animals in the backyard without proper sanitary facilities and the meat is sold in open-air local retail shops along the main roads (Muhammad et al., 2011). The meat is exposed to open-air and dust without appropriate temperature control. Disease outbreak can occur as a result of exposing the meat to such adverse environment. Raw meat displayed in open-air local retail shops and outlets without appropriate temperature control is purchased for consumption by the teaming consumers.

In Nigeria, there are a number of reports on foods including meat to have high incidence of bacteria (Okonko et al., 2008a,b; 2009a,b, Ukut et al., 2010 Clarence et al., 2009), nonetheless, there are limited reports on the health implication of food borne diseases from raw meat that are displayed in open-air for sales.

This study was conducted to determine the level of microbial contamination of meat during display at the Sokoto fish and meat market, with a view to highlight the public health implication of consuming such meat.

2. Materials and methods

The study was conducted in Sokoto, Sokoto State North-Western Nigeria, and samples were collected from the Sokoto meat and fish market. Virtually all meats sold in the market are obtained from Sokoto abattoir where about 80-90 heads of cattle are slaughtered daily. The State is the second largest livestock producer in Nigeria (Sokoto state diary, 2003). Sokoto State is located within the Sudan Savannah between Longitude 40 8' E and 60 54' E and between latitude 120 N and 130 58' N. The state has an estimated population of 3,696,999 people (NPC, 2006).

2.1. Sample collections

Twenty individual meat stalls within the Sokoto fish and meat market were randomly selected for sample collection. A total of 120 each of meat samples and 1cm surface swab samples (meat table surfaces) of the selected stalls were collected. The meat samples were collected into sterile plastic bags and transported under 40C in a cool box packed with ice to prevent further contamination, and the table surface swab samples were taken using sterile swabs in 5ml of peptone water. The collected swab samples were immediately transported in insulated ice container to the laboratory for microbial analysis. All samples were processed within 12 hours of collection during each collection visits.

2.2. Sample processing

Twenty five grams (25g) of each meat sample was weighed out and homogenized into 225 ml of 0.1% peptone water using a sterile warring blender. Ten-fold dilutions of the homogenates were made as described by Fawole and Oso (2001). The swab samples in the peptone water were processed by serially diluting 1ml of the peptone water (Containing swabbed samples) into 9mls of 0.1% peptone water (Fisher, scientific, U/K) and the serial dilution continues as describe by Fawole and Oso (2001). Similarly meat and table top surface samples were inoculated on nutrient agar (oxoid) by pour plate method for total viable count (TAC) and MacConkey agar (Fishers Scientific, UK) for total coliform counts (TCC). The plates were incubated at 370C aerobically for 24 hours. After incubation the colonies were counted using the illuminated colony counter (Galtenkamp, England) the counts for each plate of the meat sample were expressed as colony forming unit of the suspension (cfu/g) and counts from each plate of the table top surface were expressed as colony forming unit per centimeter square (cfu/cmz). Identification and isolation of bacteria species was carried out as described by the methods of Ansah, et al., (2009). Bacterial colonies were further identified by standard biochemical methods.

3. Results

The mean viable count of meat samples was 4.52 x 106 cfu/g and the mean coliform count was 2.34 x106 cfu/g (Table 1). The mean viable count for meat table top surface was 4.21 x 106 cfu/cm2, while the mean Coliform count 2.17x106cf/cm2 (Table 1). The study identified ten (10) different types of bacteria that were isolated from the samples i.e meat samples and table swabs (Table 2). The isolated bacteria are *Escherichia coli, staphylococcus aureus, salmonella* spp*. klebsiella* spp *Bacillus* sp*p enterobacter* sp*p, proteus vulgaris, shigella* spp*, streptococcus* spp and *citrobacter* spp based on their morphological and biochemical characteristic (Cheesbrough, 2003). The highest isolate of 194 was recorded from meat samples as compared to the 111 isolates made from the table top swab (Table 2).

Table 1
Mean total viable count and mean Coliform count from meat and surface swab samples.

Sample type	Mean total viable count	Mean total Coliform count
Meat	$4.52x10^6$ cfu/g	2.34×10^6 cfu/g
Surface swab	$4.21 X10^6$ cfu/cm^2	$2.17 X 10^6$ cfu/cm^2

Table 2
Frequency of bacterial pathogens in the samples.

Bacterial agents	Number of isolates meat (%)	Surface swab (%)
Escherichia coli	49 (25.3)	21 (19.0)
Staphylococcus aureus	26 (13.4)	29 (26.1)
Salmonella Spp	16 (8.2)	6 (5.4)
Klebsiella Spp	13 (6.7)	-
Bacillus Spp	27 (140)	24 (21.6)
Enterobacter Spp	31 (16.0)	15 (13.5)
Proteus vulgaris	12 (6.2)	6 (5.4%)
Shigella Spp	9 (4.6)	3 (2.7%)
Streptococcus Spp	8 (4.1)	7 (6.3)
Citrobacter Spp	3 (1.5)	-
	194 (100)	**111 (100)**

4. Discussion

The study showed high bacterial loads on the meat samples. The presence of high number of viable bacteria increases the chance of meat spoilage and shortened shelf life. The presence of bacteria on meat could be as a

result of abundance of nutrients necessary for bacterial growth. The occurrence of bacteria in meat has be reported from other parts of the country (Okonko et al., 2008b; 2009a, b; Ukut, et al.2010) and from different countries of the world (Bhandare et al., 2007; Holds et al., 2007; Haquenet al., 2008; Kinsella et al., 2008; Hassan Ali et al., 2010). It is believed that high number of background organism has a pathogen reduction strategy due to the organisms' antagonistic effect on pathogenic bacteria hence safer for meat quality. This hypothesis may apply only if the background bacteria are non-pathogenic (Jay, 1996).

Coliforms are an indicator of food and water quality, utilizing the presence of Echerichia coli to indicate the presence of fecal contamination. E. coli are normal flora of the intestines of both humans and animals and have been identified as a leading cause of food borne illness all over the world (Hussein, 2007). The prevalence recorded for E. coli in this study is 25.3% for meat and 19.0% for table swab. The lower prevalence recorded for surface swab (19%) is not surprising as microorganism are seldom recovered from food contact surface immediately after cleaning and sanitizing (Biswas et al., 2011), this was observed to be the usual practice in the study area prior to arrival of meats from the abattoir, while on the other hand the relatively high prevalence recorded for meat samples (25.3%) may not be unconnected with the poor and unhygienic processing and waste management practice in the abattoir which readily predispose carcasses to fecal contamination and thereby posing a food safety concern, as these organism are pathogenic (Gracey, et al., 1999). The prevalence recorded in this study is higher than the report of Ukut (2010) who reported prevalence of 11.1% in raw meat sold in calabar, Cross River State, Nigeria.

The high level of microbial flora on the meat and table surfaces from this study could generally be attributed to the filthy environment, poor personal hygiene of the butchers and retailers. There could be possible cross contamination between the adjacent raw meats through unclean hands of the handlers, dust deposited on carcass during transportation, as it is a common practice for carcasses to be transported on wheel barrows passing through routes with refuse dumps. In addition handling meats and money with the same unwashed hands could also be a good source of contamination (Biswas et al., 2011).

The isolation of Salmonella (8.2%) from meat and table swab (5.4%) is of great importance. Even though the prevalence recorded is lower than the report by Ukut et al., (2010) of 11.1% in fresh meat, the contamination may have resulted from handling of meat by the sellers.

Salihu et al., (2010) reported a prevalence of 36.6% for E. coli, and 69.9% for S. aureus in a study on the bacteriological quality of traditionally prepared fried ground Beef in Sokoto. The high prevalence recorded in this study may be because the products were produced in non-industrial premise, hence processed under unhygienic conditions (Salihu et al., 2010).

Other pathogenic bacterial organism isolated from meat in this study includes Staphylococcus aureus, Klebsiella spp, Bacillus spp, Enterobacter spp, Proteus vulgaris, Shigella spp, Streptococcus spp and Citrobacter spp. The presence of these organisms in fresh meat depicts a deplorable state of poor hygienic and sanitary practices employed in the slaughtering, processing, and transportation of the fresh meat. Similar observations have been reported by Clarence et al., (2009) who reported S. aureus. E. coli, klebsiella spp and pseudomonas spp in meat pie and Okonko et al., (2009a) who reported S. aureus, Enterobacter spp, Pseudomonas spp, Proteus spp, Salmonella spp, Citrobacter spp, Klebsiella spp and Serratia in a study on sea food production. Microbial counts for meat samples were slightly higher (4.52 x106 cfu/g) than that of table top swab (4.21x106 cfu/cm2). Recovery of bacterial population using swab sampling techniques is lower probably due to the usual tradition of scrubbing and washing of the table top daily before display of meat, thereby reducing the bacterial load. This observation is similar to the report of Eisel et al., (1997) who reported 1000 fold higher microbial load in meat as compared to table sample. From the result of this study, it is obvious that fresh meat sold in the public in open markets in Sokoto are grossly contaminated with coliform bacteria (Pathogenic and opportunistic) as well as other genera of bacteria capable of causing diseases in humans. The possible sources of contaminants may be as a result of unhygienic manner of handling of meat from the slaughters to the market which could serve as a viable source of various diseases.

5. Conclusion

It is recommended that, meat handlers and sellers should be educated on the importance of hygiene and sanitation when selling their products, and also veterinarians and meat inspectors should ensure that meats

identified to be unfit for consumption should be disposed properly and Government should also provide incentives for carcass owners in the form of compensation for condemned carcasses.

References

Abdalla, M.A., Siham E., Suliman, Y.Y.H., Alion, A., 2009. Microbial contamination of Sheep Carcasses at El Kadero Slaughter house – Khartoum State. Sud J. Vet. Sci. Anim, Husb. 48:1-2

Adak, G.K., Meakins, S.M., Yip, H., Lopman, B.A., O-Brien, S.J., 2005.. Disease risks from foods; England and Wales, 1996-2000. (http://www.cdc.gov/ncidod/EID/Vol. 11 no. 03/04-0191.htm

Ansah, T., Dzoagbe, G.S.K., Teye, G.A., Adday, S., Danguah, J.K., 2009. Microbial quality of table eggs sold on selected markets in the Tamale municipality in the Northern Region of Ghana. Livestock Research for Rural Development. Vol. 21 (8). Retrieved June 1, 2010. http://www.lrrd.org/lrrd21/8/ansa21128.

Bhandare S.G, Sherikarv A.T, Paturkar A.M, Waskar V.S, Zende R.J., 2007. A comparison of microbial contamination on sheep/goat carcasses in a modern Indian abattoir and traditional meat shops. Food Control 18: 854-868

Biswas, A.K., Kondaiah, N., Anjaneyulu, A.S.R., Mandal, P.K., 2011. Causes, concerns, consequences and control of microbial contaminants in meat-A review. Int. J. Meat Sci., 1: 27-35.

Borch, E., Arinder, P., 2002. Bacteriological safety issues in beef and ready-to-eat meat products, as well as control measures. Meat Sci. Savoy 62 (3): 381-390

Cheesbrough, M., 2003. Medical Laboratory Manual. Tropical Health Technology, Low priced Edition. Doddington, Cambridgeshire, England; pp. 20-35

Clarence, S.Y., Obinna, C. N., Shalom N. C., 2009. Assessment of Bacteriological quality of ready to eat food (Meat pie) in Benin City Metropolis, Nigeria. Afr. J. Microb. Res. 3 (6): 390-395

Fawole, M. O., Oso, B. A., 2001. Laboratory Manual of Microbiology: Revised edition spectrum books Ltd, Ibadan, p 127.

Gracey, J. F., Collins, D. S., Huey, R. J., 1999. Meat Hygiene. Tenth edition. W.B. Saunders Company LTD. London. Edinburgh.

Hassan, A.N., Amber, F., Adnan, K., Ameera, Y. K., Shahana, U.K., 2010. Microbial contamination of raw meat and its environment in retail shops in Karachi, Pakistan. J Infect Dev Ctries 4(6):382-388.

Haque, M.A., Siddique, M.P., Habib, M.A., Sarkar, V., Choudhury, K.A., 2008. Evaluation of sanitary quality of goat meat obtained from slaughter yards and meat stalls at late market hours. Bangla J Vet Med 6: 87-92.

Holds, G., Pointon, A., Lorimer, M., Kiermeier, A., Raven, G., Sumner, J., 2007. Microbial profiles of carcasses and minced meat from kangaroos processed in South Australia. Int J Food Microbiol 123: 88-92.

Hussein, H.S., 2007. Prevalence and pathogenicity of Shiga toxin producing Escherichia coli in beef cattle and their products. J. Animal Sci. 85: E63-E72. Doi: 10.2527/jas.2006-421

Jay J.M., 1996. Microorganisms in fresh ground meats: the relative safety of products with low versus high numbers. Meat Sci 43: 59-66.

Kinsella K.J, Prendergast D.M, McCann M.S, Blair I.S, McDowell D.A, Sheridan J.J., 2008. The survival of Salmonella enterica serovar Typhimurium DT104 and total viable counts on beef surfaces at different relative humidities and temperatures. J App Microbiol 106: 171–180.

Magnus, P., 1981. Meat Composition. Food Science and Technology, 4th edition. Gohumunary Pub. London. Pp-108-215.

Manual of Clinical Microbiology., 2002. Seventh edition. Washington DC USA American Society for Microbiology press. 442-631p.

Muhammed, M.S., Fazlina, F., Jasbir, S., Arshad, M. M., Moh'd Azam Khan, G. K and AL-Sultan, A. I., 2011. Isolation of Bacteria from Bovine meat obtained from backyard Slaughter in Kelantan. Journal of Advanced Medical Research 1:61-64

National Population Commission , 2006.. Legal Notice on Publication of 2006 Census Report. Extraordinary Federal Government of Nigeria Official Gazette No.4. Vol. 94, Pp: 47-53

Okonko, I.O., Ogun, A. A., Adejoye, O. D., Ogunjobi, A. A., Nkang, A. O., Adebayo-Tayo, B. C., 2009a.. Hazard Analysis Critical Control Points (HACCP) and Microbiology qualities of sea-foods as affected Handlers Hygiene in Ibadan and Lagos, Nigeria Afr. J. food. Sci. 3(1):35-50.

Okonko, I. O., Adejoye, O. D., Ogunnusi, T. A., Fajobi, E. A., Shittu, O. B., 2008a. Microbiological and Physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos State, Nigeria. African J. Biotechnology, 7 (3):617-621.

Okonko, I. O., Donbraye, E., Babatunde, S. O. I., 2009b. Microbiological quality of seafood processors and water used in two different sea processing plants in Nigeria. EJEAFChe. 8(8): 621-629.

Okonko, I. O., Ogunjobi, A. A., Fajobi, E. A., Onoja, B. A., Babalola, E. T., Adedeji, A. O., 2008b. Comparative studies and microbial risk assessment of different Ready to Eat (RTE) Frozen sea foods processed in Ijora –Olopa, Lagos State, Nigeria. African J. Biotech 7(16):2898-2901.

Rao, V. A., Thulasi, G., Ruban, S. W., 2009. Meat quality characteristic of non-descript buffalos as affected by age and sex. World applied Science Journal. 1058-1065

Salihu, M.D., Junaidu, A.U., Magaji, A.A., Aliyu, R.M., Yakubu, Y., 2010. Bacteriological quality of traditionally prepared fried ground beef (Dambun nama) in Sokoto, Nigeria. Adv. J. Food Sci. Technol., 2: 145-147.

Sokoto State Diary., 2003. A Publication of the Sokoto State Ministry of Information. Sokoto State Government.

Ukut, I-O.E., Okonko, I. O., Ikpoh, I. S., Nkang, A.O., Udeze, A.O., Babalola, T. A., Mejeha, O. k and Fajobi, E. A., 2010. Assessment of Bacteriological quality of fresh meats sold in Calabar Metropolis, Nigeris. EJEAFChe, 9 (1): 89-100.