Microbial composition of the abattoir environment and its health implications on the quality of fresh cow meat sold in Akure, Ondo State, Nigeria

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Abstract

This study was carried out to find the microbial composition of the abattoir environment and its health implications on the quality of fresh cow meat sold in Akure, Ondo State of Nigeria. A total of ninety samples were collected from five different abattoirs using sterile swabs and specimen bottles from the floor, slaughtering table, butchering knives, workers' clothes, waste dump and waste water. One hundred grams of fresh meat were bought differently from each of the five abattoirs kept in a sterile polythene bag and were taken to the laboratory for analysis. Five hundred and twenty nine bacteria were isolated and identified from the samples; these organisms are common to all the samples including the meats. The bacteria with their frequency of isolation included: *Aeromonas hydrophila* (2.3%), *Bacillus pumilus* (7.6%), *Bacillus subtilis* (10.3%), *Corynebacterium xerosis* (16.8%), *Escherichia coli* (24.0%), *Nitrococcus mobilis* (3.4%), *Proteus vulgaris* (5.6%), *Sarcina flava* (1.1%) and *Staphylococcus aureus* (28.5%). *Corynebacterium xerosis, Escherichia coli* and *Staphylococcus aureus* were isolated from all the samples. The fungi with their frequency of isolation were *Aspergillus* sp. (33.0%), *Saccharomyces* (20.7%). The samples of high contamination were: waste water, waste dump and all the meat samples. Many bacteria and fungi were isolated from the meat and the environment in which the animals are slaughtered, some of these organisms can cause diseases in humans. The study show that the application of good

WIT Transactions on Ecology and The Environment, Vol 170, © 2013 WIT Press
www.witpress.com, ISSN 1743-3541 (on-line)
doi:10.2495/FENV130061

manufacturing practices (GMP) should be introduced in the abattoir environment of Akure, Ondo State, Nigeria and the relevant authorities should be vigilant.
Keywords: abattoir, cow meat, environment, slaughtered, microbial effect, composition, health implication, quality, frequency, sold.

1 Introduction

Fresh cow meats have been implicated for number of meat borne infections and intoxications in several countries. Microbial population that comes in contact with fresh meat during slaughtering, dressing and processing presents a challenging problem to the meat industries. Meat is a major source of protein consumed all over the world, it has high nutrient and water composition, and therefore, it should be kept clean and free from microorganisms that can be detrimental to our health. Microbial contamination can reduce the quality of fresh meat, shorten its shelf-life and cause economic losses and health hazards. The most important issue in all meat-processing plants is maintenance of proper hygiene and adequate sanitary conditions. At most municipal abattoir, ante-mortem examination is nil as animals are offloaded and conveyed straight to the slaughter halls. Animals are then slaughtered using the muslin technique of decapitation on the bare floor with skinning or burning of the carcasses commencing on the same spot (Abiola [1]). An abattoir has been defined as a premise approved and registered by the controlling authority for hygienic slaughtering and inspection of animals, processing and effective preservation and storage of meat products for human consumption (Alonge [2]). Animals slaughtered in Bodija abattoir alone accounts for 65.93% of the total animal in Oyo State, Nigeria (Abiola [1]), the waste from the slaughtering and dressing grounds in Bodija abattoir are washed into open drainages untreated. Abattoirs are frequently located near urban centers in Nigeria and enormous amount of wastes are produced. This had been a source of embarrassments as these wastes are channeled directly into rivers in the country. Meat is the product of abattoir and a major source of animal protein consumed all over the world. Meat has high nutrient and water composition; therefore, it should be kept clean and free from microorganisms that can be detrimental to humans' health.

The slaughtering of animals results in meat supply and useful by products like leather and skin. Livestock waste spills can introduce enteric pathogens and excess nutrients into surface waters and contaminate ground waters. Abattoir operations produce a characteristic highly organic waste with relatively high levels of suspended solid, liquid and fat. The solid waste includes condemned meat, bones, undigested horns, hairs and aborted fetuses. The liquid waste is usually composed of dissolved solids, blood, gut contents urine and water. Animal food is always microbiologically contaminated by organisms living in it naturally of entering it from the surrounding such as those resulting from processing operations. Environmental pollution and other health hazards that may threaten animal and human communities can be monitored through food inspection and in live animals. Meat and its products are highly perishable and therefore adequate handling must be adopted during processing. Deterioration

begins just after slaughtering as a result of microbiological, physical and chemical processes (Hedrick [3]).

Therefore, intermittent microbial analysis and constant monitoring are necessary to produce hygienic and wholesome meat to ensure safe public health. Hence, the main aim of the present study was to determine the microbial composition of abattoir environment and its health implication on quality of fresh cow meat sold in Akure, Ondo State, Nigeria.

2 Materials and methods

2.1 Sampling and examination

A total of ninety samples were collected from five different abattoirs using sterile swab and specimen bottles. Samples from environment were taken from floor, slaughtering table, butchering knives, workers cloth, waste dump and waste water dump. Samples were collected using sterile syringe and specimen bottles. One hundred grams of fresh meat were bought differently from each of the five abattoirs and were put separately in sterile polythene bags. They were taken to the laboratory for analysis.

2.1.1 Sample preparation

Twenty-five grams of each fresh meat sample was minced into small pieces using sterile scissors and forceps and then homogenized in a sterile pestle and mortar with 225ml of 0.1% peptone water (10%w/v). Enumeration of aerobic plate count was carried out in plate count agar as suggested by Cruickshank [4] and Andrews [5]. Serial tenfold dilution of the homogenates were made in normal saline solution and subjected to aerobic plate count by standard pour plate method. Similarly, coliform counts were carried out in MacConkey agar and Sabouraud dextrose agar respectively. Swabs were homogenized for two minutes in swab transport solution (0.1% peptone water). An aliquot (1.0ml) of the homogenized solution was drawn with the aid of sterile syringe from the first sample solution into 9ml of sterile distilled water. One ml aliquot each was transferred aseptically into two sterile Petri dishes from 10^6 dilution fold, followed by pouring technique. The same procedure was repeated for the remaining samples solution, these were followed by incubation of bacteria plates at 37ºC for 24–48hours. Sabouraud dextrose agar plates were incubated at 28 ± 2ºC for 3-5 days for fungi.

The samples were analyzed for detection of possible meat borne pathogens like *Staphylococcus aureus, Salmonella* spp., *Vibrio* spp. and *Clostridium* spp. by morphological and biochemical characterization Cruickshank *et al.* [4] and Holt *et al.* [6].

3 Results

Table 1 shows the microbial viable counts of the meats and samples from the abattoir in cfu/ml. The highest count was observed on the floor in Onyearugbulem abattoir 28cfu/ml for bacterial and 12 and 4 sfu/g for mould and

Table 1: Microbial viable counts of the samples from abattoirs.

A	B	C	D	E	F	G	H	I	J
	cfu/ml							sfu/g	
Onyearugbulem	28	18	14	22	30	25	20	12	4
Iya Ibeji	22	16	13	20	34	26	18	10	2
Aule	17	11	9	12	28	21	13	6	3
Bola meat	10	6	4	4	19	14	8	3	2
Araromi	20	14	11	19	22	20	17	7	3

Keys: A=Source of samples, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water, H=Meat, I=Mould and J=Yeast.

yeast. The number of microbial colonies was highest in the slaughtering table of Onyearugbulem abattoir, while Bola meat had the least (Table 1).

The present study showed that 28.5% of the total bacterial identified were *Staphylococcus aureus* which was the highest and the lowest was *Sarcina flava* with 1.1% (Table 2).

Aspergillus sp. was the highest number of fungi isolates of 30% and *Articulospora* sp. (6.7%) was the least.

Tables 3–7 show the occurrence of bacteria in all the samples.

Table 2: Total distribution of bacterial and fungal species isolated and characterized at the various abattoirs.

Bacteria	Number of isolates	Fungi	Number of isolates
Staphylococcus aureus	151	*Amblyosporium* sp	18
Escherichia coli	127	*Aspergillus* sp	82
Corynebacterium xerosis	89	*Articulospora* sp	17
Bacillus subtilis	55	*Fusarium* sp	18
Bacillus pumilus	40	*Neurospora* sp	19
Proteus vulgaris	31	*Penicillium* sp	24
Nitrococcus mobilis	18	*Rhizopus* sp	20
Aeromonas hydrophila	12	*Saccharomyces* sp	52
Sarcina flava	6	-	-
Total	529	Total	250

Table 3: Total bacterial species isolated and identified at Onyearubulem abattoir (n=137).

A	B	C	D	E	F	G	H
Aeromonas hydrophila	0	0	1	0	0	1	0
Bacillus pumilus	1	1	1	0	2	2	0
Bacillus subtilis	2	1	2	0	2	3	1
Corynebacterium xerosis	5	3	3	0	5	4	1
Escherichia coli	8	4	2	6	7	8	4
Nitrococcus mobilis	0	1	0	1	0	1	0
Proteus vulgaris	1	1	0	2	0	0	0
Sarcina flava	0	1	0	0	0	0	0
Staphylococcus aureus	8	5	4	10	9	7	6
Total	25	17	13	19	25	26	12

Keys: A=Types of bacteria, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 4: Total bacterial species isolated and identified at Iya ibeji abattoir (n=131).

A	B	C	D	E	F	G	H
Aeromonas hydrophila	0	0	0	0	1	0	0
Bacillus pumilus	0	1	1	1	4	3	1
Bacillus subtilis	1	2	2	1	5	4	2
Corynebacterium xerosis	5	3	1	5	7	8	2
Escherichia coli	7	5	4	3	9	4	3
Nitrococcus mobilis	0	0	0	0	1	1	0
Proteus vulgaris	0	0	0	0	1	0	0
Sarcina flava	0	0	0	0	0	1	0
Staphylococcus aureus	6	4	5	4	6	5	2
Total	19	15	13	14	34	26	10

Keys: A=Types of bacteria, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 5: Total bacterial species isolated and identified at Aule abattoir (n=98).

A	B	C	D	E	F	G	H
Aeromonas hydrophila	0	0	1	0	0	0	0
Bacillus pumilus	1	1	0	0	2	3	1
Bacillus subtilis	2	1	1	2	3	3	2
Corynebacterium xerosis	2	2	2	2	5	3	1
Escherichia coli	3	3	2	2	5	4	2
Nitrococcus mobilis	0	0	0	0	1	0	0
Proteus vulgaris	0	1	0	0	0	1	0
Sarcina flava	0	0	0	0	1	0	0
Staphylococcus aureus	8	4	2	5	6	5	3
Total	16	12	8	11	23	19	9

Keys: A=Types of bacteria, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 6: Total bacterial species isolated and identified at Bola meat abattoir (n=57).

A	B	C	D	E	F	G	H
Aeromonas hydrophila	1	1	0	0	0	1	1
Bacillus pumilus	1	0	0	0	2	1	0
Bacillus subtilis	0	1	0	0	2	5	1
Corynebacterium xerosis	1	0	0	0	2	2	1
Escherichia coli	2	0	0	0	4	0	0
Nitrococcus mobilis	0	1	1	1	1	1	1
Proteus vulgaris	2	1	1	1	2	1	1
Sarcina flava	0	1	1	1	0	0	0
Staphylococcus aureus	2	1	1	1	2	2	1
Total	9	6	4	4	15	13	6

Keys: A=Types of bacteria, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 7: Total bacterial species isolated and identified at Araromi abattoir (n=106).

A	B	C	D	E	F	G	H
Aeromonas hydrophila	0	1	0	2	1	0	0
Bacillus pumilus	2	2	1	3	0	1	1
Bacillus subtilis	0	0	2	1	1	0	1
Corynebacterium xerosis	2	0	0	0	7	5	0
Escherichia coli	3	5	2	4	4	5	2
Nitrococcus mobilis	2	0	1	1	2	0	1
Proteus vulgaris	4	3	1	2	1	2	0
Sarcina flava	0	0	0	0	0	1	0
Staphylococcus aureus	6	2	3	5	4	4	3
Total	18	13	10	18	19	18	8

Keys: A=Types of bacteria, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Tables 8–12 represented the occurrence of fungi in all the locations of the abattoirs.

Table 8: Total fungal species isolated and identified at Onyearugbulem abattoir (n=65).

A	B	C	D	E	F	G	H
Amblyosporium sp	0	0	1	0	0	1	0
Aspergillus sp	1	1	1	0	2	2	2
Articulospora sp	1	1	0	0	0	1	1
Fusarium sp	2	3	0	0	5	5	1
Neurospora sp	1	1	0	0	3	2	0
Penicillium sp	2	1	0	1	2	1	1
Rhizopus sp	2	1	1	1	2	3	1
Saccharomyces sp	2	1	0	0	2	3	0
Total	11	9	3	2	16	18	6

Keys: A=Types of fungi, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 9: Total fungal species isolated and identified at Iya Ibeji abattoir (n=61).

A	B	C	D	E	F	G	H
Amblyosporium sp	0	0	1	0	0	1	0
Aspergillus sp	1	1	1	0	2	2	2
Articulospora sp	0	0	0	0	0	0	1
Fusarium sp	3	1	1	0	4	2	1
Neurospora sp	2	1	2	0	2	3	0
Penicillium sp	0	1	0	1	0	1	1
Rhizopus sp	2	1	0	0	4	3	2
Saccharomyces sp	2	1	2	0	2	3	1
Total	10	6	7	1	14	15	8

Keys: A=Types of fungi, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 10: Total fungal species isolated and identified at Aule abattoir (n=44).

A	B	C	D	E	F	G	H
Amblyosporium sp	1	0	0	0	2	1	0
Aspergillus sp	2	1	1	0	4	0	1
Articulospora sp	0	1	0	0	1	0	0
Fusarium sp	1	1	1	0	3	1	1
Neurospora sp	0	0	0	0	1	1	0
Penicillium sp	1	1	0	1	1	1	1
Rhizopus sp	1	1	0	0	3	2	1
Saccharomyces sp	0	1	1	0	2	1	1
Total	6	6	3	1	16	7	5

Keys: A=Types of fungi, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat.

Table 11: Total fungal species isolated and identified at Bola meat abattoir (n=25).

A	B	C	D	E	F	G	H
Amblyosporium sp	0	0	1	0	0	1	0
Aspergillus sp	2	1	1	0	1	2	1
Articulospora sp	0	0	0	0	0	0	0
Fusarium sp	1	1	0	0	0	1	1
Neurospora sp	0	0	0	0	1	0	0
Penicillium sp	1	1	0	0	0	1	0
Rhizopus sp	1	1	0	0	1	0	1
Saccharomyces sp	1	1	0	0	0	1	0
Total	6	5	2	0	3	6	3

Keys: A=Types of fungi, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat

Table 12: Total fungal species isolated and identified at Araromi abattoir (n=55).

A	B	C	D	E	F	G	H
Amblyosporium sp	2	0	1	0	0	1	0
Aspergillus sp	3	1	0	0	2	3	1
Articulospora sp	2	0	0	0	1	1	0
Fusarium sp	2	1	0	0	4	3	1
Neurospora sp	1	0	0	1	0	0	0
Penicillium sp	3	1	0	1	0	1	1
Rhizopus sp	1	1	0	0	3	2	1
Saccharomyces sp	2	1	1	0	2	2	1
Total	16	5	2	2	12	13	5

Keys: A=Types of fungi, B=Floor, C=Slaughtering tables, D=Butchering knives, E=Workers' clothes, F=Waste dump, G=waste water and H=Meat

4 Discussion

The predominant bacterial species isolated from the samples of the various sections of the abattoirs and meats after identification were found to be common to all the abattoirs. The total count of microbes isolated from the various

abattoirs can thus be attributed to the improper sanitary condition and personal hygiene of the handlers. *Escherichia coli* are unavoidable contaminant of meat, but the number is usually low when good hygiene is practiced. Clark [7] reported that the presence of microorganisms on meat product would invariably affect the nutritive value such as protein, fats minerals, vitamins, moisture content and calorie contents of the meat which are very important to the consumer and general populace.

The higher incidence of microbial load in fresh meat and environment obtained in this study might be attributed to unhygienic and improper handling of animals during slaughter, dressing and evisceration. The usual practice of washing the carcass with the same water in which intestines and offal had been washed was considered as one of the predominant reasons for increased microbial counts of the carcasses. A complete ignorance on the part of the meat handlers in hygienic handling of carcasses during slaughter and retailing processes might be the main factors for producing meat with high microbial load Table 1.

The bacterial isolated with their frequency of isolation were: *Aeromonas hydrophila* (2.3%), *Bacillus pumilus* (7.6%), *Bacillus subtilis* (10.3%), *Corynebacterium xerosis* (16.8%), *Escherichia coli* (24.0%), *Nitrococcus mobilis* (3.4%), *Proteus vulgaris* (5.6%), *Sarcina flava* (1.1%) and *Staphylococcus aureus* (28.5%). *Corynebacterium xerosis*, *Escherichia coli* and *Staphylococcus aureus*. The fungi with their frequency of isolation were *Amblyosporium sp*. (7.2%), *Aspergillus sp*. (23.9%), *Articulospora sp*. (6.7%), *Fusarium sp*. (7.2%), *Neurospora sp*. (7.5%), *Penicillium sp.* (9.6%), *Rhizopus* (7.9%) and *Saccharomyces* (20.7%).

Several authors like Sharma *et al.* [8] and Mukhopadhyay *et al.* [9] identified different organisms like *Staphylococcus aureus, E. coli, Bacillus* spp. from chevon and beef carcasses. Similarly, isolation of *Staphylococcus aureus* and *Corynebacterium* spp. (Tables 3–7) from the meat samples and the abattoir environment signifies the public health importance of this study. Anon [10] stated that in addition to meat spoilage caused by microbial contaminants, their presence on food have equally been reported to cause a lot of disease like diarrhea, dysentery, throat infection, typhoid, hepatitis and occasionally fatal food poisoning. Hence, the butchers and slaughter house workers should be educated in hygienic slaughtering and processing of food animals. They should be advised to maintain strict hygienic conditions in their abattoirs.

5 Conclusion and recommendation

This study reported some of the implication on the quality of fresh cow meat in Akure, Ondo State, Nigeria.

Good manufacturing practices should be introduced in the abattoir environment of Akure, Ondo State, Nigeria and the relevant authorities should be vigilant in the adequate inspection of the abattoirs.

Acknowledgements

The author would like to acknowledge the help and assistance of the butchers who helped during the collection of the samples and all the technologists in The Department of Microbiology of The Federal University of Technology, Akure, Ondo State, Nigeria.

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