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Research Article

Clinical Exploratory Recovery of Bacteria Pathogens Associated with some Abattoir Outfits in Port Harcourt, Rivers State: A Potential Public Health Concern

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Abstract

The aim of this study was to investigate the association of some pathogenic pathogens with abattoir environment in Port Harcourt and possibly highlight some of their Public Health implications. The study was a cross sectional research design; hence samples were bacteriologically collected and examined for the presence of some pathogenic pathogens and their potential implication on the overall meat hygiene, using standard microbiological technique. Frequency distribution, prevalence and ANOVA t-test statistics was used at $p<0.0$ through the application of SPSS version 21 for the analysis of the data. Results implicated the presence of four types of bacteria namely; *Clostridium spp, Staphylococcus spp, Bacillus spp*, and *Escherichia coli* with prevalence rates of 4 (5%), 16 (20%), 20 (25%) and 40 (50%) respectively. Total Number of Coliforms (MPN Index/100ml) for all the selected Abattoir locations stood at ≥ 2400.

The null hypothesis was therefore retained thus, the bacteriological quality of meat is strongly influenced by the conditions of hygiene prevailing during the production and handling process. It is therefore, strongly believed that without proper hygiene, the environment and materials used in abattoir can act as a source of microbiological contamination. However, indiscriminate littering with feaces is a threat, hence, requires serious control. Abattoir contributes to the problem of food borne diseases and potential health hazards associated with it. The findings from this study indicate that meat hygiene was compromised, and this situation calls for an improvement in abattoir management safety and the application of Hazard Analysis Critical Control Point (HACCP) by relevant stakeholders to prevent an outbreak of an epidemic.

Keywords: Pathogens; Abattoir; Hygiene; Poor environment; HACCP; Port harcourt; Rivers state; Nigeria

Introduction

Over the last few years, the concern over the safety of meat has risen to alarming proportion even as the most important aspect in meat quality standard is making sure that meat product, during production chain is free from potential pathogenic bacteria; although it is basically not possible to achieve zero tolerance, as most public abattoirs are still at risk of promoting and causing food borne outbreaks across the world [1-3] which could probably be linked to unhygienic practices and dirty environment [4,5].

In Nigeria, there are several public slaughterhouses and a few private meat processing plant distributions, where the public buy their meat daily with serious consequences arising from lack of hygiene and sanitation in such abattoirs and meat stalls [6]. The consequences include health hazards such as food poisoning and environmental pollution that may threaten animals and human health [4,7]. Hutchison and colleagues [8] comparatively investigated wet-dry swabbing and excision-sampling methods for microbial testing of bovine, porcine and ovine carcasses at red meat slaughter houses and they asserted that conventional visual examination has been shown not to be an effective strategy of protecting consumers against meat-borne infections, and physical and chemical hazards [8,9].

Therefore, there is need for investigation which should go beyond this tradition of visual inspection, nonetheless, it became paramount for the researcher to study "the laboratory based study of Bacteria Pathogens that are associated with some Abattoir Outfits in Port Harcourt, Rivers State, Nigeria" thus, this is aimed at evaluating the bacteriological quality of the materials, as well as the surrounding environment of these abattoirs which in no doubt, would reflect massively on the quality of meat sold in these abattoirs. Thus, these would further ascertain whether it is strongly influenced by the conditions of hygiene standard prevailing during the production, handling and distribution in relation to the degree of the literacy level of the handlers. In addition, to determine the probable organisms predominate in the various abattoirs understudied, since these abattoirs forms the major centers for meat sources in the region of this current study. The researcher would also possibly attempt to highlight the public health implications of the presence of the pathogens in our meat products.

Nevertheless, hazard analysis and critical control point-based approach to production and processing is better suited to produce hazard-free meat as posited by Gill [10] since it considers preventive means rather, than finished product inspection outcome [11,12]. However, microbiological sampling and examination was introduced to validate that HACCP schemes are effectively monitoring abattoir condition outcome for general Public Health protection of today and tomorrow.

Moreover, a study done in Akure, Western Nigeria on the "Environmental Implication of Unhygienic Operation of a City" which reported that Abattoirs are one of the industries that contribute to the problem of possible food borne diseases and potential health hazards associated with wastes and food especially meat. With inadequate slaughtering and disposal facilities not provided by relevant agencies, the abattoir has become a source of infection and pollution, attracting domestic and wild carnivores, rodents and flies, which are vectors of different myriad of diseases some of which are food and water borne related in our communities [4].

Description of the Study Area

In Port Harcourt, the center of oil and gas activities in Nigeria, there is high level of migration of human population in search of greener pasture; there is also high demand of meat and its products as a source of protein. Also, problems associated with poor waste management in Port Harcourt cannot be over-emphasized. Nonetheless, when it has to do with waste generated by abattoirs in various locations within the city, the city faces serious problems of high volumes of waste, characterized by inadequate disposal techniques/expertise, high cost of management and the adverse impact of wastes on the environment and humans. All these tend to compound the health problems facing man in this region.

Methodology

The observational descriptive study hypothesized no statistically significant discrepancy in the reports from the selected abattoirs within Port Harcourt Metropolis, thus the knives used in slaughtering and cutting cattle, tables used in displaying meat, the wash up areas and water used for washing meat and drinking in four abattoir sites in Port Harcourt were bacteriologically examined for their implication on the overall meat hygiene and the associated public health risks it would generate. A total number of forty-eight samples were collected, a sterile swab sticks and sterile sample container were used to collect the water samples, the samples were immediately taken to the Microbiology laboratory of Rivers State University in a cold pack to sustain the pathogens in the sample collected. Inoculation of the samples was done in various media of choice, such as blood agar, Nutrient agar, MaC conkey agar (etc.) and were further analyzed and identified according to Monica methods and techques [13,14]

Data Analysis

Frequency distribution, prevalence rate and ANOVA t- test statistics was used at $p<0.05$ to analyses the data using SPSS version 21. The results were presented in tables and graphs accordingly.

Result

Table 1: Educational Qualification and Demographic Characteristics of Abattoir Workers in Port Harcourt.

Variable	Educational Background	Number (%)
	No Formal Education	**4 (5%)**
Educational Background	Primary	16 (20%)
	Secondary	60 (75%)
	Tertiary	0 (0%)
Age Range	16-25 Years	2 (2.5%)
	26-35 Years	48 (60%)
	> 35 Years	30 (37.5%)
Organism Isolated	Bacillus spp.	20 (25%)
	Staphylococcus spp.	16 (20%)
	Clostridium spp.	4 (5%)
	Escherichia coli.	40 (50%)

The socio-demographic parameters obtained from this present study revealed that the study included a total of eighty subjects aged 16years and above, with the highest age range 26-35 years 48 (60%) and educational background of these subjects showed that no one

had tertiary level of education, whereas; 4 (5%), 16 (20%) and 60 (75%) had no formal education, primary and secondary education respectively. From the probable isolates, it was reported that four types of bacteria were isolated; *Clostridium* spp, *Staphylococcus* spp, *Bacillus* spp. and *Escherichia coli* with prevalence rates of: 4 (5%), 16 (20%), 20 (25%) and 40 (50%) respectively (Table1) and (Figure1).

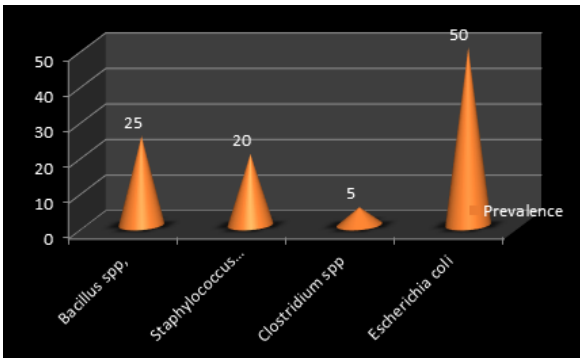

Figure 1: Prevalence of isolated organisms in the studied locations in Port Harcourt Abattoir.

Moreover, total Coliform was enumerated from this study using the Most Probable Number Index, the study reported that the Total Number of Coliforms (MPN Index/100ml) for all the selected Abattoir locations showed values ≥ 2400 (Table2).

Table 2: Most Probable Number (MPN) obtained from Different Index based on location of the Study.

Abattoir Location	Total Number of Coliforms (MPN Index/100ml)
Rumukoro (R)	≥ 2400
Trans-Amadi (T)	≥ 2400
Iloabuchi (IL)	≥ 2400
Mile 3 (M)	≥ 2400

In addition, the descriptive Statistics and ANOVA analysis of the abattoir locations and sources of sampling showed that the mean values and its associated standard deviation of bacterial counts (cfu/ml) obtained from the source of sampling are as follows: $1.75 \times 10^4 \pm 1.08 \times 10^4$, $2.02 \times 10^4 \pm 0.60 \times 10^4$, $1.73 \times 10^4 \pm 0.32 \times 10^4$ and $1.83 \times 10^4 \pm 0.62 \times 10^4$ for knife swab, wash up, table swab and water respectively. An F-value of 0.139 was obtained with no indication of statistical implication (P=0.94) thus, retained the null hypothesis of no difference.

Furthermore, the mean values and its associated standard deviation of bacterial counts (cfu/ml) obtained from the abattoir locations showed; $2.05 \times 10^4 \pm 0.53 \times 10^4$, $1.89 \times 10^4 \pm 0.44 \times 10^4$, $1.55 \times 10^4 \pm 0.45 \times 10^4$ and $1.84 \times 10^4 \pm 1.11 \times 10^4$ for Rumokoro, Trans-Amadi, Iloabuchi and Mile 3 abattoirs respectively. There was no proof of statistical discrepancy (P=0.78) in the mean bacterial counts (cfu/ml) obtained from the various Abattoir locations hence, the study failed to reject the null hypothesis (Table 3).

Table 3: Descriptive Statistics and ANOVA of the Abattoir Locations and Sources of Sampling.

Variable	Classification	Mean ± 2 SD	F-value	P-value
Sources of Sampling	Knife swab	1.75 x 104 ± 1.08 x 104		
	Wash up	2.02 x 104± 0.60 x 104	0.139	0.94
	Table swab	1.73 x 104 ± 0.32 x 104		
	Water	1.83 x 104 ± 0.62 x 104		
Abattoir Locations	Rumuokoro	2.05 x 104 ± 0.53 x 104		
	Trans-Amadi	1.89 x 104 ± 0.44 x 104	0.365	0.78
	Iloabuchi	1.55 x 104± 0.45 x 104		
	Mile 3	1.84 x 104 ± 1.11 x 104		

Discussion

Based on the socio-demographic parameters of the studied participants, abattoir workers with age range 26-35 years had the highest proportion, this might be due to the fact that most of them are dropouts from school, as a result of poverty and this shows that the educational level amongst the abattoirs workers is low as none had tertiary education, even as the highest been secondary level. The level of literacy here was reported to be low, this could possibly affect their knowledge on the safe and hygienic practices which are supposed to be maintained by all during meat handling

and processing. This portend that more is needed to be done toward increasing the literacy level among the abattoir workers and creating awareness on good sanitary practices and personal hygiene outcome. Nonetheless, Mothers haw and colleagues [15] elucidated on the importance of literacy and the role of education as well as proper training of abattoir workers as these have huge impact on the cross- contamination prevention approach; they further stated that the hygiene status of abattoirs and its products are largely dependent on the general slaughter-house hygiene and the skills of the workers on meat safety strategy [15].

Meat must, therefore, be of high microbiological quality in order to ensure that the consumer receives a product that is not spoilt or does not carry food borne disease [3]. The microbes isolated and identified in this study (*Bacillus, Escherichia, Staphylococus* and *Clostridium* spp) was in conformity with earlier reports by Tertius [3] who reported these organisms as frequently occurring bacteria pathogens from red meat abattoirs, and which have been serially implicated in food borne diseases. Also, *Fasanmi et al.* [16] isolated similar organisms from table scrapings in meat stalls in markets of Ibadan metropolis in the western part of Nigeria. In addition, the number and types of organisms encountered in the study further confirms the findings of *Olukole* [17] on the low enforcement of veterinary legislations in Oyo State, even in Nigeria at large given the similar recovery of same potential pathogens in this present study in Rivers State, South-South part of Nigeria.

Nevertheless, the Public Health implications of this unhygienic and poor sanitary environment of the abattoirs sanitary engagement policy trust, may probably result from contamination of meat and meat products, hence promoting the increasing sporadic spread of food borne disease outbreaks in our communities. Nonetheless, meat contaminating bacteria may probably be the direct and in-direct cause and rapid spread of food borne diseases, which represent a potential Public Health threat for the frequently encountered spread of drug resistance of human pathogenic agents, especially in an era of increasing antibiotic resistances episode [18] Microbial investigation of beef carcasses although mostly eaten by scavengers, using molecular techniques showed that the carcasses were already contaminated after evisceration, least frequently with *Staphylococcus aureus* strains, and most frequently with coagulase-negative potential pathogens [18].

During carcass processing, contamination with resistant or polyresistant strains of *S. aureus* and *E. coli* increases and the gene typing isolates of *S. aureus* and *E. coli* indicates that the strains probably originates in the processing plant. Furthermore; as a means of regulation, *Olugasa & Atsanda* [19] cited the proceedings of the XTH International Congress on Animal hygiene held in Maastricht, Netherlands which centered on actualization strategies for beef quality control, and it was noted that meat quality control system should be able to regulate the measure of extrinsic materials such as toxins, pathogenic microorganisms, chemical residues and putrefied tissues, which could be present in meat and are deleterious to human health. Still on public health implication, according to the World Health Organization [20] food borne diseases have been described as one of the most widespread Public Health problems of the contemporary world, creating enormous social, cultural and economic burden on communities and their health systems. *Tom, O'Brien & Mogens* [21] as well agreed to the fact that food borne diseases usually arise from improper handling, preparation processing and storage of food thus; meat production in abattoirs should involve safe practices including good environmental and personal hygiene.

Nevertheless, it is for the interest of Public Health protection gains, that the application and enforcement of Hazard Analysis Critical Control Point strategy was introduced in food safety outcome, and it was strongly advised that it should be effectively put in place in all food processing factories, hence all the strategy in the protocol must be followed to the later, during the processing and handling of meat in our abattoirs, if the safety and integrity of such products must be guaranteed, trusted and protected from microbial contamination of any sort within the environment.

Nonetheless, the prevalence of *Staphylococcus* spp from abattoir as seen in this study strongly suggest that in developing countries like Nigeria, *Staphylococcus* spp is one of the predominant organisms and it has been shown consistently to be one of the most important microorganisms responsible for food poisoning outbreaks according to Shale *et al.* Study in South Africa also revealed that after the *Staphylococci* were identified, quantified and characterized in terms of coagulase types, the highest *Staphylococci* counts were observed during week 3. The counts exceeded the National Guidelines without exception and at least 50% surpassed the level enough to produce toxins determined for *S. aureus*. In terms of coagulase types, type V was the most dominant and type VI the least [22]. The presence of *Staphylococcus aureus* and *Staphylococcus epidermidis* may also be due to unhygienic handling of sources of sampling by the abattoir workers. *Staphylococcus aureus* has been implicated in food poisoning outcome, because it also produces toxins which potentially promotes the increasing trend of its pathogenicity in a most robust way.

Furthermore, the occurrences of the organisms isolated from this study, could possibly be attributed to many reasons like the high prevalence of *Bacillus* spp in this study, could probably be attributed to the high- resistant nature of the organism, as it is an aerobic spore- former and persists in the environment for a long time[13], hence it's present in the soil, may probably enhance the chances of meat contamination due the contamination of the products by sand and dust particles by air current, especially during the dry season and possibly, due to poor handling. Furthermore, the occurrence of *Bacillus cereus* in particular has been associated with food poisoning and this is attributed to its toxin-producing capability per se whereas, the occurrence of *Clostridium* species can also be linked to its toxin-producing and spore-forming abilities towards withstanding adverse environmental condition and evading the potential damage of broad spectrum antibiotics in the system.

Nevertheless, it is strongly believed that the integrity of the sources of sampling like the knives, tables, wash up areas and water could have been undermined, thus, in this present study, it has been proven to be potential source(s) and very viable vehicles for the

transmission of microorganisms due to their salient roles that was observed in this present study, even as the sources of sampling from this study was indicative of comparable level of contamination. Nonetheless, the presence of these bacteria on knives, tables, wash up areas and water are an indication that meat placed on such tables may have probably been contaminated in the process, with a high tendency of cross contamination. However, another good reason could probably be linked to unhygienic practices of the meat handlers. These finding were like the reports of *Borch et a*l. on the bacteriological safety issues in beef and ready-to-eat meat products, as well as control measures and reports of *Eno-Obong et al*. [23] on prevalence of microorganisms in flies and meat in Uyo Abattoir, Akwa-Ibom State, Nigeria.

Besides, the above issues raised, faecal matter is a major source of contamination and can reach carcasses and work surfaces directly (through deposition) or indirectly through contact with contaminated and clean carcasses, equipment workers, installations and air [24]. Although water can contain unwanted materials, the greatest risk to human health is from faecal contamination of water supplies from abattoirs and sewage [13].

Another study which emphasized the need for pre-slaughter intervention strategies to reduce food-borne pathogens in food animals revealed a correlation of faecal shedding with carcass contamination as such, the role of the live animal in the production of a safe and wholesome food product is critical due to indiscriminate shedding of feacal matters within the slaughter environment [25]. Besides, the presence of *Escherichia coli* been the most prevalent organism in this study probably provided an indication of feacal contamination, since it is an organism of the gut.

The gross contamination of water in the abattoir locations by *Escherichia coli* and other coliforms can be attributed to the seepage of leachate into the underground layers arid wastes form slaughtering and dressing surfaces in the abattoirs. This is in conformity with the work of Akinro *et al.* [4] on the environmental implication of unhygienic operation of a city abattoir in Akure, Western Nigeria. Remarkably, the mean values of bacterial counts obtained was also like that obtained by Fasanmi *et al*. This poses a serious public health risk to the consumers of meat and also an indicator of low level of hygienic practices at the various abattoirs were the study was carried out. Furthermore, the non-existence of statistical significance evidence, observed in this study means that the various sources of sampling which were subsequently used, likely gave the same result within same context. Likewise, there was no significant difference in the mean values obtained in the four abattoirs; therefore, consumers who purchase meat from these locations are at a high risk of food poisoning outcome with a critical Public Health implication.

Microorganisms are ubiquitous in nature and domestic animals are no exception thus, by implication are found often in the environment and on both flora and fauna thereby contaminating raw foods including meat. Although, not all microorganisms are pathogenic in nature but presence of some of these microbes are indications of poor sanitary outcome and this may not certify the edibility of the food as consumption of these food-meat products, could mean consumption of germs. For instance, the presence of *E.coli, Salmonella* etc. are suggestive of evidence of fecal contamination (which is a major source of contamination in abattoirs) and therefore, these are probably some of the causes of enteric fever and diarrhea through the ingestion of feaces and consumption of unhygienic food irrespective of the bacterial load. Nevertheless, there are classifications which could be acceptable, satisfactory and unacceptable with reference to food hygiene and contamination, however, in terms of allowable permissible limit of microorganisms in food, these needs to be followed consciously and carefully if we must maintain adequate food safety and effective hygiene nonetheless, bacterial load which can either be high or low could be dependent on different factors however; bacterial load can be very high on certain key foods like raw meat, these could be as a result of poor sanitary condition and unsafe practices of the abattoirs according to a study that considered zoonotic pathogens from a food production view point. This study was however limited to poultry meat i.e. the effect of *Campylobacters* [21].

Therefore, it is important to note that; during the slaughtering process, meat which is practically sterile is exposed to contamination with bacteria from the outside surface, intestines of animal, from equipment such as knives, hooks and from the air and hands of the workers. Meat contamination in the 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. In addition, a previous study carried out in same region (Southern Nigeria) precisely in Uyo Abattoir, Akwa-Ibom State, Nigeria, the prevalence of microorganisms in Flies and Meat cuts was determined and the result showed that structural and work surfaces may also be significant hideout for microbes thus, serve as sources of bacterial contamination on meat [23].

Also, open display of meat in several abattoir slabs and markets for several hours exposes it to more flies which are known vectors of bacteria including coliforms [26]. 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 as reported by *Fasanmi & Sansi* [2]. The microbiological quality of meat product is strongly influenced by the conditions of hygiene prevailing during their production and handling. The result of bacterial contamination reported in this study has shown that without proper hygiene control, the environment in slaughter-houses and butcher slabs can act as an important source of microbiological contamination; this is in consonance with a prior study by Borch & Arinder [5] which focused on bacteriological safety issues in beef and ready-to-eat meat products, as well as control measures.

The microbiological quality of meat is strongly influenced by the conditions of hygiene prevailing during the production and handling. Without proper hygiene control, the environment in slaughterhouses, knives, water and butcher slabs can act as sources of microbiological contamination. Indiscriminate littering with feacal material is a threat thus, requires serious control as *E. coli* had the highest prevalence in this study. From the empirical construct

in this present study, the findings made it evident that consumers of meat and its products could be at risk of food poisoning health outcome. This may be as a result of inadequate abattoir operation safety, ranging from poor techniques in slaughtering of animal due to inadequate facilities to low hygienic standards by butchers and meat vendors. Food poisoning in the abattoirs can also be due to air and water pollution. Based on these findings, it also showed that all the abattoirs studied are potential sources of food poisoning and much is needed to be done to protect humans from meat borne infections to minimize or possibly avert its public health implications.

Conclusion

Abattoir contributes to the problem of possible food borne diseases and potential health hazards associated with wastes and food especially meat. The findings in this study indicate that meat hygiene is being compromised in the city of Port Harcourt and this situation calls for an improvement in abattoirs management safety, to protect the lives of the general public from meat borne pathogens. In this study, the most prevalence pathogen was *E. coli*, seconded by *Bacillus spp* while the prevalence of the *clostridium spp* was least encountered. However, majority of the meat seller and abattoir workers are illiterate, hence understanding the protocol of meat safety and hygiene was a problem, and the knowledge and application of HACCP was also a massive challenge.

Recommendation

The study thus recommends strict enforcement of laws by the government concerning veterinary legislations and abattoir operations; also, the need to educate butchers and meat vendors on the adverse effects of meat contamination on public health, safe practices, and good environmental hygiene through regular sanitation, proper waste management and sterilization of their materials including improved literacy level must be strengthened. In addition, sanitary inspectors/veterinary doctors should take their work seriously, so as to stamp out the abattoir sites that did not meet up with the standards of international best practice, and also regular workshops to train and re-train the workers on the need for HACCP systematic application during meat processing and handling must be strongly advocated, even as regular microbiological examination of the meat products should be done to rule out contamination.

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