Original Research Article

EFFECT OF ABATTOIR ACTIVITIES ON THE PHYSICOCHEMICAL AND BACTERIOLOGICAL PROPERTIES OF SOIL SAMPLES FROM CHOBA SLAUGHTER, RIVERS STATE, NIGERIA

ABSTRACT

Slaughtering and processing of animal products at abattoirs generate different waste that may be transported into the nearby water bodies through runoff and other processes. This study was therefore aimed at evaluating the effect of abattoir activities on soil physico-chemical and bacteriological properties. The soil sampling involved five (5) different points, representing regions where the live animals are kept, where the animals are slaughtered, where the animal hides are roasted, where the waste bones are stacked, and a control sample collected 20 meters away from the abattoir site. The result of the physicochemical parameters showed that all the sample points were either higher or lower than that of the control soil sample. Statistical analyses however showed that there was a statistically significant difference ($p < 0.05$) between the nitrate concentration in the region used for roasting of animal hides and the control sample. The result of Total Heterotrophic Bacterial Count (THBC) showed that the highest value of 7.2×10^8cfu/gwas obtained from the location where the animals are slaughtered, while the least value of 1.0×10^8cfu/g was from the control soil sample. The other bacterial counts varied between $0.8x10^5$cfu/g and 5.0×10^6 cfu/g; $4.3 x10^4$cfu/g and $1.0 x10^5$cfu/g; $3.7x10^4$ cfu/g and $5.6x10^4$ cfu/g, for the Total Coliform Count (TCC), Fecal Coliform Count (FCC), Salmonella and Shigella Counts (SSC), respectively. A total of 28 bacterial isolates were characterized and identified to belong to seven genera, and their percentage prevalence showed that *Staphylococcus* spp., *Bacillus* spp., and *E. coli* were the most occurring, with a frequency of 21.7% each, followed by *Salmonella* spp. (13.1 %), *Klebsiella* spp. (8.7 %), *Serratiamercescens* (8.7 %) and *Shigella* spp. (4.4 %). The result of the response of the bacterial isolates to the conventional antibiotics revealed that all the isolates where sensitive to most of the antibiotics tested. This study has shown that abattoir activities have significant influence on the bacteriological and physicochemical characteristics of the soil, thereby accentuating the need for proper waste management.

Keywords: Abattoir activities, bacteriological properties, physicochemical, soil samples, slaughter.

1. INTRODUCTION

An abattoir is a specialized facility approved and registered by the regulatory authority for inspection of animals, hygienic slaughtering, processing and effective preservation, storage and dressing of meat produced for human consumption. It is a special facility designed and licensed for receiving, holding slaughtering and inspecting meat animals and meat producers before release to the public consumption[1]. Abattoir aims at optimizing the recovery of edible portions from the meat processing

cycle for human consumption [2]. However significant quantity of waste are generated from the animal products as well as due to the day to day activities of humans. These waste may include a characteristic highly organic waste with relatively high levels of suspended solid, liquid and fats. The exact composition of the abattoir waste cannot be known since it constitute several components which is detrimental to the receiving soil.

Various organs of cattle like muscles, blood, liver and kidney have been reported to contain trace metals; also feaces of life stock consists of mucus, bacteria, cellulose fibers, paunch manure which is very acidic in nature and others [3]. Additional reports have been made on the effect of abattoir waste on soil including increased concentration of trace metals, increased population of decomposers, loss of aesthetic values, excessive soil nutrient enrichment and increase toxin accumulation as well large accumulation of sulfide, amine and organic acids[4].Due to the protein content of slaughtered animal as well as the need to satisfy the protein need of the populace, there is an increased level of meat production done in an unhygienic or unhealthy manner, resulting in large amount of generated and deposited waste on the soil environment (lithosphere) with several impact/effects. Furthermore, this polluted soil could serve as a receptacle for many microorganisms including pathogenic ones, resulting in serious public health problems, including disease outbreak. Also, if there are no regular monitoring, this could lead to the alteration of the soil physical and chemical properties, serving as a medium for the pollution of other ecosystems such as the atmosphere and the hydrosphere.

Abattoirs waste just like any other waste can be detrimental to human and the environment if definite precautions are not taken. Some slaughter houses are littered with non-meat products and wastes that needs to be recycled into useful by products for further agricultural and other industrial uses. This constitutes public health risks and nuisance in most slaughter houses spread across markets, thereby causing air, soil and water pollution as well as infestation of flies and other disease vectors [5]. For hygienic reasons, abattoir use large amount of water in processing operations; this produces large amount of waste water. When the slaughter wastes are not properly managed and especially, discharged into water ways, as such practices can introduce enteric pathogens and excess nutrients into surface water. The numerous wastes produced by abattoir operation, not only pose a significant challenge to effective environmental management but also are associated with decrease air quality of the environment, potential transferable antimicrobial resistance patterns and several infectious agents that can be pathogenic to human [6].

Ground water qualities in vicinity of the abattoir are adversely affected by seepage of abattoir effluent as well as water quality of receiving stream that is located away from the abattoir [7]. Abattoir generally use large quantities of water for measuring meat and cleaning cutlasses used for cutting meat and they are usually located near water bodies in order to gain access to water for processing [8]. Contamination of river body and land from abattoir wastes could constitute a significant environmental and health hazard[5].

Air and water qualities within the residential areas are also affected by abattoir activities especially where modern or effective waste disposal system is not practiced. Medical experts were reported by Oyedemi (2004) to have associated some diseases with abattoir activities which include pneumonia, diarrhea, typhoid fever, asthma, wool sorter diseases, respiratory and chest diseases [9]. Pathogens present in animal carcasses or shed in animal wastes may include rotaviruses, hepatitis E virus, *Salmonella* spp., *Escherichiacoli* O157:H7, *Yersiniaenterocolitica*, *Campylobacter*spp, *Cryptosporidiumparvum*, *Mycobacterium*spp and *Giardialamblia*[10]. These zoonotic pathogens can exceed millions to billions per gram of faeces and may infect humans through various routes such as contaminated air, contact with livestock animals or their waste products, exposure to potential vectors (such as flies, mosquitoes, water fowl, and rodents), or consumption of food or water contaminated by animal waste [11].

Researchers have in recent time focused on the role of the soil ecosystem as a reservoir for pathogenic bacterial species as well as a sink for antibiotic resistance genes. There is therefore the need to add to the existing data on abattoir waste as it relates to soil quality. This study therefore seeks to generate information to add to the available literature on the environmental and public health implications of abattoir waste management practices, and at the same time serve as important data set in policy formulation. This study was therefore carried out to determine the effect of abattoir activities on the soil physico-chemical and bacteriological properties.

2.0 MATERIALS AND METHOD

2.1Description of study area

The study was carried out at Choba slaughter, located close to Choba Market, within latitude 4051'25.01"N and longitude 701'18.07"E.

Comment [GN1]: Which kind of abatatoire; specificity and characteristics and capacity and type of slaughter?

2.2 Method of Sample collection

Soil samples were collected into sterile polythene bags using soil auger at a depth of 0 -15cm. The samples were labelled properly and transported aseptically to the laboratory for both physico-chemical and microbiological procedures.

Comment [GN2]: Define in which period of year.Number of samples must be specified

2.3Description of sample collection points

The top soil samples were collected from five different points within the abattoir site, to cover the areas where different activities are carried out.

Sampling point A: The region where the live animals are kept

Sampling point B: The region where the animals are slaughtered

Sampling point C: The region where the animal hides are roasted

Sampling point D: The region where the waste bones are stacked

Sampling point E: The region where no activities are carried out (control).

2.4 Determination of the Physico-chemical properties of the soil samples

Parameters such as temperature,pH, nitrate nitrogen, electric conductivity, total organic carbon, and calcium were determined using the methods from APHA (1998) [12].

2.5. Microbiological analysis of the soil samples

The enumeration and isolation of bacteria from the soil samples were done following a serial tenfold dilution of the samples (1g in 9ml of distilled water) with dilution factors from 10^{-1} to 10^{-6} using sterile physiological saline (8.5g of NaCl in 1L of distilled water) as diluents. Aliquots (0.1ml) were plated in duplicates on Nutrient agar (NA), MacConkey agar (MCA), Eosin Methylene Blue (EMB) and Salmonella Shigella Agar (SSA) plates, using spread plate method which was done by adding aliquots on already prepared plates and using flamed glass spreader to spread the already inoculated bacteria. The plates were inverted and incubated at 37^{o}C for 24 hours and 44.5 ^{o}C for EMB plates (faecal coliform count). The colonies formed on the plates were counted and described morphologically and biochemically. The colonies formed on EMB was used for the enumeration of the population of *E. coli*; MacConkey for other coliforms and SSA for *Salmonella* and *Shigella* species. Colonies formed on nutrient agar was used to estimate the total heterotrophic bacteria count (THBC). The plates yielding counts of 30-150 colonies (cfu/g) were recorded. Colony counts were multiplied by the dilution factor to give the number of organisms per gram of the soil samples. Representative discrete colonies were purified by sub-culturing on freshly prepared sterile nutrient agar plates and incubated at 37^{o}C for 24 hours to obtain pure culture.

2.6. Characterizations and identification of the isolates.

The bacterial isolates were examined for colonial morphology as well as for cell morphology and biochemical characteristics.

This was carried out to group bacteria into gram positive and gram negative. A smear was made from a 24hours culture on properly labeled grease free glass slides. This was achieved by dropping one to two drops of water on the slide and emulsifying with a loop full of bacteria on the grease free glass slide. The smear was air dried and heat fixed by passing the slide under Bunsen burner flame three times each smeared slide was flooded with the primary stain (crystal violet) for 60seconds ,rinsed in slow running water .Smears were then flooded with lugol's iodine for 30 seconds and then rinsed in slow running tap

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water .The smear were then decolorized with 70% ethanol for 10 seconds and rinsed with slow running tap water and then flooded with a counter stain (safranin) for 30 seconds and again rinsed with slow running tap water. The slides was allowed to air dry on a slide rack. The stained smear was examined microscopically using oil immersion lens(x100) for better magnification. Purple or Violet colour showed gram positive while pink or red colour showed gram negative.

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2.7. **Preservation of pure culture**.

The pure culture of isolate were stored in 10 % (v/v) glycerol suspension at -4^{o}C in bijou bottles to prevent damage of the pure cultures for further analysis.

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2.8 Preparation of standard bacterial suspension

A 24 hours old pure culture of the test organism, was emulsified in sterile nutrient broth tubes and adjusted to an equivalence of 0.5 McFarland's turbidity standard prepared by adding 99.4ml of 1% v/v solution of sulphuric acid and 0.6ml of 1% w/v Barium Chloride solution[13] .

2.9.Antibiotics sensitivity testing by the agar disk diffusion (Kirby Bauer disk diffusion) method

A sterile swab stick was dipped into the tube containing the bacterial suspension and its turbidity was equivalent to 0.5m McFarland turbidity. The swab stick was pressed against the tube above the fluid level to remove excess broth. The swab was used to streak over the entire plate surface evenly which contained already prepared Mueller- Hinton agar in three dimension rotating the plate about 60^{o}C each time. The agar plate was allowed to dry for 5 minutes then the antimicrobial disk was impregnated to the agar using a sterile forcep on the surface of the inoculated plate 15mm away from the edge of the plate. Using the head of the sterile forcep the disk is slightly pressed down to ensure good contact with the agar. After applying the disk, the plates were incubated in an inverted position at 35^{o}C for 16 to 18 hours. After incubation the test plates were examined to ensure confluence growth or near confluence. The diameter of each zone of inhibition was measured in ml using a ruler on the underside of the plate and recorded for reference purpose [14].

Comment [GN12]: summarizing the technique by citing a reference

2.10 Statistical Methods

1. A One-way Analysis of Variance (ANOVA) was used to check for significant difference between each of the different samples and the control sample. The mean separation was analyzed using Tukey High significant difference (HSD).

2. Percentage prevalence was calculated using the formula:

$$P = \left(\frac{Fi}{\sum Fi}\right) x\ 100$$

Where;

P = prevalence of the isolate (%)

F_i = Frequency of respective isolates

$\sum F_i$ = Summation of frequency of respective isolates

3. The percentage sensitivity to an antibiotic was calculated using the formula:

$S (\%) = Ns / T_i$

Where;

Ns = Number of Isolates sensitive to the drug

T_i = Total number of isolates.

3.0 RESULTS

3.1 PHYSICO-CHEMICAL CHARACTERISTICS OF THE DIFFERENT SOIL SAMPLES FROM THE ABATTOIR SITE

The results of the physicochemical parameters as presented in Table 1, showed that the highest temperature was recorded at sample point C, where the animal hides are roasted with a value of 30.3^0C. While the lowest temperature (27.5^0C) was recorded at point B, where the animals are slaughtered. The results of the pH varied between 7.52 and 8.56 with the highest at sampling point E where no activity was carried out (Control), with the least pH obtained from sample point B, the region where the animals are slaughtered. The least conductivity of 183±2.8 µs/cm was obtained at sample point E (control) with point A, where the live animals are kept having the highest electrical conductivity of 277±2.8 µs/cm.

The results of the analysis for nitrate nitrogen had the least value of 54.53mg/kg obtained from sample point B, the region where the animals are slaughtered, while where the animal hides are roasted had the highest value of 258.75 (mg/kg).

The Total Organic Carbon (TOC) varied between 4.14% and 4.80% with the least obtained from the point E, the control sample, while the highest was recorded at Point C, where the animal hides are roasted.

For Calcium (Ca), the results showed that Point C had the highest value (5092.55(mg/kg)) and point B had the least value (2571.25(mg/kg)), respectively (Table 1).

Statistical analysis however revealed that there was a significant statistical ($p < 0.05$) difference between the nitrate concentration in the rejoin where hides are roasted and the control sample, with other sample points showing no significant difference ($p > 0.05$).

Table 1: MEAN PHYSICOCHEMICAL PARAMETERS OF SOIL SAMPLES FROM THE ABATTOIR SITE

Parameter	A	B	C	D	E	P-value
Temp (^{0}c)	28.9±2.8[a]	27.5±3.1[a]	30.3±3.1[a]	28±2.8[a]	27.9±2.8[a]	0.87
pH	7.9±2.8[a]	7.5±3.1[a]	8±2.8[a]	8.5±3.1[a]	8.6±3.1[a]	0.9948
Conductivity (µs/cm)	257±2.8[a]	192±2.8[a]	220±.5[a]	277±2.8[a]	183±2.8[a]	0.1274
Nitrate (mg/kg)	57.97±0.0[a]	54.53±3.1[a]	25873.74±28.6[b]	56.88±2.8[a]	52.63±2.8[a]	<0.0001
TOC (%)	4.75±0.2[a]	4.2±0.3[a]	4.8±1.8[a]	4.14±0.0[a]	4.5±0.3[a]	0.8933
Ca (mg/kg)	2938.5±28.3[a]	2571.25±28.3[a]	5092.55±2831.6[a]	4197.8±2.8[a]	4008.7±0.3[a]	0.3876

*Pair of means with different superscript in each row are significantly different

Key:

A-The region where the live animals are kept

B-The region where the animals are slaughtered

C-The region where the animal hides are roasted

D-The region where the waste (bones) are stacked

E-The region where no activities are carried out (control)

3.2 BACTERIAL POPULATION IN THEABATTOIR SOIL SAMPLES

The result of Total Heterotrophic Bacterial Count (THBC) showed that the highest was recorded at sample point B (where the animals are slaughtered), having a value of 7.2 x 10^8cfu/g. The control sample on the other hand had theleast count (THBC) of 1.0 x 10^8cfu/g (Table 2).

The result of the Total Coliform Count (TCC) also showed that the region where the animals are slaughtered (Sampling point B) had the highest count (50x10^5,i.e 5.0 x 10^6 cfu/g) while control soil, Point E had the least value of 0.8x10^5cfu/g.

The result of the Fecal Coliform Count, FCC also had the highest (10 x10^4 (i.e 1.0 x10^5) cfu/g) obtained from sample point B, where the live animals are slaughtered, and the least bacterial count of 4.3

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x10^4cfu/g was obtained from sample point D, where the bones are piled. However, sample Point C (where animal hides are roasted) as well as the control sample (E), showed no growth.

The result of the Salmonella and Shigella Counts (SSC) showed the highest growth at sampling point A, where the live animals are kept with a value of 5.6x10^4 and least growth at sampling point D, where waste bones are heaped, with a value of 3.7x10^4. However, sampling points B (on the soil around the slab where the animals are slaughtered), sampling point C (areas where the hides are roasted) and sampling point E (control) showed no growth (Table 2).

Statistical analysis however revealed no significant statistical difference ($p < 0.05$) between each point sampled and that of the control.

TABLE 2: Mean Counts for Total Heterotrophic Bacteria (THBC), Total Coliform (TCC), Fecal Coliform (FCC) and Salmonella Shigella (SSC) - (cfu/g)

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ID	THBC x10^8	TCC x10^5	FCC x10^4	SSC x10^4
A	4.5±0.3 [a]	7.2±0.3 [a]	5.3±0.3 [a]	5.6±3.1 [a]
B	7.2±3.1 [a]	50±28.3 [a]	10±1.4 [a]	_
C	5±2.8 [a]	4.8±2.8 [a]	_	_
D	3.5±0.3 [a]	10±1.4 [a]	4.3±0.3 [a]	3.7±0.3 [a]
E	1.0±0.3 [a]	0.8±0.3 [a]	_	_
P-value	0.7261	0.6426	0.5533	0.1864

*Pair of means with different superscript in each column are significantly different

Key:

A-The region where the live animals are kept

B-The region where the animals are slaughtered
C-The region where the animal hides are roasted
D-The region where the waste (bones) are stacked
E-The region where no activities are carried out (control)

3.3CHARACTERIZATION AND IDENTIFICATION OF BACTERIAL ISOLATES.

The bacterial groups isolated from the soil were identified based on their microscopy, cultural and biochemical attributes.

Table 3 shows the cultural characteristics of the isolates. The elevation of the isolates was either flat (*Escherichia coli*), raised (*Bacillus spp.*) or smooth, for the rest of the isolates.

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Also, in Table 3, the biochemical characteristics of the isolates is shown. All the isolates were observed to be catalase positive and fructose positive. In the same manner all the isolates were urease negative and negative for Voges-Proskauer. While *Escherichia coli*wasindole positive, the rest of the isolates were found to be indole negative. Also, the motility result showed that only *Shigella* was negative.

3.4 PREVALENCE OF THE BACTERIAL ISOLATES IN THE ABATTOIR SITE

The prevalence of the bacterial species is as shown in (Figure 1**).** Theresult showed that *Staphylococcus* spp., *Bacillus* spp., and *E. coli* were the highest, showing a frequency of 21.7%, each, as they occurred in all the five (5) sample locations. *Shigella* spp. was however the least occurring (4.4 %). It also followed that the other bacterial species had variations in their frequency of occurrence. *Salmonella* spp. had a prevalence of 13.1 %, occurring in four (4) samples; *Serratiamercescens* had a prevalence of 8.7 %, occurring in two (2) samples; *Klebsiella* spp. had a prevalence of 8.7 %, occurring in two (2) (Figure 1; Appendix I).

3.5ANTIBIOTIC SUSCEPTIBILITY PATTERN OF THE BACTERIAL ISOLATES

The results of the response of the bacterial isolates to the commercial conventional antibiotics as presented in Figure 2 – 3, and Appendix II, showed the isolates were sensitive to most of the antibiotics used. It further revealed that while all the Gram positive isolates (100 %) were sensitive to six (i.e 60%) of the antibiotics, (CH, CPX, E, LEV, CN and RD) 5.3 % were each resistant to Streptomycin (S) and Ampiclox (APX), based on the standards of CLSI.

The Gram Negative isolates showed similar pattern as 100 % of the isolates were susceptible to eight (i.e 80%) of the antibiotics, (PEF, CN, CPX, SXT, S, PN, CEP, and OFX) with only 11.1 % of the isolates resistant to Augmentin (AU) alone (Figure 3).

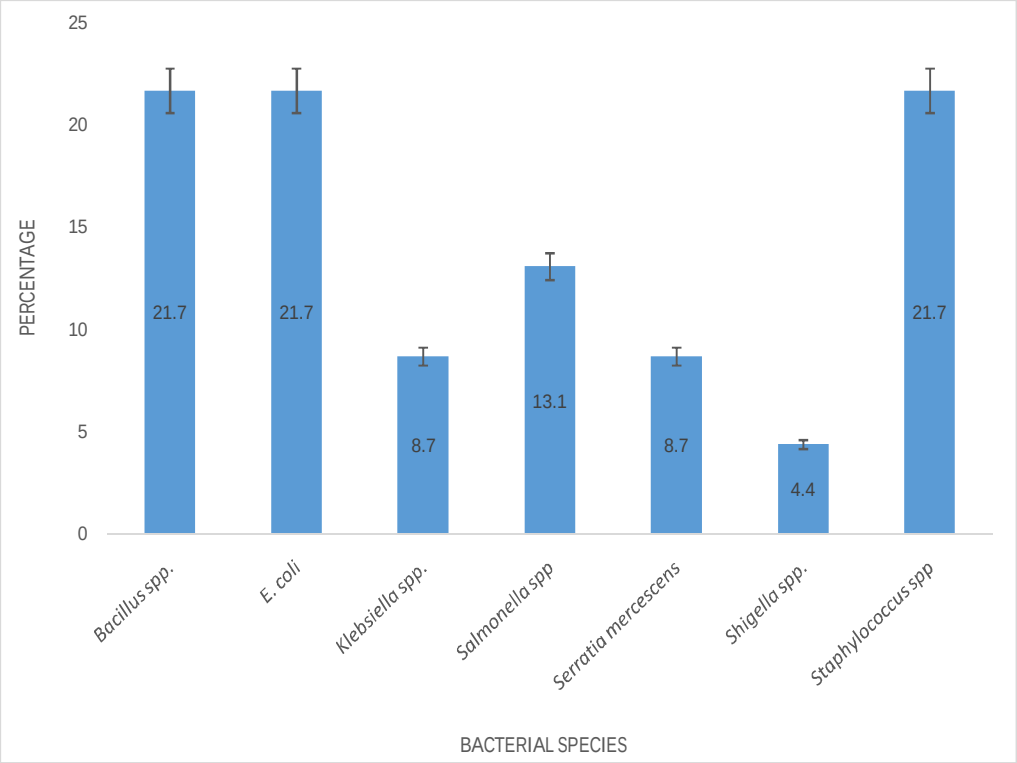

Figure 1:Prevalence of bacterial species in various soil samples at the abattoir site

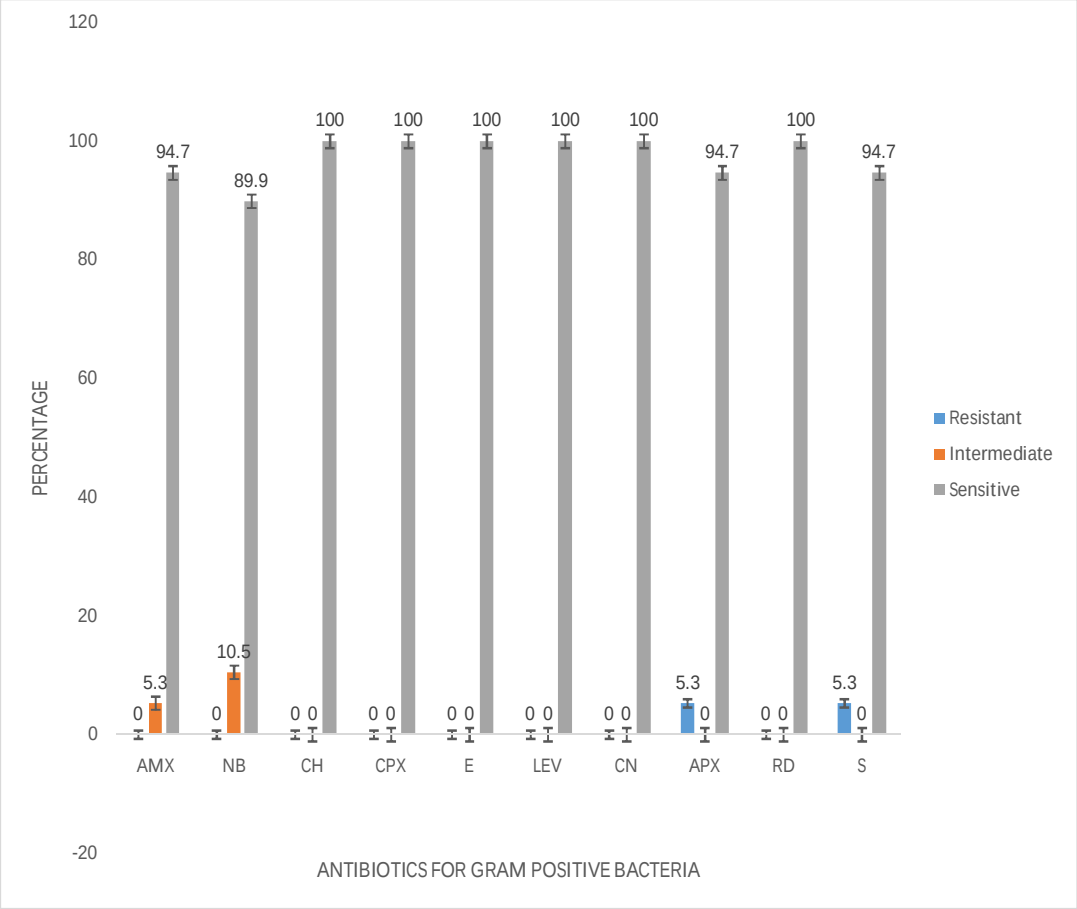

Figure 2: Antibiotics Sensitivity Pattern for Gram Positive Bacteria

KEY:

CPX: Ciproflox, CN: Gentamycin, AMX Amoxil, S: Streptomycin, RD: Rifampicin, E: Erythromycin, CH: Chloramphenicol, APX: Ampiclox, LEV: Levofloxacin, AU: Augmentin, SXT: Septrin, PN: Ampicillin, CEP: Ceporex, OFX: Tarivid,, PEF: Reflacine, NB: Norfloxacin, NA: Nalidixic acid.

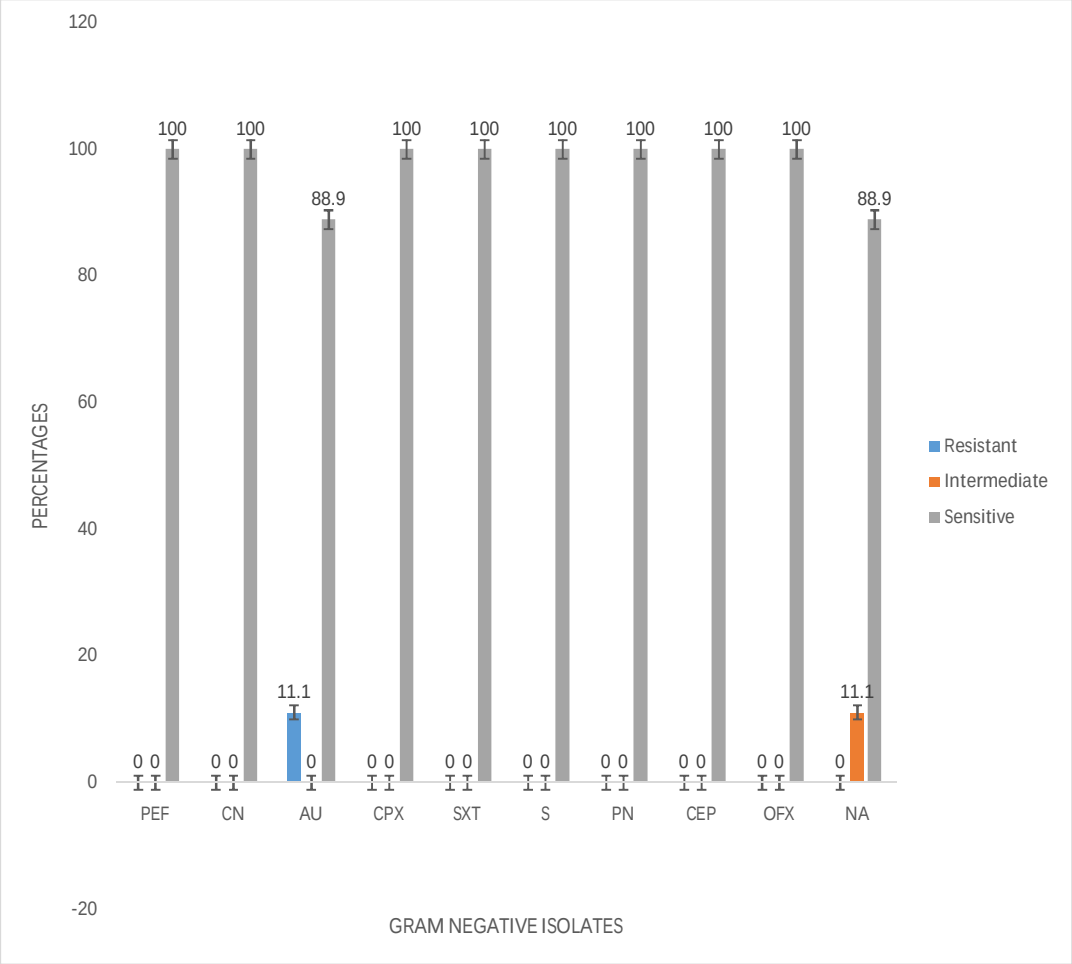

Figure 3: Antibiotics Sensitivity Pattern for Gram Negative Bacteria

KEY:

CPX: Ciproflox, CN: Gentamycin, AMX Amoxil, S: Streptomycin, RD: Rifampicin, E: Erythromycin, CH: Chloramphenicol, APX: Ampiclox, LEV: Levofloxacin, AU: Augmentin, SXT: Septrin, PN: Ampicillin, CEP: Ceporex, OFX: Tarivid, PEF: Reflacine, NB: Norfloxacin, NA: Nalidixic acid.

4.0 DISCUSSION

Due to the dependence on meat as a major protein source, the number of abattoirs in cities and rural communities is currently on the increase. This leads to an increase in waste generation which in turn impact on the physical, chemical and biological components of the environment. This present study has

presented the physicochemical and bacteriological effect of various abattoir activities at the Choba Slaughter in Rivers State.

The results of the physicochemical parameters as observed showed that the highest temperature was obtained from the region where the animal hides are burnt or roasted while the lowest temperature was recorded at the area where the animals are slaughtered. The difference in the temperature may be as a result of the heat generated during the roasting process.

The study with respect to the acidity and alkalinity, showed that the control had the highest pH value albeit the rest samples were within the neutral to alkaline range. This implies that these abattoir processes and associated waste reduced the pH towards neutrality, which may if not checked further reduce it towards an acidic range. This observation collaborates with the findings of previous researchers[15] ;[16].who also reported lower pH values compared to the control sample, and concluded that abattoir activities have the potential of influencing (lowering) the pH of the soil which will in turn give a concomitant effect on other parameters of the soil. Furthermore, from the study it was observed that abattoir activities influenced the conductivity, nitrate nitrogen content and total organic carbon percentage of the soil, as the control sample recorded the least value for these parameters.

High values of Electrical Conductivity mean that there are pollutants such as chloride, sodium, calcium etc. It is an indicator of water quality and soil salinity. The increase in conductivity of the abattoir soils could be ascribed to the build-up of wastes such as bones, hairs, flesh and blood, salts in abattoir effluents between the soil openings [17]. The observation of high levels of EC in abattoir soils than in the control soil could be ascribed to low cation exchange capacity (CEC) of the control soil and variations in rates at which metallic salts and organic matter complexes are formed [18].

The region where the animal hides are roasted as well as where the bones are stacked were also observed to have higher calcium content than other points and the control. Metals ions are known to influence the acidity. This implies that these waste materials such as bones, hides could be partly responsible for the higher conductivity as well as the differences in pH (compared to the control), observed in this study. Statistical analysis using a One-way Analysis of Variance (ANOVA) revealed a significant statistical difference ($p < 0.05$) between the nitrate content in the region where the hides are roasted and that of the control sample. This shows that burning of hides has the most significant environmental impact compared to other abattoir activities.

The population of the different bacterial groups present in the soil sample was investigated and it was reported that the Total Heterotrophic Bacterial Count (THBC) had the highest obtained at sample point B (where the animals are slaughtered), with the control sample on the other hand having theleast count. The population of the other bacterial groups (TCC, FC, and SSC) investigated followed similar fashion as

that of the THBC. Statistical analysis however indicated that there was no significant statistical difference between each point sampled and the control.

The findings from the above indicate that these abattoir activities influence bacterial growth in the soil by either serving as exogenous sources of soil bacterial population or by altering other edaphic conditions that influence autochthonous bacterial proliferation in soil.

In a similar work by researchers [19], it was reported that the total bacterial population obtained from the contaminated abattoir soil was more than that in the soil without wastewater contamination. This could be regarded as destabilization of the soil ecological balance arising from contamination. Also, previous reports have proposed extensive microbial diversity (including species richness and species evenness) with population estimated between approximately $4x10^3$ to 10^4 species per gram of uncontaminated soil [20]. It could be adduced that the higher population of bacteria observed in an impacted was possibly as a result of having more of bacteria that were able to withstand lower pH conditions.

Resistance enables bacteria to escape from being killed by antibiotics and reduces the ability to treat infections [21] .The response of the bacterial species to the different conventional antibiotics noted (as presented in Figure 2 – and 3; Appendix II and III), in this study, and it was discovered that the isolates were sensitive to most the antibiotics used. The study revealed a high rate of sensitivity of the bacterial isolates to the antibiotics tested. This high rate of sensitivity could be explained based on the fact that prior exposure of the isolate to these antibacterial drugs play a role in their resistance [22]; [23]

5.0 CONCLUSION

The study on effect of abattoir activities on the bacteriological and physico-chemical properties of soil within the abattoir environment has revealed that the effect varied with respect to location and parameter. The study concludes that the abattoir activities have the potential of influencing the physicochemical properties of soil, with burning of hides having the most significant impact, based on statistical analysis with respect to nitrate concentration of the soil samples.

The impact of the various abattoir practices on the soil bacterial community structure was noted in this study, it showed that the enteric organisms were the least occurring, except for *Escherichia coli* that occurred at per with *Staphylococcus* and *Bacillus* species. Also, the control sample had the least count for all the bacterial groups (Total Heterotrophic Bacteria, Total Coliform, Fecal Coliform, *Salmonella* and *Shigella* species) evaluated. This implies that abattoir activities leads to increase in the population of soil bacterial community, including those with potential to cause disease in man.

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