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Bacteriological assessment of Abattoir facilities and environment in Keffi, Nigeria

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Abstract

The abattoir industry is a vital constituent of the livestock industry because it makes available domestic meat to over 150 million people and makes jobs available for a large number of people in Nigeria. The study is aimed at the assessment of bacteriological of abattoir facilities and environment in Keffi. Standard microbiological methods were used in isolation and identification of different bacteria species. The overall bacteria isolated were 80.0%, where the Slaughter floor and wastewater had the highest (100%) and butchers hands had the lowest (55.0%). From butchering knives, the highest recorded was *Escherichia coli* (50.0%) and lowest was *Entercocci sp* (5.0%). From butchers hands *Escherichia coli* were highest (30.0%) isolated. From the wastewater the highest was *Pseudomonas sp* (55.0%). *Salmonella* sp had the highest haemolysin production with 100% from butchering tables and 92.3% from slaughter floor. From butchering knives *Salmonella sp, Staphylococcus aureus*, *Salmonella sp, Proteus sp* and *Entercocci sp* had the highest haemolysin production (100%). Highest percentage Congo red dye binding observed was from *Salmonella sp* from slaughter floor (92.3%), *Pseudomonas sp* (100.0%). From butchering knives survival rate in low pH the highest recorded was *Escherichia coli* (73.6%) from Slaughter floor, from butchering knives, the highest was *Staphylococcus aureus* and *Pseudomonas sp* (100%). The antimicrobial susceptibility showed that *E. coli* was highly susceptible to gentamicin (75.9%), and low susceptible to chloramphenicol (36.8%). *S. aureus* was highly susceptible to gentamicin (81.1%), and low susceptible to Trimethoprim (27.2%). From findings of this assessment it was recorded that most of bacteria isolated were pathogenic bacteria. There is need for developing a good disposal of waste from the abattoir to avoid spread of pathogenic bacteria in the community.

Keywords: Abattoir; Butchers; Low pH; Haemolysin; Antimicrobial susceptibility; Congo red dye binding

1 Introduction

An abattoir is a designated place or building where animals usually cattle, goats, sheep and pigs are killed and butchered for the intention of being processed as meat and for public consumption. The purpose of abattoir is to produce hygienically prepared meat by the human handling of the animal using hygienic techniques for slaughtering and dressing [1]. The abattoir industry is a vital constituent of the livestock industry because it makes available domestic meat to over 150 million people and makes jobs available for a large number of people in Nigeria [2, 3]. However, the siting of abattoir otherwise known as slaughtering house is not well developed and facilities for the handling of abattoir solid waste and waste water are absent. The abattoir activities include butchering, removal of the hide, intestine management, rendering, trimming, processing and cleaning activities. The continuous drive to increase meat production to meet the protein needs of the population is usually associated with some pollution problems. The meat industry uses large quantity of waste water that drains into the surrounding soil environment [4]. Tortora *et al*., [5] reported that following the discharge of untreated waste water into the soil, certain elements (for example iron, lead, phosphorus, calcium and zinc) previously present or absent in small quantities will be introduce into the magnification of these

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chemicals and the physiochemical properties of the soil may be altered, such as the pH, due to the uncontrolled discharged of untreated abattoir wastewater resulting in the loss of certain soil microbes. Some of these chemicals may be toxic to the microbial flora and faunal communities of the soil. Some of the waste water from abattoir drains into the surrounding soil environment, the resultant consequence could be the degradation of soil fertility due to the accumulation of certain nutrients and heavy metals that may lead to low productivity in the surrounding farmland, in addition to damages and destruction of aquatic lives. Since the water from both the rivers as well as the soil are used for irrigation farming along the river banks, the possibility of zootic diseases amongst the consumers of produce from such irrigated fields cannot be ruled out. Another effect of waste water draining into the soil is making the soil oxygen to become less available as an electron acceptor, promoting denitrifying bacteria to reduce available nitrate to gaseous nitrogen which enters the atmosphere with resultant negative effects. Also the anaerobic archae (methanogens) may produce excessive methane at a higher rate than aerobic methane oxidizing bacteria (Methanotrophs) could cope with.

Environmental pollution is a worldwide problem and its potential to influence the health of human populations is great. About a quarter of disease facing mankind today occur due to prolonged exposure to environmental pollution. Abattoir activities are aim at optimizing the recovery of edible portion of the meat processing cycle for human consumption. However, significant quantities of secondary waste material are also generated during this process. Abattoir are source of pollution since human activities such as animal production and meat processing have been reported to impact negatively on the soil and natural water composition leading to the pollution of the soil, natural water resource and the entire environment. Abattoir in Nigeria has been known to depose they wastes into surface water bodies and the environment directly or indirectly. Abattoir wastes have been found to contain blood, grease, inorganic and organic solids, salts and chemicals added during the operation. According to Cadmus *et al.,* Abattoirs have also been known to transmit parasites. This study aim at Assessment of bacteriological quality of abattoir facilities and its environment

2 Material and methods

2.1 Sample collections

One hundred (100) Samples were collected randomly from abattoir in Keffi Metropolises. 20 samples were collected form slaughtering floors, 20 from slaughtering tables, 20 butchering knives, 20 workers hand using swab stick, Abattoir effluent (wastewater) were collected using a sample bottles and all the samples collected were transported to Microbiology Department Laboratory, Nasarawa State University Keffi. Samples were collected for over a period of three months from June to August at random and labelled.

2.2 Media Preparations and Sterilization

All the media were prepared from commercially available powder according the Manufacturer's instructions. Sterilization will be autoclave at 121 ℃ for 15 minutes

2.2.1 Isolation of bacteria

Isolation of bacterial were carried out using the method describe by Neboh *et al.* [2], the sample were diluted in 10ml of sterile distilled water and serial dilution was carried out. One 1ml of abattoir dilute was transfer into 9ml of sterile water and 1ml for the first test tube containing 10ml and were transfer into another test tube containing 9ml of sterile water this step was repeated into seven times (10^{-7}) and 0.2ml total bacterial, sterile nutrient was aseptically inoculated with aliquot of serial dilution (10^{-4} -10^{-7}) of the sample were incubated at 37 ℃ for 24hrs.

2.3 Identification of bacterial isolates

2.3.1 Gram Staining Examination

The gram staining technique was carried out as described by cheesbrough [6] with some modifications; A small portion of cultural organism was transferred onto clean grease –free glass slide, and emulsified in a drop of distilled water until a thin homogeneous film is obtained, then the wire loop was re-sterilized and the thin homogeneous film was allowed to air dry and heat fixed by passing it through the flame. The slide was flooded with crystal violet for 1 minute and then rinsed with distilled water. The stain was again flooded with Lugol's iodine for 1 minute, and rinsed with distilled water and the decolorized, rapidly with acetone alcohol until no colour appear to flow from preparation and rinsed appropriately with distilled water and allowed to air dry and viewed under microscope using x 100 oil immersion objective. Gram positive retain the dark blue colour inferred by the iodine/ crystal violet complex, while Gram negative organisms appear red; maintaining the colour of the secondary dye.

2.3.2 Biochemical tests

The following biochemical tests was carried out on the suspected bacteria isolates: Catalase test, Indole, Methly red Vorges- Proskauer tests, nitrate reduction tests, Urease production tests, citrate utilisation and Glucose fermentation tests.

2.4 Determination of the Pathogenicity of the Bacteria Isolated

2.4.1 Determination of Antibiotic Susceptibility of the Bacteria

The antibiotic susceptibility of the bacteria isolates was determined using the Kirby- Bauer disk diffusion method. Briefly, a suspension of each isolate was prepared in a peptone water to match 0.5 McFarland turbidity standards. The standardized inoculum of each isolate was then inoculated in triplicates onto the surface of plain Mueller-Hinton agar plates and ciprofloxacin (5µg), gentamicin (10µg), augmentin (30µg), chloramphenicol (30µg), ciprofloxacin (10µg), ofloxacin (µg) and ceftriaxone (30µg) disc was the placed aseptically and incubated at 37 ℃ for 24hrs.the zones of inhibition was measured and compared to that of the Clinical and Laboratory Standards Institute (CLSI) guidelines of 2009 [7].

2.4.2 Survival in Hydrogen peroxide

The ability of the isolates to tolerate reactive oxygen intermediates produced by hydrogen peroxide was evaluated by survival in Muellar-Hinton broth containing 15 mMH_2O_2 as earlier described by Ngwai *et al,* [8]. Briefly 2 ml H_2O_2 in broth was inoculated with 100 ml of overnight Mueller-Hinton broth culture of the isolates and incubated with shaking at 37 °C. Samples with drawn at time zero (T = 0 hour). That is before incubation and at time T = 1 hour. Of incubation; the samples were diluted in normal saline and viable cells were counted after overnight incubation on Tryticase Soy agar (TSA) at 37^{o}C. Survival (%) at 1 hour was calculated from the relations ion. Bacteria CFU/ml at T = 1 hour ÷ Bacteria CFU/ml at T = 0 hour)] × 100. Results are mean of two independent triplicate experiments.

2.4.3 Survival in human serum

Survival of the isolates in 10% human serum was assayed as earlier described Ngwai *et al*. [8]. Counts were determined at T = 0 hour and T = 2 hour following addition of the inoculum to 10% normal human serum in single strength Hank's Balanced Solution (HBSS:) 137mMNaCl, 5.4mM KCl, 0.25mM Na_2HPO_4, 0.44mM KH_2PO_4, 1.3mM $CaCl_2$, 10mM $MgSO_4$, 4.2mM $NaHCO_3$ 5.6mM D-glucose, 0.02% Phenol red, distilled H_2O to 1000 ml) membrane filter sterilized (Pore size: 0.45µm). Survival (%), expressed as serum resistance factor was determined from the relationship: (Bacteria CFU/ml at T = 2 hour ÷ CFU at T = 0 hour 1× 100). Results are mean of two independent triplicate determinations.

2.4.4 Survival in Low pH

Survivals of log phase (LP 4-h Muellar-Hinton broth) and stationary phase (SP overnight Muellar-Hinton broth culture) cells in pH adjusted broth were assayed based on Ngwai *et al.* [8] with modification. Two millitre of Muellar-Hinton broth (pH 4.0-2.6) adjusted with 2N HCl were inoculated with 100 ml overnight Muellar-Hinton broth culture of the isolates and incubated with shaking at time T = 0 hour (before incubation) and T = 2 hour of incubation (pH 4.0) or T = 5 minutes of incubation (pH 2.6), diluted in normal saline and viable cells were counted after 24-hour incubation in Muellar-Hinton agar at 37 °C. Survival (%) was calculated from the relationship: [{Bacteria CFU at T = 2 hour or 5 minutes÷ Bacteria CFU/ml at T = 0 hour] × 100}]. Results are means of two independent triplicate determinants.

2.4.5 Cell surface hydrophobicity

Cell surface hydrophobicity of the isolates was evaluated based on the ability of the bacteria to partition into hydrocarbon from phosphate buffer solution as described by Akinro *et al.* [9]. Briefly Bacterial strains were grown in Muellar-Hinton broth at 37 °C for 24 hours. After centrifugation at 5000 x g for 15 minutes, the pellets will be washed twice with phosphate-buffer saline (pH 7.0) and absorbance's of the bacteria will be measured at 620 nm and adjusted to an Asorbance of A_{620} = 1.0. One millitre of the bacterial suspension was added to 1 ml of each of the hydrocarbons (n-hexadecane and vortexed vigorously for 30 seconds. After phase separation (30 min), the optical density of the aqueous phase was again measured and compared with the initial value. Hydrophobicity (%) was calculated according to the equation: ($[A_{final}$-$A_{initial}$ / $A_{initial}$ × 100]

3 Results

The cultural, morphological and biochemical characteristics of different bacteria isolated is as shown in Table 1.

Table 2 shows the Occurrence of bacteria isolated from different section of the abattoir in Keffi, out of 100 samples collected the total bacteria occurrence was 80.0%, were the Slaughter floor and wastewater had 100% occurrence rate of bacteria followed by Butchering tables with 80.0%, Butchering knives with 65.0% and Butchers hands with 55.0%.

Different bacteria isolated from different section of the abattoir in Keffi are as given in Table 3. *Escherichia coli* had the highest occurrence (95.0%) followed by Pseudomonas sp (85.0%), *Salmonella* spp and Entercocci sp (65.0%), *Klebsiella* spp (60.0%), Proteus sp (45.0), *Staphylococcus aureus* (40.0) and *Bacillus* spp (30.0%). On Butchering tables, the highest occurring was *Escherichia coli* (75.0%), *Salmonella* spp (45.0%), *Klebsiella* spp and *Pseudomonas* sp (40.0%) and *Staphylococcus aureus* (30.0%), Entercocci sp (25.0%), *Proteus* sp (20.0%) and *Bacillus* spp (15.0%). From Butchering knives, the highest was *Escherichia coli* (50.0), *Klebsiella* spp (30.0%), *Salmonella* spp (25.0%), *Staphylococcus aureus* (15.0%), *Proteus* sp and *Pseudomonas* sp (10.0%), *Entercocci* sp (5.0%). From Butchers hands *Escherichia coli* and *Salmonella* spp (30.0%), *Pseudomonas* sp (20.0%), *Klebsiella* spp (15.0%), *Staphylococcus aureus* and *Bacillus* spp (5.0%). From the Wastewater the highest was *Pseudomonas* sp (55.0%), *Klebsiella* spp(45.0%), *Salmonella* spp (30.0%), *Entercocci* sp (25.0), *Escherichia coli* (20.0%), *Staphylococcus aureus*(15.0%) and *Proteus* sp (10.0%) respectively.

Table 1 Cultural, Morphology and Biochemical characteristics of bacterial isolated from Keffi Abattoir

Cultural and Morphological			**Biochemical Test**									**Carbohydrate utilization**	
CS	**P**	**MP**	**GS**	**CAT**	**COA**	**IN**	**VP**	**MR**	**OX**	**CT**	**GL**	**LA**	**Inference**
Circular	Yellowish on MSA	Cocci	+	+	+	-	-	+	-	-	A	A	*S. aureus*
Circular	Greenish on EMB	Slightly	-	+	-	-	-	+	-	-	AG	AG	*E. coli*
Circular	smooth Whitish on NA, Whitish on NA	Flat	-	+	-	-	-	-	+	+	A	A	*Pseudomonas spp*
Irregular rough	black deposit on SSA Pinkish on MAC pinkish on MAC	Rod	+	+	-	-	+	-	-	-	AG	AG	*Bacillus* spp
Irregular rough		Rod	-	+	-	+	-	-	+	+	AG	A	*Salmonella* spp
Circular		Rod	-	+	+	-	-	+	+	+	AG	AG	*Klebsiella* spp

KEY: CS= cultural shape, P= pigment, MP= morphology, GS= gram staining, CAT= catalase, COA= coagulase, IN=indole, VP= voges proskauer's, MR= methyl red, OX= oxidase, CT = citrase, GL= glucose, LA= lactose, A=acid production, AG= acid and gas production, += positive, -= negative, MSA= mannitol salt agar, EMB= eosin methylene blue

Table 2 Occurrence of bacteria from abattoir in Keffi

Sample	**No sample**	**No (%) isolated**
Slaughter floor	20	20 (100)
Butchering tables	20	16 (80.0)
Butchering knives	20	13 (65.0)
Butchers hands	20	11 (55.0)
Wastewater	20	20 (100)
Total	100	80 (80.0)

Table 3 Bacteria isolated from abattoir in Keffi

Isolates	No samples	Slaughter Floor (%)	Butchering Tables (%)	Butchering Knives (%)	Butchers Hands (%)	Wastewater (%)
Escherichia coli	20	19 (95.0)	15(75.0)	10 (50.0)	6 (30.0)	4 (20.0)
Klebsiella sp	20	12 (60.0)	8 (40.0)	6 (30.0)	3 (15.0)	9 (45.0)
Staphylococcus aureus	20	8 (40.0)	6 (30.0)	3 (15.0)	2 (10.0)	3 (15.0)
Bacillus sp	20	6 (30.0)	3 (15.0)	0 (0.0)	1(5.0)	0 (0.0)
Salmonella sp	20	13 (65.0)	9 (45.0)	5 (25.0)	6 (30.0)	6 (30.0)
Proteus sp	20	9 (45.0)	4 (20.0)	2 (10.0)	0 (0.0)	2 (10.0)
Entercocci sp	20	13 (65.0)	5 (25.0)	1 (5.0)	0 (0.0)	5 (25.0)
Pseudomonas sp	20	17 (85.0)	8 (40.0)	2 (10.0)	4 (20.0)	11 (55.0)

3.1 Production of haemolysin

The production of haemolysin by different isolates from different section of abattoir in keffi samples is as shown in Table 4. Out of 19 *Escherichia coli* isolated from Slaughter floor 42.1% produces more haemolysin, *Klebsiella* sp (41.6%), *and Staphylococcus aureus* (75.0%) *Bacillus* sp (50.0%), *Salmonella* sp (92.3%), *Proteus* sp (33.3%), *Entercocci* sp (53.8%), *Pseudomonas* sp (76.4%). From butchering tables *Escherichia coli* (73.3%), *Klebsiella* sp (50.0%), *Staphylococcus aureus* (100%), *Bacillus* spp (66.6%), *Salmonella* sp (100%), *Proteus* sp (50.0%0, *Entercocci* sp (60.0%), and *Pseudomonas* sp (62.5%). The production of haemolysin by different bacteria isolated from Butchering knives shows that *Escherichia coli* had (70.0%) out of 19 isolated, *Klebsiella* sp (50.0%) out of 6 isolated, *Staphylococcus aureus* (100%), *Salmonella* sp (100%), *Proteus* sp (100%), *Entercocci* sp (100%), *Entrobacter* sp (50.0%) and *Pseudomonas* sp (100%). Haemolysin production by bacteria isolated from Butchers hands *Escherichia coli* (50.0%), *Staphylococcus aureus* (50.0%), *Salmonella* sp had 100% haemolysin production and *Pseudomonas* had 50.0%.

3.2 Congo red-dye Binding

Evaluation of the Congo red dye binding, the percentage Congo red binding capacity of bacteria isolated from different section of abattoir samples is as shown in Table 5. The bacteria isolate from Slaughter floor that had the highest percentage the highest Congo red dye binding was observed in *Salmonella* sp (92.3%) followed by *Pseudomonas* sp (76.4%), *Staphylococcus aureus* (75.0%), *Escherichia coli* (63.0%), *Entercocci* sp (53.8%). From butchering tables, the highest was *Salmonella* sp (100%) followed by *Staphylococcus aureus* (83.3%), *Pseudomonas* sp (75.0%) and the lowest was *Bacillus* sp (33.3%). From Butchering Knives *Salmonella* sp, *Staphylococcus aureus* and *Pseudomonas* sp had the highest binding (100%), and *Escherichia coli* (60.0%). From Butchers hands *Escherichia coli* and *Salmonella* sp had highest binding (83.5%) and *Pseudomonas* sp (75.0%).

3.3 Low pH survival

The percentage survival of bacteria isolates in low pH (2.0) is as shown in Table 6. Bacteria isolates from Slaughter floor that had the highest percentage survival rate in low pH was *Escherichia coli* (73.6%), *Salmonella* spp (69.2%), Pseudomonas sp (64.7%), *Staphylococcus* (50.0%) and *Entercocci* sp (44.1%). From butchering tables, the highest was *Salmonella* spp (77.7%), *Staphylococcus aureus* (66.6%), *Pseudomonas* sp (62.5%) and *Klebsiella* spp (50.0%). From butchering knives, the highest was *Staphylococcus aureus* and *Pseudomonas* sp (100%), *Klebsiella* spp (66.6%), *Salmonella* spp (60.0%) and *Escherichia coli* (40.0%). From the Butchers hands the highest was *Escherichia coli and Salmonella* spp (66.6%), *Staphylococcus aureus* and *Pseudomonas* sp (50.0%). From wastewater the highest was *Escherichia coli* (75.0%), *Staphylococcus aureus* (66.0%) and *Proteus* sp and *Salmonella* spp (50.0%).

3.4 Survival in human serum by bacteria isolates

Tables 7 show the percentage survival of bacteria isolates in human serum. From Slaughter floor the highest bacteria that survive in human serum was *Salmonella* spp (69.3%), *Pseudomonas* spp (52.9%), *Escherichia coli* (52.6%), *Staphylococcus aureus* (50.0%) and the lowest was *Proteus* spp (22.2%). From butchering tables, the highest was *Staphylococcus aureus* and *Salmonella* spp (66.6%), *Klebsiella* spp (62.5%), *Entercocci* spp (60.0%), *Pseudomonas* sp (50.0%). From butchering knives, the highest was *Salmonella* spp (100%), *Escherichia coli* (50.0%) and the lowest was

Klebsiella spp and *Staphylococcus aureus* (33.3). From Butchers hands the highest bacteria isolate that survive in human serum was *Escherichia coli*, *Salmonella* spp and *Pseudomonas* spp (50.0%). Bacteria isolated from wastewater that survive in human serum were *Escherichia coli* (75.0%), *Staphylococcus aureus* and *Salmonella* spp (66.6%) and *Proteus* spp (50.0%) and the lowest was *Entercocci* spp (40.0%)

3.5 Antibiotic Susceptibility

Table 4 Haemolysin production by bacteria isolated from Abattoir in Keffi

Isolates	Slaughter floor	Halo zone (%)	Butchering tables	Halo zone (%)	Butchering knives	Halo zone (%)	Butchers hands	Halo zone (%)	Wastewater	Halo zone (%)
Escherichia coli	19	8 (42.1)	15	11 (73.3)	10	7 (70.0)	6	3 (50.0)	4	4 (100)
Klebsiella spp	12	5(41.6)	8	4 (50.0)	6	3 (50.0)	3	0 (00)	9	4 (44.4)
Staphylococcus aureus	8	6 (75.0)	6	6 (100)	3	3 (100)	2	1 (50.0)	3	2 (66.0)
Bacillus spp.	6	3 (50.0)	3	2 (66.6)	0	0 (00)	1	0 (00)	0	0 (00)
Salmonella spp	13	12 (92.3)	9	9 (100)	5	5 (100)	6	6 (100)	6	6 (100)
Proteus sp	9	3 (33.3)	4	2 (50.0)	2	2 (100)	0	0 (00)	2	0 (00)
Entercocci sp	13	7 (53.8)	5	3 (60.0)	1	1 (100)	0	0 (00)	5	2 (4.0.)
Pseudomonas sp	17	13 (76.4)	8	5 (62.5)	2	2 (100)	4	2 (50.0)	11	9 (81.0)

Table 5 Congo Red Dye binding by bacteria isolated from Abattoir in Keffi

Isolates	Slaughter floor	Binding (%)	Butchering tables	Binding (%)	Butchering knives	Binding (%)	Butchers hands	Binding (%)	wastewater	Binding (%)
Escherichia coli	19	12(63.0)	15	8(53.3)	10	6(60.0)	6	5(83.3)	4	4(100)
Klebsiella spp	12	5(41.6)	8	3(37.5)	6	3(50.0)	3	1(33.3)	9	5(55.5)
Staphylococcus aureus	8	6(75.0)	6	5 (83.3)	3	3(100)	2	0(00)	3	1(33.3)
Bacillus spp.	6	3(50.0)	3	1(33.3)	0	0(00)	1	0(00)	0	0(00)
Salmonella spp	13	12(92.3)	9	9 (100)	5	5(100)	6	5(83.3)	6	6(100)
Proteus sp	9	3(33.3)	4	0(00)	2	0(00)	0	0(00)	2	1(50.0)
Entercocci sp	13	7 (53.8)	5	3(60.0)	1	0(00)	0	0(00)	5	3(60.0)
Pseudomonas sp	17	13(76.4)	8	6(75.0)	2	2(100)	4	3(75.0)	11	7(63.6)

The Susceptibility of the bacterial isolated from different section of abattoir in Keffi shows that *E. coli* was highly susceptible to gentamicin (75.9%), ceftriaxone (61.1%), ciprofloxacin (57.4%), nalidixic acid (53.7%), tetracycline (50.0%) and low susceptible to streptomycin (25.9). *Pseudomonas* sp was highly susceptible to gentamycin (73.8%), ciprofloxacin (66.6%), ceftriaxone (57.1), Chloramphenicol and tetracycline (52.3%) and low susceptible to streptomycin (33.3). *Klebisella* sp was highly susceptible to Sulphamethoxazole/Trimethoprim (68.4%), gentamicin (63.1%), ciprofloxacin (57.8%), Nalidixic acid (50.0) and low susceptible to chloramphenicol (36.8%). *S. aureus* was

highly susceptible to gentamicin (81.1%), ceftriaxone (59.0%), ciprofloxacin and Nalidixic acid (54.5%), chloramphenicol (50.0%) and low susceptible to sulphamethoxazole/Trimethoprim (27.2%). *Salmonella* sp was highly susceptible to gentamicin (70.4%), ciprofloxacin (68.1%), chloramphenicol and nalidixic acid (63.6%), ceftazidime and amoxycillin-clavulanic acid (50.0%) and low susceptible to Tetracycline (38.6%). *Bacillus* sp was highly susceptible to ciprofloxacin, gentamicin and Sulphamethoxazole/Trimethoprim (60.0%), ceftriaxone (50.0%), and low susceptible to streptomycin (20.0%). *Proteus* sp was low susceptible to ciprofloxacin, ceftriaxone and streptomycin (17.6%). *Entercocci* sp was highly susceptible to gentamicin (70.8%), ciprofloxacin (62.5%), nalidixic acid (54.1%), Streptomycin (50.0%) and low susceptible to Tetracycline (25.0%) as given in Table 8 respectively.

Table 6 Low pH survival by bacteria isolated from Abattoir in Keffi

Isolates	Slaughter floor	Survival (%)	Butchering tables	Survival (%)	Butchering knives	Survival (%)	Butchers hands	Survival (%)	wastewater	Survival (%)
Escherichia coli	19	14(73.6)	15	7(46.6)	10	4(40.0)	6	4(66.6)	4	3(75.0)
Klebsiella spp	12	5(41.6)	8	4(50.0)	6	4(66.6)	3	0(00)	9	3(33.3)
Staphylococcus aureus	8	4(50.0)	6	4(66.6)	3	3(100)	2	1(50.0)	3	2(66.0)
Bacillus spp.	6	2(33.3)	3	0(00)	0	0(00)	1	0(00.0)	0	0(00)
Salmonella spp	13	9(69.2)	9	7(77.7)	5	3(60.0)	6	4 (66.6)	6	3(50.0)
Proteus sp	9	4(44.4)	4	0(00)	2	0(00)	0	0(00.0)	2	1(50.0)
Entercocci sp	13	6(46.1)	5	2(40.0)	1	0(00)	0	0(00)	5	2(40.0)
Pseudomonas sp	17	11(64.7)	8	5(62.5)	2	2(100)	4	2(50.0)	11	5(45.4)

Table 7 Survival in human serum by bacteria isolated from Abattoir in Keffi

Isolates	Slaughter floor	Survival (%)	Butchering tables	Survival (%)	Butchering knives	Survival (%)	Butchers hands	Survival (%)	Wastewater	Survival (%)
Escherichia coli	19	10(52.6)	15	6(40.0)	10	5(50.0)	6	3(50.0)	4	3(75.0)
Klebsiella sp	12	5(41.3)	8	5(62.5)	6	2(33.3)	3	1(33.3)	9	4(44.4)
Staphylococcus aureus	8	4(50.0)	6	4(66.6)	3	1(33.3)	2	0(00)	3	2(66.6)
Bacillus sp.	6	2(33.3)	3	0(00)	0	0(00)	1	0(00)	0	0(00)
Salmonella sp	13	9(69.3)	9	6(66.6)	5	5(100)	6	3(50.0)	6	4(66.6)
Proteus sp	9	2(22.2)	4	0(00)	2	0(00)	0	0(00)	2	1(50.0)
Entercocci sp	13	5(38.4)	5	3(60.0)	1	0(00)	0	0(00)	5	2(40.0)
Pseudomonas sp	17	9(52.9)	8	4(50.0)	2	0(00)	4	2(50.0)	11	6(54.5)

Table 8 Antibiotics susceptibility of bacterial isolated from Keffi Abattoir

No. (%) Susceptibility									
Antibiotics	**Disc content (ug)**	***E. coli* (N = 54)**	***Pseudomonas* (N = 42)**	***Klebisella* (N=38)**	***S. aureus* (N=22)**	***Salmonella* spp (N=44)**	***Bacillus* (N = 10)**	***Proteus* (N=17)**	***Entercocuss* sp (N=24)**
Chloramphenicol	30	25 (46.2)	22 (52.3)	14 (36.8)	11(50.0)	28(63.6)	3(30.0)	4(23.5)	8(33.3)
Ceftazidime	10	18 (33.3)	20 (47.6)	16 (42.1)	18(36.3)	22(50.0)	4(40.0)	5(29.4)	9(37.5)
Ciprofloxacin	10	31 (57.4)	28 (66.6)	22(57.8)	12 (54.5)	30 (68.1)	6 (60.0)	3(17.6)	15(62.5)
amoxcillin-	30	20 (37.0)	18 (42.8)	15 (39.4)	0(00)	22 (50.0)	3(30.0)	4(23.5)	10(41.6)
Gentamycin	10	41 (75.9)	31 (73.8)	24(63.1)	18 (81.8)	31 (70.4)	6 (60.0)	5(29.4)	17(70.8)
Cetriaxone	30	33 (61.1)	24(57.1)	18 (47.3)	13(59.0)	21 (47.7)	5 (50.0)	3(17.6)	11(45.8)
Nalidixic acid	10	29 (53.7)	15(35.7)	17 (44.7)	12(54.5)	28(63.6)	3(30.0)	4(23.5)	13(54.1)
Streptomycin	30	14 (25.9)	14 (33.3)	19 (50.0)	10 (45.4)	18 (40.9)	2 (20.0)	3(17.6)	12(50.0)
Tetracycline	30	27 (50.0)	22(52.3)	17(44.7)	9 (40.9)	17 (38.6)	3 (30.0)	5(29.4)	6(25.0)
Sulphamethoxazole/Trimethoprim	30	22 (40.7)	17(40.7)	26 (68.4)	6 (27.2)	21 (47.7)	6 (60.0)	4(23.5)	8(33.3)

4 Discussion

This study was conducted to determine the bacteriological characteristics of different section of abattoir in Keffi and its possible health hazards. From this study, it was observed that the slaughter floor and wastewater had 100% occurrence rate of bacteria while the Butchering tables had 80.0%, Butchering knives 65.0% and Butchers hands 55.0%. This is similar to study reported by Ayoade and Olayioye [10.11] high bacterial isolated from Butchers hands and Butchering knives of the staffs in abattoir in southern Nigeria.

High bacterial count from the abattoir in this study was not surprising because faecal coliforms are normal flora of the digestive tract of animal; their counts are often used as a proxy measurement for gastro-enteric pathogens, since the presence of faecal coliform bacteria is an indication of contamination by human and/or animal wastes. *E. coli, Klebisella* sp and *Entercocci* sp is member of the faecal coliform group; livestock harbour the bacteria and release it in their faeces. And so, the isolation of *E. coli, Salmonella* spp, *Entercocci* sp, and *Klebisella* sp from different section of the abattoir is considered an indicator of faecal contamination and the presence of enteric pathogens; it is used as the general indicator organism that hints if there has been faecal contamination or not. The high levels of coliforms and *E. coli, Salmonella* spp, *Entercocci* sp, and *Klebisella* sp in the abattoir is similar to work early reported [3, 12].

The ability of *bacteria* to cause infection in both human and animal is due to the expression of variety of virulence factors which may be structurally or secreted within the cell surface that mediate colonization, tissue invasion and dissemination. Studies on evaluation of virulence markers of bacteria isolates from different section of abattoir sample were carried out in this study. The production of haemolysin by different bacteria isolates observed in this study was not surprising and in agreement with the study reported by Singh *et al.*[13,14] they reported that the production of haemolysin by *Salmonella* species isolates is an important virulence determinants of *Salmonella* species the production of haemolysin by *Salmonella* species isolates suggest that the isolates may encodes a haemolysin pore forming toxin, that may be responsible for virulence and development of systemic infections.

The survival of the isolates in low pH of 4.0 observed in this study was an indication that the isolates can withstand the low pH which they may likely encounter in the urethra or the phagosome. The survival of the isolates in the low pH was an indication that the isolates are virulent. In addition, the ability of the isolates to bind congo red dye was also indication that the isolates are also more hydrophobic. The ability for the isolates to bind congo red dye may be due to the rough surface of the membrane of the isolates [8].

The survival of bacteria isolates in low pH of 3.0 observed in this study was not surprising and it's an indication of the virulence properties of bacteria isolated at low pH suggest that the bacteria has ability to withstand the first stress find

upon the acidic pH of the stomach of the host. Although Ramos-Morales [15] reported, bacteria can survive even as low as < 2.0 pH of the stomach. Survival of bacteria at low pH 4.0 as observed in this study also suggests that this acidic environment is necessary for their survival and replication within the macrophages. Since the pH of both 3.0 and 4.0 demonstrated the ability of the organism acidic stress and aside from that low pH is also an important signal that indicates to the bacteria that is in a potential host environment and that triggers the induction of many virulence genes [15]. The percentage 10% serum survival of *bacteria* species isolates observed in this study was expected and this finding is in agreement with study earlier reported by Kintz *et al.*[16]. Although the mechanism of serum resistance observed in this study was not evaluated but Kintz *et al*.[16] reported that serum resistance is mediated by glycosylated form of O-antigen components of Lipopolysaccharides which decreases completed binding to the bacteria. In addition the ability of the isolates to bind congo red dye was also indication that the isolates are also more hydrophobic. The ability for the isolates to bind congo red dye may be due to the rough surface of the membrane of the isolates.

The high susceptibility of bacteria isolates to gentamicin, streptomycin and ceftszidime observed in the study was not surprising due to the fact that these antibiotics are injectable administered parentally and may not be have been abused in the study area. The low susceptibility of the isolates to amoxycillin-clavulanic acid, cipropfloxacin, co-trimoxazole and tetracycline observed in this study is in agreement with the study earlier reported by Bobai *et al.* [18] but not in agreement with the 76.5%, 60.9% and 70.3% susceptibility of bacteria to ciprofloxacin, co-trimoxazole and ceftriaxone respectively reported by Saana *et al.*[19]. The low susceptibility of the bacteria isolates to antibiotics may be due to inappropriate use of antibiotics.

5 Conclusion

From this study it was observed that abattoir sample collected have high different bacteria isolated, which include: Echerichai coli, Bacillus sp., Samonella sp., Klebsiella sp., Psuedomonas Sp., Staphylococus aureus, Entercocci sp. and Proteus sp. The bacteria isolated and screened for virulence shows that some of the bacteria has the ability to cause infection. The antibiotic susceptibility shows that some of the bacteria are resistance to commonly used antibiotic for treatment of infection caused by bacteria.

Compliance with ethical standards

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Disclosure of conflict of interest

There was no conflict of interest all through the period of this research work or during the time of drafting of this paper.

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