

EFFECT OF EXPOSURE TIME ON THE ANTIBACTERIAL ACTIVITY OF DISINFECTANTS USED IN UYO ABATTOIRS



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ABSTRACT

The effect of exposure or contact time on the antimicrobial activities of common disinfectants (Jik, Dettol, and Izal) were evaluated against bacteria isolates from two abattoirs in Uyo metropolis of Akwalbom. Isolation and subsequent identification of bacteria from floor, tables, knives and air in the abattoirs were carried out using the pour plate and streak plate technique and convectional biochemical tests. The results revealed that the total heterotrophic bacterial counts ranged from 3.1×10^3 CFU/ml to 9.5×10^3 CFU/ml, while total coliform count ranged from 1.1×10^2 CFU/ml to 9.0×10^2 CFU/ml. The predominant bacteria based on occurrence rates were; *Klebsiella* sp (87.5%), *Citrobacter* sp (62.7%), *Enterobacter* sp (37.5%) and *Staphylococcus aureus*(25.0%). The result of antimicrobial activities of the disinfectant revealed that all the isolates were resistant to 10% concentration of Dettol at one (1) minute contact time. Although, they were sensitive when the contact time was increased to 20, 40, and 60 minutes, respectively. The isolate was all sensitive to concentration (10%, 20%, 40% and 70%) of Jik, Savlon, and Izal notwithstanding the contact time. Therefore, it is recommended that Jik, Savlon, and Izal should be used when disinfecting abattoirs. However, Dettol can be used undiluted or when diluted, It should be allowed to stand for more than 20 minutes to ensure that pathogens do not survive.

INTRODUCTION

Slaughter house is also called “Abattoir”. It is a special facility designed and licensed for receiving, holding, slaughtering and inspecting meat animals and meat products before released to public (Alonge, 2005). Abattoir environment and slaughtering process play a very important role in the safety and wholesomeness of meat. Meat contamination by pathogens such as *Listeria monocytogenes*, *Salmonella* species and *Escherichia coli* (Oboegbulem and Muogbo, 1995; Tompkin, 2004) and chemicals in abattoirs can persist in meat processing environment, contaminate meat as they are being processed and lead to food borne illnesses and intoxication (Okolocha *et al.*, 2002). Thus, meat related illnesses are becoming increasingly widespread and consumers becoming more cognizant now than ever of the dangers associated with raw meat contamination. It is envisaged that proper disinfection of the slaughter house could bring this under control. Slaughter houses located within Uyo capital city, Akwa Ibom State, often discharge blood and untreated wastewater into the environment. Fresh blood coagulates in drains, where it becomes putrefied, causing offensive odour as well as sanitary and environmental problems. It is common knowledge that proper disinfection of the slaughter house will reduce or control the level of contamination of the environment and subsequent infection and illnesses. It was therefore necessary to determine the susceptibility of bacteria associated with slaughter houses to commonly used disinfectants and also evaluate the effect of exposure time on their efficacy.

MATERIALS AND METHOD

These disinfectants; parachlorometoxylenol (PCMX, Dettol), sodium hypochlorite (Jik), Izal and Savlon used in the study were purchased from the Supermarket in Uyo, Akwalbom State, Nigeria. Two slaughter houses, Nasarawa Abattoir and NtakInyang Abattoir were investigated. The total culture-able heterotrophic bacteria, total coliform and faecal coliform counts were

determined using the spread and settling plate techniques as described by Cappuccino and Sherman (2002) and Downes and Ito (2001). Swab samples were collected with sterile cotton swabs sticks moistened with 1ml of peptone water solution. The swab sticks were used to swab the selected objects/sections (floor, tables and knives) of the abattoir chosen for the study, while prepared and sterilized media plates were exposed for 15 minutes to obtain air samples. A total of twenty-four samples were collected and transported to the microbiological laboratory for analysis. Disinfectants (Dettol, Jik, Izal, Savlon) were diluted with sterile distilled water prior to use to obtain 10%, 20%, 40% and 70% concentrations.

One (1ml) of the bacterial suspension was added to the test disinfectants (9ml), mixed thoroughly and left at room temperature for a specified contact or exposure time (0 min, 10 mins, 20 mins, 40 mins, and 60 mins). Following exposure, an aliquot (1ml) was transferred to universal quenching agent (UQA), 9ml of a solution containing 1g peptone, 5g tween 80, 1g sodium thiosulphate and 0.7g lecithin and 1ml of de-ionized water pH 7, and allowed for 1min to inactivate the disinfectants. The quenched solution was serially diluted in sterile water and survivors enumerated on nutrient agar. Data were subjected to analysis of variance (ANOVA) using IBM SPSS windows version 20 package (IBM Corp, US) and the significance of the treatment means were tested using LSD at $p \leq 0.05$.

RESULTS AND DISCUSSION

Enumeration of Microbial Population from the Abattoir Samples

The result presented in Tables 1-3 represents the density of the culturable bacterial community present in the abattoir samples. Heterotrophic bacterial count range from 3.1×10^3 to 5.6×10^3 CFU/ml in the table and floor samples, while total coliforms and faecal coliform counts were in the range of 3.0×10^3 to 4.0×10^4 CFU/ml and 1.0×10^4 to 2.1×10^4 CFU/ml in the floor and knife samples obtained from Nasarawa abattoir respectively.

Table 1: Bacterial loads (CFU/ml) of floor, table and knife samples obtained from Nasarawa abattoir in Uyo metropolis

Bacterial Group	Nasarawa Abattoir Samples (CFU/ml)		
	Floor	Table	Knife
Heterotrophic Bacteria	5.6×10^3	3.1×10^3	4.5×10^3
Total Coliforms	3.0×10^3	7.1×10^3	4.0×10^4
Faecal Coliforms	1.0×10^4	2.1×10^4	2.1×10^4

Table 2: Bacterial loads ((CFU/ml) of floor, table and knife samples obtained from NtakInyang abattoir in Uyo metropolis

Bacterial Group	NtakInyang Abattoir Samples		
	Floor	Table	Knife
Heterotrophic Bacteria	3.6×10^3	9.5×10^3	3.2×10^3
Total Coliforms	1.1×10^3	5.0×10^3	9.0×10^3
Faecal Coliforms	9.2×10^3	2.0×10^3	2.6×10^3

For NtakInyang abattoir, heterotrophic bacterial count range from 3.2×10^3 to 9.5×10^3 CFU/ml in the knife and table samples, while total coliforms and faecal coliform counts were in the range of 1.1×10^3 to 9.0×10^3 CFU/ml and 2.0×10^3 to 9.2×10^3 CFU/ml in the (floor and knife/table and floor) samples respectively. For the air samples (Table 3), Itam Abattoir had the highest heterotrophic count of 1.5×10^3 CFU/m³ and the highest faecal coliform count of 2.5×10^2 CFU/m³. Among the Two locations in which samples were obtained for the study, NtakInyang Abattoir had the highest heterotrophic bacterial densities of 9.5×10^3 CFU/ml while Nasarawa abattoir had the highest faecal coliform count of 2.1×10^4 CFU/ml.

The cultural and biochemical characteristics of the bacterial isolates are presented in Table 4. Four species of bacteria were obtained from the abattoir samples. These include *Klebsiella*,

Staphylococcus, *Citrobacter* and *Enterobacter* species. Their distribution within the abattoir samples is shown in Table 5. *Klebsiella* sp 7(87.5%) had the highest frequency of occurrence, while *Staphylococcus aureus* had the least 2(25.0%) frequency of occurrence.

Table 3: Bacterial loads ((CFU/m³) of air samples obtained from Nasarawa and NtakInyang abattoir in Uyo metropolis

Bacterial Group	Air Samples	
	Nasarawa	NtakInyang
Heterotrophic Bacteria	3.4 x 10 ²	1.5 x 10 ³
Total Coliforms	6.8 x 10 ²	9.3 x 10 ²
Faecal Coliforms	5.7 x 10 ¹	2.5 x 10 ²

Table 4: Morphological and Biochemical characteristics Bacterial of Isolates

Isolates	G.R	Shape	Motility	Catalase	Coagulase	Oxidase	Indole	Citrate	Glucose	Lactose	Mannitol	Probable Organism
1.	-	R	-	+	-	-	+	+	AG	AG	-	<i>Klebsiella</i> sp
2.	+	S	-	+	+	-	-	+	A	-	A	<i>Staphylococcus aureus</i>
3.	-	R	+	+	-	-	-	+	AG	AG	A	<i>Enterobacter</i> sp
4.	-	R	-	+	-	-	+	+	AG	AG	A	<i>Citrobacter diversus</i>

Key: G.R = Gram Staining; + = Positive; - = Negative; R = Rod; S = Spherical; A = Acid only; AG = Acid and Gas produced

Table 5: Occurrence and distribution of bacterial isolates in the Abattoir samples

Isolates	Sample Point (Nasarawa Abattoir)				Sample Point (NtakInyang Abattoir)				Frequency of Occurrence
	Knife	Table	Floor	Air	Knife	Table	Floor	Air	
<i>Klebsiella</i> sp	+	+	+	-	+	+	+	+	7(87.5%)
<i>Staphylococcus aureus</i>	-	+	-	-	-	+	-	-	2(25.0%)
<i>Enterobacter aerogenes</i>	-	+	+	-	-	-	+	-	3(37.5%)
<i>Citrobacter diversus</i>	+	+	-	-	-	+	+	+	5(62.5%)

Key: + = Present; - = Absent

Figures 1-5 are graphical representations of the susceptibility of the bacterial isolates to different concentrations of disinfectants. The result revealed variation in the susceptibility of all the isolates to the disinfectants. Their response was concentration dependent and also determined by the contact time.



Figure 1: Susceptibility profile of *Citrobacterspp* at 10% disinfectant concentrations



Figure 2: Susceptibility profile of *Staphylococcus aureus* at 10% disinfectant concentrations

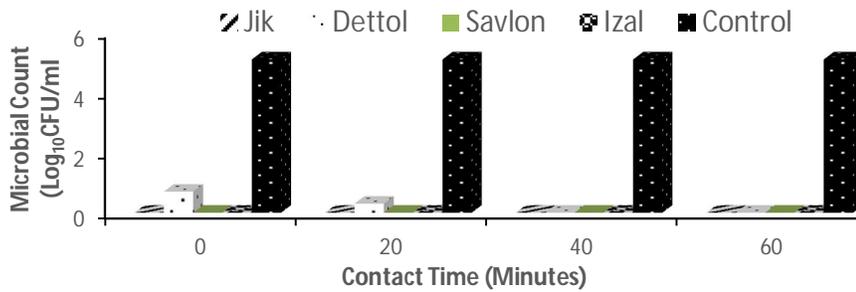


Figure 3: Susceptibility profile of *Klebsiella* spp at 10% disinfectant concentrations

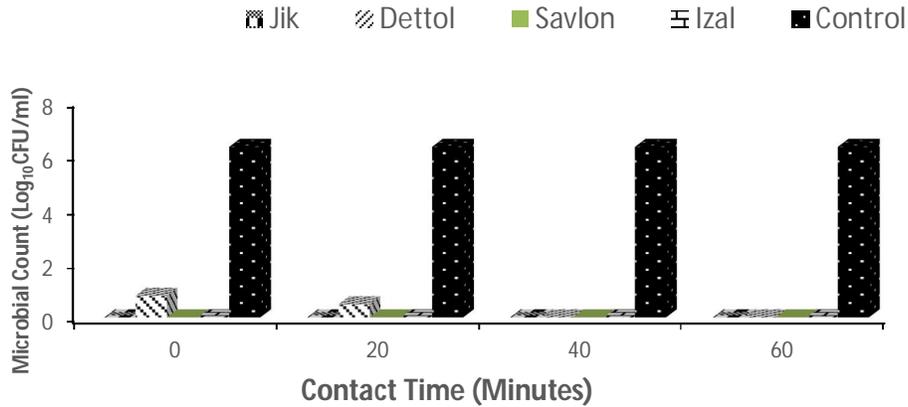


Figure 4: Susceptibility profile of *Enterobacter* spp at 10% disinfectant concentrations

The research findings have shown that Jik, Izal and savlon are very potent disinfectant, as all the concentrations used were effective against all the test isolates notwithstanding the duration of contact. Although Dettol was effective at high concentrations (70% and 40%), its effectiveness was found to reduce drastically when diluted beyond 20% and left in contact with the bacterial isolates for less than 10 minutes. These findings have shown that Jik, Izal, savlon and even Dettol, (at higher concentrations and considerably longer exposure time) can be used to sanitize the slaughter floor at 10% concentration. This will help reduce the loads of coliform and non-

coliform bacteria to levels considered safe. The number of viable colonies that survived disinfection was insignificant and its ingestion from the meat may not result into any disease or illness even in immune-compromised patients due to the acidic nature of the stomach (Langsrud et al., 2003).

The focus on safer foods and longer shelf-life has led to more frequent use of chemical disinfectants (Langsrud et al., 2003). These findings indicate that there was no significant difference in the effectiveness of Savlon, Izal and Jik on abattoir isolates. However, the efficacy of the disinfectants was significantly different at low concentration. The inhibitive effect Dettol at low concentrations was poor, and this is in discordance with the findings of Ngo (2005) who reported that the use of Dettol as a disinfectant in the presence of fat (herring juice) showed a strong bactericidal efficiency, although the study was mostly on *Salmonella* sp. Though at 20%, 40% and 70% concentrations no growth of bacteria was detected after treatment with Dettol which is an indication of increase in the potency of the disinfectant with increase in concentration. This is also in concordance with the findings of Holo et al., (2002) which stated that quaternary ammonium compound (QAC) have been used widely as disinfectants in seafood and food processing environment in developed countries such as the UK, and Norway. Its high application may be because of its low toxicity non-corrosiveness and high surface activity (Langsrud and Sundhein, 1997; Bore and Langsrud, 2005). However, several reports have described intrinsic and acquired resistance to these compounds especially among some Gram-negative species (Langsrud and Sundhein, 1997; Langsrud et al., 2003).

CONCLUSION AND RECOMMENDATION

The use of disinfectants such as Izal, Savlon, Jik and Dettol on abattoir isolates showed a strong bactericidal efficiency. Izal, Savlon and Jik were more effective than Dettol on isolates from floor, table, knife and air of abattoirs in Uyo metropolis of Akwa Ibom State. Jik, Savlon and Izal should be the disinfectant of choice when disinfecting abattoir while Dettol should only be used undiluted. It can however be diluted before use provided that the contact time will not be less than 20 minutes.

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