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THE SUSCEPTIBILITY PATTERN AND EFFICACY OF COMMERCIALLY AVAILABLE DISINFECTANTS TOStaphylococcus aureus ISOLATED FROM BUTCHERS' TABLE IN ABAKALIKI MEAT MARKET".

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ABSTRACT

This study investigated the susceptibility pattern and efficacy of commercially available disinfectants to *Staphylococcus aureus* isolated from butchers' tables in Abakaliki meat market. Butchers' tables were swabbed using appropriately labelled sterile cotton swab sticks. The labelled swab sticks were immediately transported to the laboratory for microbiological analysis. The susceptibility pattern of *Staphylococcus aureus* was determined using modified Kirby-Bauer susceptibility test method on Dettol, Purit, Isol, and Savlon. Susceptibility tests of disinfectants on *Staphylococcus aureus* isolates were done at 25 % and 50 % concentration of the stock concentration. The result of this study showed that at 50 % concentration, *Staphylococcus aureus* exhibited a high percentage of susceptibility as against its *susceptibility* at 25 % concentration. The susceptibility readings at 50 % concentration of disinfectants are 89.3 %(25) for Dettol, 89.3 %(25) for Purit, 92.9 %(26) for Isol, and 78.6 %(22) for savlon while at 25 % concentration, it was 78.6%(22) for Dettol, 78.6%(22) for purit, 96.4%(27) for Isol, and 82.1%(23) for savlon. Results showed that Isol was the most effective disinfectant against *S. aureus* isolates. This was closely followed by Dettol, Purit and savlon being the least effective disinfectant. Therefore, effective cleaning and a safe level disinfection of butchers' environment with Isol disinfectant is strongly recommended as a means of safe guarding consumers' health.

INTRODUCTION

Food-borne pathogens are the leading cause of illness and death in developing countries, resulting in the loss of labour force which could have contributed in the economic growth (Fratamico *et al;* 2005). *Staphylococcus aureus* are Gram-positive, facultative anaerobic and spherical bacteria that produce a very heat-stable toxin. The bacteria are borne by humans as part of body normal flora of the skin, nasal nares which are transported to food. The bacteria grow best at our body temperature and also at room temperature. *Staphylococcus aureus* can multiply rapidly in food held at room temperature and the toxin can be produced by the microorganism growing in the food. This toxin is called enterotoxin because it causes gastroenteritis or inflammation of the lining of the intestinal tract (CDC, 2013). Contaminated raw meat is one of the main sources of food-borne illnesses (Bhandare *et al*; 2007). The risk of the transmission of zoonotic infections is also associated with contaminated meat (Hedberg *et al*; 1992). International Food Management Agencies, especially the World Health Organization (WHO), the Food and Agriculture Organization (FAO) and the International Hazard Analysis Critical Control Point Alliance (HACCP) have already provided guidelines to member countries about safe handling procedures such as HACCP and Good Manufacturing Practices (GMPs). The widespread habit of raw beef consumption is a potential cause if food-borne illnesses besides the common factors such as over-crowding, poverty inadequate sanitary condition and poor general hygiene (Siddiqui *et al*; 2006). Ikeme (1990) noted that sources of surface fresh meat contamination could be from polluted air in the environment, unsterile knives, equipment and utensils, clothing and hands of personnel. Antibiotic resistance levels are also elevated among food-borne pathogens as in *Staphylococcus* (Mache, 2002). Although, it is difficult to prove a direct role of drug resistance in bacteria contaminating food items with increased clinical cases of resistant infections: the presence of such bacteria in food items

could play a role in the spread of antimicrobial resistance amongst food-borne pathogens (Farzana *et al*; 2009). Lack of awareness about food safety and hygiene among butchers results in food contamination. The butchers or personnel can be carriers of this pathogen who eventually transfer these food-borne pathogens to consumers (Toit *et al*; 2005). Hence, this study was therefore designed to investigate the susceptibility patterns and efficacy of commercially available disinfectants to *Staphylococcus aureus* isolated from butchers' tables in Abakaliki meat market, Ebonyi State, Nigeria.

MATERIALS AND METHOD

Sample collection: Twenty-eight swab samples were randomly collected from meat market butchers' tables within Abakaliki metropolis, Ebonyi State, Nigeria using sterile swab sticks. The samples were immediately transported to the microbiology laboratory for bacteriological analysis.

Bacteriological analysis: All the samples were aseptically cultured on bacteriological culture media such as nutrient agar, mannitol salt agar, nutrient broth and the plates were incubated at 37^{o}C for 18-24 hrs. Each of the samples was first inoculated in nutrient broth overnight at 37^{o}C prior to subculture onto solid culture media plates as aforementioned. Suspect colonies were subcultured onto fresh culture plates to get pure cultures (Cheesbrough, 2006).

ANTIMICROBIAL SUSCEPTIBILITY TEST: Antimicrobial susceptibility test was performed with Mueller Hinton agar (oxoid, England) using antimicrobial disinfectants diluted at 50% and 25% concentration. The disinfectants used were Dettol, Savlon, Purit, Isõl diluted at 50% concentration and 25% concentration respectively. The resistance and susceptibility patterns of *S. aureus* were determined by the modified Kirby-Bauer susceptibility test method as recommended by CLSI. Morphologically identical bacterial colonies from an overnight culture were suspended in 5ml nutrient broth and incubated for 4 hours at 37^{0}C. Turbidity of the broth culture was equilibrated to McFarland standards. The surface of Mueller Hinton agar (oxoid, England) plate was evenly inoculated with the cultures using a sterile cotton swab stick. After this, four (4) holes were pierced through the surface of the Mueller-Hinton agar media designated "S", "P", "I", and "D", denoting savlon, purit, Isõl and Dettol respectively using a sterile cork borer. A drop of these antimicrobial disinfectants was placed in each of these holes using a Pasteur pipette. After 18-24 hours of incubation, the diameter of growth inhibition was measured and interpreted as sensitive or resistant according to Clinical Laboratory Standards Institute (CLSI, 1999).

RESULTS

TABLE 1: DIAMETER OF INHIBITION (mm) READING AT 50% CONCENTRATION OF DISINFECTANTS

Sample (S/No)	D	P	I	S
1.	30mm	28mm	27mm	30mm
2.	27mm	32mm	40mm	22mm
	31mm	28mm	25mm	28mm
	27mm	27mm	29mm	38mm
	27mm	20mm	30mm	20mm
	33mm	30mm	25mm	40mm
	R	25mm	24mm	R
	28mm	25mm	26mm	28mm
	25mm	30mm	20mm	R
.	20mm	24mm	28mm	27mm
.	28mm	29mm	36mm	30mm
.	27mm	25mm	30mm	20mm
.	30mm	31mm	35mm	33mm
.	25mm	R	25mm	R
.	20mm	28mm	24mm	R
.	20mm	30mm	35mm	20mm
.	30mm	28	29	31
.	30mm	29mm	32mm	30mm
.	30mm	38mm	25mm	25mm
.	30mm	33mm	29mm	R
.	30 mm	34mm	30mm	32mm

.	R	20mm	25mm	20mm
.	32mm	30mm	32mm	32mm
.	30mm	30mm	35mm	30mm
.	25 mm	20mm	27mm	30mm
.	28mm	20mm	27mm	20mm
.	R	R	R	20mm
.	25mm	R	R	R
.	28mm	20mm	32mm	20mm

Key: D=Dettol, P=Purit, I=Isol, S=Savlon, R=Resistance

TABLE 2: DIAMETER OF INHIBITION (MM) AT 25% CONCENTRATION OF DISINFECTANTS

Sample (S/No)	D	P	I	S
	25mm	29mm	32mm	25mm
	24mm	20mm	32mm	24mm
	28mm	20mm	30mm	23mm
	32mm	26mm	32mm	30mm
	28mm	21mm	35mm	25mm
	30mm	26mm	32mm	30mm
	32mm	27mm	24mm	28mm
	R	24mm	32mm	28mm
	34mm	32mm	30mm	30mm
.	36mm	24mm	38mm	25mm
.	20mm	23mm	24mm	25mm
.	R	25mm	28mm	20mm
.	22mm	22mm	20mm	20mm
.	R	R	25mm	20mm
.	25mm	21mm	26mm	23mm
.	24mm	20mm	32mm	28mm
.	22mm	22mm	36mm	30mm
.	26mm	29mm	28mm	26mm
.	28mm	R	30mm	R
.	22mm	R	28mm	R
.	26 mm	20mm	28mm	20mm
.	20mm	R	22mm	20mm
.	20mm	24mm	28mm	30mm
.	30mm	25mm	30mm	22mm
.	26 mm	22mm	30mm	R
.	R	28mm	22mm	20mm
.	R	R	25mm	R
.	20mm	R	26mm	R
.	R	R	R	R

Key: D=Dettol, P=Purit, I=Isol, S=Savlon, R=Resistance

TABLE 3: PERCENTAGE SUSCEPTIBILITY AT 25% & 50% CONCENTRATION OF ANTIMICROBIAL DISINFECTANTS

(%) Dilution	Dettol	Purit	Isol	Savlon
25	78.6 % (22)	78.6 % (22)	96.4 % (27)	82.1 % (23)
50	89.3 % (25)	89.3 % (25)	92.9 % (26)	78.6 % (22)

TABLE 4: PERCENTAGE RESISTANCE AT 25% & 50% CONCENTRATION OF DISINFECTANTS

(%) Dilution	Dettol	Purit	Isol	Savlon
25	21.4 % (6)	21.4 % (6)	3.6 % (1)	17.9 % (5)
50	10.7 % (3)	10.7 % (3)	7.1 % (2)	21.4 % (6)

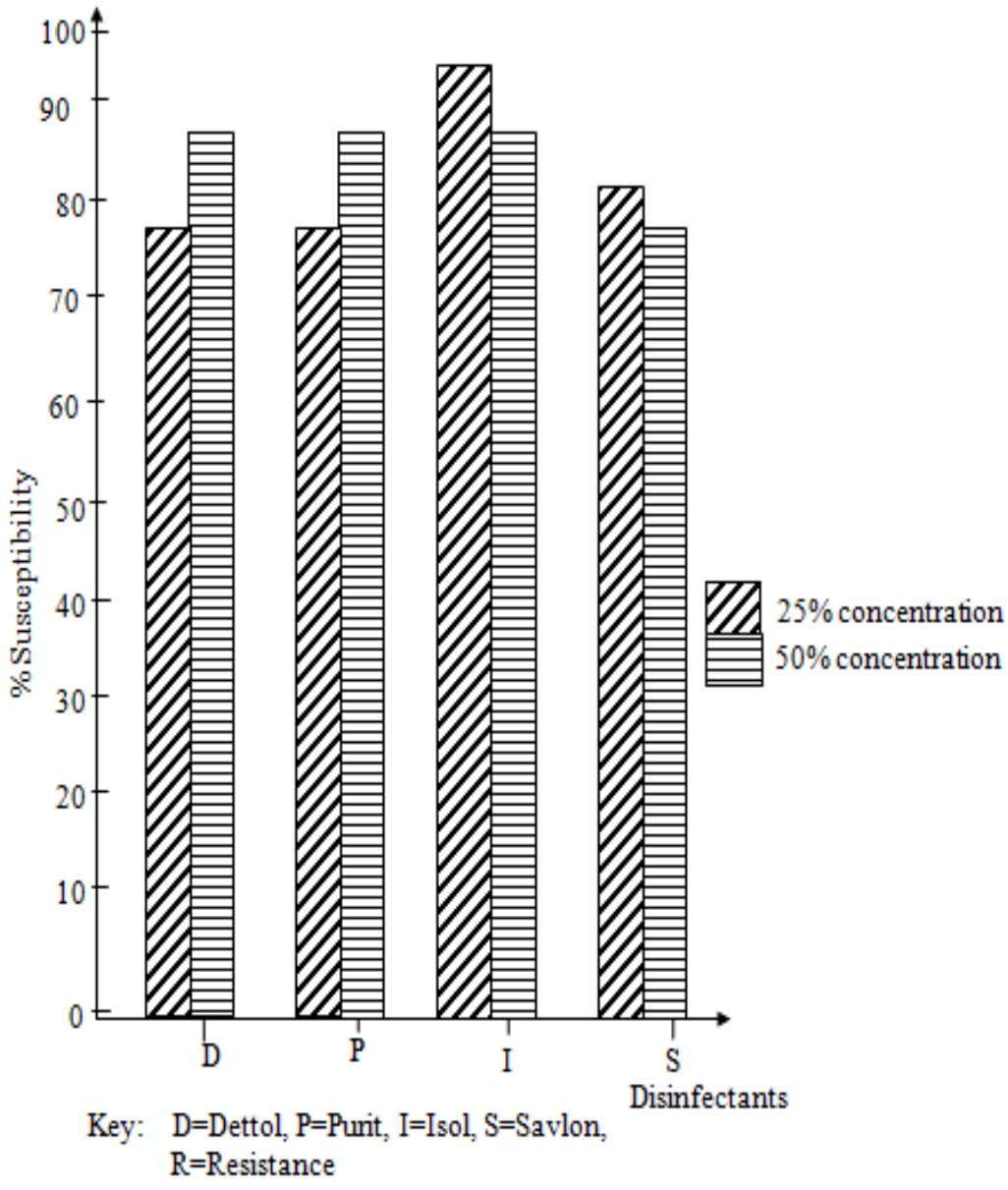

Figure 1: Component Bar Chart Representation of the Antimicrobial Susceptibility at 25 And 50% Concentration.

DISCUSSION

The result of this study showed that at 50 % concentration of the disinfectants, *Staphylococcus aureus exhibited* a high percentage of susceptibility as against *Staphylococcus aureus susceptibility* at 25 % concentration of the disinfectants. The susceptibility readings at 50 % concentration of disinfectants are 89.3 % (25) for Dettol, 89.3 % (25) for Purit, 92.9 % (26) for Isol, and 78.6 % (22) for savlon while at 25 % concentration of the disinfectants it reads 78.6 % (22) for Dettol, 78.6 % (22) for purit, 96.4 % (27) for Isol, and 82.1 % (23) for savlon, with Isol at its peak in both the two tests. This is in agreement with (Russell and McDonnell, 2000) that the efficacy of antimicrobial products may depend on, and vary significantly with the formulation used. However, from this study, *S. aureus* are more sensitive to Isol than the rest of the disinfectants. At 25 % concentration of the disinfectants, Dettol is 21.4 % resistant, Purit 21.4 %, Isol is 3.6 %, Savlon is Dettol is 10.7 %, Purit is 10.7 %, Isol is 7.1 %, Savlon is 21.4 %. It was observed that *Staphylococcus aureus* was least resistant to Isol at both 25 % and 50 % concentration. This is followed by Dettol and Purit. The scientific committee on Emerging and Newly Identified Health risks (2009) reported that bacteria resistance arises from a mechanism causing decrease in intracellular concentrations of biocides below a threshold level that is harmful to the bacterium. McDonnell and Russell (2000) also found put that resistance is either a hereditary natural property of an organism, or acquired by mutation and acquisition of plasmids or transposons. However, this resistance is likely due to the presence of active efflux. In appropriate use of antimicrobial agent as in low dosage, short contact, or irregular application is primarily responsible for the emergence of many resistant bacteria species including staphylococci (Yilmax and Kaleta, 2009). Thus, resistance to disinfecting agents induced by sub-lethal concentrations of the active compound will significantly increase minimum inhibitory concentration values for most antimicrobials. Hogan and Smith (2008) found that the responses of *S. aureus* to chlorhexidine, sodium hypochlorite and iodophor were not affected by prolonged exposure to these reagents. *Staphylococus aureus* exhibited some good level of susceptibility to Isol, Dettol, Purit and savlon disinfectants. Isol was the most effective disinfectant against *Staphylococcus aureus*. Therefore, effective cleaning and a safe level disinfection of butchers' environment (implements, wooden slabs, and tables) with disinfectants especially Isol is strongly recommended as a means of safe guarding consumers' health.

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