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Periplanata americana and *Blatella orientalis* (L) *(Dictyoptera, Blattidae)* as Vectors of Bacterial Pathogens in Maiduguri, Nigeria.

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ABSTRACT

Cockroaches are found to be associated with human dwellings worldwide thereby; affecting public health through their habits which makes them ideal mechanical carriers of several pathogens such as bacteria, viruses, helminths, protozoa and fungi. This study was conducted to isolate and identify bacteria from external surfaces and digestive tract of 50 Cockroaches collected around human dwellings in Jere Local Government Area of Borno State, Nigeria. Colonial morphology and biochemical characterization revealed that cockroaches harboured *Escherichia coli, Proteus mirabilis, Bacillus subtilis, Klebsiella pneumoniae, Corynebacterium pyogenes, Staphylococcus aureus, Staphylococcus epidermis, Streptococcus faecalis, Salmonella typhi* and *Pseudomonas aerugenosa,* on their cuticle and intestinal contents. Antimicrobial sensitivity tests were indicated by diameter of inhibition zone in millimetres. Complete resistance was observed with floxapen, ampicillin and erythromycin for Gram positive isolates, and ampicillin and ampicillin/cloxacilin for Gram negative isolates. However, pockets of resistance were observed for cephalexin, cotrimoxazole, amoxicilin, clindamycin and ofloxacin for Gram positive bacteria, and tetracycline, norfloxacin, amoxicillin, ofloxacin, chloramphenicol, cefuroxime and gentamicin for Gram negative bacteria. In conclusion, cockroaches in Maiduguri harbour pathogenic bacteria which showed resistance to antimicrobial agents.

Keywords: *Periplanata americana, Blatella orientalis,* Vectors and Bacteria,

INTRODUCTION

Cockroaches with at least 3500 species are gregarious and nocturnal, and have a propensity for human dwellings worldwide posing serious public health problems (Kassiri and Kazemi, 2012). They derive nourishment from vomitus, sputum, phlegm, excrement, and human entrails, which makes them ideal

mechanical or biological carriers of several pathogens such as bacteria, viruses, helminths, protozoa and fungi, and their habits of regurgitating some of the partially digested food onto their feeding surface, and defecating, increases their potential to contaminate household food and utensils thus perpetuating disease transmission (Fathpour *et al.,* 2003; Salehzadeha *et al.*, 2007). Cockroaches have been reported as potential vectors of dysentery, gastroenteritis, typhoid and poliomyelitis, urinary tract infections, sepsis, pneumonia and wound infections (Chaichanawongsaroj *et al.*, 2004). A bacterial load of up to 14 million was isolated from their body cuticles and 7 million in their faecal droppings, and over a hundred species of bacteria have been reported from domestic cockroaches, and these included *Escherichia coli, Enterobacter spp, Klebsiella spp, Pseudomonas aeruginosa, Acinetobacter baumannii, Campylobacter spp, Serratia marcescens, Shigella spp, Salmonella typhi, Staphylococcus aureus, Enterococcus spp; Citrobacter freundi* and *Bacillus spp*. (Fotedar *et al.,* 1991; Cloarec *et al*., 1992; Paul *et al*., 1992; Bennett, 1993).

Cockroaches, though worldwide are largely populated in tropical areas (Rivault *et al*., 1993; Eggleton, 2001) especially in areas where living conditions such as sanitation is poor (Cotton *et al*., 2000; Graczyk *et al*., 2005), and in Nigeria they are called *Kenkeso* in Hausa; *Ayan* in Yoruba and *Onchucha* in Igbo languages. The abundance of cockroaches in this study area prompted this investigation to identify their species and isolate bacterial pathogens from their cuticle and intestinal contents.

MATERIALS AND METHODS

Study Area, Collection and Identification of Cockroaches

This study was conducted in Maiduguri, the capital and largest urban centre in Borno State, Nigeria. It lies between latitude 10.2^{o} N and 14.4^{o} E, and it is within the semi-arid zone of north-eastern Nigeria with low rainfall between late June and early October followed by a prolonged dry season for the rest of the year (Hess *et al.,* 1995). The areas sampled for the roaches were the student hostels of the University of Maiduguri, restaurants, health centres and human dwellings within the metropolis.

Cockroaches were caught using food baited pit fall traps set out at night and collected the next morning. In the Veterinary Parasitology Laboratory, University of Maiduguri, the roaches were anaesthetized by freezing at 0^{o}C for 10 minutes, and

identified under the stereoscopic microscope using standard taxonomic keys of body colour and size as described by Herms (1950) and Service, (1980).

Isolation of Bacteria from Cuticular Surfaces

Individual cockroaches were put into sterile test tubes and added 2mls of sterile physiological saline solution, shaken for 2 minutes, and a 0.01ml of the wash was cultured separately on blood and Mac Conkey agar, then incubated over night at 37^{o}C for 24 hours for colonial growth which were identified using standard bacteriological methods of macroscopic morphology, Gram staining, biochemical and other specific characters as described by Baron and Finegold, (1990).

In addition, 0.5ml of the wash was also inoculated in thioglyconate and selenite broths simultaneously, and incubated for 24 hours at 37^{o}C and sub-cultured in the same media, and results determined using the methods of Baron and Finegold, (1990).

Isolation of Bacteria from Intestinal Contents

After external washings, individual roaches were put into flasks, and rinsed with 70% alcohol for 5 minutes (to decontaminate the external surface, as 70% alcohol is bactericidal). The roaches were then transferred to sterile flasks; allowed to dry at room temperature (± 27^{o} C) under sterile conditions, and again washed with sterile normal saline for 2-3 minutes to remove the alcohol, then dissected with sterile scalpel blade to collect the gut, which was macerated aseptically in a sterilised pestle and mortar in 2mls of sterile normal saline as described by Salehzadeha *et al*., (2006). The macerate was then cultured as described above and results recorded.

Antimicrobial Sensitivity

The disk diffusion method was used according to NCCLS (1999) standards and diameters of zones of inhibition measured in millimetres with a transparent ruler and those greater than or equal to 12mm considered active (Anes, 2012).

RESULTS

Table 1 shows that out of the 50 roaches examined, 25 (50%) harboured *Escherichia coli*, *Staphylococcus epidermidis* 05 (10%), *Proteus mirabilis* 07 (14%), *Corynebacterium pyogenes* 19 (38%) and *Bacillus subtilis* 16 (32%) from their cuticular washings. The intestinal contents also harboured *Salmonella typhi* 10 (20%), *C. pyogenes* 14 (28%), *Klebsiella*

pneumoniae 09 (18%), *Proteus mirabilis* 16 (32%), *Pseudomonas aeruginosa* 13 (26%), *E. coli* 50 (100%), *Staph. epidermidis* 18 (36%), *Bacillus subtilis* 15 (30%), *Staph. aureus* 15 (30%) and *Streptococcus faecalis* 20 (40%).

The antimicrobial sensitivity test results are shown in Table 2. Bacteria isolated showed both resistance, and susceptibility levels. Complete resistance was for the antimicrobials floxapen, amoxicillin and erythromycin, and partial for cephalexin, cotrimoxazole, amoxicillin, clindamycin and ofloxacin for Gram positive disk diffusion, while there was complete resistance for ampicillin and ampicillin/cloxacillin, and partial for tetracycline, norfloxacilin, amoxicillin, ofloxacillin, chloramphenicol, cefuroxime and gentamicin.

Table 1: Bacteriological Isolates from External Surfaces and Intestinal Contents of Cockroaches Caught from Human Dwellings in Maiduguri.

BACTERIAL ISOLATES	NUMBER (%) OF ISOLATES (N=50)
External Surface:	
Proteus mirabilis	07 (14)
Bacillus subtillis	16 (32)
Coryne pyogenes	19 (38)
E. coli	25 (50)
Staphy epidermidis	05 (10)
Intestinal Contents:	
Staph. aureus	15 (30)
Strept. faecalis	20 (40)
E. coli	50 (100)
Salmonella typhi	10 (20)
Klebsiella pneumonia	09 (18)
Proteus mirabilis	16 (32)
Bacillus subtillis	15 (30)
Coryne pyogenes	14 (28)
Pseudomonas aeruginosa	13 (26)
Staphy epidermidis	18(36)

Table 2: Antibiotics Sensitivity Test on Bacterial Isolates

Bacterial	Width (mm) Zone of Inhibition by									
Isolate	**CIP**	**GN**	**CX**	**CO**	**FX**	**AX**	**CD**	**AM**	**OF**	**E**
Gram-Positive										
Staph. aureus	25	15	10	20	R	R	R	R	22	R
Strep. faecalis	30	18	16	R	R	10	8	R	30	R
Staph. epidermis	30	20	17	R	R	12	20	R	R	R
Bacillus subtilis	12	25	R	15	R	R	20	R	R	R
Coryne pyogenes	27	18	R	18	R	R	R	R	25	R
Gram-Negative	**CIP**	**TE**	**NB**	**AX**	**OF**	**C**	**CF**	**AM**	**GN**	**AP**
E. coli	25	18	22	R	20	16	10	R	17	R
Salmonella typhi	30	16	25	10	30	10	R	R	20	R
Klebsiella pneumoniae	18	R	R	R	12	9	R	R	15	R
Proteus	25	R	10	16	R	12	R	R	R	R
Pseudomonas pyogenes	22	R	10	R	10	R	R	R	12	R

DISCUSSION

This study on the isolation and identification of bacteria from the cuticles and intestinal contents of cockroaches, and their antimicrobial sensitivity has revealed the prevalence of *Proteus, Bacillus, Corynebacterium, Escherichia Staphylococcus, Streptococcus, Salmonella, Klebsiella* and *Pseudomonas* species and this agrees with the findings of Rivault *et al.*, (1993) and Kassiri and Kazemi, (2012) that synanthropic cockroaches have filthy habits of inhabiting and breeding in sewage systems and indiscriminately travel between filth and food which makes them potential vectors of pathogens in developing and developed countries worldwide.

Roaches have been associated with the epidemiology and outbreaks of dysentery, allergic reactions, nosocomial infections and most common food-borne diseases among humans (Cotton *et al*., 2000; Kutrup, 2003; Graczyk *et al*., 2005; Salehzadeha *et al*., 2007), and their mere appearance causes nuisance and disgust to humans by reducing the perception of human and private dwellings.

Antimicrobial sensitivity revealed that both the Gram positive and negative bacteria isolated from the roaches were resistant to antibiotics. There have been many reports on drug resistant bacteria from cockroaches especially by Fotedar *et al*., (1991) on *Klebsiella, Pseudomonas,* and *Staphylococcus*

which were resistant to more than 4 antimicrobial agents. Antimicrobial resistance has emerged in the past few years as a major problem and many programs have been set up for its surveillance in human and veterinary medicine. These programs are aimed mainly at human pathogens, agents of zoonoses and indicator bacteria of the normal intestinal flora from animals (Habrun *et al.,* 2010).

The prescription of antimicrobial drugs in prophylaxis, ignorance of real causative agents, improper dosage, inapposite therapy periods and other irregularities have caused the appearance of antimicrobial resistance in bacteria, which is nowadays an emerging public health issue (Forbes *et al.,* 2007; Torres *et al*., 2009; Zdolec *et al*., 2011; Ataee *et al.,* 2012).

In conclusion, information on antimicrobial susceptibility may significantly reduce morbidity and mortality, cost of treatment and duration of hospitalization, when provided to clinicians at the appropriate time.

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