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Presence and isolation pattern of zoonotic bacteria in oral cavities of dogs in peri-urban areas of Makurdi, Nigeria

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ABSTRACT
Objectives: To determine the presence of potential human bacterial pathogens in oral cavities of dogs in rural communities of Benue State, Nigeria.
Methodology and results: Oral swabs from 213 local dogs were inoculated on culture media followed by standard biochemical tests for species identification of the isolates. One hundred and sixty dogs (75.1%) were positive for at least one species of bacteria. Of the positive dogs, 153 (95.6%) harbored two or more bacterial pathogens. A significant variation in the manner of occurrence of bacteria (15) was observed in the dogs sampled. A total of 448 isolates of different species of bacteria were recorded from the 160 positive dogs. The species identified and the number of dogs from which they were isolated were *Escherichia coli,* 110 (51.6%), *Staphylococcus aureus,* 93 (46.0%), *Proteus mirabilis,* 56 (26.3), *Enterobacter aerogenes,* 44 (20.7%), *Corynebacterium renale,* 42 (19.7%), *Klebsiella pneumoniae,* 25 (11.7%), *Enterococcus faecalis,* 17 (8.0), *Listeria moncytogenes,* 16 (7.5%), *Pseudomoonas aeruginosa,* 16 (7.5%), *Streptococcus canis,* 13 (6.1%), *Bacillus cereus,* 13 (6.1%), and *Pasteurella multocida,* 3 (1.4%).
Conclusions and application of finding: Most dogs in Makurdi harbour at least 1 zoonotic bacterial pathogen in their buccal cavities. The chances for multiple human infections through dog bites, direct contact with saliva or ingestion of saliva contaminated water and food are high. Proper medical care of local dogs, personal hygiene and careful selection of drugs to treat dog bite wounds or related infections are recommended.

Key words: Zoonotic bacteria, oral cavities, dogs.

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INTRODUCTION

In Benue State in North-central Nigeria, many rural households keep dogs primarily for game hunting and guarding against livestock and farm produce thieves. Most of these dogs do not receive adequate food and care, and are allowed to stray, being called only when their services are needed. These dogs often feed on decomposed foods, excreta and get exposed to other health hazards including diseases. The buccal cavities and saliva of such dogs are known to harbor many facultative anaerobes and obligate aerobes, some of which are potential human pathogens (Biberstein & Carter, 1979; Zee, 1990). Potential pathogens include *Staphylococcus aureus, Eescherichia coli, Proteus mirabilis, Bacillus* species and *Salmonella typhimurium* among others (Berge *et al.,* 1984; Podschun & Ullamann, 1998; Lyczak

et al., 2000; Roberts, 2000; Songer & Post, 2005). Dog-to-human transmission of these pathogens could occur through dog bites or contamination of human food and water by bacteria in dog saliva.

Direct mouth-to-mouth contact by dogs and children as they play is one of the likely sources of infection (Robert *et al.,* 2000). Human infections could lead to suppurative wounds, skin rashes, bronchopneumonia, diarrhoea, food poisoning and in rare cases urinary tract problem (Hanna, 1998; Coker *et al.,* 2000). Despite the close association between dogs and humans, and the adverse consequences of frequently occurring dog bites, very little information exists on oral zoonotic bacterial flora of local dogs. This study investigated the presence of potential bacterial pathogens of humans in oral cavities of dogs in rural communities of Benue State.

MATERIALS AND METHODS

Study area: The study area was Makurdi in north-central Nigeria, and the capital city of Benue State, located 7°4' N, 8°37' East within the grassland of Southern Guinea Savannah. The indigenous tribe, the Tivs, lives in the fringes of the town and are renown farmers and hunters with a high dog population.

Collection of sample: A total of 213 local dogs kept in homes in the rural suburb of Makurdi metropolis were randomly sampled from February 2004 to January 2005. These dogs were 80 males and 133 females aged one month and above. Numbering and plastic neck tags identified the households and the dogs sampled, respectively. Only dogs that were not known to be on antibacterial therapy for the last 6 months preceding the trial were sampled. A sterile cotton swab was used to swab the surface of the oral mucosa, tongue and teeth of each dog after proper physical restraint. Each swab was placed in a tube containing normal saline and transported in a cold ice pack to the laboratory. Samples that were not processed immediately were stored at 4°C.

Culture and biochemical tests: Each sample was directly plated out in duplicate on blood agar and MacConkey agar, which were prepared using the method described by Barrow and Feithan (1993) and incubated aerobically and anerobically at 37°C for 24 - 48 hours. After incubation, the resultant colonies were examined visually and microscopically. Distinct colonies were subsequently streak-purified on nutrient agar and stock cultured on nutrient agar slants for further testing. All isolates were identified to species level by standard biochemical procedures as described by Barrow and Feithan (1993).

RESULTS

One hundred and sixty (75.1%) of the 213 dogs sampled were positive for at least one species of zoonotic bacteria. Mixed infections of two or more bacteria occurred in 153 (95.6%) out of the 160 positive cases. Seven (4.4%) dogs of the positive cases had single infections. A total of 440 bacterial isolates with 15 isolation patterns were recorded from the 160 positive dogs (Table 2). The genera and species, isolation rates and the number of dogs from which they were observed are shown in Table 1.

Of the 160 dog dogs positive for one or more bacterial species, 110 (51.6%) and 93 (46.0%) harbored *Escherichia coli* and *Staphylococcus aureus,* respectively. Thus 110 (24.6%) and 93 (20.8%) of the 448 isolates were *Escherichia coli* and *Staphylococcus aureus,* respectively.

Other bacteria with significant isolation rates were *Proteus mirabilis* (12.5%), *Enterobacter aerogenes* (1.4) and *Corynebacterium renale* (9.4%). Only 3 among the sample dogs harbored *Pasteurella multocida*, which was the least isolated bacteria. SaEcCr abd SaEc were the predominant patterns Table 2. Gram-negative bacilli were the most frequently isolated followed by Gram-positive cocci (Figure 1).

Table I: Bacteria isolated from oral cavities of dogs in peri urban communities in Makurdi, Nigeria.

Isolate	(%)* dogs positive	Isolation rate**
Escherichia coli	110 (51.6)	24.6
Staphylococcus aureus	93 (46.0)	20.8
Proteus mirabilis	56 (26.3)	12.5
Enterobacter aerogenes	44 (20.7)	9.8
Corynebacterium renale	42 (19.7)	9.4
Klebsiella pneumoniae	25 (11.7)	5.6
Enterococcus faecalis	17 (8.0)	3.8
Listeria monocytogenes	16 (7.5)	3.6
Pseudomonas aeruginosa	16 (7.5)	3.6
Streptococcus canis	13 (6.1)	2.9
Bacillus cereus	13 (6.1)	2.9
Pasteurella multocida	3 (1.4)	0.7

*= % of total number of dogs sample (213); **=% of total number of bacteria isolated (448)

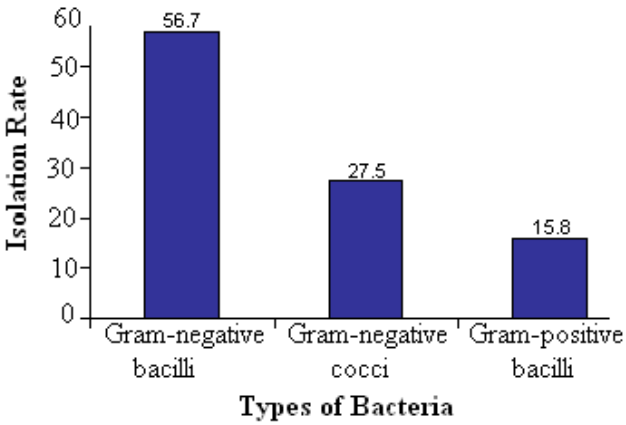

Figure 1: Grouping based on cell morphology and gram reaction of bacteria with zoonotic potential from oral cavities of dogs in peri urban communities in Makurdi, Nigeria.

DISCUSSION

The results of this study corroborated earlier reports (Kloos, 1980; Bruckner & Colonna, 1997; Vazquez-Boland *et al.,* 2003; Songer & Post, 2005) that the oral cavity of dog harbours pathogenic bacteria with zoonotic potential. The isolation rates observed were close to those reported by Osinubi *et al.* (2003) in the northern Nigeria town of Zaria but were higher than those reported by Adetola and Adekeye (2004) for Lagos town in south-west Nigeria.

The higher rate observed in this study may be due to the scavengous nature of the straying, poorly kept dogs which enhances contamination and infection by pathogenic bacteria associated with sewage, unlike the dogs sampled in Lagos which were fairly treated and had some frequent medical attention. The high isolation rates recorded for some members of the *Enterobacteriaceae (Escherichia coli, Proteus mirabilis, Enterobacter aerogene* and *Klebsiella pneumoniae)* in this study would be expected since members of this family inhabit the gastrointestinal tracts of animals and humans as major opportunistic pathogens (Gillespie & Timoney, 1973; Quinn & Markey, 2003).

Some of these bacteria infecting dogs are potential sources of infection for immuno-compromised humans through dog bites or saliva borne pathogens that may contaminate food and water (Hanna, 1998; Podschun & Ullmann, 1998). Enterotoxins of bacteria, *Staphylococcus aureus, Escherichia coli, Listeria monocytogenes* and *Bacillus cereus,* could cause food borne intoxication and gastroenteritis while dog bite infection could lead to suppurative infections, abscesses, pyoderma and septicaemia in man (Berg *et al.,* 1984; Nataro & Kaper, 1998).

Table 2: Isolation patterns of bacteria with zoonotic potential from oral cavities of dogs in peri urban communities in Makurdi, Nigeria.

Isolation patterns	% dogs positive
Sa	2 (1.3)
Ec	2 (1.3)
Pm	1 (0.6)
Ef	2 (1.3)
Pam+Pa	3 (1.9)
Sa+Ec	21 (13.1)
Sa+Ec+Cr	32 (20.0)
Sa+Pm+Kp	14 (8.8)
Sa+Ec+Lm	16 (10.0)
Pm+Ea+Ef	5 (3.1)
Pm+Cr+Ef	10 (6.3)
Sa+Ec+Pm+Sc	13 (8.1)
Ec+Pm+Ea+Kp	11 (6.9)
Ec+Bc+Pa+Ea	13 (8.1)
Kp+Ec+Pm+Ea	15 (9.4)

Key: Ec = *Escherichia coli,* Sa = *Staphylococcus aureus,* Pm = *Proteus mirabilis,* Ea = *Enterobacter aerogenes,* Cr = *Corynebacterium renale,* Kp = *Klebsiella pneumoniae,* Ef = *Enterococcus faecalis,* Lm = *Listeria moncytogens,* Pa = *Pneumonas aerugnosa,* Sc = *Streptococcus cani,* Bc = *Bacillus cereus,* Pam = *Pasteurella multocida*

Other isolated bacteria, e.g. *Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis* and *Pasteurella multocida* could produce severe septicaemia, bronchopneumonia and pharyngitis in humans (Sanders & Sanders, 1997; Lyczack *et al.,*

2000; Songer & Post, 2005). *Corynebacterium renale, Enterobacter aerogenes* and *Streptococcus canis* are often associated with abscesses, nosocomial and urinary tract infections in man (Sanders & Sanders, 1997). Large number of bacterial isolation patterns recorded in this study suggests that dogs are significant reservoirs for multiple bacterial pathogens and diseases in man.

Our findings show that on average 3 out every 4 dogs in Makurdi harbour at least 1 zoonotic bacterial pathogen. The buccal cavities of the dogs are reservoirs of pathogenic bacteria that could cause diseases in humans through dog bites or saliva contamination of food and water. The data show that chances of multiple infections for humans would be high, with serious consequences. Therefore, proper care for dogs with regular medical attention, personal hygiene in homesteads and use of effective drugs to treat dog bite wounds or related infections are recommended among measures to prevent transmission of pathogens.

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