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Salmonella Typhimurium infection in diarrhoeic and non-diarrhoiec dogs in Ibadan, Nigeria

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ABSTRACT

The incidence of *Salmonella* in dogs was investigated to assess the risk of possible transmission of *Salmonella* from dogs to humans. *Salmonella* was isolated from 17 (3.7%) of 458 faecal samples collected from both diarrhoeic and non-diarrhoeic dogs. The infection rate was 3.2% (2 of 62) in a Nigerian local breed and 4.1% (15 of 396) in the Alsatian breed. All the isolates were serotyped as *Salmonella* Typhimurium. The antibiotic sensitivity pattern of all the *Salmonella* isolates was determined. They demonstrated a high susceptibility to ciprofloxacin (100%) and chloramphenicol (89.2%) but they were all (100%) resistant to erythromycin and Cloxacillin. Resistance was also exhibited to tetracycline (70.6%), ampicillin (47.1%), cefuroxime (52.9%), amoxicillin (35.3%), cotrimaxazole (76.5%), augumentin (52.9%), gentamicin (35.3%) and streptomycin (35.3%). Dogs that harbour *Salmonella* can serve as a source of *Salmonella* infection to their human companions. They can also disseminate the organism by contaminating the environment thereby exposing the general public and other animals to the risk of infection.

Key words: dogs, faeces, public health, *Salmonella* Typhimurium, antibiotic sensitivity

Introduction

Salmonella is the aetiological agent of both human and animal salmonellosis, a very common and widely spread enteric disease. It is a significant cause of acute and chronic diarrhoea and death in numerous animal species and in human beings (McGAVIN et al., 2001). Salmonellosis is therefore of significant importance both in animal production and in public health. Although there are *Salmonella* serovars that are strictly host-restricted (such as *Salmonella* Typhi in humans, *S.* Gallinarum and *S.* Pullorum in poultry, and *S.* Dublin in cattle), the majority of other *Salmonella* serovars can infect a wide host range. Most

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cases of salmonellosis in humans are food-borne (ANONYM., 2001). However, faeces of nearly all animal species may be a potential source of *Salmonella*; therefore, the zoonotic transmission of *Salmonella* is not limited to food animals alone. Pets, especially dogs that have close interaction with humans, may be responsible for *Salmonella* transmission.

Dogs generally seem to be resistant to *Salmonella* infection and most cases are latent and non-clinical (KOZAK et al., 2003). Infected dogs may remain carriers and faecal shedders and thus serve as sources of *Salmonella* for man and other animals (KOZAK et al., 2003). SANCHEZ et al. (2002) reported that up to 36% of healthy dogs carry *Salmonella* in their digestive tract and may shed the organism. However, clinical cases of salmonellosis have been reported in dogs which if severe can result in diarrhoea, vomiting, fever, depression, abortion and death (MORSE and DUNCAN, 1975).

In Nigeria, there is paucity of information on the role of dogs as a potential source of *Salmonella* infection to humans despite an increase in dog-keeping among the elite living in the metropolitan cities. This work therefore examines the carrier status of *Salmonella* in dogs, to determine their role as a possible source of *Salmonella* infection to humans. It also investigates the role of *Salmonella* as aetiological agent of diarrhoea in dogs.

Materials and methods

Sample collection. Rectal swabs were collected from both clinically diarrhoeic and non-diarrhoeic adult dogs of both sexes. Samples were obtained from dogs in dog-keeping households and from dogs attending four different Veterinary clinics located within the metropolitan city of Ibadan, Nigeria. A total of 458 rectal swabs were collected from two breeds of dogs (a Nigerian local breed and the Alsatian breed) between October 2005 and September 2006. Clinical history was obtained and documented for each of the dogs sampled. In household sampling, only one animal was sampled per household. A total of 62 Nigerian local breed (30 diarrhoeic and 32 non-diarrhoeic) and 396 Alsatian breed (96 diarrhoeic and 300 non-diarrhoeic) were sampled.

Bacteriological analysis. Each rectal swab was inoculated into selenite F broth and incubated aerobically at 37 °C for 24 hours. Subcultures were then made from each broth culture onto MacConkey agar (Oxoid®) and Xylose lysine deoxycholate (XLD) (Oxoid®) agar. The agar plates were incubated aerobically at 37 °C for 24 hours. Colourless non-lactose fermenting colonies on MacConkey agar and red colonies on XLD agar were identified and selected for further tests. Selected colonies were Gram stained and subjected to biochemical tests as described by BARROW and FELTHAM (1993). Isolates with characteristics consistent with those of *Salmonella* were serologically confirmed using *Salmonella* 'O' and 'H' polyvalent antisera (Laboratory Diagnostic Products Ltd., Middlesex, United Kingdom) by slide agglutination test. The somatic antigenic group of

positive isolate was determined by *Salmonella* 'O' grouping kit (Difco™) after which the serotype was determined by monospecific antiserum.

Antibiotic sensitivity testing. Susceptibility of isolates to selected antibiotics was carried out using the disk diffusion method on Mueller-Hinton Agar (Oxoid®) as recommended by ANONYMOUS (1999). Susceptibility to the following antibiotics was determined: tetracycline (10 μg), chloramphenicol (20 μg), ciprofloxacin (30 μg), ampicilin (25 μg), cefuroxime (30 μg), amoxicillin (25 μg), cotrimaxazole (25 μg), augmentin (30 μg), erythromycin (5 μg), cloxacillin (5 μg), streptomycin (10 μg) and gentamicin (10 μg).

Statistical analysis. Infection rates were expressed in percentages and proportions compared by Chi-square test (SNEDECOR and COCHRAN, 1989).

Results

Incidence of Salmonella in faeces. Out of a total of 458 samples examined, 17 (3.7%) were positive for *Salmonella*. All the *Salmonella* isolates were serologically identified as *Salmonella* Typhimurium. The incidence in diarrhoeic dogs was 4.0% (5 of 126 samples) and 3.6% (12 of 332 samples) in non-diarrhoeic dogs (Table 1). There was no significant difference ($p > 0.05$) in the incidence of *Salmonella* between diarrhoeic and non-diarrhoeic dogs as well as between the Alsatian breed and the Nigerian local breed.

Table 1. Incidence of *Salmonella* in diarrhoeic and non-diarrhoeic dogs in Ibadan, Nigeria

Nature of sample	Number sampled	Number positive (%)
Diarrhoeic faeces		
Nigerian local dogs	30	1 (3.3)
Alsatian	96	4 (4.2)
Total	126	5 (4.0)
Non-diarrhoeic faeces		
Nigerian local dogs	32	1 (3.3)
Alsatian	300	11 (3.7)
Total	332	12 (3.6)
Overall total	458	17 (3.7)

Table 2. Antibiotic susceptibility pattern of *Salmonella* isolated from diarrhoeic and non-diarrhoeic dogs in Ibadan, Nigeria

Antibiotic (concentration)	Number (%) sensitive	Number (%) resistant
Tetracycline (10 μg)	5 (29.4)	12 (70.6)
Chloramphenicol (20 μg)	15 (88.2)	2 (11.8)
Ciprofloxacin (30 μg)	17 (100.0)	0 (0.0)
Ampicillin(25 μg)	9 (52.9)	8 (47.1)
Cefuroxime (30 μg)	8 (47.1)	9 (52.9)
Amoxicillin (25 μg)	11 (64.7)	6 (35.3)
Cotrimaxazole (25 μg)	4 (23.5)	13 (76.5)
Augmentin (30 μg)	8 (47.1)	9 (52.9)
Erythromycin(5 μg)	0 (0.0)	17 (100.0)
Cloxacillin (5 μg)	0 (0.0)	17 (100.0)
Gentamicin (10 μg)	11 (64.7)	6 (35.3)
Streptomycin (10 μg)	11 (64.7)	6 (35.3)

Antibiotic susceptibility pattern of Salmonella isolates. High percentages of the isolates were susceptible to ciprofloxacin (100%) and chloramphenicol (88.2%). However, all isolates were resistant to erythromycin and cloxacillin. Isolates demonstrated a high degree of multiple antibiotic resistance (Table 2).

Discussion

This study revealed that both diarrhoeic and non-diarrhoeic dogs can harbour *Salmonella.* The presence of *Salmonella* in pet dogs makes them a potential source of infection to their human companions. Cases of dog to human transmission of *Salmonella* resulting in severe infection in the latter have been reported (MORSE and DUNCAN, 1975). Dog-keeping households should be aware of this fact. Dogs might acquire the infection from their food sources and subsequently pass the infection on to their human companions. Contaminations of the immediate, shared-environment and household utensils as well as direct transmission through handling are some of the ways humans can acquire *Salmonella* from dogs. Close intimacy between dogs and human could facilitate easy transmission of *Salmonella* between them. It is therefore imperative for dog owners to take adequate precautionary measures to forestall this possible transmission. Strict hygiene should be the rule guiding canine husbandry. Kennels should be kept clean and dogs should be washed regularly.

Although *Salmonella* was isolated from cases of diarrhoea in dogs, it cannot be concluded that the organism was the cause of the diarrhoea. Intestinal helminthes, viruses, other bacteria (like *Escherichia coli*) and even non-infectious agents can produce diarrhoea in dogs (ODUYE and OLAYEMI, 1977). It is therefore important to investigate properly the cause of diarrhoea before instituting therapy. This study did not search for other aetiological agents of diarrhoea in the cases examined, but only focused on the isolation of *Salmonella*. The most common form of salmonellosis in dogs is the sub-clinical carrier state in which apparently healthy dogs shed the organism in their faeces, thereby contaminating the environment (SANCHEZ et al., 2002). However, clinical salmonellosis may occur in young dogs, due in part to their immature immune system, and they are more likely to develop septicaemia (MORSE and DUNCAN, 1975; McGAVIN et al., 2001). In clinical cases of salmonellosis in dogs, morbidity can approach 100% in puppies and mortality close to 40% (McVEY et al., 2002). Only adult dogs were included in this study.

The result of this study is similar to that of SEEPERSADSINGH et al. (2004) which reported the prevalence of *Salmonella* spp. in non-diarrhoeic dogs to be 3.6%. It is however at variance with the findings of MORSE and DUNCAN, (1975) where 20% of the dog population was reportedly infected with *Salmonella*. All the *Salmonella* isolates in this study were identified as *Salmonella* Typhimurium but dogs can harbour many serovars of *Salmonella*. MORSE and DUNCAN (1975) isolated 53 *Salmonella* serovars from dogs while SEEPERSADSINGH et al. (2004) reported 28 different serovars of *Salmonella* in dogs. *Salmonella* Typhimurium is the serotype most commonly isolated from dogs (MORSE and DUNCAN, 1975). Human cases of Salmonellosis caused by *Salmonella* Typhimurium have been linked with likely contact with the faeces of infected dogs (ANONYMOUS). Dogs infected with *Salmonella* might have acquired the organism from their food or from materials ingested during scavenging. Scavengers exposed to many contaminated materials are likely to harbour more *Salmonella* serovars than non-scavengers kept under hygienic conditions. All dogs in this study were non-scavengers. JOFFE and SCHLESINGER (2002) isolated *Salmonella* from 80% of bone and raw food (BARF) diets and from 30% of the stool samples from dogs fed the diet. It was therefore suggested that dogs fed raw chicken may be a source of environmental contamination with *Salmonella.* Since dogs can acquire *Salmonella* from their food, especially poultry products, the food should be prepared in a way that will eliminate pathogens from the food. On no account should raw meat be fed to dogs. Hunting of lizards should be discouraged in dogs because reptiles are known to harbour *Salmonella* (KONEMAN et al., 1997). Straying and scavenging should also be prevented.

The multiple antibiotic resistance pattern observed among the *Salmonella* isolates in this study is worrisome. Indiscriminate use of antibiotics in animals could be responsible

for emergence of resistant strains of bacteria. The use of antibiotics should therefore be well regulated and instituted only when it is absolutely indicated. Chloramphenicol and ciprofloxacin could be useful in the treatment of the majority of cases of salmonellosis as shown by their effectiveness against a high percentage of the *Salmonella* isolates in this study.

Apparently healthy dogs could harbour *Salmonella* thereby serving as a source of human infection and a potential threat to public health. Regular epidemiological investigations may assist in monitoring the occurrence of salmonellosis and in developing strategies for its prevention. A better understanding of the interplay of factors that contribute to the incidence, distribution and establishment of the disease may be helpful in eliminating its survival in the environment thereby protecting and promoting public health.

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SAŽETAK

Istražena je učestalost pojave salmonela u pasa kako bi se procijenio rizik od mogućega njihova prijenosa na ljude. Salmonele su bile izdvojene iz 17 (3,7%) od 458 uzoraka izmeta prikupljenih od pasa s proljevom i bez proljeva. Stopa zaraženosti iznosila je 3,2% (2 od 62) u pasa lokalne nigerijske pasmine i 4,1% (15 od 396) u njemačkoga ovčara. Svi izolati bili su tipizirani kao *Salmonella* Typhimurium. Svima je bila određena osjetljivost prema antibioticima te je ustanovljeno da su bili osjetljivi na ciprofloksacin (100%) i kloramfenikol (89,2%), a otporni na eritromicin i kloksacilin (100%), tetraciklin (70,6%), ampicilin (47,1%), cefuroksim (52,9%), amoksicilin (35,3%), kotrimaksazol (76,5%), augumentin (52,9%), gentamicin (35,3%) i streptomicin (35,3%). Psi kliconoše salmonela mogu biti izvor zaraze za ljude. Oni mogu proširiti uzročnika onečišćenjem okoliša i time predstavljati opasnost za javno zdravstvo i za druge životinje.

Ključne riječi: pas, izmet, javno zdravstvo, *Salmonella* Typhimurium, osjetljivost na antibiotike