Potential Environmental Health Hazards from the Careless Discard of Canine Faeces

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DOI: http://dx.doi.org/10.13005/bbra/1758

(Received: 01 May 2015; accepted: 11 June 2015)

Escherichia coli and Salmonella enterica were isolated from four sites contaminated with dog faeces, while no isolates were obtained from a fifth location, an uncontaminated site. The number of bacteria isolated varied from site to site with E. coli being isolated in the highest numbers. Bacteria which are potentially pathogenic were isolated from dog faeces left at ambient conditions in plastic bags. Numbers of E. coli and S. enterica increased significantly in the dog faeces, when they were left in sealed plastic bags, over a 28 incubation period. In conclusion, the results presented here show that dog faeces represent an important means by which bacterial pathogens can be transferred from dogs to humans via the soil. The reprehensible recent habit, amongst some dog owners, of leaving faeces in sealed plastic bags is likely to greatly exacerbate this problem.

Key words: public-health problems, contaminated soil, viable pathogens, Canine Faeces, United Kingdom.

The number of dogs in the UK and elsewhere in the world has increased dramatically in recent times especially in cities, and their waste represents a considerable source of pollution in relation to humans and the environment. Dog faeces are known to carry large and varied microbial and parasite populations which can cause diseases and public-health problems. Dog waste is linked to more than 60 zoonotic diseases and it thereby represents a serious public-health problem. Irresponsibility on the part of dog owners in relation to the disposal of the dog waste provides a potential source of pathogens in public places such as playgrounds, parks, gardens, public squares and playsandpits, the risks to young children being particularly obvious. Children may, by accident consume contaminated soil or grass, or touch their mouths or eyes with hands contaminated with dog faeces, or otherwise handle bags left hanging outdoors on trees branches and in parks, people using hand activated wheelchairs and active sport players may also be at risk. Viable pathogens present in dried canine faeces can also be spread by the wind and are carried into dwellings and workplaces on soiled shoes.

The aim of the work reported here was to study a) the type and number of bacteria which contaminate dog faeces deposited in a local grassed public park, a problem which is likely to be a risk to the health of young children and park visitors, b) the bacteriological consequences of the extremely undesirable practice of some dog owners, namely discarding dog faeces in plastic bags, a habit which contributes to a potentially bigger problem than does the deposition of faeces in the local environment.
MATERIALS AND METHODS

Samples collection from public parks

The following protocol was used to determine the presence of *E. coli* and *Salmonella enterica* and the “total count” of heterotrophic bacteria (as determined using Plate Count Agar) in soil samples collected from a public park in Sheffield UK (a grassed area of playing field behind the former Lodge Moor Hospital). Four samples of soil were taken (depth 0 - 3 cm) from under surface grassed soil contaminated with dog faeces (samples were taken directly from soil which had long exposure to faeces and not from under fresh material); the last sample was taken from an area not contaminated with faeces, i.e. an uncontaminated control. Samples (1g) were suspended in (9 ml) autoclave-sterilised water in sterile 15 ml tubes and shaken at 70 rpm for 30 min. A serial dilution was performed, then dilutions from 10³ to 10⁶ were taken and (100 ml) of this suspension was then spread onto the surface of selective media for *E. coli* and *Salmonella* Spp. XLT4 and Plate Count Agar; the plates were then incubated in triplicate at 37°C overnight. Presumptive isolation was based on the use of selective media such as *E. coli* and XLT4 *Salmonella* Spp. agar media, followed by use of the Gram stain. In addition, the 16s rRNA gene dependant technique was used; DNA being extracted according to the Anachem Key prep-Bacterial DNA extraction kit; bacterial 16SrRNA gene was then amplified and sequenced.

Effect of incubation of dog faeces in plastic bags left under ambient outside conditions

An undesirable and unhygienic habit has recently developed amongst some dog owners in Sheffield (and presumably other parts of the UK and elsewhere in the world) of picking up their dog waste, transferring it to polythene bags and then leaving the filled bags in the environment as litter, rather than depositing them in dedicated dog-waste containers.

In order to determine the impact of this practise, fresh dog faeces were collected from dog bins from Weston Park. Samples were placed in black plastic bags and left exposed to ambient weather conditions on the roof of the Firth Court University building from the middle of May until the middle of June, 2012 (i.e. the relatively warm (15-20°C) spring to early summer months). 

RESULTS AND DISCUSSION

*Escherichia coli* and *Salmonella enterica* were isolated from difference public sites and Table 1. While no isolates were obtained from the fifth location which was uncontaminated with dog faeces. The number of bacteria varied from site to site, with *E. coli* being isolated in the highest numbers. The isolation of these two pathogenic bacteria from playing fields which are frequented by children is obviously a major public health concern since pathogenic bacteria could be picked up from these soils, either on shoes, or by transfer from contaminated skin to the ears, eyes or mouths of infected children (and of course, people in general) from where they could cause disease.

Table 1. Numbers (1x10⁶) of *Escherichia coli* and *Salmonella enterica* in soils in areas public contaminated with dog faeces

<table>
<thead>
<tr>
<th>Park Location</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em></td>
<td>14.2</td>
<td>21.4</td>
<td>40.2</td>
<td>36.9</td>
<td>1.3</td>
</tr>
<tr>
<td><em>Salmonella enterica</em></td>
<td>2.9</td>
<td>4.7</td>
<td>8.2</td>
<td>9.8</td>
<td>0</td>
</tr>
</tbody>
</table>

All increase are significant at p=0.05

Several studies have concluded that there is a high potential risk to human health of contaminated soil and animal faeces, and direct or indirect contact with dog faeces has been implicated in several human infections with *E. coli* and *Salmonella enterica*. The risk of the transfer of pathogenic bacteria to young children from dog faeces in public areas—notably gardens, parks and playing-field probably is critical because people do not always know that they have been exposed to contamination and can touch their eyes or mouth will faeces without realising it. Contaminated garden and park soils could possibly influence the health of a large number of adults and children and it is therefore important that research and development is carried out on risk assessment and also to develop measures to mitigate such contamination.
Effect on bacterial numbers of leaving dog faeces in plastic bags

An undesirable and unhygienic habit has recently developed amongst some dog owners in Sheffield (and presumably other parts of the UK and elsewhere) of picking up their dog waste, transferring it to polythene bags and then leaving the filled bags in the environment as litter, rather than depositing them in dedicated dog-waste containers Fig.1.

Under such circumstances, dog faeces represent a potential source for spreading pathogenic bacteria such as *E. coli* and *Salmonella enterica*, bacteria which represent an obvious risk to human health. Bacterial pathogens from dog faeces could infect young children and others playing, or using, parks, etc (including of course dog owners). Many dog owners act responsibly by picking up waste from their dogs, placing this in plastic bags and then putting these bags into special, local council run dog-waste containers, from where they are transported and incinerated.

Unfortunately there is another less-welcomed trend, namely the discarding of such bags filled with dog faeces into the local environment. The results given here, show that this practise potentially increases the problem of dog faeces because the sealed polythene bags provide and environment where pathogenic bacteria (and presumably other pathogens, like viruses) can rapidly increase. Such an increase in pathogen numbers was seen during a relatively cool UK summer and could be much greater where summer temperatures are higher. In addition, there exists the possibility that the environment inside the bags could become anaerobic and select for, or otherwise encourage the growth of anaerobic, pathogenic bacteria, such as a species of *Clostridium*; clearly this habit should be discouraged. In fact it would be better to encourage dog owners to leave dog faeces in the open air, where they are able to degrade naturally (with pathogens being out-competed by saprophytic microbes) than to allow them to discard the faeces in sealed bags which, when broken (by for example a child sliding on them) could release an enhanced, and potentially more dangerous, pathogen load.

The survival of bacteria in dog faeces under environmental conditions has been studied by, amongst others7, who showed that *E. coli* in cattle can survive for 42 to 49 days at 37°C, for 49 to 56 days at 22°C, and for 63 to 70 days at 5°C7. Another study of *E. coli* in manure revealed that the pathogen may survive for up to 47 days, 4 months, and 21 months in aerated and non-aerated bovine manure, respectively6. Himathongkham and Riemann recommended that cow manure should be left for 105 days at 4°C or 45 days at 37°C in order to achieve a 5-log reduction of both *E. coli* and *Salmonella enterica*

Potentially pathogenic bacteria were isolated from dog faeces left at ambient conditions in plastic bags. Tables 1, 2 show that numbers of *E. coli* and *S. enterica* increased significantly in the dog faeces, when they were left in sealed plastic bags, over the 28 incubation period.

It would have been interesting to continue the exposure period for longer than the one month period used here, since numbers of pathogenic bacteria are likely to have increased even further.

**Table 2.** Numbers (1x10^8) of *Escherichia coli* and *Salmonella enterica* developing in sealed polythene bags

<table>
<thead>
<tr>
<th>Days</th>
<th>0</th>
<th>7</th>
<th>14</th>
<th>21</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em></td>
<td>0.3</td>
<td>0.5</td>
<td>5.6</td>
<td>9.2</td>
<td>11.6</td>
</tr>
<tr>
<td><em>Salmonella enterica</em></td>
<td>0.2</td>
<td>0.6</td>
<td>1.6</td>
<td>2.4</td>
<td>32.0</td>
</tr>
</tbody>
</table>

All increases are significant at p=0.05
E. coli and Salmonella enterica serovar. These results indicate that E. coli can survive for an extended period in bovine faeces and that bovine faeces are a potential vehicle for transmitting the pathogen to cattle, food, and the environment (Jiang et al., 2015). Pathogenic bacteria such as E. coli and Salmonella spp. can survive in animals manure or soil for up to 70 days under 14°F. A study by Kudva et al., reported that E. coli survived in the manure for 21 months, and the attentiveness of bacteria recovered ranged from <10² to 10⁶ CFU/g at different times over the course of the experiment.

CONCLUSION

In conclusion, dog faeces represent an important means of transfer of bacterial pathogens from dogs to humans via the soil. The reprehensible recent habit, amongst some dog owners of leaving dog faeces in sealed plastic bags is likely to greatly exacerbate this problem.

ACKNOWLEDGEMENTS

Thanks are extended to staff membranes of Biological Science Department at king Abdulaziz University in Saudi Arabia; I also thank staff membranes of the Department of Molecular Biology and Biotechnology (Lab G10) at Sheffield University in United Kingdom.

REFERENCES