The role of rodents as carriers of disease on UK farms: a preliminary investigation

Stuart, A.M.[1], Prescott, C.V.[1], MacIntyre, S.[1], Sethar, A.[1], Neuman, B.W.[1], McCarthy, N.D.[2], Wimalarathna, H.[2], Maiden, M.C.J.[2]
[1]School of Biological Sciences, The University of Reading, Berkshire, RG6 6AS, UK, a.stuart@reading.ac.uk
[2]Department of Zoology, Peter Medawar Building, University of Oxford, Oxford, OX1 3SY, UK

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Abstract

In the UK, *Campylobacter* spp. and Lymphocytic Choriomeningitis Virus (LCMV), an Old World arenavirus, cause two zoonoses of concern that may be transmissible from rodents to humans and livestock. The aims of this preliminary investigation were to examine the occurrence of *Campylobacter* spp. and LCMV in Norway rats *Rattus norvegicus* on UK farms and to identify and characterise the Sequence Types of the *Campylobacter* isolates. Samples were collected from wild Norway rats and fresh Norway rat faeces. Multi Locus Sequence Typing (MLST) was performed on *C.* spp. isolates and samples were tested for arenavirus RNA by RT-PCR. Six *C.* spp. isolates were identified. One isolate was *C. lari* and five isolates were *C. jejuni*. Following MSLT profiling, three unique *C. jejuni* sequence types were identified. Two of which are novel and the third is typically associated with livestock and human infection. Nine positive results for LCMV were obtained giving an overall prevalence of 25% across four sites. This is higher than previously reported for this species.

Keywords: arenavirus, *Campylobacter*, disease, Lymphocytic Choriomeningitis, *Rattus norvegicus*, rodents

Introduction

Rodents are known to be reservoirs of a large number of pathogens, many of which are transmitted to humans and their domesticated animals through contamination of stored produce and animal feed with rodent urine and faeces (Gratz, 1994). Two such zoonoses that may be transmissible from rodents to humans and livestock are *Campylobacter* spp. and Lymphocytic Choriomeningitis Virus (LCMV).

C. spp. is a common cause of gastro-intestinal infection in humans in the UK, with 57,772 cases reported for England and Wales in 2009. Transmission to humans is believed to be primarily through undercooked meat, from contaminated water, and through contact with pets. Ninety-seven percent of sporadic cases have been attributed to farm animals, and in particular the meat and poultry industry. Because Norway rats (*Rattus norvegicus*) commonly occur around UK farms and have previously been identified to carry *Campylobacter* strains (Meerburg et al., 2006), it is considered that they may be a potential source of infection to livestock.

Lymphocytic Choriomeningitis Virus (LCMV) is an arenavirus that is distributed worldwide, and is carried by rodents. It is carried as a life-long persistent infection (passing from mother to offspring), and is asymptomatic in persistently infected rodents. It is believed to be contracted by humans through breathing air that is contaminated with rodent excrements. Infections may therefore occur wherever infected rodent hosts of the virus are found. Little is known about the prevalence of this virus in wild rodents in the UK. However, recently this virus has been reported in a range of wild rodent species, with House mice (*Mus musculus*) more likely to be infected than other species (Blasdell et al., 2008).

The aims of this preliminary investigation were to examine the occurrence of *C.*spp. and LCMV in Norway rats on UK farms and to identify and characterize the strains of the *C.* spp. isolates.

Methods

For *Campylobacter* analysis, samples were collected from four rural livestock farm sites. Initial samples were obtained by extracting intestinal content from freshly killed wild Norway rats into saline water; subsequently, samples were obtained from fresh Norway rat feces collected into peptone water.

The extracts were cultured within 24 h of collection in Bolton enrichment broth at 42°C within a microaerophilic environment and *Campylobacter* isolates were obtained using modified charcoal

cefoperazone deoxycholate agar plates (mCCDA; Oxoid). Multi Locus Sequence Typing (MLST) was then performed on *C.* spp. isolates using the method of Dingle et al. (2001).

For arenavirus analysis, 35 Norway rat samples were collected from four livestock farm sites. Liver and spleen tissue was collected into Trizol reagent from rats that had previously been stored at -21ºC. Samples were tested for arenavirus RNA by RT-PCR using the methods described by Blasdell et al. (2008); RNA was extracted by using QIAamp viral RNA mini-kit (QIAGEN, Crawley, UK), first strand cDNA synthesis was carried out using primers complementary to the conserved genomic termini, and PCR was conducted using degenerate primers designed to bind conserved regions of all known arenavirus sequences.

Results

A positive result for *C.*spp. was obtained from the only site where samples were collected from intestinal content, and positive results for *C.* spp. were obtained from three of four sites where samples were collected as fresh droppings. From these, six *C.* spp. isolates were identified. One isolate was *C. lari*, for which a partial MLST profile was obtained, and five isolates were *C. jejuni*, for which full MLST profiles were obtained. Following MLST profiling, three unique *C. jejuni* sequence types (STs) were identified. Two of these strains are novel, and have been designated ST 5129 and ST 5130. The third, ST 586, is a known ST, typically associated with chicken, cattle and human infection.

Nine positive results for LCMV were obtained (3/10, 3/10, 2/10, 1/5), giving an overall prevalence of 25% across all four sites. Many of the rats in this study also had enlarged spleens, another common sign of persistent LCMV infection.

Discussion

The presence of *C. jejuni* in wild rats from UK farms correlates with previous findings in Denmark (Jensen et al., 2006) and the Netherlands (Meerburg et al., 2006). Through MLST analysis we were able to identify that the *C. jejuni* isolates included one strain that is known to infect humans and livestock and two that are usually rather ecologically separate. Rats can thus harbor a relatively wide range of *Campylobacter* strains. However, from these data it is not possible to establish whether the novel *Campylobacter* strains carried by rats are host-specific, or whether the rats were colonized by *Campylobacter* strains from a variety of sources. Further research will be conducted to clarify whether rats play a role in the transmission of *C.* spp. in the farm environment.

The high prevalence of LCMV in wild Norway rats found in this study was unexpected and is higher than previously reported for this species (Blasdell et al., 2008). With such a high incidence in wild Norway rats, as well as in wild House mice (Blasdell et al., 2008), the chance of human infection must be significant. However, because not all people exposed to the virus become ill and with symptoms similar to those of influenza, except in severe cases when it can cause meningitis or encephalitis, it is unsurprising that the disease has historically been under-reported. Further studies are needed to thoroughly investigate the prevalence levels of LCMV in wild rodents in both urban and rural areas so as to identify the risk posed to humans.

References

Blasdell KR, Becker SD, Hurst J, Begon M, Bennett M 2008 Host range and genetic diversity of arenaviruses in rodents, United Kingdom. Emerging Infectious Diseases 14: 1455-1458

Dingle KE, Colles FM, Wareing DRA, Ure R, Fox AJ, Bolton FE, Bootsma HJ, Willems RJL, Urwin R, Maiden MCJ 2001 Multilocus sequence typing system for *Campylobacter jejuni*. Journal of Clinical Microbiology 39: 14-23

Gratz NG 1994 Rodents as carriers of disease. In: AP Buckle and RH Smith (eds.), Rodent pests and their control. p. 85-108, CAB International, Cambridge, UK

Jensen, AN, Dalsgaard, Baggesen ADL, Nielsen EM 2006 The occurrence and characterization of *Campylobacter jejuni* and *C. coli* in organic pigs and their outdoor environment. Veterinary Microbiology 116: 96-105

Meerburg BG, Jacobs-Reitsma WF, Wagenaar JA, Kijlstra A 2006 Presence of *Salmonella* and *Campylobacter* spp. in wild small mammals on organic farms. Applied and Environmental Microbiology 72: 960-962