

Short Communication

Seroprevalence of *Coxiella burnetii* in cattle and farm-raised deer in Korea

Yangho Jang¹, Hyobi Kim¹, In Heo², Youngjin Park², Sangmo Kim², Myoungheon Lee³ and Nonghoon Choe^{1*}

¹College of Veterinary Medicine, Konkuk University, Hwayang-1dong, Gwangjingu, Seoul, Korea.

²Chungnam Veterinary Research Institute, Songgongli 52-1, Hongseonggun, Chungnam, Korea.

³Animal Plant and Fisheries Quarantine and Inspection Agency, Anyang, Gyeonggi, Korea.

Accepted 24 August, 2011

Q fever, caused by *Coxiella burnetii*, is a worldwide zoonosis that affects not wild animals but domestic animals throughout the world, except in New Zealand. Domestic ruminants are considered to be a major infection source of Q fever in humans. However, few studies on the prevalence of Q fever in humans or animals in Korea have been conducted. Thus, the aim of this study was to investigate the seroprevalence of Q fever in meat cattle and deer. Blood samples were collected from 1634 ruminants: 1000 cattle, 604 wapiti, and 30 sika deer. The blood samples were analyzed with CHEKIT Q fever ELISA kits. Thirteen of 1000 (1.3%) cattle, 10 of 604 (about 1.7%) wapiti, and 0 of 30 (0%) sika deer had antibodies against *C. burnetii*. The prevalence of Q fever in this study was quite low. However, the public health implications of these findings are important, because they indicate that seropositive animals that are asymptomatic may be shedding *C. burnetii* consistently. This condition could increase the risk of Q fever infection in Korea, especially because many Koreans habitually consume raw meat and drink deer blood.

Key words: Q fever, *Coxiella burnetii*, cattle, deer.

INTRODUCTION

Coxiella burnetii, the causative agent of Q fever, is a worldwide zoonotic pathogen (Guatteo et al., 2011). A variety of hosts, including wild and domestic animals and arthropods, can act as reservoirs of *C. burnetii*. Infected animals can secrete organisms consistently in urine, feces, and birth fluids. Moreover, these bacteria are able to survive environmental stresses such as heat, dry conditions, and even disinfectants (Welsh et al., 1958; Franz et al., 1997). *C. burnetii* is transmitted to humans mainly through the inhalation of aerosols shed by infected animals. However, humans can also become infected by consuming non-pasteurized or contaminated dairy products containing *C. burnetii* shed by infected livestock. Thus, domestic ruminants have been identified as the

primary reservoir of human Q fever (Tissot-Dupont et al., 1999; 2004; Kennerman et al., 2010).

Most epidemiological studies of human Q fever have shown that animals are the major source of human infection. A review of 69 publications on the prevalence of Q fever in animals found that 20% of the infections were in cattle and 15% were in sheep and goats (Guatteo et al., 2011). A 2006 epidemiological study of livestock in Korea showed that 25.6% of dairy cattle, which had no clinical history of reproductive disorders, were seropositive for *C. burnetii* using an indirect microimmunofluorescence antibody assay (Kim et al., 2006). A review of national data from the Korea Center of Disease Control showed that 51 individual cases of Q fever were reported between 2006 and 2009 in patients examined in a hospital who had clinical symptoms of Q fever. Seven of these patients had livestock-related jobs (e.g., livestock handling and abattoir- and quarantine-related jobs). However, no epidemiological relation was found between

*Corresponding author. E-mail: nojamaji@hanmail.net. Tel: +82-02-4503709. Fax: +82-02-4543709.

occupation and Q fever occurrence in the remaining cases (KCDC, 2009a). Another study of Q fever prevalence in deer-raisers indicated that 7.9% ($n = 41$) of deer raisers ($n = 516$) were seropositive for *C. burnetii* (KCDC, 2009b).

Despite the presence of Q fever in Korea, little is known about its current incidence and geographic distribution in either humans or animals. In addition, Many Koreans have the unusual dietary habit of drinking deer blood (*Cervus canadensis* and *Cervus nippon*) and eating raw beef, because of the traditional belief that the blood of deer improves stamina. In order to identify a relationship between dietary habits and human Q fever, we need more information about Q fever prevalence in diverse hosts. The objective of this study was to estimate the seroprevalence of Q fever in cattle and deer in Chungnam Province, Korea.

MATERIALS AND METHODS

Sample collection

Serum samples were collected from 200 cattle herds ($n = 1000$) and 15 deer herds (604 wapiti and 30 sika deer) from February to September 2010. Blood samples were collected from the jugular vein into sterile 10 ml anticoagulant-free Vacutainers (Becton Dickinson, Franklin Lakes, NJ, USA). The samples were transported to the laboratory on ice and centrifuged at 1,500 μg for 10 min at room temperature. Serum was separated from the samples and stored at -20°C until analysis by ELISA.

ELISA assay

Processed sera samples were analyzed for specific antibodies of *C. burnetii* with the ELISA CHEKIT Q-fever test (Idexx Laboratories, Broomfield, CO, USA). The ELISA test was performed according to the manufacturer's instructions. Briefly, sera samples were prepared at a 1:400 dilution, and specific antibodies consisting of Phase I and II, *C. burnetii* were measured using a peroxidase-labeled anti-ruminant immunoglobulin G conjugate. The results are expressed as a percentage of the optical density (%OD) reading of the test sample, which was calculated as follows: $\%OD = 100 \times (S - N)/(P - N)$, where S , N , and P are the OD values of the test sample and the negative and positive controls, respectively. On the basis of the ELISA, sera were considered to be negative for *C. burnetii* if the %OD was ≤ 30 , dubious if %OD was between 30 and 40, and positive if %OD was > 40 (Rousset et al., 2007; Sakhaee and Khalili, 2010).

RESULTS AND DISCUSSION

A total of 13 of the 1000 cattle samples (873 from females and 127 from males) had antibodies against *C. burnetii*: 11 from females with a mean age (\pm SD) of 35.7 (± 15.3) months and 2 from males younger than 20 months. Six of the 1000 samples (4 from females and 2 from males) were classified as "dubious."

A total of 604 wapiti samples (129 from females and 475 from males) were tested: 10 were seropositive, 3

from females older than 4 years and 7 were from males older than 5 years. All of the 30 sika deer samples (9 from females and 21 from males) were seronegative (Table 1). In humans, Q fever infection can lead to severe complications, such as atypical pneumonia and granulomatous hepatitis and particularly endocarditis in cases of chronic Q fever infection. However, more than 60% of human Q fever cases are asymptomatic (Franz et al., 1997). As mentioned in the introduction, the primary source of human Q fever is infected domestic ruminants, which shed *C. burnetii* through parturition discharge, feces, urine, vaginal discharge or milk. Many Koreans drink blood from the antlers of deer and ingest the raw meat of cattle and deer. These extraordinary eating habits could increase the risk of infection with *C. burnetii*. However, little information is available on the prevalence of Q fever in several host species in Korea. To our knowledge, this is the first study to report on the prevalence of *C. burnetii* in deer and meat cattle in Korea.

In the current study, the prevalence of *C. burnetii* in cattle was quite low (13 of 1000 samples, or 1.3%, were seropositive). Previous studies of the prevalence of *C. burnetii* in domestic ruminants have shown a significantly lower prevalence in cattle than in goats and sheep (Cekani et al., 2008; McQuiston and Childs, 2002). This finding might be explained by differences in the main shedding routes of *C. burnetii* in each species. Goats shed the bacteria mainly in milk and in abortion discharge, and ewes shed the bacteria mainly during abortion, in the feces, and in vaginal mucus. In contrast, cows with Q fever are generally asymptomatic and shed the bacteria primarily in milk (Rodolakis et al., 2007). In Korea, cattle raising practices minimize the transmission of infection within herds, because calves are often fed milk replacers (except for colostrums) and are maintained within fences, which reduce the exposure to ectoparasites.

However, 11 of the seropositive samples were from females of reproductive age (older than 27 months). Although milk is considered the major shedding route of *C. burnetii* in cattle, epidemiologic studies indicate that Q fever has occurred in farmers, veterinarians, and slaughterhouse workers who have contact with domestic animals. Thus, asymptomatic cows can be a source of Q fever infection in humans. The dubious results from two breeding bulls (aged 101 and 92 months) suggest the possibility of sexual transmission of *C. burnetii* between cattle (Kruszewska and Tylewska-Wierzbanska, 1997).

Approximately 1.7% of the wapiti samples were seropositive for Q fever antibodies. Because of very scarce information on the prevalence of Q fever in farmed deer, it is difficult to compare the results in this study. Several studies of Q fever infection in wild animals including wild ruminants, birds, and rodents have reported a high prevalence of *C. burnetii* in wildlife (Dorko et al., 2009; Ruiz-Fons et al., 2008; Astobiza et al., 2011). Unlike wild animals, deer raised in fenced estates are less susceptible to tick infestation and contact with other

Table 1. Seroprevalence of *C. burnetii* in cattle and deer.

Animal species	No. of tested animals		No. of seropositive animals	
	Female	Male	Female	Male
Cattle (<i>Hanwoo, Holstein</i>)	873	127	11	2
Wapiti (<i>Cervus Canadensis</i>)	129	475	3	7
Sika deer (<i>Cervus Nippon</i>)	9	21	0	0

wild animals. In contrast, such controlled farming conditions can increase the risk of *C. burnetii* infection between animals because of close contact (Acevedo et al., 2007).

No epidemiologic data on the prevalence of Q fever infection in Koreans who ingest deer blood, raw meat, and milk are available. However, 7 of the 10 seropositive blood samples in the current study were from deer raised for antler blood. Thus, farm-raised deer may be a significant source of Q fever infection in Korea.

One limitation of this study was that the blood samples were collected in only one Korean Province. Thus, the sampling area should be extended to the whole nation in future studies. In addition, future studies should focus on the specific shedding routes of *C. burnetii* in deer and cattle and on the prevalence of Q fever in animal breeders and in persons who ingest raw meat and deer blood.

ACKNOWLEDGEMENT

This paper was supported by Konkuk University in 2011.

REFERENCES

- Acevedo P, Vicente J, Höfle U, Cassinello J, Ruiz-Fons F, Gortázar C (2007). Estimation of European wild boar relative abundance and aggregation: A novel method in epidemiological risk assessment. *Epidemiol. Infect.*, 135: 519-527.
- Astobiza I, Barral M, Ruiz-Fons F, Barandika JF, Gerrikagoitia X, Hurtado A, García-Pérez AL (2011). Molecular investigation of the occurrence of *Coxiella burnetii* in wildlife and ticks in an endemic area. *Vet. Microbiol.*, 147: 190-194.
- Cekani M, Papa A, Kora M, Velo E, Berxholi K (2008). Report of a serological study of *Coxiella burnetii* in domestic animals in Albania. *Vet. J.*, 175: 276-278.
- Dorko E, Rimárová K, Pilipčinec E, Trávníček M (2009). Prevalence of *Coxiella burnetii* antibodies in wild ruminants. *Ann. Agric. Environ. Med.*, 16: 321-324.
- Franz DR, Jahrling PB, Friedlander AM, McClain DJ, Hoover DL, Bryne WR (1997). Clinical recognition and management of patients exposed to biological warfare agents. *JAMA*, 278: 399-411.
- Guatteo R, Seegers H, Taurel AF, Joly A, Beaudeau F (2011). Prevalence of *Coxiella burnetii* infection in domestic ruminants: A critical review. *Vet. Microbiol.*, 149: 1-16.
- Kennerman E, Rousser E, Gölcü E, Dufour P (2010). Seroprevalence of Q fever (coxiellosis) in sheep from the southern Marmara region, Turkey. *Comp. Immunol. Microbiol. Infect. Dis.*, 33: 37-45.
- Kim WJ, Hahn TW, Kim DY, Lee MG, Jung KS, Ogawa M, Kishimoto T, Lee ME, Lee SJ (2006). Seroprevalence of *Coxiella burnetii* infection in dairy cattle and non-symptomatic people for routine health screening in Korea. *J. Korean Med. Sci.*, 21: 823-826.
- Korean Center for Disease and Control (2009a). Communicable diseases surveillance year book, pp. 231-233 (in Korean).
- Korean Center for Disease and Control (2009b). A survey on the status of Q fever and Lyme disease in deer-raisers, pp. 1-5 (in Korean).
- Kruszewska D, Tylewska-Wierzbanowska S (1997). Isolation of *Coxiella burnetii* from bull semen. *Res. Vet. Sci.*, 62: 299-300.
- McQuiston JH, Childs JE (2002). Q fever in humans and animals in the United States. *Vecto. Borne Zoonotic Dis.*, 2: 179-191.
- Rodolakis A, Berri M, Hécharde C, Caudron C, Souriau A, Bodier CC, Blanchard B, Camuset P, Devillechaise P, Natorp JC, Vadet JP, Arricau-Bouvery N (2007). Comparison of *Coxiella burnetii* shedding in milk of dairy bovine, caprine, and ovine herds. *J. Dairy Sci.*, 90: 5352-5360.
- Rousset E, Durand B, Berri M, Dufour P, Prigent M, Russo P, Delcroix T, Touratier A, Rodolakis A, Aubert M (2007). Comparative diagnostic potential of three serological tests for abortive Q fever in goat herds. *Vet. Microbiol.*, 124: 286-297.
- Ruiz-Fons F, Rodríguez O, Torina A, Naranjo V, Gortázar C, de la Fuente J (2008). Prevalence of *Coxiella burnetii* infection in wild and farmed ungulates. *Vet. Microbiol.*, 126: 282-286.
- Sakhaee E, Khalili M (2010). The first serologic study of Q fever in sheep in Iran. *Trop. Anim. Health Prod.*, 42: 1561-1564.
- Tissot-Dupont H, Torres S, Nezri M, Raoult D (1999). Hyperendemic focus of Q fever related to sheep and wind. *Am. J. Epidemiol.*, 150: 67-74.
- Tissot-Dupont H, Amadei MA, Nezri M., Raoult D (2004). Wind in November. Q fever in December. *Emerg. Infect. Dis.*, 10: 1264-1269.
- Welsh HH, Lennette EH, Abinanti FR, Winn JF (1958). Air-borne transmission of Q fever: The role of parturition in the generation of infective aerosols. *Ann. NY Acad. Sci.*, 70: 528-540.