

Seroprevalence of antibodies to *Neospora caninum* in dogs and raccoon dogs in Korea

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Abstract: *Neospora caninum* is an important cause of abortion in cattle, and dogs are its only known definitive host. Its seroprevalence among domestic urban and rural dogs and feral raccoon dogs (*Nyctereutes procyonoides koreensis*) in Korea was studied by indirect fluorescent antibody test (IFAT) and by the neospora agglutination test (NAT), respectively. Antibodies to *N. caninum* were found in 8.3% of urban dogs and in 21.6% of dogs at dairy farms. Antibody titers ranged from 1:50 to 1:400. Antibodies to *N. caninum* were found in six (23%) of 26 raccoon dogs. However, the potential role of raccoon dogs as a source of horizontal transmission of bovine neosporosis needs further investigation. The results of this study suggest that there is a close relationship between *N. caninum* infection among dairy farm dogs and cattle in Korea. This study reports for the first time upon the seroprevalence of *N. caninum* infection in raccoon dogs in Korea.

Key words: *Neospora caninum*, Dogs, raccoon dog (*Nyctereutes procyonoides koreensis*)

Neospora caninum is now recognized as one of the most important causes of bovine abortion in many countries (Dubey, 2003). Bovine neosporosis has also been reported in Korea (Kim et al., 1997; Hur et al., 1998); the parasite has been isolated from the tissues of an aborted bovine fetus and congenitally infected calf (Kim et al., 2000). A nation-wide survey also revealed that approximately 21.1% of bovine abortions in Korea are caused by *N. caninum* (Kim et al., 2002). Both vertical (transfer of the parasite from a dam to the fetus) and horizontal (ingestion of the

oocysts shed by a definite host) transmissions of *N. caninum* occur in cattle, and the domestic dog is the only known definitive host (McAllister et al., 1998; Basso et al., 2001b). The precise route of *N. caninum* transmission to dogs is not yet fully understood, and possibility that other mammals act as natural hosts has not been explored. Relatively few studies on the prevalence of *N. caninum* antibodies in wild animal populations have been reported. *N. caninum* antibody has been found in coyotes, foxes, dingoes, and raccoons (Dubey, 2003). The present study was undertaken to determine the prevalence of antibodies to *N. caninum* in dogs (urban and rural) and in raccoon dogs (*Nyctereutes procyonoides koreensis*) in Korea.

Serum samples were obtained from 340 (289 urban

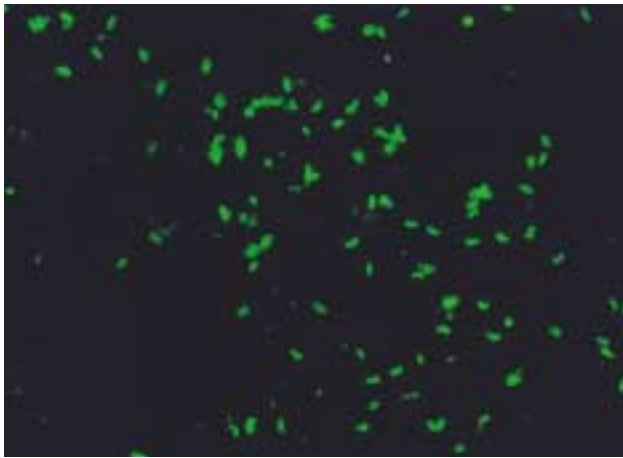
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Table 1. Prevalence of antibodies to *Neospora caninum* in dogs from urban and rural areas in Korea

Dog type	No. tested	No. Positive (%)	Antibody titers				
			50	100	200	400	800
Urban	289	24 (8.3)	15	5	3	1	0
Rural	51	11 (21.6)	6	2	2	1	0

**Fig. 1.** Note positive titer with complete peripheral immunofluorescence of canine sera on IFAT (X 40).

and 51 rural) domestic dogs and 26 Korean raccoon dogs (*Nyctereutes procyonoides koreensis*). The urban dogs were from local veterinary hospitals, and were 2 to 7 years old, with a mean age of 5 years. Serum samples from 51 dogs kept at dairy farms, which had experienced bovine neosporosis, were also collected. The raccoon dogs were collected as a part of national rabies surveillance project.

Sera from domestic dogs were examined by indirect fluorescent antibody test (IFAT). IFAT was performed on *N. caninum* as described by Hur et al. (1998) using the KBA-1 isolate of *N. caninum* as antigen and a cut-off titer of 1:50. Antibody titers higher than 1:50 were decided to be seropositive only when complete peripheral tachyzoite fluorescence was noted. Sera from raccoon dogs were tested by the neospora agglutination test (NAT), which was performed as described by Romand et al. (1998) using a cut-off titer of 1 : 512 and commercially available reagents.

Antibodies to *N. caninum* were found in 8.3% of

urban dogs and in 21.6% of dogs from dairy farms (Table 1 and Fig. 1). Antibody titers ranged from 1:50 to 1:400. Of the 35 seropositive cases, 16 were male, 10 were female, and the remainder unknown. Antibodies to *N. caninum* were found in 6 (23%) of the 26 raccoon dogs.

The seroprevalence of urban dogs to *N. caninum* was 8.3%, which is similar to the results of serological surveys performed in Japan; 7% of 198 dogs (Sawada et al., 1998), in 35 USA states and 3 Canadian provinces; 7% of 1,077 dogs (Cheadle et al., 1999), and in Brazil; 6.7% of 163 dogs (Mineo et al., 2001). However, the prevalence of antibodies to *N. caninum* in dogs kept at dairy farms that had experienced bovine abortions caused by *N. caninum* infections was approximately 3 times higher than that in urban dogs ($p < 0.05$). These findings on the seroprevalence of *N. caninum* are similar to those in urban and rural dogs in Japan (Sawada et al., 1998), the Netherlands (Wouda et al., 1999), and Argentina (Basso et al., 2001a). Moreover, epidemiologic investigations have reported a positive relationship between *Neospora caninum* infection in cattle and dog (Sawada et al., 1998; Wouda et al., 1999). We suspect that horizontal transmission of neosporosis between cattle and dogs may be occurring at affected farms.

It is interesting that 23% of raccoon dogs were found to have *N. caninum* antibodies, as this suggests that they act as a natural host for *N. caninum*. Lindsay et al. (2001) reported *N. caninum* antibodies in 10% of 99 raccoons from Florida, New Jersey, Pennsylvania, and Massachusetts in USA. In Korea, raccoon dogs are frequently observed near dairy farms and have free access to the farms (So et al., 2002). Whether these dogs can excrete *N. caninum* oocysts needs further investigation. However, as the number of raccoon dogs used in the present study was small, the role that raccoon dogs may transmitting *N. caninum* to cows remains unknown. This study is the first to report upon the seroprevalence of *N. caninum* infection in raccoon dogs in Korea.

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