

## Seroprevalence of *Neospora caninum* in dairy goats from Bahia, Brazil

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### Abstract

Sera from 384 dairy goats in nine herds from Bahia State, Brazil, were assayed for *Neospora caninum* antibodies using an indirect immunofluorescent antibody test (IFAT). Animals were selected and divided in groups by age and breed. Antibodies against *N. caninum* were found in 15% (58/384) of goats. Serum titers ranged from 1:100 to 1:3200. There was no significant difference between the age groups. Seroprevalence was higher in Alpine breed (24%) than in Saanen (14%) and Nubian (3%) breeds. The 58 *N. caninum*-positive sera were also tested for *Toxoplasma gondii* and 71% of the samples reacted solely to *N. caninum*. These results indicate that *N. caninum* infection is common in goat herds in Bahia.

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### 1. Introduction

Neosporosis, caused by the protozoan *Neospora caninum*, is an important cause of bovine abortion (Anderson et al., 1991), and neurological alterations in dogs (Barber and Trees, 1996). It can also cause abortion or neonatal mortality in other animal species, including sheep, goats, horses, and deer (reviewed by Dubey, 2003).

Several cases of neosporosis have been described in goats (Barr et al., 1992; Dubey et al., 1992, 1996; Corbellini et al., 2001; Eleni et al., 2004; Figliuolo et al., 2004). However, the rates of *N. caninum* infection and the significance of the disease in this species have

been poorly investigated. Antibodies to *N. caninum* were found in 5 of 77 goats in a farm in Costa Rica, where a case of neosporosis had been diagnosed (Dubey et al., 1996). In another report, 24 goats were examined in Taiwan and tested negative for *N. caninum* antibodies (Ooi et al., 2000). Abortion and transplacental infection were reproduced in goats after i.v. inoculation with *N. caninum* tachyzoites (Lindsay et al., 1995).

Goats are economically important in many countries, including Brazil, where this species is a major source of meat and milk for humans. In the past 10 years, the number of dairy goat herds increased substantially throughout the country. Neosporosis was reported in a goat kid in south of Brazil (Corbellini et al., 2001), indicating that *N. caninum* is associated with neonatal mortality in goats in this country, and may also be a significant cause of reproductive losses in this species.

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Table 1  
Frequency of IgG antibodies to *Neospora caninum* in goat herds by indirect fluorescent antibody test

Herds	Herd size	Samples	Positive (%)	Titer range
1	35	35	7 (20)	1:100–1:1600
2	Unknown	60	14 (23)	1:100–1:3200
3	60	16	2 (13)	1:100–1:200
4	28	20	3 (15)	1:100
5	70	51	7 (14)	1:100–1:200
6	117	62	1 (2)	1:200
7	82	60	23 (38)	1:100–1:1600
8	162	50	0 (0)	–
9	50	30	1 (3)	1:800
Total	–	384	58 (15)	–

Studying the distribution of *N. caninum* infection in dairy goat populations is an initial step to evaluate the importance of neosporosis in goats, as well as to investigate their role in transmitting the parasite to other animals. The aim of this study was to determine the prevalence of IgG antibodies against *N. caninum* in dairy goat herds in Bahia State.

## 2. Materials and methods

### 2.1. Animals and serum samples

Serum samples from 384 dairy goats were collected on nine farms, located within a distance of 150 km from Salvador in Bahia State, northeast of Brazil. The animals were randomly chosen and classified by age and breed.

### 2.2. Indirect immunofluorescent antibody test (IFAT)

IFAT for IgG antibodies to *N. caninum* was performed using tachyzoites of the strain NC-Bahia (Gondim et al., 2001) as antigen, and a commercial fluorescein isothiocyanate (FITC)-conjugate anti-goat IgG as a secondary antibody. Sera reacting at dilutions  $\geq 1:100$  (Dubey et al., 1996) were considered positive for *N. caninum* antibodies, and the maximum antibody titer was determined for all positive samples. IFAT for *Toxoplasma gondii* antibodies was carried out similarly to the *N. caninum* IFAT, using tachyzoites of the RH strain as antigen, and a dilution of 1:32 as a cut off. Positive and negative control sera were used on each slide.

### 2.3. Statistical analysis

The IFAT results for *N. caninum* and proportions of seropositive animals by age and breed, were analyzed by

Table 2  
Frequency of IgG antibodies to *N. caninum* in goats according to the age

Age (months)	Samples	Positive	Percentage
$\leq 6$	25	4	16
$> 6$	245	34	14
Unknown	114	20	18
Total	384	58	–

$\chi^2$  association, and values of  $P \leq 0.05$  were considered statistically significant.

## 3. Results

Antibodies to *N. caninum* were found in 58 (15%) of 384 dairy goats, in titers of 1:100 (33 goats), 1:200 (16 goats), 1:400 (two goats), 1:800 (four goats), 1:1600 (two goats), and 1:3200 (one goat). The number of seropositive animals per herd ranged from 2 to 38%, and in only one herd there was no seropositive animals (Table 1). There was no statistical difference in seropositivity between young animals ( $\leq 6$  months) and adult animals ( $> 6$  months). (Table 2).

IFAT-positive goats were observed in all the three tested breeds (Table 3). Nubian breed had the low-

Table 3  
Frequency of IgG antibodies to *N. caninum* in goats according to breed

Breed	Samples	Positive	Percentage
Nubian	64	2	3
Saanen	134	19	14
Alpine	144	34	24
Mixed	42	3	7
Total	384	58	–

est prevalence (3%), whereas Alpine and Saanen had prevalences of 24 and 14%, respectively. The statistical analysis showed an association between breeds and seropositivity ( $P=0.02$ ).

Seventeen of the 58 (29%) *N. caninum* seropositive animals tested positive for *T. gondii* antibodies with titers of 1:32 (three goats), 1:64 (three goats), 1:128 (five goats), 1:256 (three goats), and >1:256 (three goats).

#### 4. Discussion

A total of 58 of 384 (15%) goats were positive for antibodies against *N. caninum*, suggesting that infection with the parasite is common in dairy goats in Bahia. These results represent, to our knowledge, the highest rate of seroprevalence to the parasite reported in goats compared with results found in other continents (England et al., 1998; Naguleswaran et al., 2004). The animals had antibody titers up to 3200, and only 29% of the *N. caninum* seropositive animals were also positive for *T. gondii*, indicating that the results were not an artifact of crossreactivity between the two parasites.

In the most affected herd, where 23 of 60 (38%) goats had anti-*N. caninum* antibodies, abortions and stillborn cases were frequent. In addition to other abortifacient infectious agents, *N. caninum* may be implicated as a cause of reproductive losses in the studied farms. However, this assumption needs further investigation.

An association was found between breeds and seropositivity. However, further studies are required to understand the exact relationship between goat breeds and seroprevalance of *N. caninum*.

No association was found between age groups and *N. caninum* seroprevalance in the examined goats.

In this study, the environmental conditions of the herds seemed to be propitious to *N. caninum* transmission. Dogs were present in all farms having free access to feedstuffs. It may have contributed to increase the seropositivity observed in the tested goats.

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