



## Communication

[Comunicação]

### Seroprevalence of *toxoplasma gondii* infection in goats in the five northwestern provinces of China

[Seroprevalência de infecção por *toxoplasma gondii* em cabras nas cinco províncias do noroeste da China]

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*Toxoplasma gondii* (*T. gondii*), a parasitic zoonosis that belongs to the phylum Apicomplexa, can infect most warm-blooded animals worldwide, including mammals and birds (Dubey, 1996; Klun *et al.*, 2006; Opsteegh *et al.*, 2010; Salant *et al.*, 2009; Zhao *et al.*, 2011). The disease caused by *T. gondii* is of veterinary and medical importance, because it may cause abortion or congenital disease in its intermediate hosts (Salant *et al.*, 2009). As one of the intermediate hosts, infected goat not only results in apparent reproductive losses, but also presents an important source of human infection through consumption of infected mutton (Innes *et al.*, 2009; Zhao *et al.*, 2011). Goats are an important source of meat for humans (Santana *et al.*, 2013). Lamb and mutton are considered important sources of *T. gondii* infection in humans (Iovu *et al.*, 2012; Opsteegh *et al.*, 2010).

Humans are infected postnatal mainly through ingestion of tissue cysts from undercooked meat or oocysts from the environment contaminated by infected mammals' feces (Dubey *et al.*, 2004). In addition, infection with *T. gondii* is usually present either asymptomatic or with mild flu-like symptoms. Furthermore, if the gravida is infected during pregnancy, toxoplasmosis can lead to abortion or congenital malformations affecting the brain, eyes, or other fetal organs (Halos *et al.*, 2010). The "five northwestern provinces" is used to name the Northwest Region, originated by the

six administrative regions established from 1949-1953, including Xinjiang Uygur Autonomous Region, Qinghai Province, Gansu Province, Shanxi Province and Ningxia Province. There are more Islam believers in the five provinces than any other provinces in China, therefore, consumptions of lamb are more popular. However, few studies on the prevalence of *T. gondii* in goat have been conducted in these provinces since 1979 according to the Chinese National Knowledge Infrastructure and PubMed. The current study aimed to determine the seroprevalence of *T. gondii* infection in goats in this region to estimate the risk factors associated with exposure to the pathogen.

Serums with detailed records were randomly selected for this study. A total of 928 goat serums were collected from Xinjiang Uygur Autonomous Region, Qinghai Province, Gansu Province, Shanxi Province and Ningxia Province. *T. gondii* was determined using a commercial ELISA kit from Lanzhou Veterinary Research Institute of Chinese Academy of Agricultural Sciences for goat according to the recommendations of the manufacturer. Positive and negative control sera were supplied within the ELISA kit. The tests were performed in the College of Animal Science, Tarim University. Briefly, a 96-well ELISA plate was coated with *T. gondii*-specific antigens. After incubating the diluted serum sample (1:100) was added into the test well, after incubation and a subsequent washing step, a conjugate was added. The plate

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was washed again, then, a chromogenic enzyme substrate was added. The optical density (OD) at 450 nm was measured by a spectral photometer. A reaction was considered to be positive when the value was more than two folds of the standard negative serum.

Data were analyzed ( $\chi^2$ -test) using the statistical software package SPSS version 17.0 (SPSS, Inc, Chicago, IL, USA). The risk factors included sex, age and province in the present survey. Identification of a risk factor required a 95% confidence level ( $P < 0.05$ ) as well as a biologically plausible association between the factor and seroprevalence of *T. gondii*.

## RESULTS

The results of the survey were shown in Table 1. Among the 928 goat samples, 197 were positive by ELISA. Seroprevalence in male goat (13.83%, 13/94) was significantly lower than that in female ( $P = 0.048$ ; OR=0.567, 95% CI=0.309 to 1.041). Statistical analysis revealed that significant differences were observed in the  $\geq 2$  groups ( $P = 0.002$ , OR = 0.330, 95% CI = 0.224 to 0.488). The prevalence of *T. gondii* infection in terms of province group was 21.59% (65/301), 18.40% (23/125), 20.96% (35/167), 22.63% (43/190) and 21.38% (31/145) in Xinjiang Uygur Autonomous Region, Qinghai Province, Gansu

Province, Shanxi Province and Ningxia Province, respectively. No statistical difference was found among different provinces.

## DISCUSSION

This is the first epidemiological study on *T. gondii* infection in goats in the five northwestern provinces of China. In general, the overall seroprevalence (21.23%) was lower than that in many other domestic surveys. Many surveys on goat infection with *T. gondii* have been reported in different parts of China. For example, the prevalence in goats was 41.18% in GuiLin (LAT) (Mo *et al.*, 1993), 27.9% in DanYang (IHA) (Yang *et al.*, 1997) and 39.13% in Beijing (MAT) (Wang *et al.*, 2006). These differences may be explained by the different test methods used, survey periods, sample sizes, and cutoff values (Faria *et al.*, 2007). Domestic research was mostly performed using indirect hemagglutination antibody (IHA) test or modified agglutination test (MAT). IHA has poor resolution and sensitivity compared to ELISA (Dubey *et al.*, 1995). On the other hand, MAT may detect antibodies that appear at the early stage of infection against components of tachyzoite membrane (Hirvela-Koski, 1990). A comparative study using several serologic tests indicated that indirect ELISA is the most sensitive method (Hill *et al.*, 2006).

Table 1. Seroprevalence of *T. gondii* infection in Goat in Xinjiang Uygur Autonomous Region, Qinghai Province, Gansu Province, Shanxi Province and Ningxia Province determined by ELISA

Factor	Category	No. examined	No. positive(%)	Odds ratio(95%CI)	P
Sex	Male	94	13(13.83)	1	0.048
	Female	834	184(22.06)	0.567(0.309-1.041)	
Age	<2	331	36(10.88)	1	0.002
	$\geq 2$	597	161(26.97)	0.330(0.224-0.488)	
Province	Xinjiang	301	65(21.59)	1	0.907
	Qinghai	125	23(18.40)	1.221(0.720-2.074)	
	Gansu	167	35(20.96)	1.039(0.654-1.650)	
	Shanxi	190	43(22.63)	0.942(0.608-1.457)	
	Ningxia	145	31(21.38)	1.013(0.625-1.641)	
	Total	928	197(21.23)		

In this survey, we found that one risk factor for *T. gondii* infection in goat was gender. Seroprevalence in females was significantly higher than that in males. Similar results were also shown in other studies in Thailand (Jittapalapong *et al.*, 2005), Saudi Arabia (Sanad and Al-Ghabban 2007), Romania (Iovu *et al.*, 2012) and Ethiopia (Teshale *et al.*, 2007). The

reason might be that female animals are more susceptible to the infection of protozoan parasites (Alexander and Stimson, 1988).

The other risk factor for *T. gondii* infection in goat found in the present study was age. Significant differences were observed in the  $\geq 2$  group ( $P = 0.047$ , OR = 0.774, 95% CI = 0.405 to 1.482). It's also consistent with previous reports

in Romania (Iovu *et al.*, 2012), Ethiopia (Teshale *et al.*, 2007), Portugal (Lopes *et al.*, 2013), Nigeria (Kamani *et al.*, 2010), Mexico (Alvarado-Esquivel *et al.*, 2009) and Brazil (Ragozo *et al.*, 2009). Seroprevalence in adult goat was higher than that in lambs. Adult animals may be more exposed to the parasite and

for a longer time through the oral route of transmission than the young (Halos *et al.*, 2010; Lunden *et al.*, 1994; Opsteegh *et al.*, 2011; van der Puije *et al.*, 2000).

**Keywords:** *Toxoplasma gondii*, seroprevalence, goat, five northwestern provinces

## RESUMO

*O objetivo do presente estudo foi investigar a soroprevalência de infecção com Toxoplasma gondii (T. gondii) em cabras em cinco províncias do noroeste da China. Soroprevalência foi determinado usando o kit de teste de ensaio de imunoabsorção enzimática (ELISA). A soroprevalência geral foi 21.23% (197/928). Análise estatística revelou que diferenças significativas foram observadas em fêmeas (P= 0.048, OR= 0.567, 95% CI= 0.309 a 1.041) e nos grupos ≥ 2 (P= 0.002, OR= 0.330, 95% CI= 0.224 a 0.488). Nenhuma diferença estatisticamente significativa foi observada entre diferentes províncias. Nossos resultados indicam que a infecção com T. gondii, que pode ter implicações importantes sobre a saúde pública, teve diferenças significativas em sexo e idade, mas nenhuma significância foi observada em diferentes regiões. Além disto, nossos resultados também indicam que infecção por T. gondii em cabras é generalizada nas cinco províncias do noroeste.*

**Palavras-chave:** *Toxoplasma gondii*, soroprevalência, cabra, cinco províncias do noroeste

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