

Serological study of *Toxoplasma gondii* infection in cattle from western Iran

Jamal Gharekhani

Department of Parasitology, Central Veterinary Laboratory, Iranian Veterinary Organization, Hamedan, Iran.

Correspondence: Tel. + 988112651801, Fax +988112644474, E-mail Gharekhani_76@yahoo.com

Abstract. The aim of this study was to determine the seroprevalence of *Toxoplasma gondii* infection in Hamedan province, Western Iran. A number of 1,406 serum samples were evaluated for IgG-antibodies against *T. gondii* in rural and industrial cattle in this region using ELISA. Thirty-two (2.3%) of the samples were seropositive. The results indicated that there was a significant correlation between seroprevalence rates and the rat control in farms, cat contact with the herd, intensive system of breeding ($P < 0.05$). The differences between the type of cattle, breeds, gender, age groups and abortion history were not statistically significant. This is the first report of *T. gondii* infection in cattle from Western Iran. Although the rate of infection is low, the results indicate that this infection may partly be responsible for transmission to humans and economic losses in cattle husbandry in this region. Further comprehensive studies for *T. gondii* in cattle and other hosts are highly recommended.

Keywords: *Toxoplasma gondii*; Cattle; ELISA; Hamedan; Iran.

Received 17/08/2013. Accepted 16/09/2013.

Introduction

Toxoplasma gondii is a zoonotic heteroxenous coccidian parasite with global distribution (Dubey, 1986; Nematollahi and Moghadam, 2008). This parasite is responsible for abortion and major economic losses in livestock (Raeghi et al., 2011).

T. gondii is mainly transmitted by food contaminated with oocysts, uncooked meat containing tissue cysts and transplacentally (Heidari et al., 2013).

Cattle have high resistance to toxoplasmosis. Naturally occurring infection was first reported from USA in 1953 (Dubey, 1986). In cattle,

unlike in the sheep, *T. gondii* may cause subclinical infection (Dubey, 1986).

The diagnosis of *T. gondii* infection is based largely upon the application of histopathology, bioassay in mice, and serological examination including the Enzyme Linked Immuno Sorbent Assay (ELISA) (Dubey, 1986; Habibi et al., 2012).

Past surveys indicate that a wide range of domestic animals (cattle, buffalo, sheep, goat, horse, camel, dog, cat and chicken) and humans have been exposed to *T. gondii* in Iran (Hashemi-Fesharaki, 1996; Navidpour and Hoghooghi-rad, 1998; Asgari et al., 2006; Sadrebazaz et al., 2006; Hooshyar et al., 2007;

Hosseininejad et al., 2011; Raeghi et al., 2011). However, there is no published information of on toxoplasmosis in cattle from western Iran.

The aim of current investigation was to determine the seroprevalence of *T. gondii* infection in cattle (rural and industrial) from Hamedan province, west of Iran using ELISA.

Materials and methods

Study area

Hamedan province characterized by mountainous landscape and mild climate is located in west part of Iran (34.77°N and 48.58°E). This province is economically important for crops and animal husbandry. The average annual temperature is 11.3°C.

Sample collection

A cross-sectional study was performed in the first half of years 2010-2012. Blood cluster

samplings were collected randomly from 1,406 cattle (28.4% rural cattle, 35% industrial dairy cattle, and 36.6% industrial beef cattle). Information about age, gender, breed, cat contact with herd, rat control in farm, and abortion history in cattle were taken from owners and physical examination (table 1). All sera were removed after centrifugation at 1000×g for 15min and stored at -20°C until laboratory testing.

ELISA

Anti-*Toxoplasma* IgG-antibodies of samples were detected using a commercially available *T. gondii* ELISA kit (CHEKIT-TOXOTEST®; IDEXX Laboratories; Switzerland). The kit was used according to the manufacturer's instructions. The presence or absence of antibody was determined by calculating of value% ($\geq 100\%$ = positive) according to the manual formula.

Table 1. Comparison of *T. gondii* seroprevalence in cattle from Western Iran

Parameter	Age groups (years)			Gender		RC#	CC#	Breeding			Abortion history		Ru	Id	Ib	Total
	<2	2-4	>4	M	F			Na	Hy	Ho	Ru	Id				
NS	415	681	310	514	892	642	711	139	522	745	85 50	35	400	492	514	1406
NP (%)	24 (5.8)	8 (1.2)	0 (0)	9 (1.7)	23 (2.6)	6 (0.93)	22 (3.1)	9 (6.5)	21 (4)	2 (0.27)	5 (10)	0 (0)	21 (5.25)	2 (0.4)	9 (1.7)	32 (2.3)

RC# = Rat control in farm (n); CC# = Cat contact with herd (n); NS = number of samples; NP = number of positive; M = male; F = female; Na = native, Hy = hybrid; Ho = Holstein; Ru = rural cattle; Id = industrial dairy cattle; Ib = industrial beef cattle; #p-value<0.05

Statistical analysis

Statistical analysis was performed by using the software package SPSS version 16.0 for Windows. The differences among variables were evaluated by Chi-square test. A P-value of less than 0.05 was considered statistically significant.

Results

IgG-antibodies to *T. gondii* were found in 2.3% (95% CI, 1.52-3.08%). The association between seroprevalence and rat control in farm (P=0.001), and cat contact with herd

(P=0.037, OR=2.18), were statistically significant. Also, seropositive rate in semi-intensive breeding system (rural farms) was higher than intensive system (industrial farms) (P=0.0001). There were not statistical differences between type of cattle (P=0.559), breeds (P=0.366), gender (P=0.316), age groups (P=0.999), and presence of abortion history (P=0.231). The detailed information of results are summarized in table 1.

Discussion

T. gondii infection is common in many species of livestock. Antibodies against this parasite

have been reported in cattle worldwide (Dubey, 1986). Seroprevalence of toxoplasmosis has been found to range from zero (some regions in Australia, Canada, Egypt, Italy, Mexico, Indonesia and Vietnam) to 100% (Tennessee and Iowa regions in USA) (Dubey, 1986). In past investigations, the seroprevalence rates were reported to be between 1.6-15.9% in North-West of Iran, and zero in North of Iran (Ghazaei, 2005; Sharif et al., 2007; Nematollahi and Moghadam, 2008; Raeghi et al., 2011). In Iran, Hashemi-Fesharaki (1996) did not detect *T. gondii* in cattle using Latex Agglutination (LAT), Indirect Hemagglutination Tests (IHAT), direct microscopy and bioassay in mice.

In our study, the highest rate of seropositivity was determined in rural cattle (5.25%), followed by beef (1.7%) and dairy cattle (0.4%) (table 1, $P=0.559$). Seropositivity rate of animals with semi-intensive breeding system (rural farms) was higher than intensive system ($P=0.0001$), similar to a recent study in Brazil (Vieira-Fajardo et al., 2013).

Animal management and feed storage may be a risk factor for *T. gondii* infection and it is the main factor determining the differences between the number of infected animals, observed between the extensive and semi-intensive systems. The storage of animal feed may increase the presence of rats and, consequently, cats. Cats that are potentially infected by *T. gondii* by spending time looking for rats in the feed storage locations, can defecate on the feed contaminating it with oocysts.

A similar rate of infection (2.3%) was reported in Brazil (Vieira-Fajardo et al., 2013). The seroprevalence per animal is considered low compared to those observed in other studies. A high prevalence of toxoplasmosis in hot and humid environments compared to cold and dry ones is attributed to the longer viability of *T. gondii* oocysts under higher humidity conditions (Hamidinejat et al., 2008). Different serological tests and cut-off values, study design, climatic variations and frequency of felines and rodents in the farms are the main causes of these varied results (Heidari et al., 2013).

In the current study, differences in seroprevalence between various breeds was not statistically significant (table 1, $P=0.366$). This may be related to different production systems for dairy and beef cattle rather than to breed differences. Planning and conducting extensive research on the impact and role of different breeds in the infection prevalence is essential.

This study showed that the highest seroprevalence was in the age group of <2 years (5.8%) and the lowest in >4 years (0%), but the difference was not statistically significant (table 1, $P=0.999$), unlike in a study in Northeast Iran (Nematollahi and Moghadam, 2008). Dubey (2009) reported that age is an important factor in sheep toxoplasmosis. In this research, infection rate in younger animals was higher than in other age groups. Nematollahi and Moghadam (2008) showed that cattle under the age of one year were significantly ($P>0.05$) more infected the older cattle. This result confirms the experimental findings of some authors such as Dubey (1986) who used calves as suitable models for detailed research on toxoplasmosis. It seems that the cattle deplete *Toxoplasma* antibodies as the age increases. This could be explained on the basis that the animals included in this age group were less resistant to toxoplasmosis. Increase of seroprevalence with age may be due to the fact most animals acquire infection post-natally (Heidari et al., 2013).

Our results revealed that there is no significant difference between seroprevalence of *Toxoplasma* in male and female animals (table 1, $P=0.316$). This finding is unlike to Samad et al. (1993) in Bangladesh ($P>0.05$) and to Nematollahi and Moghadam (2008) in Northeast Iran ($P<0.01$). Pita et al. (1999) reported that female cattle were more seropositive in Brazil. These differences are probably due to different management methods in breeding of animals.

Our study showed that the prevalence of *T. gondii* antibodies in cattle with abortion history was lower than in those without abortion history ($P=0.231$). In a study from Brazil, the number of *T. gondii* positive animals from farms that had a history of abortion or stillbirth was significantly higher than in

animals from farms without abortion history ($P=0.019$) (Vieira-Fajardo et al., 2013). The results of this study together with the previously recorded low infection rates in cattle from Iran and other countries support the impression that toxoplasmosis is not a widespread cause for abortion and a latent infection in cattle.

In the current study, there was a positive correlation between contact of cats with the herd ($P=0.037$), and rat control in farm using traps ($P=0.001$) and the number of infected cattle (table 1). This finding indicates that the animals may probably be exposed to reinfection due to the presence of the definitive host and the management conditions in the farms. A large cat and rat population represent risk factors associated with *T. gondii* infection. In this study, all of rural farms had cats. Cats are capable of roaming in various areas, including food storage areas and stalls. Oocyst-contaminated pastures, fodder and drinking water are regarded as potential sources of postnatal infection in animals (Heidari et al., 2013).

Our results can provide baseline information for future studies. This is the first report of *Toxoplasma* in rural and industrial cattle from western Iran. Although the rate of infection is low, the results indicate that toxoplasmosis may be partly responsible for transmission to humans and economic losses in cattle husbandry from this region. Therefore, further additional researches (molecular and bioassay examination) and designing control strategies for improving management in cattle farms is necessary.

Acknowledgment

This study has not been supported by any foundation. The author declares that there is no conflict of interests.

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