



Seroprevalence of *Toxoplasma gondii* Infection in Wild Boars, Wild Rabbits, and Wild Chickens in Hubei Province, China

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Abstract: *Toxoplasma gondii* causes serious infection worldwide in humans and animals. In this study, the seroepidemiology of toxoplasmosis was investigated in wild boars (*Sus scrofa*) (n=377), wild rabbits (cape hare, *Lepus capensis*) (n=331), and wild chickens (red junglefowl, *Gallus gallus*) (n=571) in 4 forested and country sided area of Hubei province of China. For this, blood samples were collected and tested by indirect hemagglutination test (IHA). The seroprevalence was found to be 7.2%, 5.1%, and 12.6% in wild boars, rabbits, and chickens, respectively, with significant differences among these species. The prevalence of *T. gondii* infection in male and female wild boars was found to be 7.9% and 6.5% ($P<0.01$), in male and female rabbits was 5.6% and 4.9% ($P<0.01$), and in male and female chickens was 17.1% and 7.7% ($P<0.01$), respectively, with significant differences between 2 genders of chickens ($P<0.01$). The findings of this study may help in planning of the prevention measures against *T. gondii* infection in wild animals in this area.

Key words: *Toxoplasma gondii*, seroprevalence, indirect hemagglutination, wild boar, wild rabbit, wild chicken, Hubei province

Toxoplasma gondii is a world-widely distributed pathogen infecting almost all warm-blooded animals [1,2]. Toxoplasmosis caused by *T. gondii* is one of the most prevalent zoonotic diseases in domestic and wild animals, including wild rabbits, chickens, and pigs [3], causing fatality in rabbits [4]. The pathogenicity of *T. gondii* infection varies from symptomless infections to death [1]. Previous studies have reported that rabbits infected with *T. gondii* were a source of infection for cats which shed the environmentally resistant oocysts [5]. Infected rabbits can be a source of infection to humans too. In fact, consumption of rabbit meat was recently associated with *T. gondii* infection in humans in Mexico region [6]. *T. gondii* infection in pigs has been shown to cause serious economic losses in many countries [7-9]. Apart from infecting the pigs, *T. gondii* has also been reported to cause infection in dogs and chickens. Infection in dogs is very important for the reason that it may indicate the parasites pollution levels in their lives

and can be considered as a mechanical vector [10]. The chickens show less clinical signs of toxoplasmosis always following the chronic type of infection with high seropositive rates [11]. Keeping in view the importance of chicken meat for human consumption, *T. gondii* infection in these birds has been considered very dangerous, as the infected chickens may transmit the parasite to humans through undercooked meat [2].

In humans, *T. gondii* infection is asymptomatic generally [12]; however, the risk to pregnant women is enormous developing severe diseases like encephalitis, abortion, blindness, and mental retardation [13]. Toxoplasmosis has been reported to infect 1/3 of the world population [14-16]. However, limited reports are available or not focused of this infection in wild animals. So keeping in view, the current study was designed to investigate the prevalence of toxoplasmosis in wild pigs (wild boars), rabbits, and chickens in forested area of Hubei province, China.

The present study was performed under the instructions and approval of the ethics committee of Huazhong Agricultural University (permit no. 4200695757).

All the samples were collected in wild and forested area of Hubei province located in central part of China (Fig. 1). A total of 1,279 blood samples from wild boars (*Sus scrofa*)

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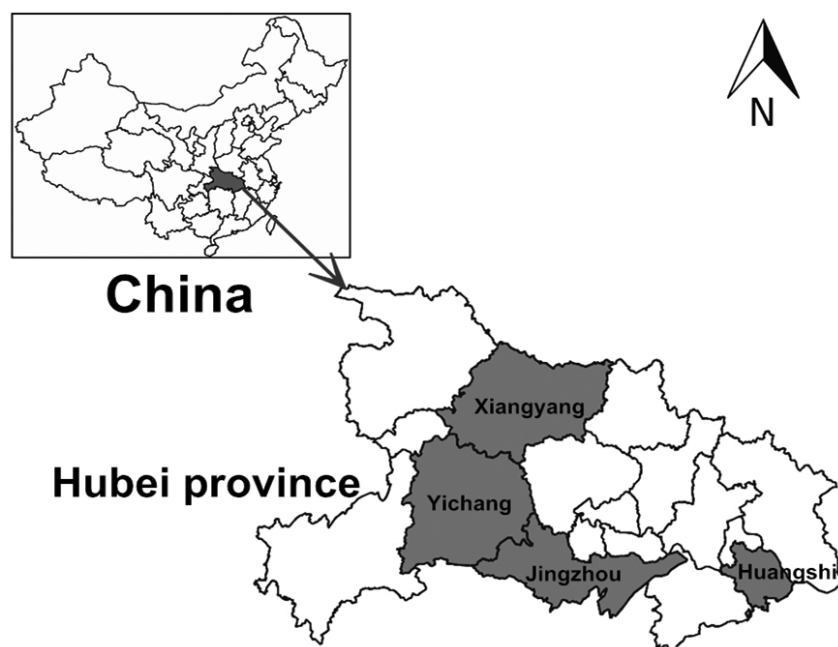


Fig. 1. Geographical distribution of sample collection.

Table 1. Seroprevalence of *T. gondii* in different animals by indirect agglutination test in Hubei province, China

Animals ^a	No. males positive/ No. total samples	Seroprevalence (%)	No. females positive/ No. total samples	Seroprevalence (%)	No. total positive/ No. total samples	Seroprevalence (%)
Wild boars	15/191	7.9	12/186	6.5	27/377	7.2
Wild rabbits	6/107	5.6	11/224	4.9	17/331	5.1
Wild chickens ^b	51/299	17.1	21/272	7.7	72/571	12.6

^aDifferences among different animals were found statistically significant ($P < 0.01$, $\chi^2 = 16.550$).

^bDifferences between male and female red junglefowls were found statistically significant ($P < 0.01$, $\chi^2 = 11.267$).

($n = 377$), wild rabbits (cape hare, *Lepus capensis*) ($n = 331$), and wild chickens (red junglefowl, *Gallus gallus*) (Table 1) were collected during 2010 to 2016. After collection, all the blood samples were centrifuged at 3,000 g for 20 min, and serum was separated and stored at -20°C till later analysis.

Each serum sample was tested for IgG antibodies against *T. gondii* by employing a commercial indirect agglutination test (IAT, Lanzhou Veterinary Research Institute of Chinese Academy of Agricultural Sciences, Gansu, China) according to the manufacturer's instructions. The test was considered positive when a layer of agglutinated erythrocytes was formed in wells employing serum dilutions of 1:64 or higher, and positive and negative controls were included in each test. Statistical analysis was performed by chi-square test with Statistical Analysis System, Version 18.0 (SAS Institute, Cary, North Carolina, USA). The differences were considered statistically significant when $P < 0.05$.

The results showed that the antibodies against *T. gondii* was

found in 377 wild boars (7.2%), 331 rabbits (5.1%), and 571 chickens (12.6%) with significant differences among 3 species ($P < 0.01$). The prevalence of *T. gondii* infection in male and female wild boars was found to be 7.9% and 6.5% ($P < 0.01$), that in male and female rabbits was 5.6% and 4.9% ($P < 0.01$), and that in male and female chickens was 17.1% and 7.7% ($P < 0.01$), respectively. Significant differences were found between 2 genders of chickens ($P < 0.01$) (Table 1).

Since the discovery of complete life cycle of *T. gondii* in 1970, a large number of *T. gondii* seropositive wild and domestic animals have been identified and reported globally [2]. The current seroprevalence of *T. gondii* in wild boars (7.2%) was lower than that reported previously in domesticated pigs in nearby Guizhou provinces and Chongqing area [17-19]. This may possibly be decided by the climatic conditions in these areas and of course, the domesticated region because of the lower annual average temperature and precipitation of Hubei

province than Guizhou and Chongqing regions. As the survival rate of *T. gondii* oocysts are longer in warmer and more humid environments [5], this might be the reason of low seroprevalence of this infection in Hubei province.

In the present study, a low seroprevalence (5.1%) of *T. gondii* infection was tested in wild rabbits, which is significantly lower than the seroprevalence of *T. gondii* infection as manifested in Mexican regions [18,20,21]. The differences are likely to be associated with different investigative methods, ecological and geographical factors, and climates [3]. As chickens have direct feeding habit from the ground, the seroprevalence of *T. gondii* infection can be considered a reflection of environmental contamination [12]. This might be the reason that the prevalence of *T. gondii* in wild chickens in our study was significant higher than other species in this region. Moreover, the prevalence of this parasitic infection in chickens in our study (12.6%) was also lower than that of the prevalence as reported previously in the same host species in Henan province of China (18.9%) and other parts of the world, i.e., Ghana (64.0%), Indonesia (24.4%), and Poland (24.2%) [22,23].

Demand for the meat of wild animals, including pigs, rabbits, and chickens for human consumption is increasing because of the leanness of their meat [4], low fat and rich nutrition, and of course increasing human population. Additionally, like other countries, there are no regulations concerning sale and slaughter of these animals. Therefore, infection in wild animals could be of importance in the epidemiology of toxoplasmosis. Especially, wild boars, rabbits, and chickens are hunted and consumed by humans. The consumption of meat and meat-derived products containing cysts of *T. gondii* can be an important source of infection for humans. Moreover, the personnel dealing with such type of meat coupled with poor hygienic measures may also become infected during evisceration and handling of the carcass [2].

In conclusion, the current study reported for the first time the prevalence of *T. gondii* infection in wild animals in Hubei province of China. As a zoonotic parasite, the infected animals may transmit the infestation to other animals and even human beings in this area. Our results may help in planning the preventive measures against *T. gondii* infection in wild animals in this province.

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CONFLICT OF INTEREST

None of the authors have any conflict of interest.

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