

First report of seroprevalence of *Toxoplasma gondii* in domestic geese in Hunan province, subtropical China

Tan, S.G.¹, Zhang, M.J.², Liu, N.¹ and Xu, P.Y.^{1*}

¹Hunan Biological and Electromechanical Polytechnic, Changsha, 410127, China

²College of Veterinary Medicine, Hunan Agricultural University, Changsha, Hunan Province 410128, P. R. China

*Corresponding author e-mail: uprecious@foxmail.com (PYX)

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Abstract. *Toxoplasma gondii* is one of the most common protozoan parasites with widespread distribution globally. However, little information is available about the seroprevalence of *T. gondii* infection in geese (*Anser domestica*) in China. In the present study, the seroprevalence of *T. gondii* in geese were investigated in Hunan province, China. A total of 900 serum samples were collected from ten administrative regions in Hunan province, China, and assayed for *T. gondii* antibodies by Indirect Haemagglutination (IHA) test. Overall, 21.1% of the animals were positive for *T. gondii* antibodies. The results of the present survey indicated the presence of *T. gondii* infection in geese in Hunan province, China. Therefore, it is important to execute integrated control strategies and measures to prevent and control *T. gondii* infection in geese in this province. This is the first report seroprevalence of *T. gondii* in geese in Hunan province, China.

INTRODUCTION

Toxoplasma gondii is a cosmopolitan obligate intercellular protozoan parasite that can infect humans and a wide range of animals, and can cause toxoplasmosis (Cañón-Franco *et al.*, 2014; Daryani *et al.*, 2014). Human *T. gondii* infection is one of the most important public health problems that affects one-third of the human population (Tenter *et al.*, 2000). In most adults it does not cause serious illness; however, blindness and mental retardation can be caused in congenitally infected children and severe diseases in those with compromised immunity (Zhou *et al.*, 2011; Lopes *et al.*, 2014). *T. gondii* can be acquired by oral ingestion of undercooked meat containing tissue cysts or oocysts from the environment contaminated with infected cat feces, such as soil, foods and water (Elmore *et al.*, 2010).

In avian, the main clinical signs of toxoplasmosis were anorexia, emaciation,

diarrhoea, blindness and sudden death (Dubey, 2010). Surveys of seroprevalence of *T. gondii* infection in geese have been reported throughout the world (Sroka, 2001; Bártoová *et al.*, 2009; Maksimov *et al.*, 2011), and there have also been surveys of *T. gondii* infection in geese in several cities of China (Yan *et al.*, 2011; Yang *et al.*, 2012; Rong *et al.*, 2014). The People's Republic of China (PRC) is one of the largest producers of geese in the world, and Hunan province, China is one of the major geese producers in the PRC. However, there have been no reports of *T. gondii* infection in geese in Hunan province, China. Therefore, investigation of *T. gondii* infection in geese in Hunan province, China has important implications for the prevention and control of *T. gondii* infection in humans and animals in Hunan province, China.

The objective of the present investigation was to examine the seroprevalence of *T. gondii* in geese in Hunan province, subtropical China. The results should provide

base-line data for recommendations with regards to prevention and control of toxoplasmosis in geese in this region and elsewhere.

MATERIALS AND METHODS

The study site

Hunan province is located in the southeastern hinterland of China between the northern latitudes 25° to 30° and eastern longitudes 109° to 134°. Climatically, it features a subtropical monsoon climate, with an average annual temperature of about 16 to 18°C, and the average precipitation of 1200 to 1700 mm, which is more than twice of the national average. Hunan province is divided into 14 administrative divisions, and the City of Changsha is the capital.

Collection and preparation of serum samples

A total of 900 blood samples were collected from ten representative administrative regions in Hunan province, subtropical China between September 2013 and September 2014 (Table 1). The numbers of geese reared on each farm ranged from 1000 to 5000, approximately. Before sampling, geese were subjected to clinical examination to determine their health status. Information

about each goose, such as age, medical history, growth hormones, and weight were collected. Healthy geese were randomly selected for bleeding. Blood samples were then centrifuged at 1,000 *g* for 10 min, and the serum was collected and stored at -20°C until assayed.

Serological examination of *T. gondii* isolates

Antibodies to *T. gondii* were tested by Indirect Hemagglutination antibody (IHA) using a commercially marketed kit (Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences, Lanzhou, Gansu Province, China). The procedures were used according to the manufacturer's instructions and previous descriptions (Miao *et al.*, 2013; Jiang *et al.*, 2014; Cong *et al.*, 2014). Samples that reacted at dilutions of 1:64 or higher were considered positive for *T. gondii* antibodies. Samples that reacted at dilutions of between 1:32 and 1:64 were re-tested, and positive and negative controls were included in each test.

Statistical analyses

The data were analyzed using PASW Statistics 18 (IBM Corporation, Somers, NY, USA); 95% confidence intervals (CI) are given. The value of $P < 0.05$ differences between levels within factors and

Table 1. Seroprevalence of *Toxoplasma gondii* infection in domestic geese in different administrative regions of Hunan province, subtropical China by indirect hemagglutination assay (IHA)

Region	Positive No. in different titers					No. tested	No. positive	Prevalence (%)
	1:64	1:128	1:256	1:512	1:1024			
Xiangtan	6	4	6	3	2	100	21	21
Changsha	7	4	6	4	3	100	24	24
Yueyang	4	3	5	4	4	100	20	20
Yongzhou	6	5	7	3	4	100	25	25
Chenzhou	5	4	6	5	3	100	23	23
Shaoyang	4	3	5	4	3	100	19	19
Loudi	5	4	5	4	3	100	21	21
Changde	4	3	5	4	3	100	19	19
Huaihua	4	3	5	3	3	100	18	18
Total	45	33	50	34	28	900	190	21.1

interactions were considered to be statistically significant. The significance was determined at the 95% confidence interval using the EpiInfo program, version 6.04 (Dean *et al.*, 1995).

RESULTS AND DISCUSSION

The present investigation revealed a high *T. gondii* seroprevalence (21.1%) in geese, which is higher than those reported in Guangzhou, Shenyang and Hainan, China (Yan *et al.*, 2011; Yang *et al.*, 2012; Rong *et al.*, 2014), but was significantly lower than that reported in Germany (Bártová *et al.*, 2009; Maksimov *et al.*, 2011). Differences in *T. gondii* seroprevalence are likely due to differences in animal welfare, climate and husbandry practices. The present and previous studies (Yan *et al.*, 2011; Yang *et al.*, 2012; Rong *et al.*, 2014) indicated that *T. gondii* infection was widespread in geese in China. The present survey showed that *T. gondii* seroprevalence in female geese (22.5%) was the higher than those of male geese (20%) ($P>0.05$); the differences were not statistically significant. The present survey indicated that *T. gondii* seroprevalence in adult geese (26.7%) was the higher than those of young geese (15.6%) ($P<0.05$), indicating that adult geese have more opportunities for contact with *T. gondii* oocysts.

The modified agglutination test (MAT), enzyme linked immunosorbent assay (ELISA), indirect fluorescent antibody test (IFAT) and direct agglutination test (DAT) are very sensitive and specific method for *T. gondii* detection in avian species. However, IHA is also considered one of the most sensitive and specific serological methods for detecting *T. gondii* antibodies, which has been used extensively in many animals, including pigs, horses, donkeys, yaks, dogs, chickens (Beltrame *et al.*, 2012; Miao *et al.*, 2013; Jiang *et al.*, 2014; Cong *et al.*, 2014). Therefore, the present study used IHA to detect *T. gondii* antibodies in geese utilizing a commercially marketed kit.

Humans can acquire *T. gondii* infection from domestic, wild or companion animals (Montoya & Liesenfeld, 2000; Hill & Dubey, 2002; Zhou *et al.*, 2011). The goose meat is mainly consumed by people and other carnivorous animals in China, and under certain conditions, it is consumed raw or undercooked. Therefore, infection in geese could be of importance in the epidemiology of toxoplasmosis, and persons in direct or indirect contact with infected geese might be at increased risk.

In conclusion, the results of the present investigation revealed that *T. gondii* infection in geese is prevalent in Hunan province, subtropical China. Therefore, it is important to execute integrated control strategies and measures to prevent and control *T. gondii* infection in geese in this province. This is the first report documenting the occurrence of *T. gondii* genotype in geese Hunan province, subtropical China.

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