

Seroprevalence of *bluetongue virus* infection in goats in the central China

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Abstract. Seroprevalence of Bluetongue virus (BTV) in goats from Hubei was investigated by a commercial competitive enzyme-linked immunosorbent assay kits. Blood samples (n=1157) were collected during the year 2014 and 2015. The results showed that 13.31% (CI 95% 11.4%–15.4%) serum samples were positive for *BTV* antibodies in goats in Hubei. The prevalence of *BTV* antibodies in each region ranged from 1.32% to 27.70%, and differences among the regions were statistically significant ($p < 0.01$). The prevalence of *BTV* in male and female goats was 14.23% (95% CI: 11.3, 17.6) and 12.58% (95% CI: 10.1, 15.4), respectively, no significant difference in genders ($p \geq 0.05$). In different seasons, the seroprevalence were 8.94% (95% CI: 5.6, 13.3) in spring; 18.31% (95% CI: 14.5, 22.7) in summer; 23.08% (95% CI: 17.0, 30.2) in autumn and 6.98% (95% CI: 4.6, 10.0) in winter, respectively with a significant difference of the prevalence in the different seasons ($p < 0.01$).

INTRODUCTION

Bluetongue Virus (BTV), a member of the genus *Orbivirus* and family *Reoviridae* (Arun *et al.*, 2014; Li *et al.*, 2015a), which causes of an infectious disease of ruminants, bluetongue (BT) (Katsoulos *et al.*, 2016), Office International Epizooties (OIE) listed arthropod-borne viral disease (Mozaffari *et al.*, 2014). *BTV* is transmitted between the vertebrate hosts by *Culicoides spp* (Arun *et al.*, 2014). *BT* was first discovered in Africa in the early 19th century and can infect all wild and domestic ruminant species (Toye *et al.*, 2013; Li *et al.*, 2015a). *BTV* may cause a hemorrhagic disease with high morbidity rates, especially in sheep (Casaubon *et al.*, 2013), Ban on the export of animals or animal

products from *BTV* infection regions (Seo *et al.*, 2015), causes a severe economic losses.

In China, goat milk and meat are important economic resources, so any disease threat to the goat results into the significant economic losses in goat production. However, until now scarce information is available about the prevalence of *BTV* infection in goats in Hubei province having abundant agricultural resources including 4.70 million (National Bureau of Statistics of China; <http://data.stats.gov.cn/easyquery.htm?cn=E0103>) goats in the central China. Therefore, the objective of the present research was to estimate the seroprevalence of *BTV* based on VP7 antibodies in goats in Hubei province for the

first time. VP7 consists of the core surface layer of the protein bilayer of the transcriptionally active BTV core (Grimes *et al.*, 1998). As this protein is more highly conserved than the components of the outer capsid, and show serological cross reactions between any BTV strains, VP7 in particular is a highly immunodominant antigen, which is detected in the majority of BTV serogroup-specific serological assays (Anthony *et al.*, 2007).

MATERIALS AND METHODS

Samples Collection: Blood samples from the caudal vein were collected by local veterinary practitioners from 1157 goats in 2014 and 2015 in 6 counties in Hubei province (Table 1). After collection, samples were centrifuged at $1000 \times g$ for 10 min, and serum was separated and stored at -20°C till further analysis.

Determination of BTV antibodies: Serum samples were tested by a commercial competitive enzyme linked immunosorbent assay (ELISA) (BTV VP7 Antibody Test Kit, IDEXX) according to the manufacturer's instructions. The S/N (%) value was calculated based on the optical density (OD) values according to the formula: $\text{S/N (\%)} = \text{OD}_{450} \text{ of samples} / \text{average OD}_{450} \text{ of negative controls} \times 100\%$. To ensure validity, the average OD₄₅₀ of negative controls was ≤ 3.000 and ≥ 0.700 ; the S/N (%) value of positive was $< 20\%$. The results were interpreted as: negative when the S/N (%) $\geq 80\%$; suspicious and tested again when the S/N (%) value was between 70% & 80% ; and positive when S/N (%) value $\leq 70\%$.

Statistical analysis: Statistical analysis was performed by chi-square test with SPSS (Statistical Analysis System, Version 17.0.). The differences were considered statistically significant when $P < 0.05$.

RESULTS

The results showed a total prevalence of BTV was 13.31% (95% CI: 11.4, 15.4). The regional seroprevalence of BTV antibodies

was 100% (6/6). Antibodies against BTV in each region ranged from 1.32% to 27.70%, and differences among the regions were statistically significant ($p < 0.01$).

The prevalence in male and female goats was 14.23% (95% CI: 11.3, 17.6) and 12.58% (95% CI: 10.1, 15.4), respectively, and there were no significant difference in different genders ($p \geq 0.05$). In different seasons, the seroprevalence was 8.94% (95% CI: 5.6, 13.3) in spring; 18.31% (95% CI: 14.5, 22.7) in summer; 23.08% (95% CI: 17.0, 30.2) in autumn and 6.98% (95% CI: 4.6, 10.0) in winter, respectively with a significant difference of the prevalence in the different seasons ($p < 0.01$) (Table 1).

DISCUSSION

BTV is an infectious disease of ruminants (Vangeel *et al.*, 2012; Li *et al.*, 2015a). Previously, BTV infection had been reported in many countries and areas. In the current study, the prevalence of BTV antibodies (13.31%) was higher than the seroprevalence of BTV infection in cattle in Kenya (0.942%) (Toye *et al.*, 2013) and Northern Kerala, India (6.9%) (Arun *et al.*, 2014), Madagascar (0.62%) (Andriam & Dimby *et al.*, 2015); and yaks (4.89%) in Tibet, China (Li *et al.*, 2015a). In our study the prevalence was lower than the prevalence BTV infection in goats in southeast Iran (67.7%) (Mozaffari *et al.*, 2014). The difference may be because of different detection methods employed, difference in geography, environment, climate (Li *et al.*, 2015b) and the distribution of *Culicoides* midges (Katsoulos *et al.*, 2016).

In China, the first report of BTV was in 1979 in Yunnan province, and since then, many provinces have reported disease and antibodies (Li *et al.*, 2015). In a study conducted in 1996, four ruminant species were found susceptible to BTV with the presence of vector species of *Culicoides* in China (Li *et al.*, 1996). In the current research, the prevalence of BTV among the regions statistically significant ($p < 0.01$). There were no significant difference with genders ($p \geq 0.05$). The results indicate that the two genders may have equal opportunity of

Table 1. The seroprevalence of *Bluetongue* in goats in different counties, genders and seasons in Hubei province, China

	Samples	Positive	Prevalence (%)	Confidence interval (95%)
County ^a				
Wuhan	191	21	10.99	6.9–16.3
Huangshi	250	36	14.40	10.3–19.4
Xiangyang	228	3	1.32	0.3–3.8
Suizhou	213	59	27.70	21.8–34.2
Yichang	161	15	9.32	5.3–14.9
Jingzhou	114	20	17.54	11.1–25.8
Gender				
Male	513	73	14.23	11.3–17.6
Female	644	81	12.58	10.1–15.4
Season ^b				
Spring	235	21	8.94	5.6–13.3
Summer	366	67	18.31	14.5–22.7
Autumn	169	39	23.08	17.0–30.2
Winter	387	27	6.98	4.6–10.0
Total	3471	462	13.31	12.2–14.5

^a There were significant difference in the prevalence of *BTV* in different counties ($p < 0.01$, $\chi^2 = 71.790$).

^b There were significant difference in the prevalence of *BTV* in different counties ($p < 0.01$, $\chi^2 = 39.238$).

infection this virus. The seasonal differences in prevalence of BTV antibodies may be because of the increasing activities of *Culicoides* in summer and autumn.

BTV is transmitted between ruminant hosts almost exclusively through the bites of the females of vector species of the *Culicoides* spp. biting midge (Khezri *et al.*, 2013). The infected goats may have a potential threat to other animals by transmitting this pathogen through midges, as in most areas of Hubei province have subtropical monsoon climates, Plentiful rainfall, with a mean annual temperature of 15–17°C.

In conclusion, the prevalence of *BTV* infections in goats is reported for the first time in Hubei province, in the central China. Considering the enormous economic losses, measures should be implemented to prevent the spread of *BTV* and zero the potential threats of *BTV* in animals in this agro-ecologically and geopolitically important region of China.

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Conflict of interest

The authors declare that they have no competing interests.

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