Seroprevalence of chlamydial infection in dairy goats in Shaanxi Province, Northwestern China

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The prevalence of chlamydial infection in dairy goats in Shaanxi province, Northwestern China was determined by indirect hemagglutination antibody (IHA) on serum samples from 729 dairy goats (263 Saanen dairy goats and 466 Guanzhong dairy goats). Antibodies to Chlamydophila sp. were detected in 21 (2.88%) serum samples, with antibody titers ranging from 1:16 to 1:64. Seropositive goats were found only in three (Zhuangli town, Wangliao town and Yangling district) of the nine locations/herds examined in six counties. The prevalence of chlamydial infection was significantly related with locations/herds ($\chi^2 = 54.36, P = 0.00$) and breeds ($\chi^2 = 56.50, P = 0.00$). Both Saanen and Guanzhong dairy goats were positive for chlamydial infection, with higher seroprevalence in Saanen dairy goats (5.70%, 15/263) than that in Guanzhong dairy goat (1.29%, 6/466). The results of the present study indicate that more integrated strategies should be carried out to prevent and control chlamydiosis in goats in Shaanxi province.

Key words: Seroprevalence, chlamydial infection, dairy goats, Shaanxi Province, Northwestern China.

INTRODUCTION

Chlamydiosis caused by the obligate intracellular gram-negative bacteria in the genus Chlamydophila (Cp.), is one of the major abortion diseases in animals and humans (Donn et al., 1997; Szeredi and Bacsadi, 2002; Pantchev et al., 2010; Xu et al., 2010). According to current taxonomy based on morphological characters and 16S rRNA and 23S rRNA gene sequences, six species were identified in the genus Chlamydophila, namely Chlamydomphila psittaci, Chlamydomphila abortus, Chlamydomphila pecorum, Chlamydomphila felis, Chlamydomphila caviae and Chlamydomphila pneumoniae (Everett et al., 1999; Siarkou et al., 2002; Pantchev et al., 2010). Among these species, C. abortus, formerly known as “Chlamydia psittaci-serotype 1”, is one of the most important causes of reproductive failure in sheep and goats, especially in the intensively managed farms (Perez-Martinez and Storz, 1985; Nietfeld, 2001). The disease caused by C. abortus usually presents ulceration of intra-caruncular areas of endometrial epithelium leading to placental infection and abortion in the last two to three weeks of gestation regardless of when the animal was infected, and also manifests epididymitis, pneumonia, arthritis and conjunctivitis (Rekiki et al., 2002; Amin, 2003; Zhong, 2009). C. abortus strains have also been isolated from faeces of healthy sheep and goats (Salinas et al., 1995; Siarkou et al., 2002).
Chlamydial infection of goats have been reported in many countries such as Poland, Tobago and Hungary (Dorn et al., 1997; Wang et al., 2001; Borde et al., 2006; Szeredi et al., 2006; Czopowicz et al., 2010), as well as China. Table 1 summarize surveys of chlamydial infection in goats in some provinces of the People’s Republic of China (PRC) which were published in the Chinese language in local journals and are not readily accessible to international readers. In recent years, much interest in rearing of dairy goats was observed among many countries including China, since consumption of goat milk is elevated in children with allergy to cow milk and also because of its similar composition to human milk (Figueiredo et al., 2001; Zhao et al., 2011). Therefore, the objectives of the present survey were to investigate the seroprevalence and associated factors of chlamydial infection in dairy goats in Shaanxi province, Northwestern China.

**MATERIALS AND METHODS**

**Experimental animals**

Blood samples were obtained from 729 dairy goats between September and October 2010, from nine randomly selected farms in six counties in Shaanxi Province. Details of locations/herds and breeds of goats, and other characteristics are listed in Table 2. Animals were farmed in extensive production systems for meat and milk and were generally kept in small herds of 20 to 200 animals. Natural breeding was the sole means of reproduction and goats from outside breeding stocks was rarely purchased. Goats were fed in-house with no grazing. In local practice, both Guanzhong and Saanen dairy goats were crossed with Saanen male goats, therefore, our study included only male goats for the Saanen breed.

**Blood sampling and serological examination**

Approximately 3 ml of blood were obtained via a jugular vein, centrifuged at 2000 g for 5 min and stored at -20°C. Antibodies to chlamydial infection were determined in sera using an indirect hemagglutination (IHA) test with a commercially available kit (Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences, Lanzhou, Gansu Province, China) according to the manufacturer’s instructions and the method of Xu et al. (2010). In brief, 75 µL of IHA dilution solution was transferred into 96 well V bottomed polystyrene plates with 25 µL of sera added and diluted in a four-fold series from 1:4 to 1:64. The plates were shaken for 2 min and then incubated at 37°C for 2 h without shaking. The test was considered positive when a layer of agglutinated erythrocytes was formed in wells at dilutions of 1:16 or higher, and positive and negative controls were included in each test.

**Statistical analysis**

Differences in seroprevalence of infected goats between the two breeds and among associated factors (location/herd, gender and age) were analyzed using the binary logistic regression in SPSS for Windows (Release 17.0 standard version, SPSS Inc., Chicago, IL, USA), and 95% confidence intervals (CI) was given (Zhao et al., 2011). The differences between levels within factors and interactions were considered to be statistically significant and highly significant when $P < 0.05$ and $P < 0.01$, respectively.

**RESULTS AND DISCUSSION**

In the present study, of the nine locations/herds in the six counties examined, only three locations/herds (one for Saanen dairy goats and two for Guanzhong dairy goats) were positive for antibodies to chlamydial infection, giving farm prevalence of 66.7% (Table 2). A total of 729 dairy goats (263 for Saanen dairy goats and 466 for Guanzhong dairy goats) were investigated. Of these, 67 were male, while 662 were female (Table 2). The binary logistic regression showed that location ($\chi^2 = 54.36, P = 0.00$) and breed ($\chi^2 = 56.50, P = 0.00$) were highly significantly associated with prevalence of infection in dairy goats. Prevalence of individual locations/herds ranged from 0 to 14.29%, with an overall seroprevalence of 2.88% (21/728). The antibody titers were 1:16 to 1:64, with 1:16 in 14 dairy goats and 1:64 in 7 dairy goats.

More also, both Saanen and Guanzhong dairy goats were positive for chlamydial infection, with higher seroprevalence in Saanen dairy goats (5.70%, 15/263) than in Guanzhong dairy goats (1.29%, 6/466). The seroprevalence in male goats (4.48%) was higher than that in females (2.72%), but the difference was not statistically significant ($P>0.05$) (Table 2). Seroprevalence in goats was different with age, and prevalence in older goats (>1 year old) was higher than that in animals below 1 year old, but the highest prevalence (10.17%) of chlamydial infection was found in the goats between 1 and 2 years old. This investigation showed that location/ herd and breed were the main factors to affect sero-prevalence of chlamydial infection in dairy goats. The prevalence of dairy goats in Shaanxi province reported in the present study was lower than that in Qinghai (Shi, 2009).
Table 2. Factors associated with seroprevalence of chlamydial infection in dairy goats in Shaanxi Province, Northwestern China.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Category</th>
<th>No. examined</th>
<th>No. positive</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td>Saanen dairy goat</td>
<td>263</td>
<td>15</td>
<td>5.70</td>
</tr>
<tr>
<td></td>
<td>Guanzhong dairy goat</td>
<td>466</td>
<td>6</td>
<td>1.29</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>67</td>
<td>3</td>
<td>4.48</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>662</td>
<td>18</td>
<td>2.72</td>
</tr>
<tr>
<td>Age</td>
<td>&lt;1 year</td>
<td>160</td>
<td>3</td>
<td>1.88</td>
</tr>
<tr>
<td></td>
<td>1 - 2 years</td>
<td>59</td>
<td>6</td>
<td>10.17</td>
</tr>
<tr>
<td></td>
<td>&gt;2 years</td>
<td>510</td>
<td>12</td>
<td>2.35</td>
</tr>
<tr>
<td>Location/Herd</td>
<td>Zhuangli town, Fuping county</td>
<td>88</td>
<td>6</td>
<td>6.82</td>
</tr>
<tr>
<td></td>
<td>Wangliao town, Fuping county</td>
<td>117</td>
<td>1</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>Dongshangguan, Fuping county</td>
<td>126</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Mizi town, Fuping county</td>
<td>160</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Yangling district</td>
<td>98</td>
<td>14</td>
<td>14.29</td>
</tr>
<tr>
<td></td>
<td>Qianyang county</td>
<td>39</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Fengxiang county</td>
<td>29</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Baishui county</td>
<td>29</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Chunhua county</td>
<td>43</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>729</td>
<td>21</td>
<td>2.88</td>
</tr>
</tbody>
</table>

2009) and Henan provinces (Wang et al., 2004) in PRC, but higher than that in Guangxi (Wu et al., 2000) (Table 1), which further indicated that goats in different locations were different in susceptibility to chlamydial infection.

Seroprevalence of chlamydial infection in dairy goats in the present study was higher than that reported in 2002 by Yang et al. (2002) (Table 1), thus suggesting that prevalence of chlamydial infection may be elevating in this province. The seroprevalence in Guanzhong dairy goats was lower than that in Saanen dairy goats. The possible explanation was that Guanzhong dairy goat is a native breed in Shaanxi province crossed with Saanen goats and may therefore get much more resistance to chlamydial infection than the pure breed of Saanen dairy goat.

In conclusion, the antibodies to *Chlamydia* were found in both Guanzhong and Saanen dairy goats, and the seroprevalence were highly associated with breed and geographical locations/herds. The seroprevalence of chlamydial infection in dairy goats in Shaanxi province is increasing with years. These results would have important implications for the prevention and control of chlamydirosis in dairy goats in this province.

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