PREVALENCE OF *SARCOCYSTIS* INFECTION IN MEAT-PRODUCING ANIMALS IN MONGOLIA

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Abstract. A survey of *Sarcocystis* infection was conducted in Mongolia between June 1998 and July 1999. Samples of muscle were taken from the diaphragm, heart, tongue, esophagus, and intercostal region of cattle, yak, hainag, sheep, horses, and camels. A muscle compress method was used to determine the prevalence of infection: cattle 90.0% (27/30), yak 93.3% (28/30), hainag 100% (30/30), sheep 96.9% (753/777), horses 75% (3/4) and camels 100% (5/5). Of the various muscles, heart was the most commonly infected in cattle (100%), yak (86.7%), and hainag (100%); tongue was most likely to be infected in sheep (100%) and horses (100%).

INTRODUCTION

*Sarcocystis* spp are common parasites of a broad range of vertebrates, including mammals, birds, and fish. Merogony and cyst formation (asexual stage) take place in the intermediate host; gametogony and sporogony (sexual stages) take place in the definitive host. Most pathogenic *Sarcocystis* spp cause disease only in their intermediate, and not definitive, hosts. In general, the *Sarcocystis* spp that are transmitted by canids or primates are more pathogenic than those transmitted by felids. Intermediate hosts show symptoms of fever, anemia, weight loss, reduction of wool quality and milk yield, abortion, and CNS signs; death may result.

The prevalence of *Sarcocystis* must be notified to livestock farming countries like Mongolia in order to reduce *Sarcocystis* infection in stock farm products. This paper reports on a study of the prevalence of *Sarcocystis* spp in meat-producing animals in Mongolia.

MATERIALS AND METHODS

Muscle samples from diaphragm, heart, tongue, esophagus and intercostal region of cattle, yak, hainag, sheep, horses, and camels were collected from the Makh Inpex and Chingeltei slaughterhouses and the Veterinary Institute, Ulaanbaatar City, the Hisig slaughterhouse, Darkhan City, and an army camp in the Central Prefecture, between June 1998 and July 1999. The cattle were brought from the Zawkhan Prefecture; the sheep were from the Zawkhan, Khuwsgul, Sukhbaatar, and Central prefectures; and the camels were from the Zawkhan Prefecture (Fig 1).

All samples were processed by the compress method in order to detect the sarcocysts. Pieces of muscle (2 mm x 8 mm) were squashed between two glass slides and examined by means of a light microscope (x100). Two preparations were made from each muscle sample and examined for positivity of *Sarcocystis*. In some animals, multiple muscle samples were examined in order to estimate parasitic diffusion. Chi-squared and Fisher’s exact tests were used to determine significant differences. A p-value of 0.05 was regarded as significant.

RESULTS

*Sarcocystis* species were detected in 90.0% of cattle, 93.3% of yak, 100% of hainag, 96.9% of sheep, 75.0% of horses, and 100% of camels (Table 1).
Table 1

Prevalence of sarcocystis infection in meat-producing animals in Mongolia.

<table>
<thead>
<tr>
<th></th>
<th>Makh Inpex</th>
<th>Chingeltei</th>
<th>Hisig</th>
<th>Vet Institute</th>
<th>Army</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animals positive</td>
<td>Animals positive (%)</td>
<td>Animals positive (%)</td>
<td>Animals positive (%)</td>
<td>Animals positive (%)</td>
<td>Animals positive (%)</td>
<td>Animals positive (%)</td>
</tr>
<tr>
<td>Cattle</td>
<td>30</td>
<td>27 (90.0)</td>
<td>30</td>
<td>27 (90.0)</td>
<td>30</td>
<td>27 (90.0)</td>
</tr>
<tr>
<td>Yak</td>
<td>30</td>
<td>28 (93.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hainag</td>
<td>27</td>
<td>28 (100)</td>
<td>30</td>
<td>28 (100)</td>
<td>30</td>
<td>28 (100)</td>
</tr>
<tr>
<td>Sheep</td>
<td>665</td>
<td>632 (96.5)</td>
<td>20</td>
<td>20 (100)</td>
<td>777</td>
<td>753 (96.9)</td>
</tr>
<tr>
<td>Horses</td>
<td>4</td>
<td>3 (75)</td>
<td>4</td>
<td>3 (75)</td>
<td>4</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Camels</td>
<td>5</td>
<td>5 (100)</td>
<td>5</td>
<td>5 (100)</td>
<td>5</td>
<td>5 (100)</td>
</tr>
<tr>
<td>Total</td>
<td>720</td>
<td>692 (96.1)</td>
<td>24</td>
<td>23 (96)</td>
<td>75</td>
<td>75 (100)</td>
</tr>
</tbody>
</table>

Table 2

Detection of sarcocysts in three different muscle tissues.

<table>
<thead>
<tr>
<th></th>
<th>Diaphragm</th>
<th>Heart</th>
<th>Tongue</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>Sample Detection (%)</td>
<td>Sample Detection (%)</td>
<td>Sample Detection (%)</td>
<td>Sample Detection (%)</td>
</tr>
<tr>
<td>Cattle</td>
<td>18</td>
<td>11</td>
<td>61.1</td>
<td>74</td>
</tr>
<tr>
<td>Yak</td>
<td>30</td>
<td>17</td>
<td>56.7</td>
<td>90</td>
</tr>
<tr>
<td>Hainag</td>
<td>25</td>
<td>21</td>
<td>84.0</td>
<td>81</td>
</tr>
<tr>
<td>Sheep</td>
<td>517</td>
<td>482</td>
<td>93.2</td>
<td>1,300</td>
</tr>
<tr>
<td>Horses</td>
<td>6</td>
<td>3</td>
<td>33.3</td>
<td>5</td>
</tr>
<tr>
<td>Camel</td>
<td>5</td>
<td>5</td>
<td>100</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>596</td>
<td>537</td>
<td>90.1</td>
<td>1,563</td>
</tr>
</tbody>
</table>

%: Detection rates
The sites of sarcocysts were: diaphragm 61.1% (11/18), heart 100% (26/26), and tongue 90% (27/30) in cattle; diaphragm 56.7% (17/30), heart 86.7% (26/30), and tongue 76.7% (23/30) in yak; diaphragm 84.0% (21/25), heart 100% (30/30), and tongue 73.1% (19/26) in hainags; diaphragm 93.2% (482/517), heart 94.2% (660/701), and tongue 100% (82/82) in sheep, diaphragm 100% (1/1), heart 33.3% (1/3) and tongue 100% (1/1) in horse, diaphragm 100% (5/5), heart 20% (1/5), tongue 33.3% (1/3), esophagus 80% (4/5), and intercostally 66.7% (2/3) in camels (Tables 2 and 3). Multiple muscle samples were examined in some animals. The detection rates are shown in Figs 2-6. The infection rates of sheep (by prefecture) were Khuwsgul 91.4%, Sukhbaatar 98.5%, Zawkhan 97.1%, and Central 96.3%.

## DISCUSSION

In Mongolia, large-scale slaughterhouses prepare and export meat to foreign countries, such as Jordan, Russia, Japan, and parts of Europe, whereas small-scale slaughterhouses provide meat for consumption within Mongolia.

Nomadic farming obliges livestock to be slaughtered during six months from June to wait for growing fat. Therefore the sampling was stopped between January and May.

A high prevalence of *Sarcocystis* infection (75-100%) was found among meat-producing animals in the studied Prefectures (Fig 1). Multiple muscle samples were examined in some animals in order to estimate the diffusion of sarcocysts: diffusion in muscle was positively correlated with the number of animals (Figs 2-6). The mean detection rate for diaphragm, heart, and tongue were 90%, 93.6%, and 89% respec-
Sarcocystis infection in animals in Mongolia

Fig 2–Detection of sarcocyst in multiple muscle samples from 18 cattle.

Fig 3–Detection of sarcocyst in multiple muscle samples from 30 yaks.

Fig 4–Detection of sarcocyst in multiple muscle samples from 25 hainags.

Fig 5–Detection of sarcocyst in multiple muscle samples from 25 sheep.

Fig 6–Detection of sarcocyst in multiple muscle samples from 5 camels.

Fig 7–Detection of sarcocysts in diaphragm, heart, and tongue muscles.
Sarcocystis phagoeicanis and S. poephagi have been reported from China as causing sarcocystosis in yaks (Wei et al., 1985). In our study the prevalence of infection among yaks was high, 93.3% (28/30), and a significantly higher (p<0.01) detection rate was seen in heart samples 86.7%, compared with diaphragm samples, 56.7%. This result shows the usefulness of inspecting heart tissue samples for Sarcocystis infection in yaks.

Hainags are hybrids of cattle and yaks. Hainags have longer coats than cattle, and the male is infertile because of immature sperm. In our study the prevalence of infection in hainag was 100% (30/30), and sarcocysts were detected in 100% of heart samples. This is significantly higher (p<0.01) than the prevalence in tongue samples (75%). This result shows the usefulness of inspecting heart tissue samples for Sarcocystis infection in hainags. Sarcocystis infection of hainag has not been reported before.

Cattle can be the intermediate host of Sarcocystis hominis and S. hirusta; yak can act as the intermediate hosts for S. poephagicanis and S. poephagi. In this study, the species of Sarcocystis that infected the hainag was not identified.

The prevalence of sarcocystosis in sheep reported from other countries is: 93.8% (195/208) in Ethiopia (Woldemeskel and Gebreab, 1992), 97% (587/605) in Iraq (Latif et al., 1999), 80.0% (4/5), 44.4% (16/36) and 45% (45/100) from different studies in Japan (Mori, 1985; Imai et al., 1990; Saito et al., 1996). In our previous study, the prevalence was 84.6% (236/279) (unpublished data).

In the present study, the prevalence of infection among cattle was higher (90.0%, 27/30) than in Australia, Ethiopia, the Philippines, and Japan. The detection rate for sarcocystis in heart tissue, 100% (26/26), was significantly higher (p<0.01) than that for the diaphragm 61.1% (11/18) (Fig 7). These results show the usefulness of inspecting heart tissue samples for Sarcocystis infection in cattle.

Yaks inhabit the mountainous regions (over 2,000 m) of Tibet, the Tarim basin, and Mongolia. Sarcocystis phagoeicanis and S. poephagi have been reported from China as causing sarcocystosis in yaks (Wei et al., 1985).

Fig 8–Cardiac muscle from sheep: heavily parasitized with sarcocysts (x100).
Wild Bactrian camels, *Camelus bactrianus ferus*, inhabited Central Asia and Northeast of China before they were domesticated. Mason (1910) made the first report of *Sarcocystis* in camels in Egypt. Kirmse and Mohanbabu (1986) reported 61.5% (118/192) infection in dromedary camels, *Camelus dromedarius*, in Afghanistan. Fatani *et al* (1996) reported 88.4% (91/103) *Sarcocystis* infection in dromedary camels in Saudi-Arabia; the muscle detection rates were 79.6% (diaphragm), 72.8% (heart, and 71.8% (esophagus). In our study, the prevalence of infection in camels was high 100% (5/5). The highest infection rate was seen in the diaphragm (100%), and was significantly higher (p<0.01) than that of heart (20%). This result shows the usefulness of inspecting diaphragm muscle samples for *Sarcocystis* infection in camels.

ACKNOWLEDGEMENTS

The authors acknowledge the cooperation of the staff of the Veterinary Institute, the Department of Ectoparasitology and Protozoology, the Immunology Center, and the slaughterhouses.

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