Diversity and seasonal occurrence of *Eimeria* species in a mixed flock of communally reared sheep and goats in Mafikeng in the North West Province, South Africa

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**ABSTRACT**

Diversity and seasonal occurrence of coccidia in a communally reared mixed flock of sheep and goats at Mafikeng, North West Province, South Africa, was determined between March 2008 and February 2009. Faecal specimens were collected directly from the rectum of the animals and the number of oocysts per gram of faeces (opg) determined. The mean monthly opg for goats was significantly higher than that for sheep. Higher oocyst counts were observed during the hot, rainy season than during the cold, dry season. The highest mean values for both the sheep (862.5 opg) and goats (1200 opg) were recorded during March. Six species (*Eimeria crandallis, E. bakunzi, E. weybridgensis, E. ahsata, E. intricata, and E. ovistriata*) were recovered from sheep, with *E. crandallis* and *E. vanzakensis* occurring most frequently. The last 2 species, together with *E. ahsata*, are considered among the most pathogenic species in sheep. In goats, 7 species (*E. arloingi, E. jolchijevi, E. caprina, E. alijevi, E. caprovinia, E. christenseni and E. hirci*) were recovered, with *E. arloingi* and *E. jolchijevi* occurring most frequently. Up to 5 *Eimeria* species were recovered from individual specimens in goats while up to 4 were recovered in sheep. No cross-infections between goats and sheep were recorded and no clinical coccidiosis was noted during the study. It is increasingly becoming evident that the pathogenic *E. arloingi* is one of the most commonly occurring *Eimeria* species in goats in South Africa.

**Keywords**: communal sheep, diversity, *Eimeria* species, goats, seasonal occurrence.


**INTRODUCTION**

Coccidiosis in small ruminants, caused by host-specific *Eimeria* species, is of economic and medical importance. Infections of sheep and goats, involving both normal and diseased individuals, have been observed in almost all rearing systems worldwide. Clinical coccidiosis is a major contributor to enteric disease of sheep and goats, occurs mainly in young animals, and has higher prevalence under conditions of intensive husbandry and various stress factors. Even though coccidiosis may prove fatal, its greater economic importance lies in the unthriftiness and lowered productivity that it causes.

Fifteen and 16 *Eimeria* species have been described from sheep and goats, respectively. Knowledge of the prevalence of *Eimeria* species in a flock helps to minimise economic losses, and to evaluate infection potential and control programmes. Coccidial infections of small stock have been reported from several African countries, including Botswana, Kenya, Nigeria, South Africa, Tanzania and Zimbabwe. Except for a few reports, there is a general paucity of information on the species and prevalence of coccidiosis in sheep and goats in South Africa, however, more so the communally reared ones. The objectives of this study were therefore to determine the diversity and seasonal occurrence of coccidial oocysts in a communal, mixed flock of sheep and goats in Mafikeng. **MATERIALS AND METHODS**

The study was conducted at the North West University teaching farm in Mafikeng (25°49’5, 25°36’E), in the North West Province of South Africa from March 2008 to February 2009. Mafikeng has a typical semi-arid savanna climate, with a long dry season extending from May to October. The mean monthly minimum temperatures vary from 2.7 °C in July to 17.7 °C in January, while mean maximum temperatures vary from 20.7 °C in June to 30.6 °C in December. The mean monthly meteorological data for Mafikeng over the last 18 years are presented in Fig. 1.

Thirty-two each of adult (>1 year) Dorper sheep and Boer goats were used in this study. The animals were housed together in a partially roofed enclosure (15 × 15 m) that had a dirt floor. The animals were kraaled at night and let out by day to graze on communal rangelands where they mixed freely with indigenous goats, sheep and cattle.

Faecal samples from goats and sheep...
were collected directly from the rectum of the animals at monthly intervals. The faecal samples were transported to the laboratory on ice and if not analysed immediately were stored at 4 °C. The modified McMaster technique was performed to determine the number of oocysts per gram (opg) of faeces. For species identification, faecal samples were collected directly from the rectum of 10 each of sheep and goats, and immediately sent to the laboratory for processing. At the laboratory, the samples were allowed to sporulate, after which they were processed and species identification performed as previously described.\\n
RESULTS\\n
Over the 12-month period, 768 faecal specimens were collected, 384 from sheep and 384 from goats. Six species, namely E. crandallis (100 %), E. bakuensis (100 %), E. weybridgensis (60 %), E. intricata (20 %) and E. ovinoidalis (20 %), were recovered from the sheep. Seven species were recovered from goats, namely E. arloingi (80 %), E. jolchijevi (80 %), E. caprina (40 %), E. alijerci (40 %), E. christenseni (20 %), E. caprovin (20 %) and E. hirci (20 %). Up to 5 Eimeria species were recovered from individual specimens in goats, while up to 4 were recovered from sheep. No cross-infections between goats and sheep were recorded.

Overall mean opg counts in sheep and goats were 544 and 774, respectively (Table 1). The lowest mean values for sheep (263 opg) and goats (375 opg) were recorded in March, at which occurred less frequently in this study. The current results also compare well with those recorded in June and October, respectively, with 6 and 7 species, respectively, being identified in this study. The most frequently occurring species in sheep were E. crandallis and E. bakuensis, which together with E. alijerci, are also the most pathogenic species in sheep. This implies higher risk of coccidiosis in sheep around Mafikeng when other predisposing factors exist. In a study on coccidiosis of sheep on commercial farms in South Africa, an additional 3 species to those identified around Mafikeng, namely E. parva, E. faurei, and E. granulosa were identified. The current results also compare well with those recorded in Tanzania and Jordan, with most of the species being similar. In goats, 7 species were identified, with E. arloingi and E. jolchijevi being the most frequently occurring. Eimeria arloingi is regarded as one of the most pathogenic species in goats together with E. christenseni and E. ninakohlyakimovae, again indicating the possible high risks for goats around Mafikeng. In a similar study in an area about 300 km east of Mafikeng, E. arloingi was also the most frequently occurring species followed by E. hirci, which occurred less frequently in this study. Another study in South Africa identified all the species in the current study except E. caprovin. Based on the current study and others conducted in South Africa, it appears E. arloingi is among the most commonly occurring Eimeria species of goats in South Africa.

Sheep excreted significantly fewer oocysts than goats in this study. This was in agreement with studies in Kenya, other parts of South Africa and Tanzania, where the mean opg counts for goats were higher than those of sheep. In both sheep and goats, higher oocyst counts were observed during the months of January to March, peaking in March (Table 1), most likely owing to the heavy rains and higher temperatures which occur in these months (Fig. 1) that favour oocyst sporulation. A study performed in southern Botswana, however, revealed no obvious seasonal patterns in the faecal levels of coccidial oocysts in goats. No evidence of clinical coccidiosis was found in this study. Previous studies have shown that Eimeria oocysts are widely present in the faeces of both normal and diseased individuals. In conclusion, goats had higher oocyst counts than sheep, while the highest counts for both species of small stock occurred during the hot, wet season than during the dry, cold season. Six different species of Eimeria were recovered from sheep, while 7 species were recovered from goats. Up to 5 Eimeria species were recovered from individual specimens in goats while up to 4 were recovered in sheep. No cross-infections between goats and sheep were recorded for all Eimeria species together with E. christenseni, E. faurei, and E. granulosa. The current results also compare well with those recorded in Tanzania and Jordan, with most of the species being similar. In goats, 7 species were identified, with E. arloingi and E. jolchijevi being the most frequently occurring. Eimeria arloingi is regarded as one of the most pathogenic species in goats together with E. christenseni and E. ninakohlyakimovae, again indicating the possible high risks for goats around Mafikeng. In a similar study in an area about 300 km east of Mafikeng, E. arloingi was also the most frequently occurring species followed by E. hirci, which occurred less frequently in this study. Another study in South Africa identified all the species in the current study except E. caprovin. Based on the current study and others conducted in South Africa, it appears E. arloingi is among the most commonly occurring Eimeria species of goats in South Africa.

ACKNOWLEDGEMENTS

The authors are grateful to the National Research Foundation (NRF-South Africa) and the North-West University for financing this study. Technical staff at the Centre for Animal Health Studies are thanked for their assistance during sample collection and analysis.

REFERENCES


Table 1: Mean monthly oocysts per gram of faeces counts and standard error of the mean (SEM) for sheep and goats.

<table>
<thead>
<tr>
<th>Months</th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 2008</td>
<td>575.0 ± 062.9</td>
<td>887.5 ± 125.1</td>
</tr>
<tr>
<td>May 2008</td>
<td>387.5 ± 053.1</td>
<td>987.5 ± 128.4</td>
</tr>
<tr>
<td>Jun 2008</td>
<td>262.5 ± 030.1</td>
<td>550.0 ± 071.8</td>
</tr>
<tr>
<td>Jul 2008</td>
<td>412.5 ± 053.1</td>
<td>587.5 ± 076.3</td>
</tr>
<tr>
<td>Aug 2008</td>
<td>435.5 ± 055.4</td>
<td>400.0 ± 063.2</td>
</tr>
<tr>
<td>Sep 2008</td>
<td>400.0 ± 054.7</td>
<td>393.5 ± 062.2</td>
</tr>
<tr>
<td>Oct 2008</td>
<td>375.0 ± 054.3</td>
<td>375.0 ± 051.2</td>
</tr>
<tr>
<td>Nov 2008</td>
<td>525.0 ± 068.0</td>
<td>775.0 ± 085.3</td>
</tr>
<tr>
<td>Dec 2008</td>
<td>825.0 ± 070.4</td>
<td>975.0 ± 099.7</td>
</tr>
<tr>
<td>Jan 2009</td>
<td>812.5 ± 111.7</td>
<td>1062.5 ± 123.4</td>
</tr>
<tr>
<td>Feb 2009</td>
<td>850.0 ± 199.0</td>
<td>1100.0 ± 123.8</td>
</tr>
<tr>
<td>Mean (opg)</td>
<td>543.7</td>
<td>774.4</td>
</tr>
</tbody>
</table>

Means with the same letter in a row are not significantly different (P > 0.05).

DISCUSSION

Six and 7 Eimeria species were recovered from sheep and goats, respectively, with no cross-infections occurring. This was not surprising since Eimeria species are known to be host specific. Fifteen and 16 species of Eimeria have been recorded in sheep and goats, respectively, of which 6 and 7 species, respectively, were identified in this study. The most frequently occurring species in sheep were E. crandallis and E. bakuensis, which together with E. alijerci, are also the most pathogenic species in sheep. This implies higher risk of coccidiosis in sheep around Mafikeng when other predisposing factors exist. In a study on coccidiosis of sheep on commercial farms in South Africa, an additional 3 species to those identified around Mafikeng, namely E. parva, E. faurei, and E. granulosa were identified. The current results also compare well with those recorded in Tanzania and Jordan, with most of the species being similar. In goats, 7 species were identified, with E. arloingi and E. jolchijevi being the most frequently occurring. Eimeria arloingi is regarded as one of the most pathogenic species in goats together with E. christenseni and E. ninakohlyakimovae, again indicating the possible high risks for goats around Mafikeng. In a similar study in an area about 300 km east of Mafikeng, E. arloingi was also the most frequently occurring species followed by E. hirci, which occurred less frequently in this study. Another study in South Africa identified all the species in the current study except E. caprovin. Based on the current study and others conducted in South Africa, it appears E. arloingi is among the most commonly occurring Eimeria species of goats in South Africa.
This DVD is essentially a teaching tool. It is a result of a stated aim to provide practitioners as well as students and academics with a visual and 3-D appreciation of normal and abnormal parturition. In addition, there is provision by a panel of experienced clinicians of recommended therapeutic methods for correction of abnormal parturition (dystocia).

The DVD is remarkable for being the result of the coordination of a relatively large group of internationally acknowledged authorities in the field of equine reproduction, more specifically in the areas of pregnancy and obstetrics. The editors and co-editors were assisted by numerous additional contributors.

It contains 2 film sequences and 45 minutes of 3-D animations. The material covers intra-uterine foetal development, the normal sequences of parturition together with associated abnormalities and complications of the pre-, intra-, and post-partum periods, respectively. There is additional material (film and animation) illustrating obstetrical and surgical intervention via manipulation, foetotomy and caesarian section.

The DVD has voice-overs and text translations in PDF format available with a selection of English, French, Spanish, Italian, Japanese, Dutch and German.

The modules are subdivided into the following chapters: a) foetal development; b) stages 1, 2 and 3 of parturition; c) dystocia, and d) miscellaneous conditions.

The foetal development chapter has useful animation showing foetal development and selected features from day 150 of gestation until term. The parturition chapter includes both a film and 3-D animation sequence of normal parturition. The dystocia chapter is comprehensive in detailing the many maldispositions that may be encountered. Accompanying these different scenarios is recommended therapeutic intervention by both manipulation and foetotomy. A film sequence shows the surgical approach to an elective caesarian section. In the miscellaneous chapter, animation sequences illustrate uterine torsion, bladder eversion and prolapse and rectal prolapse as complications of pregnancy and parturition.

The animation sequences are of an extremely high standard of graphical representation of a 3-D appreciation of the events, both normal and abnormal. The film sequences are also of an adequate standard to illustrate normal parturition as observed. There is also a reasonably comprehensive demonstration of the criteria for evaluating the immediate post partum neonate. The film sequence of the depiction of caesarian section is adequate and is made credible by showing operators obviously experienced in their approach to this procedure.

The DVD would have been even more useful to practitioners if it provided additional material illustrating the presenting clinical signs and diagnostic approaches to the various clinical scenarios.

The English voice-over is good, featuring a well-modulated and clear voice. There are nevertheless a few minor translational errors in the dialogue; these ‘false notes’ do not, however, detract from the overall presentation.

I found that the DVD is a remarkable achievement. The contributors represent a wealth of scientific knowledge, clinical experience and acumen. The DVD will be invaluable primarily to veterinary students as well as very useful to practitioners in understanding the events of normal parturition and enhancing the ability of clinicians to intervene rationally and effectively in problems associated with parturition.