Relationship between Coccidiosis Infection and Hematological Profile, Body Weight and Famacha Scores in Dorper Sheep

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Abstract

Imported Dorper sheep raised in the Tropics are subjected to endo-parasitic infestation which may affect their morbidity and total productivity in lamb production. Few reports are available to provide guidelines in the efficient husbandry of these sheep, especially those raised in this country. A study was conducted to examine the association between hematological parameters, body weight and Famacha scores and coccidia infection from Eimeria spp. in Dorper lambs managed in an oil palm holding in Lepar, Pahang. Fresh faecal samples of purebred Dorper (n=20) and crossbred Dorper-Damara (n=20) lambs aged 2 to 3 mo were taken twice at 7-day interval for assessment of coccidial infestation as measured by number of oocysts per g of faeces (OPG). Blood samples were collected for hematological profile. The mucosa colour of the eyes of the sheep was scored using the Famacha chart. Eimeria oocysts were present in all purebred and 90% of crossbred Dorper lambs. The frequency of Eimeria species identified were *E. parva* (31%), *E. marsica* (18%), *E. weybridgensis* (17%), *E. pallida* (12%), *E. bakuensis* (11%), *E. faurei* (5%), *E. ahsata* (4%) and *E. granulosa* (2%). OPG and body weight showed no significant difference between breed groups. Significant correlation between body weight and OPG ($r = -0.49$, $P<0.01$) was detected. The severity of coccidiosis as measured by OPG when classified as low-medium, high and very high showed a significant correlation ($r=0.48$, $P<0.01$) with FAMACHA score. Packed cell volume (PCV) and plasma protein (PP) did not differ significantly ($P>0.05$) between breed groups. However, significant differences between breed groups for electrolyte parameters (Na, K and Cl, $P<0.05$) were found. In conclusion, purebred and crossbred Dorper lambs do not show significant difference in pre-weaning body weight, PCV and PP levels while coccidiosis appears to affect body weight, Famacha scores and electrolyte levels.

Key words: coccidiosis, hematological parameters, body weight, Famacha scores, Dorper sheep

Introduction

Dorper sheep are known to be hardy and have the ability to perform well in the Tropics (Budai *et al*., 2013) with the capacity to produce top quality carcass at a relatively early age (Milne, 2000). Dorper sheep have been known to be highly resistant towards ticks and parasites and thus are easy to manage with minimal health problems. Coccidiosis due to *Eimeria* spp is an economically important disease in ruminants as it may result in lower productivity due to its associated high morbidity and mortality. Sheep of all ages are susceptible to *Eimeria* infection but lambs are most severely affected by clinical coccidiosis (Khan *et al*., 2011; Wang *et al*., 2010).

The major *Eimeria* species known to cause coccidiosis in sheep are *E. ovinoidallis*,

E. crandallis, E. bakuensis, E. ahsata and *E. parva* (Skirnisson, 2007), of which the first two spp. are highly pathogenic (Andrews, 2013). Although sheep have been infected in higher number of non-pathogenic or moderately pathogenic Eimeria spp. sheep do not show any clinical signs of coccidiosis and the infected sheep appear healthy (Constable, 2012).

A higher number of oocysts per g of faeces (OPG) present in young lambs is not necessarily indicative that the lambs are diseased with coccidiosis. However, it is related to the pathogenicity of the *Eimeria* spp. (Berriatua *et al*., 1994). Coccidia invade and destroy intestinal epithelium of the host, causing electrolyte loss and poor absorption of nutrients. Some lambs that were severely infested with pathogenic *Eimeria* spp. showed anemia and diarrhea (Wang *et al*., 2010). Speciation is conducted to confirm the involvement of pathogenic strains in sporulation and differentiation of *Eimeria* spp. based on specific features of the oocyst such as size, shape, colour, presence or absence of micropylar cap and shape of the sporocyst.

However, there is a paucity of information regarding coccidiosis infestation in Dorper sheep raised in the country. A study was conducted to identify coccidia species and examine the relationship among hematological parameters, body weight and Famacha scores and coccidiosis infection in purebred and crossbred Dorper sheep raised locally.

Materials and Methods

Study Site and Animals

The study was conducted at a Dorper sheep farm in a Felda oil palm scheme, Batu 8, Lepar, Pahang. The breeding stock comprised mainly of purebred Dorper and Damara-Dorper crossbred sheep which were imported from South Africa. The farm was managed intensively and sheep were managed in separate pens in raised floor sheds. Sheep were fed with cut Napier (*Pennisetum purpureum*) and Guinea (*Panicum maximum*) grasses, and palm kernel expeller feed concentrate. Mineral blocks and water were provided *ad libitum.*

Twenty purebred Dorper and 20 crossbred Dorper-Damara lambs were selected randomly from a uniform group of healthy recently born lambs and divided equally by gender. The age of the lambs ranged from 2 – 4 mo. Anthelminthic treatment was not provided to the general herd six mo prior to the study. Faecal samples were taken twice at 7 d-interval and blood samples were obtained once during the study. Body weight and body measurements (body length, height at withers and heart girth) were also obtained.

Faecal oocysts were identified and quantified by using modified McMaster technique (Jalila, 1994). Faecal samples of selected lambs were collected from the rectum using examination gloves and stored at 4 °C until examined.

Parameters

The OPG was determined following equation:

$$\text{OPG} = \frac{\text{number of oocysts counted}}{\text{weight of faeces}} \times \frac{\text{volume of sodium chloride}}{2 \times 0.15^*}$$

*volume of McMaster chamber

All counts and identification of oocysts were performed by the same personnels. OPG results were presented as means of the two independent examinations.

Species identification was done by sporulation process where the fecal samples with positive oocyst count were mixed with 2.5% potassium dichromate solution.

Unsporulated coccidia oocysts in the mixture solution were allowed to sporulate in petri dishes at room temperature for 2-3 d until sporulated oocysts were observed. The *Eimeria* spp were identified based on their size and morphological characteristics as described by Wang *et al*. (2010). The length and width of each sporulated oocyst were measured . The presence of morphological characteristics especially the micropyle cap was determined using microscope Moticam live module 20. Both size and morphological characteristics were used for speciation of *Eimeria* spp.

Blood samples were obtained from jugular vein using plain and EDTA vacutainer tubes. Blood samples from plain tubes were centrifuged and used to determine packed cell volume (PCV), total protein and plasma protein (PP) levels and albumin to globulin ratio (A:G). EDTA tubes were used for determination of electrolyte parameters of Na, Cl and K.

Famacha scores were used to measure level of anaemia or blood loss based on the colour of the lower eyelid mucous membrane Famacha chart. Famacha-scores ranked from 1 to 5 (1= dark red eyelid membrane indicating no significant anemia, 2 - 4 = light red, pink and pinkish white colours of the eyelids indicating increasing levels of anemia and 5 = denoting white colour eyelid with severe anemia) corresponding to the parasite burden carried by that animal (Azlina, 2010).

Statistical Analysis

Data on BW, body measurements and hematological parameters were analyzed with independent t-test to detect the difference between breed groups while OPG data were analyzed with t-test on log10 transformed mean OPG. Difference between breed groups for Famacha score was detected using non-parametric Mann-Whitney test. All analyses were performed using IBM SPSS Statistic Version 22. Chicago, IL: IBM.

Results and Discussion

The length and the width of sporulated oocysts of the *Eimeria* spp are presented in Table 1 and the distribution of the Eimeria spp by size was represented in Figure 1. Among the *Eimeria* sp. recovered in the faeces of Dorper lambs the smallest *Eimeria* species identified was *E. parva* (13.6 x 12.1 µm).

Table 1: Mean values of length and width of *Eimeria* species

Species	No. measured for length	Length (µm)	No. measured for width	Width (µm)
E. parva	31	13.6[a]	12	12.1[a]
E. pallida	12	14.3[a]	18	11.1[a]
E. marsica	18	15.9[ab]	31	11.2[a]
E. weybridgensis	17	20.2[bc]	17	13.3[a]
E. granulosa	2	20.7[bc]	2	14.3[a]
E. faurei	5	22.6[c]	11	16.9[ab]
E. bakuensis	11	23.4[c]	5	14.3[a]
E. ahsata	4	28.6[d]	4	18.8[b]

[abcd]Means within columns with different superscripts differ significantly at $P < 0.05$

E. ahsata appeared to have the largest size among the species identified as it stood alone in length (28.6 µm) and width ((18.8 µm) but was not larger (P>0.05) in width compared with *E. faurei* (16.9 µm).

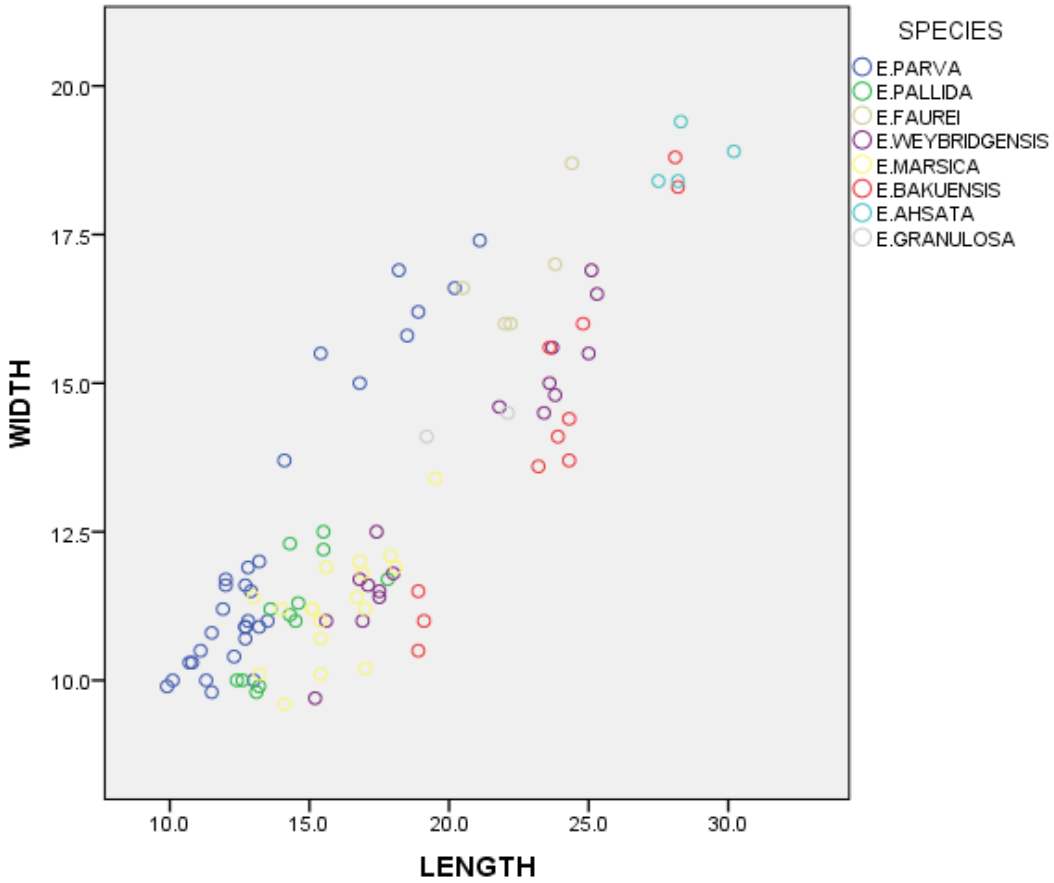

Figure 1: Distribution of *Eimeria* species by mean length and width of sporulated oocysts

Eimeria oocysts were presented in all purebred and 90% of crossbred sheep sampled. Eight species of *Eimeria* were identified by coprological examination (Figure 2). The prevalence rate of *Eimeria* sp. in both breed groups have shown *E. parva* was the commonest identified species (31%), followed by *E. marsica* (18%), *E. weybridgensis*(17%) , *E. pallida* (12%), *E. bakuensis* (11%), *E. faurei* (5%), *E. ahsata* (4%) and *E. granulosa* (2%) (Table 2). *E. marsica* (15%) was the highest species present in purebred Dorper lambs whereas *E. parva* (23%) was the highest species found in crossbred Dorper sheep. However, no highly pathogenic *Eimeria* spp of *E. crandallis* and *E. ovinoidallis* were observed in the sample studied. Clinical coccidiosis only occurs in the presence of pathogenic *Eimeria* species. Coccidiosis is present worldwide and thus it is difficult to link any particular geographical distribution with one or other species of coccidia. This could probably be a reason why not all *Eimeria* spp infect sheep in the present study.

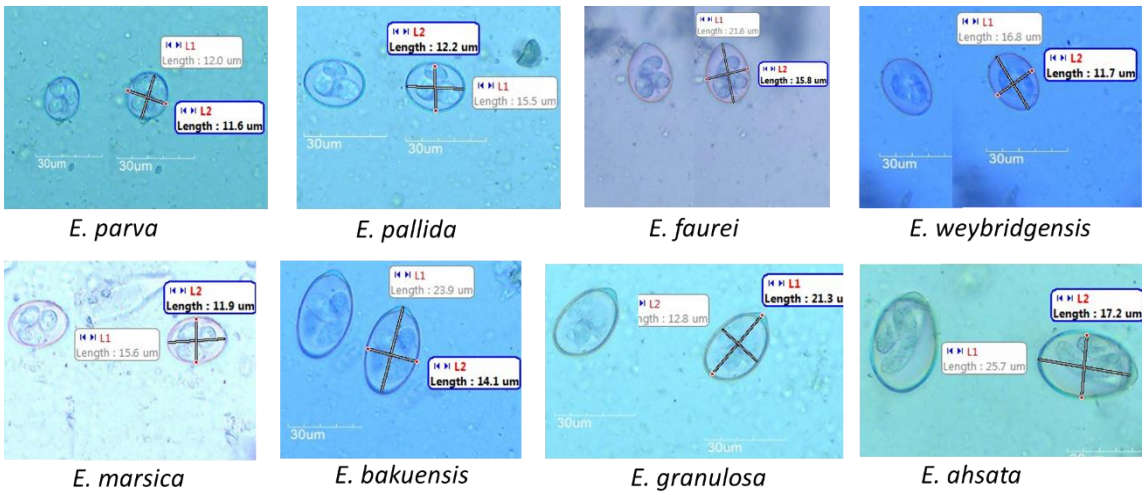

Figure 2: Identification of *Eimeria* spp in Dorper lambs

Table 2: Prevalence of *Eimeria* spp in purebred and crossbred Dorper lambs

Species	% Prevalence		
	Purebred (n=40)	Crossbred (n=40)	Overall
E. parva	8	23	31
E. pallida	5	7	12
E. faurei	5	0	5
E. weybridgensis	9	8	17
E. masica	15	3	18
E. bakuensis	6	5	11
E. ahsata	2	2	4
E. granulosa	0	2	2

The mean OPG of purebred Dorper lambs (1,848) was not significantly different from that of crossbreds (1,985, P>0.05). Similarly no significant difference in BW and body measurements between breed groups was detected (Table 3).

Table 3: Mean body weight, body measurements and oocysts per g (OPG) in purebred and crossbred Dorper lambs

Parameter	Purebred	Crossbred	P value*
Body weight (kg)	12.9±0.57	12.9±0.55	0.950
Body length (cm)	46.2±0.76	48.0±0.90	0.135
Height at withers (cm)	45.2±0.89	25.9±0.52	0.531
Heart girth (cm)	52.9±1.16	54.6±0.97	0.905
OPG	1848.4±1.57	1985.2±1.46	0.905

*P value for mean comparison between purebred and crossbred sheep

No clinical signs of coccidiosis were seen in any of the lambs studied. Most samples collected consisted of well-formed faeces and diarrhoea was not seen in any of the sheep. PCV and PP values in both breed groups were within the normal range with no significant differences between the two breed groups. However, electrolyte parameters especially Na and Cl together with total protein serum values in both purebred and crossbred Dorper lambs were within the lower range with significant difference ($P<0.05$) detected between breed groups (Table 4). In animals infected with coccidiosis, the serum protein and electrolyte parameters may appreciably be altered which reduces transiently the level of sodium (hyponatremia) while level of potassium remains stable (Daugschies *et al*., 1997).

Table 4: Mean values of hematological parameters of purebred and crossbred Dorper lambs

Parameter	Normal range	Purebred	Crossbred	P value
PCV	0.27-0.45 L/L	36.30±0.824	35.50±0.734	0.473
Plasma protein	60-75 g/L	59.90±1.244	59.70±1.242	0.910
Na	139-152 mmol/L	122.10±2.580[a]	112.52±2.115[b]	0.007
K	3.9-5.4 mmol/L	5.02±0.268[a]	4.25±0.197[b]	0.026
Cl	95-103 mmol/L	83.46±2.147[a]	75.43±1.740[b]	0.006
Total protein	55-70 g/L	38.96±1.643[a]	33.74±1.446[b]	0.022
Albumin:globulin ratio	0.5-1.2 units	1.07±1.204	1.07±1.188	0.608

[ab]Means within rows with different superscripts differ significantly at $P < 0.05$

The results revealed that electrolyte loss in crossbred Dorper lambs was higher compared to purebreds. This may be due to presence of a high number of moderately pathogenic *E. parva* in crossbreds than in purebred Dorper lambs which had a high number of non-pathogenic species (*E. marsica*). The electrolyte loss in the present

study showed only mild changes. It could be due to the subclinical changes of hematological profile. If the animal was not treated when other associated risk factors such as stress and heavy oocyst burden were observed, they may develop into diarrhoea over the time. Malnutrition may also affect the electrolyte parameters, however, the albumin level was within normal range and thus the cause of the electrolyte changes could be attributed to gastrointestinal problem.

In this study, only Famacha scores 2 and 3 were identified in the lambs. Both scores were compared with the mean OPG (Table 5). Animals showing borderline anaemia score (score 3) had significantly higher coccidia count compared to animals with score 2.

Table 5: Log10 mean values of OPG in Famacha score 2 and 3

Famacha score	Mean OPG
2 (acceptable)	3.02 ± 0.140^{a}
3 (boderline)	3.79 ± 0.194^{b}

[ab]Means within column with different superscripts differ significantly at $P < 0.05$

Three parameters: OPG, BW and PCV were examined for their relationship with Famacha score which reflected the anaemic level of the animals due to the effect of coccidiosis (Table 6). Highly significant correlation between OPG and BW (-0.49, P<0.01) and Famacha score (0.477, P<0.01) indicated that increasing OPG had the effect of decreasing body weight of the Dorper lambs and was correlated with high Famacha score. Severity of anaemic condition as reflected in high Famacha score was significantly associated with decreased body weight of the lambs (r=-0.334, P<0.05).

Table 7: Correlation coefficients among coccidia count (OPG), body weight (BW), packed cell volume (PCV), and Famacha score

	BW	PCV	Famacha score
OPG	-0.490**	-0.081	0.477**
BW		0.026	-0.334*
PCV			-0.193

** Highly significant correlation (P<0.01), *Significant correlation (P<0.05)

Conclusion

Three *Eimeria* sp (*E. bakuensis*, *E. ahsata* and *E. parva*) of moderate pathogenicity were observed in Dorper lambs. Coccidiosis infection appears to be associated with decreased body weight and blood electrolyte levels. Lambs with high OPG for coccidia count would most likely score higher on the Famacha chart reflecting severity of anaemic condition of those lambs infected with coccidia.

References

Andrews, A.H. 2013. Some aspects of coccidiosis in sheep and goats. *Small Ruminant Research*. 110: 93-94.

Azlina, A.A. 2013. Anthelmintic resistance, validation of FAMACHA and effects of management practices in selected goat farms in Terengganu, Malaysia. Master thesis, Universiti Putra Malaysia.

Berriatua, E., Green, L.E., and Morgan, K.L. 1994. A descriptive epidemiological study of coccidiosis in early lambing housed flocks. *Veterinary Parasitology*. 54: 337-349.

Budai, C., Gavojdian, D., Kovacs, A., Negrut, F., Olah, J., Cziszter, L.T., Kusza, S., and Javor, A. 2013. Performance and adaptability of the Dorper sheep breed under Hungarian and Romanian rearing conditions. *Scientific Papers: Animal Science Biology* 46: 344-350.

Constable, P.D. 2012. Overview of coccidiosis. *The Merck Veterinary Manual 10th Edition*. Retrieved from http://www.merckmanuals.com/vet/digestive_system/coccidiosis/overview_of_coccidiosis.htm

Daugschies, A., Burger, H., and Akimaru, M. 1997. Effects of experimental infection with *Eimeria bovis* on the balance of sodium, potassium and water in calves. *Parasitology International*. 46: 159-166.

Khan, M.N., Rehman, T., Iqbal, Z., Sajid, M.S., Ahmad, M., and Riaz, M. 2011. Prevalence and associated risk factors of *Eimeria* in sheep of Punjab, Pakistan. *International Science Index*. 55: 366-367.

Milne, C. 2000. The history of Dorper sheep. *Small Ruminant Research*. 36: 99-101.

Skirnisson, K. 2007. Eimeria spp. (Coccidia, Protozoa) infections in a flock of sheep in Iceland: Species composition and seasonal abundance. *Iceland Agricultural Science*. 20: 74-79.

Wang, C.R., Xiao, J.Y., Chen, A.H., Chen, J., Wang, Y., Goa, J.F., and Zhu, X.Q. 2010. Prevalence of coccidial infection in sheep and goats in northeastern China. *Veterinary Parasitology*. 174: 213-215.