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Impacts of naturally acquired protozoa and strongylid nematode infections on growth and faecal attributes in lambs

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ABSTRACT

On two separate sampling occasions, faecal samples were collected from lambs (2–5 months of age) grazing pasture on two separate sheep farms in southern Western Australia. Live weight, body condition score (BCS), faecal consistency score (FCS) and faecal dry matter percentage (DM%) were measured. Faecal samples were screened by PCR for *Cryptosporidium* (18S rRNA, actin and 60 kDa glycoprotein [*gp60*] loci), *Giardia duodenalis* (glutamate dehydrogenase [*gdh*] and β-giardin) and patent strongylid nematode infections (ITS-2 nuclear ribosomal DNA for *Haemonchus contortus*, *Teladorsagia circumcincta*, *Trichostrongylus* spp. *Chabertia ovina* and *Oesophagostomum* spp.). Faecal worm egg counts (WECs) were performed using a modified McMaster WEC technique. The WECs were adjusted for FCS and transformed using $\log_{10}$(adjusted WEC + 25) prior to statistical analyses.

Cryptosporidium, *Giardia* and *Trichostrongylus* spp. detected by PCR were associated with an increased risk of non-pelleted faeces (FCS $\geq$ 3.0) for both flocks. *Cryptosporidium*-positive lambs were 2.8–11.6 times more likely to have non-pelleted faeces and *Giardia*-positive lambs were 2.4–14.0 times more likely to have non-pelleted faeces compared to lambs negative for each respective parasite. Lambs positive for both *Cryptosporidium* and *Giardia* were 2.9–11.8 times more likely to have non-pelleted faeces than lambs positive for only one or neither of these parasites. Mixed internal parasite infections were found to have greater impacts on FCS and BCS than single infections. A higher number of internal parasites detected per lamb was associated with lower BCS and more loose faeces. The relationship between parasite detection and live weight or growth rate were inconsistent for both flocks. Adjusted WEC was correlated with FCS and faecal DM% for one flock only, although little or no correlation was found with live weight and growth rate for both flocks. *Cryptosporidium ubiquitum* and *Cryptosporidium parvum* were the most prevalent *Cryptosporidium* species isolated in the two flocks. *Giardia* assemblage E was the most commonly isolated genotype assemblage from both flocks, while assemblage A was isolated almost as frequently as assemblage E in the one flock. One flock was a potential source of zoonotic *Cryptosporidium* and the other flock was a potential source of zoonotic *Giardia*.

1. Introduction

Strongylid nematodes have important impacts on sheep health, welfare and productivity worldwide (Fox, 1997; Sackett et al., 2006; Broughan and Wall, 2007; Sutherland et al., 2010) and have been associated with reduced live weight (Datta et al., 1999), growth rate (Datta et al., 1999; Macchi et al., 2001; Louie et al., 2007), diarrhoea (Broughan and Wall, 2007) and mortalities (Dargie and Allonby, 1975) in lambs. Diarrhoea is one of the most common clinical signs associated with strongylid infections in lambs (Besier and Love, 2003), but can also be caused by other pathogens

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including coccidia (*Eimeria*), protozoa (*Cryptosporidium* and *Giardia*), bacteria (*Campylobacter* spp., *Yersinia* spp. and *Salmonella* spp.) and viruses (Skirrow, 1994; Belloy et al., 2009). Diarrhoea results in an increased risk of breech faecal soiling of the fleece (Broughan and Wall, 2007). Breech fleece faecal soiling increases the risk of cutaneous myiasis (blowfly strike), and management of this disease increases costs and reduces productivity for sheep enterprises (Morley et al., 1976; Hall and Wall, 1995; Sackett et al., 2006). Breech fleece faecal soiling also increases the risk of carcase contamination with faecal pathogens associated with food poisoning, meat spoilage, reduced product shelf life and reduced efficiency of carcase contamination, as faecal pathogens are associated with food poisoning, (Greer et al., 1983; Hadley et al., 1997).

The intestinal protozoan parasites *Cryptosporidium* and *Giardia* are capable of infecting both domestic livestock and humans worldwide (Thompson et al., 2008; Xiao and Fayer, 2008). Protozoan infections have been commonly reported in young, naive lambs worldwide, including Australia (Yang et al., 2009; Sweeny et al., 2011b). Both organisms have been associated with diarrhoea (Aloisio et al., 2006; Sweeny et al., 2011a), reduced growth rate and feed intake (Olson et al., 1995; Ralston et al., 2003), depression and dehydration in lambs (Aloisio et al., 2006). However, the consequences of mixed parasite infections (strongylid nematodes and protozoan) in lambs raised specifically for meat production have not been well described.

The aims of this study were to investigate associations between intestinal parasites (specifically strongylid nematodes, *Cryptosporidium* and *Giardia*) with live weight, growth rate and body condition score (BCS), as well as the faecal attributes of lambs grazing pasture in southern Western Australia. A further aim of this study was to use molecular instruments to characterise the *Cryptosporidium* and *Giardia* species/genotypes in both lamb flocks, to determine whether either flock was a potential zoonotic source for these protozoa.

2. Materials and methods

2.1. Study sites, animals and production measurements

This experiment was approved by the Murdoch University Animal Ethics Committee (permit R2369/10). Lambs were located on two farms, Boyup Brook and Kojonup (Table 1) in southern Western Australia, specifically in a region which experiences a Mediterranean environment characterised by hot, dry summers and cool, wet winters (Moeller et al., 2008). Lamb flocks were each raised on a single paddock, the major pasture plant species being annual rye-grasses (*Lolium* spp.) and sub-terraneum clover (*Trifolium subterraneum*).

Lambs from each flock were randomly selected and identified with ear tags. Faecal samples were collected rectally from only these identified lambs in September (2–3 months old) and December 2010 (4–5 months old). Faecal samples were placed in individually labelled, airtight 70 ml containers and stored at 2–4 °C. Faecal consistency score (FCS) was recorded using a scale of 1 (hard dry faecal pellet) to 5 (liquid/fluid diarrhoea) previously described

Table 1
Geographical location and sheep information for sheep farms in this present study.

Geographical farm location	Sampling occasions		Mean annual rainfall (mm)	Farm size (Hectares)	Sheep on farm (*n*)	Lamb breed	Commencement of lambing	Goats and/or cattle on property	Winter stocking rate
	First sampling	Second sampling							
Boyup Brook	Oct 27th	Dec 1st	560	350	1850	Merino × White Suffolk	Late May	Cattle, no goats	5.6 DSE/Ha
Kojonup	Nov 8th	Dec 7th	525	450	1350	Merino × Poll Dorset	Mid June	Neither	9.0 DSE/Ha

Note: DSE = dry sheep equivalent, is a standard unit frequently used to compare animal carrying capacity and potential productivity of a given farm or area of grazing land. It also aids in helping assess feed requirements of different classes for livestock (McLaren, 1997).