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TURNING THE WORM

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Welcome to this issue of TTW. The main purpose of this informal newsletter is to share information with those particularly interested in the management of endoparasites of farmed animals, including sheep, goats and cattle.

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Roo worms and domestic livestock

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There is a plethora of intestinal nematodes in kangaroos and wallabies (Spratt, Beveridge and Walter 1990), but few are pathogenic even in large numbers. One exception is the macropod hookworm *Globocephaloides* spp. in eastern grey kangaroos (*Macropus giganteus*) where death can results from severe anaemia (Arundel, Baker and Beveridge 1977). The numbers of nematodes in the sacculated forestomach of macropods, particularly of the genus *Cloacina* are so great as to warrant being labelled a "Species flock" (Beveridge, Chilton and Spratt 2002).

Most macropod species have their own unique nematode species, but several can be found in a range of hosts. As far as I am aware there are no important (common) worms from macropods that also infect domestic livestock (Smales and Mawson 1978). However, I vaguely recall that some trichostrongylids from sheep may rarely be found in wallabies or other marsupials, but not the other way round.

The best examples are seen in the brushtail possum *Trichosurus vulpecula*, which is recorded to have been infected with a number

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of Trichostrongylidae (see Viggers and Spratt 1995 for a review of parasites in the possum).These include *Trichostrongylus colubriformis* where possums graze pastures that are contaminated from infected sheep (Bowie and Bennett 1983). Other 'trichs' include *T.axei*, *T.rugatus*, *T. retortaeformis* (ex rabbits), and *T.vitrinus*. Other species that have also been found rarely in possums in the Sydney region (Gordon and Sommerville 1958) include *Cooperia curticei* and *Nematodirus* spp.

In parasite groups other than nematodes, as far as zoonoses are concerned *Toxoplasma* would be top of the list of parasites that can be found in both macropods and livestock, but transmission from one to the other would of course be dependent on cats as final hosts. Coccidia are plentiful in macropods (see Duszynski, Couch and Upton 2000 for a recent listing) but as with most *Eimeria* species in other hosts such as sheep or cattle, they are very host specific and there are no reports of cross transmission to livestock.

Most macropods are also highly susceptible to liver fluke (*Fasciola hepatica*), and some species are good intermediate hosts for hydatid disease. Therefore macropods could act as reservoir hosts and contribute to the spread of these diseases to cattle or sheep if livestock are introduced to areas with infected macropods where they had not been previously.

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Effect of immunosuppression on host-parasite interaction in sheep infected with *Haemonchus contortus*

Natasha Morley and Steve Walkden-Brown

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Summary

It has been recently reported that immunosuppression using methylprednisolone caused greatly increased worm burdens of *Trichostrongylus colubriformis* and *Teladorsagia circumcincta* with little effect in

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sheep performance (Greer et al., 2005a;b). This indicates that the host immune response is heavily involved in the pathological effects induced by these two parasites. This fits with the Le Jambre theory of co-evolution (Love, 2005) that sheep evolved in Asia with *Trichostrongylus* spp. and *Teladorsagia circumcincta* as commensals rather than parasites and that immune responses against them are an unneeded consequence of the need to develop an immune response to the far more pathogenic *Haemonchus contortus*.

Results of previous studies on immunosuppression with dexamethasone and *H. contortus* infection have found that corticosteroids increased worm burden (Adams, 1982; 1988; Adams and Davies, 1982; Presson, Gray and Burgess, 1988). While, in one case it has been reported that corticosteroids had no effect on worm burden (Adams and Davies, 1982), most of this work did not formally test effects of immunosuppression on the pathogenesis of infection with proper control groups as used by Greer and colleagues (2005a;b), prompting the following experiment.

The objective of this experiment was to investigate the role of the host immune response in the pathogenesis of *Haemonchus contortus* infection of non-naïve six-month-old superfine merino wethers. One group (n=10) was infected with 150 L3 per kg body weight (BW) on day 0 followed by 250 Kirby strain L3 *H. contortus* larvae per head, maintenance dose three times a week (IF) while a second group (ISIF) received the same infection but with immune function suppressed by a weekly injection of 1.3mg/kg BW of the corticosteroid methylprednisolone acetate intramuscularly. Immunosuppression started concurrently with the initial infection. A third group received only the corticosteroid (IS) and the fourth remained as uninfected and non-immunosuppressed controls (C). Treatments were applied for 8 weeks following a 3 week adaptation period to the animal house.

The parasitological and performance variables measured were liveweight, voluntary feed intake, worm burden, whole blood haematology analysis and carcase variables. WEC and worm burden results revealed no significant effect of immunosuppression. A plateau effect was observed in WEC from day 28 for both treatments, however this effect was more obvious in immunosuppressed sheep. There was a trend towards lower WEC and total worm burden in immunosuppressed sheep (6310, IF v. 5888, ISIF). Despite these findings, immunosuppression was successful as evidenced by significantly higher neutrophil count ($2.7l \pm 1.1x10^6$/ml, IS v. $2.2 \pm 1.1x10^6$/ml, NIS) and significantly reduced lymphocyte ($2.1 \pm 1.1x10^6$/ml, IS v. $2.6 \pm 1.1x10^6$/ml, NIS) and eosinophil counts ($0.04 \pm 1.1x10^6$/ml, IS v. $0.08 \pm 1.1x10^6$/ml, NIS). Significant differences were also revealed for liver weight (899g ± 33.4, ISIF v. 798g ± 22.4, IF) and adrenal gland weight (2.09± 0.08g, IF v. 1.35± 0.08g, ISIF). The level of immunosuppression induced did not prevent growth impairment in IF animals and itself slowed growth overall despite significantly greater voluntary feed intake in immunosuppressed sheep. Infection caused a significant reduction in VFI.

The lack of an effect of immunosuppression on worm burdens was unexpected, being reported only once before (Adams, 1982). It did not appear to be due to lack of immunosuppression as functional immunosuppression was evident in results achieved for adrenal gland weight, liver weight and neutrophil, eosinophil and lymphocyte counts. Trickle infection was successful and there was no loss of infectivity with all stages of development of *Haemonchus* recovered following termination of the experiment. The use of non-naïve sheep is an unlikely cause as responses in both naïve and non-naïve sheep have been reported previously before. The timing of immunosuppression relative to infection appears not be critical based on previous publications (Adams, 1982; Pena, Miller & Horohov, 2004), nor is the breed of sheep used likely to explain the findings as immunosuppression increased *H. contortus* infection in many experiments with Merinos. However the dose of corticosteroid and level of immunosuppression may be a factor. Corticosteroids have different levels of potency with regards to the induction of immunosuppression in ruminants. Methylprednisolone is 5 times more potent than hydrocortisone, while Dexamethasone is 30 times more potent than hydrocortisone (Ferguson and Hoenig, 1995). In this experiment we used 1.3mg/kg of Methylprednisolone weekly whereas other studies with *H. contortus* have used Dexamethasone 0.5mg/kg weekly or up to 3

times weekly which could potentially induce 2-6 fold greater immunosuppression than the immunosuppression treatment used in this experiment.

Because the level or type of immunosuppression induced in this experiment did not affect the level of infection with *H. contortus*, firm conclusions about the role of the host immune response in mediating the pathogenic effects of infection cannot be made. Nevertheless, the sheep were immunosuppressed as determined by a range of other measures and this did not influence the pathogenicity of the infection. This is in sharp contrast with infections with *T. colubriformis* or *Te. circumcincta* using the same experimental model in which the host immune response is clearly implicated in the pathogenic effects of infection (Greer *et al* 2005a; 2005b). This apparent species difference is consistent with the Le Jambre hypothesis that *Haemonchus* spp evolved in African wild ruminants and infected sheep after they migrated to Africa with humans. Due to its pathogenicity, sheep evolved an immune response to this parasite which also resulted in development of an immune response to other gastrointestinal species including the former commensals *T. colubriformis* and *Te. circumcincta*. For the former commensals this is an "inappropriate" response that causes much of the loss of production associated with them. Final conclusions about the role of the immune response in the pathogenic effects of *H. contortus* infection await the result of experiments in which effective differences in immunity to *H. contortus* are achieved. However these interim results did not reveal any amelioration of the effects of infection with immunosuppression, unlike the results reported for *T. colubriformis* and *Te. Circumcincta* in New Zealand (Greer *et al*, 2005a;b).

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Drench efficacy in the Coonabarabran RLPB district of NSW

Dr. Steve Eastwood is the District Veterinarian for the Coonabarabran Rural Lands Protection Board in north-western New South Wales (west of Tamworth). Because of lack of information on the likely prevalence of anthelmintic resistance in the district, Steve undertook to do faecal egg count reduction tests (FECRTs) on 17 fairly representative properties in different parts of the district in 2004 and 2005. This was supported by the Coonabarabran RLPB and NSW DPI, with assistance also from Virbac and Dr Jane Parker

Due to tough conditions, only eight of the 17 farms had sufficient *Haemonchus* burdens (> 200 *Haemonchus* eggs per gram faeces) in weaner Merino sheep to conduct FECRTs. The tests were performed according to a standard protocol, and the groups in each case were: Control (no drench), closantel (2.5mg/kg (one third of recommended dose), ivermectin (half rec. dose), ivermectin (full dose), and levamisole and BZ (both at rec. doses).

Table 2. Tests with FECR <95%	
Closantel (1/3 dose)	38% (3 ex 8)
Ivermectin (1/2 dose)	60% (6 ex 10)
Ivermectin (full dose)	60% (6 ex 10)
Levamisole (full dose)	0% (0 ex 9)
Benzimidazole (full dose)	55% (6 ex 11)

The results – *Haemonchus* egg count reductions post-treatment - are summarised in Table 1.

In table 2, I have further summarized Dr Eastwood's results outlined in the first table.

Table 1. Drench efficacy (% FECR) on tested farms					
	Anthelmintic				
Property identifier	Closantel (1/3 dose)	Ivermectin (1/2 dose)	Ivermectin	LEV	BZ
Project properties					
1	100	51	93	100	94
2	64	48	64	100	94
3	100	99	100	100	95
4	100	100	100	100	93
5	100	97	99	100	100
6	47	12	28	99	0
7	99	82	90	100	46
8	16	41	44	100	77
Additional properties (Privately conducted FECRTs)					
A		93	92		100
B		81			100
C			100	100	100

Steve plans to do further work once seasonal conditions improve somewhat.

While the figures above should not be taken as statistically valid estimates of prevalence, it is clear that resistance of *Haemonchus* in the Coonabarabran district to various anthelmintics including ivermectin is common. In the higher rainfall area of the Northern Tablelands to the east, the New England Closantel Resistance Survey found 60-70% of properties had closantel-resistant *Haemonchus* (Love and others, 1998), with current estimates of the prevalence in that region of closantel resistance being about 80% of farms. Around 70% of New England farms have ivermectin-resistant *Haemonchus* (Love S, 2005; citing various sources, including Veterinary Health Research).

In the somewhat drier Riverina districts of southern NSW, Suddes and Salmon (2005) found approximately 30% of the farms they tested to have ivermectin-resistant *Ostertagia (Teladorsagia).*

Clearly, farmers need to perform regular drench efficacy tests. *(... References follow...)*

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