Observations on resistance and 'self-cure' to nematode parasites exhibited by grazing lambs and Saanen kids

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ABSTRACT

Resistance and the 'self-cure' phenomenon were examined in Coopworth lambs and Saanen kids when they were between 6 and 8 months old. The animals had been reared on pasture from birth until February 1987 at which time they were treated with anthelmintic and withheld from pasture for 2 weeks. They were given *Trichostrongylus colubriformis* (500 infective (L3) larvae kg^{-1}) when they were returned to grass. Additional dosings were performed approximately 6 (500 L3 kg^{-1}) and 17 (1000 L3 kg^{-1}) weeks after the initial dose.

Faecal egg counts estimated at weekly intervals were significantly higher in kids than in lambs throughout the experiment. Furthermore, a strong acquired resistance was effected in the lambs subsequent to and as a result of the second dosing. The kids failed to show a similar response.

Worm counts estimated at necropsy confirmed that spontaneous rejection, against *Trichostrongylus* and *Ostertagia* had been produced only in the lambs.

These results show clearly that there are some significant differences between grazing lambs and kids in their ability to acquire and sustain a resistance to nematode parasites.

Keywords Saanen; kids; lambs; *Trichostrongylus colubriformis*; *Ostertagia*; grazing; artificial; natural; challenge; acquired, resistance; nematode; parasites

INTRODUCTION

Lambs acquire a strong enduring resistance to nematode parasites as a consequence of prolonged intake of infective larvae from pasture. The event generally occurs some time after 7 months of age and the timing relates to both the size and prolonged nature of the challenge as well as other factors (Brunsdon, 1962a,b; Gibson and Parfitt, 1972, 1973; Stewart and Gordon, 1953; Waller and Thomas, 1981; Windon *et al.*, 1980). Although the goat industries in New Zealand are expanding rapidly, sound information documenting the epidemiology of nematode parasites in this small ruminant is for the most part lacking. Commonly, it has been farm and veterinary practice to treat lambs and kids similarly in planning nematode parasite control. However, there is little published scientific information to suggest that the two species can and do respond similarly to natural challenge and reinfection. The research presented herein examines some responses of lambs and kids to repeated 'pulse-dosed' challenge with *Trichostrongylus colubriformis* when superimposed on infections naturally acquired during their grazing.

MATERIALS AND METHODS

Nine Saanen kids and 9 Coopworth lambs were reared by their dams until weaning. At that time, monthly treatment with ivermectin began at the therapeutic rate recommended by the manufacturer for lambs (200 μg kg^{-1}). To commence the trial all stock were drenched and housed off pasture on 9 February 1987. On 25 February (week 0) each animal was given 500 infective third stage (L3) larvae of *Trichostrongylus colubriformis* per kg body weight and turned out to graze together (Table 1).

Both kids and lambs ran together undrenched until slaughter with additional artificial challenges given at 6 (500 L3 kg^{-1}) and 17 (1000 L3 kg^{-1}) weeks after the primary artificial challenge.

Three of each species were selected at random and slaughtered after 14 weeks to determine total worm counts. The remaining 12 animals were killed after 23 weeks.

Three mature does, determined after treatment with ivermectin to be free of nematode parasites (on the basis of finding no worm eggs in their

faeces), were grazed across the pasture for the last 14 weeks of the trial without further anthelmintic treatment. They were then killed and full necropsies undertaken to estimate total worm burdens to assess the size and composition of the natural nematode challenge available from pasture.

RESULTS

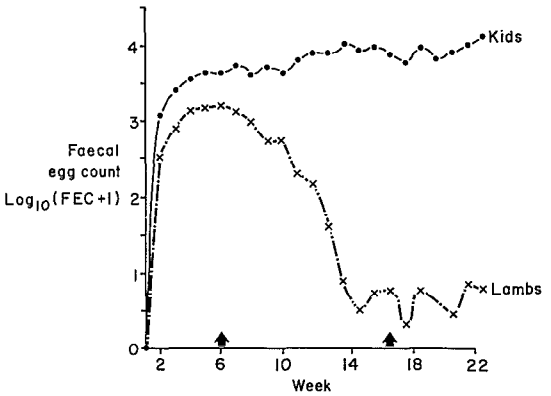

FIG. 1 Mean faecal egg counts for lambs and kids "pulse-dosed" with *Trichostrongylus colubriformis* on weeks 0, 6 and 17 while grazing contaminated pasture.

Animals began shedding parasite eggs within 3 weeks of the primary artificial challenge (Fig. 1). Mean faecal egg counts (FECs) reached maxima in both species within 6-7 weeks. Lambs receiving the second artificial infection failed to exhibit any increase in FEC whereas FEC in the kids continued to rise steadily to plateau between 12 and 17 weeks into the trial (Fig. 1). Dosing at 17 weeks caused no change to the low FECs in the lambs. The kids, on the other hand, maintained the elevated plateau established prior to the last artificial challenge (Fig. 1).

TABLE 1 Nematode parasite recoveries after 14 weeks grazing and artificial challenge with *Trichostrongylus colubriformis* superimposed at 0 and 6 weeks.

Tag	Host species	Infection site: Abomasum *Ostertagia*	Abomasum *Trichostrongylus*	Small intestine *Trichostrongylus*	
622	G	2300	100	10800	(48)*
638	G	2600	300	21300	(106)
651	G	700	100	24300	(145)
657	S	0	300	18700	(69)
671	S	0	200	6000	(17)
672	S	0	100	300	(1)

* % of total artificial challenges

TABLE 2 Nematode parasite recoveries after 23 weeks grazing and artificial challenge with *Trichostrongylus colubriformis* superimposed at 0, 6 and 17 weeks.

Tag	Host species	Infection site: Abomasum *Ostertagia*	Abomasum *Trichostrongylus*	Small intestine *Trichostrongylus*	
623	G	3960	0	33330	(74)*
627	G	3630	1320	20460	(46)
637	G	5280	330	46200	(90)
639	G	1320	330	43560	(85)
648	G	990	0	36300	(89)
649	G	2310	0	41580	(102)
613	S	0	0	0	(0)
625	S	0	330	330	(0)
640	S	0	330	0	(0)
650	S	0	0	330	(0)
670	S	0	0	0	(0)
679	S	0	0	0	(0)

* % of total artificial challenge

Worm counts at 14 weeks revealed that all animals harboured mixed *Trichostrongylus* infections, predominantly made up of *T. colubriformis* but moderate numbers of Ostertagia were found only in the kids (Table 1). At 23 weeks, 3 of 6 lambs were lightly infected whereas all 6 kids were found to be infected with large numbers of *T. colubriformis* and Ostertagia spp. (Table 2).

TABLE 3 Nematode parasite recoveries from mature does which grazed contaminated pasture for 14 weeks.

Tag	Infection site: Abomasum *Ostertagia*	Abomasum *Trichostrongylus*	Small intestine *Trichostrongylus*
3519	7260	330	2640
3582	15180	990	990
3598	11880	330	8580

The 3 mature does killed as tracers at the end of the trial had mixed *Ostertagia* and *Trichostrongylus* populations with the former predominant (Table 3).

DISCUSSION

Based on worm counts and FECs, the lambs appear to have begun to effect a strong acquired resistance to both polyspecific natural and monospecific artificial challenges at about 6 weeks into the trial, when the second dose of *Trichostrongylus* was given. Slaughter data from the mature does indicate that there was a large mixed larval challenge available to all stock grazing the pasture. Clearly, at the final exposure all lambs had the ability to spontaneously reject some or all incoming infective larvae irrespective of the source.

Worm counts in the kids were significantly higher at the second slaughter date than at the first suggesting that much of the *Trichostrongylus* burden originated from the final artificial challenge. Generally, the *Trichostrongylus* population approximately doubled that estimated at the first slaughter. This possibly reflects the fact that the final dose was twice that of the two previous ones. Establishment rates for *Trichostrongylus* in the kids killed at both times suggest that the kids were picking up additional larvae from the pasture. This is supported by the observation that mature does naturally acquired *Trichostrongylus* solely as a consequence of grazing.

Lambs developed resistance to both *Trichostrongylus* and *Ostertagia*. This characteristic concomitant immunity is well documented as acquired resistance shown by lambs during their first year. There was no evidence that the kids could mount a similar strong resistance to reinfection. Clearly, under the rotational mixed grazing management performed during this trial, there appear to be major differences between lambs and kids in their abilities to resist nematode parasite infection. Since both natural and artificial challenges were given, exposure to both parasite species was guaranteed. However, because of liveweight differences, the lambs received considerably more larvae in the artificial doses than did kids. The size of the challenge is one of a series of triggers that will elicit 'self-cure' and subsequently result in the strong acquired resistance documented in lambs (Donald *et al.*, 1964; Chiejina and Sewell, 1974). Although true 'self-cure' was not observed the lambs definitely resisted reinfection.

Considerably more work is warranted to determine the mechanisms and triggers required to initiate resistance in kids grazing pasture since recent experimental work has demonstrated that kids will exhibit an acquired resistance when housed and maintained on high protein concentrate diets and artificially 'pulse-dosed' with monospecific infections of either *Haemonchus contortus* or *Trichostrongylus colubriformis* (Watson, pers. comm.).

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