Onderstepoort J. vet. Res., 46, 27–30 (1979)

PARASITES OF DOMESTIC AND WILD ANIMALS IN SOUTH AFRICA. XII. ARTIFICIAL TRANSMISSION OF NEMATODES FROM BLESBOK AND IMPALA TO SHEEP, GOATS AND CATTLE

I. G. HORAK, Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Box 12580, Onderstepoort 0110

ABSTRACT

HORAK, I. G., 1979. Parasites of domestic and wild animals in South Africa. XII. Artificial transmission of nematodes from blesbok and impala to sheep, goats and cattle. *Onderstepoort Journal of Veterinary Research*, 46, 27–30 (1979).

Sheep were successfully infested artificially with the larvae of *Haemonchus contortus*, *Trichostrongylus axei*, *Trichostrongylus falculatus* and *Impalaja nudicollis*, cultured from the faeces of blesbok naturally infested with these nematodes.

Haemonchus placei, *Longistrongylus sabie*, *Trichostrongylus colubriformis*, *T. falculatus*, *Impalaia tuberculata* and *Cooperia hungi* likewise became established in sheep, goats and calves dosed with larvae cultured from the faeces of infested impala. Sheep and goats could also be infested with *Cooperioides hamiltoni* and *Oesophagostomum columbianum* of impala origin, but *Cooperioides hepaticae* could not be transmitted either to these hosts or to calves.

Résumé

PARASITES DES ANIMAUX DOMESTIQUES ET SAUVAGES EN AFRIQUE DU SUD. XII. TRANSMISSION ARTIFICIELLE DE NÉMATODES AUX CHÈVRES, MOUTONS ET GROS BÉTAIL A PARTIR DU BLESBOK ET DE L'IMPALA

*On a réussi à infester artificiellement des moutons avec des larves d'*Haemonchus contortus, Trichostrongylus axei, Trichostrongylus falculatus *et* Impalaia nudicollis, *provenant de cultures de matières fécales de blesboks parasités naturellement par ces nématodes.*

De façon analogue Haemonchus placei, Longistrongylus sabie, Trichostrongylus colubriformis, T. falculatus, Impalaia tuberculata *et* Cooperia hungi *se sont acclimatés chez des moutons, des chèvres et des veaux auxquels on avait administré des larves provenant de cultures de fèces d'impalas parasités. Il a été également possible d'infester des moutons et des chèvres avec* Cooperioides hamiltoni *et* Oesophagostomum columbianum *en provenance de l'impala, mais* Cooperioides hepaticae *n'a pu être transmis ni à ces hôtes ni à des veaux.*

INTRODUCTION

In many regions of South Africa, sheep, goats or cattle graze the same pastures as various antelope species. Many of the helminths recovered from antelope are those usually encountered in sheep and cattle (Horak, 1978b, c), while other helminths of sheep, cattle and antelope seem to be more host-specific and are rarely encountered in other species.

The artificial infestation of sheep with the nematodes of a number of antelope species was successfully achieved by Mönnig (1931, 1932, 1933). However, since he made no mention of the number of infective larvae dosed to sheep nor of the number of worms recovered at necropsy, no estimate can be made of the viability of the parasites in the abnormal host.

Surveys conducted in white-tailed deer and sheep on common range in West Virginia (Prestwood, Pursglove & Hayes, 1976) and in white-tailed deer and cattle on an island off the coast of Georgia, United States of America (Prestwood, Kellogg, Pursglove & Hayes, 1975) indicate that cross-infestation with certain helminth species does take place, but only to a limited extent. Cross-infestation is of considerable importance where the parasites of one host species may be pathogenic to another, as is the case with the lungworm *Dictyocaulus magnus* of the springbok, which is pathogenic to the bontebok (Verster, 1973, cited by Heinichen, 1973) and where a control programme may be complicated by wild antelope serving as reservoir hosts of the common helminths of domestic livestock.

The present paper describes the artificial infestation of sheep with infective larvae cultured from the faeces of blesbok culled in a helminth survey conducted in the Lunsklip area (24°01′S; 29°07′E; Alt. ±1 475 m), and of sheep, goats and cattle with larvae from impala culled in a similar survey in the Boekenhout area (24°29′S; 28°42′E; Alt. ±1 100 m) of the Transvaal (Horak, 1978b, c).

Received 31 October 1978—Editor

MATERIALS AND METHODS

Infective larvae

Faecal cultures were made from rectal faeces collected from the antelope culled on various occasions during the 2 surveys. The larvae obtained from these cultures were identified, counted, concentrated on filter-paper and dosed to domestic livestock.

Recipient animals

The sheep, goats and calves used in these experiments were either raised worm-free or were treated with large doses of an anthelmintic and then maintained under worm-free conditions prior to infestation.

Four sheep were each infested once at approximately monthly intervals with larvae of blesbok origin. Each sheep received larvae cultured from the faeces of 2 blesbok culled 11–16 days previously, and were slaughtered for worm recovery 30–52 days post-infestation.

On 3 separate occasions a sheep, a goat and a calf were each infested once at approximately monthly intervals with larvae of impala orign. The first 3 animals received larvae cultured from the faeces of 5 impala culled 29–58 days previously, the second from 3 impala culled 20–27 days previously and the third from a single impala culled 28 days previously. At slaughter, 32–43 days post-infestation, egg counts and larval cultures were done on the faeces of these animals.

Worm burdens

Worms were recovered by the method described by Horak (1978c) at slaughter from donor antelope and recipient domestic stock, counted and identified. The descriptions of Roberts, Turner & McKevett (1954) were used to differentiate adult *Haemonchus placei* from adult *Haemonchus contortus*.

Results

The mean adult worm burdens of the 2 blesbok from which larvae were obtained for each of the 4 sheep infested, the estimated number of larvae dosed and the number of worms recovered from the infested sheep are summarized in Tables 1 & 2.

The 4 nematodes recovered from the blesbok, namely, *H. contortus, Trichostrongylus axei, Trichostrongylus falculatus* and *Impalaia nudicollis,* could all be transmitted to sheep. Whenever the mean adult worm burden of a particular species did not exceed 20 worms in the donor blesbok, cross-transmission of that species did not occur.

The mean adult worm burdens of the 1–5 impala from which larvae were obtained for each of the 3 sets of infestation, the numbers of larvae dosed, the numbers of worms recovered from the recipient sheep, goats and calves and the faecal worm egg counts of these animals are summarized in Tables 3 & 4.

Ten nematode species were present in the impala from which faeces were cultured. Of these it was possible to transmit *Haemonchus placei, Longistrongylus sabie, Trichostrongylus colubriformis, T. falculatus, Impalaia tuberculata* and *Cooperia hungi* to sheep, goats and valves. *Cooperioides hamiltoni* and *Oesophagostomum columbianum* were recovered only from sheep and goats, *T. axei* from sheep only and *Cooperioides hepaticae* could not be transmitted artificially. With the exception of *H. placei, O. columbianum,* and, in one instance, *T. axei,* cross-transmission did not occur when the mean adult burden of a particular species did not exceed 200 worms in the donor impala.

TABLE 1 The number of larvae cultured from the faeces of blesbok and dosed to sheep

Recipient sheep	Nematode species and number of larvae dosed		
	H. contortus	*Trichostrongylus* spp.	*I. nudicollis*
Sheep A	1050	500	0
Sheep B	4860	270	3870
Sheep C	1950	120	1830
Sheep D	2700	780	2520

TABLE 2 The worm burdens of donor blesbok and of sheep that received larvae cultured from the faeces of the blesbok

Item	Nematode species			
	H. contortus	*T. axei*	*T. falculatus*	*I. nudicollis*
Mean adult worm burden of 2 donor blesbok	274	255	5	19
Worm burden of recipient Sheep A	461	147	0	0
Mean adult worm burden of 2 donor blesbok	1035	21	920	2505
Worm burden of recipient Sheep B	6620	0	381	1914*
Mean adult worm burden of 2 donor blesbok	328	3	297	1951
Worm burden of recipient Sheep C	1131	0	66	671*
Mean adult worm burden of 2 donor blesbok	223	6	486	721
Worm burden of recipient Sheep D	952	0	63	240*

* Many 4th stage larvae

TABLE 3 The number of larvae cultured from the faeces of impala and dosed to sheep, goats and cattle

Recipient sheep/goat/calf	Nematode species and number of larvae dosed					
	H. placei	*L. sabie*	*Trichostrongylus* spp.	*I. tuberculata*	*Cooperia/ Cooperiodes* spp.	*O. columbianum*
1	1560	310	5620	5770	1880	160
2	3230	950	1330	10830	2470	190
3	2280	180	1400	11560	1230	350

TABLE 4 The worm burdens and faecal worm egg counts of donor impala and of sheep, goats and cattle that received larvae cultured from the faeces of the impala

Item	Nematode species and faecal worm egg counts										
	H. placei	*L. sabie*	*T. axei*	*T. colubriformis*	*T. falculatus*	*I. tuberculata*	*C. hungi*	*C. hamiltoni*	*C. hepaticae*	*O. columbianum*	E.p.g.
Mean adult worm burden of 5 donor impala....	202	10	48	1 931	96	817	291	396	56	12	500
No. of worms recovered from recipient:											
Sheep 1.....	230	0	0	13	0	376	280	14	0	0	10 500
Goat 1.....	211	0	0	4	0	120	50	1	0	7	200
Calf 1.....	50	0	0	0	0	0	16	0	0	0	150
Mean adult worm burden of 3 donor impala.....	91	519	87	716	218	6 019	1 294	1 280	96	34	3 650
No. of worms recovered from recipient:											
Sheep 2.....	20	205	5	132	40	50*	530*	33	0	103	N.S.
Goat 2.....	20	29*	0	0	10	336	21	0	0	3	700
Calf 2.....	0	4	0	20	11	20	91	0	0	0	50
Adult worm burden of single donor impala...	10	419	0	3 692	110	8 146	1 559	4 560	3	71	4 100
No. of worms recovered from recipient:											
Sheep 3.....	0	0	0	131	0	470*	231*	0	0	29	100
Goat 3.....	4	0	0	60	0	1 049	93	1	0	6	4 200
Calf 3.....	0	0	0	32	0	602	82	0	0	0	1 550

N.S.—Not sampled

* Many 4th stage larvae

The egg counts of the artificially infested animals varied between 100 and 10 500 eggs per gram of faeces and infective larvae of all the above-mentioned genera, with the possible exception of *Cooperioides* spp., of which the larvae have not been described, were recovered from cultures made from their faeces.

Discussion

The artificial infestation of the sheep with the larvae of *H. contortus, T. falculatus* and *I. nudicollis* of blesbok origin confirms the results of similar experiments conducted by Mönnig (1932). He stated then that apparently *I. nudicollis* did not readily adapt itself to sheep. The present results indicate that, although the number of *I. nudicollis* recovered from sheep was high when compared with the number of larvae dosed, many of these worms did not mature. This would probably account for the absence of *Impalaia* sp. larvae from the faeces of the first sheep that Mönnig (1931) infested with larvae from blesbok.

The numbers of *H. contortus, T. axei* and *T. falculatus* recovered from the blesbok and sheep indicate that these nematodes are well adapted to both species and that cross-transmission can readily take place. The blesbok from which the larvae were cultured had probably had no contact with sheep for at least 40 years (Horak, 1978b), and yet no difficulty in cross-transmitting these species was experienced.

The numbers of *H. contortus* and *T. falculatus* recovered from Sheep B were greater than the numbers of larvae used for infestation, most probably because more larvae than estimated were dosed to this particular sheep.

Mönnig (1933) was able to transmit *Cooperia hungi* artificially from impala to sheep, but there appear to be no accounts of the transmission of other nematodes of impala to domestic livestock. In the present experiment the total numbers of worms recovered from the artificially infested animals were generally small when compared with the total numbers of larvae administered, and from this it would seem that cross-transmission between impala and domestic livestock does not readily take place. That even species such as *H. placei, T. colubriformis, T. falculatus* and *O. columbianum,* regarded as normal parasites of cattle or sheep, were not easily transmissible, may be due to adaptive changes in the parasites necessary for their survival in impala. *Dictyocaulus viviparus,* too, a parasite normally encountered in cattle, could not be artificially transmitted to cattle from naturally infested moose (Gupta & Gibbs, 1971) and only apparently in small numbers from elk or black-tailed deer (Presidente, Worley & Catlin, 1972; Presidente & Knapp, 1973).

The fact that *H. placei,* a parasite normally encountered in cattle in South Africa (Horak, 1978d; Horak & Louw 1978) and not in sheep (Horak, 1978a; Horak & Louw, 1977), was recovered in greater numbers from the sheep than from the calves, indicates some alteration in the host-dependent viability of these nematodes. Judging by the numbers of mature worms recovered, goats were better alternative hosts for *I. tuberculata* than sheep or cattle.

The fact that, with the exception of *H. placei* and *O. columbianum,* cross-transmission generally did not take place when the adult worm burden of a particular species in the donor antelope was less than 200

worms, can be ascribed to the fecundity of the female worms of the various species, and hence their contribution to the larval pool from which the larval doses were made up. Both *Haemonchus* and *Oesophagostomum* species are particularly fecund (Gordon, 1948) and thus a few adult females would make a considerable contribution to the larval pool. The other species, being less fecund, would contribute fewer larvae. Consequently, the chances of cross-transmission would be minimal from those donor animals in which only a few adult worms of the latter species were present.

The presence of fairly high faecal worm egg counts and of infective larvae of most nematode genera of impala origin in the faecal cultures of artificially infested animals shows that these parasites can complete their life cycles in domestic livestock.

The results of surveys conducted in impala and cattle utilizing the same pasture in the Boekenhout area of the Transvaal suggest that very little natural cross-transmission occurs (Horak, 1978c, d). Because *H. placei, T. colubriformis* and *T. falculatus* occur naturally in both species, however, it is not possible to say what role cross-infestation plays in maintaining the parasitic levels of these helminths in either host.

The recovery of *H. contortus* from donor blesbok and *H. placei* from donor impala could be a result of the host-preferences of these helminths or could be entirely fortuitous, being determined by the availability of infestation in a particular locality.

Acknowledgements

I wish to thank MSD (PTY) LTD for their financial support of the experiment conducted in the blesbok and sheep, and Sentrachem (Pty) Ltd for financial support of the experiment conducted in the impala, sheep, goats and cattle.

References

GORDON, H. McL., 1948. The epidemiology of parasitic diseases, with special reference to studies with nematode parasites of sheep. *Australian Veterinary Journal,* 24, 17–44.

GUPTA, R. P. & GIBBS, H. C., 1971. Infectivity of *D. viviparus* (moose strain) to calves. *Canadian Veterinary Journal,* 12, 56.

HEINICHEN, IRMGARD G., 1973. Parasitological studies on impala: Preliminary report, *Journal of the South African Veterinary Association,* 44, 265–269.

HORAK, I. G., 1978a. Parasites of domestic and wild animals in South Africa. V. Helminths in sheep on dryland pasture on the Transvaal Highveld. *Onderstepoort Journal of Veterinary Research,* 45, 1–6.

HORAK, I. G., 1978b. Parasites of domestic and wild animals in South Africa. IX. Helminths in blesbok. *Onderstepoort Journal of Veterinary Research,* 45, 55–58.

HORAK, I. G., 1978c. Parasites of domestic and wild animals in South Africa. X. Helminths in impala. *Onderstepoort Journal of Veterinary Research,* 45, 221–228.

HORAK, I. G., 1978d. Parasites of domestic and wild animals in South Africa. XI. Helminths in cattle on natural pasture in the northern Transvaal. *Onderstepoort Journal of Veterinary Research,* 45, 229–234.

HORAK, I. G. & LOUW, J. P., 1977. Parasites of domestic and wild animals in South Africa. IV. Helminths in sheep on irrigated pastures on the Transvaal Highveld. *Onderstepoort Journal of Veterinary Research,* 44, 261–270.

HORAK, I. G. & LOUW, J. P., 1978. Parasites of domestic and wild animals in South Africa. VI. Helminths in calves on irrigated pastures on the Transvaal Highveld. *Onderstepoort Journal of Veterinary Research,* 45, 23–28.

MÖNNIG, H. O., 1931. Wild antelopes as carriers of nematode parasites of domestic ruminants—Part I. *Report of the Director of Veterinary Services and Animal Industry, Union of South Africa,* 17, 233–254.

MÖNNIG, H. O., 1932. Wild antelopes as carriers of nematode parasites of domestic ruminants—Part II. *Report of the Director of Veterinary Services and Animal Industry, Union of South Africa,* 18, 153–172.

MÖNNIG, H. O., 1933. Wild antelopes as carriers of nematode parasites of domestic ruminants—Part III. *Onderstepoort Journal of Veterinary Science and Animal Industry,* 1, 77–92.

PRESIDENTE, P. J. A. & KNAPP, S. E., 1973. Susceptibility of cattle to an isolate of *Dictyocaulus viviparus* from black-tailed deer. *Journal of Wildlife Diseases,* 9, 41–43.

PRESIDENTE, P. J. A., WORLEY, D. E. & CATLIN, J. E., 1972. Cross-transmission experiments with *Dictyocaulus viviparus* isolates from Rocky Mountain elk and cattle. *Journal of Wildlife Diseases,* 8, 57–62.

PRESTWOOD, ANNIE K., PURSGLOVE, S. R. & HAYES, F. A., 1976. Parasitism among white-tailed deer and domestic sheep on common range. *Journal of Wildlife Diseases,* 12, 380–385.

PRESTWOOD, ANNIE K., KELLOGG, F. E., PURSGLOVE, S. R. & HAYES, F. A., 1975. Helminth parasitisms among intermingling insular populations of white-tailed deer, feral cattle, and feral swine. *Journal of the Amercian Veterinary Medical Association,* 166, 787–789.

ROBERTS, F. H. S., TURNER, HELEN N. & McKEVETT, MARGOT, 1954. On the specific distinctness of the ovine and bovine "strains" of *Haemonchus contortus* (Rudolphi) Cobb (Nematoda: Trichostrongylidae). *Australian Journal of Zoology,* 2, 275–295.

Printed by and obtainable from the Government Printer, Private Bag X85, Pretoria, 0001