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## VARIABLE ACTIVITY OF DISOPHENOL AGAINST HOOKWORMS AND LICE OF NORTHERN FUR SEAL PUPS ON ST. PAUL ISLAND, ALASKA<sup>1</sup>

E. T. LYONS,<sup>2</sup> K. C. KIM<sup>3</sup> and M. C. KEYES<sup>4</sup>

**Abstract:** Six critical tests with disophenol were conducted in July, 1978, in fur seal pups (*Callorhinus ursinus*) naturally-infected with adult hookworms, *Uncinaria lucasi*, and infested with various stages of two species of sucking lice, *Proechinophthirus fluctus* (Ferris) and *Antarctophthirus callorhini* (Osborn). Disophenol at a dose rate of 12.5 mg/kg was administered subcutaneously to each of six pups. Each pup was contained in an individual cage for 60 h posttreatment at which time pups were examined at necropsy. Efficacy against hookworms ranged from 2% to 88% and of both species of lice ranged from 26% to 90% for the six pups. Disophenol removed approximately 90% of all adult lice but only slightly more than 60% of all nymphs. The only sign of toxicosis was a probable drug related fluid-like feces for four pups from 12 to 60 h posttreatment.

### INTRODUCTION

Efficacy of two commercially prepared canine anthelmintics, dichlorvos and disophenol, was evaluated previously against adult *Uncinaria lucasi* in fur seal pups (*Callorhinus ursinus*).<sup>3</sup> Dichlorvos was highly effective in removal of hookworms from pups but disophenol was inconsistent at the dose rate used, 9.9 mg/kg. Both compounds appeared to be highly effective against the sucking lice, *Proechinophthirus fluctus* (Ferris) and *Antarctophthirus callorhini* (Osborn). Due to variable activity of disophenol at dose rate of 9.9 mg/kg on *U. lucasi*, a higher dose rate, 12.5 mg/kg, was evaluated in the present investigation. Also, a more quantitative

evaluation of activity of disophenol against the two species of lice was made by a modified Cook's technique<sup>1</sup> which is more accurate than the method used in the previous test.<sup>3</sup>

### MATERIALS AND METHODS

Critical tests were done with six pups (No's. DNP-1, DNP-2, DNP-3, DNP-4, DNP-5, and DNP-6) collected from Northeast Point Rookery on 16 July 1978. These pups were presumably no more than one month of age. All pups were assumed to be harboring intestinal infections of hookworms because virtual 100% prevalence of this parasite has been found previously on the rookery where

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pups were collected. Hookworm eggs were found in feces of four of the pups (No's. DNP-3, DNP-4, DNP-5, and DNP-6) at time of treatment.

Pups in critical tests were weighed, sexed, and individual doses of drug were calculated. Disophenol,<sup>□</sup> a 4.5% solution, was administered immediately after collection of pups, by injection subcutaneously into the left axillary region. Pups were observed after treatment for any signs of toxicosis.

Each pup was put in an individual cage which was placed on heavy brown paper. Pup feces, and any hookworms or lice present, were collected for each 12 h posttreatment period. Collection of feces of the pups for recovery of hookworms passed posttreatment and techniques for recovery of residual hookworms in pups at necropsy were similar to previous reports.<sup>2,4</sup> Material examined for hookworms and lice was washed through a 60 mesh sieve. Pups were examined at necropsy at 60 h posttreatment. Fecal samples were collected at time of treatment and at necropsy; examination of feces for hookworm eggs was as previously reported.<sup>2</sup> After necropsy, the animal was skinned and the pelt was kept frozen for extraction of the remaining lice. The pelt was digested and specimens were collected by a modified Cook's technique.<sup>1</sup>

Percent removal of hookworms and lice for each pup was computed:

$$\frac{\text{Hookworms or lice collected from paper posttreatment}}{\text{Hookworms or lice collected from paper posttreatment} + \text{hookworms or lice collected at necropsy}} \times 100$$

## RESULTS

The data resulting from the six critical tests of activity of disophenol against naturally acquired infections of adult *U. lucasi* in fur seal pups are recorded (Table 1). The total number of hookworms present in the pups ranged from 8 to 224. Removal of hookworms varied from 2% to 88% for the six pups.

Signs of toxicosis were not seen during an almost constant 3.5 h posttreatment observation period. Pups were asleep during most of the time observed. Observations throughout the remainder of the posttreatment period revealed no abnormal signs of behavior. However, feces from four pups appeared to be more fluid-like than normal for periods of 12 to 60 h posttreatment. Also, frequency of defecation appeared to be accelerated for one pup (No. DNP-5) after treatment.

TABLE 1. Data on the hookworm (*Uncinaria lucasi*): activity of disophenol at dose rate of 12.5 mg/kg in critical tests with six fur seal pups.

Pup No.	No. of hookworms									
	Passed in feces			Found at necropsy			Total present			
	♂	♀	Both sexes	♂	♀	Both sexes	♂	♀	Both sexes	(%) removal
DNP-1	0	7	7	0	1	1	0	8	8	(88)
DNP-2	22	14	36	88	100	188	110	114	224	(16)
DNP-3	8	11	19	18	7	25	26	18	44	(43)
DNP-4	0	3	3	91	78	169	91	81	172	(2)
DNP-5	39	68	107	25	4	29	64	72	136	(79)
DNP-6	2	4	6	4	4	8	6	8	14	(43)

□ D.N.P. American Cyanamid Company, Princeton, New Jersey, 08540, USA.

TABLE 2. Lice (*Proechinophthirus fluctus* and *Antarctophthirus callorhini*) recovered from six northern fur seal pups treated with disophenol at dose rate of 12.5 mg/kg in critical tests.

Pup No.	Shed from pup*										Both Species Total
	<i>P. fluctus</i>					<i>A. callorhini</i>					
	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	A	Total	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	A	Total	
1	703	242	0	1	946	82	0	0	22	104	1,050
2	6	32	1	98	137	3	5	0	29	37	174
3	140	20	0	1	161	18	5	0	12	35	196
4	129	0	0	19	148	3	3	0	26	32	180
5	100	0	0	13	113	2	1	0	67	70	183
6	640	924	0	2	1,566	34	0	0	16	50	1,616
Total	1,718	1,218	1	134	3,071	142	14	0	172	328	3,399

  

Pup No.	On pup at necropsy**										Both Species Total	Total shed and at necropsy
	<i>P. fluctus</i>					<i>A. callorhini</i>						
	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	A	Total	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	A	Total		
1	170	1	0	0	171	194	0	0	0	194	365	1,415
2	1	0	0	8	9	26	7	1	2	36	45	219
3	177	0	0	0	177	175	0	0	0	175	352	548
4	273	0	0	1	274	8	4	0	4	16	290	470
5	457	0	0	8	465	42	1	0	6	49	514	697
6	87	25	0	1	113	70	4	1	1	76	189	1,805
Total	1,165	26	0	18	1,209	515	16	2	13	546	1,755	5,154

\*Lice recovered from paper under cage;

\*\*Lice recovered from skin and hair by Cook's technique  
N = Nymph; A = Adult

Data on numbers of the two species of sucking lice *P. fluctus* and *A. callorhini* present, are shown in Table 2. The total number of lice present on the pups ranged from 219 to 1,805, the majority being first-stage nymphs. Infestations of *P. fluctus* were much heavier than *A. callorhini*. The data on percent removal of lice are presented in Table 3. Removal of all stages of both species of lice varied from about 26% to 90% for the six pups. The majority of adult lice was removed by disophenol; 88% of *P. fluctus* and 93% of *A. callorhini*. Removal of *P. fluctus* nymphs was relatively high (71%) but low (23%) for *A. callorhini* nymphs.

## DISCUSSION

Disophenol, at the 12.5 mg/kg dose rate, was inconsistent and generally poor in removal activity against hookworms from fur seal pups in the present critical tests. Previous data obtained from critical and controlled tests<sup>4</sup> showed that disophenol at 9.9 mg/kg was also inconsistent in removing *U. lucasi* from pups.

The administration of disophenol for tests at both dose levels was the same in regard to site, axillary area, and method of injection; subcutaneous. Generally, the axillary area of pups has an abundance of blubber which may impede absorption of the drug. However, it would seem that the variation in drug activity as seen with a total of 18 pups at both dose levels could not be related directly to the thickness of the blubber. In other words, it does not seem proper to definitely assume that the drug was more effective in pups having a "thin" layer of blubber in axillary area.

Possibly, a higher dose of disophenol than 12.5 mg/kg would be more consistent in efficacy and produce a generally high level of activity against adult *U. lucasi* in fur seal pups. However, a dose rate much higher than 12.5 mg/kg may cause toxicosis.

Diarrhea, probably caused by disophenol, was evident in four of six

TABLE 3. Percent removal of lice (*Proechinophthirus fluctus* and *Antarctophthirus callorhini*) from six fur seal pups treated with disophenol at dose rate of 12.5 mg/kg.

Pup No.	<i>P. fluctus</i>			<i>A. callorhini</i>			Both Species		
	Nymphs	Adults	Total	Nymphs	Adults	Total	Nymphs	Adults	Total
1	85	100	85	30	100	35	74	100	74
2	98	92	94	19	94	51	57	93	79
3	47	100	48	12	100	17	34	100	36
4	32	95	35	33	87	67	32	90	38
5	18	62	20	7	92	59	17	85	26
6	93	67	93	31	94	40	90	90	90
Total	71	88	72	23	93	38	64	91	66

treated pups in the present test. Further testing of disophenol in pups may be of value by injecting it into an area of little blubber such as the back. However, it appears that disophenol has limited practical value for the control of adult *U. lucasi* in fur seal pups. An anthelmintic that is highly effective against gastrointestinal stages of *U. lucasi* and can be administered as an injectable formulation would be more practical in regard to route of administration than one necessitating oral administration.

Disophenol was active against the sucking lice found on fur seal pups but the activity was not as high as suggested in the previous test.<sup>3</sup> Removal of all stages of both species of sucking lice varied from 26% to 90% for the six pups in the present test. This amounted to about 66% removal of lice from all the pups. Variable removal of *P. fluctus*, especially nymphs, was noted. Activity against nymphs of *A. callorhini* was poor for all

pups. The removal of over 90% of all adult lice of both species was consistent with the finding in the previous test. However, overall, there was a much lower removal of nymphs in the present test, probably indicating poor recovery of these stages from the skin of pups at necropsy in the previous test. The digestion technique used in the present test indicated that it is a superior method for recovery of lice from the pup pelt; particularly nymph stages in the skin. The method used in the other test of relying on lice stages to emerge from the skin after death of the pups apparently gave an inaccurate impression of high activity of disophenol against lice. It is possible that low emergence of nymphs from the skin of pups after death may be due to either a slow mobility or inactive behavior of the nymphs.

In general, activity of disophenol was not consistent against both hookworms and lice in the same pup.

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