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Investigations on fish parasite control: I. --Di-n-butyl tin oxide as a vermifuge on Eubothrium crassum (Bloch, 1779) in rainbow trout

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Abstract

Rainbow trout (Salmo gairdneri) at the Harrietta State Fish Hatchery have, for a number of years, been infested with the tapeworm Eubothrium crassum. Di-n-butyl tin oxide was tested as an anthelmintic on this intestinal tapeworm, both in the laboratory and in a raceway. The drug was found to be 100 percent effective in removal of the worms, when mixed with a commercial pelleted diet. The total dose level was 500 milligrams per kilogram of body weight of fish; it was fed over a three-day period (one-third of the total dose, per day).

Introduction

Rainbow trout broodstock and large fingerlings at the Harrietta State Fish Hatchery have, for a number of years, been heavily infested with the tapeworm Eubothrium crassum (Bloch, 1779). Although Wardle & McLeod (1952) believed that a closely related worm of salmon was not

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harmful, it appeared to me that a heavy infestation of E. crassum had a debilitating effect on the fish, and in order to maintain a healthy broodstock, removal of the tapeworm was desired. It was also possible that other fish in the hatchery could become parasitized, which might lead to a spreading of the tapeworm into natural waters when the fish were planted for sport fishing. Therefore, control of this tapeworm infestation seemed necessary.

Allison (1957) found that di-n-butyl tin oxide was effective in removing the tapeworm Corollobothrium finebriatum (Cestoda) and the intestinal fluke Alloglossidium corti (Trematoda) from the channel catfish. Mitchum (1967) found this drug effective in the laboratory in the removal of Crepidostomum farionis (Trematoda) from golden trout. The present study was undertaken to determine the effectiveness of the drug against Eubothrium crassum (Cestoda) in rainbow trout.

Methods

A total of 52 rainbow trout (approximately two pounds per fish) from broodstock at the Harrietta Hatchery were examined; 50 were positive for E. crassum, with an average of 9.3 (range 2-32) worms per fish. For drug dosage, I was guided by Mitchum (1967) who recommended feeding 150-250 milligrams per kilogram of body weight over a three-day period as an effective dose in his work with Crepidostomum farionis. In my present study, doses of 100, 250, 400, and 500 milligrams per kilogram of body weight were tested for the efficacy on E. crassum. Table I

summarizes laboratory tests, and Table II reports the results of raceway tests. In the laboratory tests I used a glass balling gun to force-feed the fish a diet of gelatin capsules containing measured amounts of the drug. The fish were closely observed for any regurgitation of the drug. It was found that if liver were force-fed immediately after the capsule, the fish were less apt to regurgitate.

In the raceway tests, the fish were first "starved" for two days, and then fed a regular pelleted diet coated with the appropriate amount of drug. Pellets, drug, and cod liver oil were mixed in a large coffee can; it took 20 milliliters of oil to bind the drug to 450 grams of food. Tin oxide is insoluble in either water or oil, and the latter merely serves to bind the drug onto the surface of the pellets. Fish readily consumed the pellets the first two days, but showed marked loss of appetite on the third day of feeding. Therefore, it was necessary to increase the concentration of drug on the pellets, to insure that the fish received an effective dose.

Toxicity was tested on five-year-old rainbows which had an average weight of 975 grams. Four test fish and two control fish were used, with the test fish receiving weighed amounts of drug in gelatin capsules, force-fed with a glass balling gun. Two fish were tested at 800 milligrams per kilogram of body weight, and two at 1000 milligrams per kilogram, with the total dose fed over a three-day period. The fish were kept in an aquarium with running water at 50^{o} F. One fish from each

group was sacrificed and examined one week after the last feeding. The other fish were kept three weeks, then sacrificed. No toxic symptoms were observed in any fish.

Results and Discussions

The data in Table I show the drug di-n-butyl tin oxide to be 100 percent effective in removing the tapeworm E. crassum from rainbow trout when force-fed in the laboratory at a total dose of 250 milligrams per kilogram of body weight over a three-day period. This is the level which Allison (1957) found to be effective, and which Mitchum (1967) recommended. However, tests of the drug incorporated into diets fed at a hatchery raceway (Table II) showed that this level was 100 percent effective only when repeated one week later. However, one exposure to a total dose rate of 500 milligrams per kilogram (1/3 daily for three days) was found to be 100 percent effective in a hatchery situation. The necessity for an increased dose in hatchery raceways is no doubt due to leaching action of the water and the fact that the fish fed poorly on the third day of treatment. Further testing is necessary to determine if the drug can be fed successfully in only one or two doses.

Mitchum (1967) showed that the drug is not toxic to rainbow trout at levels as high as 600 milligrams per kilogram of body weight. My tests at this laboratory showed di-n-butyl tin oxide to be non-toxic to rainbow trout at doses of 800 and 1000 milligrams per kilogram. Mitchum showed by tissue assay that the drug is not readily absorbed by

tissues outside the alimentary tract, also that the drug is rapidly passed from fish. On the basis of the above information, including tests reported in this paper, di-n-butyl tin oxide is an effective anthelmintic when used as a treatment for intestinal tapeworms at a level of 500 milligrams per kilogram of body weight incorporated into a standard hatchery diet and fed over a three-day period, one-third of the total dose per day.

The drug is sold at $5.00 per pound; a pound will treat approximately 2000 pounds of fish at the effective raceway dose. One ounce of drug (42¢) will treat 125 pounds of fish. It is available from M & T Products of Canada, Ltd., Box 211, Station C, Hamilton, Ontario.

Table I.--Laboratory tests for effect of di-n-butyl tin oxide on Eubothrium crassum.

Number of fish and sex	Dose of drug, Mg/kg			Autopsy record		
	Total	Daily	Days	Days past treatment	Worms per fish	Group % efficacy
1♀	100	33	3	1	9	
1♀	100	33	3	1	0	
1♂	100	33	3	1	32	
2♂s	100	33	3	1	0	60
1♀	240	240	1	5	0	
1♂	240	240	1	7	6	
2♂s	240	240	1	5	0	75
*1 ♂	250	83	3	5	2	
4♀ s	250	83	3	5	0	
8♂ s	250	83	3	5	0	100
*1♀	400	133	3	2	0	
* 1♂	400	133	3	2	2	
1♀	400	133	3	2	0	
1♀	400	133	3	2	3	
1♂	400	133	3	2	0	67

* These three fish regurgitated some or all of the drug, and are not included in the evaluation of efficacy.

Table II. --Raceway tests of di-n-butyl tin oxide on Eubothrium crassum.

Number of fish and sex	Dose of drug, Mg/kg			Autopsy record		
	Total	Daily	Days	Days past treatment	Worms per fish	Group % efficacy
1♀	250	83	3	5	4	
1♂	250	83	3	5	1	
1♂	250	83	3	5	4	
3♀ s	250	83	3	5	0	
7♂ s	250	83	3	5	0	77
1♂	250	83	3	7	1	
4♀ s	250	83	3	7	0	
3♂ s	250	83	3	7	0	88
*6♀ s	500	83	6	7	0	
*5♂ s	500	83	6	7	0	100
6♀ s	500	167	3	7	0	
4♂ s	500	167	3	7	0	100

* These 11 fish received the following special treatment:

250 mg/kg fed one-third daily for three days, followed by a lapse of one week, then a repeat of 250 mg/kg fed one-third daily for three days. Autopsy 7 days thereafter.

Literature cited

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