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Treatment of *Pseudodactylogyrus* infestations of *Anguilla anguilla* II

TRIALS WITH BUNAMIDINE, PRAZIQUANTEL AND LEVAMIZOLE.

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To prevent selection of benzimidazole resistant parasites, treatment of *Pseudodactylogyrus* infestations of eels in intensive eel culture plants should not exclusively be conducted by use of only one drug type e.g. the benzimidazoles (Buchmann et al. 1989). Use of anthelmintics with other action mechanisms in rotation with the effective drug mebendazole (Székely and Molnar 1987, Buchmann and Bjerregaard 1989) could counteract development of resistance. In this second paper on screening of anthelmintics in order to find alternatives to benzimidazoles we report on trials with bunamidine, praziquantel anf levamizole against *Pseudodactylogyrus* infestations in eels.

Bunamidine-hydrochloride, a member of the naphthamidine group, is a cestocidal drug used for treatment of domestic animals (Roberson 1988). The effects of the isoquinoline-pyrazine derivative praziquantel on *Pseudodactylogyrus* parasites were elucidated by Schliffka (1986) and Buchmann (1987). Levamizole, an imidazo-thiazole derivative, was suggested to be effective against monogeneans by Schmahl and Taraschewski (1987)

Materials and methods

Specimens of European eel (*Anguilla anguilla*) infected by *Pseudodactylogyrus anguillae* were used for the experiments. Batches of 8 to 10 eels were exposed to drugs for 25 hours in 17 l plastic aquaria containing 7 l aerated bath solution (25° C). Thereafter they were transferred to pure tapwater under similar conditions. Eels were examined for parasites 4 to 6 days after treatment. Mortality and behaviour of eels during and after drug exposure were recorded.

Results.

Before treatment the abundance was 5.0 parasites per fish and the prevelance was 89% (Table 1). This infection level was also found in the control group (in pure tapwater) 5 days later (Table 2).

Bunamidine in concentrations of 10 and 1 mg/ml was lethal to eels (Table 3). No clear toxic effects on eels of 0.1 mg/l of this drug were observed, although one eel died after 25 hours (Table 3). However this concentration had no effect on the infection level (Table 2).

Praziquantel in concentrations of 10 and 1 mg/l elicited no clear toxic effects on eels although one eel from the 1 mg/l treatment group died 5 days after treatment (Table 3). Praziquantel in a concentration of 10 mg/l eradicated all parasites from the exposed eels, whereas a rather high infection level was still found in eels after exposure to 1 mg/l praziquantel (Table 2).

Levamizole 10 mg/l elicited minor toxic effects in the eels: Two eels showed balance disturbances and two eels died after 25 hours (Table 3). However this concentration of levamizole did not affect the infection level (Table 3).

Discussion

Mebendazole (Vermox®) is a highly potent anthelmintic against pseudodactylogryrosis (Székely and Molnar 1987, Buchmann and Bjerregaard 1989). However, frequent use of benzimidazoles increases the risk for development of anthelmintic resistance in parasites (see Anderson & Waller 1985). Such a selection for resistance could be broken if drugs with other modes of action were used in rotation with the benzimidazoles. Therefore, we have screened possible alternative drugs to benzimidazole.

Many anthelmintics are rather toxic to eels, and in nontoxic concentrations the parasitocidal effect is unsatisfactory (Buchmann et al. 1990). This seems to be the case for bunamide and levamizole. Treatment with the latter drug in a concentration of 10 mg/l was shown to have effect on *Gyrodactylus aculeati* and *Diplozoon paradoxum* by Schmahl and Taraschewski (1987). However in our study this concentration of levamizole had no effect on *Pseudodactylogyrus* parasites even in a much longer exposure time, and in addition some toxicity to eels was recorded. Praziquantel in a concentration of 10 mg/l for 36 to 48 hours was reported to be effective against pseudodactylogryrosis (Schiffka 1986), and our results confirm the potency of this drug even when it is used for a shorter (25 hours) exposure time. However treatment with praziquantel (10 mg/l) should be conducted for at least this period as Buchmann (1987) recorded survival of *P. bini* after incubation in 10 mg/l for 8 hours. Effects of this drug on other monogeneans were also noted by Schmahl and Mehlhorn (1985) and Schmahl and Taraschewski (1987). Thus praziquantel in a concentration of at least 10 mg/l used for 25 hours could be a complementary drug to mebendazole for use in control schemes based on rotation between different drug groups.

However we still do not have any information on the influence of praziquantel on physio-chemical parameters and biofilter organisms in recirculated eel-culture systems. So, unless the deworming of eels is carried out before the eels are introduced into the fish-culture systems, this problem should be investigated as the above mentioned parameters are essential in recycled fish-culture systems. Although praziquantel might prove to be a realistic alternative to the benzimidazoles, the search for other effective anthelmintics against *Pseudodactylogyrus* infestations should be continued. Access to a number of effective drugs with different modes of action will further minimize selection for anthelmintic resistance.

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Summary:

Bath treatment with praziquantel in a concentration of 10 mg/l and exposure time for 25 hours was found to eradicate *Pseudodactylogyrus anguillae* from the European eel. Lower dosages of this drug were ineffective. Bunamidine was lethal to

eels (10 and 1 mg/l) or ineffective against the parasites (0.1 mg/l). Levamisole (10 mg/l) for 25 hours was slightly toxic to eels and without effect on parasites.

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Table 1. Data for eels before treatment.

No. of eels examined:	9
Mean body weight (g.) S.D.	3.2 2.2
Mean body lenght (cm) S.D.	12.8 3.0
Abundance	5.0
Prevalence (%)	89

Table 2. Effect of drugs on abundance and prevalence of *P. anguillae* infestions of eels. Only surviving eels were examined.

Drug	Concentration mg/l	No. of eels examined	Body weight (g) $\bar{x}$/ S.D.	Body length (cm) $\bar{x}$/ S.D.	Infection level abundance $\bar{x}$/ S.D.	Infection level prevalence %
Bunamidine hydrochloride (Scolaban vet.®)	0.1	9	1.3/0.6	10.9/1.6	9.1/ 5.5	100
Praziquantel (pure substance)	1 10	9 10	2.9/2.6 3.6/3.5	11.1/5.7 13.1/ 4.3	8.8/11.9 0/0	89 0
Levamisole hydrochloride (Ripercol vet.®)	10	8	4.1/3.9	13.8/ 4.4	10.5/ 8.9	88
Control (pure tap-water)	-	10	1.3/0.5	10.2/ 1.4	4.7/3.9	90

Table 3. Toxicity of drugs to eels.

Drug	Concentration mg/l	No. of eels exposed	Mortality within 25 hours	Mortality after 25 hours	Behaviour
Bunamidine	0.1	10	-	1	Normal
hydrochloride	1	10	10 (within 9 hours)	-	Whirling, escaping, upside down
(Scolaban vet.®)	10	10	10 (within 2 hours)	-	Whirling, escaping, upside down
Praziquantel	1	10	-	1	Normal
(pure substance)	10	10	-	-	Normal
Levamisole hydrochloride (Ripercol vet.®)	10	10	-	2	Two eels with balance disturbances
Control (pure tap-water)	-	10	-	-	Normal