Efficacy of Oral Administration of Praziquantel and Mebendazole against Microcotyle sebastis (Monogenea) Infestation of Cultured Rockfish (Sebastes schlegeli)

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The efficacy of praziquantel and mebendazole against Microcotyle sebastis infestation in juvenile rockfish by oral administration was evaluated at low (10 ± 1°C) and high (20 ± 1°C) water temperatures. Oral administration of praziquantel or mebendazole resulted in significant reduction or complete extermination of M. sebastis infestation in juvenile rockfish. The treatment efficacy of praziquantel 200 mg/kg B. W. at both temperatures (10°C and 20°C) and mebendazole 200 mg/kg B. W. at 20°C was 100%. Praziquantel was more effective against M. sebastis than mebendazole at 10°C. Our results strongly suggest that oral administration of praziquantel and mebendazole can be used practically in netpen-culture of rockfish as an effective control measure against M. sebastis infestations without imposing handling-related stress to fish.

Key words: praziquantel, mebendazole, oral administration, Microcotyle sebastis, Sebastes schlegeli

Materials and Methods

Fish

Netpen reared juvenile rockfish (body length: 8–13 cm) were obtained from a local producer in Tongyoung (endemic area of M. sebastis), Korea. The presence of M. sebastis on the gills was confirmed by examination of 10 fish. The prevalence was 100%, and the intensity was 54.2 ± 32.8. A total of 150 juvenile rockfish...
was randomly divided into a low water temperature (10 ± 1°C) and a high water temperature group (20 ± 1°C), then separated again into 5 groups of 15 fish in each temperature group. The fish were acclimated to 10 ± 1°C or 20 ± 1°C for 2 weeks prior to the experiment in a flow-through laboratory system. The water temperature was adjusted by means of cooling and heating devices. Fish were fed commercial pelleted rockfish food (1.0% of body weight per day) throughout the experiment. The volume of each experimental aquarium was 50 l, and flow rate was maintained at approximately 0.2 l/min under the condition of 16L: 8D. The seawater had a salinity of 33‰.

Treatment

Fish were anaesthetized with benzocaine and were intubated directly onto the stomach with varying concentrations of the test chemotherapeutants. In each temperature regime, one group was fed with 100 mg praziquantel (Shinpoong Pharm. Co. Ltd.)/kg B. W., and the second group 200 mg praziquantel/kg B. W. The third group 100 mg mebendazole (Sigma)/kg B. W., and the fourth group 200 mg mebendazole/kg B. W. The fish in the control group were given 0.8% saline (Table 1). The effectiveness of each treatment was confirmed by the comparison of the number of parasites in each treatment group with those in the control group at 7 days post-treatment. Abundance and prevalence were determined according to the methods given in Margolis et al. (1982).

Statistical analysis

All data were analyzed using Mann-Whitney’s U-test (SPSS 7.5 for Windows, SPSS Inc.).

Results

Oral administration of praziquantel or mebendazole resulted in significant reduction or completely extermination of M. sebastis infestations in juvenile rockfish, irrespective of the different dosages and water temperatures (Table 1). The treatment efficacy of praziquantel 200 mg/kg B. W. at both temperatures (10 ± 1°C and 20 ± 1°C) and mebendazole 200 mg/kg B. W. at 20 ± 1°C was 100%. No apparent abnormalities were noticed in the experimental fish during the experimental period.

At 10 ± 1°C, statistically significant differences in treatment efficacy were revealed between praziquantel and mebendazole (Table 2). Praziquantel was more effective against M. sebastis than mebendazole at 10 ± 1°C. At 20 ± 1°C, however, there was no significant difference in treatment efficacy between praziquantel and mebendazole at each equal dosage.

Praziquantel was highly effective against M. sebastis at both temperatures. No statistically significant difference in treatment efficacy of praziquantel was revealed between 10°C and 20°C at each equal dosage (Table 2). On the other hand mebendazole showed a temperature-dependent exterminating property. The efficacy of mebendazole against M. sebastis was considerably higher at the higher water temperature.

There were significant differences in treatment efficacy between the two different dosages of praziquantel at both temperatures (Table 2). The efficacy of mebendazole was not significantly different between the two different dosages at 10 ± 1°C, but was significantly

<table>
<thead>
<tr>
<th>Water Temp.</th>
<th>Experimental group</th>
<th>Dosages (mg/kg B. W.)</th>
<th>No. of rockfish examined</th>
<th>Prevalence (%)</th>
<th>Abundance (Mean ± S.D.)</th>
<th>Range of parasite number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ± 1°C</td>
<td>Control</td>
<td>Only saline</td>
<td>15</td>
<td>100.0</td>
<td>56.9 ± 39.3</td>
<td>3 – 136</td>
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<td>Praziquantel</td>
<td>100</td>
<td>15</td>
<td>66.7</td>
<td>1.9 ± 2.3</td>
<td>0 – 6</td>
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<tr>
<td></td>
<td></td>
<td>200</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Mebendazole</td>
<td>100</td>
<td>15</td>
<td>100.0</td>
<td>16.7 ± 14.8</td>
<td>2 – 49</td>
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<tr>
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<td></td>
<td>200</td>
<td>15</td>
<td>86.7</td>
<td>12.3 ± 10.8</td>
<td>0 – 38</td>
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<tr>
<td>20 ± 1°C</td>
<td>Control</td>
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<td>15</td>
<td>100.0</td>
<td>58.7 ± 36.1</td>
<td>5 – 122</td>
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<td>0 – 7</td>
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<td></td>
<td></td>
<td>200</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Mebendazole</td>
<td>100</td>
<td>15</td>
<td>60.0</td>
<td>4.1 ± 6.4</td>
<td>0 – 24</td>
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<tr>
<td></td>
<td></td>
<td>200</td>
<td>15</td>
<td>0</td>
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</table>
Table 2. The values of significance among experimental groups calculated using Mann-Whitney’s U-test

<table>
<thead>
<tr>
<th>Group</th>
<th>LC</th>
<th>LP1</th>
<th>LP2</th>
<th>LM1</th>
<th>LM2</th>
<th>HC</th>
<th>HP1</th>
<th>HP2</th>
<th>HM1</th>
<th>HM2</th>
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<tr>
<td>LC</td>
<td>S</td>
<td>0.000</td>
<td>0.000</td>
<td>0.002</td>
<td>0.000</td>
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<td>LP1</td>
<td>S</td>
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<td>S</td>
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</tr>
<tr>
<td>LM2</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.007</td>
<td>S</td>
<td>0.000</td>
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<td>HC</td>
<td>S</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<td>S</td>
<td>0.000</td>
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<tr>
<td>HP1</td>
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<td>0.001</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>S</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>HM1</td>
<td>S</td>
<td>0.001</td>
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<td></td>
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<td></td>
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</tbody>
</table>

[L: Control (10 ± 1°C), LP1: Praziquantel 100 mg/kg B. W. (10 ± 1°C), LP2: Praziquantel 200 mg/kg B. W. (10 ± 1°C), LM1: Mebendazole 100 mg/kg B. W. (10 ± 1°C), LM2: Mebendazole 200 mg/kg B. W. (10 ± 1°C), HC: Control (20 ± 1°C), HP1: Praziquantel 100 mg/kg B. W. (20 ± 1°C), HP2: Praziquantel 200 mg/kg B. W. (20 ± 1°C), HM1: Mebendazole 100 mg/kg B. W. (20 ± 1°C), HM2: Mebendazole 200 mg/kg B. W. (20 ± 1°C), S: Same data]

different \((p < 0.05)\) at 20 ± 1°C.

**Discussion**

The results clearly show that oral administrations of praziquantel or mebendazole are effective for controlling *Microcotyle sebastis* infesting the gills of cultured rockfish. Praziquantel has a very broad spectrum of activity against trematodes and cestodes infections in mammals (Andrew et al., 1983), and has recently been employed to control monogenean diseases in fish by bath treatment. Although praziquantel has been injected or given orally to eliminate endoparasitic helminths such as metacercariae of *Diplodostomum spathaceum* infecting eye lenses of trout (Bylund and Sumari, 1981), *Clinostomummarginatum* infecting muscle of channel catfish (Lorio, 1989) and adult cestodes of both freshwater and marine fishes (Pool et al., 1984; Moser et al., 1986; Sanmartin Duran et al., 1989), it has never been used to treat monogenean diseases by oral administration.

In the present study, we report for the first time that oral administration of praziquantel is a very effective method in treatment of infections with gill monogeneans. Mebendazole is a member of the benzimidazole group commonly used against nematodes infections in mammals (Roberson, 1982) but previously shown to be potent against fish monogeneans by bath treatment (Goven and Amend, 1982; Székely and Molnár, 1987; Buchmann, 1993; Buchmann and Bjergaard, 1990; Mellergaard, 1990). According to the results of Kim and Choi (1998), oral administration of mebendazole at a dosage of 100 mg/kg B. W. (23 ± 1°C) significantly reduced the infestation level of *M. sebastis* in rockfish.

In the present experiment, mebendazole administered orally at a dose of 100 mg/kg B. W. (20 ± 1°C) significantly reduced the number of *M. sebastis*, also, and at a dose of 200 mg/kg B. W. (20 ± 1°C) completely eradicated *M. sebastis* from the gills of juvenile rockfish. Therefore it is indicated that oral administration of praziquantel and mebendazole can be used practically in netpen-culture of rockfish as an effective control measure for *M. sebastis* infestations without imposing handling related stress to fish.

The efficacy of praziquantel in treatment of *M. sebastis* was not significantly affected by water temperature but that of mebendazole was affected significantly. Elevated temperature apparently enhanced the efficacy of mebendazole against *M. sebastis* infestation. This was also shown by Buchmann et al. (1992) for gill monogeneans on European eel, *Anguilla anguilla*. Temperature-related variations in pharmacokinetic properties of antibiotics in fish have been previously demonstrated in several studies (Borgan et al., 1981), but the effects of temperature on the mode of action of praziquantel and mebendazole in fish administered orally are not known. Our results indicate that praziquantel can be used at both high and low water temperatures to orally treat *M. sebastis* infestation, and mebendazole can be used at a high water temperature to get high efficacy against *M. sebastis* infestation.

Experimental fish were infected not only with adult parasites, but also with immature ones. There was no big differences in the susceptibility of the parasite at different developmental stages to the chemotherapeutants tested (data not shown).

Buchmann et al. (1992) demonstrated that extended
exposures to subtherapeutic dosages of mebendazole resulted in drug resistant parasite populations and it was recommended by these authors to alternate between mebendazole and praziquantel treatments in order to delay the emergence of anthelminthic resistance. Indeed, our experiments suggest that development of the drug resistance in _M. sebastis_ can be prevented or delayed by alternating in use between praziquantel and mebendazole.

Although Mellergaard et al. (1990) and Iosifidou et al. (1997) reported the residues of mebendazole in eel after bath treatment, no work has been done on the metabolism and excretion of mebendazole and praziquantel in fish administered orally. Regarding safety for the human consumption, therefore, it would be recommended that the oral administration of these chemotherapeutants should be limited to juveniles of rockfish until the residue depletion times of these compounds from flesh of fish are determined.

Although eradication of the parasite from the gills of rockfish was successful in the present experiments, we have the problem of reinfection in the field. We have to establish the retreatment scheme for net-pen cultured rockfish. Experiments on the determination of the retreatment interval is now in progress.

Acknowledgement

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References


