SUSCEPTIBILITY OF BROWN TROUT (*Salmo trutta*) TO INFECTIOUS HEMATOPOIETIC NECROSIS VIRUS

By S.E. LaPatra and J.L. Fryer

Infectious hematopoietic necrosis (IHNV) is a lethal, contagious viral disease of certain species of salmon and trout. However, no information is available concerning the susceptibility of brown trout (*Salmo trutta*) to infectious hematopoietic necrosis virus (IHNV). This species is susceptible to other rhabdoviruses including viral hemorrhagic septicemia virus (VHSV) (de Kinkelin and Le Berre, 1977; Jorgensen, 1980) and pike fry rhabdovirus (Adair and McLoughlin, 1986). Although the culture of brown trout in the Pacific Northwest of the USA is limited, it does occur in IHNV enzootic areas. No IHNV epizootics have been reported in juvenile brown trout and adult fish are not frequently examined for virus. In Europe the culture of brown trout is extensive and with the recent detection of IHNV, information on the susceptibility of this species becomes important to fish health managers. The objective of this study was to determine the susceptibility of brown trout to two strains of IHNV and compare it to mortality induced in rainbow trout (*Oncorhynchus mykiss*).

Brown and rainbow trout fry were obtained from virus-free stocks in Oregon, USA. They were transported and held at the Oregon State University Fish Disease Laboratory in 12°C fish-pathogen-free well water and fed a commercial diet ad libitum. The IHNV viruses used in this study were the same as reported by LaPatra et al. (1990a) and included the electrophoretic type-1 strain isolated from fish in Oregon and a type-2 strain obtained from fish in Idaho, USA. Virulence of the two IHNV strains was determined by exposures of fish to waterborne virus. Dilutions of virus were prepared in 1.0 L of static well water to obtain concentrations that ranged from $10^{2.5}$ to $10^{5.5}$ plaque-forming units (PFU/ml). Groups of 25 brown trout (mean wt. ~0.6 g) were exposed to four concentrations of each IHNV strain and groups of 20 rainbow trout (mean wt. ~1.4 g) were exposed to one concentration ($10^{3.5}$ PFU/ml) of each strain. Fish in control groups were treated the same except no virus was added. Virus exposures were conducted for 12 h, the water was aerated, and containers partially immersed in free-flowing water (12°C) to maintain a constant temperature. After the exposure period, fish from each container were placed in 60 L fiberglass aquaria receiving single-pass water flowing at a rate of about 1 L/min. Dead fish were removed daily, weighed, and examined for virus by plaque assay on EPC cells (LaPatra et al., 1989). Isolations of IHNV were confirmed by the fluorescent antibody test (LaPatra et al., 1989).

Susceptibility of brown trout to IHNV was demonstrated for the two strains of virus tested (Table 1). Virus-induced mortality in the rainbow trout was 10% (2/20) for the type-1 strain and 40% (8/20) for the type-2 strain with a mean day to death of 8.0 and 7.5 d, respectively. Virus was isolated from most mortalities and the virus concentration determined from individual fish ranged from 390 to $>3.0 \times 10^6$ PFU/g.

In this study the type-1 strain of IHNV was again more virulent for rainbow trout than the type-2 virus (LaPatra et al., 1990a; LaPatra et al., 1990b). Brown trout appeared to be more susceptible to the type-1 strain but cumulative percent mortality never exceeded 50% even at the highest concentration of virus tested. Mean number of days to death for the brown trout generally increased as the concentration of virus used to infect them decreased. This was true for both strains. There were no major differences in the mean time to death for fish
Table 1. Cumulative percent mortality (CPM) and mean number of days to death (MDD) of brown trout (*Salmo trutta*) infected with two strains of infectious hematopoietic necrosis virus (IHNV)

<table>
<thead>
<tr>
<th>Concentration of IHNV at the time of exposure</th>
<th>5.5</th>
<th>4.5</th>
<th>3.5</th>
<th>2.5</th>
<th>0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>IHNV strain</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>1 - type-l IHNV obtained from infected fish in Oregon, USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2 - type-2 IHNV obtained from infected fish in Idaho, USA</td>
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</tbody>
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<table>
<thead>
<tr>
<th>CPM</th>
<th>MDD</th>
<th>CPM</th>
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<tbody>
<tr>
<td>48</td>
<td>6.8</td>
<td>32</td>
<td>7.3</td>
<td>13</td>
<td>6.0</td>
<td>12</td>
<td>9.0</td>
<td>0</td>
<td>nm^d</td>
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<tr>
<td>29</td>
<td>8.9</td>
<td>36</td>
<td>6.7</td>
<td>4</td>
<td>6.0</td>
<td>12</td>
<td>12</td>
<td>0</td>
<td>nm^d</td>
</tr>
</tbody>
</table>

a Infectious hematopoietic necrosis virus concentrations expressed as log_{10} plaque-forming units/ml of water at the time of exposure.

b Virus strains:
1 = type-l IHNV obtained from infected fish in Oregon, USA
2 = type-2 IHNV obtained from infected fish in Idaho, USA.

c N = 25 fish for each viral dose and strain.

d nm = no mortality.

infected with the type-1 or type-2 strain at a given concentration (Table 1). Examination of IHNV isolates from Europe suggest that they are similar to type-1 and type-2 strains known in the USA (Arkush *et al.*, 1989). Although susceptibility of brown trout to the European isolates of IHNV has not been reported, these results indicate infection with this virus can occur. Rainbow trout are susceptible to both IHNV and VHSV and brown trout appear to be more refractory to infection with these two viruses. Brown trout are only susceptible to certain strains of VHSV (Jorgensen, 1980) and further testing of this species with other strains of IHNV may provide similar information. The major epizootiologic impact of brown trout may be as asymptomatic carriers of VHSV or IHNV that serve as a reservoir of infection for other more susceptible species (Jorgensen, 1980; Enzman and Konrad, 1985).

**Summary**

The susceptibility of brown trout (*Salmo trutta*) to two strains of infectious hematopoietic necrosis virus (IHNV) is reported. Waterborne exposures to virus were done on 25 fish groups at four concentrations (10^5 to 10^7) of a type-1 strain of IHNV obtained from Oregon, USA and a type-2 strain of IHNV obtained from Idaho, USA. Brown trout had a cumulative percent mortality which ranged from 48-12% when infected with the type-1 strain and 36-12% for the type-2 strain. Mean number of days to death tended to increase with decreased virus concentration used in the waterborne exposure for both strains. There were no major difference in the mean number of days to death for fish infected with the type-1 strain at a given concentration when compared to the type-2 strain. Although brown trout were susceptible to both strains of IHNV this species appears to be more refractory to infection than rainbow trout (*Oncorhynchus mykiss*).

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**References**


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