

SALINITY TOLERANCE OF *GYRODACTYLUS DERJAVINI* FROM RAINBOW TROUT *ONCORHYNCHUS MYKISS*

K. BUCHMANN

Department of Veterinary Microbiology, Section of Fish Diseases, Royal Veterinary and Agricultural University,
13 Bülowsvej, DK-1870 Frederiksberg C. Denmark

Abstract

The salinity tolerance of the ectoparasitic monogenean *Gyrodactylus derjavini* parasitising the rainbow trout was investigated. Following direct transfer (at 11°C) of parasites from freshwater to 5, 10, 15 and 20 ppt NaCl, respectively, only parasites in 5 ppt survived a 4 days period. However, after a 7 days acclimation period of infected fish in 5 ppt NaCl, subsequent transfer to higher salinities demonstrated parasite survival in 7 ppt. The investigation showed 45.2% parasite survival in 6 ppt and 0.6% survival in 7 ppt but total parasite elimination at higher NaCl concentrations. These findings will explain field observations showing absence of *G. derjavini* in salmonid populations from an isolated Danish island surrounded by brackish water with salinities above 7 ppt. The parasite seems less salinity tolerant than the congener *G. salaris*.

Introduction

The monogenean *Gyrodactylus derjavini* parasitising the fins and skin of salmonids is abundantly occurring in the northern part of Europe, including the Baltic area (Prost, 1991; Malmberg, 1993; Mo, 1993; Buchmann & Bresciani, 1997). The river Mörrum in the Southern part of Sweden draining into the Baltic Sea supports equally well populations of this gyrodactylid on both *Salmo salar* and *Salmo trutta* (Malmberg & Malmberg, 1993). As the latter species is a good host for this gyrodactylid (Buchmann & Uldal, 1997) it was surprising to find complete absence of this ectoparasite during a thorough parasitological investigation in 1987 of *Salmo trutta* from two main streams on the island of Bornholm in the Baltic Sea located app. 100 km from Mörrum river (Buchmann, 1987, 1989). The characteristic salmonid endoparasite fauna found in that survey otherwise indicated colonisation with parasites from nearby Baltic rivers. The surface water surrounding Bornholm has a relatively low salinity of 7.8 ppt (Müller, 1988). This is a salinity which will allow the related species *Gyrodactylus salaris* to spread between different rivers (Soleng & Bakke, 1991, Lund & Heggberget, 1992). Thus, it would have

been expected that *G. derjavini* could be able to spread from the Swedish Mörrum river with infected migrating sea trout through this brackish area to Bornholm. However, as this is evidently not the case, a relatively low salinity tolerance of *G. derjavini* could serve as an explanation. Therefore, a laboratory experiment was implemented to elucidate the salinity tolerance of the parasite.

Materials and methods

A strain of *G. derjavini* was isolated from a Danish trout farm on which previously uninfected rainbow trout (total body length 9-10 cm) were infected as previously described (Buchmann & Uldal 1997). These hosts carrying a 4 week old infection were placed with uninfected rainbow trout in glass aquaria (total volume 200 l) containing 50 l aerated and internally recirculated water (Buchmann & Uldal 1997) with different concentrations (0, 5, 10, 15, 20 ppt) of NaCl (Ribdel-Dehaën 31434, Germany) in laboratory water at 11°C (thermostat-regulated cold room). The room was illuminated with artificial light on a 12h darkness:12h light cycle.

The infection of fish was determined before exposure (day 0) and after 4 days exposure (day 4) by examination in a dissecting

Table 1. Direct transfer from freshwater. Survival of *Gyrodactylus derjavini* on rainbow trout during a 4 day investigation period after direct transfer to 200 l aquaria with various concentrations of NaCl.

NaCl concentrations	0 ppt	5 ppt	10 ppt	15 ppt	20 ppt
No. of parasites at Day 0	941	976	1055	977	878
No. of parasites at Day 4	1162	921	0 #	0 #	0 #
No. of infected fish/total No. of fish Day 0	9/22	9/22	9/23	7/21	9/23
No. of infected fish/total No. of fish Day 4	22/22	21/22	0/23	0/20*	0/13*

*: host mortality

#: significant reduction of infection, $p < 0.05$ (Mann-Whitney U-test)

Table 2. After 5 ppt acclimation. Survival of *Gyrodactylus derjavini* during a 4 days period after transfer to higher salinities in small 10 l aquaria. #: significant reduction of parasite number, $p < 0.05$, chi-square-test.

NaCl concentrations	5 ppt (control)	6 ppt	7 ppt	8 ppt	9 ppt	10 ppt	11 ppt
No. of fish	4	4	4	4	4	4	4
No. of aquaria	4	4	4	4	4	4	4
No. of parasites Day 0	121	115	169	87	137	150	112
No. of parasites Day 4	117	52	1 #	0 #	0 #	0 #	0 #
Per cent survival	96.7%	45.2%	0.6%	0%	0%	0%	0%

microscope (7-40x magnification) of anaesthetised (80 mg l⁻¹ MS 222) immersed fish. All external body parts including fins, body proper, head and cornea were scrutinised. Subsequently, it was investigated if acclimation in 5 ppt prior to transfer to higher salinities would result in better survival. After 7 days in 5 ppt NaCl individual trout carrying a known number of parasites were incubated (11°C) in smaller plastic aquaria (total volume 10 l) containing 3 l water of different salinities (5, 6, 7, 8, 9, 10, 11 ppt NaCl). After 4 days the numbers of parasites were determined as described above.

Results

Parasites survived in freshwater and 5 ppt NaCl, whereas total elimination of *G. derjavini* was the result of 4 days exposure to 10, 15 and 20 ppt NaCl (Table 1). Reproduction of parasites was seen in freshwater but not in 5 ppt salinity. In both cases *G. derjavini* spread from infected to

uninfected hosts. When acclimated in 5 ppt before transfer to higher salinities parasites survived relatively well in 6 ppt (app. 50 % mortality) but exhibited a drastic population decline (almost total eradication) in 7 ppt NaCl (Table 2).

Discussion

These observations strongly indicate that the low salinity tolerance of *G. derjavini* will explain the lack of parasite colonisation from Swedish rivers to the streams of the island of Bornholm. Thus, this island ecosystem is separated from the Swedish mainland by a 100 km wide stretch of water with a salinity of 7.8 ppt (Müller 1988) which has, in the present investigation, been demonstrated to be near the lethal salinity limit for the parasite. Although the present investigation was conducted with NaCl and not with natural seawater the different salinity tolerance compared to the related *Gyrodactylus salaris* from Norway is compelling. Lund & Heggberget (1992)

found that *G. salaris* on Atlantic salmon could survive more than 12 ppt seawater during a migration in brackish water between different rivers. Likewise, Soleng & Bakke (1991) demonstrated experimentally that *G. salaris* will survive for months in 7.5 ppt also at temperatures comparable to the conditions used in the present work.

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