COMPARISON OF PHYSIOLOGICAL AND BIOCHEMICAL PARAMETERS IN RAINBOW TROUT, COHO AND ATLANTIC SALMON FOLLOWING INFESTATION WITH SEA LICE (*LEPEOPHTHEIRUS SALMONIS*)

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Introduction

A number of strategies to control sea lice have been used over the last decade with limited success. A better understanding of host-parasite relationships is essential in order to develop more effective control measures (for the future). Natural resistance to sea lice infestation has been observed in coho salmon; however the mechanism remains unknown (Johnson and Albright, 1992) . We are examining the response of sea lice (*Lepeophtheirus salmonis*) to different host species and the response of different host species to sea lice. Our focus is on biochemical parameters of salmonid mucus and physiological parameters of salmonid blood during infestation with sea lice.

Methodology

Three salmonid species (rainbow trout, coho and Atlantic salmon) were cohabited in four tanks for two weeks to acclimate. The tanks were separated into two test and two control tanks and approximately 100-150 infective copepodids/fish were added to each test tank. On days 0 (prior to infestation), 1,

3, 7, 14, and 21, post infestation, blood and mucus samples were collected. Cortisol, glucose, hematocrit, electrolytes and protein were measured in the blood as previously described (Bowers et al, 2000). Alkaline phosphatase, lysozyme, and protease activities were analyzed in the mucus as previously described (Ross et al, 2000).

Live lice incubations

Incubations were carried out by adding live lice for up to one hour in test tubes containing either seawater or mucus from rainbow trout, coho salmon, Atlantic salmon or winter flounder. Lice were then removed and protease activity in seawater and mucus was measured using zymography.

Statistical methods

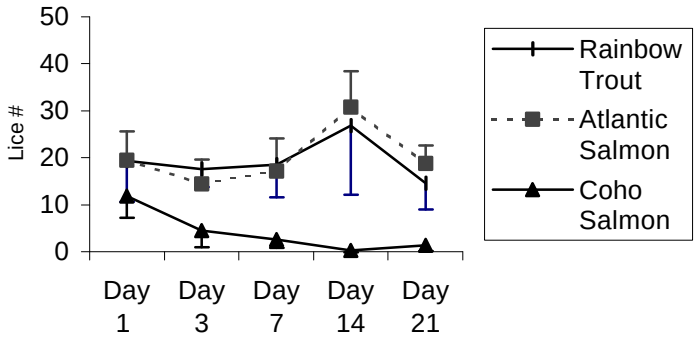
Analyses of variance (ANOVAs) were performed to observe tank effects during the trial (1-way), and to compare blood and mucus parameters among species, day and condition (test/control) (3-way).

Results

Sea lice counts

There were no significant differences in lice load on any day between rainbow trout and Atlantic salmon. Lice counts were significantly lower on coho salmon than on Atlantic salmon and rainbow trout (Figure 1). The number of lice on coho salmon steadily decreased over time with only 3 total lice found on 10 fish on day 14. On day 21 the number of lice increased on coho salmon while they decreased on rainbow trout and Atlantic salmon.

Figure 1: Lice counts on the three salmonid species over the course of the experiment



Blood Physiology

Several blood parameters were examined including cortisol, glucose, osmolality, electrolytes, protein and hematocrit. Only hematocrit, protein and glucose levels were analyzed for coho salmon. Electrolytes such as sodium, chloride and potassium showed no significant differences between infected and control fish or between species. Sodium levels ranged between 150-165 mmol/L in both Atlantic salmon and rainbow trout. Chloride levels ranged between 120-135 mmol/L and potassium levels fluctuated between 0.8-1.5 mmol/L in both Atlantic salmon and rainbow trout. Blood osmolality, cortisol and glucose levels also showed no significant difference between infected and control fish or between the two species. Osmolality ranged from 320-340 mosm/L while glucose levels stayed between 4-8 mmol/L. Cortisol levels ranged anywhere from 0-200 nmol/L but mostly hovered between 20-40 nmol/L for all three species.

Protein and hematocrit levels did not vary significantly between infected and control fish but did vary between species. Coho salmon had significantly higher hematocrit levels ($p<0.05$) than the other two species while rainbow trout had significantly higher protein levels ($p<0.05$) than the other two species over the course of the study.

Mucus Biochemistry

Alkaline phosphatase levels were significantly higher ($p<0.05$) in infected Atlantic salmon compared to controls on days 3 and 21, while no significant differences were noticed between infected and control fish in coho salmon and rainbow trout. There were no significant differences in alkaline phosphatase levels between Atlantic salmon and coho salmon, but they both differed significantly from rainbow trout on day 21 ($p<0.05$). There was a significant interaction between species, day and condition in lysozyme activity. Lysozyme levels were significantly higher in infected rainbow trout than control fish throughout, and infected coho also had significantly higher lysozyme activities compared to control fish on day 21. Quantitative measurements of protease activity (azocasein hydrolysis) did not differ significantly between species or control and infected fish except on day 21when infected coho salmon had significantly less protease activity compared to controls. Qualititative measurements of protease activity (zymography) showed a significant increase in low molecular weight proteases in infected rainbow trout and Atlantic salmon. These proteases were secreted by the louse as shown by Ross et al (2000).

Live lice incubations

Atlantic salmon and rainbow trout mucus appeared to stimulate protease release from lice more consistently (75-80% positive responses) (n=20) than seawater or coho salmon and flounder mucus (20 –30 % positive responses) (n=20) as determined by the appearance of lice-derived low molecular weight protease bands on zymograms.

Conclusions

Almost all lice were sloughed off from coho salmon between days 7 and 14, consistent with the findings of Johnson and Albright (1992). Lice numbers on day 21 increased on coho salmon. The lice on coho salmon at day 21 had probably migrated from the other species. Sea lice have been observed to move from one host to another (Jacobsen, 1993). The lack of change in blood physiology suggests that cortisol, and other stress responders measured, are not involved in the coho salmon inhibitory response to *L. salmonis* challenge. However, the above results suggest that differences in skin mucus between species may play a role in resistance to sea lice.

Acknowledgements

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