SALINITY ACCLIMATION IN RAINBOW TROUT:

MOLECULAR AND PHYSIOLOGICAL RESPONSES

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Salinity acclimation occurs in a limited number of teleost species. The rainbow trout, while having a restricted capacity to tolerate abrupt transfer from freshwater to full seawater, is capable of acclimating to gradual increases in salinity. The response to gradual salinity increases in the trout has not been fully characterized at the molecular level. Evidence for the involvement of a number of important gill transport proteins, channels and receptors during acute seawater exposure has been demonstrated in several teleost species including: Brown trout (Madsen et al. 1995), the Atlantic salmon (Singer et al. 2002) and the euryhaline killifish (Singer et al. 1998). To better characterize the acclimatory responses, we have examined changes in mRNA levels and protein content of salinity-responsive genes from the gill in rainbow trout.

Juvenile trout were gradually acclimated to increased salinity over 5 days (Day 1: 33% full seawater; day 2: 50% full seawater; day 5: 66% full seawater). Plasma cortisol, glucose, Na^+ and Cl^- levels and gill Na^+,K^+-ATPase activity were measured from each fish at each time point. The gill Na^+,K^+-ATPase α-subunit, CFTR, and GR mRNA abundance were measured using quantitative Real-Time PCR.

Plasma Na^+ and Cl^- levels were undisturbed at each salinity suggesting that the trout was capable of osmoregulation. Plasma cortisol levels also showed no change, while gill GR mRNA levels increased 3-fold over FW levels after 24h at 33% full seawater and peaked (4-fold increase) at day 3 at 50% seawater. The potential for increased GR capacity may be involved in the regulation of specific genes regulated mediated through glucocorticoid responsive elements (GREs). Trout gill CFTR mRNA levels increased with salinity exposure, suggesting a role for this chloride channel in trout salinity acclimatory response. The response is similar to both killifish CFTR and the Atlantic salmon CFTR I isoform which both show sustained increases in mRNA levels following abrupt exposure to full seawater (Singer et al. 1998, Singer et al. 2002). In contrast to CFTR, gill Na^+,K^+-ATPase α-subunit mRNA levels rose transiently, peaking at 24 hours and 33% full seawater, followed by a significant decrease in mRNA levels compared with freshwater at both 3 day and 5 day (50% and 66% seawater). The reduced trout gill Na^+,K^+-ATPase α-subunit mRNA levels at 3 and 5 days reflect the decline in gill Na^+,K^+-ATPase enzyme activities. Overall, this study demonstrates that salinity acclimation in rainbow trout is mediated by molecular pathways previously described in other teleosts.

References

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