

**INFLUENCE OF ENERGY INTAKE ON THE SOMATOTROPIC AXIS  
IN ARCTIC CHARR**

Colin Cameron  
Department of Biomedical Sciences, University of Guelph  
Guelph, Ontario, N1G 2W1, Canada  
(519) 824-4120 X4953 colin@uoguelph.ca

Richard Moccia  
Department of Animal and Poultry Science, University of Guelph

John Leatherland  
Department of Biomedical Sciences, University of Guelph

**EXTENDED ABSTRACT ONLY - DO NOT CITE**

**Introduction**

The starvation-induced elevations of plasma growth hormone (GH), in the absence of any growth promoting effects of GH, has been observed in mammals as well as in fishes (Farbridge and Leatherland, 1992;Thissen et al., 1994). It appears that an insensitivity to GH results in decreased expression of hepatic insulin-like growth factor-I (IGF-I) leading to low plasma IGF-I levels (Duan and Plisetskaya, 1993). It has been suggested that a lack of negative feedback by IGF-I allows plasma GH to become elevated.

This study was undertaken to investigate the nutritional control of the GH / IGF-I axis in Arctic charr (*Salvelinus alpinus*), by examining the effect of food intake on both in vivo plasma hormone concentrations and in vitro control of GH secretion by SRIF-14 and IGF-I.

**Materials and methods**

Arctic charr (*Salvelinus alpinus*) of the Labrador strain were obtained from the Alma Aquaculture Research Station, Alma, ON and were randomly assigned to one of three ration groups (0, 0.35, and 0.7 % BW•d<sup>-1</sup>, 3 replicate tanks each). At five weeks the fish were euthanized, blood was collected in heparinized tubes, and

pituitary glands were removed for use in pituitary cultures.

Pituitary glands were separated into equal halves and the hemipituitaries were cultured in medium 199 for 4 hours at 10°C to establish basal release. This was followed by an 18 hour incubation with or without human recombinant IGF-I (GroPep Pty. Ltd., Adelaide, Australia) or somatostatin-14 (Sigma Chemical Co., St. Louis, MO) at concentrations of 0.01 nM and 1 nM.

GH in plasma and pituitary gland culture medium was measured using a double antibody enzyme-linked immunosorbent assay (ELISA). Plasma IGF-I was measured using a fish-specific radioimmunoassay (GroPep Pty. Ltd., Adelaide, Australia).

## Results

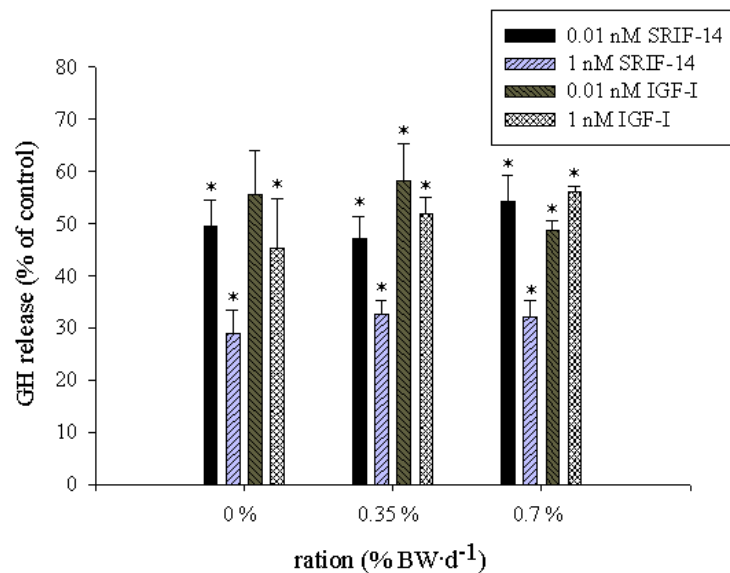
Average final body weight (ave BW) increased significantly with increasing ration. Thermal-unit growth coefficients (TGC) were significantly higher for fish fed the 0.7 % BW•d<sup>-1</sup> and 0.35 % BW•d<sup>-1</sup>, as compared to the group fed 0 % BW•d<sup>-1</sup>. Feed conversion efficiencies (FCE) were not significantly different between groups fed 0.7 % BW•d<sup>-1</sup> and 0.35 % BW•d<sup>-1</sup> (table 1).

Table 1. Average body weights, thermal-unit growth coefficients (TGC), feed conversion efficiencies (FCE), and plasma growth hormone (GH) concentrations for Arctic charr fed three different rations (0, 0.35, and 0.7 % BW•d<sup>-1</sup>) for 5 weeks. Data presented as mean ± SEM. Means with different superscripts are significantly different ( $\alpha=0.05$ ).

ration (%BW•d <sup>-1</sup> )	ave BW (g)	TGC	FCE	GH (ng•ml <sup>-1</sup> )
0	494.9 ± 3.6 <sup>a</sup>	0.010 ± 0.01 <sup>a</sup>	0 <sup>a</sup>	26.4 ± 5.9 <sup>a</sup>
0.35	561.9 ± 5.7 <sup>b</sup>	0.150 ± 0.02 <sup>b</sup>	1.3 ± 0.1 <sup>b</sup>	47.8 ± 9.3 <sup>ab</sup>
0.7	629.1 ± 17.2 <sup>c</sup>	0.204 ± 0.01 <sup>b</sup>	1.7 ± 0.2 <sup>b</sup>	59.6 ± 10.2 <sup>b</sup>

Plasma GH concentrations were significantly higher in fish fed full ration as compared to those that were starved, however there was no significant difference between fish fed 0.35 % BW•d<sup>-1</sup> and either those that were starved, or fed 0.7 % BW•d<sup>-1</sup>.

Arctic charr hemipituitaries exposed to doses of 0.01 nM or 1 nM hIGF-I show a significant inhibition of GH release, except at a dose of 0.01 nM in fish fed 0 % BW•d<sup>-1</sup>. Hemipituitaries exposed to SRIF-14 display a dose dependent inhibition of GH release from 0.01 nM to 1 nM. No significant differences were observed between treatment groups with respect to hemipituitary responses to either hIGF-I or SRIF-14 (figure 1).



Fi

Figure 1. Percent growth hormone release relative to control of Arctic charr hemipituitaries exposed to SRIF-14 and IGF-I at doses of 0.01 nM and 1 nM for 18 hours in static culture. Asterisks indicate values significantly different from control ( $\alpha=0.05$ ).

**Discussion**

The differences observed in average body weights and TGC indicate that the different rations achieved different rates of growth. The lack of significant difference in TGC between groups fed 0.7 % BW•d<sup>-1</sup> and 0.35 % BW•d<sup>-1</sup> may be explained by the trend for a higher FCE in fish fed 0.7 % BW•d<sup>-1</sup>, indicating that this group may have been slightly overfed.

The higher plasma GH levels in groups fed a ration of 0.7 % BW•d<sup>-1</sup> was unexpected. These data will be considered with regard to parallel measurements of plasma IGF-I concentrations.

This study confirms that hIGF-I is a potent inhibitor of GH release from the Arctic charr pituitary gland. However, SRIF-14 resulted in a higher maximum inhibition of GH release (31.7% of control) as compared to IGF-I (52.9%) at the doses used. The lack of dose-dependent inhibition by IGF-I may indicate that maximal inhibition of GH release was achieved with all doses used.

The lack of treatment (ration) effect indicates that changes in pituitary sensitivity to either SRIF-14 or IGF-I in response to ration level cannot account for differences observed in plasma GH concentrations. These results will be compared to data collected from a pituitary perfusion system to investigate whether short-term (secretory) patterns of GH release from Arctic charr pituitaries in response to SRIF-14 and IGF-I reflect those seen in long-term pituitary culture.

### **Acknowledgements**

The authors wish to thank Lucy Lin for technical assistance as well as the Alma Aquaculture Research Station and staff. Funding was provided by OMAFRA to Richard Moccia, and OMAFRA and NSERC to John Leatherland.

### **References**

- Duan, C. and E.M. Plisetskaya. 1993. Nutritional regulation of insulin-like growth factor-I mRNA expression in salmon tissues. *J. Endocrinol.* 139: 243-252.
- Farbridge, K.J. and J.F. Leatherland. 1992. Temporal changes in plasma thyroid hormone, growth hormone and free fatty acid concentrations, and hepatic 5'-monodeiodinase activity, lipid and protein content during chronic fasting and re-feeding in rainbow trout (*Oncorhynchus mykiss*). *Fish Physiol. Biochem.* 10: 245-57.

Thissen, J.-P., J.-M. Ketelslegers, and L.E. Underwood. 1994. Nutritional regulation of the insulin-like growth factors. *Endocr. Rev.* 15: 80-101.

