

**THE REGULATORY ROLES OF CORTISOL AND
CATECHOLAMINES IN TROUT WHITE MUSCLE GLYCOGEN
METABOLISM STUDIED *IN VITRO*.**

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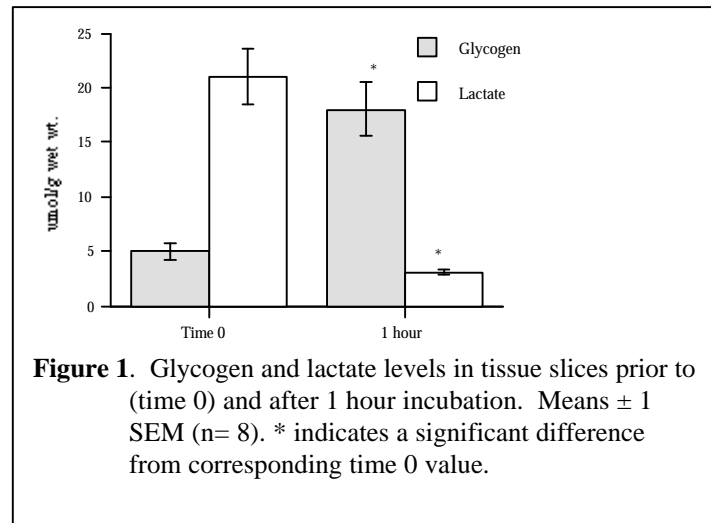
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EXTENDED ABSTRACT ONLY – DO NOT CITE

In fish, high intensity exercise results in a near total depletion of white muscle glycogen stores. Glycogen replenishment and hence, restoration of sprint performance, was thought to be a slow process, requiring in excess of 6 hr. The time period required for metabolic recovery from a bout of exhaustive exercise may, in fact, be considerably shorter (Pagnotta *et al.*, 1994; Eros & Milligan, 1996; Milligan *et al.*, 2000), if the post-exercise elevation in plasma cortisol is prevented. Under these conditions, muscle glycogen and lactate are restored to pre-exercise levels within 2 h after exercise. The story emerging from these *in vivo* studies is that cortisol is involved in the regulation of muscle glycogen metabolism, though its mechanism of action is not understood.

To test the hypothesis that cortisol is having a direct regulatory role in muscle glycogen metabolism and determine what that role might be, we developed an *in vitro* white muscle slice preparation from rainbow trout. Fish, either at rest or after 5 min of exhaustive exercise, were killed by anaesthetic overdose and a block (~1.5 cm³) of the dorsal epaxial muscle was excised and placed in ice-cold Cortland's saline. Tissue slices (~1.1-1.3 mm thick) were obtained with a Stadie-Riggs microtome. One slice was immediately freeze-clamped under

liquid nitrogen and served as a “time 0” point of reference for each 1 hour incubation. The other slices were individually incubated in 3.5 ml Cortland’s saline containing 10 mM pyruvate, and 5 mM lactate and continuously aerated with humidified 99.5% O₂: 0.5% CO₂ for 1 hour at 15 °C in a shaking water bath. At the end of 1 hour, slices were removed, blotted dry and freeze-clamped under liquid nitrogen.



Muscle slices obtained from exhaustively exercised trout were capable of significant glycogen synthesis and lactate clearance (Figure 1). After 1 hour incubation in Cortland’s saline containing 5 mM lactate, approximately 13 umol of glycogen was synthesized and 18 mol of lactate was cleared. This is unequivocal evidence that trout white muscle is capable of *in situ* glycogenesis.

The regulatory roles of cortisol and catecholamines are complex and dependent upon the endogenous levels of glycogen (figure 2). In muscle slices where glycogen levels were > 5 umol/g, both dexamethasone (a cortisol analogue) and epinephrine stimulated glycogenolysis and the relative activity of glycogen phosphorylase. However, when glycogen levels were <5 umol/g, both glycogenesis and the relative activity of glycogen synthase were stimulated.

In conclusion, these data indicate that the *in vitro* white muscle slice preparation is a good model system for studying the regulation of glycogen metabolism. Furthermore, cortisol and epinephrine have direct, though complex effects on white muscle glycogen metabolism.

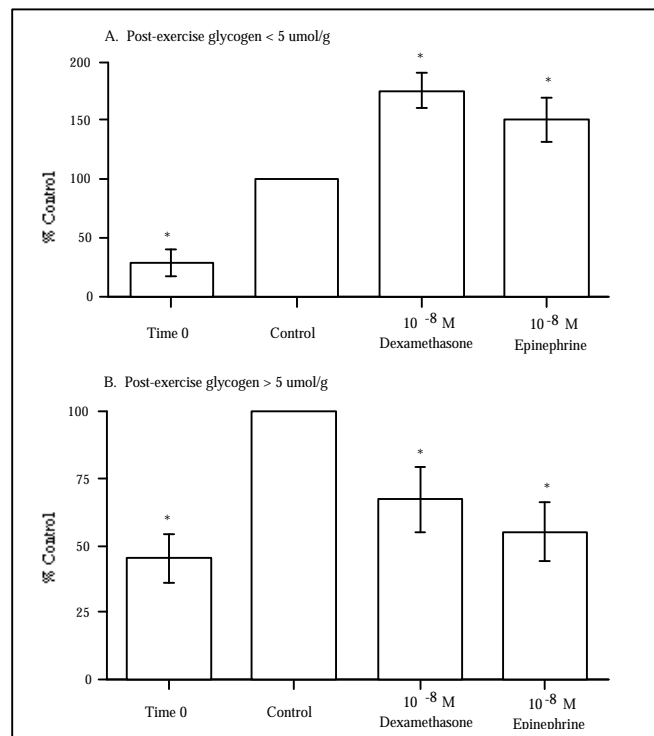


Figure 2. The effects of exogenous dexamethasone-21-phosphate and epinephrine on muscle glycogen levels *in vitro*. Data are presented as % of control, the control representing a tissue slice incubated in the absence of any exogenous hormones. The time 0 data are the glycogen levels immediately after the slice is obtained from the fish. Means \pm 1 S.E.M., n=8. * Indicates a significant difference from control value.

References

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