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## **On-line venous oxygen tensions in rainbow trout during graded exercise at two acclimation temperatures**

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### **Abstract:**

For most teleost fish, the majority of the myocardial oxygen supply is provided by the oxygen reserve remaining in venous blood after other tissues have extracted oxygen. We examined the effect of graded exercise and water temperature on this venous blood oxygen supply to the heart (termed the cardiac circulation) by performing novel on-line measurements of venous partial pressure of oxygen ( $P_{vO_2}$ ) using a fibreoptic micro-optode implanted in the ductus Cuvier of rainbow trout (*Oncorhynchus mykiss*). As expected, ( $P_{vO_2}$ ) decreased progressively and significantly as swimming velocity approached the critical swimming speed ( $U_{crit}$ ). Unsteady swimming behaviours during the graded exercise, however, caused abrupt and generally short-lived decreases in  $P_{vO_2}$ . For the cold-acclimated (6-10°C) fish,  $P_{vO_2}$  reached a minimum plateau value of  $15.3 \pm 3.7$  torr (1 torr = 133.3 Pa) before  $U_{crit}$  was reached, and so increased swimming effort near to  $U_{crit}$  did not reduce  $P_{vO_2}$  further. Warm-acclimated fish had a significantly higher  $P_{vO_2}$  ( $28.9 \pm 3.5$  torr) at  $U_{crit}$ . Despite this difference in the  $P_{vO_2}$  at  $U_{crit}$ , we estimated that there was little difference between warm- and cold-acclimated fish in terms of oxygen supply in the cardiac circulation because of a right-shift in the haemoglobin-oxygen dissociation curve at warm temperatures. Furthermore, although  $P_{vO_2}$  decreased significantly at  $U_{crit}$ , our estimates suggest that the expected increase in cardiac output would easily maintain the oxygen supply in venous blood at a level similar to that found in resting fish. Although unsteady swimming behaviours decreased  $P_{vO_2}$ , unsteady swimming rarely decreased the minimum  $P_{vO_2}$  value observed at  $U_{crit}$  by more than 10%. The findings are discussed in terms of a threshold  $P_{vO_2}$ , required to maintain adequate rates of oxygen diffusion from the cardiac circulation to the myocardial tissues.

Key-words: venous oxygen tension, exercise, temperature, cold acclimation, warm acclimation,  $P_{vO_2}$ ; heart, swimming speed, rainbow trout, *Oncorhynchus mykiss*, teleost