Alterations in Exogenous Carbohydrate, Liver and Muscle Glycogen Oxidation with Different Doses of Glucose and Fructose ingestion during Prolonged Cycling

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There appears to be a dose dependent curvilinear exercise performance response to ingested carbohydrate (CHO), with an optimum of ~80-90 $g.h^{-1}$when glucose and fructose (GF) are coingested. However, endogenous (liver and muscle) glycogen fuel use responses to such mixtures have not been investigated fully.

PURPOSE: To investigate the effect of three CHO doses on fuel selection during exercise, in particular exogenous and endogenous (liver and muscle) CHO oxidation. **METHODS:** Eleven trained male cyclists ($\dot{V}O_{2max}$: 60.0 ± 4.3 ml/kg/min) cycled on 4 occasions at 60% $\dot{V}O_{2max}$ for 3 hours after an overnight fast. From 15 min into exercise and every 15 min thereafter, either 80 $g.h^{-1}$ (LOW), 90 $g.h^{-1}$ (MED), 100 $g.h^{-1}$ (HIGH) of GF (all 2:1 ratio) or a placebo (PLA) was ingested in a double-blind randomised order. The formulations contained ^{13}C isotope tracers and were designed to span the reported saturation levels for SGLT1 and GLUT5. Total, exogenous, endogenous (muscle and liver) CHO oxidation, and total fat oxidation were computed using indirect calorimetry and isotope ratio mass spectrometry. **RESULTS:** Total CHO oxidation was elevated, and total fat oxidation suppressed in all CHO conditions relative to PLA (CHO range 94.0-125.0 g higher, Fat 29.7-34.3 g lower: both ES > 1.05). Exogenous oxidation in the final hour was greatest in HIGH (91.1 $g.h^{-1}$), a *moderate* effect to LOW (81.6 $g.h^{-1}$, ES = 0.64, P = 0.10) and MED (82.9 $g.h^{-1}$, ES = 0.70, P = 0.39) a *moderate* increase from the second hour in all conditions (ES = 1.38-2.00, P < 0.014). However, increasing GF dose beyond intestinal saturation increased muscle glycogen utilisation in the final hour (101.6 ± 16.6 $g.h^{-1}$ in HIGH; 6.2, -23.5 to 11.1 $g.h^{-1}$ higher [95% CI] *vs.* LOW, ES = 0.47, P = 0.61 & 16.1, 0.9 to 31.4 $g.h^{-1}$ [95% CI]) higher *vs.* MED, ES = 0.68, P = 0.16), and second hour (ES = 0.51 & 0.48, P > 0.05). A *small*, non-significant reduction was seen in liver glycogen oxidation with HIGH in the last hour compared with LOW (-2.6, -5.6 to 0.4 $g.h^{-1}$, ES = 0.40) and MED (-2.6, -6.8 to 1.6 $g.h^{-1}$, ES = 0.42). **CONCLUSION:** Increasing CHO ingestion beyond previously reported saturation rates produces higher exogenous oxidation, but results in an increased reliance on muscle glycogen. Ingestion of

90 $g.h^{-1}$ GF can attenuate the rate of muscle glycogen oxidation by the end of 3 hours prolonged exercise, but recommendations should remain in the region of 80 to 90 $g.h^{-1}$.