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**The effect of mouth rinse and ingestion of carbohydrate solution  
on short intensive exercise – How can we explain the increase in  
exercise performance?**

A thesis presented for a degree of Master of Science in Sport and Exercise Science at Massey  
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## **The effect of mouth rinse and ingestion of carbohydrate solution on short intensive exercise – How can we explain the increase in exercise performance?**

### **1.0 Abstract**

**Background:** Ingestion of carbohydrates during exercise in a fasted state has been shown to improve high-intensity exercise performance. The mechanism responsible for the improvement remains uncertain. Recent studies suggest that rinsing the mouth with a carbohydrate solution improves performance in the latter stages of high-intensity exercise without changes in circulating glucose levels. There has also been an absence of a peripheral metabolic action of exogenous carbohydrates and thus central effects have been postulated to explain this phenomenon. **Aim:** The purpose of the present study was to investigate whether there were individual and/or additive effects of carbohydrate mouth rinse, fluid intake and carbohydrate ingestion on 1-h time trial cycling performance. The project further investigated the response in circulating markers of fuel utilization. **Methods:** Eight recreationally trained cyclists volunteered for this randomised, counterbalanced, double-blind study. After a preliminary familiarisation session, four main trials were performed on an electronically-braked cycle-ergometer with each trial separated by 7 days. Each main trial took place over two days. On Day 1 the participants underwent a 90 min glycogen reducing exercise protocol, immediately followed by a low carbohydrate meal and then a subsequent overnight fast. The following morning a 1-h time trial performance test was conducted. Subjects performed a certain amount of work as fast as possible for the performance test. The main trials included a 15% carbohydrate mouth rinse (CHOR), ingestion of a 7.5% carbohydrate solution (CHOI), a placebo mouth rinse (PLAR) and placebo ingestion (PLAI); solutions were administered every 12.5% of exercise completed. Blood samples and perceptual measures (perceived activation, pleasure-displeasure and ratings of perceived exertion) were taken every 25% of exercise. A profile of mood states questionnaire was also administered prior to the time trial and immediately post exercise. **Results:** There were no significant differences in performance time between treatments ( $P=0.55$ ). However, there was a main effect of treatment for power output ( $P=0.002$ ) with higher values in CHOI ( $231.4 \pm 9.8$  W) relative to other trials ( $222.1-224.6$  W;  $P<0.05$ ). Plasma glucose was higher in CHOI at 75% ( $5.4$  mmol·L<sup>-1</sup>) and 100% ( $5.9$  mmol·L<sup>-1</sup>) of the time trial relative to other trials ( $3.9-4.7$  mmol·L<sup>-1</sup>;  $P<0.05$ ). There was a main effect of treatment for insulin ( $P=0.001$ ) with highest values in CHOI ( $5.14$  mmol·L<sup>-1</sup>) relative to the other trials ( $4.2-4.7$  mmol·L<sup>-1</sup>;  $P<0.05$ ). There were no significant differences reported between treatments for any of the perceptual measures. **Conclusion:** Ingestion of a carbohydrate-electrolyte solution was associated with a decrease in performance time during a 60-min cycling performance time trial in comparison with CHOR, PLAR and PLAI in a glycogen reduced state. This suggests that peripheral and not central effects are largely influenced by the use of a carbohydrate supplement.

**Keywords:** *fatigue, endurance performance, ergogenic, supplementation, central, peripheral, metabolism, fluid intake*

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