EFFECT OF CAFFEINE AND CARBOHYDRATE INGESTION ON SUBSTRATE METABOLISM AND EXERCISE PERFORMANCE

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Introduction: Several studies report increased endurance exercise capacity following caffeine ingestion. The beneficial effects are typically observed when a large dose (6-9 mg/kg) is consumed 1 h before prolonged exercise, often performed in a fasted state. Under these conditions caffeine can increase free fatty acid utilisation and reduce the rate of muscle glycogenolysis. Recent studies report beneficial effects of caffeine ingested throughout exercise in combination with carbohydrate (CHO). The effect of combined ingestion of caffeine and CHO on substrate metabolism remains unclear. Therefore the aim of the present study was to examine the effect of caffeine, co-ingested with CHO during exercise, on substrate metabolism and exercise performance.

Method: Ten endurance-trained male cyclists (VO2max: 65.7 ± 1.9 mL/kg/min) performed four exercise trials separated by at least 1 wk. Each trial consisted of 105 min cycling at 62% VO2max followed by a time trial in which subjects completed a set amount of work (688 ± 18 kJ) as quickly as possible. During the first trial all subjects ingested plain water. During the remaining three trials subjects ingested either: placebo (PLA), glucose (GLU) or glucose plus caffeine (GLU+CAF). The rate of CHO ingestion was 0.71 g/min for GLU and GLU+CAF. The rate of caffeine ingestion was 3 mg/kg/h for GLU+CAF. Throughout steady state exercise substrate metabolism was determined using indirect calorimetry and stable isotope techniques (13C ingestion and [6,62H2]-glucose infusion).

Results: CHO ingestion increased the rate of CHO oxidation (umol/kg/min: GLU 159 ± 9, GLU+CAF 162 ± 14, PLA 128 ± 15, P<0.05) and decreased the rate of fat oxidation (umol/kg/min: GLU 29 ± 3, GLU+CAF 30 ± 3, PLA 38 ± 4, P<0.05). Liver-derived glucose oxidation was reduced in both CHO trials (umol/kg/min: GLU 11 ± 2, GLU+CAF 14 ± 2, PLA 35 ± 2, P<0.05), while the rate of muscle glycogen oxidation was unaffected by CHO intake (umol/kg/min: GLU 111 ± 13, GLU+CAF 116 ± 17, PLA 112 ± 13). Ingested CHO was oxidised at similar rates for GLU and GLU+CAF (peak rates of 0.69 ± 0.04 and 0.67 ± 0.04 g/min, respectively). Mean power output sustained during the time trial was significantly higher with GLU+CAF (262 ± 9 W) compare to GLU (250 ± 8 W; P < 0.05) and PLA (240 ± 8 W; P < 0.01). This resulted in a significant reduction in time taken to complete the set amount of work (4.6% compared to GLU; P < 0.05 and 9.0% compared to PLA; P < 0.01). Performance time was 43.45 ± 0.86 min, 45.45 ± 1.07 min and 47.40 ± 1.30 min for GLU+CAF, GLU and PLA, respectively.

Conclusion: The main finding of the present study was that caffeine (3 mg/kg/h) had no effect on substrate metabolism when co-ingested with CHO. However, combined ingestion of caffeine and CHO enhanced exercise performance by 4.6% when compared to CHO alone.

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