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File: ■ Cocoa (*Theobroma cacao*, Malvaceae)
■ Dark Chocolate
■ White Chocolate
■ Oxygen Demands of Exercise

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RE: Dark Chocolate Consumption Reduces Oxygen Demand in Moderate-intensity Exercise

Patel RK, Brouner J, Spendiff O. Dark chocolate supplementation reduces the oxygen cost of moderate intensity cycling. *J Int Soc Sports Nutr*. December 2015;12:47. doi: 10.1186/s12970-015-0106-7.

Dark chocolate (DC) is rich in cocoa (*Theobroma cacao*, Malvaceae) flavanols, which reportedly increase the bioavailability and bioactivity of nitric oxide (NO). Increased NO bioavailability is associated with reduced oxygen cost, enhanced performance during submaximal exercise, and increased flow-mediated dilation in healthy subjects and patients with hypertension. Past research has focused on DC's beneficial effects on cardiovascular health; limited focus has been directed toward its effects on exercise performance. These authors conducted a randomized, crossover trial to examine whether consumption of DC, compared with white chocolate (WC), improves the gas exchange threshold (GET), lowers oxygen consumption during moderate-intensity cycling, and improves performance in a time trial.

The authors, from the School of Life Sciences at Kingston University in Kingston upon Thames, United Kingdom, recruited 9 moderately trained males whose median age was 21 ± 1 years, whose weight was 76.0 ± 9.3 kg (167.6 ± 20.5 lb), and whose height was 177 ± 9.4 cm (69.7 ± 3.7 inches). Their maximal oxygen consumption (VO_{2max}) at baseline was 41.89 ± 5.4 ml/kg/min.

Baseline tests were used to accustom the subjects to testing protocols and to establish GET for the protocol. The subjects were then randomly assigned to either a daily intake of DC, 40 g, in the form of DOVE® Dark Chocolate (Mars, Incorporated; Hackettstown, New Jersey) made with 100% pure cocoa butter, or WC, 50 g, in Milkybar® (Nestlé UK Ltd.; Gatwick, West Sussex, United Kingdom), for 14 days. After a 7-day washout period, each subject then switched to the alternative treatment. Matched for calorific content, the total energy provided for the 2 supplements during the study was 12,887 kJ for DC and 12,945 kJ for WC.

At baseline and at visits 2 and 3, each subject underwent assessment for VO_{2max}, blood pressure, oxygen cost, and lactate levels during a 20-minute cycle test at 80% GET and during a 2-minute, all-out sprint performance. Heart rate and pulmonary gas exchange were recorded throughout the 20-minute cycle session and averaged to 5-minute intervals. Blood draws were conducted every 5 minutes to determine lactate concentrations. The subjects were instructed to maintain their normal diet and refrain from alcohol, vitamin supplements, and anti-inflammatory products. They were asked not to consume milk 2 hours before and after DC or WC intake. They were also given a list of prohibited foods high in nitrate, with an appropriate low-nitrate replacement.

In the 24 hours before the first exercise test at baseline, the subjects recorded their dietary intake; they consumed the same diet during the 24 hours before the subsequent testing sessions at visits 2 and 3. They were asked to avoid any strenuous activity for 24 hours and to refrain from caffeine for 6 hours before each testing session. During the 2-week washout period between interventions, the subjects' diets were not restricted, except for abstaining from chocolate.

The authors report that VO_{2max} was 6% higher after DC consumption compared with baseline ($P=0.037$). Although VO_{2max} was greater after DC consumption than after WC consumption, the difference was not statistically significant. No significant difference was found following WC consumption compared with baseline.

DC consumption significantly increased the GET by 21% compared with baseline ($P=0.007$) and by 11% compared with WC ($P=0.05$). Compared with baseline, the GET was not significantly different following WC consumption.

Oxygen consumption during the 20-minute moderate-intensity cycling did not differ between the 2 interventions at any time point; however, at baseline and at visits 2 and 3, oxygen consumption increased between 0 and 20 minutes ($P<0.001$) with both interventions. Similar findings were reported for respiratory exchange ratio and for heart rate. No statistically significant changes were reported in systolic or diastolic blood pressure during the 3 measured time points. Lactate levels did not differ significantly at baseline or after WC or DC consumption.

Results from the 2-minute sprint revealed a greater total distance covered after DC consumption (17%) compared with baseline ($P=0.001$), and a 13% increase in distance covered compared with WC consumption ($P=0.003$). Total distance covered following WC consumption compared with baseline was not significant. Although the specific mechanisms underlying the increased GET and 2-minute maximal sprint are not clear, the authors propose that the flavanols in DC are responsible for the observed effects.

This study's main finding was that the regular consumption of 40 g DC daily for 14 days improved GET and increased total distance covered during a 2-minute sprint compared with both baseline and WC conditions.

DC ingestion "may be an effective ergogenic aid for short-duration moderate intensity exercise," the authors conclude. However, they also suggest further double-blinded studies are needed to confirm this effect.

—Shari Henson

Referenced article can be accessed at www.jissn.com/content/pdf/s12970-015-0106-7.pdf.

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