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FILE: ■ Dark Chocolate (*Theobroma cacao*)

■ Flavanols

■ Cardiovascular Disease Risk

■ Plant Sterols

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RE: Regular Consumption of Dark Chocolate May Benefit Cardiovascular Health

Allen RR, Carson L, Kwik-Urbe C, Evans EM, Erdman JW Jr. Daily consumption of a dark chocolate containing flavanols and added sterol esters affects cardiovascular risk factors in a normotensive population with elevated cholesterol. *J Nutr.* 2008;138:725–31.

An elevated low-density-lipoprotein (LDL) concentration is a major risk factor for cardiovascular disease (CVD). Dietary interventions, such as the American Heart Association (AHA) and the National Cholesterol Education Program Step I and II diets, have been shown to be effective at lowering LDL-cholesterol concentrations by approximately 10-20% under controlled conditions, but less so under free-living conditions. The consumption of foods containing plant sterols (e.g., margarine, milk, orange juice, yogurt, and snack bars) and flavonoids (e.g., fruit, vegetables, red wine, chocolate, and green tea) has been shown to reduce the risk of CVD. A subclass of flavonoids, the flavanols, has received increasing attention for their role in CVD risk reduction. One flavanol-rich food, cocoa (*Theobroma cacao*), has been shown to improve endothelial function, platelet reactivity, and insulin sensitivity and to reduce blood pressure. The objective of this study was to evaluate the effect of the regular consumption of a flavonoid-containing chocolate bar on serum cholesterol levels, blood pressure, and markers of inflammation and adhesion molecules in a free-living population.

Forty-nine men and women aged 24-70 years with elevated serum total cholesterol levels (5.20-7.28 mmol/L) were recruited from the University of Illinois area into this double-blind, placebo-controlled, cross-over study. The use of cholesterol-lowering, antihypertensive, or weight-loss drugs in the 6 months before the study was reason for exclusion. The participants were randomly assigned to consume plant sterols or placebo as part of an AHA-type low-fat diet for 2 weeks before being randomly assigned to consume 2 chocolate bars containing cocoa flavanols (CF) daily with (PS+) or without (PS-) plant sterols at separate times with or within 30 minutes of a meal for 4 weeks. Each PS+

chocolate bar (CocoaVia®; Mars Inc., McLean, VA) contained 419 kJ, 6 g of total fat, 0 mg of cholesterol, approximately 180 mg CF, and 1.1 g of canola sterol esters; the control bar contained the same amounts of nutrients and CF as in the PS+ bar. After the 4-week period, the subjects were crossed over to the alternate regimen. Blood samples were collected for the measurement of lipid, glycated hemoglobin, inflammatory marker, and adhesion molecule concentrations at baseline, 4 weeks, and 8 weeks. Blood pressure was measured at baseline and at 4, 6, and 8 weeks.

Forty-four subjects completed the study. No significant differences in lipid or inflammation marker levels were observed between groups at baseline; however, serum intercellular adhesion molecule-1 (sICAM-1) levels were significantly lower in the PS+ group than in the PS- group ($P < 0.05$). Total and LDL-cholesterol levels decreased from baseline significantly more in the PS+ group than in the PS- group [by 3% ($P = 0.017$) and 4% ($P = 0.014$), respectively] after the dietary intervention. No significant differences in the change in very-LDL, high-density-lipoprotein, triacylglycerol, glycated hemoglobin, C-reactive protein, sICAM-1, or soluble CD40 ligand levels after the intervention were found between groups. The data for both groups were combined to assess the effects of CF on blood pressure. Systolic blood pressure decreased significantly from baseline at 4, 6, and 8 weeks; diastolic blood pressure decreased significantly from baseline at 4 and 6 weeks. No significant changes in body weight were observed.

The results indicated that the regular consumption of CF-containing chocolate bars with plant sterols as part of an AHA-type low-fat diet decreased serum total and LDL-cholesterol and blood pressure levels significantly. Because the consumption of CF-containing chocolate bars without plant sterols did not induce such a decrease, the authors conclude that the consumption of plant sterols was responsible for the reduction in serum total and LDL-cholesterol levels. It was noted by the authors that the relatively short duration of the study, the absence of a wash-out period between the two 4-week periods, and the non-use of a low-CF food product were potential limitations of the study.

—*Brenda Milot, ELS*

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