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File: ■ Cocoa (*Theobroma cacao*)
■ Blood Pressure
■ Nitric Oxide Production

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RE: Dark Chocolate Increases Nitric Oxide Levels and Decreases Blood Pressure in Prehypertensive Subjects

Sudarma V, Sukmaniah S, Siregar P. Effect of dark chocolate on nitric oxide serum levels and blood pressure in prehypertension subjects. *Acta Med Indones*. October 2011;43(4):224-228.

Prehypertension, a risk factor for coronary heart disease and stroke, is defined as a systolic blood pressure between 120 and 139 mm Hg or diastolic blood pressure between 80 and 89 mm Hg.^{1,2} According to these authors from the University of Indonesia, the mean blood pressure in Indonesians aged 25 to 34 years is 124.7/79.9 mm Hg. Risk factors for hypertension are obesity, age, high intake of energy and sodium, a low level of physical activity, and alcohol intake. Vascular disorders in prehypertensive patients are influenced by, among other factors, a decrease in synthesis and bioavailability of nitric oxide (NO) leading to endothelial dysfunction.³ Flavanols reportedly can activate endothelial nitric oxide synthase, which increases synthesis and bioavailability of NO and in turn restores endothelial function. Dark chocolate (*Theobroma cacao*) is a major source of flavanols. These authors conducted a parallel, randomized clinical trial to investigate the effects of dark chocolate on NOx serum levels and blood pressure in individuals with prehypertension. NOx serum levels are the sum of nitrite and nitrate levels as the metabolite of NO. Investigators estimate NO production by measuring NOx levels.

Thirty-two male and female employees of a dental faculty and a private company were recruited and divided into 2 groups of 16 each. Exclusion criteria included those with a history of hypertension; smokers; those who consumed red wine or alcohol; pregnant or breast feeding women; menopausal women; those who used antihypertension drugs; and those who took vitamin C, vitamin E, or other antioxidant supplements. Data are reported on 30 of the subjects (14 in the treatment group and 16 in the control group). The treatment group received 30 grams of dark chocolate daily (containing 70% cocoa; no other data on the source given) and dietary counseling. Those in the placebo group received 25 grams of white chocolate daily (no data on the source given) and dietary counseling. The study lasted 15 days.

The subjects were aged 25 to 44 years, prehypertensive, and had a body mass index (BMI) of 18.5 to 24.9 kg/m². The characteristics of the members of the 2 groups were similar, except that the treatment group was more physically active than the placebo group.

Food intake data were obtained to determine energy, sodium, and polyphenol intake. The subjects were asked to fast overnight for 10 to 12 hours before having blood samples drawn to measure NOx serum levels.

At baseline, on treatment day 8, and after treatment, blood pressure was measured for all subjects. Mean intakes of energy and sodium were not significantly different between the 2 groups. The polyphenol intake of the treatment group during weeks 1 and 2 were significantly higher than those of the placebo group. After 15 days, the NOx serum levels in the treatment group increased significantly compared to baseline ($P=0.001$), while the same levels in the placebo group decreased significantly compared to baseline ($P=0.001$). The intergroup difference was also significant ($P<0.001$), with the treatment group being 4-fold higher than the control after 15 days. After 15 days, the systolic blood pressure decreased by an average of 8 mm Hg compared to baseline (significant, but P value not fully reported). The difference in systolic blood pressure between the groups was significant ($P=0.001$), while the difference in diastolic blood pressure was not significant.

The authors report a strong negative correlation between the changes in NOx serum levels and the changes in systolic blood pressure, while there was a significantly moderate negative correlation for the changes in diastolic blood pressure. The authors cite a study⁴ confirming that increased NOx serum levels increase vasodilation, which in turn decreases blood pressure.

According to the authors, this study was limited by the difficulty in blinding between the dark and white chocolate, although they claim that it was minimized by placing the chocolates in boxes of the same shape and color.

The authors conclude that in prehypertensive subjects, the consumption of 30 grams of dark chocolate with 70% cocoa daily for 15 days increased NOx serum levels. Systolic blood pressure was significantly decreased in those who consumed the dark chocolate; however, the decrease in diastolic blood pressure was not significant. There were a number of limitations to the study, including insufficient blinding and use of a food database lacking in many of the locally eaten foods. The reporting in this paper was also of poor quality with errors in data interpretation, omissions of critical information about the study design, and misreporting of statistics. The authors mention the importance of flavanols, but yet no testing was done on the dark chocolate to evaluate the flavanol level. The use of a list of polyphenol content is not enough.

—Shari Henson

References

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²Lim S. Recent update in the management of hypertension. *Acta Med Indones*. 2007;39(4):186-191.

³Foëx P, Sear JW. Hypertension: pathophysiology and treatment. *Continuing Education in Anaesthesia, Critical Care & Pain*. 2004;4(3):71-75.

⁴Hall WL, Formanuk NL, Harnpanich D, et al. A meal enriched with soy isoflavones increases nitric oxide-mediated vasodilation in healthy postmenopausal women. *J Nutr*. 2008;138(7):1288-1292.

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