

THE TRUTH IS OFTEN BITTERSWEET... CHOCOLATE DOES A HEART GOOD

Our parents, grandparents, physicians, dentists, countless friends, total strangers, and, more recently, the ever vigilant food nazis (aka, Center for Science in the Public Interest) have long admonished us to avoid indulging in the sensual pleasures of chocolate. The payoff for such abstinence, we are promised, is a diminished likelihood of developing maladies ranging from acne to obesity, tooth decay, atherosclerosis, coronary artery disease, diabetes, hypertension, and all their evil and lethal sequelae. So life is full of trade-offs and those of us in nursing who have now and then traded Hershey for health have learned to live with such hypocrisy in our professional lives. How could we reasonably argue against logic that considers this substance, however luscious, is laden with sugar, calories, and fat?

As it turns out, evidence has been accumulating to suggest that such generalizations regarding the nutritional sinfulness of chocolate are neither adequate nor accurate. One of the recently identified virtues of chocolate, by contrast, is its lofty ranking as the third largest dietary source of antioxidants¹—those chemicals beloved for their free radical-fighting properties that preserve cell membranes, protect DNA, prevent the oxidation of low-density lipoprotein (LDL) cholesterol that leads to atherosclerosis, and prevent plaque formation within arterial walls.

Chocolate is derived from the cocoa bean, one of the most concentrated sources of flavanols, a subgroup of the natural antioxidant plant compounds called flavonoids, found in tea, red wine, tomatoes, and other foods believed to reduce the risk of cardiovascular disease.

Flavonoids, in turn, are a subgroup of compounds called polyphenols.² Cocoa beans are a potent source of polyphenols. The specific antioxidants in chocolate (ie, cocoa flavanols) include catechin and epicatechin, which are single flavanol molecules structurally similar to the antioxidants found in grapes and tea.³ According to the Cleveland Clinic's Heart & Vascular Institute Guide,² flavonoids are thought to

- exert antioxidant protections against free radicals,
- help reduce platelet activation,
- contribute to vasodilation to improve blood flow, and
- positively influence production of eicosanoids to foster their role in cardiovascular health.

In addition to supplying antioxidants, chocolate also has been found to improve endothelial function,^{4,5} demonstrate abundant antioxidant activity,³ and inhibit platelet activation (clumping) and function,^{6,9} all of which would afford a cardioprotective role to this former nutritional no-no.

Furthermore, the fat in chocolate comes from cocoa butter and consists of approximately equal amounts of oleic acid (a monounsaturated, heart-healthy fat) and stearic and palmitic acids (both saturated fats). Although saturated fats are ordinarily linked with a higher risk of heart disease, stearic acid has been found to have a more neutral effect on cholesterol, neither raising nor lowering LDL-cholesterol levels. Palmitic acid, on the other hand, does affect cholesterol levels but represents only one third of fat calories in chocolate.² Other research indicates that much of the fat contained in chocolate exists primarily

...consumption of the flavanol-rich cocoa was associated with significant improvement in blood flow and significant increases in circulating nitric oxide.

in the form of stearic triglycerides, which increase high-density lipoprotein (the “good cholesterol”) and, rather than being retained as either sinful adipose or clogging cholesterol, readily is cleansed from our corporal souls via gastrointestinal excretion.^{3,10} In short, chocolate may not only not be bad for us; some forms of chocolate may actually be good for us.

As a journalist, I am bound to pursue the “who-knew-what” and “when-did-they-know-it” approach to data investigation; therefore, the following is a not-to-be-confused-with-all-inclusive yet thought-provoking synopsis of some of these findings.

Rich Source of Antioxidants

❖ Chocolate is the third highest daily source of antioxidants for US consumers, preceded by coffee and tea.¹

❖ Of the approximately 6000 antioxidants identified to date, about 4000 are categorized as polyphenols. In both an in vitro animal model as well as an in vivo human study, epicatechin, a major polyphenol found in chocolate, inhibits plasma lipid oxidation because of its ability to bind to LDL. In an animal model of atherosclerosis, cocoa powder significantly inhibited atherosclerosis; lowered cholesterol, LDL, and triglycerides; raised high-density lipoprotein; and protected LDLs from oxidation.¹

Lowers Blood Pressure

❖ Buijsse and colleagues¹¹ from the National Institute for Public Health and the Environment in the Netherlands examined cocoa’s relationship to cardiovascular health in 470 Dutch men aged 65 to 84 years. The men underwent physical examinations and were interviewed about their dietary intake when they enrolled in the study in 1985 and again at 5-year intervals. Over the next 15 years, men who consumed cocoa regularly had significantly lower blood pressure than those who did not. Over the course of the study, 314 men died, 152 due to cardiovascular diseases. Men in the group with the highest cocoa consumption were half as likely as the others to die from cardiovascular disease. Their risk remained lower even when considering other factors, such as weight, smoking habits, physical activity levels, calorie intake, and alcohol consumption.

Enhances Blood Flow

❖ Evidence exists that consumption of flavanol-rich chocolate causes a rise in epicatechin antioxidant levels

and in antioxidant activity and a fall in fat oxidation (a necessary step in the formation of plaque) in a dose-related manner. Processes that retard plaque formation within arterial walls favor smooth and efficient blood-flow.¹²

❖ Harvard researchers¹³ found that healthy adults who consumed flavanol-rich cocoa beverage for 5 successive days had significantly greater acute and sustained increases in peripheral blood flow compared to those who consumed a flavanol-poor cocoa beverage.

❖ After menopause, women experience increased risk for cardiovascular disease, which can be associated with endothelial dysfunction. A double-blind study⁵ of 32 postmenopausal hypercholesterolemic women, randomly assigned to consume a high- or low-flavanol cocoa beverage for 6 weeks was the first to identify beneficial vascular effects of flavanol-rich cocoa consumption in this population. In addition, the study results suggested that reductions in plasma soluble vascular cell adhesion markers after chronic consumption of a flavanol-rich cocoa may be linked to the improved vascular reactivity.

Facilitates Nitric Oxide Synthesis

❖ Scientists in Germany¹⁴ compared the effects of consuming a high- versus low-flavanol cocoa beverage in adults known to have a single cardiac risk factor. Participants in the high-flavanol group demonstrated both significant increases in circulating nitric oxide levels as well as significant vasodilatation compared to those in the low-flavanol beverage group.

❖ The same lead German researchers¹⁵ more recently reported results using the high- versus low-flavanol cocoa beverage technique with a sample of smokers, who consumed either the high- or low-flavanol cocoa in random order. Using the sample as its own controls, consumption of the flavanol-rich cocoa was associated with significant improvement in blood flow and significant increases in circulating nitric oxide, while neither change was observed when the same subjects ingested the low-flavanol cocoa.

❖ The Department of Nutrition at University of California at Davis¹⁶ found that healthy men who ingested flavanol-rich cocoa demonstrated acute elevations of circulating nitric oxide, enhanced flow-mediated vasodilation in conduit arteries, and augmented microcirculation. Effects were thought to be mediated by the flavanol (-)-epicatechin.

Inhibits Platelet Activation

❖ Researchers studied the effects of administering a flavanol-rich cocoa beverage alone and together with 81 mg (“baby”) aspirin on platelet function. Ingestion of the beverage alone resulted in modest, aspirin-like effects on platelet function, while the combined effects of the beverage and aspirin were additive in nature, suggesting enhanced clot prevention afforded by cocoa flavanols.⁷

May Improve Cognitive Performance

❖ As the body’s most metabolically active and oxygen-demanding organ, the brain is particularly susceptible to free radical damage, which has been implicated in cognitive decline and memory loss as people age and in Alzheimer’s disease. A recent study¹⁷ of young, healthy subjects using functional magnetic resonance imaging found that ingestion of a flavanol-rich cocoa was associated with increased blood flow to cerebral gray matter, suggesting that cocoa flavanols might play a role in treatment of cerebral impairment attributable to poor blood flow, including dementia and stroke.

May Reduce Overall Mortality

❖ In a 15-year study conducted in Amsterdam with 470 elderly (65 to 84 years) men who were free of chronic diseases at baseline and 5 years later, the amount of cocoa intake was inversely related to both cardiovascular death as well as death from all causes. Of the 314 men who died during the course of the study, 152 deaths were attributed to heart disease. Those who consumed the highest amounts of cocoa, however, were half as likely to die from cardiovascular disease compared to those who consumed little or no cocoa and those who ingested the most cocoa were less likely to die from any cause. Although blood pressure is typically associated with risk of cardiovascular death, that was not the case in this study, however, where lower blood pressure did not account for the reduced cardiovascular mortality associated with cocoa intake.¹¹ The study authors suggest that the lower mortality risk is mediated by other mechanisms, possibly by flavan-3-ols.

Some Necessary Qualifications

When discussing the potential health benefits of chocolate, it is essential to distinguish that these advantages are dose dependent, that the optimal “dose” of chocolate is unknown, that they do not apply to all types of chocolate, that they are not universally accepted, and

that many have been identified through financial underwriting from cocoa and chocolate industry vendors and markets throughout the world.

Advantages Are Dose Dependent

Although some of the proposed benefits of chocolate consumption (eg, lowering blood pressure) are positive and linear, neither is limitless because processed cocoa products such as candy bars, cookies, and cakes are typically laden with substantial calorie loads, which can readily offset their antioxidant benefits. In addition, a number of steps aimed at reducing the rather pungent, bitter taste of cocoa products achieve this goal by reducing the amount of flavonoids contained in the product. The more processed the chocolate, the more flavonoids (and all of their related health benefits) are lost.²

Most Beneficial Dose Is Unknown

What constitutes the optimal serving of dark chocolate to reap its entire menu of cardiovascular benefits is not known. Until that amount is determined, the usual admonitions regarding moderation apply and are hedged in language appropriately vague—eg, “enjoy a small piece of dark chocolate once in awhile” and “enjoy chocolate in moderate portions a few times per week.”² When volunteers are needed to ingest one of those flavanol-rich cocoa beverages, however, I’d like to make public notice here of my availability for the experimental group.

Advantages Depend on Type

Many types of processed cocoa products, mainly chocolate, are available today: dark chocolate, which contains the highest concentration of cocoa; milk chocolate, with a lower concentration of cocoa; and white chocolate. On the basis of this broad distinction, the health benefits ascribed to chocolate relate nearly exclusively to the dark, bittersweet-tasting chocolate and to products with a cocoa content of 60% or more.

As a general rule, the darker the chocolate, the more likely it is to offer health benefits. Because polyphenols are found in the cocoa bean but not in milk, cream, sugar, or other additives added to other types of chocolate, the darker the chocolate, the better. By contrast, the lighter color yet sweeter-tasting milk chocolate is often prepared in products that dilute the cocoa concentration with other ingredients that both minimize antioxidant activity and add harmful forms of saturated fat and calo-

ries. In addition, researchers at the National Institute for Food and Nutrition Research in Rome² believe that milk may interfere with absorption of antioxidants from chocolate. White chocolate, which is devoid of antioxidants, offers no health benefits.

Cocoa Flavanoid Research Underwriting

Anyone reading the results of research in this area should be careful to note that much of this work—particularly early work—has been financed by corporate entities such as Mars and Hershey or is conducted in European countries such as Germany, Italy, and the Netherlands where chocolate delicacies have been created to be enjoyed by millions. Such self-interest, while understandable, still warrants due consideration in both reading the results as well as implications of this work.

Nonetheless, as you enjoy that Valentine's Day box of chocolates this month, you might want to reach for those dark chocolate morsels. Pop a few in—just for the health of it!

References

1. Vinson JA, Proch J, Bose P, et al. Chocolate is a powerful ex vivo and in vivo antioxidant, an anti-atherosclerotic agent in an animal model, and significant contributor to antioxidants in European and American diets. *J Agric Food Chem*. 2006;54:8071-8076.
2. DeNoon D. Dark chocolate is healthy chocolate. WebMD Medical News; August 27, 2003. Available at: <http://www.ClevelandClinic.org/heart-center/pub/guide/prevention/nutrition>. Accessed November 22, 2006.
3. Raloff J. Chocolate hearts: yummy and good medicine? *Sci News*. 2000;157:177-192.
4. Engler MB, Engler MM, Chen CY, et al. Flavanoid-rich dark chocolate improves endothelial function and increases plasma epicatechin concentrations in healthy adults. *J Am Coll Nutr*. 2004;23:197-204.
5. Wang-Polagruto JF, Villablanca AC, Polagruto JA, et al. Chronic consumption of flavanol-rich cocoa improves endothelial function and decreases vascular cell adhesion molecule in hypercholesterolemic postmenopausal women. *J Cardiovasc Pharmacol*. 2006;47(suppl 2):S177-S186.
6. Murphy KJ, Chronopoulos AK, Singh I, et al. Dietary flavanols and procyanidin oligomer from cocoa (*Theobroma cacao*) inhibit platelet function. *Am J Clin Nutr*. 2003;77:1466-1473.
7. Rein D, Paglieroni TG, Wun T, et al. Cocoa inhibits platelet activation and function. *Am J Clin Nutr*. 2000;72:30-35.
8. Weisberger JH. Chemopreventive effects of cocoa polyphenols on chronic diseases. *Exp Biol Med*. 2001;226:891-897.
9. Holt RR, Schramm DD, Keen CL, et al. Chocolate consumption and platelet function. *JAMA*. 2002;287:2212-2213.
10. Wan Y, Vinson JA, Etherton TD, et al. Effects of cocoa powder and dark chocolate on LDL oxidative susceptibility and prostaglandin concentrations in humans. *Am J Clin Nutr*. 2001;74:596-602.
11. Buijsse B, Feskens EJM, Kok FJ, Kromhout D. Cocoa intake, blood pressure, and cardiovascular mortality: the Zutphen elderly study. *Arch Intern Med*. 2006;166:411-417.
12. Wang JF, Schramm DD, Holt RR, et al. A dose-response effect from chocolate consumption on plasma epicatechin and oxidative damage. *J Nutr*. 2000;130:2115S-2119S.
13. Fisher ND, Hughes M, Gerhard-Herman M, Hollenberg NK. Flavanol-rich cocoa induces nitric-oxide-dependent vasodilation in healthy humans. *J Hypertens*. 2003;21:2281-2286.
14. Heiss C, Dejam A, Kleinbongard T, et al. Vascular effects of cocoa rich in flavan-ols. *JAMA*. 2003;290:1030-1031.
15. Heiss C, Dejam A, Kleinbongard T, et al. Acute consumption of flavanol-rich cocoa and the reversal of endothelial dysfunction in smokers. *J Am Coll Cardiol*. 2005;46:1276-1283.
16. Schroeter H, Heiss C, Balzer J, et al. (-)-Epicatechin mediates beneficial effects of flavanol-rich cocoa on vascular function in humans. *Proc Natl Acad Sci USA*. 2006;103:1024-1029.
17. Francis ST, Head K, Morris PG, Macdonald IA. The effect of flavanol-rich cocoa on the fMRI response to a cognitive task in healthy young people. *J Cardiovasc Pharmacol*. 2006;47(suppl 2):S221-S223.



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