foods evoke such passion. mug of velvety hot cocoa. Few, if any, other your spirits. You crave a truffle, a Kit-Kat, a fudge drizzling over ice cream raises when you *nood* chocolate. Nothing else will do. Just thinking about hot here is a word for you: "chocoholic,"

that chocolate may be healthier than is usually scientific findings are providing new evidence So what is unique about chocolate? Recent

## chemicals ... So many good

94 °F and 97 °F. A morsel of chocolate slides the temperature at which it melts: between across your tongue and Ilquefies into a perfect offely true. 98.6 °F is just above the chocolate's melting :mperature, "Metts in your mouth"? Defiuddle of taste sensation. The human body, at One of the reasons chocolate is unique is

The two molecules are identical except for one methyl group (CH<sub>3</sub>), but it is not yet clear how chemicals. Caffeine, a stimulant, is the most they act together in chocolate. lound in amounts slightly higher than caffeine well known, but it is present only in small nounts. Another stimulant is theobromine Chocolate contains more than 300



depression.

But when anandamide is produced by the brain and blocks out pain and ent in chocolate, but it is also produced "bilss" in Sanskrit. Not only is it presdamide, so named because it means happy when we eat chocolate is anan-

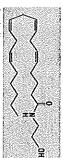
by the brain, it is broken down quickly, so its effects don't last.

Plamelli, professor of pharbiologist at Massachusetts Emmanuelle diTomaso, an assistant Boston, Mass., and Danlele General Hospital,

macology at the University of California-Irvine, chemicals in have shown that

of anandamide. This means that when chocolate may inhibit you eat choco-

the body longer. chocolate stay in molecules from late, anandamide



ChemMatters APRIL 2009 13

ics the brain chemistry of a person in love. natural brain chemical which stimulates the parts of the brain that keep you alert and mim-Then, there is phenylethylamine (PEA), a

## healthy? is chocolate

damage from free radicals—atoms, moldants. These chemicals protect cells against to a larger group of chemicals called antioxiscules, or ions with unpaired electrons. shocolate called polyphenois, which belong

these diseases disease, heart disease, and cancer. Antioxitherefore reduce the risk of being affected by plocking the action of free radicals and may dants prevent this damage from happening by and have been associated with Alzheimer's inside cells, free radicals damage DNA

can produce free radicals. Antioxidants termibered benzene rings. that contain OH groups attached to six-mempolyphenols, which are organic compounds that contain a functional group composed of from being formed. Examples of antioxidants nate this reaction by preventing free radicals a sulfur atom and a hydrogen atom (-SH) and nelude thiols, which are organic compounds a chemical reaction called oxidation, which Antioxidants work by slowing or preventing

Recent studies have explored chemicals in

cocoa flavanois could also be used imount of nitric oxide in the blood cocoa beverage also increases the the consumption of a flavanol-rich and colleagues have observed that Brigham and Women's Hospital,

Phenol (a) and three examples of phenol derivatives; pyrogal(o) (b), phloroglucizel (c), and hydroquiczee (d). These incledules are components of large molecules called polyphenols. the Spanish Research are working on pro Spain, and colleagues Council in Murcia research scientist at Espin de Gea, a senio Also, Juan Carlos

3

to drink chocolate milk made from the flavonoid-enriched cocoa, these traditional cocoa. When they drank beans. They asked six volunteers to lavonold-enriched cocoa and later consume a milk beverage made with usually lost in the processing of the include the flavonoids

flavonoids, a group of several thousand comvolunteers had eight times more of

of chemistry at the Uni-

Joe Vinson, professor

and chocolate,

pounds present in various fruits, vegetables,

are still being investigated. The largest and lished, while other polyphenols' health effects such as quercetin, which is found in citrus

ruit, buckwheat, and onlons--are well estab-

The health benefits of some polyphenois-

best studied group of polyphenois are the

raised the levels of good cholesterol. disease in which fot clogs up arteries, and nhibited atheroscierosis, a type of heart dark chocolate bars per day significantly cocoa powder at a dose equivalent to two the scientists discovered that in hamsters with coconut butter and sugar alone. Also, acted as antloxidants in the body, compared scientists showed that cocoa polyphenols beneficial effects against heart disease. The

> teeth, and makes you fat. Not so, No curthink that chocolate causes acne, decays than when they drank regular chocolate milk.

antioxidants epicatechin and procyanidin B2

Another piece of good news: You might

impairments in the brain resulting from, say, flavanols could be used to prevent vascular heir brains. This result suggests that cocoa cocoa beverage had increased blood flow in that people who consumed a flavanol-rich of Nottingham, and colleagues have shown of metabolic physiology at The University tea, wine, and nuts. Ian Mcdonald, professor flavanols, which are flavonoids also found in Cocoa is especially rich in chemicals called

> chocolate is not totally healthy. at how chocolate is made to understand why blamed for the ills of chocolate? Let's look

is made

The cacao beans used to make chocolate

How chocolate

causes weight gain,

But how about all this saturated fat, usually

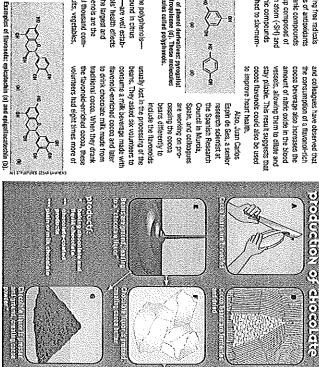
offset the added sugar), and too much food problems. Chocolate husks contain chemicals rent research connects specific foods to skin

hat prevent tooth decay (although they don't

at the Harvard Medical School and Norman Hollenberg, professor of medicine

> (food of the Gods) that is cultivated in the tropics. Thry flies called midges pollinate the come from a tree called Theobroma cacao

to improve heart health, stay pilable. This result suggests that vessels, allowing them to dilate and



14 ChemMatters, APRIL 2009

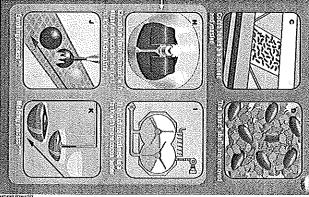
nols in chocolate have have found that polypheand his research students versity of Scranton, Pa.

www.acs.org/chemmatters

and beans are removed and fermented under the tree, split with a machete, and the pulp banana leaves in the sun. in a sweet pulp. The pods are removed from trees, and each pod contains 20 to 60 seeds

fermentation, the beans are dried on change from purple to chocolate brown. After ing the beans. Many chemical changes take rich cocoa aromas develop, and the beans place, affecting flavor, aroma, and color. The Then, the sugary pulp breaks down, heat-

are dark chips called the bean shells so nibs, which are crushed removed. What is left they can be easily sorted, and roasted. This shipped to the manufacturing bamboo mats or wooden floors. roasting loosens These dried beans are



to form a liquid paste called chocolate fiquor. To make dark, semisweet, and bittersweet for up to 72 hours to further smooth and chocolates, nibs and sugar (and sometimes biend all particles, creating creamy chocolate additional cocoa butter) are mixed together

calories in the body, although they do not cause three kinds of fats produce high amounts of chocolate's fat is known to be unhealthy, All to oleic acid in the liver. Overall, one-third of otelc acid, a heart-healthy monounsaturated fat, and stearic acid, part of which later converts "bad-for-you" saturated fat called palmitic acid; essentially all fat. There are three major kinds: a So here's the bad news: Cocoa butter is an increase in blood cholesterol when consumed in chocolate.

late straight from the tree has more beneficial chemicals than possibly any other food, including blueberries, red wine, or green tea. anti-inflammatory, anti-allergic, anti-cancerous, and anti-viral. They are not only antioxidant, but Here's the good news; Chaca-

with sugar, milk, and extra stores self mainly milk chocolate the amount of antioxidants. Food and fermenting tends to decrease lunk? It's all in the processing. nigh-catorle indulgence, Roasting thocolate is a healthy food or a processing determines whether So why is chocolate often rated

added to cocoa, the more dliute the healthy noncocoa Items are good, but the more cocoa butter added themicals become because they taste

versions healthier Making

of chocolate

semisweet baking chips, mlik baking chocolate, dark chocolate, were natural cocoa, unsweetened The products they considered in cocoa-containing products. pared the amount of antioxidants Penn., and colleagues have comscientist at Hershey Co., Hershey, W. Jeffrey Hurst, principal

> off choosing natural cocoa or dark chocolate on an equal weight basis. So if you want to milk chocolate and syrups, when compared dark chocolates, baking chips, and finally covered that natural cocoa contains the most chocolate, and chocolate syrup. They disrather than milk chocolate or chocolate syrup antioxidants, followed by baking chocolates, consume a lot of chocolate, you may be better

with high cacao content, no milk, and fewer entific knowledge by making chocolate-based makers-including The Hershey Co. and vanols. The most recent trend is "premium" candles that are high in antioxidants and fia-Mars, Inc.—have been trying to use this scichocolate, often made of top-quality beans Over the past two decades, various candy

cocoa bean. The team of scientists from these three institutions may find ways to make the better-tasting chocolate. cocoa tree more resistant to pests and disease five-year project to unravel the genome of the June, Mars, Inc., partnered with IBM and the U.S. Department of Agriculture to launch a genes of the cocoa tree in the future. Last and provide healthler, more nutritious, and Scientists may even be able to modify the

are a healthy afternative to milk chocolate or on the labels. The fewer additives, the better, Meanwhile, dark chocolate or chocolate nibs dollars? Check out the nutrition information Want the most for your calories? And you

luxury item, or junk? It can be all three, So, is chocolate a healthy food, a just not all at the same time. The choice is yours, Go easy! Go dark! Go chocolate! 🛦

Bockett, S. P. The Science of Chocolate, 2nd ed; The Royal Society of Chemistry: Cambridge, UK, 2008. SELECTED REFERENCES Chemical Society: The Elements of

The Exploratorium, Science Museum in Sar Francisco: The Sweet Lurc of Chocolate ntp://acsolomentsolchocolate.typepad.com/elements\_ol\_chocolate/ [February 2009]. http://www.exploratorium.edu/exploring/ exploring...chocolate/ [February 2008].

Gall Kay Haines is a science writer and book author from Olympia, Wash, Her most recent article, "Coffee: Brain Booster to Ge?" appeared in the December 2008 issue.

ChemMatters, APRIL 2009 15