

Chocolate has long been a magical and mystical food. Ancient civilizations referred to chocolate as the food of the gods, and Emperor Montezuma was known to consume goblets of chocolate before retiring to his harem. Cassanova went so far as to call hot chocolate the elixir of love. Whether they are simple folklore or if there is truth in these stories, they have carried through the centuries and have added to the rich history and allure of chocolate.

Today, our attraction to the confection is paradoxical; it is both a beloved food and a sinful indulgence. On Valentine's Day, the holiday for love, we give chocolate as a gift, but once it has been eaten, we feel guilty. What is it about this food that delights so many yet is perceived as sinful? Most likely, it is the belief that something so enjoyable cannot possibly be good for you. Surprise! New discoveries may help to alleviate some of the guilt associated with eating chocolate. Current research findings indicate that chocolate is not only a delicious food but may also have health benefits.

### CHOCOLATE'S MAGICAL SEED

Scientists have conducted studies to understand the strong attraction to chocolate, which, in the United States, seems to have its hold primarily on women. Several bioactive compounds, including cannabinoid-like substances, methylxanthines, and biogenic amines, have been found in chocolate and may contribute to this fascination. However, research has yet to prove any pharmacological properties exist in chocolate that cause or satisfy this strong attraction. Instead, it is believed that chocolate's sensory properties are responsible — specifically, people love the taste, smell, and mouth feel of chocolate.

A study at the University of Pennsylvania used cocoa capsules to find if there were any pharmacological links between this strong attraction and chocolate. They concluded that indeed there were none. In addition, the gender-preferred effect seems to be cultural. In Spain, chocolate is favored equally by women and men, while, in the United States, about 50% of women and less than 20% of men strongly desire chocolate.

### EARLY SOCIETIES TOUT CHOCOLATE'S HEALTH BENEFITS

Recently, chocolate's popularity has taken a new route. Research suggests that chocolate may have health benefits. This may be hard to accept today, but ancient civilizations believed it to be true. A rich body of literature, dating back to the period after Cortez landed on Mexico's shores, reveals more than 100 medicinal uses for chocolate. It has been claimed to improve anemia, awaken the appetite, strengthen the brain, aid in digestion, improve longevity, and increase sexual appetite and virility. Documents from the early colonial era note the use of chocolate to treat fatigue, alleviate fever, and treat the faint of heart.<sup>1</sup> In the 1800s, English physicians recommended cocoa and milk beverages for children, and French doctors believed chocolate was beneficial for chronic illness and broken hearts. Brillat-Savarin (1755-1826), a French magistrate and gastronome, wrote, "Chocolate, when carefully prepared, is a wholesome and agreeable form of food ... it agrees with the feeble stomachs, has proved beneficial in cases of chronic illness ...".<sup>2</sup> Today, science attempts to test what earlier societies practiced.

### SCIENTISTS EXAMINE POTENTIAL CARDIOVASCULAR HEALTH BENEFITS OF FLAVONOID-CONTAINING FOODS

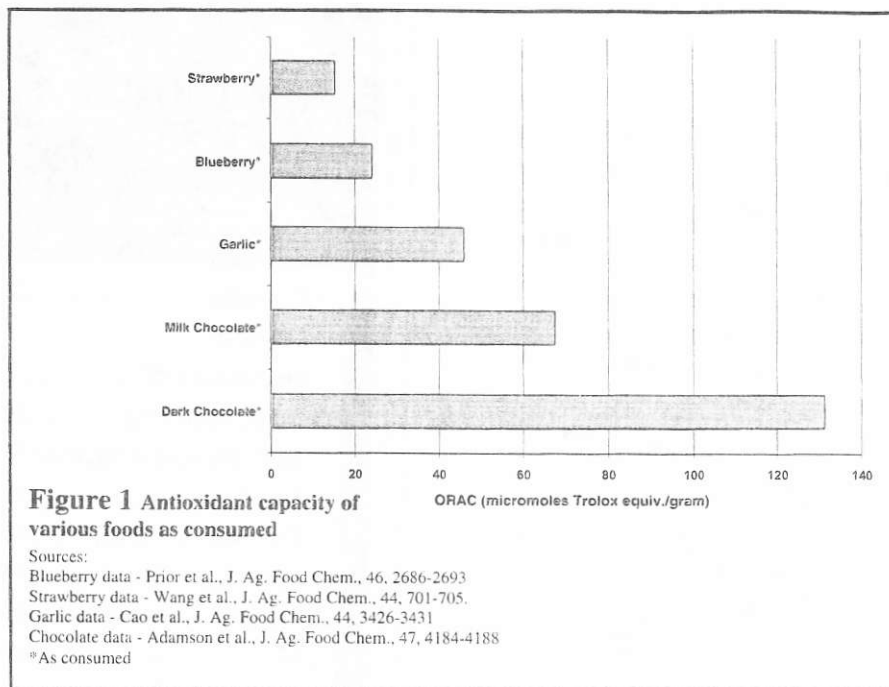
During the past several years, plant-based foods and beverages have come into the spotlight because of their potential health benefits. In the last decade, industry and academic researchers have made considerable headway in understanding the health benefits of our food supply, extending beyond that of basic nutrition. Scientists have found a variety of naturally occurring compounds called polyphenols that exist in plant-based foods and beverages. Flavonoids, a subclass of polyphenols, are found throughout the plant kingdom, and research suggests they may provide cardiovascular benefits. Tea and red wine, for example, have received increased attention because of these compounds.

In addition to understanding the biological effects of flavonoids, food manufacturers have learned that processing can impact the retention of these compounds in their food products. Similar to vitamins, the compounds can be unstable in extreme pH (ie, alkalization) and heat conditions. Given their potential health benefits, the retention of flavonoids in finished products may prove worthwhile. Epidemiological studies suggest an inverse association between the consumption of flavonoid-containing foods and cardiovascular event fatalities and stroke.<sup>3</sup> These studies have prompted further investigation into flavonoid-containing foods.

### CHOCOLATE: A SURPRISING FLAVONOID-CONTAINING FOOD

People eat chocolate in many forms, rarely pondering its origin. Furthermore, many do not realize that chocolate comes from the cacao tree and, therefore, is a plant-based food. As such, it contains flavonoids, which scientists believe act as powerful antioxidants that may help protect living cells and tissues from degradation. Dr. Ron Prior of Tufts University presented Oxygen Radical Absorbance Capacity (ORAC) data at the American Dietetic Association (ADA) Annual Food and Nutrition Conference and Exhibition in Colorado last year, indicating that certain chocolates (both milk\* and dark\*), relative to other plant foods, have a potent antioxidant capacity (See Figure 1). In addition, the data showed a direct correlation between antioxidant activity and chocolate's flavonoid content (See Figure 2).<sup>4</sup> Interestingly, chocolate is especially abundant in the oligomeric flavonoids, which are large molecules made up of single-unit flavonoids. (See Figure 3).

These compounds also seem to be biologically active. Test tube studies suggest that isolated cocoa flavonoids may decrease LDL oxidation and modulate biomarkers related to immune function.<sup>5,7,8,9</sup> In addition, recently published clinical studies suggest that chocolate may have health benefits.<sup>10,11,12</sup> In one study, volunteers consuming a flavonoid-rich chocolate\* experienced an increase in antioxidant capacity of their plasma. They ate one to three servings of chocolate with a bagel or a bagel alone. Those consuming the chocolate experienced an increase in plasma epicatechin (single flavonoid compound) levels with a concurrent increase in antioxidant capacity and decrease in lipid oxidation by-products. These protective effects peaked within one to three hours and returned to near baseline at six hours after consumption.<sup>10</sup> The transient effect of dietary antioxidants provides a strong rationale for current advice suggesting we eat antioxidant-containing foods, including fruits and vegetables, throughout the day.



Beyond their antioxidant effects, the flavonoids in cocoa and chocolate may protect vascular health in other ways. In a recently published study, subjects consumed a high-flavonoid cocoa beverage.\* A decrease in platelet aggregation markers and an increase in clotting time of the blood were observed.<sup>11</sup> A lead researcher in this area, Carl Keen, PhD, chair of the nutrition department at the University of California, Davis, believes, "These results are promising and warrant future research. We're seeing some very positive effects with just an average serving of chocolate. Further research may indeed discover a chocolate paradox not unlike the phenomenon seen with red wine."

During her presentation at the annual ADA meeting, Francene Steinberg, PhD, RD, a nutrition researcher at the University of California, Davis, stated, "Chocolate is one of a whole host of flavonoid-rich foods, and you can get many of the same things from fruits and vegetables. It's not a substitute [for fruits and vegetables], it's something that can be added to the diet after some of the basic needs are met through fruits and vegetables." Steinberg presented results suggesting that chocolate may affect eicosanoid balance. Eicosanoids are involved in several areas of cardiovascular health, including platelet aggregation, vascular permeability, and inflammation. Subjects who consumed a flavonoid-rich chocolate bar\* experienced a positive effect on eicosanoid balance.<sup>13</sup> Keen says, "This human study supports the concept that food-derived flavonoids can influence inflammatory biomarkers in a positive direction."

However, as promising as these preliminary studies may be, the saturated fat in chocolate is a concern that should be ad-

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dressed. Current research shows the consumption of a chocolate bar instead of a carbohydrate snack in an NCEP/AHA Step I diet does not negatively affect cholesterol levels.<sup>14</sup> This may be explained by the unique fatty acid profile of chocolate. Three main fatty acids are found in chocolate, each at 30% — oleic, stearic, and palmitic acids. Oleic acid may help to improve cholesterol levels, whereas stearic acid, despite being a saturated fat, has been shown to have a neutral effect on cholesterol levels.

### CHOCOLATE (IN MODERATION) MAY CONTRIBUTE TO A HEALTHY DIET

It's no surprise that chocolate is a truly loved food. Throughout history, it has played an important part in the medicinal practices and eating habits of many. Today, however, the overconsumption of sugar and fat is a major concern in the United States, and chocolate consumption has incurred a degree of guilt. However, with the increased focus on foods in maintaining health and as researchers discover more about the potential benefits of flavonoid-containing foods, it is reassuring to know that foods enjoyed by so many can be included in a healthy diet.

The studies described suggest that flavonoid-containing foods, specifically certain chocolates, may have a multifactorial effect in maintaining cardiovascular health. It is becoming clear that, in the context of a flavonoid-rich diet with plenty of fruits and vegetables, chocolate in moderation may contribute to a healthy diet and lifestyle.

In this context, Norman K. Hollenberg, MD, PhD, professor of medicine and radiology at Harvard Medical School and director

of research in radiology at the Brigham and Women's Hospital in Boston, Mass., writes, "Although the evidence is still incomplete, it is worthwhile and constructive to consider the fact that the evidence for a health benefit of cocoa and chocolate at least matches, and probably exceeds, the evidence favor-

ing green tea and wine."

\*Specific chocolates used are detailed in research studies.

