



# HEALTHY DARK CHOCOLATE



*By, Tony Escobar*

Here is a list of ORAC values for foods you commonly eat, (ORAC is the measuring standard for antioxidant activity for a specific food) as calculated by the United States Department of Agriculture and the Journal of the American Chemical Society:

Ponder this rating list; nothing else even comes close to matching the levels of Dark Chocolate. It is off the charts!

1. Dark chocolate 13,120
2. Milk chocolate 6,740
3. Prunes 5,770
4. Raisins 2,830
5. Blueberries 2,400
6. Blackberries 2,036
7. Kale 1,770
8. Strawberries 1,540
9. Spinach 1,260
10. Raspberries 1,220
11. Brussels sprouts 980
12. Plums 949
13. Alfalfa sprouts 930
14. Broccoli 890

Beyond its value as a food that is super-rich in antioxidants, Dark Chocolate is also abundant in nutritives that help stimulate blood flow within your circulatory system.

The following;

Phenylethylamine (PEA) - can help to promote mental alertness and focus and balance brain chemistry.

It is also thought to combat feelings of depression.

The next important one is very important to diabetics as all are short of Magnesium, as it is urinated out along with high blood sugar. Magnesium is very important for diabetics; this is why Dark Chocolate is an excellent food for Diabetics.

## HISTORY OF CHOCOLATE

### Chocolate's Roots in Ancient Mesoamerica

Chocolate dates back to the ancient peoples of Mesoamerica who drank chocolate as a bitter beverage. For these people, chocolate wasn't just a favorite food—it also played an important role in their religious and social lives.

### The ancient Maya grew cacao and made it into a beverage.

The first people clearly known to have discovered the secret of cacao were the Classic Period Maya (250-900 C.E. [A.D.]). The Maya and their ancestors in Mesoamerica took the tree from the rainforest and grew it in their own backyards, where they harvested, fermented, roasted, and ground the seeds into a paste and then a drink that helped them endure the humidity and heat of the jungle.



### An Ancient MAYA Crop

Many anthropologists consider the ancient Maya to be the first people to have made chocolate. The first evidence of chocolate in glyphs and actual remains in ancient vessels come from the height of Mayan civilization, the Classic Period (250-900 C.E. [A.D.]).

The Maya shared a common culture and traded with each other over long distances. Their territory covered the countries that we know today as southern Mexico, Belize, Guatemala, Honduras, and part of El Salvador.

**Ancient Maya artifacts often show people collecting cacao for chocolate.** Archaeologists aren't sure exactly how the Maya first learned the tasty secret of cacao—a tree that grew in the tropical rainforests of their homeland.

But one thing is for sure: chocolate was a treasured Maya treat. Many Maya artifacts are painted with scenes of people pouring and enjoying chocolate.

**The ancient Maya grew cacao in their own backyards.**

In 1976, a bulldozer unearthed an ancient Maya village in El Salvador. There,

archaeologists found the remains of cacao gardens near Maya homes. Many clay dishes also contained preserved cacao seeds.

### **The Aztecs adopted cacao.**

By 1400, the Aztec empire dominated a sizeable segment of Mesoamerica. The Aztecs traded with Maya and other peoples for cacao and often required that citizens and conquered peoples pay their tribute in cacao seeds—a form of Aztec money. Like the earlier Maya, the Aztecs also consumed their bitter chocolate drink seasoned with spices—sugar was an agricultural product unavailable to the ancient Mesoamericans.

### **Drinking chocolate was an important part of Maya and Aztec life.**

Many people in Classic Period Maya society could drink chocolate at least on occasion, although it was a particularly favored beverage for royalty. But in Aztec society, primarily rulers, priests, decorated soldiers, and honored merchants could partake of this sacred brew. Chocolate also played a special role in both Maya and Aztec royal and religious events. Priests presented cacao seeds as offerings to the gods and served chocolate d

### **Cacao Becomes an Expensive European Import**

Europe's first contact with chocolate came during the conquest of Mexico in 1521. The Spaniards recognized the value attached to cacao and observed the Aztec custom of drinking chocolate. Soon after, the Spanish began to ship cacao seeds back home. An expensive import, chocolate remained an elite beverage and a status symbol for Europe's upper classes for the next 300 years.

### **Sweetened chocolate became an international taste sensation.**

When the Spanish brought cacao home, they doctored up the bitter brew with cinnamon and other spices and began sweetening it with sugar. They managed to keep their delicious drink a Spanish secret for almost 100 years before the rest of Europe discovered what they were missing. Sweetened chocolate soon became the latest and greatest fad to hit the continent.

### **Chocolate was a European symbol of wealth and power.**

Because cacao and sugar were expensive imports, only those with money could afford to drink chocolate. In fact, in France, chocolate was a state monopoly that could be consumed only by members of the royal court. Like the Maya and the Aztecs, Europeans developed their own special protocol for the drinking of chocolate. They even designed elaborate porcelain and silver serving pieces and cups for chocolate

that acted as symbols of wealth and power.

**Cacao farming required lots of land and workers.**

Cacao and sugar were labor-intensive agricultural products. To keep up with the demand for chocolate, Spain and many other European nations established colonial plantations for growing these plants. A combination of wage laborers and enslaved peoples were used to create plantation workforces.

**Chocolate ... Commercial Production and Machinery**

For centuries, chocolate remained a handmade luxury sipped only by society's upper crust. But by the 1800s, mass production made solid chocolate candy affordable to a much broader public. To meet the demands of today's global market, chocolate manufacturing relies on both ancient techniques in the field and new technologies in the factory.

**New inventions and ingredients improved chocolate's taste and texture.**

The Industrial Revolution witnessed the development of an enormous number of new mechanical inventions and ushered in the era of the factory. The steam engine made it possible to grind cacao and produce large amounts of chocolate cheaply and quickly. Later inventions like the cocoa press and the conching machine made it possible to create smooth, creamy, solid chocolate for eating—not just liquid chocolate for drinking.

**Cacao growing hasn't changed much since ancient times.**

New processes and machinery have improved the quality of chocolate and the speed at which it can be produced. However, cacao farming itself remains basically unaltered. People grow cacao in equatorial climates all around the world today using traditional techniques first developed in Mesoamerica. Cacao is still harvested, dried, cleaned, and roasted mostly by hand.

**We use cacao for more than just making chocolate.**

Today, additional steps in the processing of cacao help create a variety of new flavors and forms for chocolate candy. But cacao is more than a source for calories and confections. The chemicals and substances in cacao can be extracted and incorporated into health foods, cosmetics and modern medicines. And the by-products of cacao can be used as mulch or fodder for cattle.

Chocolate is made from plants, which means chocolate contains many of the health benefits of associated with dark vegetables.

These benefits are derived from flavonoids, which act as powerful, naturally occurring antioxidants. Antioxidants protect the body from premature aging caused by free radicals, which can cause damage that leads to heart disease.

Dark chocolate contains a large number of antioxidants nearly 10 times the number found in strawberries and raspberries. Flavonoids also help relax blood pressure through the production of nitric oxide, and balance certain hormones in the body, especially those affecting the brain.

**Dark Chocolate contains 4-5 times the anti-oxidants found in Green Tea. When researchers found this out it came as quite a surprise. This was the conclusion of a recent study by Holland's National Institute of Public Health and Environment. Researchers found that chocolate - specifically Dark Chocolate - contains 53.5 mg of catechins per 100 grams. (Catechins are the powerful anti-oxidants that fight against cancer-causing cells and help prevent heart disease). By contrast, 100 ml of Green Tea contained 13.9 mgs of catechins. The amount of 13.9 is remarkably high, but imagine 53.5!**

Cocoa and dark chocolate have recently been extensively studied. The fat in chocolate is primarily derived from cocoa. It is comprised of two saturated fatty acids, palmitic and stearic acids, and the monounsaturated oleic acid. It is these acids that have prevented chocolate from raising blood cholesterol.

In addition to these fats and the simple sugars present in chocolate, the cocoa component in chocolate can be rich in a number of essential minerals, depending on the processing, including magnesium, copper, potassium and manganese. Indeed, chocolate is thought to be one of the largest single contributors of copper to the diet in the United States.

In addition to the well-known and essential macro- and micronutrients present in chocolate, there are a number of phytochemicals in cocoa and chocolate that have important health effects in humans. Phytochemicals are naturally occurring chemical compounds present in cocoa, and they are attracting a great deal of interest in the nutrition and medical research community because of their potential health benefits beyond that of vitamin C, vitamin D, etc. Over the last few years, cocoa has been praised for its phytochemical content, especially the methyl xanthines (naturally

occurring caffeine) and theobromine, and the antioxidant flavonoids. Although chocolate is often thought to contain relatively large amounts of caffeine, the actual amount is relatively low compared with that present in tea and coffee.

Of much greater interest in the context of health benefits is the rich flavonoid content of raw cocoa. Flavonoids are part of a large and diverse class of phyto-chemicals called polyphenols. Several thousand flavonoids exist in plant-based foods.

Epidemiological research, which studies the association between diet and health, in the last decade, has suggested that some flavonoids might protect against certain chronic diseases, especially cardiovascular disease.

In spite of the equivocal nature of this research, the appealing nature of it has sparked needed research to understand the mechanism by which flavonoids might be able to protect against heart disease, and these results have shown that at least some flavonoids do have the potential to promote a healthy cardiovascular system.

There is more good news for chocolate lovers. Scientists have found that eating dark chocolate appears to improve the function of important cells lining the wall of blood vessels for at least three hours. In a study, they found that eating dark chocolate seemed to make the blood vessels more flexible, which helps prevent the hardening of the arteries that leads to heart attacks.

Dark chocolate is rich in flavonoids, which are natural antioxidants - chemicals that combat the damage oxygen does to the body. The amino acid Tryptophan is found naturally in dark chocolate. Tryptophan enhances relaxation and promotes better sleep.

Dark chocolate has antioxidant properties, which can actually help to protect the body from damaging oxidative stress. Studies have shown that by adding milk to the chocolate cancels out the antioxidant benefits, according to a study published in the noted journal "Nature". Researchers suggested that proteins in the milk bind with the antioxidants, making them less easily absorbed by the body. This is why one should never eat any protein foods for at least two hours before eating dark chocolate.

**According to Harvard researchers, a few pieces of dark chocolate every week may help you live longer and healthier.**

The researchers, Dr. I-Min Lee, and Dr. Ralph S. Paffenbarger Jr., of the Harvard School of Public Health, in Boston, Massachusetts, studied the candy-consuming habits of more than 7,800 men participating in the Harvard alumni health study.

**Product Scan Online a popular online trend tracking organization used by many companies throughout the world, a company regularly quoted by the Wall Street Journal, CNN, ABC news and many others, recently released a profound prediction for health and wellness trends in the upcoming year. Dark healthy Chocolate was number one by far, followed by the Acai Berry, Omega Fatty Acids and Antioxidants.**

Researchers have discovered that phenylethylamine (PEA) has a positive effect in enhancing feelings of love. And Chocolate has been proven to be an excellent source of PEA.

Dark chocolate is the richest food source of magnesium of any common food. Magnesium is the number one mineral that assists and supports healthy heart functioning.

Dark chocolate has plenty of L. Arginine, the aphrodisiac-like amino acid believed by body builders to stimulate blood flow build muscle and aid in recovery.

And much, much more!

By improving the blood vessel flexibility in apparently healthy people, dark chocolate emerges as perhaps a power food.

**Studies from Europe, Canada and the United States have documented Dark Chocolate having the highest ORAC rating of any plant food with 12 -15 times more antioxidants than raw spinach and broccoli, and 10-30 times more anthocyanins and lucoanthocyanins than red wine!**

There are now hundreds of studies now that have documented and support the benefits of Dark Chocolate

Supports Cardiovascular Function (Heart Attack)  
Supports Respiratory Function (Asthma/Breathing)  
Helps make you happy  
Helps to control Inflammation  
Helps one avoid Allergies  
Helps as an Appetite Suppressant  
Helps one to avoid LDL "Bad" Cholesterol  
Helps one to avoid Gum Disease and Cavities  
Helps with blood flow and supports libido  
Helps balance Blood Sugar  
High in Fiber  
Helps with Heartburn  
Helps supply vitamins, minerals as well as Essential Oils  
Helps with Blood Pressure  
Helps with Skin and Hair Health  
Improves Liver Health  
Helps the Pancreas  
An excellent food for Cancer and Heart Patients  
Helps Kidney Function  
Helps alleviate Stress  
Increases Serotonin Levels and helps balance oxytocin and dopamine

Eating only 30 calories a day of dark chocolate for 18 weeks lowered blood pressure by two or three points in a study of 44 middle-aged and older adults with either high blood pressure or pre-hypertension. The dark-chocolate eaters had higher blood levels of S-nitrosoglutathione, which relaxes blood vessels. That could explain how dark chocolate lowers blood pressure!

Just remember -- you don't want to use these results as an excuse to over-indulge in chocolate! The people in this study ate too little chocolate to harm their weight. An overenthusiastic chocolate eater could get carried away, add pounds and have the opposite effect because excess poundage contributes to high blood pressure! So you probably don't want to "go there".



## WHAT'S IN DARK CHOCOLATE

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Chocolate contains stearic acid, which after eaten, is converted to oleic acid in the body.

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Oleic acid is a heart-healthy mono-unsaturated fat.

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Chocolate, especially dark chocolate, contains potent antioxidants called phenols. Antioxidants are believed to help to reduce the effects of cell damage in the body and help to prevent cancer. Phenols also prevent LDL, the bad cholesterol, from building plaque in the arteries, while raising the levels of HDL, the good cholesterol.

One dark chocolate bar contains the same amount of phenols as a glass of red wine or five servings of fruits and vegetables. Chocolate contains four times more antioxidants than green tea.

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Chocolate, as well as most fruits and vegetables, contains compounds called flavonoids that help maintain a healthy heart, promote good blood circulation, and reduce the risk of blood clots. A bar of dark chocolate contains as many flavonoids as 4 cups of tea, 6 apples, and 2 glasses of red wine.

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Chocolate contains tannins, which inhibit the action of bacteria on your teeth, preventing the bacteria from causing cavities.

Chocolate is a rich source of the minerals magnesium and phosphorus.

Contrary to popular belief, chocolate does not contain a great deal of caffeine. A piece of chocolate contains about 5 mg of caffeine, while one cup of regular coffee contains 115 mg and one cup of tea contains 40 mg.

Chocolate does not interfere with the body's absorption of calcium or magnesium

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Chocolate does not cause hyperactivity in children.

One serving of dark chocolate has 14 percent of the daily requirement for copper, a critical mineral that aids in the absorption of iron and is a key component of enzymes that form skin-strengthening collagen. Copper also is critical to heart health. During the early stages of development a diet low in copper can result in cardiovascular abnormalities and later on in life can contribute to the development of vascular disease.

A serving of dark chocolate bar can deliver nearly 12 percent of your daily magnesium requirement. Studies show magnesium may help reduce the risk of several chronic illnesses, such as type 2 diabetes, hypertension and cardiovascular disease. Up to 90 percent of Americans don't get the recommended daily allowance of magnesium from their diet alone.

Symptoms of magnesium deficiency can include leg cramps, migraines, fatigue, loss of appetite, depression, nausea and vomiting.

Cocoa and chocolate are natural sources of potassium, which studies have shown to be a key factor in affecting blood-pressure and stroke. The more potassium present in the body, the less likelihood of developing high blood pressure or stroke, the studies show. The U.S. Food and Drug Administration (FDA) says: "Diets containing foods that are good sources of potassium and low in sodium may reduce the risk of blood pressure and stroke."

Cocoa and chocolate naturally contain iron, a key component of overall good health and the most common nutritional deficiency in the U.S. On average, a dark chocolate bar has nearly 7 percent of the required daily allowance. Some specific brands of chocolate even have higher iron contents. The main function of iron is to help carry oxygen from the lungs to the muscles and other organs. If your body is low in iron, fatigue, irritability and headaches may occur. If the iron deficiency becomes significant, you can become anemic.

### **Phenylethylamine (PEA):**

PEA is a chemical in cacao that increases the activity of neurotransmitters (brain chemicals) in parts of the brain that control our ability to pay attention and stay alert. Elevated PEA levels occur when we are captivated by a good book, movie, or project; this happens specifically during those moments when we are so focused that we lose all track of time, food, and the outside world.

### **Brain Chemicals**

Cacao is also a great source of serotonin, dopamine, and phenylethylamine, three well-studied neurotransmitters, which help alleviate depression and are associated with feelings of well being. Cacao contains monoamine oxidase inhibitors (MAO Inhibitors) that improve our mood because they allow serotonin and dopamine to remain in the bloodstream longer without being broken down.

Cacao contains anandamide which delivers blissful feelings.

Cacao also contains B vitamins, which are associated with brain health.

Everybody knows chocolate can be good for your over-all mood, even if it's not so good for the teeth and waistline. But now there's another excuse to indulge because it may also be good for your brain and your memory.

Tryptophan is found naturally in dark chocolate. Tryptophan enhances relaxation and promotes better sleep.

Dark chocolate has at least 33% more L-Arginine, the aphrodisiac-like amino acid believed by body builders to build muscle and aid in recovery.

## WHATS IN DARK CHOCOLATE FROM A CHEMICAL - SCIENTIFIC POINT OF VIEW

Per 100 g, the seed is reported to contain 456 calories, 3.6 g H<sub>2</sub>O, 12.0 g protein, 46.3 g fat, 34.7 g total carbohydrate, 8.6 g fiber, 3.4 g ash, 106 mg Ca, 537 mg P, 3.6 mg Fe, 30 mg b-carotene equivalent, 0.17 mg thiamine, 0.14 mg riboflavin, 1.7 mg niacin, and 3 mg ascorbic acid.

According to studies, the edible pulp of the fruit contains 79.7–88.5% water, 0.5–0.7% albuminoids, astringents, etc.; 8.3–13.1% glucose, 0.4–0.9% sucrose, a trace of starch, 0.2–0.4% non-volatile acids (as tartaric), 0.03% Fe<sub>2</sub>O<sub>3</sub> and 0.4% mineral salts (K, Na, Ca, Mg).

The shell contains 11.0% moisture, 3.0% fat, 13.5% protein, 16.5% crude fiber, 9.0% tannins, 6.0% pentosans, 6.5% ash, and 0.75 theobromine. Raw seeds contain 0.24 mg/100 g thiamine, 0.41 riboflavin, 0.09 pyridoxine, 2.1 nicotinamide, and 1.35 pantothenic acid.

The component fatty acids of cocoa butter are 26.2% palmitic and lower acids, 34.4 stearic and higher acids, 37.3% oleic acid, 2.1% linoleic and traces of isoleic. In g/100g the individual amino acids in the water soluble fractions of unfermented and fermented beans are lysine 0.08, 0.56; histidine 0.08, 0.04; arginine 0.08, 0.03; threonine 0.14, 0.84; serine 0.88, 1.99; glutamic acid 1.02, 1.77; proline 0.72, 1.97; glycine 0.09, 0.35; alanine 1.04, 3.61; valine 0.57, 2.60; isoleucine 0.56, 1.68; leucine 0.45, 4.75; tyrosine 0.57, 1.27; and phenylalanine 0.56–3.36 g/100g.

Unfermented and fermented beans contain p-hydroxybenzoic acid, vanillic acid, p-coumaric acid, ferulic acid, and syringic acid, while the fermented beans also contain protocatechuic, phenylacetic, phloretic

acid and the lactone esculetin and o- and p-hydroxyphenyl acids. Caffeic acid occurs in the unfermented beans (C.S.I.R., 1948–1976). According to an article in the Chicago Sun Times, people who suffer extreme depression as victims of unrequited love have an irregular production of phenylethylamine. Such individuals often go on chocolate binge during periods of depression.

Chocolate is particularly high in phenylethylamine, perhaps serving as medication. Theophylline is a potent CNS and cardiovascular stimulant with diuretic and bronchial smooth muscle relaxant properties. Recently this drug was proven effective in preventing and treating apnea in premature infancy. Cocoa contains over 300 volatile compounds, including esters, hydrocarbons, lactones, monocarbonyls, pyrazines, pyrroles, and others.

The important flavor components are said to be aliphatic esters, polyphenols, unsaturated aromatic carbonyls, pyrazines, diketopiperazines, and theobromine. Cocoa also contains about 18% proteins (ca 8% digestible); fats (cocoa butter); amines and alkaloids, including theobromine (0.5 to 2.7%), caffeine (ca 0.25% in cocoa; 0.7 to 1.70 in fat-free beans, with forasteros containing less than 0.1% and criollos containing 1.43 to 1.70%), tyramine, dopamine, salsolinol, trigonelline, nicotinic acid, and free amino acids; tannins; phospholipids; etc.

Cocoa butter contains mainly triglycerides of fatty acids that consist primarily of oleic, stearic, and palmitic acids. Over 73% of the glycerides are present as monounsaturated forms (oleopalmitostearin and oleodistearin), the remaining being mostly diunsaturated glycerides (palmitodiolein and stearodiolein), with lesser amounts of fully saturated and triunsaturated (triolein glycerides).

Linoleic acid levels have been reported to be up to 4.1%. Also present in cocoa butter are small amounts of sterols and methylsterols; sterols consist mainly of  $\beta$ -sitosterol, stigmasterol, and campesterol, with a small quantity of cholesterol.

**Dark Chocolate can be classified as “healthy chocolate” if the enzymes, flavonoids, and amino acids are active, (This can only be accomplished if the cocoa bean nibs are processed at low temperature) the cacao content is 70% or better, if the calories are 30 or less and if the sugar content is less than 3 grams**



# DARK CHOCOLATE STUDY

## Flavonoid - rich dark chocolate enhances blood vessel function

*Compiled by: Tony Escobar*

UCSF scientists have published the results of a recent study examining chocolate's effects on blood vessel function in healthy people.

The team reports that small daily doses of flavonoid-rich dark chocolate consumed over a two-week period improved blood vessels' ability to dilate, or expand. They also report that a particular flavonoid thought to be beneficial for blood vessel function, epicatechin, was absorbed at high levels in the blood.

"This is the longest clinical trial to date to show improvement in blood vessel function from consuming flavonoid-rich dark chocolate daily over an extended period of time," says lead author Mary Engler, PhD RN, professor of physiological nursing in the UCSF School of Nursing.

**"It is likely that the elevated blood levels of epicatechin triggered the release of active substances that vasodilate, or increase, blood flow in the artery. Better blood flow is good for your heart."**

The study appears in the June issue of the Journal of the American College of Nutrition.

Previous clinical studies have shown the beneficial effects of dark chocolate on the function of blood vessel endothelium [the inner lining of blood vessels] after either a single dose or several doses of chocolate over a few days.

**Flavonoids, a group of powerful chemical compounds with antioxidant properties, are derived from a variety of plants. They have been shown to promote several beneficial effects in**

**the cardiovascular system, including decreasing oxidation of LDL cholesterol (a harmful process that allows cholesterol to accumulate in blood vessels); inhibiting aggregation of blood platelets (which contributes to the risk of blood clots that produce stroke and heart attack); and decreasing the body's inflammatory immune responses (which contribute to atherosclerosis).**

In the randomized, double-blind, placebo-controlled study, eleven people received 46 grams (1.6 ounces) of dark, flavonoid-rich chocolate every day for fourteen days. At the end of the two-week trial, Engler and her team recorded the ability of the principal artery in the arm, the brachial artery, to expand. The brachial artery's dilation measurements correlate well with those of the coronary arteries that supply the heart.

The team measured the artery's "flow-mediated dilation" using ultrasound to obtain the brachial artery's diameter immediately after deflating a blood pressure cuff that had been inflated for five minutes on study participants' forearms. "This measurement actually gives us a "video-clip" of an individual's vascular health, and can be helpful in determining whether one is at risk for heart disease," says Engler. The induced increase in blood flow after the cuff is deflated causes release of many dilator substances, such as nitric oxide and prostanoids, which relax the artery. Flow-mediated dilation is expressed as the percentage maximum change in vessel diameter from baseline.

In the high-flavonoid group, flow-mediated dilation increased from an initial 10.2 percent at the beginning of the study to 11.5 percent at the end of the study, while in the low-flavonoid group dilation decreased from 10.7 percent at the beginning of the study to 9.74 percent at the end of the study. The mean increase in flow-mediated dilation between the two groups showed a statistically significant difference, says Engler.

"Improvements in endothelial function [the ability of the artery to dilate] are indicative of improved vascular health and a lower risk for heart disease," Engler says.

**"Arteries that are able to dilate more have increased blood flow, and this is especially important for the heart."**

Engler and her group also found that concentrations of the cocoa flavonoid epicatechin soared in blood samples taken from the group

that received the high-flavonoid dark chocolate, rising from a baseline of 25.6 nmol/L to 204.4 nmol/L.

The authors also found that the participants did not have increased blood cholesterol levels after these daily snacks of dark chocolate for two weeks.

The study was funded by the University of California at San Francisco, School of Nursing. Dark chocolate for the study was provided by the American Cocoa Research Institute, Vienna, VA.

In the past five years, scientists have developed increasingly accurate methods of detecting flavonoids.

Only a few years ago, dark chocolate was found to contain more flavonoids than any other food that's been tested so far, including such flavonoid-rich teas such as green and black tea, red wine and blueberries, says Engler.

**"Most people don't realize that chocolate is plant-derived, as are the fruits and vegetables recommended for a healthy heart. Chocolate is made from the cacao bean found in the fruit pod of the cacao tree (Theobroma cacao)."**

Standard manufacturing that uses excess heating of the dark chocolate destroys about a quarter to half of its anti-oxidant rich, flavonoids. Now, some companies are using processing methods with reduced heat and alkalizing methods, which can preserve as much as 70 - 95 percent of the dark chocolate flavonoids.

The UCSF study suggests that the beneficial effects of eating small doses of dark chocolate can be found in eating chocolate with higher amounts of cocoa, i.e., at least seventy percent cocoa content, says Engler.

The current study supports many other studies that have shown benefits from cocoa flavonoids, Engler says.

**"Even though we still have a long way to go before we understand all of chocolate's effects, for now, there's little doubt that in moderation and in conjunction with a healthy, balanced diet and exercise we can enjoy -- and even benefit from -- moderate amounts of high-flavonoid dark chocolate."**

**Engler's co-author, Marguerite Engler, PhD, RN, presented an abstract of this research at the American Heart Association's Scientific Sessions in New Orleans in November 2002. Mary Engler and her team also presented the work at the Experimental Biology 2003 meeting in San Diego in April 2003. The abstract was published in The FASEB Journal in conjunction with that meeting.**

Other researchers who participated in the study are Amanda Browne, RN, BS, Elisa Chiu, RN, MS, Michele Mietus-Snyder, MD, all from the Department of Physiological Nursing, UCSF School of Nursing; Chung Y. Chen, PhD, Ho-Kyung Kwak, PhD, Paul Milbury, MS, and Jeffrey Blumberg, PhD, FACN, all from the Jean Mayer USDA Human Nutrition Research Center on Aging, Antioxidants Research Laboratory at Tufts University, Boston, MA; Mary J. Malloy, MD, Cardiovascular Research Institute at UCSF, and Steven M. Paul, PhD, Office of Research, UCSF School of Nursing.

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## **STUDIES**

### **Blood Pressure, Glucose and Insulin Response**

Researchers in Italy compared the effects of dark chocolate to white chocolate in relation to blood pressure, blood glucose and insulin response. Fifteen healthy adults consumed dark chocolate, containing 50 mg of polyphenols for fifteen days. After a break of seven days, the same group consumed white chocolate, which contained no polyphenols, for fifteen days. Dark, but not white, chocolate was associated with lower systolic blood pressure, higher sensitivity to insulin and lower insulin resistance, which translates into reduced risk for diabetes.

Grassi D et al. Short-term administration of dark chocolate is followed by a significant increase in insulin sensitivity and a decrease in blood pressure in healthy persons. *Am J Clin Nutr.* 81(3):611-4, Mar 2005.

## **Cholesterol and Oxidative Damage**

Researchers in Finland studied 45 healthy adults during a three-week clinical trial. One group consumed 75 grams of white chocolate, another group consumed 75 grams of dark chocolate and the last group consumed 75 grams of high-polyphenol chocolate. An increase in HDL (good) cholesterol was observed in the groups who ate the dark chocolate and high-polyphenol chocolate, while the group who ate white chocolate experienced a small decrease. Lipid peroxidation (the oxidation of fats which forms dangerous free radicals that damage cells) decreased in all three groups. Researchers concluded that polyphenols in cocoa increase the HDL (good) cholesterol and the fatty acids in chocolate may modify the composition of LDL (bad) cholesterol, making it more resistant to oxidative damage.

Mursu J et al. Dark chocolate consumption increases HDL cholesterol concentration and chocolate fatty acids may inhibit lipid peroxidation in healthy humans. *Free Radic Biol Med.* 37(9):1351-9, Nov 2004.

## **Blood Vessel Function**

Researchers in Greece studied 17 healthy volunteers who ate 100 grams of dark chocolate. They found an acute (short term) beneficial effect on blood vessels and concluded that consumption of dark chocolate may have a protective effect on the cardiovascular system.

Vlachopoulos C et al. Effect of dark chocolate on arterial function in healthy individuals. *Am J Hypertens* 18(6):785-91, Jun 2005.

## **Platelet Aggregation**

Researchers in Scotland studied the effect of 100 grams of white chocolate, 100 grams of milk chocolate and 100 grams of dark chocolate on thirty healthy volunteers. Dark chocolate inhibited platelet aggregation, which leads to blood clot formation. This was not observed in those who ate white chocolate or milk chocolate. Researchers concluded that dark chocolate may play a role in the prevention of cardiovascular and thromboembolic diseases (such as stroke).

Innes AJ et al. Dark chocolate inhibits platelet aggregation in healthy volunteers. *Platelets*, 14(5):325-7, Aug 2003.

**If you want to know everything about chocolate and develop wonderful stories about it get the book NAKED CHOCOLATE by David Wolfe & Shazzie. Here is synopsis of the book**

## **Introduction**

David  
Shazzie  
Cacao's Properties

## **Part I: Cacao**

Legends of Cacao  
Theobroma Cacao  
A Brief History of Chocolate  
Money Does Grow on Trees

## **Part II: Scientific Properties of Chocolate**

Chemical Composition of Cacao  
Magnesium  
Antioxidants  
Methylxanthines: Theobromine and Caffeine  
Phenylethylamine  
Anandamide (the Bliss Chemical)  
Neurotransmitter Modulating Agents  
Tryptophan

## **Part III: Exotic Properties of Chocolate**

Aphrodisia  
Nobility  
Nature's Prozac (Anti-Depressant Properties of Cacao)  
Tryptamines, Phenylalanines, Lactones and Cannabinoids  
Chocolate as Medicine  
Chocolate and Pregnancy  
Chocolate Yoga  
Overcoming Chocolate Addictions  
Saving the Planet with Chocolate

## Part IV: Chocolate Alchemy

Curing by Contraries  
Naked Chocolate  
Organic Food  
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# Studies and Clinical Trials Galore

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**Researchers have some news for chocolate lovers: it may be good for you. Scientists reported preliminary evidence recently that cocoa and other chocolates may keep high blood pressure down, your blood flowing and your heart healthy.**

The research, the latest which correlates eating flavonoid-rich foods with a reduced risk of cardiovascular disease (1), was presented in February at the American Association for the Advancement of Science's (AAAS) annual meeting in Boston.

One study found that a substance in cocoa helps the body process nitric oxide (NO), a compound critical for healthy blood flow and blood pressure. Another study showed that flavonols in cocoa prevent fat-like substances in the bloodstream from oxidizing and clogging the arteries, and make blood platelets less likely to stick together and cause clots. Flavonoids are plant compounds with potent antioxidant properties; so far, scientists have found more than 4,000 kinds. Cocoa beans contain large quantities of flavonoids, and so do red wine, tea, cranberries, peanuts, strawberries, apples and many other fruits and vegetables. (2) The flavonoids in chocolate are called flavonols.

Generally, science has found that dark chocolate is higher in flavonoids than milk chocolate. (3) The way that cocoa powder and chocolate syrups are manufactured removes most flavonoids.

### **Nitric Oxide**

In the first study, researchers gave Boston volunteers cocoa with either a high or low amount of flavonols. Those who drank cocoa with more flavonols showed more nitric oxide activity. (4)

"Nitric oxide plays such an important role in the maintenance of healthy blood pressure and, in turn, cardiovascular health," said lead researcher Dr. Norman K. Hollenberg, physician and professor of medicine at Brigham and Women's Hospital and Harvard Medical School.

The residents of an island called Kuna in Panama prompted Hollenberg's study. These indigenous people rarely develop high blood pressure, although they drink about 5 cups of cocoa each day and include it in many recipes. But if they leave the island, the risk of high blood pressure increases, and studies found it wasn't related to salt intake or obesity.

Next, Hollenberg's team will determine if regulating nitric oxide with flavonols has a positive impact.

"If our research results continue to support a link between consumption of flavonol-rich cocoa and nitric oxide synthesis, there could be significant implications for public health," said Hollenberg.

### **Promotes Blood Flow**

**The other study compared how blood platelets responded to a flavonol-rich cocoa drink with 25 grams of semi-sweet chocolate pieces and a blood-thinning, 81-milligram aspirin dose. The research found similar reactions to the two from a group of 20- to 40-year-olds: both the drink and the aspirin prevented platelets from sticking together or clotting, which can impede blood flow. (5)**

In other words, flavonol-rich cocoa and chocolate act similarly to low-dose aspirin in promoting healthy blood flow. Reducing the blood's ability to clot also reduces the risk of stroke and heart attacks.

Lead study author Dr. Carl Keen cautioned that his team isn't suggesting that people eat a couple of candy bars instead of taking their daily dose of aspirin.

"We're not advocating that people consume flavonol-rich foods in place of aspirin," stressed Keen, who is also the University of California-Davis nutrition department chairman. For people who cannot take aspirin, however, he said eating flavonol-rich foods "may be a useful approach."

He noted one important difference between aspirin and flavonol-rich foods: "The effects you see in aspirin are longer-lasting than the effects you see in flavonols," he said.

Although the trial involved just 40 people, Keen called the results "remarkably robust" and said the platelet effect may be related to the nitric oxide benefits found by Hollenberg's study.

Keen's team currently has an article under review in which they show a direct comparison to low-dose aspirin using the same study group.

"The next thing on our agenda is to look at chronic effects," said Keen. "What happens when a person has a high flavonol intake for two weeks? Do you still see the same effects? Many times...the body adapts or adjusts and you don't necessarily see the same thing after two or three weeks."

## **Chocolate's Benefits?**

A PWC who was a true chocoholic could do a little research and argue that there are several bioactive compounds in chocolate that promote alertness, lessen pain and promote well-being.

For example, the stimulants theobromine, caffeine, tyramine and phenylethylamine (PEA) provide a brain-fogged PWC with a much-needed lift. Tryptophan, an essential amino acid, lessens anxiety by producing the neurotransmitter serotonin; endorphins, the body's natural opiates, reduce sensitivity to pain.(6)

Anandamide acts like a cannabinoid to promote relaxation.(7) And last but certainly not least, chocolate is a natural analgesic, and high-fat, chocolate foods trigger the brain's production of natural opiates. (6)

So let's sum up. Chocolate gives you an energy lift, less anxiety, a reduction in pain-who wouldn't recommend something that did all that? Well, a nutritionist or biochemist could argue that chocolate doesn't contain much of these ingredients.

For example, while caffeine does encourage alertness, there is less caffeine in chocolate than there is in a cup of coffee. (6) (There are about 30 milligrams of caffeine in your average chocolate bar, while a cup of coffee contains 100 -150 mgs.)

Another example: PEA causes blood pressure and blood sugar to rise, and you'll feel alert and content for awhile. But those good feelings are likely to be followed by a sugar-induced drop in energy that leaves you more tired than before you ate the candy.

Cannabinoids are substances that mimic marijuana. The chemical in marijuana that makes people "high" - tetrahydrocannabinol (THC) - binds to certain receptors in the brain. The anandamide in chocolate can bind to the same receptors, producing a "high."(8)

However, Christian Felder at the National Institute of Mental Health would point out that a 130-pound person would have to eat 25 pounds of chocolate all at once to get a marijuana-like effect. (8)

And what about chocolate's ability to trigger the brain's natural opiates? At a CFS conference held September 1999 in Brussels, Belgium, Professor Jonathan Brostoff of London discussed "Allergy in CFS." He said about 25 percent of the population suffers from intolerances or allergies and the percentage is the same for PWCs.

Brostoff said food and inhalant sensitivities could lead to health problems, including migraine, irritable bowel syndrome, arthralgia and chronic fatigue. He suggested an elimination diet to find out whether someone is intolerant. Furthermore, he blamed the "exorphins" (external morphine-like substances) in chocolate for "gut problems" and even "psychological sequelae."(9)

Don't laugh: A study published in 1999 in the Journal of the American Dietetic Association found that chocolate contains "several biologically active constituents (methylxanthines, biogenic amines, and cannabinoid-like fatty acids), all of which potentially cause abnormal behaviors and psychological sensations that parallel those of other addictive substances."(10)

So, about those chocolate cravings: At "The Challenge of Chronic Illness" CFS conference in Sydney, Australia, in 1999, Abhijit Chaudhuri, a neurologist on the Glasgow, Scotland-based team researching CFS, said about 40 percent of his patients routinely craved chocolate. He suggested SSRIs or and low-dose tricyclics to help prevent those cravings.

Some people find that Bupropion (Wellbutrin) reduces chocolate cravings.(6) That may be because Bupropion's chemical structure is similar to PEA.(11)

### **Antioxidant Power**

Here's an argument you could win with the nutritionist: Studies show that cocoa powder, dark chocolate and milk chocolate have higher Oxygen Radical Absorption Capacity (ORAC) values than many common foods, such as prunes and blueberries. (12) (ORAC values measure how powerful an antioxidant a substance is. An antioxidant is a substance that inhibits oxidation or reactions promoted by oxygen and peroxides, and that include many held to protect the living body from the deleterious effects of free radicals. Examples include beta-carotene, vitamin C, and alpha-tocopherol.

**Dark chocolate has more than 13,000 ORAC units and milk chocolate has about 6,700, according to the Chocolate Manufacturers Association in McLean, Va. Unsweetened powdered cocoa starts out with almost twice as much antioxidants as dark chocolate, but when it's diluted with water or milk and sugar to make hot chocolate, the flavonoid total per serving plummets to about half that in milk chocolate. (13)**

**In different terms, a 40-gram serving of milk chocolate contains about 400 milligrams of antioxidants, the same as a glass of red wine, according to research published by Joe A. Vinson of the University of Scranton, Pa. (14) Vinson's team's results were also supported by ACRI.**

**Vinson and his colleagues found that the flavonoids in chocolate are more powerful than vitamins such as ascorbic acid in protecting circulating lipids from oxidation.(14) Atherosclerosis studies suggest that oxidation of lipoproteins is part of the process that creates the plaque that clogs artery walls. (1)**

**"Chocolate just stands out," Vinson said. "It's much higher than anything else."**

**If that doesn't convince your doctor, try this: researchers from the Harvard School of Public Health found that those who eat chocolate and sweets up to three times each month live almost a year longer than those who eat too much or those who steer clear of junk altogether. (15)**

### **Industry-funded Research**

Both studies presented at the February AAAS meeting used an experimental cocoa supplied by Mars Incorporated, and the candy company commissioned the research as well. Mars Incorporated makes M&Ms and Mars, Snickers and Dove bars, among other candies.

For the last few years, Mars Incorporated and the American Cocoa Research Institute (ACRI) in McLean, Va., have jointly funded research to try to find health benefits in chocolate. Mars Incorporated external affairs director Marlene Machut said the studies began as "flavor research" but shifted to health benefits as the evidence grew.

One problem with that was alluded to in an AAAS symposium on chocolate held in 2000: Why should consumers trust data on chocolate when it comes from industry-funded research?

"That's a valid question," acknowledged John W. Erdman, professor of food science and human nutrition at the University of Illinois at Urbana-Champaign and cochair of that symposium. But he also said in a recent interview that if the candy industry hadn't funded the

research, "it would have been very difficult to get off the ground otherwise."

Erdman said the situation is similar to Quaker Oats' preliminary funding of research that showed oats' lowered serum cholesterol, or to Midwestern soy farmers funding most of the initial studies which showed that proteins and antioxidants in soy fight heart disease. Later clinical research done by independent labs around the world confirmed those smaller studies' conclusions and expanded upon them, he said.

"It's often necessary for a lot of promising, peer-reviewed, industry-financed studies to be done before government steps in with financial support for larger-scale research," Erdman said. "Nowadays the FDA wants preliminary information before they fund a major project."

Rather than questioning the data, Professor Keen believes people should applaud the industry for investigating the nutritional value of their products.

"Responsible food companies have a responsibility to fund research into the potential value of nutrients in those foods," he said. "If [these] companies help fund research at independent campuses and universities, and generate exciting data, that tells the NIH, 'This is a worthwhile area in which to invest precious taxpayer dollars.'"

### **Conclusive Evidence?**

So does chocolate contribute to disease prevention? Should we eat chocolate for its health benefits as well as for its terrific taste?

When asked to choose how far along the preliminary-conclusive continuum this research is, Erdman said, "It's moving along. People are starting to say, 'There's something here.' Scientists are finding similar results with compounds in fruits and vegetables, tea, red wine and tomatoes."

Keen agreed, pointing out that the tea, grape and chocolate industries are just a few of the groups exploring antioxidants' potential benefits.

"I think one should view it from a collective perspective," he suggested. "There are a number of industries with very different types of food products who are saying, 'It looks like these compounds may have some potential health benefits,'" he said.

Of course, people should always be "skeptical" until results are repeated and published in peer-reviewed journals, Keen said.

The USDA Food Composition Laboratory is already sold: They're developing a database reporting the levels of flavonoids in plant foods, and cocoa will be included along with fruits, berries and other foods that provide health benefits, said Machut. In addition, the lab adopted Mars Incorporated's methods for looking at the flavonol levels in food products.

### **Methods Matter**

"The cacao bean and its bran have the highest polyphenol levels," nutritionist Angela Miraglio noted in a May 2001 article in Nutrition Notes. "Processing the beans destroys some polyphenols; temperature, chemical changes and duration of exposure contribute to the loss. So the level of polyphenols in the final product vary. Cocoa processors and chocolate manufacturers are beginning to take precautions to minimize the losses."(13)

### **Future**

Both Keen's and Hollenberg's teams plan future research into the benefits of cocoa. As you might expect, Mars Incorporated plans more, too.

But the surest sign of the candy company's faith in its main product is the fact that they're "working with several pharmaceutical companies to isolate and develop cocoa components as cardiovascular pharmaceuticals." In other words, they're trying to develop a drug based on chocolate's cardiovascular health benefits.

<http://www.exploratorium.edu/chocolate/>

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# Understanding Chocolate ...

## Chocolate Glossary

### **BITTER CHOCOLATE**

Known as the best type of chocolate for baking, it is made from chocolate liquid which has been cooled and molded into blocks.

**Also Known As:** Unsweetened Chocolate.

### **BITTERSWEET CHOCOLATE**

A dark chocolate containing a minimum of 35% chocolate liquor as a general rule. In spite of that ruling, bittersweet usually contains about 50% chocolate liquor. Semi-sweet chocolate falls more into the 35% range. Can be used interchangeably with baking chocolate.

**Also Known As:** Semi-sweet blocs, squares, bits.

### **BLOOM**

Cocoa butter, the fatty part of chocolate, can solidify into different crystalline forms at different temperatures. This means that untempered chocolate is vulnerable to changes in temperature. Chocolate must be tempered to stabilize it before use, or crystals may form, causing what is called "bloom". This can appear as a white film on the surface of chocolate, and in some cases the chocolate may become soft or crumbly. While bloom is unwanted, it is not harmful and chocolate with bloom is still safe to eat.

### **BREAKFAST COCOA**

Cocoa powder which contains at least 22% cocoa butter.

### **CACAO**

The cacao tree (*Theobroma cacao*) is a native of South America. Its fruit is a large pod which can contain many imbedded seeds. The pod is fermented, and then the seeds are removed, cured and roasted. The end results are called nibs. Cacao has a high fat, carbohydrate and protein content. Besides chocolate, cacao is used in the preparation of cosmetics and medicines.

### **CHOCOLATE LIQUEURS**

The most common type is creme de cacao, and is found in many chocolate-based drinks. There are also many other specialty chocolate liqueurs available.

## **CHOCOLATE LIQUID**

This is the basic building block from which all chocolate and cocoa products are developed. It comes from ground nibs.

**Also Known As:** Chocolate Liquor.

## **CHOCOLATIER**

A shop or a candy maker that creates and sells chocolate confections.

## **COCOA BEANS**

Seeds from the pod of the cacao tree (*Theobroma cacao*), native to Amazon or African forests. The center of the cocoa bean is called the nib, from which chocolate liquor is made.

## **COCOA BUTTER**

The vegetable fat contained in a cocoa bean. It is a yellowish-white fat. It is removed from chocolate liquid by using high pressure.

## **COCOA POWDER**

The portion of chocolate liquid that remains after most of the cocoa butter is removed. It is an unsweetened powder. Different types of cocoa powder include breakfast cocoa, medium and low fat cocoas, and Dutch process cocoa.

## **CONCHING**

Raw unprocessed chocolate is not yet ready to eat, because it is too gritty. To make it smooth, liquid and rich, it is rolled and kneaded until it achieves the desired state. Special machines designed to perform this action contain rollers that are shaped like conches, giving the process its name.

## **CONFECTIONARY COATING**

A blend of sugar, vegetable oil, cocoa powder and other products. Vegetable oil is used in place of cocoa butter to reduce costs, and to cause it to melt easily and then harden quickly. It is really more of a chocolate-flavored candy, not a true chocolate. It can be used to coat fruit bits, and for other decorating purposes.

**Also Known As:** Compound or Decorator's Chocolate.

## **COUVETURE CHOCOLATE**

For a chocolate to be couverture it must contain at least 32% cocoa butter. Some couverture chocolates contain up to 39% cocoa butter. The addition of this extra cocoa butter give it the right texture and consistency to be used for hand-dipping chocolates. It can also be used to enrobe a candy, which means that the chocolate is poured

over the candy to coat it.

**Also Known As:** Coating Chocolate, Enrobing Chocolate

### **DUTCH PROCESS COCOA**

Cocoa powder which has been treated with alkali to neutralize acidity. The process creates a darker, milder chocolate.

### **GANACHE**

Ganache is used to glaze cakes, or can be beaten until fluffy to use as fillings for truffles and other candies. It is made by mixing chopped semi-sweet chocolate with boiling cream, then stirring until smooth.

### **LOW FAT COCOA**

Cocoa powder containing less than 10% cocoa butter.

### **MEDIUM FAT COCOA**

Cocoa powder containing between 10% and 22% cocoa butter.

### **MILK CHOCOLATE**

Milk chocolate is made by combining chocolate liquid, extra cocoa butter, milk or cream, sweetening, and flavorings. This chocolate is generally considered the best for eating, because of its sweetness.

### **MOLINILLO**

A wooden stick with rings attached to the bottom. It is used to whip chocolate drinks to make them foam on top.

### **NIBS**

After cocoa beans are fermented and roasted, the nibs, which are the center of the bean, are ground and become chocolate liquid. The high fat content is what allows them to become a liquid.

### **SEMI -SWEET CHOCOLATE**

Semi-sweet chocolate is created by blending chocolate liquid with varying amounts of sweetening and extra cocoa butter. Flavorings may be included. Semi-sweet chocolate is available in bar form, but is usually sold in pieces or chips. Semi-sweet contains between 15% and 35% chocolate liquor, cocoa butter, sugar, lecithin, and vanilla. It may be used in recipes that call for bittersweet or sweet chocolate, but is not interchangeable with milk chocolate.

**Also Known As:** Semi-sweet blocs, squares, bits, chocolate chips, morsels.

## **SWEET CHOCOLATE**

Made by mixing chocolate liquor with sweeteners and extra cocoa butter. Flavorings may be included. Sweet chocolate is usually molded into bars. It contains a minimum of 15% chocolate liquor.

## **TEMPERING**

A method of preparing chocolate so that it will not develop fat bloom. Chocolate that will be used for dipping or coating must be tempered, which also gives it a glossy quality, free of streaks. The classic tempering method is to melt chocolate until it is lump free. Then 1/3 of the chocolate is poured onto a marble slab, spread and worked back and forth with a metal spatula until it becomes thick and reaches a temperature of about 80 degrees. This chocolate is then added back to the remaining 2/3 of the melted chocolate and stirred. The process is repeated until the entire mixture reaches 88-92 degrees for semi-sweet chocolate, 84-87 degrees for milk or white chocolate. Care must be taken not to over temper chocolate, which brings it back to its original state - grainy and susceptible to fat bloom.

## **UNSWEETENED CHOCOLATE**

Chocolate liquid which has been cooled and molded into blocks. This is the best type for baking or cooking.

**Also Known As:** Bitter Chocolate.

## **WHITE CHOCOLATE**

Not a true chocolate, since it does not contain cocoa solids. It is a mixture of sugar, cocoa butter, milk solids, lecithin, and vanilla. If cocoa butter is not mentioned, the product is a confectionary or summer coating, not white chocolate. You need to be careful when melting white chocolate because it is more fragile than true chocolates.

## **Antioxidant**

A substance that helps prevent or reduce oxidative damage to the body, cells and tissues. Antioxidants are compounds that are naturally manufactured by the body and/or are ingested, primarily as components of fruits and vegetables, which have the ability to stabilize free radicals by donating an electron, and at the same time, do not become free radicals themselves. Simply put, antioxidants protect our bodies from harmful molecules we are exposed to every day of our lives.

## **Catechins**

Simple flavanols present in cocoa and other foods such as tea.

**Epicatechin**

A specific type of catechin.

**Flavanols**

A specific class of flavonoids with antioxidant activity.

**Flavonoids**

A special group of polyphenols present in many plant foods such as berries, apples, garlic, onions, tea, and dark chocolate.

**Free Radicals**

Unstable, highly reactive forms of oxygen that can attack the body's cells. They are natural by-products of metabolism and are also formed in the body as a result of smoking, air pollution and exposure to sunlight. Antioxidants help protect the body against the damage from free radicals.

**Polyphenols**

A term used to describe a broad class of phytochemical compounds that includes flavonoids. Many polyphenols have antioxidant properties.

**Procyanidins**

Complex flavanols made of various numbers of monomers joined together.