Chocolate: Food of the Gods

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“Life is like a box of chocolates. You never know what you’re going to get.” (Forrest Gump)

Objectives

- Origins and history of chocolate
- Production of chocolate
- Types of chocolate
- Chemicals in chocolate
- Health benefits of chocolate
- How chocolate can fit into a healthy diet.

History

- The Maya of Central America in the rainforests (250-900 A.D.) collected the cacao beans from cacao trees
- They ground the beans into a paste and made a frothy, bitter chocolate drink called “xocoatl” (“bitter water”)

History

- Chocolate played an important role in their social and religious life
- Used for medicinal purposes
- Favored drink of the wealthy (royalty, priests, etc.)
- Cocoa beans were also used as money and trading

Ancient Medicinal Uses of Cocoa

- >150 medicinal uses:
  - Stomach Disorders
  - Stimulant
  - Reduces Fatigue
  - Weight gain
  - Antiseptic
  - Emollient
  - Laxative
- CVD-Related Uses:
  - “faint of heart”
  - Angina (relieves)
  - Blood (generates/produces)
  - Heart palpitations (relieves)
  - Heart (strengthens)
The Aztecs conquered the Maya (1400-1521)
- Conquered the Maya and were then introduced to chocolate
- Only rulers, wealthy merchants and priests could enjoy the drink

Spanish explorer, Cortez, brings the cacao bean to the Spanish court (1528)
- The Aztec emperor Montezuma offered the cacao drink to Hernando Cortez who then brought it back to Spain in 1528.

Spanish explorer, Cortez, brings the cacao bean to the Spanish court (1528)
- Europeans did not like the bitter taste, so they added spices and sugar to the mix. They also heated the drink.

Chocolate in Europe - Some Dates
1528: Hernán Cortéz returned to Spain with cocoa beans and the formula for the chocolate drink
1615: The Spanish princess Anne of Austria married Luis XIII of France, so chocolate came to France
1657: A Frenchman opened the first “Chocolate House” in London → became as popular as Coffee Houses

Chocolate in Europe - Some Dates
1674: The first solid chocolate in a stick form had been sold
End of 17th century: chocolate came to Germany → first pralines were made by a German cook
1792: A chocolate factory was opened in Berlin

Mid-1700s-Chocolate became more affordable and more than just the wealthy were able to enjoy it.
1875: The first milk chocolate was put on the market
1893: Milton S. Hershey built a chocolate factory in Southern Pennsylvania

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Theobroma cacao plant used to make chocolate

Theobroma cacao, which translates to “cacao, food of the gods.”

Where Does Chocolate Come From?
- Inside the fruit are the cocoa beans
- Dried cocoa beans
- Cocoa powder
- Cocoa liquor
- Cacao Tree with ripe fruit
The process

- After harvesting the beans are sorted, fermented then dried (in the sun) for several days and then roasted.
- Next they are opened, the shells are discarded and the nibs are ground and separated into cocoa butter and cocoa powder.

Flow Diagram of Chocolate Production

Step 1: cocoa beans
Step 2: shell and nibs
Step 3: cocoa powder

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Flow Diagram of Chocolate Production

Step 1: cocoa beans
Step 2: shell and nibs
Step 3: cocoa powder
Step 4: plain chocolate

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Dark Chocolate vs. Milk Chocolate
What’s the Difference?

- Dark Chocolate—tastes semisweet
  - Cocoa liqueur, cocoa butter, sugar, sometimes vanilla, no milk
- Milk Chocolate—tastes sweet
  - Milk, sugar, less cocoa liqueur, cocoa butter, vanilla

What About Other Types of Chocolate?

- White Chocolate—made from some of the same ingredients
  - Sugar, cocoa butter, milk, sometimes lecithin, sometimes vanilla, no chocolate liquor or cocoa powder
  - With no cocoa liquor is it not technically considered chocolate
- For Cooking
  - Semisweet Chocolate
  - Bittersweet Chocolate

Chocolate production video
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Isn’t Chocolate High in Fat?

- 1/3 of the fat is oleic acid, same monounsaturated fat found in olive oil
- 1/3 of the fat is stearic acid, it is a saturated fat, but does not raise cholesterol levels, the body can metabolize it into oleic acid.
- 1/3 of the fat is in the form of palmitic acid, another saturated fat, however careful studies found that eating chocolate does not increase cholesterol levels.

Stearic Acid has a NEUTRAL effect on serum cholesterol

- Unlike the other long-chain SFA, stearic acid had no effect on total cholesterol and LDL cholesterol in men and women. 
- Stearic acid is a unique SFA in that it elicits neutral cholesterolemic effects.
- Stearic acid lowers total and LDL cholesterol somewhat when it replaces dietary carbohydrate.

*Stearic acid is the predominant SFA in chocolate.

Bioactive Compounds in Cocoa

- Polyphenols
- Methylxanthine
  - Theobromine
  - Caffeine
- Tryptophan, Arginine
- Phenylethylamine
- Anandamide

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Methylxanthine

- Diuretic agent
- CNS stimulant
- Clinically, used as a bronchodilator.
- Chocolate contains two members of this class of chemicals:
  - Theobromine
  - Caffeine

Theobromine

- Theobromine is the predominant methylxanthine found in cocoa beans.
- Theophylline is the predominant methylxanthine in tea.
- Caffeine is the predominant methylxanthine in coffee.
- Theobromine has a mild diuretic action (increases urine production) similar to caffeine, but does not stimulate the central nervous system like caffeine.

Caffeine Content

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Caffeine Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double espresso (2oz)</td>
<td>45-100 mg</td>
</tr>
<tr>
<td>Brewed coffee (8 oz)</td>
<td>60-120 mg</td>
</tr>
<tr>
<td>Instant coffee (8 oz)</td>
<td>70 mg</td>
</tr>
<tr>
<td>Decaf coffee (8 oz)</td>
<td>1-5 mg</td>
</tr>
<tr>
<td>Tea - black (8 oz)</td>
<td>45 mg</td>
</tr>
<tr>
<td>Tea - green (8 oz)</td>
<td>20 mg</td>
</tr>
<tr>
<td>Tea - white (8 oz)</td>
<td>15 mg</td>
</tr>
<tr>
<td>Coca Cola (12 oz can)</td>
<td>34 mg</td>
</tr>
<tr>
<td>Pepsi (12 oz can)</td>
<td>38 mg</td>
</tr>
<tr>
<td>7-up (12 oz)</td>
<td>0 mg</td>
</tr>
<tr>
<td>Chocolate milk (8 oz)</td>
<td>4 mg</td>
</tr>
<tr>
<td>Dark chocolate (1 oz)</td>
<td>20 mg</td>
</tr>
<tr>
<td>Milk chocolate (1 oz)</td>
<td>6 mg</td>
</tr>
</tbody>
</table>

Bioactive Compounds in Cocoa

- Polyphenols
- Methylxanthine
  - Theobromine
  - Caffeine
- Tryptophan, Arginine
- Phenylethylamine
- Anandamide

Tryptophan

- Tryptophan is an essential amino acid. It is the precursor for the mood-modulating neurotransmitter serotonin.
- Enhanced serotonin function typically diminishes anxiety.

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Phenylethylamine (PEA)

- This compound may be responsible for some of the pleasurable feelings you get after eating chocolate because it releases natural feel-good chemicals called endorphins in your brain.
- This effect led to labeling cocoa as an aphrodisiac.
- PEA is released by the brain when people are falling in love. Perhaps this explains why chocolate and Valentine's Day are so closely linked.

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Love Drug?

- Chemicals like tryptophan and phenylethylamine, which are also found in many other foodstuffs, are present in chocolate only in very small quantities.

Chocolate Pot?

- The same is true of anandamide, the current favorite candidate for a psychoactive chocolate ingredient.

Chocolate Pot?

- Anandamide is a neurotransmitter that targets the same brain structures as THC, (Tetrahydrocannabinol) the active ingredient in cannabis.
- But to make a substantial impact on the brain's own natural anandamide levels, Scientists doubt if anandamide and other chemicals in chocolate have much effect because they are present only in small amounts.

Chocolate Pot?

- It is estimated that a 130-pound person would have to eat 25 pounds of chocolate at one time to get any marijuana-like effect.
- As well as anandamide itself, chocolate contains two chemicals known to slow the breakdown of anandamide.
- Chocolate might therefore work by prolonging the action of this natural stimulant in the brain.
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Polyphenols

- A large family of natural compounds widely distributed in plant foods.
- Polyphenols have specific health-promoting actions, and it is generally recognized that they can reduce the risk factors for many types of chronic diseases.

Polyphenols

- The largest and best studied polyphenols are the flavonoids, which include several thousand compounds, among them the flavonols, flavones, catechins, flavanones, anthocyanidins, and isoflavonoids.
- Important dietary sources of polyphenols in Western societies are onions (flavonols); cocoa, tea, apples, and red wine (flavonols and catechins); citrus fruit (flavanones); berries and cherries (anthocyanidins); and soy (isoflavones).

What Are Flavonoids and Flavonols?

- Flavonoids are a type of polyphenols
- More than 4,000 different flavonoids exist
- Naturally found in many different plant foods
- They provide certain health benefits—many act as antioxidants
- Flavonols are one type of flavonoid.

Results demonstrate that cocoa has a high flavonoid content and substantial antioxidant capacity:
- 4-5X stronger than black tea;
- 2-3X stronger than green tea;
- Almost 2X stronger than red wine.
Chocolate is rich in antioxidant flavonoids called flavanols, which include procyanidins, epicatechins, and catechins.

Chocolate Polyphenols reduces CVD risk factors
- ↓ LDL oxidation (Antioxidant)
- ↑ HDL Cholesterol
- ↓ blood platelet aggregation
- Improve endothelial function (flexibility of blood vessels and ↑ blood flow (↑ production of nitric oxide).
- ↓ CRP levels
- ↓ moderately high blood pressure

Other benefits
- Improvement in insulin sensitivity
- ↓ cognitive decline in aging
- Protects damage to skin from UV radiation
- ↓ stress hormones in people who had high anxiety levels

"It has been over 10 years since the first mention in a medical journal about cocoa and chocolate as potential sources of antioxidants for health. During this time, cocoa has been found to improve antioxidant status, reduce inflammation and correlate with reduced heart disease risk."

British Journal of Nutrition, 2008
Cocoa powder and dark chocolate may favorably affect cardiovascular disease risk status by modestly reducing LDL oxidation susceptibility, increasing serum total antioxidant capacity and increasing HDL-cholesterol concentrations.


Researchers found that cocoa flavanol and procyanidin supplementation for 28 d significantly increased plasma epicatechin and catechin concentrations and significantly decreased platelet function. These data support the results of studies that used higher doses of cocoa flavanols and procyanidins. Am J Clin Nutr. 2003 Jun;77(6):1466-73

A recent clinical study simultaneously compared low-dose aspirin and a flavanol-rich cocoa beverage, and found reductions in platelet "stickiness," which may improve blood flow, with both.

Cocoa Versus Aspirin – Platelet Effects

- Population: 16 healthy men & women
- Treatments: 81 mg aspirin
- 300 ml cocoa
- Aspirin + Cocoa
- Results: Cocoa inhibits platelet activation at 2 hr
- Effect is similar to that of aspirin

Dark chocolate improves endothelial and platelet function

- Cigarette smokers exhibit increased atherogenic potential, as they consistently have endothelial and platelet dysfunction, which are associated with an increased cardiovascular risk.
- Dark but not white chocolate induced a rapid and significant improvement of endothelial and platelet function in healthy smokers (40 g of dark chocolate or 40 g of white chocolate (4% cocoa, Nestlé Galak))

Eating dark chocolate reduces CRP

- Researchers studied 1317 people who did not eat any chocolate and 824 people who ate dark chocolate regularly. They looked at the levels of CRP in their blood to their usual chocolate intake.
- Consuming moderate amounts of dark chocolate can significantly reduce levels of C-reactive protein (CRP).
- Those who ate up to 1 serving (20 g) every 3 days had CRP concentrations significantly lower than those who ate none or those who ate larger amounts.


Eating dark chocolate reduces CRP

- The 17% average reduction observed may appear small, but it is enough to decrease the risk of cardiovascular disease for one-third in women and one-fourth in men.
- The lowering of CRP corresponds to a shift from medium risk of cardiovascular disease to low risk.
- If you increase the consumption, the protection is lost, similar to the effects of wine.

A Primary Mechanism by which Cocoa & Chocolate affect Cardiovascular Health

- Arginine is a precursor of NO
- Platelet Inhibition
- Anti-Inflammatory
- Angiogenesis
- Inhibit SMC Proliferation
- Vasodilation
This study suggests that higher cocoa intake is associated with reduced blood pressure and reduced risk of cardiovascular and all-cause mortality in elderly men.

The inclusion of small amounts of polyphenol-rich dark chocolate as part of a usual diet efficiently reduced BP and improved formation of vasodilative nitric oxide.

Recent News

- New study found only 6 grams of dark chocolate necessary to show positive results
- About 1 and ½ Hershey’s Special Dark Chocolate Kisses (30 calories, 2 grams of fat, 4 grams of sugar) decreased blood pressure in middle-aged men and women with slightly high blood pressure.
**Cocoa increases blood flow to brain**

- Cocoa flavonoids have been directly linked with improved cerebral blood flow.
- Thirteen men and women (avg age 72) consumed flavonol-rich cocoa and a 21 participants consumed a flavonoid-poor cocoa product.
- Ultrasound methods were used to analyze blood flow to the brain.
- The 13 participants who consumed flavonol-rich cocoa for 2 weeks (900 mg flavanols daily) achieved a 10% increase in cerebral blood flow.


**Cocoa increases blood flow to brain**

- Harvard researchers report that cocoa flavanols improve brain flow in older adults. It has been speculated that increasing blood flow to the brain could help reduce cognitive decline in aging individuals. The current finding could be helpful in improving cognitive function among individuals suffering from conditions in which brain flow is impaired, such as stroke and dementia.


**Cerebrovascular disease response to flavanol-rich cocoa in healthy elderly humans**

The researchers tested the effects of beverage containing high amounts of cocoa flavanols on participants between the ages of 59 and 83. The investigators found an 8 percent increase in the participants' brain blood flow following one week of consuming the beverage, and a 10% increase after 2 weeks.

Neuropsychiatric Disease and Treatment, 2008; 4(2), 433-330.
Eating chocolate can significantly protect the skin from UV light

- Flavonol-Rich Chocolate may offer photoprotection. Eating chocolate rich in flavonoids may help protect the skin against ultraviolet (UV) light damage, researchers report.
- In the study, 30 adults were randomly assigned to eat 20 grams of high-flavonoid chocolate or regular chocolate daily for 12 weeks. The authors tested the skin's minimal erythema dose (MED), which is the amount of ultraviolet light that causes the skin to turn red.
- The researchers concluded that chocolate rich in flavonoids significantly increased the skin’s MED. In contrast, the conventional chocolate did not offer protection against UV rays.

References:

Chocolate May Reduce Stress

- For their review, the researchers found 88 studies between 2001 and 2009 that assessed flavonoids and stroke risk, but narrowed it down to three that looked specifically at chocolate and stroke.
- One found that eating chocolate on a weekly basis decreased stroke risk by 22% compared with not eating any (RR 0.78, 95% CI 0.65 to 0.94).
- Another study looked at flavonoid intake from chocolate -- also on a weekly basis -- and found that 22% of subjects who ate chocolate daily cut risk of death from stroke almost in half (HR 0.53, 95% CI 0.30 to 0.96).
- The third study found no association between flavonoid intake and risk of stroke or death when 3% of catechin intake came from chocolate (OR 0.92, 95% CI 0.51 to 1.66).
- The researchers said that more prospective studies are needed to fully understand the health benefits of chocolate.

References:
- The researchers report.

Red wine, chocolate kill cancer

- In addition to blueberries, garlic and some teas, red wine and dark chocolate also have cancer-fighting qualities.
- "What we eat is really our chemotherapy three times a day," he said. The foods appear to cut off the blood supply to tumors and quite literally starve them to death.
- Eating dark chocolate significantly lowered the stress hormones cortisol and catecholamines in people who had high anxiety levels.

References:
- The researchers reported that chocolate may keep sweethearts safe from stroke.
- Eating chocolate can significantly reduce the urinary excretion of the stress hormone cortisol and catecholamines and partially normalized stress-related differences in energy metabolism (glycine, citrate, trans-aconitate, proline, alanine) and gut microbial activities (hippurate and p-cresol sulfmate).

References:
- The study provides strong evidence that a daily consumption of 40 g of dark chocolate during a period of 2 weeks is sufficient to modify the metabolism of free living and healthy human subjects, as per variation of both host and gut microbial metabolism. Journal of Proteome Research, 2009; 8: 5568-5579

Toronto -- Just in time for Valentine’s Day, researchers have reported that chocolate may keep sweethearts safe from stroke.

Like wine, chocolate has frequently been spotlighted as an indulgence that may have health benefits, including improved vascular function and decreased blood pressure (See ACC: Dark Chocolate Improves Vascular Function and Dark Chocolate a Comfort to Early Blood Pressure).

Red wine, chocolate kill cancer

- Feb 11, 2010: Even though we knew that red wine and dark chocolate have health benefits, a new study finds that the two are actually potent medicine for killing cancer.
- In addition to blueberries, garlic and some teas, red wine and dark chocolate also have cancer-fighting qualities.
- "What we eat is really our chemotherapy three times a day," he said. The foods appear to cut off the blood supply to tumors and quite literally starve them to death.
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So, this Valentine’s Day, indulge in a nice glass of Cabernet and some chocolates without the guilt!
How Much Chocolate?

- Dark chocolate is recommended because it has more of the heart healthy flavonols and flavonoids than milk chocolate.
- To receive the health benefits of chocolate, some studies have found you would need to eat about 1-3 ounces of dark chocolate per day.

Plasma antioxidants from chocolate


Effects of ingesting 100g dark chocolate (DC), 100 g dark chocolate with 200 ml milk (DC+ MK), or 200 g milk chocolate on total antioxidant capacity and epicatechin content of human plasma. (red=DC; blue DC+MK; grey=MC. FRAP= ferric-reducing antioxidant potential was used to measure antioxidant capacity. Asterisk = P<0.001)

Ongoing Studies

- How much chocolate should be eaten
- How to keep high levels of flavonoids without affecting the taste
- Chocolate and aging

Aim for 70%

- Make sure cocoa solids, chocolate liquor is listed as the first ingredient.
- One that lists sugars first means that cocoa makes up less than 50% of the bar.
Chocolate for our soldiers

- It's a regular feature in army food rations
- During the Gulf War, critical equipment flown out to US forces included a specially formulated heat-stable chocolate bar.

What Adds Calories?

- In the chocolate making- sugar, milk, added fat
- In chocolate bars
  - Caramel
  - Peanut butter
  - Nuts
  - Marshmallow
  - Added fat and sugar
  - Eggs
  - Milk

A Healthy Diet

~Balance, variety and moderation~

- Chocolate can be part of a healthy diet! The first listed ingredient should be cocoa or chocolate liquor, not sugar.
- Limit yourself to a few ounces a day.
- Moderation is the key!

Watch The Label!

- Look for total calories and sugar (if you're diabetic)
- Look at the serving size
- Example: Dove Dark Chocolate Bar (3.5 oz bar)

Reading the Label

- Serving Size
- Calories
- Total Fat
- Carbohydrate (sugar)

Chocolate Quotes

- There is nothing better than a good friend, except a good friend with chocolate.
  (Linda Grayson, "The Pickwick Papers")
Chocolate Quotes

- This guy found a bottle on the ocean, and he opened it and out popped a genie, and he gave him three wishes. The guy wished for a million dollars and poof! there was a million dollars. Then he wished for a convertible, and poof! there was a convertible. And then, he wished he could be irresistible to all women… poof! He turned into a box of chocolates. *(unknown)*

Chocolate Quotes

- Chemically speaking, chocolate really is the world’s perfect food. *(Michael Levine, nutrition researcher)*
- I have this theory that chocolate slows down the aging process. It may not be true, but do I dare take the chance? *(unknown)*

Chocolate Quotes

- Man cannot live on chocolate alone; but woman sure can. *(unknown)*

It is not that chocolates are a substitute for love. Love is a substitute for chocolate. Chocolate is, let’s face it, far more reliable than a man. *(Miranda Ingram)*
1800 TO PRESENT

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