



- Chocolate native to Central and South America.
- For a description of raw fruit, see [Exploring Chocolate](#) web site.

- History
- Source
- Types
- Ingredients

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Cocoa Beans

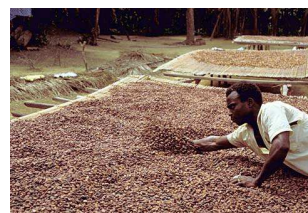
Processing

- Cocoa tree: 'evergreen', \approx 20 feet tall
- Pods: 6 - 10" long, 3 - 4" diameter.
- Beans: 20 to 40 beans/pod, each \approx 1" long.

West Africa produces almost 75% of all cocoa beans.



Cocoa tree



After Harvest:

- Beans: Removed from pod & dried where grown.
- Roasted \approx 1 hour at 250°F.
- Shell removed from the interior (nib).
- Grinding nibs creates [chocolate liquor](#).

Chocolate liquor is over half cocoa butter (fat).

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Source of Chocolate

Types of Chocolate



Hershey's (surprise) has a large amount of information on their web site about the production of chocolate.

[Hershey's Tour.](#)

Chocolate liquor: Paste produced when cocoa beans roasted & ground

- Baking: Solid form of chocolate liquor, unsweetened
- Cocoa Butter: Fat from chocolate liquor
- Cocoa Powder: Solid remains of chocolate liquor after most cocoa butter removed (10-35% fat remains)
- Bittersweet - sweet: Chocolate liquor + sugar
- Milk: Chocolate liquor plus sugar plus milk
- White: Cocoa butter, milk, and sugar

Taken in part from [CNN site](#)

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What's in Chocolate?

Estimates for the number of different chemicals in chocolate range from ~300-800.

- Fats: 15-55%
- Serotonin: 0.6-6.0%
- Theobromine: 0.5-3%
- Polyphenols: 0.75%
- Phenylethylamine: 0.02-2.2%
- Caffeine: 0.02-0.06%

Taken in part from [Amer. Chem. Soc.](#), [AllChocolate.com](#), and [MIT](#) sites.

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Fats and Triglycerides

In chocolate, three fatty acids account for about 95% of the fatty acids present.

- ≈34% Stearic acid (18:0)
- ≈26% Palmitic acid (16:0)
- ≈35% Oleic acid (18:1^{Δ9})

Three fatty acids can combine with glycerol to form a triglyceride. In chocolate, most of these triglycerides are arranged as:

Saturated fatty acid chain (Stearic or Palmitic)

Unsaturated fatty acid chain (Oleic)

Saturated fatty acid chain (Stearic or Palmitic)

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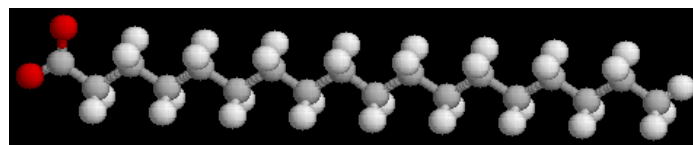
Fat and Tempering of Cocoa

Chocolate contains fat with an unusually small amount of variation (i.e. - almost all same).

- Solid → liquid transition much sharper than for most other fats. (Compare to butter).
- Can more easily form crystals, giving a gritty taste.
- White coating on old chocolate (bloom) due to separation and crystallization of part of the fat. Butter can slow this process.
- Six different crystalline forms exist. Tempering used to produce optimal form. (See [Nature of the Chemical Blog](#))

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Stearic Acid



(≈34% of fats in chocolate)

- Stearic Acid is a saturated fatty acid.
- Most saturated fatty acids contribute to increased cholesterol levels.
- High cholesterol levels → heart disease.
- Nutritionists report: stearic acid doesn't appear to ↑ cholesterol.
- Another study indicated milk chocolate may increase HDL.

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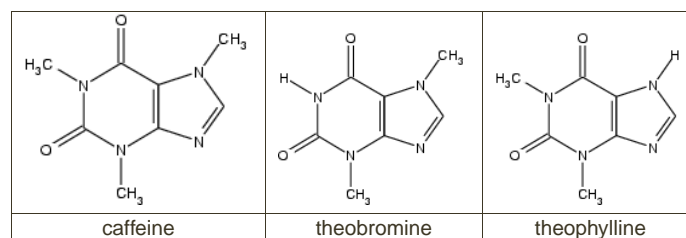
Xanthines

Xanthines are a class of naturally-occurring alkaloids (nitrogen-containing, basic) and similar synthetically produced derivatives.

- Main Role in Plants - Discourage animals from eating
- May serve as antioxidants in humans (Cf. [Article in J. Chim. Phys., Vol. 96, No. 1, January 1999](#)).
- Xanthine drugs relax smooth muscle, especially in the airways.

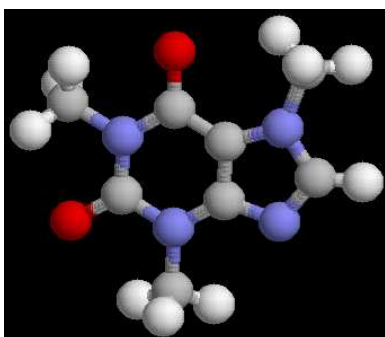
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Xanthine Images



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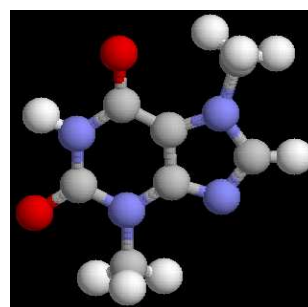
Caffeine



The common stimulant found in coffee, tea, many soft drinks, ... Small amounts present in chocolate.

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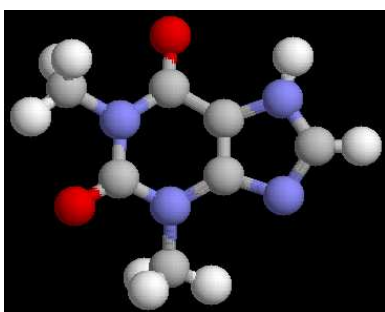
Theobromine



The most common xanthine in both chocolate and tea. Diuretic (increased urine output), mild stimulant, relaxes bronchi in lungs. Dangerous to animals.

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Theophylline



A prescription drug commonly used to treat asthma. Also used to aid breathing in premature infants.

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Serotonin

Neurotransmitters are chemicals found in the brain that facilitate communication with nerve cells. Serotonin is found in a variety of cells. Serotonin appears to affect:

- Eating disorders (anorexia nervosa, bulimia)
- Carbohydrate craving associated with SAD
- Mood
- Temperature regulation
- Pain perception
- Sleep

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Phenylethylamine

Phenylethylamine is a naturally occurring substance with amphetaminelike effects.

- Causes blood pressure and blood sugar to rise.
- MAO (monoamine oxidase) inhibitors cause phenylethylamine levels to increase. Sometimes administered as anti-depressants.
- Chocolate contains measurable amounts of phenylethylamine.
- This may explain why depressed individuals crave chocolate. Clinical confirmation lacking.

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Other Mind-Altering Chemicals

- Fatty acid amines (N-linoleylethanolamine and N-oleylethanolamine) reported (cf. [Science News, Oct. 12, 1996](#)) to give a sense of pleasure similar to cannabinoids.
- Researchers are looking into possible production of opioids, which dull pain and increase a feeling of well-being.

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Polyphenols are antioxidants.

- Have been shown to prevent the oxidation of LDL (bad cholesterol).
[Univ. Missouri Site](#)
- Chocolate contains high levels of phenols, a chemical that helps reduce the risk of heart disease. [CNN article](#)

Following are links to sites discussing the health benefits of chocolate.

- [Pro Health](#)
- [Cleveland Clinic](#)
- [Live Science](#)
- [About.com](#)

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Composition of Chocolate

	Choc. Liq.	Cocoa butter	Sugar	Milk
Bitter	95%	5%	–	–
Bittersweet	35-50%	15%	35-50%	–
Sweet	15%	15%	70%	–
Milk	10%	20%	50%	15%

Taken from Harold McGee “On Food and Cooking” Macmillan, 1984

Chocolate Nutrition

	Fat	Carb.	Protein
Bitter	55%	30%	10%
Sweet	35%	60%	4%
Milk	30%	60%	5%
Cocoa	15%	55%	18%

Taken from Harold McGee “On Food and Cooking” Macmillan, 1984

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Summary



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