# Introduction

Chocolate comprises a number of raw and processed foods produced from the seed of the tropical Theobroma cacao tree. Cacao has been cultivated for at least three millennia in Mexico, Central and South America, with its earliest documented use around 1100 BC.



The seeds of the cacao tree have an intense bitter taste, and must be fermented to develop the flavor. After fermentation, the beans are dried, then cleaned, and then roasted, and the shell is removed to produce cacao nibs. The nibs are then ground to cocoa mass, pure chocolate in rough form. Because this cocoa mass usually is liquefied then molded with or without other ingredients, it is called chocolate liquor. The liquor also may be processed into two components: cocoa solids and cocoa butter. Unsweetened baking chocolate (bitter chocolate) contains primarily cocoa solids and cocoa butter in varying proportions.

Cocoa solids contain alkaloids such as theobromine and phenethylamine, which have physiological effects on the body. It has been linked to serotonin levels in the brain. Some research found that chocolate, eaten in moderation, can lower blood pressure. The presence of theobromine renders it toxic to some animals, especially dogs and cats.

Chocolate has become one of the most popular food types and flavors in the world. Gifts of chocolate molded into different shapes have become traditional on certain holidays: chocolate bunnies and eggs are popular on Easter, chocolate coins on Hanukkah, Santa Claus and other holiday symbols on Christmas, and chocolate hearts or chocolate in heart-shaped boxes on Valentine's Day. Chocolate is also used in cold and hot beverages, to produce chocolate milk and hot chocolate. Around three quarters of the world's cacao bean production takes place in West Africa.

# Etymology

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he word "chocolate" entered the English language from Spanish. How the word came into Spanish is less certain, and there are multiple competing explanations. Perhaps the most cited explanation is that "chocolate" comes from Nahuatl, the language of the Aztecs, from the word "chocolātl. However, as William Bright noted the word "chocolatl" doesn't occur in central Mexican colonial sources making this an unlikely derivation. Santamaria gives a derivation from the Yucatec Maya word "chokol" meaning hot, and the Nahuatl "atl" meaning water. More recently Dakin and Wichmann derive it from another Nahuatl term, "chicolatl" from Eastern Nahuatl meaning "beaten drink. They derive this term from the word for the frothing stick, "chicoli".

# History

Chocolate has been used as a drink for nearly all of its history. The earliest record of using chocolate dates back before the Olmec. In November 2007, archaeologists reported finding evidence of the oldest known cultivation and use of cacao at a site in Puerto Escondido, Honduras, dating from about 1100 to 1400 BC. The residues found and the kind of vessel they were found in indicate that the initial use of cacao was not simply as a beverage, but the white pulp around the cacao beans was likely used as a source of fermentable sugars for an alcoholic drink.

The Maya civilization grew cacao trees in their backyard, and used the cacao seeds it produced to make a frothy, bitter drink. Documents in Maya hieroglyphs stated that chocolate was used for ceremonial purposes, in addition to everyday life. The chocolate residue found in an early ancient Maya pot in Río Azul, Guatemala, suggests that Maya were drinking chocolate around 400 AD. In the New World, chocolate was consumed in a bitter, spicy drink called xocoatl, and was often flavored with vanilla, chili pepper, and achiote (known today as annatto). Xocoatl was believed to fight fatigue, a belief that is probably attributable to the theobromine content. Chocolate was also an important luxury good throughout pre-Columbian Mesoamerica, and cacao beans were often used as currency. All of the areas that were conquered by the Aztecs that grew cacao beans were ordered to pay them as a tax, or as the Aztecs called it, a "tribute".

# Types

Several types of chocolate can be distinguished. Pure, unsweetened chocolate contains primarily cocoa solids and cocoa butter in varying proportions. Milk chocolate is sweet chocolate that additionally contains milk powder or condensed milk. White chocolate" contains cocoa butter, sugar, and milk but no cocoa solids. Dark chocolate has been promoted for its health benefits, as it seems to possess substantial amount of antioxidants that reduce the formation of free radicals.

White chocolate is formed from a mixture of sugar, cocoa butter and milk solids. Although its texture is similar to milk and dark chocolate, it does not contain any cocoa solids. Because of this, many countries do not consider white chocolate as chocolate at all. Although first introduced by Hebert Candies in 1955, Mars, Incorporated was the first to produce white chocolate within the United States. Because it does not contain any cocoa solids, white chocolate does not contain any theobromine, meaning it can be consumed by animals.

Dark chocolate is produced by adding fat and sugar to the cacao mixture. The U.S. Government calls this "sweet chocolate", and requires a 15% concentration of chocolate liquor. European rules specify a minimum of 35% cocoa solids. Dark chocolate, with its high cocoa content, is a rich source of epicatechin and gallic acid, which are thought to possess cardioprotective properties. Dark chocolate has also been said to reduce the possibility of a heart attack when consumed regularly in small amounts. Semisweet chocolate is a dark chocolate with a low sugar content. Bittersweet chocolate is chocolate liquor to which some sugar (typically a third), more cocoa butter, vanilla and sometimes lecithin have been added. It has less sugar and more liquor than semisweet chocolate, but the two are interchangeable in baking.

Unsweetened chocolate is pure chocolate liquor, also known as bitter or baking chocolate. It is unadulterated chocolate: the pure, ground, roasted chocolate beans impart a strong, deep chocolate flavor.

# Production

Roughly two-thirds of the entire world's cocoa is produced in Western Africa, with 43% sourced from Côte d'Ivoire, where child labor is a common practice to obtain the product. See the Wikipedia article children in cocoa production for a description of this and proposed solutions. According to the World Cocoa Foundation, some 50 million people around the world depend on cocoa as a source of livelihood.[31] In the UK, most chocolatiers purchase their chocolate from them, to melt, mold and package to their own design. Despite some disagreement in the EU about the definition,[clarification needed] chocolate is any product made primarily of cocoa solids and cocoa butter.

Production costs can be decreased by reducing cocoa solid content or by substituting cocoa butter with another fat. Cocoa growers object to allowing the resulting food to be called "chocolate", due to the risk of lower demand for their crops.

There are two main jobs associated with creating chocolate candy, chocolate makers and chocolatiers. Chocolate makers use harvested cacao beans and other ingredients to produce couverture chocolate. Chocolatiers use the finished couverture to make chocolate candies (bars, truffles, etc.).

## Cacao varieties

Cacao trees are small, understory trees that need rich, well-drained soils. They naturally grow within 20 degrees of either side of the equator because they need about 2000 millimeters of rainfall a year, and temperatures in the range of 21 to 32 degrees Celsius. Cacao trees cannot tolerate a temperature lower than 15 degrees Celsius (59 degrees Fahrenheit).

The three main varieties of cacao beans used in chocolate are criollo, forastero and trinitario.

Representing only five percent of all cocoa beans grown, criollo is the rarest and most expensive cocoa on the market and is native to Central America, the Caribbean islands and the northern tier of South American states. There is some dispute about the genetic purity of cocoas sold today as Criollo, as most populations have been exposed to the genetic influence of other varieties. Criollos are particularly difficult to grow, as they are vulnerable to a variety of environmental threats and produce low yields of cocoa per tree. The flavor of Criollo is described as delicate yet complex, low in classic chocolate flavor, but rich in "secondary" notes of long duration.

The most commonly grown bean is forastero, a large group of wild and cultivated cacaos, most likely native to the Amazon basin. The African cocoa crop is entirely of the Forastero variety. They are significantly hardier and of higher yield than Criollo. The source of most chocolate marketed, forastero cocoas are typically strong in classic "chocolate" flavor, but have a short duration and are unsupported by secondary flavors, producing "quite bland" chocolate.

Trinitario is a natural hybrid of Criollo and Forastero. Trinitario originated in Trinidad after an introduction of Forastero to the local Criollo crop. Nearly all cacao produced over the past five decades is of the Forastero or lower-grade Trinitario varieties.

## Processing

Cacao pods are harvested by cutting the pods from the tree using a machete, or by knocking them off the tree using a stick. The beans with their surrounding pulp are removed from the pods and placed in piles or bins to ferment. The fermentation process is what gives the beans their familiar chocolate taste. It is important to harvest the pods when they are fully ripe because if the pod is unripe, the beans will have low cocoa butter content, or there will be insufficient sugars in the white pulp for fermentation, resulting in a weak flavor. After fermentation, the beans must be quickly dried to prevent mold growth. Climate and weather permitting, this is done by spreading the beans out in the sun from 5 to 7 days.

The dried beans are then transported to a chocolate manufacturing facility. The beans are cleaned (removing twigs, stones, and other debris), roasted, and graded. Next the shells are removed to extract the nib. Finally, the nibs are ground and liquefied, resulting in pure chocolate in fluid form: chocolate liquor. The liquor can be further processed into two components: cocoa solids and cocoa butter.

## Blending

Chocolate liquor is blended with the cocoa butter in varying quantities to make different types of chocolate or covertures. The basic blends of ingredients for the various types of chocolate (in order of highest quantity of cocoa liquor first), are as follows:

Chocolate made with high levels of cocoa butter, allowing it to flow gently over a chocolate fountain to serve dessert fondue.

Usually, an emulsifying agent such as soy lecithin is added, though a few manufacturers prefer to exclude this ingredient for purity reasons and to remain GMO free, sometimes at the cost of a perfectly smooth texture. Some manufacturers are now using PGPR, an artificial emulsifier derived from castor oil that allows them to reduce the amount of cocoa butter while maintaining the same mouth feel.

The texture is also heavily influenced by processing, specifically conching (see below). The more expensive chocolate tends to be processed longer and thus have a smoother texture and "feel" on the tongue, regardless of whether emulsifying agents are added.

Different manufacturers develop their own "signature" blends based on the above formulas, but varying proportions of the different constituents are used.

The finest, plain dark chocolate couvertures contain at least 70% cocoa (both solids and butter), whereas milk chocolate usually contains up to 50%. High-quality white chocolate couvertures contain only about 35% cocoa.

Producers of high quality, small batch chocolate argue that mass production produces bad quality chocolate. Some mass-produced chocolate contains much less cocoa (as low as 7% in many cases) and fats other than cocoa butter. Vegetable oils and artificial vanilla flavor are often used in cheaper chocolate to mask poorly fermented and/or roasted beans.

In 2007, the Chocolate Manufacturers Association in the United States, whose members include Hershey, Nestlé, and Archer Daniels Midland, lobbied the Food and Drug Administration to change the legal definition of chocolate to let them substitute partially hydrogenated vegetable oils for cocoa butter in addition to using artificial sweeteners and milk substitutes. Currently, the U.S. Food and Drug Administration (FDA) does not allow a product to be referred to as "chocolate" if the product contains any of these ingredients.

## Conching

The penultimate process is called conching. A conche is a container filled with metal beads, which act as grinders. The refined and blended chocolate mass is kept in a liquid state by frictional heat. Chocolate prior to conching has an uneven and gritty texture. The conching process produces cocoa and sugar particles smaller than the tongue can detect, hence the smooth feel in the mouth. The length of the conching process determines the final smoothness and quality of the chocolate. High-quality chocolate is conched for about 72 hours, lesser grades about four to six hours. After the process is complete, the chocolate mass is stored in tanks heated to approximately 45–50 °C (113–122 °F) until final processing.

## Tempering

The final process is called tempering. Uncontrolled crystallization of cocoa butter typically results in crystals of varying size, some or all large enough to be clearly seen with the naked eye. This causes the surface of the chocolate to appear mottled and matte, and causes the chocolate to crumble rather than snap when broken. The uniform sheen and crisp bite of properly processed chocolate are the result of consistently small cocoa butter crystals produced by the tempering process.

The fats in cocoa butter can crystallize in six different forms (polymorphous crystallization). The primary purpose of tempering is to assure that only the best form is present. The six different crystal forms have different properties.

Making chocolate considered "good" is about forming as many type V crystals as possible. This provides the best appearance and texture and creates the most stable crystals so the texture and appearance will not degrade over time. To accomplish this, the temperature is carefully manipulated during the crystallization.

Generally, the chocolate is first heated to 45 °C (113 °F) to melt all six forms of crystals.[45] Next, the chocolate is cooled to about 27 °C (81 °F), which will allow crystal types IV and V to form. At this temperature, the chocolate is agitated to create many small crystal "seeds" which will serve as nuclei to create small crystals in the chocolate. The chocolate is then heated to about 31 °C (88 °F) to eliminate any type IV crystals, leaving just type V. After this point, any excessive heating of the chocolate will destroy the temper and this process will have to be repeated. However, there are other methods of chocolate tempering used. The most common variant is introducing already tempered, solid "seed" chocolate. The temper of chocolate can be measured with a chocolate temper meter to ensure accuracy and consistency. A sample cup is filled with the chocolate and placed in the unit which then displays or prints the results.

Two classic ways of manually tempering chocolate are:

Working the molten chocolate on a heat-absorbing surface, such as a stone slab, until thickening indicates the presence of sufficient crystal "seeds"; the chocolate is then gently warmed to working temperature.

Stirring solid chocolate into molten chocolate to "inoculate" the liquid chocolate with crystals (this method uses the already formed crystal of the solid chocolate to "seed" the molten chocolate).

Chocolate tempering machines (or temperers) with computer controls can be used for producing consistently tempered chocolate, particularly for large volume applications.

## Storage

Chocolate is very sensitive to temperature and humidity. Ideal storage temperatures are between 15 and 17 °C (59 and 63 °F), with a relative humidity of less than 50%. Chocolate is generally stored away from other foods as it can absorb different aromas. Ideally, chocolates are packed or wrapped, and placed in proper storage with the correct humidity and temperature. Additionally chocolate is frequently stored in a dark place or protected from light by wrapping paper. Various types of "blooming" effects can occur if chocolate is stored or served improperly. If refrigerated or frozen without containment, chocolate can absorb enough moisture to cause a whitish discoloration, the result of fat or sugar crystals rising to the surface. Moving chocolate from one temperature extreme to another such as from a refrigerator on a hot day can result in an oily texture. Although visually unappealing, chocolate suffering from bloom is perfectly safe for consumption.

# Health

Health effects of chocolate include both positive and negative effects. While chocolate is regularly eaten for pleasure, there are potential beneficial health effects of eating chocolate. Cocoa or dark chocolate benefits the circulatory system. Other beneficial effects suggested include anticancer, brain stimulator, cough preventer and antidiarrheal effects. An aphrodisiac effect is yet unproven.

On the other hand, the unconstrained consumption of large quantities of any energy-rich food such as chocolate is thought to increase the risk of obesity without a corresponding increase in activity. Raw chocolate is high in cocoa butter, a fat which is removed during chocolate refining, then added back in in varying proportions during the manufacturing process. Manufacturers may add other fats, sugars, and milk as well, all of which increase the caloric content of chocolate.

Chocolate absorbs lead from the environment during production and there is a slight concern of mild lead poisoning for some types of chocolate. The average lead concentration of cocoa beans was a very low ≤ 0.5 ng/g, one of the lowest reported values for a natural food. Lead concentration of chocolate was as high as 70 ng/g for chocolate products and 230 ng/g for manufactured cocoa. 200,000 ng is the WHO tolerable daily limit for lead consumption. Additionally, chocolate is toxic to many animals because of insufficient capacity to metabolize theobromine.

A study reported by the BBC indicated that melting chocolate in one's mouth produced an increase in brain activity and heart rate that was more intense than that associated with passionate kissing, and also lasted four times as long after the activity had ended.