

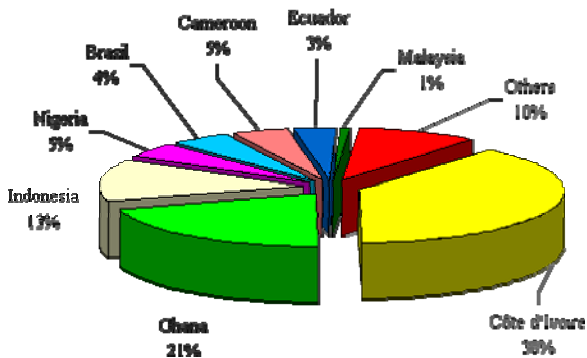
Chocolate: Food of the Gods

Chocolate is one of the most popular sweets and also one of the most popular flavours for a variety of foods including beverages, ice creams, etc. It has even entered many ethnic foods like burfi, shrikhand etc. Chocolate has a history of almost 3400 years and was consumed as beverage by Central American people including Maya and Aztecs. Ancient Mayans and Aztecs associated chocolate with their gods and goddesses of fertility and so they called it Food of the Gods. Early chocolate products were beverages rather than solid sweets. Even fermented alcoholic drinks prepared from it were consumed. After the Spanish conquest of Aztecs, chocolate was brought to Europe and the rich started drinking chocolate beverage.

Famous British physician Hans Sloane in Jamaica came across a drink made of cocoa enjoyed by locals. He made it more palatable by mixing it with milk, thus making the first milk chocolate beverage. This recipe was eventually acquired by Cadbury Brothers who then started manufacture in the 19th century. The industrial revolution enabled separation of cocoa butter and cocoa powder, so various different products including the most popular chocolate candy were made from the various ingredients. As cocoa plantation was possible in other parts of the world besides Central and South American places, especially in Africa, and large manufacturing units started producing chocolate based products, these were then affordable by common people too.

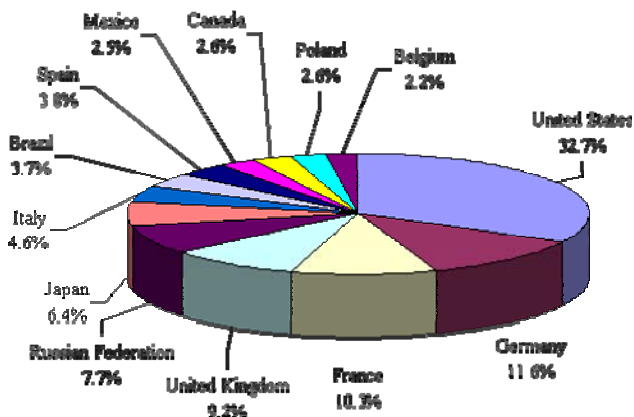
Production of Cocoa Beans and Chocolate Products

Cocoa beans are grown mainly in West Africa, Central and South America and Asia with Côte d'Ivoire (Ivory Coast, 38%), Ghana (21%) and Indonesia (13%) being top producers out of the world cocoa bean production of over 3.5 million tones in 2005-06.



Cocoa Bean Production 2005-06 (UNCTAD)

Whereas cocoa is grown mostly in developing countries, consumption is mostly in industrialised countries. Cocoa beans are procured by processors and chocolate manufacturers in consuming countries. Following chart gives consumption by different countries.



Consumption pattern in 2004-05 (UNCTAD)

Global chocolate sales in 2006 were US \$ 74 billion according to the International Cocoa Organisation representing a 20% increase over 5 years. Of the total, 27% sales were for chocolate covered snack bars, 23% for solid moulded bars or tablets, and 20% for boxed chocolates often sold as gifts. About 14% were sold as bagged or boxed products like M&Ms or Gems, 11% for seasonal theme items like Easter eggs, 3% for chocolate with toys and 2% for regional specialities. Western Europe consumed maximum chocolate products (45%) compared to the US (20%). Following table gives idea of how much chocolate is consumed per capita in different countries in 2005.

- Germany ... 11.12 kg
- Belgium ... 11.03 kg
- Switzerland ... 10.74 kg
- United Kingdom ... 10.22 kg
- Austria ... 9.43 kg
- Norway ... 8.53 kg
- Denmark ... 7.74 kg
- France ... 6.78 kg
- Finland ... 6.77 kg
- Sweden ... 6.76 kg
- United States ... 5.58 kg
- Australia ... 5.31 kg
- Italy ... 4.26 kg
- Canada ... 3.90 kg
- Poland ... 3.67 kg

Although per capita consumption in the US is not very high compared to Europeans, it is the largest chocolate market. Here the gourmet chocolate products have increased by 28% as consumers are increasingly buying premium chocolates, including dark chocolate bars, chocolate covered strawberries, cherries, nuts and pretzels. Current per capita Russian consumption is only 2kg with preference for dark and bitter-sweet, it has strong potential for growth in gourmet products. Countries like China and India are showing huge international market potential especially for gourmet chocolate.

According to a study by AC Nielson, chocolate market in India is estimated at Rs. 1500 crores and growing at 18-20%. Per capita consumption is just 300gram but over 70% consumption is in urban markets. Euromonitor estimated Indian candy market to be currently at US \$ 664 million of which 70% (US \$ 461) is sugar confectionary and the remaining US \$ 203 million is chocolate confectionery. Traditional Indian sweets, mithai, is getting substituted by chocolates among well-to-do. Range and variety of chocolates is growing with designer chocolates becoming status symbols. Indian palate is now accepting dark chocolates which had negligible market in the past. India also started cocoa cultivation in south and produced 8000 Tonnes cocoa valued at over 6 million dollars in 2005.

Processing Cocoa Beans

Cocoa trees (more correctly cacao trees) are small and grow naturally in areas near the equator because of their fastidious requirements of plenty of rains and warm temperature. There are two main varieties of beans used in chocolate namely Criollo and Forastero. Criollo beans are rare and very expensive and account for a very small portion of total bean production. They are mostly grown in Central and South America. They have a fine, mild and rich aroma and are used in high quality chocolate and for blending. Most common bean is Forastero which is hardier and giving higher yield. African beans are almost all Forastero. Trinitario is a hybrid of Criollo and Forastero originated in Trinidad and may be considered as the third variety also producing lower grade beans.

Cacao pods, the multicoloured fruits with woody exterior, are harvested and the beans with the surrounding pulp are removed from the pods and fermented in piles or in bins using naturally present microbes. Although beans are fermented to remove the adhering pulp and to prepare beans for drying, fermentation produces acid and heat that promote changes in taste and colour within the beans that are essential in proper development of chocolate flavour and colour during roasting. After fermentation beans are dried in sun for about a week before sending to processing unit.

Chocolate manufacture begins by cleaning the beans to remove stones, string, chaff, broken or hollow beans and shell by using air stream to remove lighter particles from beans. The beans are then roasted to develop flavour and colour of chocolate and to remove moisture. Roasting is carried out in roasters that are commonly rotating drum type at temperatures around 130 - 150°C. After roasting the shell becomes brittle and can be easily separated from nibs inside when beans are broken. Again air separation is used to remove lighter shell particles from heavier nibs. Nibs contain 51 to 56% fat or cocoa butter contained in cellular structure in nibs. When the nibs are ground the structure disrupts and heat of the grinding melts fat resulting in chocolate liquor. The liquor is ground fine enough to release the fat but coarse enough to easily separate fat from the cocoa solids. Chocolate liquor can be used to make various chocolate products or it is separated into cocoa butter and cocoa solids to vary the proportion of these in different products. Dutching or alkalizing is a process given to chocolate liquor or cocoa to darken colour and make the flavour milder. Cocoa butter and powder are separated using large steel filter screen presses. Dutched cocoa butter needs deodourisation.

Chocolate Manufacture

Chocolate liquor is mixed with cocoa butter in different amounts to make different types of chocolates. Dark or semi-sweet chocolates contain sugar, cocoa butter and chocolate liquor and may be vanilla. For milk chocolate milk or milk powder may be used in addition while white chocolate contains all ingredients for milk chocolate except chocolate liquor. Higher proportion of chocolate liquor gives darker and more expensive chocolates. Some cost reduction may also be done by using cocoa butter substitutes. Various ingredients

are blended using mixing and grinding to produce a homogeneous mass coating all solid particles with fat. This may require melangeurs with heavy rollers to do adequate mixing and grinding when nibs are used.

Refining is the next operation after mixing that obtains proper particle size. This operation uses rolls between which the chocolate mass passes through. Both sugar and chocolate liquor particles are reduced in this operation to desired sizes. Conching is the next process in which develops final chocolate flavour and also gives a smooth texture by reducing the particle size so small that tongue cannot detect it and fully coating each particle with fat.

The chocolate mass is then subjected to tempering. If it is cooled rapidly to low temperature, then many different forms of crystals form including some unstable ones. These would then slowly form more stable crystals during storage changing to uneven, mottled and matte appearance rather than smooth and shiny. This defect is called fat bloom. To avoid this, chocolate mass is first heated to about 45°C to melt all types of crystals and then cooled to about 27 or 28°C which allows only stable crystals to form. The mass is agitated to promote many desirable crystals to form at this temperature. There is likelihood of some unstable forms of crystals forming so it is reheated to around 31 to 32°C to melt them. Thus tempered chocolate is ready.

Chocolate may be moulded into various shapes or sizes and further cooled. If during subsequent period of processing or storage it gets too hot, the temper may be lost and again tempering may have to be carried out. Holding the chocolate mass at correct temperature is critical as it should be warm enough to be soft and pliable to be moulded but temperature should not be too high to lose the temper. After moulding the chocolate must also be stored at lower temperature or else crystals will melt together with loss of temper and cooling again may cause fat bloom.

Types of Chocolate	
Baking Chocolate	Pure cocoa liquor with nothing added
Semisweet Chocolate	Pure cocoa liquor with extra cocoa butter and some sugar
Milk Chocolate	Pure cocoa liquor with extra cocoa butter, sugar and milk solids; more milk than chocolate liquor
White Chocolate	Cocoa butter with sugar and milk; no cocoa bean solids

Composition of Chocolate

Nutrition Facts

The presented values are based on a selection of brands. Variations outside the given ranges can be expected. (Numbers are % by weight, not % of daily value).

Ingredient	Cocoa - low fat (European type)	Cocoa - high fat (Breakfast cocoa)	Unsweetened chocolate	Bittersweet chocolate	Semisweet chocolate and baking chocolate
Fat	10-15%	20-25%	45-55%	33-45%	20-35%
Carbohydrates	45-60%	45-60%	30-35%	20-50%	50-70%
Sugars	0-2%	0-2%	0-2%	13-45%	45-65%
Dietary fibre	20-35%	30-35%	15-20%	5-8%	3-8%
Protein	17-22%	15-20%	10-15%	5-10%	3-8%
Calories per 100 g	ca 200	ca 300	470-500	500-550	450-550

From: Cocoa Web (<http://www.cacaoweb.net/nutrition.html>)

Milk Chocolate – Nutrition Facts

Serving Size 1 bar (43 g)	
Amount Per Serving	%DV *
Total Calories 210	
Calories from Fat 110	
Total Fat 13 g	20%
Saturated Fat 8 g	40%
Cholesterol 10 mg	3%
Sodium 35 mg	1%
Total Carbohydrate 26 g	9%
Dietary Fiber 1 g	4%
Sugars 24 g	
Protein 3 g	6%
Vitamin C	0%
Calcium	8%
Iron	2%

From: <http://www.hersheys.com/products/>

Chocolate & Health

While chocolate is consumed for pleasure, there are potential health benefits of eating chocolates. There are reports that cocoa or dark chocolate benefits the circulatory system because of the substance epicatechin. This flavonoid has strong antioxidant property and helps modestly lower blood pressure. However, this benefit is very less in milk chocolate and none in white chocolate.

Health benefits of chocolate

Studies have suggested that cocoa or dark chocolate may have beneficial effects on human health. Cocoa contains flavonoid epicatechin having a significant antioxidant action. Studies have shown a modest reduction in blood pressure after daily consumption of dark chocolate. Milk or white chocolate does not possess this ability. Dutch process or alkalization reduces flavonoids and also reduces this beneficial effect. Cocoa butter does not seem to elevate the LDL cholesterol in blood, thus dark chocolate consumption seems to be beneficial.

In a study using ultrasound, eating a bar of dark chocolate seems to improve flexibility of blood vessels which helps prevent hardening of arteries leading to heart attacks. The effect was temporary and it is not known whether regular consumption of dark chocolate would result in reduction of cardiovascular disease. Also experts caution that eating too many chocolates would cancel out the apparent benefit due to sugar and other fat in them.

Recent studies conducted in the US and Europe seem to support chocolate's beneficial effects on cardiovascular system encouraging chocolate manufacturers to develop proprietary methods of processing cocoa beans aimed at preserving flavonoid content as traditional methods of fermentation and roasting seem to destroy $\frac{3}{4}$ of these compounds. New chocolate products containing such beans with higher flavonols have been shown to lower total and LDL cholesterol are offering chocoholics a healthier, low-fat alternative to high fat chocolate bars.

Chocolates are often associated with mood elevation and sensual feeling. Sweet and fatty nature may stimulate hypothalamus inducing pleasurable sensations which is also due to some increase in serotonin levels. Cocoa also has alkaloid theobromine, partly responsible for mood-elevating effect. Chocolates also contain unsaturated N-acyl-ethanolamines that might give heightened sensitivity. However, there is no firm proof of their being aphrodisiac although chocolates are common in courtship ritual.

Among other benefits, cocoa flavonoids may possess anticarcinogenic mechanism reducing the risk of cancer. Preliminary studies also suggest that chocolate may boost memory, attention span, reaction time and problem-solving skills by increasing blood flow to the brain. Some studies have also suggested that specially formulated cocoa may delay brain function decline in elderly people. Recently a small study also showed that cyclist drinking chocolate milk scored better on fatigue and endurance tests showing that chocolate may help recover after a hard workout.
