

Stimulating Beverages

Coffee, Tea, Chocolate

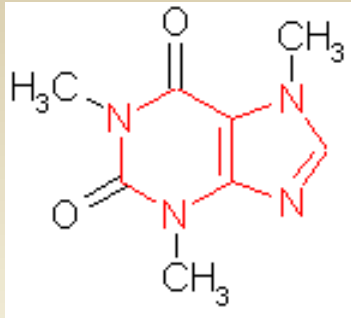


Caffeine Drinks

- Beverages that contain caffeine or purine derivatives, are used world wide for their stimulating and refreshing qualities.
- Caffeine is an alkaloid that is a diuretic and nerve stimulant
- Tea originated in southeastern Asia
- Coffee originated in Ethiopia
- Cocoa from tropical America
- Lesser known stimulants
 - Cola – south Africa
 - Khat – Arabs
 - Mate – South America

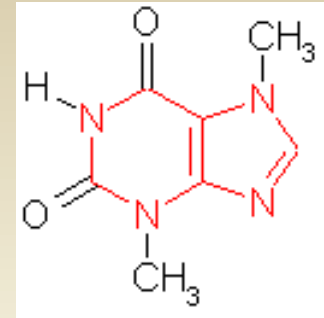


Caffeine and Theobromine – Mild Stimulants



caffeine

- alkaloids (note N, ring structure)
- “methylated xanthines” = methylxanthines



theobromine

Effects of Caffeine:

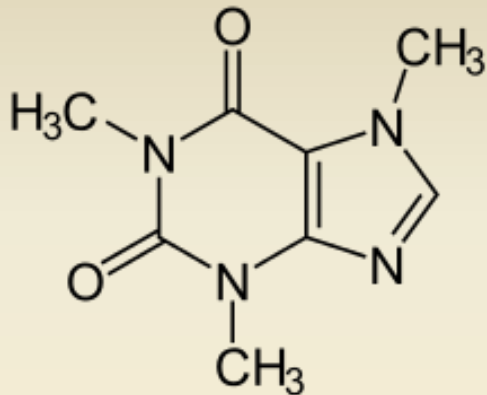
- central nervous system stimulant
- mild diuretic

Mode of action:

- interferes with enzyme, so that adrenaline remains active => alert feeling
- blocks adenosine receptors => inhibits sleep signals

Note: latter activity also interacts with dopamine receptors

Caffeine



- The world's most widely consumed psychoactive drug
- In North America, 90% of adults consume caffeine daily



Table 16.1 Caffeine Content of Common Products

Product	Caffeine Content
Coffee	
Drip (5-ounce cup)	115 mg (60–180 mg)*
Instant (5-ounce cup)	65 mg (30–120 mg)*
Decaf (5-ounce cup)	3 mg (1–5 mg)*
Espresso (1.5–2 ounce cup)	100 mg
Tea	
Brewed (5-ounce cup)	40 mg (20–90 mg)*
Cocoa	13 mg
Soft Drinks (12-ounce serving)	
Coca-Cola	34.5 mg
Diet Coke	46.5 mg
Dr. Pepper	39.6 mg
Mr. Pibb	40.8 mg
Mountain Dew	55.5 mg
Mellow Yellow	52.5 mg
Pepsi-Cola	37.5 mg
RC-Cola	36.0 mg
Diet Rite	36.0 mg
Surge	52.5 mg
Jolt Cola	71.5 mg
Water Joe	45.0 mg
Krank2O	70.0 mg
Red Bull	120.0 mg
Over-the-Counter Medications (per tablet or caplet)	
Excedrin, Extra Strength	65 mg
Anacin	32 mg
NoDoz	100 mg
Vivarin	200 mg
Midol	60 mg

*A range in caffeine content occurs because of variation in brewing time and strength.

Health Effects of Caffeine

Most widely used psychoactive drug

- small amounts -> no long term effects have been noted
- even small amounts taken regularly can produce withdrawal if stopped (often manifested as headaches)
- large amounts -> adverse symptoms such as anxiety, insomnia
- dose-dependent, so that has greater effects on young, unborn

NOTE: current recommendations, pregnant women should reduce or eliminate caffeine consumption during pregnancy

- addictive, withdrawal symptoms, headaches
- effects on other animals can be different, e.g. dogs, cats, birds

Major Plant Sources of Caffeine

Coffee – *Coffea arabica* and related species

Tea – *Camellia sinensis*

Chocolate – *Theobroma cacao*

Other sources of caffeine:

- Mate, *Ilex paraguariensis*
- Guaraná, *Paullinia cupana*
- Kola, *Cola nitida*

Coffee



Coffee, *Coffea arabica* or *C. canephora* (Rubiaceae)

- The dried, fermented fruits of *Coffea arabica* or *C. canephora* (Rubiaceae)
- Second only to petroleum in the value of the material traded annually on the international market.

Coffee - *Coffea arabica*



Coffea – member of Rubiaceae

- Shrubs

- Fruit = berry (called a bean)

- Pericarp, seed coats removed
=> seed used (not a bean!)





Costa Rican Coffea: Gold Bean

Arabica = *Coffea arabica*

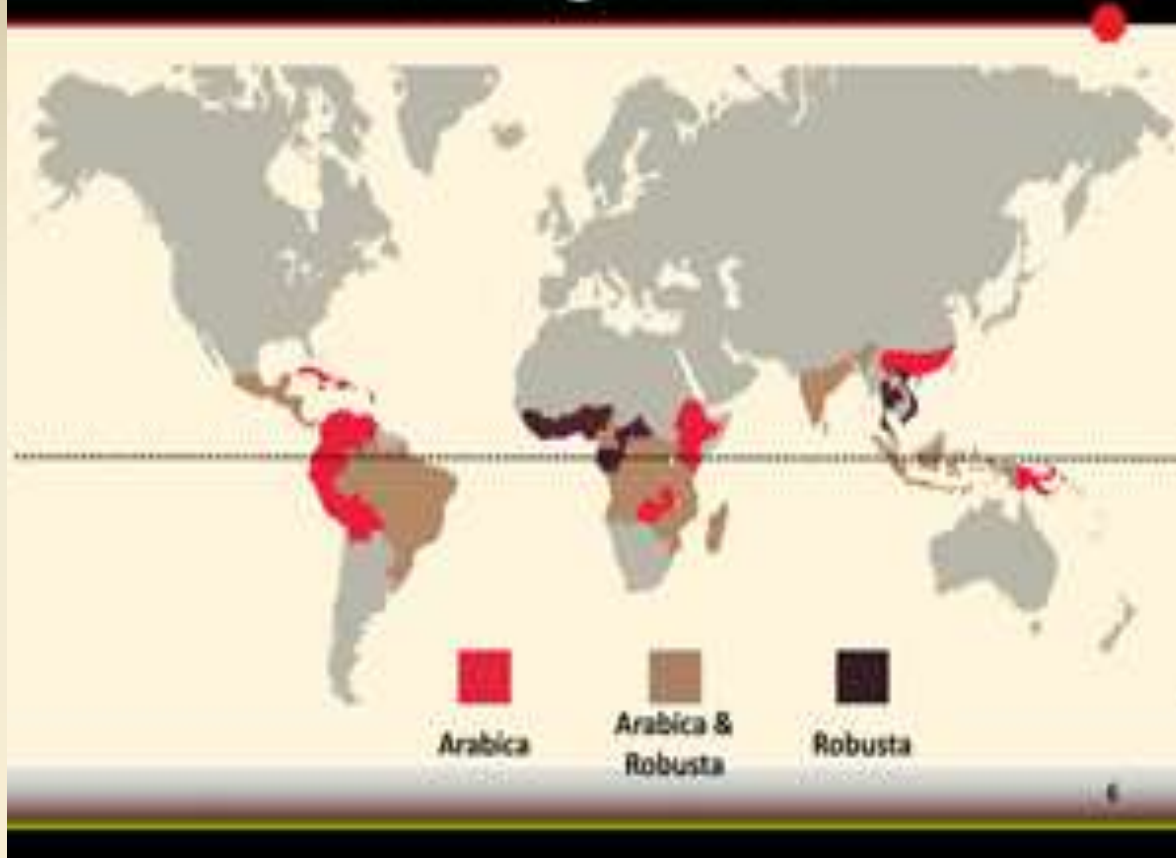
- Accounts for about 90% of world's trade in coffee.
- Harder to grow.
- Higher elevation, “mountain grown”
- Has the best flavor.

Robusta = *Coffea canephora*

- Accounts for about 9%.
- Flat, neutral taste. Higher caffeine
- More productive, hardier plants. Low elevation.
- Used to make instant coffee, cheap ground coffee.
- Preferred in some parts of Africa.

Coffea liberica accounts for about 1%.

Arabica and Robusta Producing Countries



Robusta: 1.8 – 4.0% caffeine,
Arabica: 0.9-1.4% caffeine



Coffee Cultivation - Shade

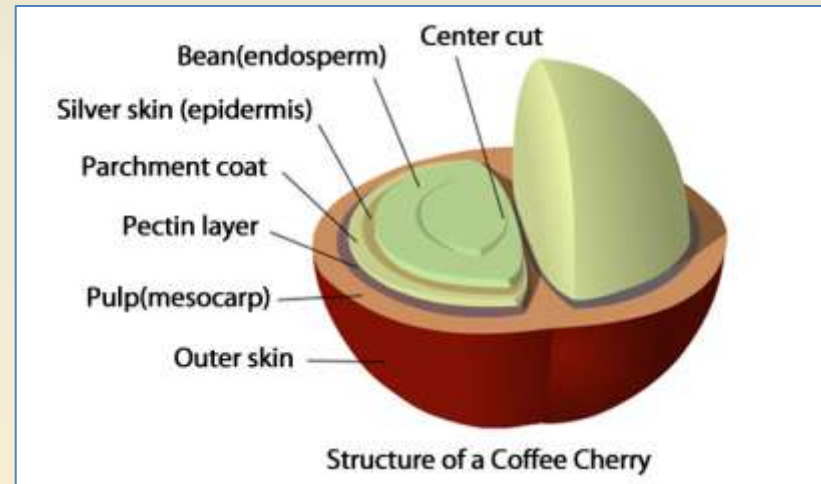


The plants are often shaded in plantations, but open orchards are used as well. Many of the shade trees are legumes and fix nitrogen

Coffee “Bean” is a Berry

The coffee fruit is a berry, sometimes called a “cherry”

The “bean” is the interior of the seed, with the seed wall removed



Hand-picking selects the best quality fruits

Coffee “Beans”



Coffee Pickers in Jamaica



Coffee Processing - Dry Method



Dry Process - fruits are dried in the open while pulp ferments, and the husk is rubbed off mechanically.

Coffee Processing – Wet Method



Wet Process - fruits are thrown into pool, bad fruits float and are removed, pulping machine removes husk, residue on beans allowed to ferment for 24 hours..

Coffee Drying



Coffee Roasting



Coffee Roasting



Coffee Roasting Stages



1. City/Light (first crack, a volatile sound of the beans cracking, has finished)
2. City+/Medium (shortly after first crack is complete)
3. Full City/Medium Dark (second crack is about to happen at any moment)
4. Full City+/Dark (the first few moments into second crack, a quieter snapping sound)
5. Vienna/Light French Roast/Very Dark (second crack is happening) – (if roasted any darker, the coffee would taste burnt and bitter)
6. French Roast/Extremely Dark (second crack is almost done)

Coffee Grinding and Brewing



Coffee originated in Ethiopia, taken to Yemen by Arabs, taken to Java by Dutch, then taken to Europe by Dutch, then to Americas.

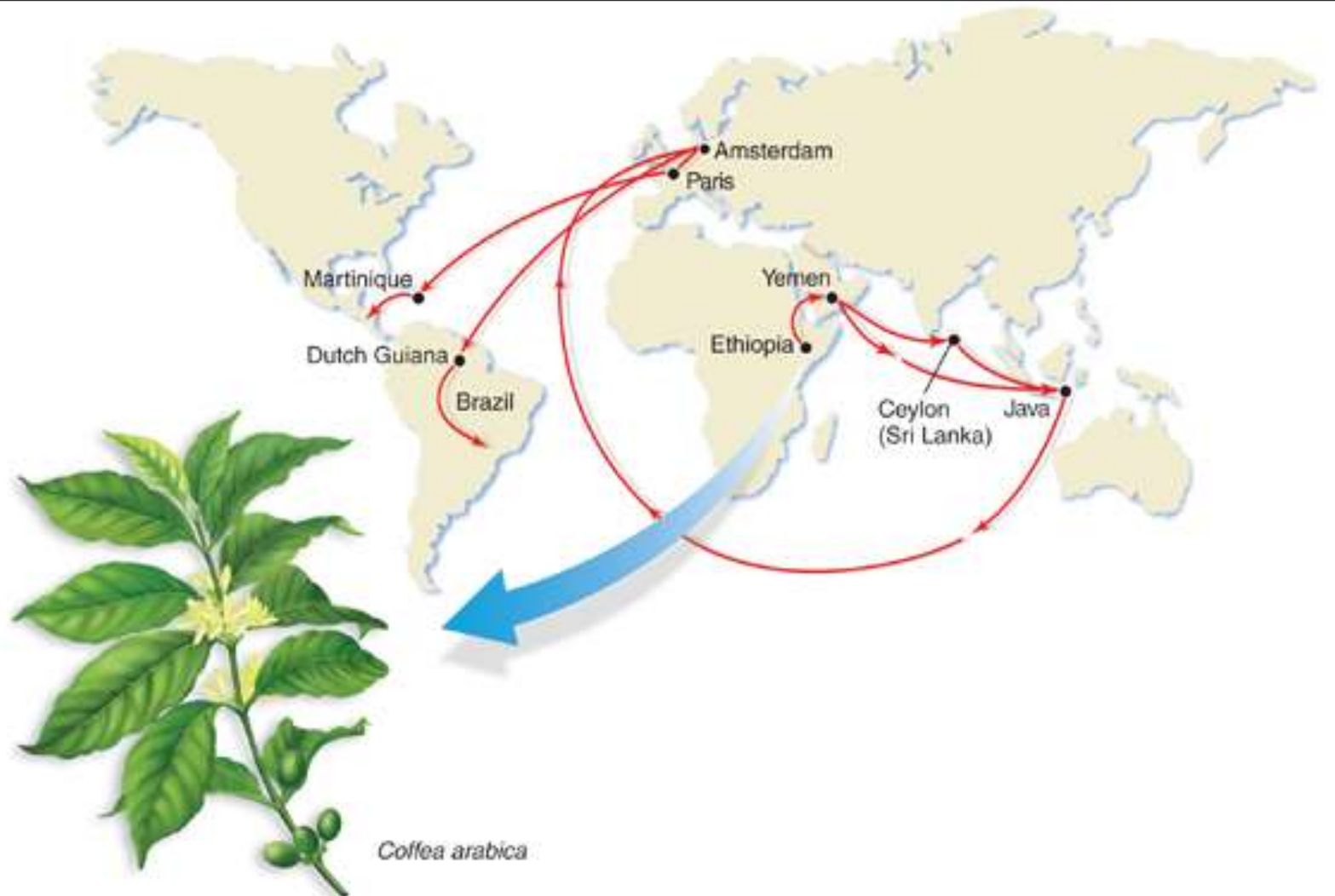


Figure 16.1 *Coffea arabica*, native to the mountains of Ethiopia, was spread through many tropical areas. Plantations became well established in the New World early in the eighteenth century.

Coffeehouses



Figure 16.2 The London Coffee House, opened in the 1750s, was a major center of mercantile and political life in Philadelphia during the colonial period.

Coffee Issues

1. Pollution

- processing of coffee requires large amount of water

2. Disease

- fungal diseases wiped out coffee production in Sri Lanka (Ceylon) completely, switched to tea.
- fungal diseases still threaten crops in Brazil and other places

3. Shade vs. sun coffee

- traditionally, coffee grown under shade coffee plantations preserve biodiversity, open sun yields more beans

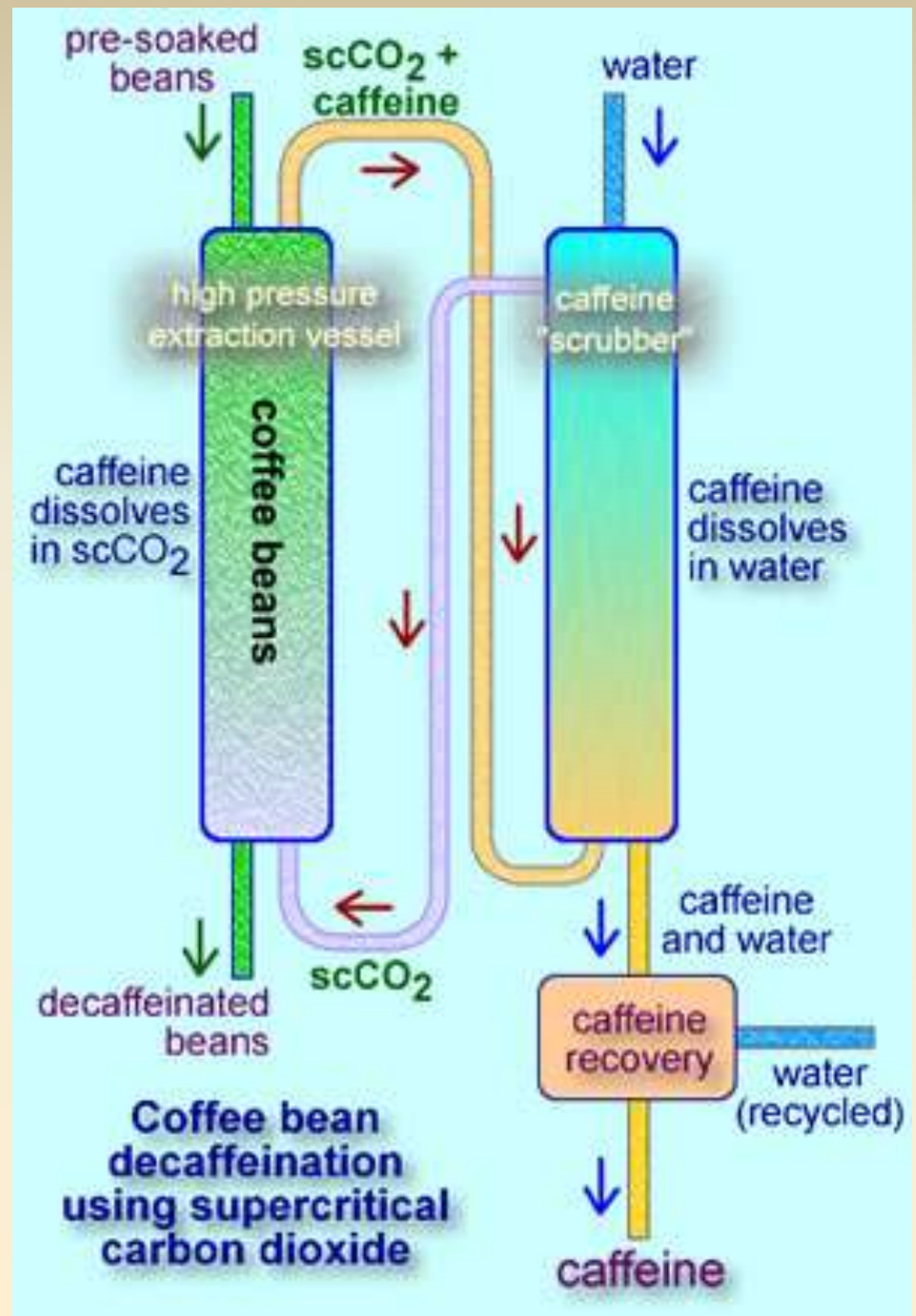
4. Decaffeination – solvent vs. water extraction vs. CO₂ CP

- solvent extraction, caffeine recovered, sold

De-caaffeinated Coffee



- Solvent extraction
Methyl acetate
Ethyl acetate
- Supercritical CO₂ Process



Fair Trade Coffee



- Fair trade means a fair price for products
- Focuses on requiring companies to pay prices at or above market price
- A worker receives a price on their goods that allows them to make a decent living



<http://www.fairtrademag.com/>

Coffee YouTube Videos

A Day in the Life of a Coffee Farmer.mov

<https://www.youtube.com/watch?v=frbSo59xGkw>

Meet Atandi: a Coffee Farmer in Kenya

<https://www.youtube.com/watch?v= ebTi2KSRuM>

On the Farm: Coffee Farming in Uganda

<https://www.youtube.com/watch?v=E6oXx8hZojA>

India Coffee Tour - Part I

<https://www.youtube.com/watch?v=Tc8asXSKxF4>

India Coffee Tour - Part II

<https://www.youtube.com/watch?v=DB3bclYKuCg>

Coffee Production Process

<https://www.youtube.com/watch?v=SvBj4O44Fnw>

How coffee is made

<https://www.youtube.com/watch?v=FcV2GJOAEbI>

Fair Trade: Every Purchase Matters

<https://www.youtube.com/watch?v=7K4G5-ydhS0>

How To: Secrets of a NYC Coffee Roaster

<https://www.youtube.com/watch?v=akAO0fK2-vI>

Coffee Roasting Basics - Color Changes

<https://www.youtube.com/watch?v=aYy47C0Xw0I>

All about how to make a good coffee with Gwilym

https://www.youtube.com/watch?v=M-l_F2CBELo

27 Drinks Made From Coffee

https://www.youtube.com/watch?v=CeTyXKanY_4

Coffee Around The World

<https://www.youtube.com/watch?v=aBLYSO0DSVI>

Tea



Tea – Beverage of the World

Camellia sinensis – Theaceae
Shrub, native to China



Tea, *Camellia sinensis*, Theaceae

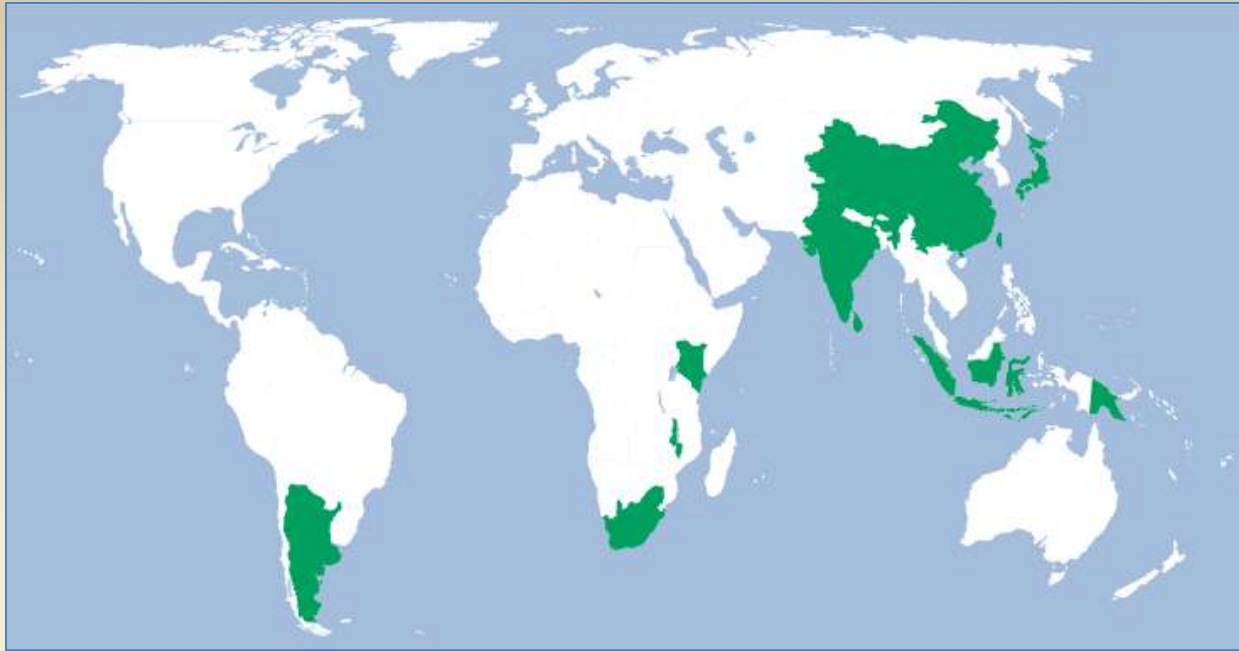
- Tea is drunk by a larger number of people than coffee, but does not have as high dollar value.
- Most tea is consumed locally and comparatively small quantities enter international trade.

Tea – In the Field

- Tea Shrubs are grown in large plantations
- Picking is done by hand – only the shoot tips are taken



Where Tea Comes from



- The exact origin of tea, *Camellia sinensis* (Theaceae), is obscure, but the plant appears to have arisen in China.
- The first book on tea was written in 780 B.C. Tea came to Japan in 593 B.C.
- The Mongols got tea from the Chinese and traded it across Asia. The Russians got tea in this way.

Tea harvesting in Sri Lanka



Courtesy Dr. Guido Holzkamp

- Europeans first got into tea when the Portuguese brought it back from China.
- In the 1700's tea had become an important item of trade. Both the British and Dutch bought tea in the Orient and sold it in Europe.
- People drank tea predominately in the English colonies in America until the Boston Tea Party; then coffee became a more popular beverage.
- Tea is of course still very popular in England.

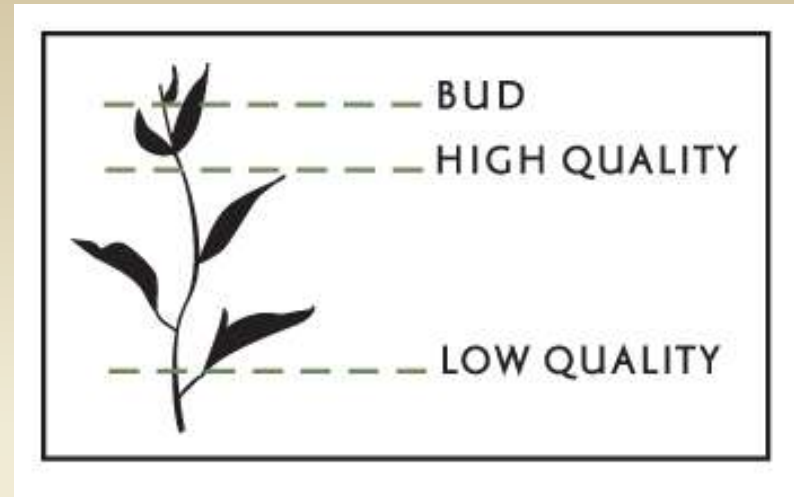
Tea harvesting

- During harvesting, only the top 1-2 inches of the plant are picked.
- These buds and leaves are called “flushes.”
- A plant will grow a new flush several times during the growing season.
- The flavor of the tea leaf changes with each flush throughout the summer and into fall.
- The best teas typically come from the 1st or 2nd flushes



Tea harvesting

- High quality tea is made from the bud and/or 1st set of leaves on the tea plant during the 1st and 2nd flush.
- Mass-produced teabags are made from the older, coarser leaves of late season harvests.



Tea bag invented in 1904

Tea Types

- Black tea – leaves are withered, rolled, fermented, dried; strong. 90% of tea in U.S.
- Green tea – leaves are steamed (destroys fermentation enzymes), dried, and rolled; weak
- Oolong tea – intermediate between black and green – short fermentation
- White tea – leaves are dried only; weak



White Tea



Green Tea



Oolong Tea



Black Tea



White tea is made from baby tea leaves and is the rarest and least processed of all tea varieties. Buds and leaves have white hairs.

As a result of minimal processing, green tea retains its natural appearance and vibrant color as well as high levels of the plant's healthy properties.

In-between green and black. During production, leaves are lightly bruised. The outer part of the leaf is allowed to oxidize, but the center is kept green.

Leaves are withered until they are pliable, rolled, releasing juices and enzymes that react with oxygen. The bruised and sticky leaves are spread out and begin to turn brown

Tea Processing - Plucking



Tea Processing - Withering



Tea leaves begin to wilt soon after picking. This process is called withering, and is used to remove excess water from the leaves and allow slight oxidation.

Tea Processing - Rolling



Rolling shapes the leaves brings out all the juices. The damp tea leaves are rolled and shaped by hand which causes the important oils and juices inside the leaves to ooze out - which enhance and better the taste.

Tea Processing - Drying



Tea leaves are heated very carefully to stop the oxidation process and seal the natural flavors till the tea is brewed in during actual preparation. The drying process is responsible to finish the creation of the new compounds for flavor - especially important in green tea. This job must be done with great skill and care

Boston Tea Party



Figure 16.5 Currier and Ives lithograph from 1846 depicts the destruction of tea during the Boston Tea Party.

- Tea Act of 1773. British didn't have to pay taxes on tea.
- Taxation without representation.
- Led to declaration of Independence

How to Make Tea

BASIC DIRECTIONS:

1. Bring fresh, cold water to a rolling boil. Always start with the freshest, purest source of water available as this will heavily impact tea's flavor ... it is the main ingredient, after all!
2. Add tealeaves to a teapot, fill-your-own teabag or infuser basket. Use 1 teaspoon – 3 teaspoons (1 tablespoon) per cup (8 oz) of water depending upon desired strength. Adjust to taste.
3. Pour boiling water directly over black, oolong and herbal tea. Allow water to cool slightly before brewing green tea, white tea or yerba maté. Cover.
4. Infuse (steep) leaves for 2-5 minutes; 3.5 minutes is a good standard steep time that works well for most teas. Do not oversteep or tea may become bitter. If you prefer strong tea, do not over steep; simply use more leaves.
5. Remove tea sachet, bag or infuser from water or strain leaves. ENJOY!

Japanese Tea Ceremony



Famous Teas

- Earl Gray – bergamot oil added, favorite British tea
- Darjeeling is a blend of light teas from the Darjeeling region of India
- Lipton Tea – blend of 20 different teas.
- Jasmine Tea – addition of jasmine blossoms



Charles Grey was Prime Minister of England from 22 November 1830 to 16 July 1834. Not only was he Prime Minister, he was an Earl.

Thomas Lipton opened a series of stores in 1880s, became chain, purchased tea gardens in Ceylon. Big hit in U.S.

Tea YouTube Videos

How It's Made - Tea

<https://www.youtube.com/watch?v=jaHrUfRjmqE>

How tea is made - the whole process! India

<https://www.youtube.com/watch?v=ZJFaYKEDle4>

How Tea is Processed

<https://www.youtube.com/watch?v=m6yiKKXR2o>

Tea Harvest and Processing in Doi Mae Salong, North Thailand

<https://www.youtube.com/watch?v=dPIBfjVJKTk>

Traditional Japanese Tea Ceremony

<https://www.youtube.com/watch?v=IL9BiNuImws>

Tea Ceremony Explained

https://www.youtube.com/watch?v=K6_KC3OuZEK

Japanese Tea Ceremony

<https://www.youtube.com/watch?v=K4t4s8P1uVE>

Chocolate



Food of the Gods



Theobroma cacao – Malvaceae
(formerly Sterculiaceae)

Understory tree, native to New
World



Chocolate Tree and Pods

Cauliflorous tree



Chocolate Pods



Two Main Varieties:

- Criollo (“native”) – best quality, worst yield, worst disease tolerance
- Forastero (“foreign”) – worst quality, best yield, best disease tolerance

Cacao Flowers and fruit



A typical pod has 20 to 50 cream-colored beans.



Pulpy seeds are scooped out and allowed to ferment to develop flavor, then dried

Cacao fruit, *Theobroma cacao*, Malvaceae



Courtesy Axel Walther

Chocolate Chemistry

Caffeine – less than coffee (chocolate bar 30 mg; cup coffee, 100 mg)

Theobromine – stimulates heart muscle

Phenylethylamine – reputed to be “mood elevator”, antidepressant

- found in brain; low levels linked to depression; chocolate contains low levels of PEA; knowledge of chemistry still incomplete

Chocolate Myths:

- chocolate does not cause acne
- chocolate is not a trigger for migraines
- chocolate is probably not an aphrodisiac

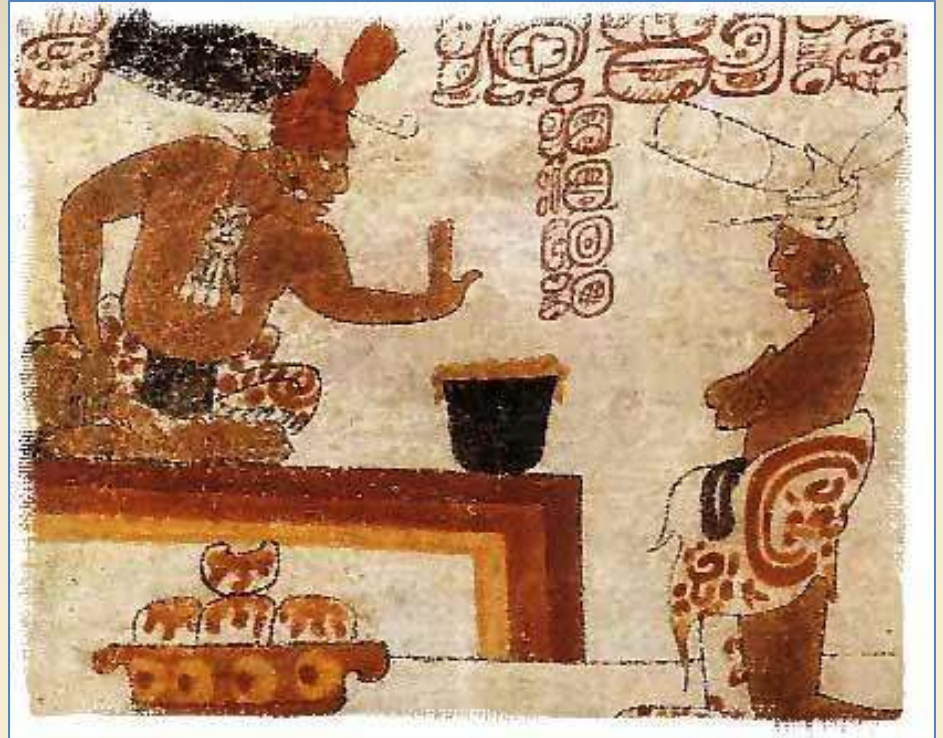
NOTE: chocolate “craving” is probably real; reasons, mechanism are unclear

Origin in Amazonia, Central America

Chocolate – from Aztec word *Chocolatl*



Aztec. *Man Carrying a Cacao Pod*,
1440–1521.



Maya lord forbids a person to touch a
container of chocolate.

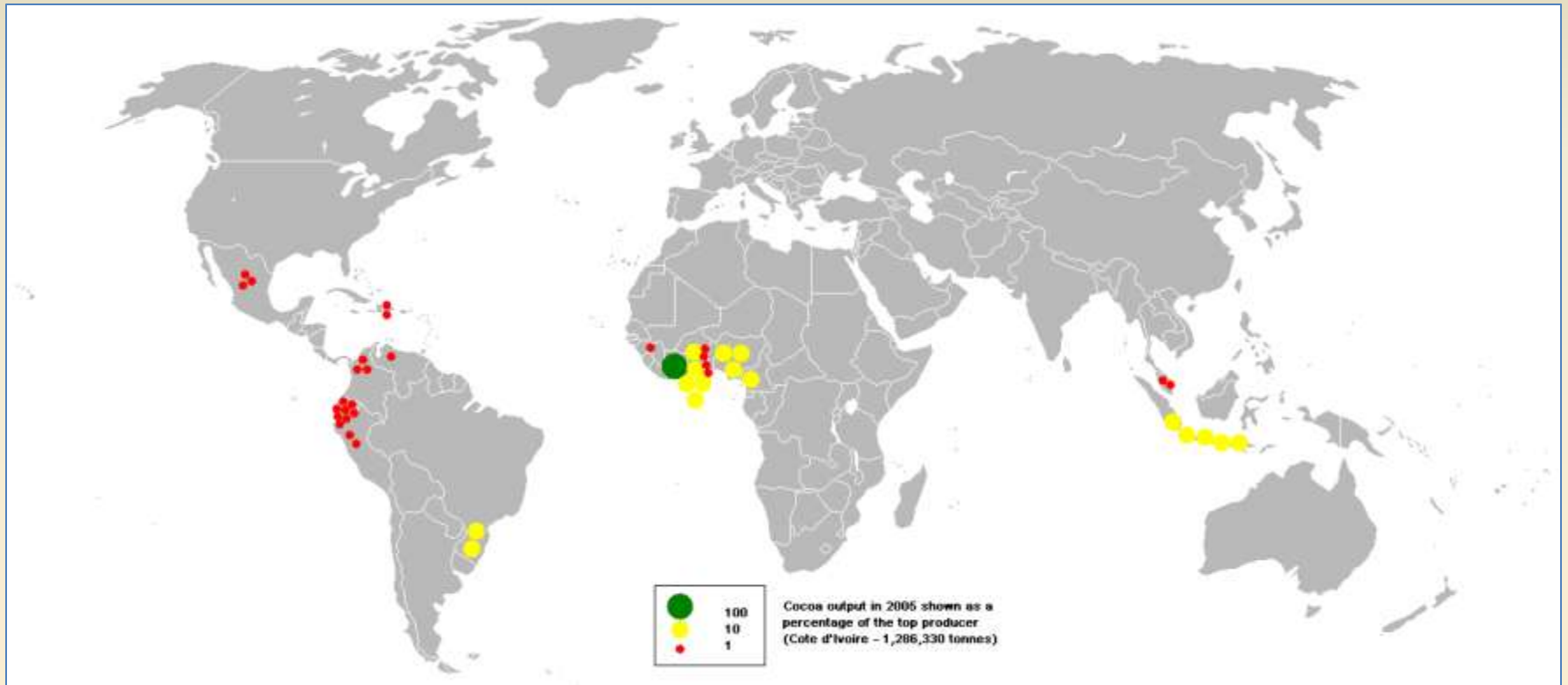


Figure 16.6 The Aztec god Quetzalcoatl, envisioned as a plumed serpent, was believed to have given cacao beans to the Aztec people.

Cocoa Producing Countries



Cacao - the Tropical Crop



Cacao Plantation - Harvest



Harvested Pods

Scooping the beans



The pods are cut from the trees and sliced open manually using machetes.

Harvesting the beans from the pod



Cacao - Processing

1. Seeds are spread out and allowed to ferment
2. Fermented seeds are dried and roasted
3. Seed coats are removed
4. “Nibs” are ground, which produces a thick liquid called chocolate liquor (non-alcoholic)
5. Chocolate liquor is fed through a high pressure press which separates the fat (cocoa butter) from the solids (cocoa powder)
6. The cocoa butter and cocoa powder can be recombined together with sugar or milk to produce chocolate

Cacao Bean Fermentation



The seeds are left to ferment; flavor develops, bitterness subsides, and cocoa beans are born. It is during fermentation that the cacao beans start to develop the typical cacao flavors.

Fermenting in the sun – no temperature control



Drying the beans in the sun



Drying can take place for 5 to 12 days, depending on the humidity, during which time the moisture content of the bean is substantially reduced.

Delivery of Cacao Beans



Chocolate YouTube Videos

Hershey's chocolate making process

<https://www.youtube.com/watch?v=0TcFYfoB1BY>

The Story of Chocolate

https://www.youtube.com/watch?v=VS0-_laKIRg

On the Farm: Growing Cocoa

<https://www.youtube.com/watch?v=JD8r02e9xn8>

Cacao Organic growing and harvesting

<https://www.youtube.com/watch?v=u4Laz4u1IU>

Guatemala: Chocolate Making Part 1 - Roasting Cocoa Beans the Traditional Way

<https://www.youtube.com/watch?v=qMaTJly1Vl8>

Guatemala: Chocolate Making Part 2 - Cracking the Beans and Extracting the Nib

https://www.youtube.com/watch?v=ny8o_D3CCY8

Guatemala: Chocolate Making Part 3 - Rolling the Beans Using a Metate

<https://www.youtube.com/watch?v=qMaTJly1Vl8>

Guatemala: Chocolate Making Part 4 - Adding Ingredients (Mayan bartender)

<https://www.youtube.com/watch?v=2-Yb-jS-dYw>

Making Chocolate

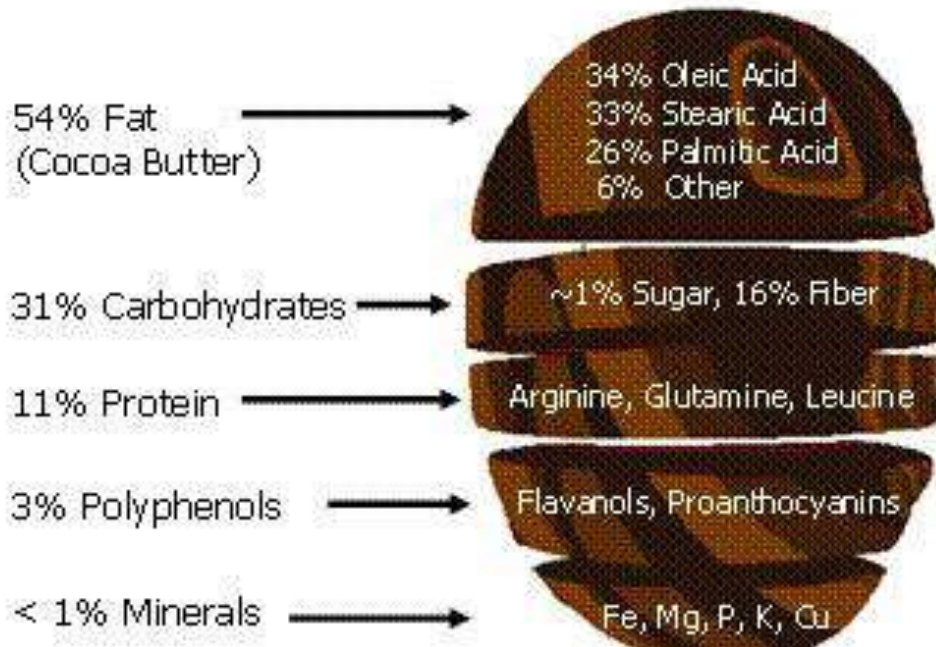
<https://www.youtube.com/watch?v=PXFLsqVgbY>

The Dark Side Of Chocolate

<https://www.youtube.com/watch?v=7Vfbv6hNeng>

Raw Chocolate

What's in the cocoa bean?



Nutrition Facts

Serving Size: 1 oz. (28 g)
Servings Per Container:

Amount Per Serving

Calories 170 Calories from Fat 120

% Daily Value*

Total Fat 13 g 20%

Saturated Fat 8 g 40%

Trans Fat 0 g

Cholesterol 0 0%

Sodium 20 mg 1%

Total Carbohydrate 9 g 3%

Dietary Fiber 9 g 36%

Sugars 0 g

Protein 4g

Vitamin A 0% • Vitamin C 0%

Calcium 2% • Iron 8%

*Percentage daily values based on a 2,000 calorie diet. Your Daily values may be higher or lower depending on your calorie needs.

Roasting Chocolate Beans



Once in the factory, the beans are roasted for a few hours at about 225 degrees which brings out the flavor (similar to toasting almonds or roasting coffee). Both dried and roasted beans don't taste very good... yet.

As for coffee, roasting is an important part of development of cacao flavor. The chocolate flavor only develops during this part of the processing. The seed coats are removed.



Cacao beans are then roasted, and then ground into non-alcoholic chocolate liquor.



The nibs are then ground under heavy stone which separates the colorless cocoa butter and the remaining cocoa liquor.

Cacao – Processing

- **Chocolate liquor** is intensely flavored, bitter – diluted with water and flavored it provides a drink – this is how Montezuma and other Aztec royalty would have consumed it, flavored with vanilla and chili pepper
- **Cocoa powder** contains the chocolate flavor – it can be darkened and the flavor intensified by treating with alkalization = “Dutching”
- **Cocoa butter** is the fat – it is tasteless but has the distinctive property of melting at about the human body temperature

Cocoa Powder

Chocolate liquor which has been ground to powder. The product is only contains a small amount of cocoa butter so it is inherently low in fat. Unsweetened cocoa powder is used for baking and for making hot beverages.



Natural
Very acidic, bitter

Dutch processed
alkali-treated
pH neutralized



- The English devised adding milk to cocoa as a beverage.
- The Swiss started adding milk to the cocoa to make milk chocolate. Cocoa butter is re-added to make the product more creamy.

Ingredients such as sugar and milk are added, and the liquid is conched (a mixing process that develops texture and flavour).



Figure 16.8 The conching process imparts smoothness to chocolate.

Finally, it is molded, packaged and distributed to a shop near you.



Figure 16.9 Far removed from the tropical cacao tree, these delectable chocolate confections gladden the heart of many “chocoholics.”

Chocolate – the Products

Unsweetened: Chocolate liquor +
cocoa butter, no sugar

Semisweet and bittersweet
– sugar added

-- mole sauce etc.



Milk chocolate – has milk solids + sugar + unsweetened chocolate

Chocolate crisis

Economics, Diseases, now we are consuming more than produced

By 2030, the world consumption is forecast to exceed production by 2 million metric tons

In 2013, the world ate roughly 70,000 metric tons more cocoa than it produced.



By 2020, the world is expected to consume 1 million metric tons more cocoa than it produces.

Price will probably continue to go way up

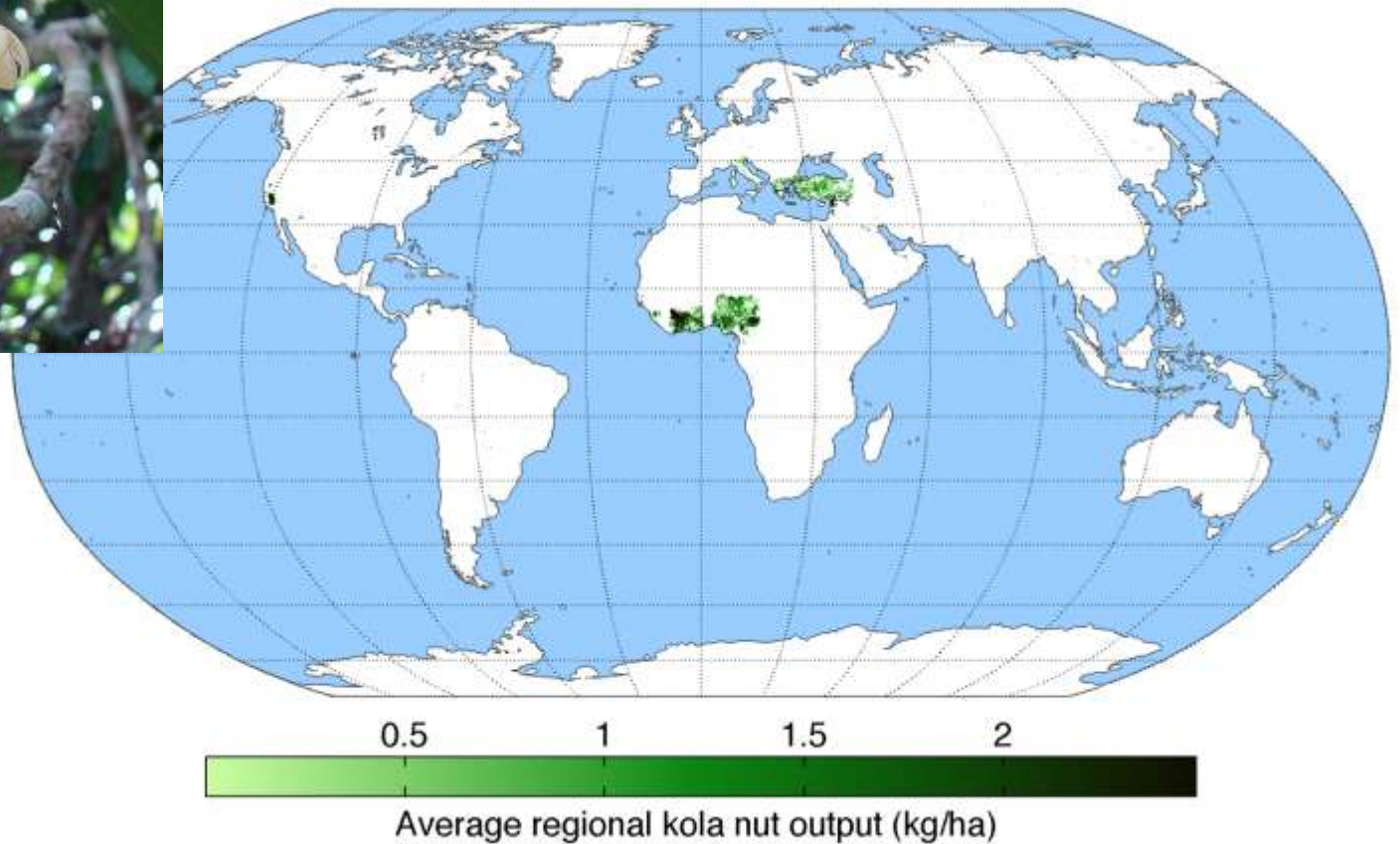
Other Stimulating Beverages

Kola Nut Tree - *Cola nitida*,

- Malvaceae (formerly Sterculiaceae), relative of cacao
- Used to prepare the flavor of cola beverages.
- The seeds of the plant are fermented in manufacture of the flavoring.
- Cola is native to West Africa where it has been used for a long time.



Kola Nut Tree, *Cola acuminata*



Kola fruits, *Cola nitida*



Knobby green pods of *Cola nitida*

Kola Nuts

- The pulp of the fruits is also eaten in many African countries.
- The seeds are dried and ground to make a beverage in West Africa.
- This plant also contains caffeine.



Kola Nuts



Coca Cola

Invented by John Pemberton,
Pharmacist, 1886

- Carbonated water
- Caramel coloring
- Kola nut extract
- Coca leaf extract (cocaine)
- Sugar
- Vanilla
- Cinnamon
- Lime juice
- Secret ingredients

1904 - Cocaine prohibited from soft drinks in U.S. Kola nuts not used anymore either



Yerba Maté

- *Ilex paraguariensis*, Aquifoliaceae, Holly Family
- Maté is a common beverage of southern South America.
- The Indians of much of South America used maté before Europeans arrived
- The leaves, small twigs, and stems are crushed and used to make a tea like beverage.
- Caffeine



Ilex paraguariensis, Aquifoliaceae



Yerba maté

- Maté is traditionally drunk from a gourd, or maté, filled with plant material.
- Hot water is added.
- The "straw" is called a bombilla.



Yerba Mate for sale in market Mercado de la Boqueria in Barcelona, Spain



Yaupon – *Ilex vomitoria*



Yaupon, Cassena - *Ilex vomitoria*



Yaupon – *Ilex vomitoria*

- *Ilex vomitoria*, native to the southeastern U.S.
- Aquifoliaceae, Holly Family
- Contains caffeine
- Used to prepare “black drink” and used ceremonially by Indians of Southeastern U.S.
- Limited use by Americans in Civil War
- Maybe making a come-back?



Native Americans made “Black Drink”, used ceremonially, involved fasting, tea and other herbs, vomiting, visions. But also used it everyday.

Shaman with shell cups
for drinking Black Drink
from *Ilex vomitoria*



Yaupon Holly, Black Drink, Ethnobotany YouTube
<https://www.youtube.com/watch?v=ztxYp6HBmyo>



Aucuba japonica *Nicotiana glauca*
Primula *Ilex vomitoria*

Asparagus densiflorus
Ilex vomitoria

End