Major beverages (alcoholic and non-alcoholic) are consumed not only to quench thirst but to provide a mild stimulant or “lift.” Nonalcoholic beverages such as coffee, tea, mate, cocoa do this by the presence of an alkaloid (caffeine or theobromine—which differ by a mere methyl group). Typically their taste is an acquired one; thus none of these major beverages are initially liked by children unless sweetened.

Alkaloids: Cyclic Nitrogen Compounds

History

Coffee, traditional morning “eye opener,” is widely consumed as a pick-me-up break the world over in various ways including steeped, steamed, or boiled. The plant originated in Africa, and entered Arabia (Yemen) from raids into Abyssinia now Ethiopia (Mocha, a slang name for coffee is derived from the city of Mocha (Al Mukha in Arabic) in southern Yemen on the Red Sea.
African natives chewed leaves and berries as a stimulant. Coffee was grown as early as the 7th century in Arabia and neighboring countries. Ground roasted “beans” (the seeds) are steeped in water to make the familiar beverage which is usually consumed hot. Coffee was introduced into Southern Europe by Arab traders in the late Middle Ages but was not widely known in Europe until sea routes to the East were opened by the Dutch and English in the 17th Century (1615).

Coffee houses were established in England, the Netherlands and elsewhere in Northern Europe about 1650, later in the American colonies. Coffee houses became social, literary, and political centers (Lloyds of London originated in a coffee house). Interestingly, this is being repeated today as interest in espresso, coffee, cappuccino, etc. has become a new fad in American culture.

Arabia remained the sole source of supply until the Dutch introduced C. arabica into Ceylon (Sri Lanka) in 1658 and Java in 1699 (now the main island of Indonesia). Another slang name “java” for coffee still used is based on this derivation (a famous grill in the old Fowler Hotel in Lafayette was called the Java shop). Coffee moved to the New World (Martinique) from Java via Paris. Presently the main center of production is the New World, particularly Brazil and Colombia.
Main consumption is still in Scandinavia particularly Sweden (8 kg/capita). Hence, a fictitious Mrs Olsen, a sweet busybody, was long used by Procter and Gamble in the ad campaign for their Folger’s brand of coffee.

Other major consuming countries are USA, France, Germany. Until recently UK and former colonies were low coffee consumers preferring tea but coffee consumption is increasing. Interestingly, per capita consumption of coffee has shown a decrease because the present generation X prefers soft drinks—which also contains caffeine—even for breakfast.

<table>
<thead>
<tr>
<th>Continent</th>
<th>1000 tonnes</th>
<th>Chief countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>World total</td>
<td>7,044</td>
<td></td>
</tr>
<tr>
<td>Africa</td>
<td>1,160</td>
<td>Ivory Coast (280), Ethiopia (228),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uganda (197)</td>
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<tr>
<td>North America</td>
<td>1,293</td>
<td>Mexico (330), Guatemala (276),</td>
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<td>Honduras (206)</td>
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<td>South America</td>
<td>2,742</td>
<td>Brazil (1780), Colombia (560),</td>
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<td></td>
<td></td>
<td>Peru (158)</td>
</tr>
<tr>
<td>Asia</td>
<td>1,765</td>
<td>Viet Nam (800), Indonesia (377),</td>
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<td></td>
<td></td>
<td>India (301)</td>
</tr>
<tr>
<td>Oceania</td>
<td>84</td>
<td>Papua New Guinea (84)</td>
</tr>
</tbody>
</table>
Botany
Over 25 to 100 species native to tropical Africa, but some in SE Asia.
Related species are Cinchona spp., source of quinine.

Four important species of Coffea:
C. arabica, 90% of world’s coffee; self fertile;
6–8 months from bloom to ripening.
Two subspecies:
var. arabica common in Brazil and East Africa,
dominant type in Asia
var. bourbon, from Reunion, formerly Bourbon,
an island 400 miles east of Madagascar.
A high altitude coffee.

C. canephora
Known as Robusta coffee; 9% of world’s coffee;
9–11 months from bloom to ripening; self sterile;
indigenous to African equatorial forests and thus a
lowland coffee; vigorous growth, productivity and
disease resistance.
Quality inferior to C. arabica in flavor and aroma, but
seems to be increasing with production of instant
coffees.

C. excelsa
Vigorous; ripens 11–12 months from bloom.

C. Liberica
Ripens 14 months from bloom; 1% of world’s coffee.
Coffee represents understory vegetation of tropical forest. Best adapted 4500–6000'; it is grown in full sun in Brazil because not enough moisture for shade trees. The tree is 15 to 40' when mature but some dwarf types. Adapted from 28°N to 34°S; sea level to 7000'. Rainfall is critical. Average annual temperature of 70°F. Frost and cold can damage coffee; freeze can kill.

Shade
Used in most areas, probably important to prevent temperature fluctuations and to provide protection from winds and drought. However, higher yields are obtained without shade. Benefits of shade:
- Extends life of tree
- Prevents overbearing
- Annual cropping
- Reduce temperature of air and soil
- Reduce hail
- Reduce evaporation and transpiration
- Organic mulch from leaves
- Protects organic matter of soil

Shaded Coffee
Flowering
Rainfall is important for flowering.
Requires 30 to 100" per year, usually 40 to 70".
Definite wet and dry needed to bring plant to flower and rest.
Without rain there is no flowering.
However constant rain gives continual flowering and no peak harvest season.
Sao Paulo, Brazil is ideal for coffee (Savanna climate).
8–14" of rain per month for 5 months
2–3" of rain per month for 3 months
0" of rain for the next 3 months (harvest season).

Culture
Propagation by seedlings is still carried out either by direct planting (old system) or by transplants.
Clonal propagation by grafts or cuttings is more expensive but use of superior genotypes give higher yields.
At the present, vegetative propagation using tissue culture via somatic embryos is being investigated by the French (Nestle).
Clonal propagation is more expensive but produces more homogenous plantings.

Pruning
Renewal pruning can be carried out to control shape and height of the tree and to renew productive wood.

A. Vegetative growth, current year
B. Main crop on previous years growth
C. Lateral growth on 3 year old wood
D. Fruit on laterals
E. Lateral growth on old verticals
Coffee is dimorphic composed of two types of growth: spreading (plagiotropic) or upright (orthotropic). Cuttings and grafts from vegetative uprights give upright growth; cuttings from horizontal (plagiotropic) growth give trees that sprawl on the ground and are worthless. This is the reason seed propagation gives desirable trees.

Coffee may be topworked by grafting reproductive branches (plagiotropic) on the seedling rootstocks 2.5–3 m (7–10'). In each leaf axil there are two leaf buds, one above the other. The top bud is plagiotropic and produces horizontal growth; the bottom orthotropic bud is dormant and produces uprights. Dominance of apical bud assures horizontal branching.
Tropical Horticulture: Lecture 17

**Yields**

Highest yields (2000 lb/acre) are found in Hawaii (Kona coffee).
Coffee could not compete in Hawaii because of high labor costs, but is making a comeback with resurgence of interest in gourmet coffee and the tourist industry.
Kona coffee is being sold at $10–15/lb to tourists and cannot meet demand.
At the present time when you by Kona coffee it is diluted with cheaper coffees.
In Brazil yields are usually 400 lb/acre.

**Diseases**

Rust due to *Hemileia vastatrix* has caused collapse of coffee in Ceylon and Java.
This disease is not as serious with robusta coffees if shaded and therefore *C. canephora* is replacing *C. arabica* in some areas.
Rust has now appeared in the Americas.
The ripe coffee “berry” (a fruit) consists of seed covered by a silvery testa (silverskin), a parchment layer, flesh, and skin.

The seed is mostly endosperm, and it is the endosperm not the embryo that produces the coffee flavor.

Note that all the layers must be removed in processing to produce the seed.

Seed consists mainly of green, corneous endosperm with a small embryo near the base.

Dried seeds after removal of silver skin provide the coffee beans of commerce; 5–6 lb of cherry (whole fruit) provides ~1 lb of clean coffee; 1,000-dried seeds/lb.

Processing

Wet processing (most common)

1. Flotation: Defective berries are first separated by flotation, good ones sink.

2. Pulping and separation: Ripe berries run through machines which pulls of skin and most of the flesh.

This must be done within 24 hours with red ripe fruit to prevent overheating and tainting of “beans” from rotting pulp.
3. Berries from separator are washed
4. Put in fermentation tanks to remove flesh adhering to parchment coat (18–24 hr) up to 80 hr if elevation is high and temperatures are cool.
5. Washing
6. Curing
7. Hulling or picking off parchment layer and silverskin by machinery.
   Seeds become shiny after polishing (removal of silverskin).
   Grading by weight and size.
   Often picked over by hand to remove stones, black beans etc.
   Now electronically sorted in advanced operations.

**Dry Processing**

Fermentation step is eliminated.
All stages of berries are dried in heaps (15–25 days) and dehusked.
Often moistened to remove silverskins.

**Economics**

Economy of coffee has been disturbed by boom and bust economies.
Gluts cause low prices; government usually buy and store coffee to protect prices but system collapse when stored coffee gets to high levels resulting in dumping.
Rust is now a major problem causing shortages and high prices.
The interest in decaffeinated coffees has increased the importance of African robusta.