Economic Botany

BEVERAGES, TEA, COFFEE

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BEVERAGE PLANTS AND BEVERAGES

Beverages are considered to be an essential items of human diet because of their stimulating and refreshing nature and liquid content. They are used all over the world. Since the earliest time man has looked for some palatable drinks which have refreshing qualities. Man’s earliest beverage was probably the juice squeezed from fruits, but the civilized man found a vast array of refreshing and stimulating beverages for his enjoyment.

Fresh juices (unfermented) of sweet orange, sourlime, mandarin, lemon, grapefruit, apple, mango etc. are considered as soft drink as they do not contain alcohol. Out of these, orange squash is the most popular of all. Fruit juices are useful for their vitamins and potassium content. Present day bottled fruit juices (Soft drinks) are essentially synthetic fruit juices, compound of sugar, fruit acids and other flavouring substances. Such juices are not only an alternative to water in hot weather but also contain useful amount of vitamins and contribute some calories through their sugar content.

Our daily requirement of water is in the form of coffee, tea, fruit juices, beer, wines or other liquids. These are taken more for their taste and zest than for their nutritional value. Coffee and tea have no nutritive value but may be a vehicle for large intakes of sugar, milk or lemon. The alcohol in beer and wines is a source of energy up to some extent.

Of the large number of plant species used for this purpose, only a few have become commercially important.
Beverages can be grouped into two following groups:

- **Non-alcoholic**
  - Major
    - Tea
  - Minor
    - Paraguay Tea /mate
    - Guarana
    - Khat
    - Cola

- **Alcoholic Beverages**
  - Fermented
    - Wines
  - Distilled
    - Whiskey
    - Rum
    - Gin
    - Brandy

**NON-ALCOHOLIC BEVERAGES**

Non-alcoholic beverages which includes tea, coffee, cocoa are considered as refreshing and stimulating properties of them is due to the presence of **caffeine** or related alkaloids. Caffeine when taken in small quantities, increases mental activity and reduces fatigue. It stimulates the production of digestive juices and has a marked diuretic action.

All major non-alcoholic beverages belong to the tropical crops. The tea and coffee have little nutritive value while cocoa is considered a source of energy.

Less known non-alcoholic beverages are used in different countries of the world are as follows:

- *Mate or Paraguay Tea – Leaves of* *Ilex paraguariensis* (*Aquifoliaceae*)
- *Guarana – Seeds of* *Paullinia cupana* (*Sapindaceae*)
- *Cola – Powdering seeds of* *Cola nitida* (*Sterculiaceae*)
- *Khat – Plants of* *Catha edulis* (*Celastraceae*)
- *Yoco – Bark of* *Paullinia yoca* (*Sapindaceae*)
Of these beverages, tea is most important and used by about more than half of the population of the world, while coffee is next to it in importance and used by about 1/3 of the world population. In many countries, cocoa is used as both food and drink.

**Tea (Chai)**

Tea is the ‘Queen of beverages’. It is stimulating without intoxication.

**Bot. Name** - Camellia sinensis (L.) O. Kuntze.  
(C. sinensis Var. sinensis – Chinese tea)  
(C. sinensis var. assamica – Assam tea)

**Family** - Theaceae
**Sources** - Leaves
**Native Place** - Assam, Burma, Indo-China
**Cult. in India** - Assam, Darjeeling (W.B.), Nilgiris

**Taxonomic Details**: Tea plant is an evergreen woody shrub. Branches glabrous. Leaves are leathery, oil gland dotted, simple, alternate, exstipulate, elliptic, oblong, with serrated margin, acute at both the ends or acuminate at apex. 10-20cm long and 3-7cm broad. Flowers pinkish white solitary, axillary, often in cluster of 2-4, bisexual, stamens many in several whorls, of outer whorls united and of inner whorls free. Ovary superior, 3-5 carpellary with 4-5 pendulous ovules in each locule, fruit a loculicidal capsule.

**History and Origin**: The world ‘tea’ comes from ‘te’ which is used in one of the Chinese dialects in place of the more universal ‘cha’. It is not known when the cultivation of tea was undertaken on a commercial scale. Around 2700 B.C. Chinese Emperor Shen Nung discovered the stimulatory properties of tea leaf extract and that at first tea was used as a medicine. It is believed to have originated in China or India or even both. It was only in the fifth century A.D. that the habit of tea drinking became a social custom in China from where tea was brought to Japan by Buddhist monks in the early of the 8th century. However, it did not spread to other Asian countries until 17th century. The Turks introduced tea from China to England in 17th century. Tea was introduced into North America by the English Emigrants. In India, **East India Company** started commercial cultivation in 17th century.

**Agroclimatic conditions**: Moist and warm climatic conditions are required for tea cultivation. It grows to an altitude of 2460m. A good 150-370 cm rainfall well distributed throughout the year, absence of dry wind and freezing temperature are some of the essential requirements. Well drained acidic soil having low calcium content and rich in iron and manganese is suitable for tea cultivation.

**Cultivation**: Land with steep slopes and soil too poor for other types of agriculture, is used for tea plantation. First of all land is cleared by removing forest growth. To provide shade to the tea plants Grevillea robusta,
Erythrina lithosperma, Derris robusta, Albizia procera, A. chinensis etc. are commonly left or planted. The tea plants are most commonly raised from seeds sown first in a nursery. Seedlings are transplanted into field when they are about 30 cm in height. After few months main stem is removed in order to get more lateral branches. Periodical pruning and skiffing are done to encourage vegetative growth and to enable the bush to attain a height of 40-50 cm, convenient for plucking. The economic life of the tea bush in Northern India is generally 40 to 50 years. Vegetative propagation of tea plant is done by cuttings which are planted in clonal nurseries.

To encourage growth of leaves, nitrogenous manures are frequently added. Foliar application of zinc sulphate gives better result in production and healthy growth of leaves.

**Plucking of leaves**: Plucking of leaves is one of the most important operation in the tea industry and it is done usually by women who carry basket on their back for collection of leaves. Constant pruning stimulates the vigorous development of new shoots called ‘flushes’ which are source of commercial product. The first picking is done when the plants are 3 to 4 years old and are the repeated at regular intervals. Only three or four pickings in a year are possible.

| Grade of Tea leaves: The grade of tea leaves depends on the age of the leaves which, are given below: |
| 1. ‘Golden tips’ – The youngest terminal buds rich in tannin (28%) |
| 2. ‘Orange Pekoe’ (O.P.) – Smallest leaf (28% Tannin) |
| 3. ‘Pekoe’ (P) – Second leaf (21% Tannin) |
| 4. ‘Pekoe Souchong’ (P.S.) – The third leaf (18% Tannin) |
| 5. ‘Souchong’ (S) – The fourth leaf (14% Tannin) |
| 6. ‘Congou’ (C)– The fifth and largest leaf with less tannin content. |

Categories are also implied for the broken parts of leaves belonging to their respective categories.

- ‘Broken Orange Pekoe’ (B.O.P.)
- ‘Broken Pekoe’ (B.P.)
- ‘Broken Pekoe Souchong’ (B.P.S.)
- ‘Broken Souchong’ (B. S.)

Finally the smallest particles are graded as dusts. The flavour and quality of tea vary with the soil, climate, age of leaf, time of picking, and method of preparation.

**Processing of Commercial Tea**:

Commercially tea may be divided into following four basic types:-

1. Black tea
2. Green tea
3. Oolong tea.
4. Brick tea.
BLACK TEA (Fermented Tea) : This tea is commercially most important and involves four main operations :-


The freshly collected tea leaves after picking are tightly packed in baskets (to prevent bruising & heating) and are immediately sent to processing units.

Withering : The leaves are first spread thinly over withering racks and allowed to remain there for 12 to 18 hours, to eliminate excessive moisture of leaves (i.e. up to 50% of the moisture content). This makes them soft and flaccid like soft leather and are ready for rolling. Care is taken not to injure leaves, other-wise premature fermentation will start.

Rolling : The withered leaves are then passed through rollers to rupture the cells and release of cell sap which is exposed to the action of the oxygen in the air. Rolling is done for about half-an hour. After this leaves are removed in aluminum trolleys to filter the broken leaves and fine particles. The remaining larger leaves are again rolled for the second time with increased pressure. After this leaves are sent to fermentation room.

Fermentation : This process is carried out in specially fermentation houses where temperature, (between 240c to 270c) humidity (90%) and air circulation can be regulated. The period of fermentation is normally 3 to 3.5 hours. Oxidation which has started during rolling continues. The shorter the fermentation period, the more pungent liquor, and the longer fermentation the softer the liquor. During fermentation, the leaves develop a characteristic aroma.
**Drying or Firing** : This is done in specially designed ovens at 90-1000°C for 20 to 25 minutes to arrest further oxidation. Regulation of temperature is very essential to maintain the quality of tea. The dried product contains 3-4% moisture only.

After complete drying, leaves are sent through different size of sieves to sort out tea leaves into different sizes. The waste left after sorting and grading, is sold as ‘fluff’ from which caffeine is extracted.

**GREEN TEA** : (Unfermented Tea)

Green tea is mostly produced in China and Japan. In contrast to black tea this type of tea does not require artificial weathering and fermentation. Freshly picked leaves are briefly heated to inactivate enzymes. The leaves are then rolled and dried just like black tea and polished with soapstone or French chalk to improve the colour. Tannin and caffeine content in green tea is higher than the black tea. Green tea thus obtained are finally scented with flowers of Jasminum sambac or other aromatic plants by mixing them with the dried tea leaves.

**OOLONG TEA** (Partially fermented Tea)

This is a partially fermented tea and is an intermediate between green and black tea. It has the flavour of green tea but the colour of black tea. This type of tea is exclusively produced in Taiwan.

**BRICK TEA**

This tea is prepared from the waste left after the preparation of black and green tea. It may consist of leaves, stalk or even small pieces of twigs or mainly coarse tea dust. Weathering is not required. This waste is softened with steam and then compressed in to blocks or bricks. Bricks are ultimately packed in paper and put in sunlight. This tea is mainly consumed in Tibet and exported by China.

**Diseases and Insect Pests**

Various diseases and insect pests of tea are given in the table

<table>
<thead>
<tr>
<th>Name of Diseases</th>
<th>Causal organisms</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red rust</td>
<td>Cephalouros mycoidea</td>
<td>Bordeaux mixture.</td>
</tr>
<tr>
<td>Black rot</td>
<td>Corticium invisum</td>
<td>Bordeaux mixture.</td>
</tr>
<tr>
<td>Brown blight</td>
<td>Colletotrichum camelliae</td>
<td>Bordeaux mixture.</td>
</tr>
<tr>
<td>Copper blight</td>
<td>Guignardia camelliae</td>
<td>Bordeaux mixture.</td>
</tr>
<tr>
<td>Pink disease</td>
<td>Pellicularia salmonicolor</td>
<td>Fungicides</td>
</tr>
<tr>
<td>Die back</td>
<td>Nectria cinnabaria</td>
<td>Fungicides</td>
</tr>
<tr>
<td>Black root</td>
<td>Rosellinia sp.</td>
<td>Fungicides</td>
</tr>
<tr>
<td>Char coal rot</td>
<td>Ustulina zonata</td>
<td>Fungicides</td>
</tr>
<tr>
<td>Root rot</td>
<td>Botryodiploridea Theobromae</td>
<td>Fungicides</td>
</tr>
</tbody>
</table>
**Common Pests**

<table>
<thead>
<tr>
<th>Name</th>
<th>Zoological Name</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tea mosquitoes</strong></td>
<td><em>Helopeltis antoni</em>&lt;br&gt;<em>H. febriculosa</em></td>
<td>Spray of 0.1% malathion</td>
</tr>
<tr>
<td><strong>Tea looper</strong></td>
<td><em>Buzura suppresssaria</em></td>
<td>Spray of 0.1% malathion</td>
</tr>
<tr>
<td><strong>Termites</strong></td>
<td><em>Microtermes sp.</em></td>
<td>Mixing 5-10% Aldrin in Soil</td>
</tr>
<tr>
<td><strong>Tea thrips</strong></td>
<td><em>Taeniothrips setiventris</em></td>
<td>Spray of 0.1% malathion</td>
</tr>
<tr>
<td><strong>Tea slugs</strong></td>
<td><em>Conytheyla rotunda</em></td>
<td>Spray of 0.1% malathion</td>
</tr>
<tr>
<td><strong>Mites</strong></td>
<td><em>Acaphylla sp.</em>&lt;br&gt;<em>Aceria gossypii</em>&lt;br&gt;<em>Brevipalpus obovatus</em>, <em>Tetranychus bioculatus</em></td>
<td>By dusting sulphur.</td>
</tr>
</tbody>
</table>

**Chemistry of Tea Leaves :**

Followings are the contents of tea leaves:

1. about 77% moisture (in freshly plucked tender shoot)
2. 23% solid matter –
   - 50% of solid matter is insoluble in water and composed of crude fibres, cellulose, starch, proteins etc.
   - remaining soluble half includes-
     - over 20 amino acids.
     - 12 sugars.
     - 6 organic acids.
     - About 30 polyphenolic compounds
       - Mainly Caffeine (2.5-4.5%)
       - Theine (2-5%)
       - Theophylline (Fraction)
       - Tannin (13-14%)
       - Volatile oil.
       - B-complex vitamins and nicotinic acid.

‘Theine’ an alkaloid, identical to caffeine occurs in combination with tannins, and is only released by fermentation. The distinctive character of the beverage is due to mainly by three principle components :-

- Essential oil (Ethereal, Theol oil) – For aroma and flavour
- The alkaloids fraction (Theine) – Stimulating and refreshing quality.
- Tannin (Poly phenols) – Bitterness and astringency.

Indian teas are peculiar in having relatively larger tannin content than Chinese varieties. Chinese tea is known for their delicacy and are favourite drinks of person with delicate digestive systems. A tea is normally consumed for its theine content. A cup of tea boiled water and tea leaves (without sugar and milk) provide 4 calories. A cup of tea with milk and sugar given 40 calories. If the tea leaves are steeped for a longer period, the tannin dissolves and the liquid become bitter and loses its beneficial qualities.
**Tea Board of India:** The production, marketing quality control, research etc. are controlled by the board. India and Ceylon are the main exporter of tea, where half of the world’s tea is supplied from these countries, this is followed by Indonesia, China, Japan, and Taiwan.

Great Britain is the great consumer of tea, followed by United States, Australia, USSR, Canada and Holland. Chinese and Japanese teas are more popular in the United States.

In India, main tea producing areas are Assam, West Bengal, Tamil Nadu, Kerala, Karnataka.
Coffee (Kafi)

<table>
<thead>
<tr>
<th>Bot. name</th>
<th>Coffea arabica L.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>Rubiaceae</td>
</tr>
<tr>
<td>Source</td>
<td>Seeds</td>
</tr>
<tr>
<td>Native place</td>
<td>Ethiopia</td>
</tr>
<tr>
<td>Cult. in India</td>
<td>Karnataka, Orissa, Andamans, Kerala, Tamil Nadu</td>
</tr>
</tbody>
</table>

**Taxonomic details:** The Arabian Coffee plant is an evergreen shrub or small tree. Leaves opposite with interpetiolar stipules, ovate or elliptic with undulate margins, glabrous and glossy with prominent acuminate apex. Flowers small snow white star like, borne in axillary clusters, fragrant, bisexual, and epigynous. Sepals 4-toothed, petals 4-5 connate in a funnel shaped corolla, Stamens 4-5, carpels 2, syncarpous; fruits small, fleshy berries turning green to crimson red at maturity. Seeds (Coffee beans) ellipsoidal or oval, each with delicate silver skin seed coat, seed contains a folded endosperm enclosing a very small embryo.

**Kind of Coffee:** Coffee belongs to the genus Coffea which consist of nearby 25 species, of which following are of commercial importance.

1. Arabian Coffee – (Coffea arabica)
2. Congo Coffee, Robust Coffee – (Coffea robusta)
3. Liberian Coffee – (Coffea liberica)

**History and Origin:** Coffea arabica is indigenous to the tropical rain forests of Ethiopia where it is called as Kaldi or bun. This was brought to Arab in 15th century, by Arab invaders. The Arabs themselves became so fond of coffee drinking that the 1st public coffee houses were opened in Mecca and Madina in 1470. The coffee plant reached Europe in the beginning of the 17th century. The plant reached Ceylon and Java by 1700, West Indies in 1720 and Brazil in 1770.

As regards to the history of its introduction into India, it was brought to Mysore three centuries ago, by Muslim pilgrim on his return from Mecca.
At one time, Ceylon was leading producer of Coffee in the Indian ocean and its economy was depended heavily on this crop. But the entire plantation were devastated within few years in 19th century when one of the great plant plague ‘Leaf spot of coffee’ rust caused by fungus *Hemileia vastatrix* swept through the island.

Nowdays Brazil is the largest producer of coffee, followed by Colombia, Ivory Coast, Mexico, Uganda, Indonesia, Ethiopia, Salvador, Guatemala. United States of America is the world’s leading importer followed by West Germany, France, Italy, Sweden, Canada and the Netherlands.

*Agroclimatic conditions:* Arabian coffee plant prefers the cooler and less humid climates of mountainous region from 600-700 m while ‘robusta’ and ‘liberian’ coffee are well suited to the warm humid lowlands. It grow well where less seasonal temperature fluctuation occurs. Required temperature ranges from 12°C to 36°C and rainfall of 150 cm per annum for healthy growth and productivity. A well distributed rainfall are quite suitable for cultivation of coffee. Coffee plants require a porous, moisture retentive soil rich in organic matter. Coffee is a soil exhausting crop, growing best in deep, slightly acidic, well drained fertile loam of literitic and volcanic origin. In the past coffee was grown in the shade but better results can be achieved without shade or partial shade if other practices like trimming weeding and nitrogenous fertilizers are used.

Propagation of coffee is done by seeds. Seeds are sown in December or January and beds are covered by paddy straw to prevent drying. Germination takes place within 45 days. Seedlings of 16-18 months old are selected for planting which is done in the month of September.

Tipping is a common practice to tip the main stem twice, first when plant is over a half meter and the second one when it attains a height of about 1.5 meter height.
Fruiting begins after three to four years of planting and continues for 40 years. Collection of ripe coffee fruits is done by hand plucking or by shaking coffee bushes.

![Coffee berries, unroasted coffee beans & roasted coffee beans](image)

Quality of coffee depend on different characteristics, namely :-

- General appearance when raw
- Taste when roasted
- Quality of the liquor, which comprises factors like aroma, acidity, nutritional value,
- Weather condition during development
- Stages of maturity of the beans.

The coffee berries are processed for market by two different methods i.e. Dry method and wet method.

**Dry method** – It is a older but simple and slow process. After drying under sunlight dried skin and pulp is removed by peeling machines. The seeds commonly known as ‘coffee beans’ are then graded and packed in bags for transportation.

**Wet method** – The cherries are placed in large tank filled with water. The well developed fruits sink to the bottom, while the defective ones float on the surface which are then removed. Thereafter the ripe fruits are subjected to normal process of pulping, fermenting, drying and curing. Fermentation may be hastened by adding enzymes. Polishing improves the look of the beans. After grading the seeds are bagged and packed for export.

**Processing** – Polished coffee beans are roasted in oven for 5 minutes at the temperature of 260°C. The seeds develop deep rich brown colour and texture become porous and crumbly under pressure. By doing this seeds lose 14-23% of their weight but increase in size 30-100% and develop the characteristic coffee aroma and flavour. Roasted beans are rapidly cooled and are ready for grinding. Powdered coffee is immediately packed in impervious containers, under vacuum or in an atmosphere of inert gas. Powdered coffee, if kept open loses its aromatic quality and turns rancid.
‘Caffeine’ is an important alkaloid free from the tannin complex caffeotannic acid. The flavour of coffee is due to presence of a volatile oil caffeol.

The quality and flavour of coffee depends on number of factors such as:
- The location
- Varietal type
- The degree of ripeness of the seed
- The method of curing and drying
- The practice of roasting
- The extent & type of substitutes used.

Uses: Coffee has definite medicinal values acting as a diuretic and nerve stimulant, but it is also harmful if taken in large quantity. In the case of sufferers from nervous disorders, caffeine containing beverages should sparingly be given.

The chief substitute of coffee are:
1. Dried and roasted roots of *Cichorium intybus* a member of Asteraceae
2. Roasted seeds of Leguminous plants mainly *Cassia tora*, *Cassia occidentalis*.

Instant Coffee: Powder is obtained by vaporising a strong infusion of coffee in vacuum or by the freeze drying technique.
Cocoa and Chocolate

Bot. Name - *Theobroma cacao* L.
Family - Sterculiaceae
Source - Seeds
Native place - Tropical central & South America.
Cultv. in India - Kerala, Karnataka.

**Taxonomic details**—A medium sized tree leaves simple, stipulate alternate, short petiole with two articulations. Leaves are oblong oval with prominent veins and

* The term cacao is often employed for a tree and cocoa for the product of a tree.

*Cocoa and chocolate are two major products obtained from the roasted kernels of the ripe seeds of cacao tree.*

*Linnaeus named it Theobroma cacao from Greek words :- theos = God, and broma = food*

venlet. Flowers borne in small clusters on the bark of the old trunk (never on young shoots) a character called cauliflory. Only a few of the many thousand flowers develop into fruits. Flowers are typical pentamerous. The
mature fruit (a berry but called a pod), has a fairly thick, leathery smooth or corrugated pericarp or husk. Fruits are somewhat cucumber shaped and colour ranges from green yellow, red to purple. Flat or round 20-40 seeds arranged in 5 rows are embedded in a white pink or brown, aromatic mucilaginous, sweet and faintly acidic pulp.

*Varieties*: Out of numerous varieties of Cocoa there are only two from a commercial point of views, within a species *Theobroma cacao*

(i) **Criollo** – (Venezuelan Type) Grown mainly in Colombia, Central America, Mexico. The fruits are yellow, deeply furrowed and pointed ends.

(ii) **Forastero** (Amazonian Type) – Grown in Africa and South America particularly Brazil. Pods are green, less deeply furrowed.

‘Trinitario Cacao’ is a hybrid variety of the above two.

*History of Origin*: Inhabitants of the tropical forests of the Amazon valley in South America used to prepare a drink called ‘chocolatl’ by pounding cacao seeds with maize grains and then boiling the powder with water. Cocoa was brought to Europe by the Spaniards who found sweetened cocoa more palatable. The Spaniards, who are regarded the pioneer in its cultivation, learnt the use of cocoa from the local people of Mexico in the 16th century. Soon after, cultivation of the crop spread to the West Indies and the Philippines. It is now extensively grown in Africa, Asia, South America. In India it was introduced between, 1795 and 1880 and its cultivation in small scale is being done in Kerala and Karnataka.

*Agroclimatic Conditions*: It is a sensitive plant to drought and wind. It grows in area where the daily temperature is not less than 18°C. It is cultivated from the sea level upto an elevation of 650 m. Higher elevation is not suitable. Crop requires a mean minimum rainfall of over 150 cm per year. It requires well drained clayey soil.

*Propagation*: Propagation is done by seeds. Sowing is done either in bamboo baskets, or polythene bags. After a 6 to 8 months, the seedlings are transplanted in the main field. Propagation by grafting, budding and layering is also done.

Cacao plant is allowed to grow one main trunk for obtaining good yields.

*Harvesting and Curing*: Although cacao tree begins to flower after second year of planting however, full bearing stage of the tree is reached in 7-10 years. There are two main flushes every year, one in October to February (main crop season) and the other in May to August (minor crop season). Matured pods are plucked
with a knife. The seeds and pulp are scooped out and both are kept in fermentation boxes, for 4 to 7 days. During the fermentation, the sugar present in the pulp, is first converted into alcohol by yeast and finally into acetic acid by *Acetobacter* sp. The beans now become brownish, the cotyledons get shrink from the seed coats and separated. The characteristic aroma is due to presence of an essential oil *cacool*. Fermentation is carried out in specially designed perforated boxes called sweating boxes or fermentation bins. The boxes are put on raised platforms to facilitate aeration and drainage. The seeds along with pulp are dumped into the topmost fermentation box and covered with banana leaves. The beans of topmost box are transferred to the middle on the third day and covered with banana leaves as before. On the 5th day, they are shifted to the bottom box and covered as usual. During each transfer from one box to another, the beans are stirred. On the 7th day, the fully fermented beans, are washed out and then spread out on mats or trays or concrete floors for drying under sunlight. Dried beans are polished either by machine or by the trampling the beans by foot, a practice known as “dancing the cacao”.

**Roasting** – Roasting helps to reduce the acidity and astringency. After the beans have been dried, they are fried at the temperature from 125°C to 140°C in iron drums. This decreases the amount of tannin and increases the fat and protein content. Corrugated rollers are used to break the shells of the beans, which are removed with the help of a winnowing machine.

### The roasted cacao beans contains

- **Fat** (cacao butter- 30-56%) most stable fat with storage life 2-5 years.
- **Starch** (15%)
- **Albuminoids** (15%)
- **Mineral matters.**
- **Theobromine** (stimulating Material – 3%)
- **Caffeine**

Thus cocoa is a highly concentrated energy food.

The seeds are then ground to an oily paste which after cooling and hardening results into ‘bitter chocolate’ or ‘chocolate liquor’ or ‘cacao mass’ of commerce. ‘Sweet chocolate’ is prepared by adding sugar, extra cocoa butter and various flavouring materials. The mixture is re-pulverized and cast in small consumer size bar or bricks. For the preparation of ‘milk chocolate’, a portion of chocolate liquor is replaced by whole milk solid. This is lighter in colour. In the manufacture of cocoa powder, nearly 2/3 of the fat from the ‘cacao mass’ is removed by hydraulic pressing and the residual cake is pulverized. Cocoa powder may be flavoured with spices, vanilla and other natural or artificial flavourings. All the processes of curing, roasting and cocoa and chocolate manufacturing are shown in flow sheet below.

### Diseases and Insect Pests - The common disease of cocoa tree are mentioned below -

<table>
<thead>
<tr>
<th>Disease</th>
<th>Caused Organism</th>
<th>Controlled by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Black Pod</td>
<td><em>Phytophthora palmivora</em></td>
<td>Boardeaux mixture</td>
</tr>
<tr>
<td>2. Anthracnose</td>
<td><em>Glomerella cingulata</em></td>
<td>Copper spray</td>
</tr>
<tr>
<td>3. Swollen shoot</td>
<td><em>Virus</em></td>
<td>No control measure</td>
</tr>
</tbody>
</table>
Insect Pests – Common insect pest of Cocoa is Mealy bug (*Pseudococcus citri*) which can be controlled by spraying 0.02% Parathion or 0.1% HETP.

Flow Chart of Cocoa and Chocolate manufacture

- Cocoa Beans left for 4-7 days for fermentation
- Fermented and dried beans
  - Drying
  - Cleaning
  - Polishing
  - Roasting (at 125 °C to 140 °C)
  - Breaking and winnowing
    - Nib-shell mixtures
    - Nibs (heavier cotyledons)
      - Germ separation
    - Shell
    - Germ free nib
      - Milling
        - Grounding into oily paste
          - CACAO-MASS (Chocolate Liquor)
            - Cocoa manufacture
              - Alkalisation
              - Removal of excess moisture and fat by hydraulic pressing
                - Press cake
                - Cocoa Butter
                  - Gridding
                    - Cocoa powder
            - Chocolate manufacture
              - Addition of sugar, flavourings, milk, etc. and cocoa butter
                - Mixing
                  - Refining
                    - Moulding/Casting in small consumer size brick
BEVERAGES OF MINOR IMPORTANCE

**Cola**

*Bot. Name* - *Cola nitida* (Vent.) Cheval

*Family* - Sterculiaceae

*Source* - Leaves

*Native place* - Brazil

*Cult. in India* - South Indian States.

The source of ‘Cola’ or ‘Kola’ nuts is cultivated in Brazil, India, Jamaica, Sudan and certain other parts of Asia. The plant is a tall tree, which attains a height of 15 –20 m and possesses a straight trunk.

The fruit consists of follicles and contain eight fleshy seeds with reddish colour and aroma of roses. The nuts contain 1- 2.5 % caffeine, traces of theobromine, fat, sugar, starch etc. The nuts are sometimes chewed and are used for the preparation of a beverage, for which powdered seeds are boiled in water for a few minutes. They are also used in USA in soft drinks.

**Mate**

*Bot. Name* - *Ilex paraguariensis* St. Hil.

*Family* - Aquifoliaceae

*Source* - Leaves

*Native place* - South Africa

*Cult. in India* - Central place of India

Mate, variously known as ‘Yerba mate’ or ‘Paraguay tea’ is an evergreen shrub or small tree. Leaves alternate, 9.5-12.5 cm long, elliptic, ovate and crenate, serrate resemble with tea leaves. Flowers axillary, fascicled or in stalked cymes. Fruit drupe, rounded, about 6.25 mm in diameter.

The leaves of the plant constitute the source of a beverage, which is next to coffee, tea and cocoa in importance. Leafy branches are cut from 3 –5 years old plant at the time of ripening of fruits. They are dried and roasted over fire. Leaves are then separated and dried by placing them on a platform over a slow wood –fire. After
drying for 24 –36 hours, the leaves are crushed to make a coarse powder. The material thus obtained is placed in sacks, protected from moisture and allowed to mature for about a year before being used for preparation of the beverage. As in the case of tea, mate is taken in the form of an infusion, which has a pleasant aroma and a slightly bitter taste. It has a valuable restorative and stimulating properties. In addition to caffeine it has small amounts of the theobromine and trigonelline, which make mate as nutritive universal drink as beverage. The beverage is prepared by pouring boiling water on the leaves. To this, sugar and lemon are also added, it is then sucked by hollow pipes.

**Guarana**

<table>
<thead>
<tr>
<th>Bot. Name</th>
<th>Paullinia cupana Kunth.,</th>
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<tbody>
<tr>
<td>Family</td>
<td>Sapindaceae.</td>
</tr>
<tr>
<td>Source</td>
<td>Seeds</td>
</tr>
<tr>
<td>Native place</td>
<td>Brazil, Amazon</td>
</tr>
<tr>
<td>Cult. in India</td>
<td>Some part of India</td>
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The plant is a large woody climber of the Amazon valley. The seeds, which have three times as much caffeine as coffee, are ground and mixed with cassava flour to make a paste. Sausage-shaped cylinders are then made with the paste and dried in smoke to make a stony structure. The beverage is prepared by adding grated pieces of the above material to hot or cold water. It is regarded the most stimulating of all the caffeine-containing beverages.

**Khat**

<table>
<thead>
<tr>
<th>Bot. Name</th>
<th>Catha edulis Forsk.</th>
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<tbody>
<tr>
<td>Family</td>
<td>Celastraceae</td>
</tr>
<tr>
<td>Source</td>
<td>Leaves</td>
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<tr>
<td>Native place</td>
<td>Ethiopia</td>
</tr>
<tr>
<td>Cult. in India</td>
<td>Maharashtra and Karnataka</td>
</tr>
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</table>

Khat is the most important beverages of the natives of Arabia and is prepared like tea from the leaves of *Catha edulis* Forsk. The plant was grown in Arabia long before the introduction of coffee and tea. It is cultivated in parts of North-Eastern Africa. The plant is a small shrub, with thin and coriaceous leaves. Leaves and buds which contains an alkaloid similar to caffeine are sometimes chewed for stimulating effect. The khat is an excellent sweet, aromatic and astringent beverage. It is reported to be good for cough, asthma and other chest diseases. Besides tannin, reducing sugars and volatile oil, the leaves also contain three alkaloids namely, cathine, cathinine and cathidine.
ALCOHOLIC BEVERAGES

Alcoholic beverages contain alcohol as a main part their constitution. From the time immemorial, the man exploited the natural process of fermentation and used its products for his own pleasure. Nowadays, the alcoholic beverages are consumed all over the world, as a refreshing and stimulating agents, but their use in large quantities cause cerebral excitation followed by depression. One of the most important and best known industrial fermentations is that in which ethyl-alcohol is produced from sugar by yeasts.

Alcoholic beverages fall naturally into two categories :-

(a) The fermented beverages, and
(b) The distilled beverages.

In the former category, the alcohol is formed by the fermentation of sugar present either naturally in the source or produced by transformation of starch, and in latter type alcohol is obtained by the distillation of some alcoholic liquor

[A] Fermented Beverages

Wine - It is produced by the conversion of fruit sugar into alcohol and carbon dioxide. This process is brought out by wild yeast present on the skins of the fruits. Ripe grapes (Vitis vinifera L.) are most commonly used in commercial alcohol production. Relatively small amount of wines are also prepared from apples, berries, peaches, cherries, orange, apricots, pomegranates raspberries, pears, honey and strawberries. The wine made from the fruit is named after the fruit for example-‘grape wine’ ‘apple wine’, and so on. The alcoholic yeast which grow well on substrates rich in sugar (such as glucose, sucrose, lactose, starches etc.) are used in commercial production of ethyl alcohol in industrial fermentation. There are two main alcoholic products : wine and beer.

Grapes Vines (Vitis spp.)

The species Vitis vinifera L. and its varieties are the principal source of wine. Grape vines seem to have been introduced into India by invaders from Persia (Iran) and Afghanistan around A.D. 1300. Grape cultivation called as ‘Viticulture’ was introduced in South Africa in the 17th century and Australia in 19th century. At present grapes are grown extensively throughout the temperate zones of both hemispheres.

There are three main species of Vitis which are being used for the production of wine. They are :

1. American fox or bunch grapes (V. labrusca L.)
2. Muscadine grapes (V. rotundifolia Michx.)
3. California grapes or European grapes (V. vinifera L.)

Vitis vinifera is the most common species of wine group.

Taxonomic details : Grape vines are tendriled, woody climbers with alternate, palmately nerved and frequently lobed veins. Flowers are borne in panicles. The fruits (grapes) are produced in clusters and developed laterally
near the base of the leafy branches. The fruits are berry, juicy, round to elongated, and contains relatively large amounts of soluble sugar i.e., glucose. The grape varieties differ in colour i.e., white, green, pink, red or purple. Sometimes the skin of the grape fruits were found to covered by wild yeast cells *Saccharomyces cerevisiae* var. *ellipsoideus*. The enzymes produced by these yeast cells are responsible for the fermentation of grape sugars to alcohol.

![Grapes and Glass of Wine](image)

*Agroclimatic Conditions*: Grapevine is grown under semi-arid and sub-tropical conditions. The ideal climate for wine growing is one that is warm but not too warm, cool but not too cool, both extremes are undesirable for the production of high quality wine. A Continuous warm weather is isolately essential for the production of a high sugar content.

Grapes are propagated most commonly by cutting. Under intensive cultural practices (pruning etc.) and maintaining the vines with in the plucking height the grape production is satisfactory where as unpruned vines produce grapes in large quantities of small size, and low quality fruits. Grape vines are regularly irrigated and fertilized.

*Composition of grapes* :- Following are the important constituents of grape fruits :-

- The ‘stem’ (rachis, branches, pedicels) and seeds constitute about 10-20% of total weight of the ripe fruit cluster.
- Remaining pulp and juice (‘must’) 80-90% but 18 to 25% by weight is sugar
- Organic acid 0.3%
- Tartaric and malic acids in 90% of total acids content.
- Small amount of citric acid, phosphoric, oxalic, gluconic, and glucoronic acids are present.
- 20 amino acids
- Anthocyanin
- Vitamins
- Enzymes
- Minerals etc.
Of the total production of grape in the world, nearly 80% is used in wine preparation, only 10% is consumed as fresh and remaining 10% is dried.

**Principal wines and wine growing countries:** In general, wines can be classified as **Beverage wines** and **Fine wines**. The former are used as a food, and they are inexpensive and constitute the backbone of the wine industry, comprises about 95% of all wines, whereas the latter are the commercial type which is prepared more carefully and hence expensive.

**Beer:** For making beer and other related beverages, a combination of two processes are required. First one is called **malting** which involves the conversion of the starch present in the grains into sugar. This is brought about with the enzymatic activity of diastase, which is produced during seed germination. Generally rice, maize and rye are used on the small scale but barley has been used for commercial production of beer. Large, fresh perfect, light coloured barley grains are used. Barley grains are steeped in water from 1 to 4 days. The grains are then placed in heaps or layers of 6 inches deep until germination start. When seeds undergo sprouting, the process is called **malting**. After this germinated seeds are spread out on malting floor at 50-60° F and regularly turned over. This prevent the further germination process. The barley grains are then **kiln dried** for 12 hrs. After this grains are ready for brewing. :-

In brewing, the malt is coarsely grounded by roller and mixed with water heated to 170° C. By doing this, sugar is dissolved and the infusion or wort is drawn off. This process of mashing is repeated several times. The liquid portion is cool down to which yeast is added for fermentation of the sugar at the particular temperature. The beer is then drained off and collected in wooden box to cool. A slow process of fermentation goes on which increases the alcoholic content and result in the formation of CO₂ which is responsible for the effervescence of the beer.

Beer contain 3-8% alcohol. Nutritive properties of beer is due to presence of sugar, dextrin and various proteins and phosphates.
In nutshell, for making beer, two processes are involved i.e.

(a) Malting (Germination / Sprouting of seeds-and conversion of starch into sugar)
(b) Brewing (Sugar is fermented by yeast into alcohol + CO₂)

The above two steps involve the use of diastase, malt and yeast.

[B] Distilled Beverages:

These beverages are obtained by the distillation of some alcoholic liquors. Some of the common distilled beverages are described below:

Whisky: It is colourless first, and colour develops during the aging process. Whisky is an alcohol distilled from a fermented mash of grains, or unmalted cereals or potatoes. This Whiskey is kept for aging in oak containers, at least for 4 years. During this process, nearly 40 volatile principles disappear.

Other whiskeys are prepared from different sources such as:

- Scotch Whisky - from barley malt
- Irish Whisky - from malt or unmalted grains of barley, oat and maize
- Russian Vodka - from wheat mash.
- American Straight Whisky - from maize or rye.

Rum: It is an alcoholic distillate prepared from sugarcan i.e. juice and molasses. It is one of the oldest and most widely known of the distilled beverages. Characteristic feature of rum are: dark colour (due to caramel), good aroma and 40% alcohol.

Brandy: It is distilled only from wine. The best quality brandy termed as ‘Cognac’ is produced in France. Other French Brandies are known as Armagnac. Alcohol content is high (65-75%).

Gin: It is prepared from a fermented mash of malt or raw grain. The best quality gin is obtained from barley malt and rye. Several distillations are necessary. Aromatic essential oils are added for flavouring. Mainly because of the presence of ‘juniper oil’, gin becomes medicinally important.

Fenny: Cashew apple (Kaju) Liquor of Goa. It is obtained from the excessive distillation of cashew apple (Anacardium occidentale) juice called ‘Fenny’. Goa in India is the only place where cashew liquor is being produced since 16th Century, when Portuguese brought it to Goa from Brazil.