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Learning Outcome

- ✓ **What are the masticatories and fumatories?**
- ✓ **What is source of tobacco?**
- ✓ **Detail account of tobacco processing, production and utilization.**
- ✓ **What are health hazards due to tobacco consumption by human beings?**

Introduction

All over the world, since the dawn of civilization, human being has been smoking or chewing various substances for religious, cultural or social ceremonies; to alleviate physical sufferings or purely for experiencing the pleasure. The substances used for smoking are called as **fumitories**, whereas those used for chewing to produce salivation as **masticatories**. Masticatory word originated from Latin *masticare* or Greek *mastikhe*, meaning to grind the teeth.

The chemical constituents of these substances either stimulate or depressed the Central Nervous System. Due to presence of various alkaloids in these substances, causing addiction to the person who consume them is a major health concern in long run, that leave deleterious effect or sometime leads to death of the addicted person.

Interestingly, some of these substances when taken in a limited dose are used as very effective medicine: either as stimulant which increase the functional activity of the body; or depressant (true narcotics) which relieve anxiety, pain and induce badly desired sleep.

Classification: Masticatories and fumatories can be classified based on their effects on consumption (Figure).

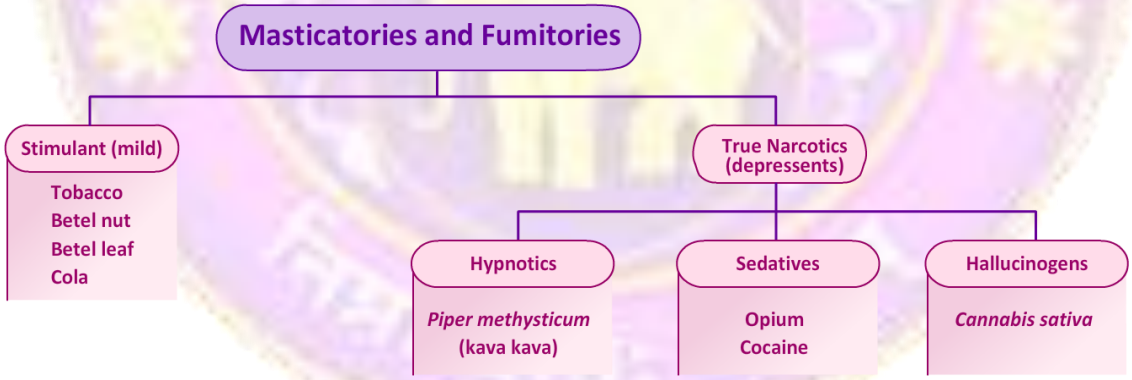


Figure: showing classification of mastcatories and fumitories based on their effect on consumption.

Table : List of the some plants used as fumitories and masticatories along with botanical name, family and characteristics of important plant part

Common Name	Botanical Name and Family	Characteristics of important plant part
Tobacco leaf Tambaku	*Nacotiana* sp. Solanaceae	Fumitory and masticatory, leaves rich in nicotine
Kola or cola	*Cola nitida* Sterculiaceae	Masticatory, seed or nut rich in caffeine
Betel palm supari	*Areca catechu* Arecaceae	Masticatory, seeds rich in arecoline
Betel vine pan	*Areca betle* Piperaceae	Masticatory, leaves
Coca or cocaine	*Erythroxylon coca* Erythroxylaceae	Leaves rich in cocaine
Indian Hemp	*Cannabis sativa* Cannabaceae	Resinous exudate rich in tetra hydro cannabinol (THC) an hallucinogenic compound

Tobacco (*Nicotiana* species)

Tobacco also called "Golden Leaf" is a major cash crop of India. India ranks second among world's tobacco producing countries during 2012. It provides employment (directly or indirectly) to 36 millions of people and contributed as much as Rs. 19,891.50 crores as excise duty and Rs. 4979 crore in terms of foreign exchange to the national exchequer, during 2012-13 (Tobacco Board, India, Annual Report 2012-13). Today, *Nicotiana* is grown throughout the world, except in the arctic regions.

Among all other species *Nicotiana tabacum* is most important one that originated in tropical America and now cultivated commercially throughout the world, which is smoked or chewed for its mild stimulant effects. According to World Health Organization (WHO) estimate around 1 billion people smoke tobacco worldwide i.e. 14% of global production.

Origin of word Tobacco: On the name of place i.e. Island of Tobago (West Indies) where Christopher Columbus during his visit in 1492, found natives using the leaves for pleasure.

Origin of Word *Nicotiana*: To honour the Jean Nicot a French Ambassador to Portugal who has introduced the tobacco into France in 1560.

Botanical name: Genus *Nicotiana*

N. tabacum

N. rustica

Systematic Position:

Family: Solanaceae

Chromosome Number: 2n = 48 Vernacular Names: Tamaku (in hindi); Tambaku (in hindi)

History and Origin

There are many contradictions and ambiguity in establishing the origin and history of tobacco. According to some reports, tobacco was in existence in Asia during 12th century, and was not only used as an intoxicant but also to cure a variety of illness and for worshiping the deities. However, the practice of tobacco smoking was first observed by Christopher Columbus and his followers when visiting the island of Tobago (West Indies) in 1492, found the natives using the leaves for pleasure in the form of handmade cigar. They also noted people were also sniffing a powdered dry leaf for pleasure. It is also thought that Tobacco was first observed by Columbus and his followers on landing in the Cuba, saw natives of Cuba inhaling the smoke through rolled leaves.

According to another version, the Red Indian were used tobacco for both ceremonial as well as medicinal purposes. They used to inhale smoke from burning leaf through the nostrils using hollow forked canes (tobaccos). The name of the instrument (tobacco) was given to the plant i.e. 'Tobaco' in Spanish and 'Tobacco' in English.

Tobacco was widely used and cultivated for medicinal and ritual purposes in many native cultures throughout America. Tobacco was introduced to Europe in the 1500s for medicinal purposes. It was brought to Spain in 1558 by a Spanish physician sent to Mexico. During 1560s, Jean Nicot, the French Ambassador to Portugal, introduce the plant to France, and later to honour the plant was named *Nicotiana* by Linnaeus.

History of Research on Tobacco in India

Tobacco was introduced into India by Portuguese in the beginning of 17th century. Initially, it was cultivated in Mehsana and Kaira districts of Gujrat state and later spread to other parts of the country.

Further, with the establishment of Botanical Garden in Hawrah in 1787, the effort to improve the Indian tobacco has begun. The seven species of *Nicotiana* imported from America in 1814, were grown in botanical garden at Calcutta. In 1875, a farm was established for cultivating and curing the tobacco at Pusa, Bihar.

Imperial Agricultural Research Institute, established in 1903, carried out research on tobacco. The first Director of IARI isolated 52 lines of tobacco, later Shaw and Kashiram added more lines in this sequence. In 1940, Dr B. P. Paul identified a selection NP-70.

Virginia tobacco cultivation and experiments were initiated in Pusa and Ghazipur (U.P). Flue curing was first successfully done in1928 at Guntur, Andhra Pradesh. In 1936, IARI established a Cigarette Tobacco Research Station at Guntur.

In 1945, Government Of India constituted Indian Central Tobacco Committee (ICTC). The Central Tobacco Research Institute (CTRI) was established in 1947, under the aegis of ICTC, Madras. In 1965, Indian Council of Agricultural Research (ICAR) has taken over the function of CTRI.

Origin of Commercial *Nicotiana* species:

Among all the recognized species of the genus *Nicotiana* 50 are indigenous to North and South America, 25 members of section Suaveolentes are native to Australia and Australian archipelago, and only 1 species (*Nicotiana africana*) is indigenous to Africa.

Among all the species, two species namely *N. tabacum* and *N. rustica* are important economically. The former is most important and occupying 90 % of world's acreage. *N. tabacum* originated in the tropical Americas (South America, Mexico and West Indies) and now cultivated worldwide. In fact, the natural cross between *N. sylvestris*, *N. tomentosiformis* and *N. otophora* and further duplication of hybrids gave rise the *N. tabacum* (Figure).

N. rustica is native of Mexico and Texas. This species is also amphidiploid, it is believed to be hybrid of two wild species, *N. undulata* and *N. paniculata* with subsequent duplication (Figure).

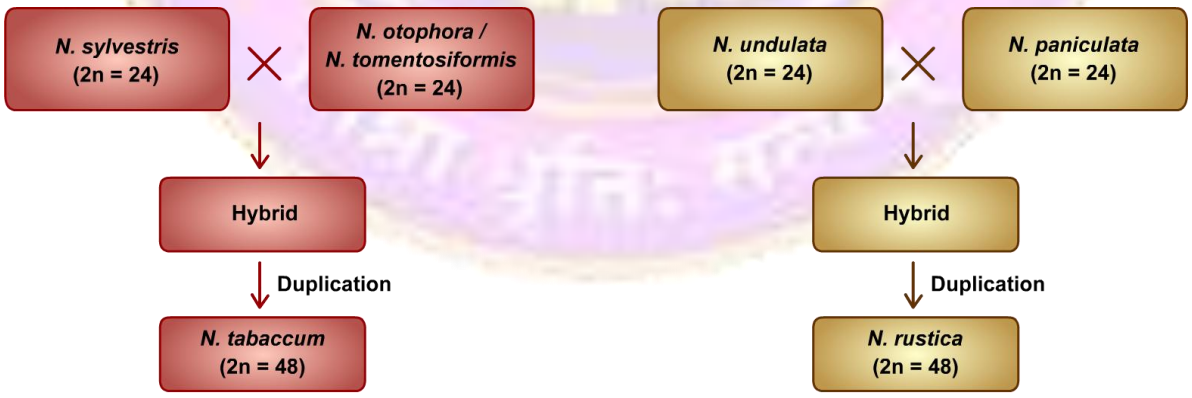


Figure: Probable ancesters of two most cultivated species i.e. *N. tabaccum* and *N. rustica*

Source: Author

Taxonomic Diversity and their diverse Utility

Nicotiana is a relatively large genus. Initially, the members of Genus *Nicotiana* were grouped in to 3 subgroups (Rustica, Tabacum, Petunioides) 14 sections, and 60 species.

- Smoking purpose: *N. tabacum*
- Ornamental purpose: *N. sylvestris*, *N. langsdorffii*, *N. alata*, N. glauca, *N. sanderae*.
- Industrial purpose: *N. rustica*, *N. gluca*. Recently, *N. rustica* has also been utilized as a source of nicotine for insecticides and of citric acid.
- Plant breeding and genetic research: *Nicotiana* species used as a very good system for several basic research on gene introgression studies. In fact, some species of *Nicotiana* offer a number of research advantages including broad phenotypic diversity, amenability to controlled hybridizations and ploidy manipulations, high fecundity and outstanding response to tissue culture.
- Model system in plant transformation: *Nicotiana* species have also been used as model systems in gene function investigations and for developing methodologies for plant transformation.

Production

India rank second in tobacco production among world's tobacco producing countries by producing 0.875 million metric tonne in 2012, whereas China was on top in the same year and produced 3.2 million metric tonne of tobacco (Table).

Table : Top five tobacco producing countries with their per cent of total world's production.

Country	Production in 2012 (1000 metric tonne)
China	3200
India	875

Brazil	**810.55**
United States	**345.84**
Indonesia	**226.7**

Source: Data extracted from http://www.statista.com

In fact, tobacco quality depends very much on climatic conditions, soil type, variety and curing. In fact, India grow all types of tobacco owing to its rich agro-climatic diversity which are broadly classified as:

Table: Showing different type of tobacco grown in various states of India.

S.N.	Tobacco type	State of cultivation in India
1.	FCV tobacco	Andhra Pradesh, Karnataka
2.	Bidi tobacco	Gujrat, Nipani area of Karnataka
3.	Cigar, Cherrot	Tamilnadu, West Bengal
4.	Hookah tobacco	Assam, W.B., Bihar, UttarPradesh
5.	Chewing, Snuff	Tamilnadu, W.B., Bihar, U.P., Assam
6.	Natu, Lankan, Burley, HDBRG	Andhra Pradesh
7.	Pikka tobacco	Orissa

In India, major tobacco producing states include Andhra Pradesh and Karnataka followed by Orissa, Maharashtra etc. Currently, tobacco is being cultivated in an area of about 4.93 Lakh hectares (0.24%) of total arable land in the country covering different types of tobacco (Table).

Out of the total production about 50% is cigarette type. In the cigarette type, most produced in India is flue-cured Virginia (FCV) tobacco type that cultivated in an area of 2.17 Lakh hectares mainly in the states of Andhra Pradesh and Karnataka. Bidi tobacco is cultivated in an area of about 1.02 Lakh hectares, mostly in Gujarat and Karnataka.

Morphology of Plant

***Nicotiana tabacum* (Smoking tobacco):** It is stout annual herb that can grow 1 to 3 m in height. The leaves are large but narrow, oblong to lanceolate in shape, sessile, alternate and spirally arranged around the stem. The flowers are white pinkish flowers.

The fruits is a capsule. Seed are numerous, very small, light coloured and ovoid in shape. All parts of the plant are sticky, covered with short gummy glandular hairs, which exudate a yellow secretion that contain nicotine.

Figure : Morphology of *Nicotiana tabacum*

Source: http://www.pfaf.org/user/Plant.aspx?LatinName=Nicotiana+tabacum

http://en.wikipedia.org/wiki/Nicotiana_tabacum#mediaviewer/File:Tabak_P9290021.JPG

***Nicotiana rustica* (Aztec/ wild tobacco):** It is bushy annual, relatively smaller plant with the height ranging 0.6 to 1.2 m. The Leaves are ovate to elliptic in shape; larger; hairy, fleshy and sticky; petiolate. The flowers are greenish yellow in colour.

It contains very high nicotine content (upto 9 times) than that of any other species of *Nicotiana*.

Figure: Morphology of *Nicotiana rustica*

Source:

http://en.wikipedia.org/wiki/Nicotiana_rustica#mediaviewer/File:Nicotiana_rustica_-_K%C3%B6hler%E2%80%93s_Medizinal-Pflanzen-226.jpg

http://upload.wikimedia.org/wikipedia/en/0/01/SacredTobacco.jpg

Table : Comparative analysis of two species of tobacco

Characteristics	*N. tabacum*	*N. rustica*
Origin	South America, Mexico, West Indies	Mexico, Texas
Climate conditions Required	Warmer conditions	Cooler conditions
Distribution in India	Peninsular India	North India
Height	Tall	Dwarf
Leaves	Large but narrow	Large and broad
Flowers	Reddish or pinkish white in colour	Dull green in colour
Seeds	Small and light weight	Larger and heavier
Varieties	Virginia, Nata, Adcock, Harrison special	Calcuttiya, Mohihari
Nicotine content	1 to 3%	3.5 to 9%
Utilization	Bidi, cigarette, cigar etc.	Chewing gum, hookah etc. organic pesticide

Source: Author

Ecological Requirements and Cultivation

Soil and Climate

Tobacco is originally a tropical crop but due to its wide adaptability, it is successfully grown under tropical, sub-tropical and temperate climates. Soil type and climatic conditions influences the growth and development of tobacco plant.

Well drained alluvial, loam or silt loam, properly aerated and open soil, with pH ranging from 5.0 to 6.5 are best soils for tobacco cultivation. But in many parts crop is successfully cultivated at pH 8 or more. Soil rich in humus and nitrogen gives better yield but poor quality of tobacco as it gives objectionable smoke.

In addition to soil type, climatic conditions such as rainfall, temperature, relative humidity, wind and sunlight influences growth, flowering and overall metabolism of the tobacco plant. Ideally, it requires about 3 to 4 frost free months after transplanting the seedling; long day lengths; rainfall during active vegetative growth; mean temperature of 26°C, and high relative humidity of 70 to 80%.

Cultivation

In India, tobacco is cultivated under very wide range of ecological conditions from coast line to an altitude of 3000 feet. In Punjab, it is grown as an early summer crop, but in South India it is winter crop grown from October to March. In the eastern and western part of India the crop is cultivated between September and January.

Preparation of Land For Nursery: Land is by ploughed 2- 3 times. Harrowing many times is better before seed beds are prepared.

Nursery Management

Tobacco seeds are egg shaped and very small with thick seed coat covering. The size and weight of the seed vary considerably and depends upon various factors such as species and variety, and the conditions under which seed is produced. In *N. tabacum* the average weight

of the seed varies from 0.08 to 0.09 mg, in other words 1100 to 1200 seeds/gram. In *N. rustica* seeds are lager and three times heavier than that of *N. tabacum*.

As Tobacco seeds are very small, the emerging seedlings are also very tiny, delicate and consequently the seeds are not sown directly to the field. But seeds are sown in seed beds or nurseries and extra care taken till the seedling attain a particular height before transplanting in the main field. For raising the seedlings in nurseries successfully, the important steps need to be taken care off are as follows:

- Seed bed are prepared on sandy to sandy loam soil and on an elevated area in the farm.
- It is desirable to select a new site for nursery or seed bed every time so as to minimize the incidence of pests and diseases and also eliminates contamination of other varieties. Old nursery site can be used for seed beds only after sterilization by **rabbing**. Rabbing is a soil sterilization method in which easily available slow burning waste materials like, tobacco stalks, sugarcane trash, paddy husk etc. burned in the seed beds after field preparation and few days before seed sowing.
- Size of seed beds are also varies. Ideal seed beds may be 10 cm high, 120 cm wide and 10 m in length.
- Green manuring
- Some farm yard manure (FYM)
- Seed are mixed with ten parts of the fine sand helps in the uniform sowing of the tiny seeds in seed beds.
- Seed beds are weeded, water and pesticides on regular basis.
- After 5 to 9 weeks of sowing, seedlings attain 12 to 15 cm height, having 4 to 5 leaves are ready for transplantation.

Preparation of Land For Cultivation: After ploughing 2 - 3 times, stubbles of the previous crop are collected and burned. Spreading of appropriate amount of FYM on land and then ploughing and harrowing is needed to mix it in the upper layer of soil properly.

Transplantation of seedlings

Depending upon the species and variety, and climatic conditions, the age of seedlings for transplantation varies considerably due to variability in growth rate.

- After seven to nine week old Tobacco seedlings can to be transplanted in case of *N. tabacum*, whereas five to six weeks requires before transplantation in case of *N. rustica*.

- In Punjab where seedlings are raised in winter season, the seedlings are ready for transplantation after 9 to 12 week of sowing.

Irrigation and de-weeding:

- Usually tobacco is grown during rainy season in moderate rainfall areas.

- In dryer regions, saplings are watered after 40 days of transplantation. In low rainfall areas, one to two irrigations are adequate.

- The irrigating water should not contain more than 50 ppm of chloride, as chloride badly affect the burning quality of tobacco.

- Hoeing and de-weeding is required regularly.

Topping and Desuckering:

Removal of the flower buds along with some topmost small leaves is called as 'topping'. Tobacco proposed for manufacturing 'bidi' or for chewing purposes topped greatly, whereas for aromatic tobacco use the plants are rarely topped.

In response to topping, the branches are arise from the axil of the leaves. These branches are known as 'suckers' and removal of these suckers after attaining 5 cm length is known as 'desuckering'. Both topping and desuckering operations help to divert the nutrients towards the leaves that improve its size and quality of tobacco. Desuckering can be done either by hand or by spraying chemicals (e.g. maleic hydazide).

Harvesting:

- After 4 months of transplantation, the leaves gradually change their colour and texture, that indicates the crop is ready for harvesting. In general, the dark green colour changes to greenish yellow and texture become brittle and tough.

- Infact, indication of maturity of leaves differ according to type of tobacco. In cigarette types, leaves turn yellow, droop down become gummy and stiffer.
- In case of hookah type mottling of leaves take place. In bidi type tobacco, brown coloured spots i.e. spangles are formed on leaves.
- 'Pruning' is the practice of tobacco harvesting in which whole crop is cut off close to the ground. Cigar and cheroot tobacco is harvested by pruning.
- Mature leaves picked separately, such leaf wise harvesting is known as 'Priming'. Harvesting is completed in 4 - 6 primings at weekly intervals. Cigarette and hookah tobacco is harvested by priming. Priming gives better quality of tobacco than that of obtained from pruning where whole plant is harvested.

Figure: Showing tobacco crop fields

SEEK PERMISSION

Source: http://www.ctri.org.in/index.php

Processing or Curing of Tobacco:

It is processing of tobacco in which moisture is removed from tobacco leaves. In fact, it is essentially dry fermentation or oxidation of tobacco leaves. During curing, green colour of leaves disappears, leaves become tougher in texture and go through chemical changes.

It is the type of curing that leaves receive determines the quality of tobacco and type of tobacco. The five major types of curing are described below.

Flue Curing:

- More than 40% of world tobacco production is flue cured and most of it used for cigarette manufacture. Flue cured is also called as **"Bright"** and **"Virginia"** in world market.
- Flue cured tobacco leaves are characterized by a high sugar:nitrogen ratio and colour vary from lemon to orange.
- Flue curing is carried out in barns specially designed to manage the humidity and temperature accurately. A system consisting the flue (metal pipes) starts from furnace and spread along the sides of the barn and led out through the wall as a chimney. Frequent slits in the walls after intervals are also part of the system for ventilation purpose.
- The leaves are harvested early and tied in a log and hang on the bamboos in the barn. Coal or wood is used as fire material for furnace of the barn.
- Flue curing consists basically in yellowing the leaves at moderate temperature and at high relative humidity, and then drying the leaves by gradual increasing the temperature and lowering the humidity without causing discolouration.
- The flue curing is completed in three stages as described: yellowing of leaves, fixing of colour, and drying of leaves.
- **Advanced flue curing** method are given below:

(a) Yellowing of Leaves: Temperature- dry bulb at 85 to 105°F; wet bulb 82 to 94°F; Time 36 to 48 hours. Furnace is charged after loading the tobacco leaves and temperature raised by 5 to 6°F above ambient temperature. Ventilators are left slightly open.

(b) Fixing of Colour: Temperature- dry bulb at 105 to 120°F; wet bulb 94 to 98°F; Time 5 to 10 hours. Progressive total time 39 to 47 hours.

(c) Drying of Leaves: Temperature- dry bulb at 120 to 145°F; wet bulb 98 to 110°F; Time 36 to 48 hours. After getting 130°F the top ventilators are closed and later the bottom ventilators are closed. At 140°F all the ventilators are closed.

(c) Drying of Midrib: Temperature- dry bulb at 145 to 160°F; wet bulb 110 to 114°F; Time 24 to 36 hours. Progressive total time: 88 to 101 hours. Temperature is raised and maintained at a maximum of 160°F until the stem is dry.

After the curing is over, the fire is put off. The barn is allowed cooled down keeping the ventilators closed.

Air Curing:

- About 20% of world's production is air cured that include various indigenous tobaccos such as **Wrapper tobacco**, **Lanka tobacco** and **Burley tobacco**. It is used mainly for cigar manufacturer. Other uses include for making bidi, chewing and snuff tobacco.
- Air cured tobacco contain high nicotine content but low percentage of starch and sugar.
- Air curing is take place in normal conditions and a slow process.

Sun Curing:

- About 14 to 16% of world's tobacco production is sun-cured. A number of tobacco are sun-cured in India.
- Sun curing is relatively rapid (2 to 3 weeks) as it is carried out in direct sun light in comparison to air curing that is a slow process and carried out in shade.
- There are four main modifications of the sun curing adopted in various states responsible for diverse type of tobaccos.

  (a) **Ground Curing** is the process in which either whole harvested plants or heap of primed leaves are left to dry in the field (ground). The first practice i.e. curing whole plant on ground is common in bidi tobacco of Gujarat and chewing tobacco in Bihar.

Other modification of curing in which heap of primed leaves are dried on ground is followed for hookah tobacco in West Bengal and chewing tobacco in Uttar Pradesh.

(b) **Rack Curing** is the process in which either whole plants or primed leaves together with pieces of stalk are cured on racks and exposed to sun to dry. The former practice is followed for cigar and chewing tobaccos of Tamil Nadu. Second practice where primed leaves together with pieces of stalk are cured on rack that is used for Natu tobacco in Andhra Pradesh.

Fire Curing (Smoke Curing):

- Fire-cured tobacco is generally used for chewing purposes, and very common in Jaffna, Sri lanka and Tamil Nadu, India. Soil preferences are silt or clay loam.
- The leaves are harvested either by priming or stalk cutting, and allow to wilt in the field for four hours before tied into bundles and then hung of laths in smoke huts. Then treated with smoke (burning of coconut husk, leaf stalk or any other easily available biomass) for 12 hours, stacked for 3 days and again treated with smoke.
- In fact, smoking and then stacking alternatively, makes the colour of tobacco leaves in an even way.
- During smoke treatments, tobacco leaves give a peculiar taste due to deposits of creosotic substances.
- Now at the end, the smoked leaves are bulked for 3 to 4 weeks and then specially treated with salt water from sea or with a jaggery to provide different taste.

Pit Curing:

- It is old and crude curing method, and is used only for chewing and hookah tobacco.
- The curing is done in pits (usually 90x90x90 cm in sizes). The pits are covered all around by using cheap straw or dried leaves and stem of sorghum (kadbi).
- The tobacco plants are arranged in layers in pit and then covered with straw and gunny bags. The top is covered with soil and then heated. Sometime water also sprinkled on pit for lowering down the temperature so as to avoid any over- heating.
- Pit curing takes one to two weeks. After curing, leaves are taken out of the pits and made into bundles or twisted into ropes.

Fermentation and Ageing of Tobacco

Bundles of cured tobacco leaves are bulked into stacks on the floor of fermentation barn for four to six weeks. These piles of leaves may be changed upside down so as to avoid any overheating or decomposition of lower leaves. These processes improves the combustibility, colour and aroma of the tobacco leaves.

Grading: According to size, colour and texture, tobacco leaves can be graded. Different grades of tobacco leaves are then tied in to bundles of about 20 leaves, called **hands,** or make of large blocks using machine, called **bales**. These bales then can be transported.

Ageing: The hands or bales of tobacco leaves are 'aged' for one to three years that reduces nicotine contents, improve flavour and reduces bitterness.

Chemical Constituents of Tobacco

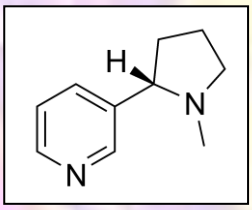
A great number of compounds have been isolated from the leaves. Tabacco smoke also release a large number of compounds. The processed leaves contains 10 to 15% moisture and 85 to 90% organic matter that includes carbohydrates, nitrogenous compounds, acids, polyphenols, pigments, alkaloids and other substances. Diverse essential oils and resins secreted by the glandular hairs of the leaves gives the characteristic aroma and flavour to the processed tobacco.

Tobacco contains various phytochemicals- alkaloids such as nicotine, anabasine (similar to nicotine but less active), myosmine and nicotyrine etc; glycosides such as tabacinine and tabacine. Others include 2- napthylamine, 2- methylquinone, propionic acid, nicotianine, choline, anatalline, anthalin, anatabine, nicotelline, nicotianine, cembrene and pyrene.

Nicotine is the main alkaloid distributed throughout every parts of tobacco plant, but reaches its highest concentration in leaves. Phytochemical analysis reveals that 64% of the total nicotine exists in the leaves, 18% in the stem, 13% in the roots, and 5% in the flowers. Seeds are devoid of any nicotine content. Further, nicotine concentration in the tobacco products determined by various factors such as species and variety, type of soil and climatic conditions, and the type of curing. Plant age and position of leaves on plant are also control the nicotine contents - as nicotine content increases with the age of plant and the lower leaves generally contain less nicotine. **The nicotine concentration in *N. tabacum* ranges from 4 to 6%, whereas higher concentration i.e. upto 12% in *N. rustica*.**

Did you know ?

- Nicotine (C10H14N2) is a tertiary amine composed of a pyridine and pyrrolidine ring.
- Chemically, it is also called as 3-(1-methyl 1-2- pyrrolidyl) pyridine.
- Chemical Structure



(Source: http://en.wikipedia.org/wiki/Tobacco#/media/File:Nicotine-2D-skeletal.png)

- Physico- chemical characteristic shows it is a colorless to pale yellow in colour, oily liquid; unpleasant pungent odour.
- It is soluble in water, ether, chloroform. alcohol, ether, karosene and fixed oils. Needs protection from light.

Tobacco Industry in India and Tobacco Export

Tobacco is very important crop of India that grown in about 15 states and influencing the economy and prosperity of the farmers. A number of types of tobacco grown in the country. FCV, Burley and Oriental tobacco are the major exportable types.

In India about 30 million people's livelihood depends on tobacco that include 6 million farmers and 20 million farm labour in addition 10 million people working in tobacco processing, manufacturing and export. Bidi rolling alone provides employment to 4.4 million people and 2.2 million tribals are involved in tendu leaf collection.

Annually, tobacco contributes 4400 crores towards foreign exchange earnings (accounting for 4% of total agri-exports) and 14000 crores to excise revenue (10% of the excise revenue collection of all sources).

India is one of the leading exporters of tobacco and occupies second position after Brazil. The country accounts for 0.7% by value of the world tobacco trade and more than 80% of our export include FCV. More than 60% of Indian FCV tobacco exported to U.K, Belgium, Germany, the erstwhile USSR, South Korea and South Africa. The exports of scented Bidis, scented chewing tobacco, Zarda and hookah tobacco paste are remarkable and there is a possibility of increase of these products in the near future.

Regulation Mechanism for Tobacco In India:

The following organizations are dealing with tobacco in India. **(For detail visit: http://dtd.dacnet.nic.in/organisation.htm)**

- Directorate of Tobacco Development
- Indian Tobacco Development Council
- Indian Council of Agricultural Research
- Tobacco Board
- Directorate of Marketing and Inspection
- Central Board of Excise and Customs
- Department of Agriculture in various States

Directorate of Tobacco Development: Ministry of Agriculture (Department of Agriculture & Co-operation), Government of India established the Directorate of Tobacco Development, on April 1, 1966 to look after development, marketing and other residual functions of erstwhile Indian Central Tobacco Committee. **(For details visit: http://dtd.dacnet.nic.in/index.htm)**

Tobacco Board: The Government of India under the Tobacco Board Act of 1975, established the Tobacco Board to regulate production, promote overseas marketing and control recurring instances of imbalances in supply and demand. The Board came into existence from January 1, 1976 and opened its head quarters at Guntur, Andhra Pradesh.

Mission: "To strive for the overall development of tobacco growers and the Indian Tobacco Industry".

Vision: "Tobacco Board is committed to accomplishing its role- the expressed will of parliaments - for the smooth functioning of a vibrant farming system, fair and remunerative prices to tobacco growers and export promotion."

Activities of the Tobacco Board: The Board aim at planned development of Tobacco industry in the country. **(For detail visit: http://tobaccoboard.com/index.php)**

Research Organizations

Central Tobacco Research Institute (CTRI):

(For details visit: http://www.ctri.org.in/index.php)

The institute is located at Rajahmundry in Andhra Pradesh. It was established by Indian Central Tobacco Committee (ICTC), Madras in 1947, and run under administrative control of ICTC from 1947 to 1965. During 1965, Indian Council of Agricultural Research (ICAR), New Delhi has taken over the institute for conducting fundamental and applied research on Tobacco for the benefit the farming community. The CTRI has six Regional Stations at Guntur, Kandukur, Jeelugumilli, Vedasandur, Hunsur and Dinhata, and a Burley Tobacco Research Centre at Kalavacharla.

The mandate of the CTRI and Regional Stations is to improve the yield and quality of various types of tobacco. The All India Coordinated Research Project on Tobacco (AINRPT) was sanctioned by the ICAR in April, 1970 with four main centers (Rajahmundry and Pusa, Shimoga and Anand) and five sub centres (Guntur, Hunsur, Dinhata, Nipani and Nandyal) to

strengthen the research on major problems of tobacco having regional and inter-regional significance. Two new centres at Berhampur (Orissa) and Araul (Kanpur, Uttar Pradesh) were also functioning from 1987-88 and 1988-89 respectively.

Later, AINRPT was merged with CTRI in August, 1988 with Director, CTRI also as the Project Coordinator. The new CTRI building was constructed during 1982 in the prime land of 15 acres. The institute headquater is located in Rajahmundry on the bank of river Godavari in East Godavari District of Andhra Pradesh.

Today, the CTRI is the biggest of its kind in Asia, well equipped with the most sophisicated instruments for carrying out basic and applied research. Presently, about 316 employees are working in the institute including 36 scientists, 126 technical staffs and 55 administrative staff and 99 other skilled support staff.

The CTRI has two patents to its credit: (i) process for purification of Solanesol (95%) from crude/enriched extracts of Tobacco green leaf/tobacco cured leaf/ Tobacco waste in October 2007, and (ii) invention of Palmyrah Fibre Separating Machine in January 2009.

Utilization of Tobacco and its products:

After curing, ageing and grading, the tobacco is used for various purposes such as snuff, chewing or smoking tobacco. The quality with respect to aroma/flavour and taste of tobacco products may also be improved by addition of sugar, glycerine, honey, vanilla, chocolate, cherry, mango etc. A variety of smoking form and an array of smokeless tobacco products are in use.

- Bidis consists of tobacco wrapped in a rectangular piece of dried tendu leaf (*Diospyros melanoxylon*).
- A cigarette is a combination of cured and finely cut tobacco, reconstituted tobacco and other ingredients rolled in to a paper (made up of flax or hemp) wrapped cylinder. A number of cigarettes also have a filter on one end.
- Cigar are generally made up of air cured tobacco. Cigar tobacco leaves after ageing and then fermented for 3 to 5 months that gives different taste and smell from cigarettes. cigar also contain higher level of nicotine than cigarettes.
- Dissolvable tobacco is a finely processed tobacco that dissolved on the tongue or in the mouth. It contains nicotine and is smoke and spit free.

- Hookah consists of head, body water bowl and hose. In hookah smoking, a pipe is used, a combination of tobacco that is heated and the smoke is filtered through water.
- Pipes are consist of a bowl, stem and mouthpiece. Tobacco is placed into the bowl and lit, and smoke is drawn through stem and mouthpiece and inhaled.
- Smokeless Tobacco may be either chewing tobacco/spitting tobacco or snuff. Chewing tobacco comes in the form of loose leaf, plug, or twist. The user kept the tobacco in their cheek or between their gum and cheek, and then suck on the tobacco and spit out the tobacco juices.

  Snuff is finely ground tobacco that can be moist, dry or in tea bag like pouches. Some form of snuff can be used by sniffing or inhaling into the nose.

- E- cigarette is battery powered device that contains a cartridge filled with nicotine, favor and other additives. It is a electronic nicotine delivery system.
- Tobacco seed oil contain no nicotine. Refined tobacco seed oil can be used as a substitute for groundnut oil. It is also used in oil paint and varnish industries.
- The seed cake is nutritious and used as feed for cattles.
- The nicotine obtained from tobacco crop waste (stem, midrib etc.), is commonly used in agriculture as insecticide for the control of aphids, thrips and leafhoppers. Nicotine bentonite, a insecticide is also synthesized from tobacco crop waste.
- Traditionally, Tobacco preparations are known to their medicinal properties. It is used as sedative and for treatment of gastro-intestinal disorders.
- Nicotinic acid (oxidized product of nicotine) is important constituent for many vitamin preparations.

Health Hazards:

- Tobacco is not safe to health in any form as all forms contain nicotine and can cause addiction and health problems and cause killing of nearly six million people worldwide each year.
- The smoking of tobacco contains tar and nicotine, besides carbon monoxide, ammonia, dimethyiniyrosamine, formaldehyde, hydrogen cyanide and acroline. Tobacco tar (particulate phase) is a carcinogen whereas Nicotine is an alkaloid that is addictive and also increased cholesterol level in blood.

- More than 4000 different chemicals have been identified in tobacco and tobacco smoke. Among these, more than 60 chemicals are known to cause cancer.
- According to the International Agency for Research on Cancer (IARC), the tobacco smoking causes cancer of the lungs, oral cavity, naso-, oro- and hypo-pharynx, nasal cavity, larynx, stomach, esophagus, pancreas, liver, kidney, ureter, urinary bladder, uterine cervix and bone marrow. Tobacco smoking cause 90% of all lung cancer deaths in men and 80% in women.
- Bidis are carcinogenic. Bidi smoking is also associated with an increased risk for coronary heart disease and heart attacks, and risks for chronic bronchitis. There is no evidence to indicate that bidis are safer than cigarettes. Incidence of oral cancer among bidi smokers were reported 42% as compared to that of Cigarettee smokers.
- Smoking cigarettes causes cancers of bladder, oral cavity, pharynx, larynx, esophagus, cervix, lung, kidney, pancreas, and stomach, and causes acute myeloid leukemia. It also causes heart diseases and stroke.
- Cigar smoking cause cancer of mouth, lips, tongue, throat, larynx, pancreas, lung and bladder cancer. Like cigarette smoking, it is linked to disease where gums shrinking away from the teeth, and also cause sexual impotence in men.
- Dissolvable Tobacco is very new to the market, the research on its health effects need to be conducted.
- Smokeless Tobacco products are known to addictive in nature, cause health risks and are not safe substitute for smoking tobacco. The nicotine is absorbed mainly through the skin in the mouth. Smokeless tobacco contain 28 carcinogens and cause cancer of oral cavity, leukoplakia and recession of the gums.
- E- cigarette also contains known carcinogens and toxic chemicals that cause risks to users.
- In hookah smoking, even after passing through water, smoke contains nicotine, besides high levels of toxic compounds including carcinogens, heavy metals and carbon monoxide. Hookah smoking is linked to lung, mouth and other cancers, heart diseases and respiratory infections.

- Pipes smoking is linked to cancer and cause gum diseases, and stroke, coronary heart disease. It also cause ” hairy tongue".

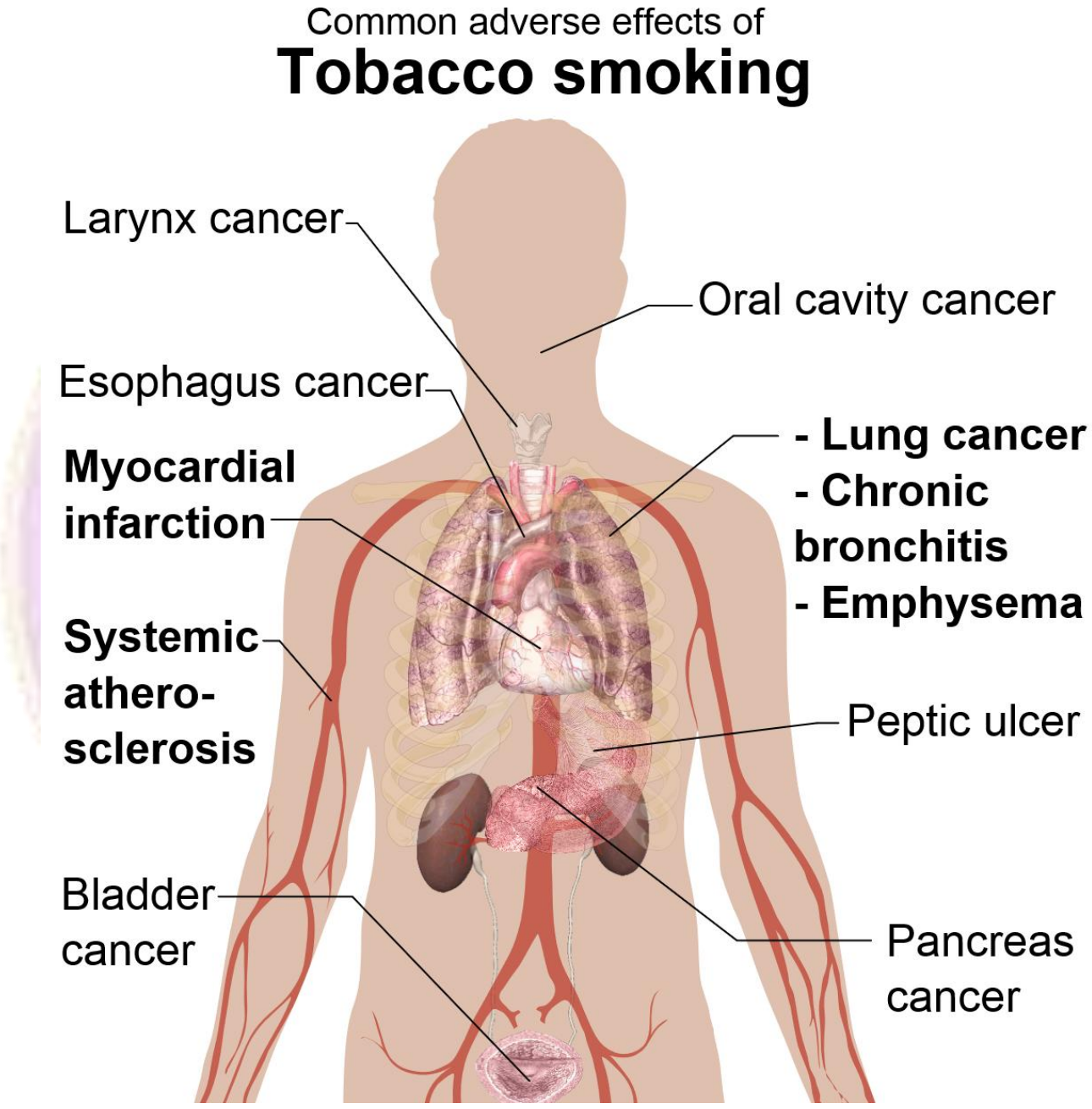


Figure: showing common adverse effects of tobacco smoking on various human systems

Source:

http://commons.wikimedia.org/wiki/File:Adverse_effects_of_tobacco_smoking.svg

Legislations to Control Tobacco in India:

- Cigarettes (Regulation of Production, Supply and Distribution) Act, 1975

  Warning on Packages and Advertisements: "Cigarette Smoking is Injurious to Health"

- Tobacco Board Act, 1975

  Brought tobacco under a single jurisdiction i.e. Central Government

- In 1990, Central Government issued directive for prohibiting smoking in public places, banned tobacco advertisements on National Radio, T.V. channels and also advised the State Governments to discourage sale of tobacco around educational institutions. Mandatory display of statutory health warning on chewing tobacco products.

- In 1999, Ministry of Railway banned sale of cigarettes and beedies on railway platforms and in trains

- In 2001, Supreme Court of India mandated a ban on smoking in public places

- The Cigarettes and other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production, Supply and Distribution) Act, 2003 **(COTPA 2003)**. The key provisions are as follows:

  - Prohibition of smoking in public places. It has been implemented from October 2, 2008.
  - Prohibition of sale to minors <18 years
  - Prohibition of sale within a radius of 100 yards of educational institutions
  - English and one more Indian language to be used for health warnings on tobacco packages
  - Pictorial health warnings
  - Regulation and testing of ingredients (Tar and Nicotine) and decelerating of tobacco product packages

- After drafting health warning policy in 2006 and revised in 2006 and 2007, released in 2008 and were implemented on all cigarette packages on May 31, 2009.
- In 2011, Government of India (Ministry of Health and family Welfare) proposed an amendments to the rules included four additional pictorial warnings to be used on tobacco and bidi packages, and 4 additional pictorial warnings for smokeless tobacco packages. The date of implementation of these rules was December 1, 2011. Further, out of each set of four pictures for smoking tobacco and smokeless tobacco products, the tobacco companies were allowed to choose any one picture.

Figure: Images proposed after April 2015.

- On 27 September, 2012, new rounds of pictorial warnings were proposed. Fourty percent of the front of all cigarette packages required to cover health warnings.
- On 15 October, 2014, Government of India has made further amendments to the rules.
- On 1 April, 2015, health warnings will be required to 85% of the front and back of the package of tobacco products.

International Initiatives and Tobacco Control

- ✓ Resolution of World Health Assembly in 1986 1nd 1990 to urged member states to impose stronger legislative measures
- ✓ Ministry of Health, Government of India and WHO in 1991 organized regional and national consultation on "Tobacco or Health"

The WHO Framework Convention on Tobacco Control (WHO FCTC)

(Also visit http://www.fctc.org/)

It is the world's first modern-day global public health treaty that entered into force in February 2005. It is also the first treaty negotiated under the auspices of the World Health Organization (WHO). It was signed by 168 of the 192 WHO member states and more than 170 WHO member states have become parties to the convention.

The convention provides an well co-ordinated international response to combating the tobacco epidemic, and set out specific steps for governments addressing use of tobacco and its products, that include:

- To adopt tax and price measures to reduce tobacco consumption;
- To ban tobacco advertising, promotion and sponsorship;
- To create smoke-free work and public spaces;

- To put health warnings on tobacco packages;
- To combat illicit trade in tobacco products; and
- To help the people to quit tobacco use.

Summary

- The substances used for smoking are called as **fumitories**, whereas those used for chewing to produce salivation as **masticatories**.
- Tobacco also called **"Golden Leaf"** is a major cash crop of India. India rank second in tobacco production among world's tobacco producing countries by producing 0.875 million metric tonne in 2012, whereas China was on top in the same year and produced 3.2 million metric tonne of tobacco
- It provides employment (directly or indirectly) to 36 millions of people and contributed as much as Rs. 19,891.50 crores as excise duty and Rs. 4979 crore in terms of foreign exchange to the national exchequer, during 2012-13.
- Tobacco is being cultivated in an area of about 4.93 Lakh hectares (0.24%) of total arable land in the country. Most produced in India is **flue-cured Virginia (FCV) tobacco** type that cultivated in an area of 2.17 Lakh hectares mainly in the states of Andhra Pradesh and Karnataka. **Bidi tobacco** is cultivated in an area of about 1.02 Lakh hectares, mostly in Gujarat and Karnataka.
- Tobacco is originally a tropical crop but due to its wide adaptability, it is successfully grown under tropical, sub-tropical and temperate climates. ***Nicotiana tabacum*** (Smoking tobacco) and ***Nicotiana rustica*** (Aztec/ wild tobacco) are two commercial species. *N. rustica* contains very high nicotine content (upto 9 times) than that of any other species of *Nicotiana*.
- In India, tobacco is cultivated under very wide range of ecological conditions from coast line to an altitude of 3000 feet.
- As Tobacco seeds are very small, seeds are sown in seed beds or nurseries and extra care taken till the seedling attain a particular height before transplanting in the main field. Depending upon the species and variety, and climatic conditions, the age of seedlings for **transplantation** varies considerably due to variability in growth rate. **Topping** and **desuckering** is also very important in tobacco cultivation.
- After 4 months of transplantation, the leaves gradually change their colour and texture, that indicates the crop is ready for **harvesting**.

- **Curing** is processing of tobacco in which moisture is removed from tobacco leaves. In fact, it is essentially dry fermentation or oxidation of tobacco leaves. During curing, green colour of leaves disappears, leaves become tougher in texture and go through chemical changes.

- It is the type of curing that leaves receive determines the quality of tobacco and type of tobacco. The five major types of curing are described. More than 40% of world tobacco production is **flue cured** and most of it used for cigarette manufacture. Flue cured is also called as **"Bright"** and **"Virginia"** in world market.

- About 20% of world's production is **air cured** that include various indigenous tobaccos such as **Wrapper tobacco**, **Lanka tobacco** and **Burley tobacco**. It is used mainly for cigar manufacturer. Other uses include for making bidi, chewing and snuff tobacco.

- About 14 to 16% of world's tobacco production is **sun-cured**. A number of tobacco are sun-cured in India. **Fire-cured tobacco** is generally used for chewing purposes, and very common in Jaffna, Sri lanka and Tamil Nadu, India. **Pit Curing** is old and crude curing method, and is used only for chewing and hookah tobacco.

- Nicotine is the main alkaloid distributed throughout every parts of tobacco plant, but reaches its highest concentration in leaves. **The nicotine concentration in *N. tabacum* ranges from 4 to 6%, whereas higher concentration i.e. upto 12% in *N. rustica*.**

- India is one of the leading exporters of tobacco and occupies second position after Brazil. The country accounts for 0.7% by value of the world tobacco trade and more than 80% of our export include FCV.

- The Government of India under the Tobacco Board Act of 1975, established the **Tobacco Board** to regulate production, promote overseas marketing and control recurring instances of imbalances in supply and demand. **Central Tobacco Research Institute (CTRI)** is located at Rajahmundry in Andhra Pradesh.

- Tobacco is **used for various purposes** such as snuff, chewing or **smoking tobacco**. Tobacco seed oil contain no nicotine. Refined tobacco seed oil can be used as a substitute for groundnut oil. It is also used in oil paint and varnish industries. The seed cake is nutritious and used as feed for **cattles**. The nicotine obtained from tobacco crop waste (stem, midrib etc.), is commonly used in agriculture as

insecticide for the control of aphids, thrips and leafhoppers. Nicotine bentonite, a insecticide is also synthesized from tobacco crop waste. Traditionally, Tobacco preparations are known to their medicinal properties. It is used as sedative and for treatment of **gastro-intestinal disorders**. Nicotinic acid (oxidized product of nicotine) is important constituent for many vitamin preparations.

- Tobacco is **not safe to health** in any form as all forms contain nicotine and can cause addiction and health problems and cause killing of nearly six million people worldwide each year. The smoking of tobacco contains **tar and nicotine**, besides carbon monoxide, ammonia, dimethyiniyrosamine, formaldehyde, hydrogen cyanide and acroline. Tobacco tar (particulate phase) is a carcinogen whereas Nicotine is an alkaloid that is addictive and also increased cholesterol level in blood.

Exercise/Practice

- Write the botanical name, plant part and name of the family of the plant that yield tobacco. Describe briefly the different types of processing/curing of tobacco leaves.
- Describe briefly the various tobacco products and their uses. Also mention their health hazards.
- Differentiate between the followings:
    - *Nicotiana tabacum* and *Nicotiana rustica*
    - Air curing and Flue curing
- Define the followings:
    - Tar
    - Bidi
    - Smokeless tobacco
- Write short notes on the followings:
    - Curing
    - Health Hazards of Tobacco Smoking
    - Nicotine
    - Central Tobacco Research Institute
    - Role of Tobacco Board
- Expand the followings: CTRI, FCV.

Glossary

Addiction: It is a strong dependence on a drug despite adverse consequences. In fact, it is associated with long-lasting changes in the brain

Ageing: It is a mild state of fermentation. The hands or bales of tobacco leaves are 'aged' for one to three years that reduces nicotine contents, improve flavour and reduces bitterness.

Bidi (bee-dee): a small, thin hand-rolled, granulated tobacco wrapped in tendu (Diospyrus melanoxylon) leaves and tied with thread. Bidis are most commonly smoked tobacco product in India.

Cellulose Acetate (secondary acetate): Chemically, it is a partially acetylated cellulose. It is a white, tasteless, odorless nontoxic solid used for making cigarette filters.

Cigarette: It is a cured and finely cut tobacco, reconstituted tobacco and other additives rolled into a paper wrapped cylinder.

Cigarette Paper: This is the paper to wrapp the cigarette rod. Flax and hemp are the most common plant source for making cigarette paper. Others such as kenaf, rice straw, esparto grass, high quality cellulose may be used. The paper which encloses the tobacco column is called the cigarette wrapper.

Curing: It is dry fermentation or oxidation of tobacco leaves. Consequently, colour, texture and chemical change occurs in leaves.

Desuckering: In response to topping, the branches are arise from the axil of the leaves. These branches are known as 'suckers' and removal of these suckers after attaining 5 cm length is known as 'desuckering'.

Dissolvable tobacco: It is a finely processed tobacco that dissolved on the tongue or in the mouth. It contains nicotine and is smoke and spit free.

Nicotine: It is most abundant alkaloid; first isolated from smoke in 1809 by L. Vaqueline. Nicotine is derived from the *Nicotiana* plant (tobacco), and it is mainly responsible for smoking's addictive and psychoactive effects.

Pruning: It is the practice of tobacco harvesting in which whole crop is cut off close to the ground. Cigar and cheroot tobacco is harvested by pruning.

Second hand Smoke: A mixture of gases and fine particles that includes smoke from burning cigar, cigarette etc; smoke that breathed out by the people smoking.

Smokeless tobacco: It may be chewing or snuff. Chewing tobacco comes in the form of loose leaf, plug, or twist. Snuff is finely ground tobacco that can be moist, dry or packaged in sachets.

Tar: It is a condensable residue present in smoke from burning tobacco; contains resins, phenols, acids, and essential oils.

Tendu leaves: These are derived from *Diospyrus melanoxylon* leaves and used for wrapping granulated tobacco than tied with thread that makes bidi. Bidi is a very common tobacco product in India.

Topping: Removal of the flower buds along with some topmost small leaves is called as 'topping'.

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