

# E-PRACTICAL CUM TEACHING MANUAL

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**Non- Timber Forest Products**

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**B.Sc. (Hons) Forestry**



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## **E-PRACTICAL CUM TEACHING MANUAL**

### **Non- Timber Forest Products**

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## Preface

The forest cover of India as per the present assessment of the Forest Survey of India is 63.73 million ha comprising 19.36% of the total geographic area. Out of this, 37.74 million ha (11.48%) is dense forest, 25.5 million ha (7.76%) open forest and 0.49 million ha (0.15%) consists of mangroves. The forest areas situated in the vicinity of population centers/villages are degrading rapidly, primarily due to the collection of fuel wood, cattle-grazing and over-exploitation of forest products.

In the ancient times forests were treated as a sacred resource in India. However, in past couple of hundred years, due to faulty policies, they have been looked merely as a source of commercial timber and the entire forestry department has been geared only for that end use. It is time to realize the importance of forest as a source of Non-Timber Forest Products (NTFPs), as an environmental necessity, as an aesthetic need, a source of recreation and a home of important heritage of wildlife. All these useful contributions of forests, other than just timber, are being realized now.

The significance of the NTFPs is being increasingly realized through better understanding of their value to the economy as well to the environment. The emerging trend of market preference for natural products and the increasing emphasis on the efficient and sustainable use of natural resources have further helped gain this appreciation. Greater understanding of the role of NTFPs in the overall socio-economic well being of the communities living around forests is better understood today. It is now realized that NTFPs play an important role in the household food security of rural populations in most of the developing countries. Furthermore, it is understood that their benefits are even more significant for women and for the disadvantaged classes of society.

It was felt opportune to compile relevant information on NTFPs since such information was not readily available in one source of literature. A panel of expert forestry scientists of India was identified and requested to contribute their knowledge on the selected topics of their fields of specialization. An attempt has been made to cover the widest possible range of subjects falling within Non-Timber Forest Products of India.

I would like to particularly acknowledge the help of Dr. (Prof.) Narendra Pratap Singh Honorable Vice-Chancellor, Banda University of Agriculture and Technology Banda. Dr.A.K.Shrivastava, Director PMEC, BUAT, Banda, Dr. A.K. Mishra Director Research BUAT, Banda, Dr. Sanjeev Kumar Dean, CoF, BUAT, Banda for all legal permissions to the editor of the E-Teaching cum Practical Manual of Non-Timber Forest Products.



Dr. Yogesh Yadavrao Sumthane

Assist. Professor Forest Product  
and Utilization

## Foreword

Worldwide, forests have been under constant threat of degradation through uncontrolled and highly diversified land use for increasing societal needs; agricultural expansion; and environmentally non-sustainable management, including lack of adequate forest-fire control, poaching, unsustainable commercial logging, over grazing, unregulated browsing, airborne pollution and economic incentives offered by other sectors of economy, detrimental to the forests.

Renewable forests resources, when sustainably maintained, are compatible with environmental conservation. The implications of the harvesting of forest resources, other than timber, should be fully taken into consideration in the development of forest policies. It is also possible to increase the intrinsic value of forests through such uses as eco-tourism and the managed harvesting of valuable genetic resources. Concerted action is needed to enhance the people's perception of the value of forests and of the vast range of often ignored benefits they provide.

The value of forests to the environment has long been recognized. Forests help in the moderation of climate, in the conservation of soil and water supplies, in the control of droughts and floods, in the improvement of landscape and in meeting several recreational needs. Economically, besides timber and firewood, forests contribute a range of non-timber products, collectively called 'Non-Timber Forest Products' (NTFP).

Some eighty percent of developing world population depend on Non Timber Forest Products for their day to day primary health and nutritional needs. Several millions of rural people all over the world depends on these products for their subsistence and income. They support village-level artisanry and crafts. NTFPs provide raw material to support several large scale processing enterprises as well. These include a number of important commodities used in food products and beverages, confectionery, flavourings, perfumes, medicines, paints, polishes and more.

I appreciate the efforts made by Dr.Yogesh Y. Sumthane, Assist.Professor and His Team have collected and compiled valuable information pertaining to NTFPs of India. I am Confident that the information presented in this E-Teaching cum Practical manual will help the Students, Academicians and Industrialists, in their respective fields.

I wish the authors success in their endeavour.



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Dean, CoF,  
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## **IMPORTANCE, SCOPE AND POTENTIAL OF NON-TIMBER FOREST PRODUCTS**

Forests constitute some of the richest natural resources of the world. Of the 6.2 billion people on the planet, 25 percent depend to varying degrees on the forest resources for their Sustenance and livelihood security. Forest helps humanity by different ways, both economically as well as ecologically. These contribute to the environment in the moderation of climate, conservation of soil, regulation of water supplies, control of droughts and floods, improvement of landscape, recreation etc. Throughout the world forests have a tremendous value both in terms of timber and non-timber forest products. NTFP's or minor forest products other than "Major Forest Products" (which consist of timber, small wood and fuel wood) cover grasses, fruits, leaves, barks, exudates, animal products, medicinal and aromatic plants, soil, minerals, etc. 400 million people living in and around forest in India depend on NTFP's for the sustenance or livelihood and often use forest products extensively, both for their own consumption and for income generation. The World Health Organization (WHO) estimates that about 80 per cent population of the developing world use NTFP's for health and nutritional needs: Globally the forests cover 3,625 m ha or 22.7 per cent of the total land surface (an covered with ice) of the world.

India is one of the twelve mega-biodiversity areas of the world with its approximately 48,000 species of plants (Flora) and 81,000 species of animal life (Fauna). Thus bestowed with varied climatic conditions and rich biodiversity. Indian people have been utilizing NTFP's from time immemorial as the main source of food, fodder, fibre, medicine, cosmetics and local crafts etc. In India, out of approximately 17,000 species of flowering plants and about 31,000 non-flowering species, 10,000 species are used by the people in one form or the others.

Production of around 1,01, 200 tonnes of food products, 1,32,250 tonnes of Myrobalan, 70,97,000 tonnes of Sal seeds, 6,97,600 tonnes of Mahua seeds, 1,15,000 tones of Neem seeds, 1,600 tonnes of Palmarosa oil, 150 tonnes of Eucayptus oil, 160 tonnes Sandal oil, 950 tonnes of Lemon grass oil, 1,80,00 tonnes of gums, 17 000 tonnes of resin, 360,000 tonnes of bidi leaves, 47,16000 tonnes of Bamboos, 5,750 tonnes of fibres ad 13,000 tonnes of lac had been recorded in India (Tiwari, 1994).

Millions of people living near the forests in the developing countries on NTFP's. In Asia NTFP's have long been an important part of national and local economics (FAO, 2001). In India, out of approx 17,000 species of flowering plants, and around 31,000 non-flowering species. 10,000 species are used by the people in one form or the other.

## Classification of non timber forest products

- |                               |   |
|-------------------------------|---|
| 1. Fibres and flosses         | 6. Drugs, spices, poisons and insecticide     |
| 2. Grasses, bamboos and canes | 7. Leaves                                     |
| 3. Essential oils             | 8. Edible products                            |
| 4. Oil seeds                  | 9. Lac and its products                       |
| 5. Tans and dyes              | 10. Animal, mineral and miscellaneous product |

Non-timber forest products also permeate every aspect of daily life in rural India| like fruits tubers, vegetables, mushrooms, spices toothbrushes, dyes, baskets, leaf plates, brooms, leaf manure, sticks, stakes, fencing, pesticides, fodder and ropes etc.

## Cottage Industries based on NTFP's

- Bamboo and cane work, basket making, curtain making etc.
- Manufacture of match-splints, tool handles and foot mats
- Beedi manufacturing
- Distillation of essential oils viz., lemongrass, rose, palmarosa, eucalyptus, khus, sandal wood, mentha, wild marigold etc.
- Katha manufacturing
- Extraction of tanning materials
- Rope making
- Leaf plates
- Wood carving
- Charcoal making
- Sericulture
- Tans, dyes, colours, ink etc.
- Bee keeping
- Starch making Collection and processing of medicinal plants
- Handmade paper manufacturing
- Brooms, brushes, mats and cushions etc.

These are truly the people's products and their use and trade are integral components not only of economics and culture, but also for maintenance of biodiversity and conservation of ecosystems. In the Himalayas, indigenous people normally consume various parts of the

selected NTFP's constituting about 25 per cent to 75 per cent of their normal diet. NTFP's can be a major source of foreign exchange in India as well. These provide as much as 50 per cent of the income to about 30 percent of rural people. In India 40 per cent of the total forest revenue and 55 Per cent of forest based employment comes from non-wood forest product ( Nautiyal and Kaul 2003).

Studies in Orissa, Madhya Pradesh, Himachal Pradesh and Bihar indicate that over 80 per cent of forest dwellers depend entirely on NTFP's. 17 per cent landless depend on it for daily paid laborers and 39 per cent are involved in NTFP's collection as an occupation (Shiva, 1996). The value of direct contributions of NTFP's in India has been estimated to be about 27 billions US \$ compared to only about 17 billion US \$ for wood products without including the service charges (Anonymous, 1996).

NTFP's have attracted considerable global interest in recent years due to an increasing recognition of their contribution to household economics and food security and conservation of biological diversity at the same time.

Medicinal plants are important in almost all the countries in the Asia and pacific region. More than 80 per cent of the population in the developing countries of the region is believed to be dependant medicinal plants for curing various diseases. Forests in India provide hundreds of medicinal plants some of which are recognized by the National Pharmacopoeia, while others are in indigenous medicine. Out of around 3000 plants mentioned in the Indian Materia Medica, over 1800 are used frequently in the preparation of medicines under Indian Systems of medicines and Homoeopathy (ISM&iH).

In Indian, The ecological status and genetic diversity consists of large number of species possessing medicinal and aromatic properties. Indian pharmacopoeia has recognized only cent of these plants for use as drugs and much needs to be done.

Therefore, when people think of NTFP's, they often think of medicinal and aromatic plants first. Ayurvedic and pharmaceutical industries have been obtaining 95 percent of raw material medicinal plants from forests till date. Essential oils are also a good source of forest revenue India 30 million US \$ perfume market is fast growing, creating demands for natural fragrance which are used in making perfumes, soaps, cosmetic, pharmaceuticals, aerated waters, food flavours etc.

The Himalayan hills are the abode of medicinal and aromatic plants and the Western Himalaya excels in producing herbs of high medicinal value ever since Vedic times. In the Western Himalayan region, the sources of nearly 80 per cent of Ayurvedic medicines raw materials are existing, which contribute to national economy by feeding indigenous industries to earn foreign exchange through the export of these drugs in crude or purified form 1 various parts of the world. A total of 880 species of medicinal plants are in active



trade in tinea country with an estimated volume of 1,28,000 tonnes of raw material traded during 2001 and 3,28,000 tonnes during 2004-2005 (Anonymous, 2003, EXIM Bank). The major portion of this raw material is consumed by 10,000 odd licensed units manufacturing herbal medicines and other products across the country. Total turnover of domestic herbal sector in the country for the year 2001 was around Rs. 4200 crores. About 85 per cent of the raw material of these traded species still comes from the wild sources. Export of plant based crude drugs was about Rs. 463 crores during 2001. The national herbal sector is growing at 30 per cent and was valued at Rs. 5000 crores in 2004. It has recently reached to around Rs. 8800 crores and the export of these items has also gone up to Rs. 515 crores.

There is a great scope for the rare and high value medicinal plant species of the Himalayan region and the rich ethno-medicinal knowledge of its people regarding use of such species for various healthcare needs and converting these into furnished/semi furnished value added products before export.

NTFP's provide greater employment opportunities to the people than the wood itself. This is particularly true in respect of an unskilled labour force. Most of the activities pertaining to NTFP's like collection, plucking, processing, transport, marketing etc. are labour intensive and provide substantial employment. Has been estimated that NTFP's generate employment to the tune of about 1.2 million persons per year, which is 55 per cent of the total employment in the forest sector (Dwivedi, 1993).

### **Annual demand of medicinal plants (INDIA)**

S.NO.	Species	Demand ( In tonnes)		Annual Growth (%)
		2001-2002	2004-2005	
1.	<i>Emblica officinalis</i> (Amla)	22729.5	41782.9	22.5
2.	<i>Withania somnifera</i> (Ashwagandha)	9127.5	9127.5	9.1
3.	<i>Aconitum heterophyllum</i> (Atis)	270.1	484.4	18.4
4.	<i>Phyllanthus amarus</i> (Bhumi amalaki)	2212.6	2985.3	10.5
5.	<i>Bacopa monnieri</i> (Brahmi)	3822.4	6621.8	20.1
6.	<i>Swertia chirayita</i> (Chirata)	965.2	1284.7	10.0
7.	<i>Berberis aistata</i> (Daru haridra)	1187.3	1829.7	15.5

8.	<i>Tinospora cordifolia</i> (Giloe)	2258.3	2932.6	9.1
9.	<i>Nardostachys grandiflora</i> (Jatamansi)	674.9	866.8	8.7
10.	<i>Gloriosa superba</i> (Kalihari)	65.4	100.2	15.4
11.	<i>Andrographis paniculata</i> (Kalmegh)	2005.0	2197.3	3.1
12.	<i>Saussurea costus</i> (Kuth)	1414.1	1826.3	8.9
13.	<i>Picrorhiza kurrooa</i> (Kutki)	220.3	317.0	12.9
14.	<i>Solanum nigrum</i> (Makoi)	2077.9	2192.2	1.8
15.	<i>Glycyrrhiza glabra</i> (Mulethi)	873.4	1359.8	15.9
16.	<i>Coleus barbatus</i> (Patharchur)	37.8	60.8	17.2
17.	<i>Piper longum</i> (Pippali)	3992.5	6280.4	16.3
18.	<i>Cassia angustifolia</i> (Sanaye)	6462.5	11677.3	21.8
19.	<i>Asparagus racemosus</i> (Shatavari)	10942.7	16658.5	15.1
20.	<i>Ocimum sanctum</i> (Tulsi)	3296.8	5402.9	17.9
21.	<i>Aconitum ferox</i> (Vatsnabh)	322.3	3426.8	30.0

### Strategies for Development of NTFP's

- Item-wise resources inventory, survey and formulation of projects.
- A conservation programme including protection, management and propagation of NTFPS.
- A systematic harvesting/collection programme under Joint Forest Management approach.
- Species selection (elite trees/plants), provenance trial, micro and macro propagation, germplasm conservation, regeneration and plantation of NTFP's.
- Sustainable management of natural habitat and protection of pests, diseases and biotic pressures.
- Action research on NTFP's collection/extraction, drying, storage and further process followed by marketing.

- Organization for procurement, storage, marketing and trading of NTFP'S.
- Socio-economic studies for improving the economy and value addition.
- Training and awareness on creation for scientific collection, storage, processing and
- Marketing of NTFP's. People should know appropriate collection time for maintaining quality of the product.
- Feasibility study of important products to be completed to attract investment in this sector for poverty alleviation.

## **CONSTRAINTS**

- Through the demand is increasing, yet the inequitable trade practices allow a very small amount of profit to percolate down to the collectors, cultivators and harvesters from NTFP's including medicinal and aromatic plants.
- Highly developed illegal trade practices control the trade in raw material through tax border controls in Pakistan, Nepal, Bhutan, India and Myanmar.
- Inadequate funding, lack of government prioritization, insufficient information sharing and co-ordination among stake holders.
- Lack of mechanism to improve resource conservation and livelihood security in rural and marginal communities.
- Lack of co-ordination of holistic research programme to strengthen linkages between stakeholders from production to consumption chain.

## **WHAT NEEDS TO BE DONE**

- Sustainable use and conservation of NTFP's by promoting sustainable management and genetic conservation schemes at the community level.
- Improved livelihoods for rural poor by equitable distribution of benefits through: Providing training for value addition, primary processing, grading, packaging, storage and marketing.
- Ensuring improved collection, cultivation, marketing and benefits for women.
- Developing bio-partnership between local communities and industry.
- Facilitating networking at all levels among the stakeholders involved in R&D and manufacturers.
- Production of sufficient quantity of quality seed and planting material of medicinal and aromatic plants for ensuring its availability to the cultivators.
- Developing Agro-techniques and adoption of existing practices for large scale cultivation of rare and endangered species used in Indian System of Medicines through the use of appropriate technology and its transfer to farmer's fields. Followed by its assessment and refinement to maintain sustainability and competitive advantage.

- Transplant and tissue culture techniques are needed to be adopted for such species which are either shy seed producers or their propagation through seed is not easy. Ex situ conservation of endangered species at molecular level with creation of DNA libraries for long term storage and replication of important genes is of paramount importance
- Establishment of demonstration plots for NTFP's and herbal drugs at institutional and a chain of such herbal gardens in all developmental blocks followed by establishment of multipurpose farms and a well stocked Central Gene Pool Conservatory.
- Diversification of cropping patterns and integration of multi benefit providing NTFP's plants social/ agro forestry and existing cropping patterns of our farmers will provide more economic gains per unit area per unit time as productivity improvement measures coupled and with enhanced sustainability, increased profitability and improved human health a livelihood security.
- Establishment of nodal agencies both at the centre and the states for coordination of collection, cultivation, extraction, marketing and utilization of the NTFP's with the support of good analytical laboratories for ensuring quality control measures.
- Generation of trained and skilled manpower to handle all aspects of NTFP's through intensive training programmes and upgrading the technical knowhow for field functionaries by evolving long term human resource development strategy and ensuring continued competence and skills through national and international trainings.
- Post harvest management of NTFP's need emphasis for ensuring remunerative market prices. New initiatives in the areas of processing, product development and value addition need special emphasis.
- Liaison with the consumer industries to facilitate marketing of the produce. Rationalization of trade practices, collection and export, issuing of permits/licenses and levying of taxes under proper legal framework.
- Encourage confidence building measures to invite private sectors investment in research and development for collaborative use of the produce/product.
- Use of print, electronic media and information technology for public awareness programmes specifically arousing conservation, consciousness and judicious exploitation among school and college students through the introduction of topics on NTFP's in their curricula. To start with, this can be initiated by including most common plants in the form of botanical names, local/common vernacular names, their brief description and broad medicinal uses.

## **Trade and Enterprise**

Trade practices related to NTFP's have been traditionally complex and secretive with a chain of commission agents involved from the harvesting stage to the final

destination of every plant raw drug. In the process, the gatherers and producers of this resource receive only incidental charges for collection from the wild or subsistence prices for cultivated material. These trade practices are affecting the quality (as quantity being the principle, adulteration of the material takes place) and cultivation (being non-remunerative) of medicinal plants on one hand development of value addition enterprise on the other. To improve the situation the NTFP's related trade and enterprise must start making significant contribution to the economy of the country especially of the rural areas through:

- Establishment of models for viable public-private-community partnerships for value addition and marketing of NTFP's based enterprise.
- Organizing gatherers and producers frequent interactions.
- Introducing for quality certification and fair trade practices.

Dr. Yogesh. Y. Sumthane

## FODDER TREE LEAVES

Indian is endowed with a significant share of the world's livestock population which is growing steadily and continuously. India's livestock currently account for more than half (53%) of the world's buffaloes, 20% of goats, 15% of cattle, 4% of sheep and poultry each and 1% of pigs. For such a huge and varied livestock, fodder requirements are naturally more. An estimate on fodder requirement given by the committee on fodder and grasses set up by the national Wasteland Development Board is presented in the table as below:

Category	Annual requirement of fodder					
	1996		2001		2006	
	Green	Dry	Green	Dry	Green	Dry
Cattle	383.27	305.08	446.28	344.28	501.79	371.58
Goats	-	19.43	-	21.59	-	23.98
Buffaloes	209.53	150.02	252.27	177.64	315.46	211.70
Sheep	-	7.13	-	7.40	-	7.67
Total	593	482	699	552	817	615

On the total land in India, 23 per cent falls under various types of forests. The leaves from the tree constitute an important source of fodder. Trees and shrubs have long been considered as important source of called browse or top feed. They are effective insurance against seasonal feed shortages, supplementing the quantity and quality of pasture compounds (Lefroy et al., 1992). Fodder trees are less affected by seasonal dry condition because of their more extensive root systems and longer life spans (Abel et al., 1997).

The forage value of any feed depends on the combination of its palatability, nutritional value and digestive (Lefroy et al., 1992). Most feed types are not sufficient digestible or nutritional to meet all of an animal's needs in isolation. During the dry season, feed usually has poor digestibility, because dry grasses are rich in fibre (cellulose and lignin) but poor in sugar and protein. Fodder trees can provide protein and energy to keep rumen microbes active, increasing their ability to digest fibre and thus enable livestock to make use of dry season pasture.

The leaf fodder from the trees is exceptionally rich in essential nutrients like crude protein nitrogen, calcium and phosphorus, as compared to grasses /crop by-products. On a rough estimate forest fodder contribute about 30 per cent of the total consumption and 178 million tones of green fodder and 145 million tones of dry fodder comes from the forest areas.

The fodder obtained from trees and shrubs is of great economic value particularly during scarcity and famine period, when fodder from agriculture sector is low especially in the hills. Fodder can be obtained from forest without causing any significant adverse effect on trees a most of the tree are of deciduous nature and shed their leaves. Therefore, the leaves from these trees can be harvested for feeding the livestock before they are shed.

### Important Fodder Trees

Scientific name / Common name / Family	Distribution	Leaf constituents
Grewia optiva (Beul) Tiliaceae	Occurs in Himalaya from Jammu and Kashmir to Nepal up to an elevation of about 2,000 m. It is found in forest areas and is mostly cultivated along agricultural fields.	The leaf fodder yield from a single tree in Himachal Pradesh is about 12-15 kg. The leaves are fairly rich in protein and other nutrients. Leaves contain 40.1-49.0 per cent dry matter, 15.6-20.0 per cent crude fibre, 41.7-49.0 per cent nitrogen free extract, 9.6-14.5 per cent total ash, 2.4-4.0 per cent calcium and 0.15-0.30 per cent phosphorus.
Leucaena leucocephala (Subabul) leguminosae	This is an exotic species and has been largely planted in tropical areas.	Leaves on an average contain about 22.22 per cent crude protein, 3.56 per cent other extract, 46.30 per cent fibre, 16.77 per cent cellulose, 16.51 per cent hemicelluloses and 1.92 per cent tannin. The leaves have high mimocene content, hence, result hair fall in animal when taken pure.
Celtis australis (Khirak) Ulmaceae	Occur in Western- Himalaya, Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh at an	Leaves contain crude protein 14.47-15.33 per cent other extract 2.54-

	altitude of 500-2500 m.	5.62 per cent, crude fibre 19.45-21.45 per cent, nitrogen free extract 42.65-49.02 per cent total ash 11.66-17.91 per cent, calcium 3.47-4.87 per cent and phosphorus 0.18 per cent.
Bauhinia variegata (Kachnar) caesalpinaceae	Occur in the sub- Himalaya region and outer Himalaya valley up to an elevation of about 1500 m. it is widely cultivated throughout the greater part of the country.	Fodder yield obtained from the tree is about 15-20 kg. leaves contain 41.4-49.8 per cent dry matter, 10.73-15.91 per cent crude protein, 1.33-3.93 per cent other extract, 25.28-32.97 per cent crude fibre, 40.87-51.83 per cent nitrogen free extract, 6.27-12.37 per cent total ash, 1.76-4.13 per cent calcium and 0.20-0.38 per cent phosphorus.
Robinia pseudoacacia (Robinia) Leguminosae	This species planted in temperate areas in Himalaya.	Leaves are used as fodder. Leaves contain 25.5 per cent crude protein, 33 per cent other extract, 17.2 per cent crude fibre, 46.5 per cent nitrogen free extract, 1.5 per cent calcium, 0.32 per cent phosphorus.
Acacia catechu (Khair) Mimosaceae	Occurs throughout greater part of India except in the temperate and humid regions.	Leaves contain 13.03-18.72 per cent crude protein, 3.05-4.55 per cent other extract, 21.88-22.55 per cent crude fibre, 46.69-50.96 per cent nitrogen free extract, 9.66-9.80 per cent total ash, 2.46-2.74 per cent calcium and 0.14-0.17 per cent phosphorus. The total digestible nutrients are 46.33 kg/100 kg of dry matter.



<p>Acacia nilotica (Babul) Mimosaceae</p>	<p>It is tree of dry warm regions, indigenous to the western part of the Indo-gangetic plains and the northern part of the Deccan plateau.</p>	<p>Leaves contain 13.90 per cent crude protein, 2.9-4.20 per cent other extract, 6.46-9.81 per cent crude fibre, 69.80 per cent nitrogen free extract, 4.79-11.23 per cent total ash, 1.11-2.80 per cent calcium and 0.25-0.52 per cent phosphorus. The pods are also used as fodder.</p>
<p>Adina cordifolia (Haldu) Rubiaceae</p>	<p>It grows in the sub-Himalayan tract.</p>	<p>Leaves contain 8.68-12.50 per cent crude protein, 3.14-5.62 per cent other extract, 12.10-13.84 per cent crude fibre, 67 per cent nitrogen free extract, 7.72-8.22 per cent total ash, 2.29-3.15 per cent calcium and 0.16-0.53 per cent phosphorus.</p>
<p>Anogeissus latifolia (Bakli) Combretaceae</p>	<p>Occur in tropical and sub-tropical climate throughout the sub-Himalayan tract up to 1200m elevation. It grows in abundance in the south eastern part of the country.</p>	<p>Leaves contain 7.45-11.48 per cent crude protein, 2.68-4.41 per cent other extract, 16.38-24.15 per cent crude fibre, 16.38-24.15 per cent nitrogen free extract, 8.67-10.93 per cent total ash, 2.66-3.68 per cent calcium and 0.16-0.58 per cent phosphorus.</p>
<p>Albizia lebbek (Siris) Mimosaceae</p>	<p>It grows wild in the sub-Himalayan regions such as West Bengal, Tamil Nadu and Kerala. It is a tree of mixed deciduous forests.</p>	<p>Leaves contain 16.81-26.50 per cent crude protein, 2.85-4.68 per cent other extract, 26.47-37.52 per cent crude fibre, 35.99-42.76 per cent nitrogen free extract, 7.11-11.54 per cent total ash, 1.10-2.71 per cent</p>

		calcium and 0.14-0.25 per cent phosphorus.
Bombax ceiba (Semul) Bombacaceae	Common throughout India including Andemans up to 1600 m elevation.	Lopped for fodder (crude protein 18.69 per cent). Seed (crude protein 36.5 per cent ) and cake are excellent cattle feed.
Morus alba (Shahtoot) Moraceae	It is cultivated in Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, Karnataka, Tamil Nadu, West Bengal, Kerala and other parts of India.	Leaves contain 15.00-27.64 per cent crude protein, 2.30-8.04 per cent other extract, 9.07-15.27 per cent crude fibre, 47.98-49.70 per cent nitrogen free extract, 63.75 per cent total carbohydrates, 14.32-18.57 per cent total ash, 2.42-4.71 per cent calcium and 0.23-0.97 per cent phosphorus.
Quercus leucotrichophora (Ban) Fagaceae	This species occur in the lowest portion of temperate belt in western Himalayas and is extensively lopped for fodder.	Leaves contain 10.20-11.42 per cent crude protein, 3.53-4.84 per cent other extract, 31.34-32.11 per cent crude fibre, 46.74-48.38 per cent nitrogen free extract, 5.13-3.83 per cent total per cent total ash, 0.90-1.65 per cent calcium and 0.11-0.15 per cent phosphorus. Leaves also contain manganese & copper.

## FODDER GRASSES

Grasses are a source of considerable revenue and meet the grazing needs of large number Population in developing countries. India holds around 416 million livestock population which is around 16 per cent of the total livestock population of the world. Livestocks is an important component in rural economy. In India, agriculture largely depends on livestock for manure draught power. The availability of fodder does not fulfill the requirements of livestock and is always. The availability and requirement of green fodder, crop residue and concentrates in India (as per ICAR data) is given in the following table:

Type of fodder	Availability(million tonnes)	Requirement(million tonnes)
Green fodder	224.08	611.99
Crop residues	231.05	869.79
Concentrates	31.60	95.40

### Present sources of fodder

- Agricultural crop residues
- Agriculture green fodder
- Grasses and shrubs
- Tree leaf fodder

The grasses for fodder are obtained from natural grasslands occurring in forest areas uncultivable lands, other uncultivated land (permanent pastures and grazing lands, under miscellaneous tree crops, groves and cultivable wastelands) and fellow land other than current fellow. On the basis of land use statistics, the area available for the production of grasses in the country is given in the table below:

### Estimated area under grass production

Types of areas	Extent (million tonnes)
Forest	74.78
Barren and unculturable land	20.17
Other uncultivated land(excluding fellow land)	
• Permanent	12.00
• pastures and grazing lands	3.49
• Lands under miscellaneous tree	16.73

crops and groves • Culturable wasteland  Fellow land other than current fellow	9.82
<b>Total</b>	136.99

The quantity and quality of the grasses produced depends on the type of area, soil fertility type of the grass, climate conditions and biotic factors. Most of the grasslands in the country are very poor, degraded and over grazed. The productivity of the grassland is, therefore, very low. The productivity of the grasses in the forest areas generally varies from 0.5-5.0 tonnes/ha/year (Dabadghao and Shankannarayan, 1973).

### Some important fodder grasses of India

Source	Distribution	Uses
Andropogon pumilus	Found in dry region and is an important genus of perennial grasses.	It is suitable for silage and hay and is palatable, eaten by cattle when young, but after flowering, it becomes hard.
Bromus inemis	It is found in mountains of tropical and temperate regions.	An average yield of grass is about 8.5 ha. It is cultivated as forage plant in dry areas and is one of the most palatable pasture grasses.
Cenchurus ciliaris	It is a perennial tufted grass cultivated in Punjab and South India as fodder.	Total yield is 20-30 ha in 3-4 cuttings. This is considered as the most nutritious grass among all the fodder grasses.
Cynodon dactylon	Hardy perennial grass. Found throughout India.	Contains crude protein 10.47 per cent, N-free extract 11.75 per cent Ether extract 1.8 per cent. It is also a good source of vitamin A. Good forage

		grass.
Chrysopogon aciculatus	Occur mostly throughout Indian.	It is highly valuable and nutritious (crude protein 6.14 per cent) fodder. It can be converted into hay
C. fulous	Densely tall tufted perennial grass and is specially distributed in grass. High rainfall areas.	It yield valuable fodder and converted into hay. It is regarded as a good fodder grass.
Heteropogon contortus	Gregarious perennial grass. Found mostly in dry areas.	Crude protein 7.52 per cent, 49.51 per grass. Found mostly in cent N-Free extract, 28.87 per cent Crude fibre, 3.25 per cent Ether extract.
Pennisetum spp	Several species found in India.	Fairly nutritive. 22 per cent dry matter, in India. 1.0 per cent protein, 7.5 per cent fibres, 3.1 per cent mineral and 0.5 per cent fat.

### Problems of grasslands

- Higher incidence of grazing than carrying capacity
- Adverse site factors
- Poor management
- Degraded conditions
- Poor productivity

### Improvement of grasslands

- Controlled grazing
- Soil and water conservation
- Protection
- Introduction of improved fodder
- Use of manures and fertilizers

## Uses of grasses other than fodder

Grasses are used in India for variety of purposes other than fodder, Grasses not only supply the fibre for paper, pulp and cordage etc. but it also act also survival tool for tribal communities as well as urban population.

S.NO.	Uses of grasses	Name of the species
1.	Grasses for paper	Imperata cylindrica, Desmostachya bininnata, Saccharum spontaneum, S. bengalense (S. munja) and Arundo donax.
2.	Grasses for matting	Phragmites spp., Arundo spp., Saccharum bengalense and Cyperus rotundus.
3.	Grasses for ropes	Eulaliopsis binata, Desmostachya bipinnata, Saccharum bengalense, S. spontaneum and Themeda arundinacea.
4.	Thatching grasses	Imperata cylindrica, Heteropogon and Saccharum bengalense.
5.	Essential oils yielding grasses	Cymbopogon wintrianus, C. nardus, C. flexuosus. Bothriochloa odorata B. compressa and Vetiveria zizaniodes.
6.	Lawn grasses	Imperata cylindrica, Chrysopogon aciculatus and Zoisia japonica.
7.	Ornamental grasses	Phalaris arundinacea, Saccharum officinarum and S. spontaneum.
8.	Medicinal grasses	Cymbopogon spp., Vetiveria zizaniodes Agropyron repens and Cynodon dactylon.
9.	Grasses used for food	Triticum aestivum, Oyza sativa, Zea mays, Digitaria crusiata, Penicum miliaceum, Setaria etalica, Paspalum scrobiculatum and Saccharum officinarum.
10.	Cigarette and cheroot paper grasses	Zea mays

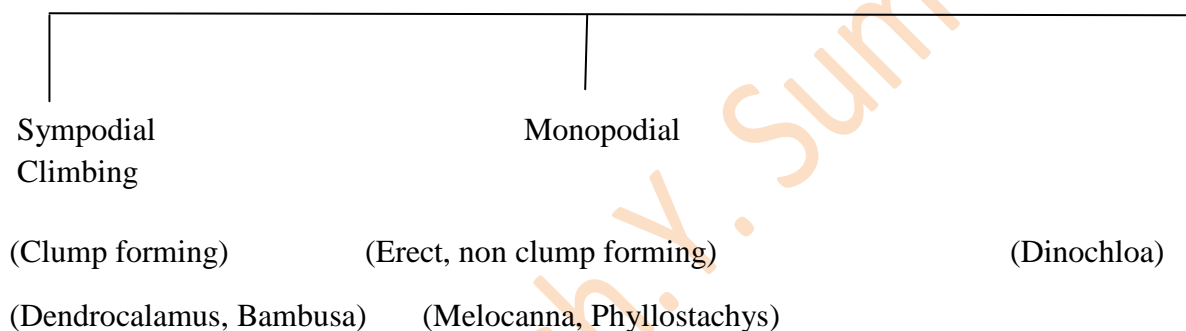
11.	Grasses for ornamental	Coix lachrymat jobi
12.	Rodent repellent grasses	Sataria verticillata
13.	Grasses for musical instrument	Phragmites karka, Arundo donax
14.	Grasses for Hindu rituals	Desmostachya bipinnata and Cynodon dactylon

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## BAMBOOS

Bamboos are one of the most important group of forest produce utilized for variety of purposes. Bamboos are tall, perennial, arbores cent grasses belonging to the Sub family Bambusoideae of family Poaceae. Almost all the 75 genera and 1250 species of bamboos are woody and fast growing. India is one of the leading countries of the world second only to China in bamboo production with 32, 30,000 MT production per year. India also possesses one of the largest bamboo resources in the world spread over an area of 10, 03 million hectares. In India, there are about 125 indigenous and exotic species of bamboos falling under 23 genera. This constitutes around 12.85 per cent of the total area under forest cover in the country which accounts for more than 505 of the total bamboo reserves in the world. Most of the bamboos require a temperature from 8°-30°C, a minimum of 100 cm rainfall and high humidity for good growth.

### Classification



### Important of bamboos

- Bamboos play an important role in the daily life of rural communities in numerous ways-In house constructions, making agricultural implements, arrows, bottles, caps, chopsticks, fishing rods, flower pots, kites, ladders, lamps, lanterns, musical implements etc.
- For making pulp, paper and rayon from bamboos which are of high grade chemical pulp with long fibre.
- Bamboo is an ideal renewable material for use to reduce the damage to life and property facilitates immediate relief and rescue operations, shelter and rehabilitation works in the affected areas and stabilization of damaged buildings, communications and the soil.
- Medicinally white silicious secretion-banslochan used as stimulant, febrifuge, cooling tonic. Leaves are also used for treatment of bronchitis, gonorrhoea, fever.
- Leaves are used for wrapping rice dumplings called "zongi," Leaves used for lining the bottoms of pans when cooking rice cakes, meat patties etc.
- Bamboos are made into plywood, laminated beams, boards etc. Bambusa tulda, B.



bamboos, *B. vulgaris*, *Melocanna baccifera* and *Dinochloa andamanica* are the main species used for the purpose.

- The tender sprouts of several bamboo genera are often eaten as vegetable, including *Phyllostachys* and *Banbusa*.
- Elephants relish young leaves and twigs of *Dendrocalamus strictus*, commonly used for fodder. Giant pandas of China also feed on bamboos.
- The hollow sections are strung into attractive necklaces.
- The wooden sword called a "shinai" used in the Japanese martial art of kendo is made from longitudinal strips of strong bamboo culms. There are many weapons made from bamboo including bows and arrows and sharpened bamboo stakes.
- *Arundinaria spathiflora*, *Bambusa arundinacea* etc. are commonly used for making baskets. It supports a number of traditional cottage industries such as basket making furniture handicrafts etc.
- Bamboos are known as "the poor man's-timber", "friend of the people:", "green gold" and the cradle to coffin timber.
- For making pulp and paper, bamboos provide high grade chemical pulp and long fibre.

### Commercially important bamboos of India

Scientific name	Common name	Distribution	Uses
<i>Arundinaria racemosa</i>	Himalayan bamboo	It is a shrubby, erect and gregarious bamboo. It is found in West Himalaya, Sikkim and Arunachal Pradesh at an elevation of 3000-3600 m.	It is used for making baskets, arrows, fishing rods, lining, of the roofs of houses.
<i>Bamboosa bambos</i> syn. <i>B. arundinacea</i>	Thorny bamboo, Katany bans	The species prefer rich and soil and grows along perennial rivers and moist valleys. It is a thorny bamboo, bearing bright culms, 20-30 cm in diameter.	Culms are used for making paper, also found suitable for rayon grade pulp. Young shoots and grains are consumed as food.
<i>Bambusa striata</i> syn. <i>B. vulgaris</i>	Feathery bamboo, Bansini, Basini bans	It is a moderate sized bamboo, not densely tufted. It is cultivated extensively in North-East, Bihar, Madhya Pradesh, and Uttar Pradesh. Culms are 10-20 m high, 5-10 cm in diameter.	It is used for paper making, scaffolding poles. Ring prepared from split culms are put into ear perforation by Tunkul, Naga tribes.
<i>Dendrocalamus giganteus</i>	Giant bamboo	This is tallest bamboo. 25-30 m, tall 20-30 cm in diameter. But cultivated in Arunachal Pradesh, Assam, Manipur, Nagaland, West Bengal and Malabar.	Culms cut into sections are used for water buckets and boxes. Hut and houses, construction, flower vases, handicraft items.
<i>Dendrocalamus hamilton</i>	Kagzi bans	This occurs in sub-Himalayan tract up 900 m/amsl. The culms are 15-20m tall, 10-18 cm in diameter.	It is commonly used for making baskets, mats, water and molk vessels, walling of nuts and for making paper.
<i>Dendrocalamus strictus</i>	Bans or lathi bans, male bamboo	It is a deciduous and densely tufted bamboo, widely	It is widely used for construction purposes. Thin solid

		distributed in Semi-dry and dry areas up to an altitude of 1000 m. high, 4-8 cm in diameter.	culms are used as lathis. It is also used in paper, baskets, brushes and cellulose gum. Also found suitable for rayon grade pulp.
Melocanna baccifera syn. M. bambusoides	Tarai bamboo or Muli bamboo	It is an evergreen bamboo, avoids formation of clumps. It is distributed in North- Eastern states in lower hill slopes and plains.	It is especially used for house building, scaffolding and boat making. It is also used for making toys, mats, wall plates, wall hangings, hats, umbrella, sticks, baskets and food grain containers. Culms contain tabasheer which is used in medicine.
Ochlandra Bans	Bans	It is a shrubby, gregarious bamboo found in the mountains of Kerala, Karnataka and Tamil Nadu. Culms are 5m tall and 2.5 cm in diameter.	It is used for making mats, baskets, and paper pulp.
Pseudostachyum polymorphum	Munro bambooo	It is a thin walled, shrubby bamboo of river banks and valleys in Tarai and lower hills of Sikkim, Assam extending east wards to Burma.	It is in considerable demand among tea planters for basket. It is also used for making umbrella handles and walking sticks.
Thamnocalamus spathiflora syn.	Bans	A small bamboo, growing gregariously	It is used for making hookah pipes, mats,

Arundinana spathiflora	Hill bamboo	in the under growth of fir, oak and deodar forests of Western Himalaya at an elevation of 2000- 3000 m. Culms are around 6 m tall and 2 cm in diameter.	baskets and handicraft items.
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## **CANES**

Canes are one of the important non-timber forest products of tropical parts of Asia commercially canes are also known as Rattans. The name, cane stands collectively for the climbing members of big groups of palms known as Lepidocaryoideae. It includes 14 genera and 600 species all over the world. These are climbing, spiny palms of family Arecaceae (Palmae). Calamus is commercially one of the important genera of cane and a few other related genera are Daemonorops, Ceratolobus, Plectocomia and Korthalsia.

### **Distribution**

The genus Calamus consists of about 390 species found in the evergreen forests of the tropical and sub-tropical regions, of which 30 species occur in India. It is distributed chiefly in Assam, Kerala, Mysore, Tamil Nadu and Andaman.

### **General Characteristics**

- The stems in the climbing species are long (often up to 100 m), usually cylindrical and of uniform thickness, solid, straw- yellow in colour.
- They are exceedingly strong, tough and elastic.
- The outer surface is hard, smooth and shining (due to deposition of silica).
- However, the core however is spongy.
- The canes are said to attain maturity in about five years.

### **Harvesting of Canes**

While harvesting, mature culms are cut at the base and hand pulled from the crowns of supporting trees on which they perch upon. The soft, terminal portions are discarded. The sheaths are removed with a chopper or by dragging them against the trunks of trees with rough bark. Soon after cutting, the canes are dried in the sun.

### **Processing of canes**

Proper processing of canes after harvesting is essential if good quality is to be maintained. The processing of the cane is done as under

**Collection-**Canes are considered mature for harvesting, when the leaf sheath starts loosening and the lowest part of the stem is exposed after discarding the top tender portion. The remaining portion is cut into pieces (4.8m long) bent, dried and treated in various ways.

## **Desilication**

The silica layer is removed by rubbing the freshly harvested cane over a knife. After desilication, the cane requires bleaching in order to get the fine creamy colour. This is generally done in the forests by fumigation with burning sulphur. The fumigation probably helps making it more immune to insect attack.

## **Polishing**

After the above two processes the natural lusture of the cane is lost and in order to restore it, the cane requires polishing.

## **Smoking treatment**

To obtain a fine reddish brown colour, Malacca canes are treated by smoking them over a fire and polishing them with coconut oil.

## **Grading**

After processing, the canes are sorted out in different grades according to colour and thickness and tied in bundles of a hundred and stored for marketing.

## **Uses of canes**

- Canes find a variety of uses due to their remarkable pliability, strength and the long lengths in which they are usually obtained.
- They are used as substitutes for ropes and cables in suspension bridges.
- Thick canes are used for making furniture frames, walking sticks, polo-sticks, and umbrella handles and thinner ones for making baskets.
- Used for making seats and backs of chairs and sofas, furniture, baskets, sieves, mats etc.
- Refuse from the split cane is useful for stuffing and packing and for making rough cordage, matting and a variety of other articles.

India imports annually from Malaysia, Indonesia, and Burma a small quantity of canes which are considered to be superior to Indian canes. Main imported canes are *Calamus caesius*, *Calamus scipiomum* and *C. omatus*

### Commercially important canes of India

Scientific Name	Distribution	Uses
<i>Calamus acanthospathus</i>	This is a common climber occurring in Eastern Nepal, Sikkim, Bhutan and Assam.	It is extensively used for making tea baskets, bridges, chairs, walking Assam. Sticks etc.
<i>C. andemanicus</i>	It is found in Andaman and Nicobar Islands.	It is used in making furniture, handicraft items, wicker work, basket etc.
<i>C. flagellum</i>	It is distributed in Sikkim, Assam ascending up to 1200 m elevation	It is used in making handicraft items, and furniture.
<i>C. guruba</i>	It is distributed in West Bengal, Assam Orissa and Meghalaya	It is used in making furniture, handicraft umbrella handles.
<i>C. latifolius</i>	It is distributed throughout Sikkim, Himalaya and Assam ascending up to 600 m elevation.	It is used in making furniture, umbrella handles handicraft items.
<i>C. leptospadix</i>	It is distributed in Sikkim, Himalaya, Khasi and Naga Hills.	It is used for making handicrafts.
<i>C. pseudo-tenuis</i>	It is distributed in Deccan peninsula, on Western Ghats from Canara southwards.	Stems are used for furniture handicrafts, polo sticks, walking sticks, umbrella handles.
<i>C. rotang</i>	This species grows in Deccan Peninsula and Ceylon.	Stems are used for making baskets, furniture, mats etc. Fleshy. Mucilaginous, sweet, bitter pulp of the fruit is edible. Decoction of rot is a remedy for dysentery.

C. tenuis	It is distributed in tropical Himalayas from Kumaon eastwards to West Bengal, Assam, Mizoram, Manipur, Tripura and Kerala.	Stems are used for walking sticks mats, screens, baskets.
C. viminalis	It is found in lower Bengal, Orissa, Karnataka and Andaman.	The species is used for making furniture, photo frames, polo-sticks umbrella handles, rough cordage, fibre mats etc.

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## ESSENTIAL OILS

Essential oils of plant origin have been in use in India and other parts of the world for the last thousands of years as perfumery materials. Use of essences, perfumes, scented waters, sandal, camphor in religious ceremonies and marriage functions are frequently mentioned in Vedas and other holy scriptures. At one time, perfumes were considered a sign of rich people, however, now a days this is not so. Many of our day to day requirements like soaps, tooth pastes, talcum powders, aggravates, etc. cannot be manufactured without the use of perfumery chemicals; otherwise they will be poorly accepted in the market. Perfumery chemicals also find extensive use in confectionery items and drinks. The production and use of perfumery chemicals/formulations is increasing day by day due to both population increase and change in the outlook. The world market in the herbal health care products fetches more than 71 billion US \$ and it is estimated that it will further increase to 5 trillion US \$ by 2050. According to an estimate, 1,000 different aromatic plants out of a total of 1,500 varieties used in perfumery throughout the world are found in India.

### Uses of essential oils

- Essential oils are used in perfumes, soaps, cosmetics, tooth pastes, toiletry produces, Scented tobacco, confectionery, aggarbattis, attars etc.
- These are also used for flavouring candy, ice-creams, liquors, alcoholic and non-alcoholic beverages.
- Also used in medicines for flavouring pharmaceutical products, as an antiseptic, insecticide deodorants etc.

### Extraction of essential oils

Distillation of essential oils depends upon the material to be distilled. Some materials such as flowers must be distilled immediately after harvesting, whereas the leafy material requires wilting for 24-48 hours before distillation. Roots and woody material can be ground and distilled even after longer periods.

### Water Distillation

This is the simple method in which the material to be distilled is immersed in water in the still, which is heated from below. The vapors of water and essential oil are passed through condenser. The condensed vapors are collected in the separator, where essential oil being lighter floats above water and can thus be separated. This method is advantageous for certain materials especially when they are in finely powdered form. Although, it is not good for material containing saponifiable or high boiling point constituents.

## **Water and steam distillation**

This is an improved method in which the plant material to be distilled for aromatic oil is supported over a perforated grid above the water level in the still. When water is heated then oil is steam passes through the' mat passing through the condenser get condensed get condensed and are collected in the separator for separation. In this method hydrolysis is fairly at low rate, while the distillation is rapid, the oil is also better and the physico-chemical properties of the oil are also good.

## **Steam distillation**

This is a better method. This method requires less distillation time and also gives oil of better quality. From a boiler steam saturated or super heated with pressure higher than atmospheric. Is passed through the bottom of the still in which material is kept over the grid. In this pro using Steam does not penetrate the cell membranes and the essential oil is vaporized only after diffusing out as an aqueous solution through the cell membranes.

## **Expression method**

This method is generally used for getting essential oils from citrus fruit skins. The shavings are mechanically pressed whereby essential oil along with water is collected and then separated.

## **Enfleurage**

It is the process of extraction of oil from flowers which do not yield appropriate quantity essential oil by steam or water distillation; are too delicate to withstand exposure to heat and steam. During the process, a fatty or greasy base is smeared or glass plates arranged in tears one above the other. The fat will absorb the perfume oil exhaled by flowers. The fat with flowers adhering to it is left for 203 days. The exhausted flowers are then replaced by another layer of fresh flowers. After repeated processes in this fashion, the perfume saturated fat is removed which is called Pomade. The pomade is washed with alcohol to extract the perfume, Jasmine. Flowers are the example. The fat used could be neutral, colourless and high absorbent ability.

## **Solvent extraction**

Solvent extraction method is used for preparing oleoresins of spices and herbs. The essential oils of flowers such as Jasmine are also extracted with the help of solvent extraction using solvents like n-hexane. The flowers are put in n-hexane solvent and then after filtration the extract is distilled at low temperatures under vacuum. The mass thus left is called concrete. Then small amount of absolute alcohol is added to the concrete and then contents are kept overnight in

the refrigerator. The separated out waxy substances are filtered and filtrate on distillation gives absolute as the undistilled portion.

### Extraction with critical gasses

Extraction with critical gasses like Carbon dioxide is the best method which gives essential oil of high quality. However, this method is costly.

### Classification of essential oils

Essential oils are classified on the basis of their occurrence in the following categories.

Source	Colour of the oil	Uses
<b>Wood oils</b>		
Agar oil-Aquilaria malaccensis)	Golden yellow to yellowish brown with balsamic odour	Used in perfumery and for making aggarbattis. It is a best fixative for high grade Scents.
Deodar oil (Cedrus deodara)	Reddish brown oil with characteristic balsamic odour	Used in making soaps, perfumes, cosmetics, furniture polish, paints etc. It is also used as a medicine for relieving rheumatic pain, cough and cold.
Linaloe oil (Bursera penicillala)	Pale yellow	The oil is used in perfumery, soap industry flavoring of food and beverages.
Turpentine oil (Pinus roxburghii)	Oil is clear transparent liquid with pungent and bitter taste	The oil is used as a solvent for thinning paints and varnishes, in pharmaceutical preparation, perfumery industry and in the manufacture of disinfectants, insecticide, antimicrobials and deodorants.
Sandal wood oil (Santalum album)	Pale yellow to yellow viscous liquid with a characteristic sweet balsamic odour	The oil is used in perfumery, soap soaps, face creams, toilet powders and manufacturing of attars such as rose and kewda attars.

<b>Leaf oils</b>		
Camphor oil (Cinnamomum camphora)	Pale yellow	Oil is used in cold liniments, expensive, perfumery and insecticides.
Cinnamon oil (Cinnamomum zeylanicum)	Light yellow	The oil is used in flavouring of liqueurs, pharmaceutical, confectionary, soaps, and tooth paste and mouthwash preparations.
Citriodora oil(Eucalyptus citriodora)		The oil find use in perfumery, soap, scented hair oil etc.
Eucalyptus oil(Eucalyptus globulus)	Pale yellow	The oil is used in asthma, chronic bronchitis, as mosquito and vermin repellent as ingredient in antiseptic, germicidal, disinfectant.
,Mint oil (Mentha spp.)	Pale yellow with strong odour and aromatic taste	The oil is used in flavouring of liqueurs, tooth paste and mouthwash cough syrups, soaps etc.
Patchouli oil(Pogostemon cablin)	Yellowish green to brown	The oil is used in perfumery, cosmetics, and Scented tobacco, incense and soap industry.
Pine needle oil(Pinus roxburghi)	Pale yellow	Its oil has strong anti-bacterial activity.
Geranium oil (Pelargonium graveolens)	Light yellow to brown	The oil is used to adulterate rose attar and flavouring tobacco products, tooth powders ointments and pharmaceutical preparation.
<b>Grass oil</b>		
Citronella oil (Cymbopogon nardus var.	Light yellow	Oil is extensively used in low cost perfumes soaps, floor waxes, insecticides and other household products.
Ginger grass oil	Pale yellow	Used in the preparation of

Cymbopogon martini var. sofia)		soaps and perfumes.
Lemon grass oil (Cymbopogon citratus)	Pale yellow or Light yellow	Oil is used in perfumery, soaps, cosmetics as mosquito repellent and also in many pharmaceutical preparations like pain balm disinfectants, creams etc.
Palmarosa oil (Cymbopogon martini var. motia)	Pale yellow with characteristic geranium odour	Oil is used in perfumery, cosmetic and soap industry. In medicine it is used for lumbago, stiff joint and skin diseases.
Vetiver oil (Vetiveria zizanioides)		The oil is used in medicines, soaps, perfumery and cosmetic industries.
<b>Root Rhizome oils</b>		
Costus oil (Saussurea costus)	Pale yellow to brown	The oil is used in high class perfume and cosmetics.
Indian valerian oil (Valeriana jatamansi)	Pale brown	The oil is used for perfumery, medicines, flavoring tobacco and beer.
Curcuma oil (Curcuma aromatica)	yellow	Used as tonic, carminative and externally applied on the skin to give glow and to cure bruises and sprains.
<b>Flower oils</b>		
jasmine oil (Jasminum officinale)	Yellow brown	Used in making attars, scented hair oils, in perfumery and cosmetics industries.

Rose oil (Rosa damascena)	Yellowish to greenish	The oil is used in making perfumes, for flavoring soft and alcoholic drinks, snuff and chewing tobacco.
<b>Seed oil</b>		
Ambrette oil (Abelmoschus moschatus)	Musk colour	It is used in high grade perfumes and lotions.

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## **FIXED OILS**

Fixed oils are compounds of glycerine with certain complex organic acids called fatty acids. The oils described are called as fatty oils, fixed oils, expressed oils or non volatile oils in contrast to volatile oils, distilled oils or essential oils. They do not evaporate or become volatile and cannot be distilled without being decomposed.

Oils are fluids at ordinary temperatures; whereas the fats are solids or semi- solids. Oil in a warm climate may be a fat at the cold. Fats contain stearic acid or palmitic acid; whereas oil contains oleic acid. When fat is kept for long, it becomes rancid due to breakdown of the fat into glycerine and fatty acids.

### **CLASSIFICATION OF FIXED OILS**

#### **Non drying oils**

This type of oil remains in fluid state for prolonged period on exposure to air e.g. groundnut and castor oil. Such oils are used in soaps and lubricants.

#### **Semi-drying oils**

These are intermediates between none drying and drying oils and absorb oxygen slowly e.g. sesame and cotton seed oil. Some of these are edible.

#### **Drying oils**

These absorb oxygen and on exposure dry into thin elastic film e.g. linseed oil, used in paints and varnishes.

### **GENERAL USES OF OILS**

- Food form oils are used as cooking oils, oleomargarines, butter substitutes and as salad dressing.
- Non food form oils are used for manufacture of items like soaps, paints, varnishes and lubricants.
- Oils are burnt for heat and light as well.

### **METHODS OF EXTRACTION OF OIL FROM SEEDS**

#### **Expression**

- In expression, the clean seeds are pressed between chilled iron rollers and the oil is forced

out by the pressure exerted by the rollers.

- Heating of seeds enhances the yield of oil.
- The crushed seeds are placed in a kettle provided with a steam jacket and a mechanical stirrer to ensure uniform heating.
- The oil is expressed from the heated mass in hydraulic press.

### Extraction

- The use of volatile solvents is done which gives higher yield, but the cake obtained from this method is unfit for animal consumption as traces of solvent may remain in the cake.
- Crushed seeds are subjected to the reaction of solvents and the oil is separated by distil and the solvent is used again.

### Important fixed oil yielding plants

Scientific name	Common name	Distribution	Uses
Azadirachta indica (Meliaceae)	Neem	It is a large sized evergreen tree found almost throughout the country and planted as a venue tree.	Oil is used for soap making.  Also used in pesticides pharmaceutical and preparations.  Oil cake is used as manure and pest repellent.
Madhuca indica (Sapotaceae)	Mahua, Indian Butter	It is a large size tree found along the Sub Himalaya tracts from Gangetic plains to Bhutan.	The seeds yield an oil called as "Phulwara Butter" which has a consistency of ghee.  Its oil is used for the manufacture of soaps candles, chocolates and vanaspati ghee, as a substitute for cocoa butter in confectioneries and as a medicine for skin disease.



			Mahua cake is used as manure with insecticidal properties and also used as wormicide in Golf lawns.
Jatropha curcas (Euphorbiaceae)	Bagher Japhlota, Dravante	It is a semi-wild shrub growing in the vicinity of the villages on the hedges almost throughout India.	oil is used for illumination, as lubricant purgative, applied to livestock in sores, utilized for manufacturing of soaps, candles, hair oils etc  Infusion of leaves is used in urinary disorders and diabetes.  Seed cake is used as manure and cattle feed and can also be used as a raw material for plastic and synthetic fibres.
Actinodaphne angustifolia (Lauraceae)	Pisa	It is a medium sized evergreen tree found in Western Ghats, Maharashtra, Orissa, Assam, Sikkim etc.	Oil is used for making soap and detergents.
Calophyllum inophyllum (Guttiferae)	Punnag. Undi, Sultan champa	It occurs in coastal areas of India and Andaman and Nicobar Islands.	Its oil is used as an illuminant, lubricant for painting. Wood work and soap making.  Is used as a varnish with the addition of Vateria indica oil. Medicinally, the oil is used in rheumatism, leprosy and skin diseases.

Schleichera aleosa (Sapindaceae)	Kusum, Lac tree	It is a large sized tree occurring deciduous forests throughout Central and Peninsular India.	<p>Oil is used for cooking, lightening, soap making, as lubricant perfumery.</p> <p>Cake is used as manure. It contains 5.5 per cent N, 2.08 per cent P, and 1.13 per cent K. Powdered seeds are applied to ulcers of animals for removing throughout Central and Peninsular India maggots.</p> <p>It is also used as cattle feed, contains 22.31 per cent protein.</p>
Shorea robusta (Dipterocarpaceae)	Sal, Sakhuya	It is a large sized tree Cotyledons of its seed found in forest areas in North-East and Central parts of India along the Himalayan tracts.	<p>Cotyledons of its seed yield "Sal butter, which is used for cooking, lightening and as substitute of cocoa butter in confectionaries.</p> <p>It is also used for soap making.</p> <p>Sal cake is used as manure and cattle feed. Also used as extender for making urea formaldehyde adhesive for plywood.</p>
Vateria indica(Dipterocarpaceae)	Ral, Indian Copal tree, Safed Damar	It is an evergreen tree occurring in tropical, evergreen and moist Deciduous forests in	The oil is known as "Piney tallow. It is used in paints and. varnishes, for illumination, soap

		Western Ghats and South India.	and candle making.
Garcinia indica (Guttiferae)	Kokam butter tree	It is a small, ever It's fat obtained green tree found in tropical rain forests up to an elevation of 2000 m.	Its fat obtained from Kokam butter, which is at edible and also used soap candle making and is suitable for ointments and other pharmaceutical preparation.
Mesua ferrea (Guttiferae)	Nagkesa Nagchampa	It is also used in paints and evergreen and semi evergreen forests	Its oil is used for illumination, lubricating, soap making and medicinal purposes for curing skin diseases and rheumatism. It is also used in paints and varnishes.

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## Gum

Gum are the sticky substance, formed as result of disintegration of internal tissue mainly cellulose, which decomposes into a viscous substance through the process called gummosis. Gum is a group of plant products related to sugars and carbohydrates and consist of polysaccharides or their derivatives. Gum dissolve or soften in cold water while they are in soluble in alcohol or other organic solvents. Gums exude from crack and wounds of the plant in liquid form but on exposure to air, it dries up into translucent. Amorphous and ovoid, tear shaped bodies which remain stickled to the bark of the stems or branches. Iran and Turkey are the main producers of gums.

### Use of gums

- High grade gums are used as adhesives in industries, for clarification of liqueurs, finishing of silk and preparation of quality water colours.
- Intermediate grade guns are used in confectioner, pharmaceutical preparation, printing inks, finishing of textile fabrics and dyeing.
- The low grade gums are used as adhesives, in calico printing, sizing of paper and in plant industry.
- In pharmaceutical and cosmetic industries, gums are used as demulcent or emollient or emulsion to blind mixture resin creams, lotions and ointments.
- They are also used in preparing ice creams and chewing gums and other confectionary items.

### Gum yielding trees of India

Many tree exude gums. However only few have economic or commercial importance. The major gum yielding trees of India are:

Source	Properties of gum	Uses
Acacia catechu (Gum tragacanth)	It is light yellow	Used in medicine, paints and varnish industry.
Acacia modesta (Gum tragacanth)	It is a viscous to semi viscous liquid.	It is high valued in indigenous medicines and in calico printing.
Acacia nilotica (Gum arabic)	It is a pale straw, dark reddish brown or almost black in colour.	Used in sizing of silk calico-printing, dyeing of clothes and in paper manufacturing. It is also used as mucilage or

		adhesive in many industries, in sweeteners, as an additive in foods and beverages, as thickener in liquid, in soft drinks and food flavorings.
Acacia Senegal ( Sudan or Senegal gum)	It is of vermiform shape.	This gum is used as demulcent and emulsifying agent. It finds use in the textile mucilage, paste, polish, and confectionary industries and as a glaze in painting.
Anogeissus latifolia (Ghatti gum)	It is whitish yellow to amber in colour. Its tears are round or vermicular, opaque externally and It is partly soluble in water, forming colourless mucilage.	The gum is used for calico printing in pharmaceutical industries and for sizing paper. It is also used in ceramics and foods.
Bauhinia retusa (Semal gum)	Whitish yellow in colour	It is used for sizing cloth and paper and for water-proofing of terraced roofs. Also used as an efficient binder in the manufacture of charcoal briquettes, either alone or in conjunction with other binders of a starchy nature. Poor people use it for eating purposes.
Cochlospermum religiosum (Katira gum or Hog gum)	It is a viscous to semi viscous gum.	The gum is sweetish, cooling and sedative and used in coughs. It is also used in calico printing, leather dressing, in cigar paste and in ice-cream industry viscous gum.
Lanea coromandelica (Jhingan gum)	This gum is soluble in water, forming thin mucilage, having good adhesive properties.	It is used in calico-printing, paper and cloth sizing, inferior varnishes, for preserving fishing nets and in confectionery.
Pterocarpus marsupium (Kino. gum)	This is blood red or ruby coloured and astringent gum exuding from the bark.	It is a valuable medicine used in cases of diarrhea and dysentery. It is a good tannin bit is very expensive for use on an economic basis.
Sterculia urens (Gum karaya or Katira gum)	It forms a jelly like mass in water but not actually soluble in it and can be classified It is	This gum is widely used as a thickening agent in the preparation of printing pastes

	also used in into 4 grades on the basis of colour as under Grade 1= White Grade 2 = Pink Grade 3 = Black Grade 4 = Muddy or dust	for textile industries. It is also used in pharmaceutical industries for preparing lotions, emulsions, sprays, pastes, cosmetics etc. Besides this, it s also used in bakery and dairy industries.
<b>Gums of lesser importance</b>		
<i>Albizia chinensis</i>	The tree yields an insoluble gum	It is suitable for sizing of paper.
<i>Albizia lebbeck</i>	A reddish brown gum.	It is usually adulterated with gum arabic and used in sizing of paper and clothes.
<i>Albizia odoratissima</i>	The tree yields a dark-brown. gum in the form of rounded tears	It is used in sizing of paper.
<i>Albizia procera</i>	The tree yields a copious gum.	It is used in sizing of paper.
<i>Anacardium occidentale</i>	The tree yields a pale yellow to reddish brown.	It is said to possess insecticidal properties and also used in book blinding.
<i>Azadirachta indica</i>	The tree exudes gum in the form of clear, bright, amber coloured tears or fragments.	It is used as a constituent of ghatti gum.
<i>Bauhinia</i> spp . ( <i>B. purpurea</i> , <i>B. racemosa</i> , <i>B. vaiegata</i> )	Creamish yellow	The gum produced by all the species is used for local purposes.
<i>Elaeodendron glaucum</i>	This tree yields a gum which occurs in colourless to reddish-brown roundish tears about 1.3 cm in diameter. . It readily dissolves in water to give a clear, slightly yellow adhesive.	It is a gum of first grade.
<i>Feronia limonia</i> ( <i>E elephantum</i> )	It occurs in irregular semi-transparent tears, varying in colour from reddish-brown to pale yellow.	Gum obtained from the trunk and branches is used as a substitute for gum Arabic.
<i>Spondias pinnata</i> ( <i>S. mangifera</i> )	An insipid gum is exuded by bark	It is edible gum.
<i>Terminalia bellirica</i>	It is a gum which is insoluble in water. Crystals of calcium carbonate are found to occur in the gum.	It has antibiotic activity.
<i>Terminalia tomentosa</i>	The bark yields an astringent gum.	Used as an incense and in the preparation of cosmetic.
<i>Mangifera indica</i>	It has a dull fracture and a	The stem exudes a gum resin

	reddish-brown colour.	which is a reddish-brown colour good substitute for gum arabic.
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## Resins

Resins are the complex oxidation products of various essential oils, and vary in their chemical. They originate through reduction and polymerization of carbohydrates. Generally resins occur as starch derivatives. Resins are insoluble in water but soluble in alcohol. thick viscous They are Composition inflammable and burn with smoke flame upon drying. Resins generally remain thick viscous Sometimes change to solid form. These can be classified into following three classes:

### True resins or hard resins

These are solid, brittle, more or less transparent-colourless and odourless exudations. They are the best source of varnishes. Generally, essential oil is absent e.g. Copals and Dammar

### Gum Resins

Gum resins are a mixture of both gums and resins and possess the properties of both the groups. They contain traces of essential oils and these are usually derived from the plants growing in dry and arid regions.

### Oleoresins

These are liquids with a considerable amount of essential oil and resinous material and are termed as oleoresins. They possess a distinct aroma or flavour. The groups of oleoresins include the turpentine, balsams and elemis.

### Formation of resin in plants

- Resinous secretions occur in special cavities or passages in a wide variety of plants. Presumably resins originate through reduction and polymerization of carbohydrates.
- Highly aromatic resins are termed balsams.
- They may also represent oxidation products of various essential oils.
- They are brittle, amorphous and more or less transparent. They possess lustre, are ordinarily fusible and burn with smoky flame when ignited.
- Though wide spread in nature, only a few dozens of plants are commercially important as source of resin.
- Plant sources are chiefly the members of families like Anacardiaceae, Dipterocarpaceae, Guttiferae, Hamamelidaceae, Leguminosae, Liliaceae, Pinaceae, Styraceae and Umbelliferae.



The resins, oleo-resins and gum resins are classified as Pine resins and Resins from broad leaved trees.

Pine Resins Confined to genus *Pinus* i. e. *Pinus roxburghii* (Chirpine), *P. wallichiana* (Blue Pine), *P. kesiya* (Khasi Pine) and *P. gerardiana* (Chilgoza Pine)

Resins from Broad Leaved Trees *Canarium strictum* (White dhup), *Hopea odora* (Jhingan), *Vateria indica* (Vellapine), *Shorea robusta* (Sal). Oleo-resins, *Boswellia serata* (Salai), *Dipterocarpus turbinatus* (Gurjan), *Kingiodendron pinnatum* (Piney). Gum-resins: *Garcinia morella* (Gamboge), *Commiphora wightii* (Guggulu).

### **Use of resins**

The importance of natural resins has declined considerably in recent years due to phenomenal advance made in the preparation of synthetic resins of the thermosetting and thermo plastic. Natural resins are applied to a great variety of industrial purposes and the most important of these are the manufacture of varnishes and lacquers.

For this purpose they may be divided into two classes

Those resins, which after melting can be combined with linseed oil or turpentine oil to form an "Oil varnish"

Those which dissolve in alcohol, turpentine or other volatile solvents to form a "Spirit varnish".

### **Classification of Resins**

The classification of resins is chaotic as these occur either in the pure or nearly pure state or in mixtures with essential oils, gums and the like. For simplicity, resins can be distinguished into three types namely (i) Hard resins (ii) Oleo resins and (iii) Gum resins.

#### **(1) Hard resins**

##### **Copals**

The copals comprise a considerable group of resins of recent semi fossil and fossil-origin found in many tropical and subtropical countries, They yield hard and elastic varnish used for outdoor work.

##### **Dammar**

This is the Malay term for all gums and resins that exude from cracks or cuts and solidify

upon exposure to the air, but commercially used group of varnish resins are obtained from Indian or east Indian trees belonging to the families Dipterocarpaceae and Burseraceae. The true dammar is obtained from *Agathis loranthifolius*-a conifer not found in India.

### **Amber**

This is a fossil resin found principally on the shores of the Baltic sea. The principal source was the *Pinus succinifera* which is now extinct. It is used in making ornaments, buttons, beads, mouth pieces of cigars and cigarette holders.

### **Lacquer**

This is a natural varnish exuded by *Rhus vernicefera*, a native of China. It is used as insulator and in paint industry as resin.

### **Sandarac**

This is a soft, pale yellow resin obtained from *Callistris quadrivalvis*, a small tree of Northern Africa. Some Australian species of *Callistris* also yield sandarac. It is used for coating leather, photonegatives and metals.

### **Mastic**

This is derived from *Pistacia lentiscus*, small trees of the Mediterranean region. It is used as a masticatory to freshen the breath. It is good for gums and to fill the cavities in the teeth and is also used to flavour alcoholic beverages.

## **(2) Oleo resins**

### **Turpentine**

Turpentine are also resins obtained almost exclusively from coniferous trees. For commercial purposes crude turpentine is obtained by tapping the tree. On distillation turpentine yield the essential oil or spirits of turpentine and resin.

### **Balsams**

Balsams are oleo resins that contain benzoic or cinnamic acid and so are highly aromatic the name is usually applied to same substances like Canada Balsam, which is a tree turpentine. True balsam contains much less oil than the turpentine. They yield essential on distillation from trunk tissues of *Myroxylon balsamum*. It is used as an antiseptic stimulant and as an ingredient in cough syrups.

## **Other Oleo- Resins**

There are several other oleo resins. Which do not belong to either the turpentine or balsams. Among these may be mentioned copaiba and elemi.

### **Copaiba**

It is also known as copaiba balsam. It is a natural oleo- resin obtained from several species of *Copaifera*, native to tropical South America. It is employed in preparation of varnishes, lacquers, medicines and as a fixative in scented soaps and perfumes.

### **Elemi**

These are more or less soft resins yielded by *Bursera coccous*, the trees of the genera *Canarium*. *Manila elemi* from *Canarium luzonicum* is a fragrant resin used for toughening varnishes.

## **(3) Gum-Resins**

### **Gamboge**

This is a hard, brittle, yellow gum resin produced by several species of *Garcinia*, especially *G. harburyi* in China and *G. morelia* of India. It is used as a pigment for colouring varnishes, used for lacquer and metal work.

### **Assafoetida**

The sources of assafoetida are *Ferula assafoetida*, and allied species found in Iran and Afghanistan. The gum resin exudes from the roots, when the stem is cut off. It is used for adding flavour to curries, sauces, and pickles. It is also used as medicine against asthma, whooping cough, flatulence etc.

**Galbanum** A gum resin extracted from the lower part of stems of *Ferula galbaniflua*. It has tenacious and powerful aromatic odour. It is used in medicine, as a uterine tonic and in inflammatory swellings.

### **Frankincense or dibanum**

Gum resin obtained from *Boswellia carterii*.

### **Myrrh**

Gum resin derived from species of *Commiphora* i.e. *Commiphora myrrh*.

## Tannins

Tannins and dyes are secretion products found universally in plant tissues in small quantities. They are simple chemical compounds made of carbon, hydrogen and oxygen along with some nitrogen. Tannins include organic substances which on combining with albumen along with and gelatine form an insoluble compound that resist decay. By their action on animal hides and skins, they cause changes thereby making them resistant to decomposition, flexible, stronger and greatly improved in wearing qualities. Hides and skins, so treated are called leather approximately 90 per cent of the vegetable tannin materials are used for tanning leather. The vegetable dyes have given way largely to synthetic dyes, whereas vegetable tannins have held their own to a large extent, as synthetic tannins not be made sufficiently cheap to compete with natural resources.

Tannins are widely distributed in several plant species and are found in wood, bark, leaves and fruits of many forest plants.

### Classification of tanning material

On the basis of plant parts from where tannins are obtained, they are classified into following four groups. (i) Wood tans (ii) bark tans (iii) fruit tans (iv) leaf tans.

### Important tannin yielding wood, bark, fruit and leaves are obtained from following plants

Scientific name	Distribution	Uses
<b>Wood tans</b>		
Forest tree which with wood yielding material are termed as wood tans		
Quebracho Colorado	It is widely distributed in south America	The heartwood contains 20-27.per cent South America. Tannin, which is obtained by cutting the wood into small chips and extracting the tannin with water. India imports sizeable quantity of this extract from South America.
Acacia catechu (Khair)	It is found growing in majority of the states in India especially in warmer regions.	In India, the cutch obtained (about 4000-5000 tones) from khair is used for tanning purposes as well as a blend.

### Bark tans

There are numerous tree species yielding bark, useful for tannins purposes. the bark is taken as y by product when the tree is harvested for timber or firewood. In earlier times, hides were tanned by placing them in alternate layers ground bark, but it look long time, this process was super ceded in the use of tan- extracts or tan – liquors extracted from the raw materials which take less time to complete the tannin process. Tan liquors are extracted from the bark or other raw material by the application of steam and mixed with other extracts to give required colour and quantity to leather.

Acacia meamsii (Wattle, Mimosa)	It is native of South Australia. In Indian, it is grown in Tamil Nadu, Nagaland, Kerala, hills of Jammu& Kashmir and Meghalaya.	The bark yield an excellent quality of tannin which is astringent, catechol type.  It is used in blends, in plywood industries, in adhesive formulation.
Acacia nilotica (Babul)	It is native of India and common species of Northern and Southern tropical thorn forests and dry mixed deciduous forest and waste land.	The tannin content of the bark vary form 7-20 per cent.  The bark older tree is richer in tannin which has a deeper colour.
Cacia auriculata (Avaram)	A small shrub found growing in South and Western India. Grow well on dry, stony hills and black soils.	The bark of this species i9s regarded as one of the best known tanning material in India. It has 15-23 per cent tannin content.  It penetrates the hide very quickly.
Cassia fistula (Konnoi)	It is widely distributed throughout tropical in India.	The tannin contents of bark vary form 10-14 per cent while that of leaves ranges from 8-10 per cent.  It produces smooth grained, pale leather.

### Fruit tans

The fruits of many forest trees are used for tanning purposes and for manufacturing tannin extract.

Acacia nilotica (Babul)	It is native of India and common species of Northern	The pods babul produces good
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	and Southern tropical thorn forests and dry mixed deciduous forest and waste land.	quality tannins.  Tannin content is 12-20 per cent in pods and 18-30 per cent after the removal of seeds.  Pod also impart good colour to leather and render it soft.
Caesalpinia coriaria Divi-divi)	It is a small tree, native of South America. India, it is cultivated in Tamil Nadu Maharashtra and Karnataka.	Pods have high tannin content (24-41per cent).  Leather is affected with weather Conditions. Hence, it is blended with tans.  Also used as mordanting agent in textile industries.
Zizyphus xylopyras (Kath-ber)	It is a shrub generally found in Sub-Himalayan tracts, North-West and Southern parts of India.	Tannin contents vary up to 10 per cent.  The fruits impart black colour to the leather.
Terminalia chebula chebulic (Myrobalan)	The tree occurs in sal. and mixed deciduous forests. . It is found in MP Orissa,' AP, HP, Maharashtra, Tamil. Nadu, Karnataka, and Bihar.	It produces soft, mellow, spongy leather which lacks good wearing properties. Hence, it is blended with quick penetrating tans such as babul, avaram bark etc.  It is used in the dyeing of cotton, manufacture of ink as softener to the leather etc.  The myrobalans of Salem district (Tamil Nadu) are regarded as the best in India for colour and tannin content.
<b>Leaf tan</b>		
Leaves of certain plants are used for tanning purposes by local tanners as colouring agents Generally artisans and shoe makers use them for tanning leather on a small scale.		
Anogeissus latifolia (Axle wood, Dhawal Sumac)	This is a medium to large size tree found in the Sub-Himalayan tracts, Bihar, Chota	Its leaves yield tannin known as Dhawa. Its dry leaves contain

	Nagpur, Central and Southern parts of India up to 1000 m altitude.	<p>about 32 per cent of tannins.</p> <p>It penetrates quickly and produces pale coloured leather with a greenish tinge.</p> <p>It is used to tan various types of Skins and hides.</p>
Carissa spinarum (Karaunda)	It is a thorny, evergreen shrub found along the foots of the Shiwaliks Central India.	<p>The tannin contents of the leaves vary from 9-15 per cent.</p> <p>It act slowly and causes swelling on the hides.</p> <p>It can be mixed with other tan material.</p>

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## DYES

India have been considered as the forerunners in the art of natural dyeing. A dye can generally be described as a colored substance that has an affinity to the substance to which it is being applied. The dye is generally applied in an aqueous solution, and may require a mordant to improve the fastness of the dye on the fibre. Dyes are substance used for coloring textile, tooth paste, fur, foods stuffs, cosmetic, paint, varnishes, leather, ink, paper, wood; medicine etc. natural dyes, dye stuffs and dyeing are as old as textiles themselves. Earliest authentic records of dyeing were found in the tombs of ancient Egypt paintings five to six thousand years ago. Henna was used even before 2500, while saffron is mentioned in the Bible. Natural dye stuffs were exclusively used from ancient till the middle of 10<sup>th</sup> century for coloring textile fabric. The first human- made (synthetic) organic dye, mauveine, was discovered by William Henry Perk in Germany in 1856. Subsequently on its commercialization, aniline and coal tar dyes began to compete with natural dyes. Today only a few dyes from plants withstand the competition. Even today, some dyes continue to be obtained from natural sources, for example, dyes for lipstick still obtained from Bixa Orellana and Lithospermum erythrorhizone. Over 2000 pigments secreted by plant are known of which only about 150 have been commercially exploited. Nearly 450 plants in India that can yield dye of which 50 are considered to be most important: ten of these are from roots, four from bark, five from leaves, seven from flowers and fruits each, these from seed, eight from wood, They are mainly used in textile industries. Few natural dyes are also used in confectionaries. Synthetic dyes quickly replaced the tradition natural dyes. Natural dyes are safe to the environment and are also used in textiles/ drugs, cosmetic and various food products. Dyes can be collected from animals, minerals and different parts of the plants viz. wood, bark flower, fruit, root, leaf etc. and used in pharmacy, for dyeing leather, staining wool. On the basis of their origin dyes can be classified into the following classes:

### Classification of dyes

Wood dyes

Root dyes

Bark dyes

Leaf dyes

Flower dyes

Animal dyes

Fruit dyes

Source	Colour of the dye	Uses
<b>Wood Dyes</b>		
Cutch Dye Obtained from the wood of Acacia catechu (Khair)	Dark brown	Used for dyeing fishing nets, mail bags, leather, canvas, silk and woolen fabric etc.



Artocarpus dye  Obtained from the wood of Artocarpus heterophyllus and A. lakoocha (Kathal)	Bright yellow	Used for dyeing robes of monks and saints. It is also used to give fast color on silken clothes.
Brazilein dye obtained from the wood of Caesalpinia sappan (Sappan). Commercially known as Brazilein.	Red akum used as mordant	The dye is extracted by boiling chipped wood pieces in water. It is most valuable dye used in coloring leather, silk, cotton, wool, fibres. Also used in calico printing, mat industries Furniture, floors, feather, medicines and several handicrafts. Sappan dye along with kaya (Memecylon edule) produces red, violet and black colour combinations on mats made of koral, palm leaves and screw pine.
Santaline dye Obtained from the heartwood of Pterocarpus santalinus (Red Sanders)	Bright red, salmon pink	It is used as coloring agent in pharmacy. It is also used for dyeing silk and cotton clothes, when mixed with Brazilian dye. It along with different mordents gives variety of colors on woollen, cotton and linen clothes.
<b>(B) Bark Dyes (Mostly brown and black dyes)</b>		
Acacia'spp. Acacia catechu, A. concinna (Shikakai), A. famesiana (Gandh babul), A. leucophloea (Safed Kikar)	Brown, black	Used for dyeing canvas, fishing nets and ropes. Extracts from the tree are used in natural shampoos or hair powder, under its popular name of shikakai.
Alnus spp. Alnus nepalensis (Udis), and A. nitida (Kunis)	Brown	Used in dyeing to fasten the colour of the fabric previously dyed with brown dye of Himalayan madder (Rubia cordifolia ).It is also used to dye wool.
Casuarina equisetifolia (Casuarina, Jangli Jhau)	Light reddish	Used for toughening fisher men's nets.
Myrica esculenta (Kafal)	Yellow	Used for colouring pharmaceutical products.
Teminalia alata (Saja)	Black	Used as a tanning as well as

		dyeing material. It gives black colour to the fabric.
<b>(C) Flower dyes</b>		
Butea monosperma (Dhak)	Yellow or orange	Used for dyeing sarees, cotton and silk clothes.
Toona ciliata (Toon)	Red	Considered important source of natural dye stuff. Gives light yellow colour to cotton and woollen fabric, when immersed in boiling extract of flowers. colour can be fastened by using suitable mordants.
Nyctanthes arbortristis (Harsingar)	Orange or golden yellow	Dye is often used to colour liquors.
Crocus sativus (Kesar)	Deep yellow	Used for colouring food and medicines.
<b>(D) Fruit dyes</b>		
Mallotus philippinensis (Kamala)	Bright orange to red Alum used as a mordant	Commercially known Kamala dye. as Generally for dyeing silk used and wool. Used for Also colouring oils, soaps, used as mordant ice creams, soft drinks.
Bixa orellana (Anatto)	Bright orange to red Alum used as a mordant	The seeds contain bixin, a major coloring matter. The dye is extracted from the seeds of this tree gives beautiful pink color to silk and clothes. This dye is also used for calico printing, coloring foodstuffs ice creams, baker products edible oils, nail gloss, shoe polishes etc.
<b>(E) Root dyes</b>		
Berberis aristata (Daru haldi) Used	Yellow	Used for manufacture of morocco leather.
Datisca cannabina (Alkabir)	Yellow	Used for dyeing silk, wool and cotton.
Morinda tinctoria Togariwood	Red Alum used as a mordant	Used for dyeing handkerchiefs, linen, woollen items, turbans etc.
Punica granatum (Daru)	Yellow and red	For dyeing medicine and cotton.
Rubia cordifolia (Manjitha)	Red	The roots contain Alizarin, which gives red colour to a textile dye known as Rose madder. Used for dyeing food, medicines, facial creams etc.

<b>(F) Leaf dyes</b>		
Indigofera tinctoria (True indigo)	Blue Alum used as a mordant	One of the original sources (natural colouring) of indigo dye. The blue dye Indigotin obtained from the leaves is used to produce different shades of blue and purple. Also used for its stability and strength of the colour in dyeing clothes.
Lawsonia inermis (henna),	Reddish, black, orange	Used for fabric and leather. Also used for dyeing hairs (henna), nails and eye brows. It is also used to decorate the skin with designs.
<b>(G) Insect Dyes</b>		
Dyes Kema lacca Syn. Laccifer lacca (Lac insect)	Crimson red	Seed lac and shellac is used in gramophone records, electric insulators, printing ink, leather and wood finishing industries. It is also used in making bangles, nail polishes, painting wooden toys etc.
Dactylopius coccus, D. tomentosus (Cochineal insects)	Brilliant red	The carminic acid obtained from the cochineal insect is used for coloring beverages, cakes, sweets, for dyeing wool, silk and leather etc., as a cosmetic and in medicine for treating whooping cough.

## **CUTCH AND KATHA**

Cutch and Katha are obtained by boiling the heartwood of *Acacia catechu* (Khair), a common tree found in the tropical deciduous and thorn forests of India, mainly in riverain tracts in water. The chief Constituents of heartwood are catechin (katha) and catechu tannic acid (cutch). A third article of Commerce is also obtained from his tree in the shape Or a write powder known as Kheersal.

### **Extraction of cutch**

- Cutting of heartwood into chips. Boiling with water in earthen pots.
- Pouring of liquid into other pots.
- Boiling of liquid to a thicker consistency.
- Continuation of process until liquid of correct consistency is obtained.
- Pouring of liquid into iron cauldron.
- Boiling and stirring until it attains a consistency of syrup, when it is poured into wooden frames lined with leaves and allowed to cool.
- Dark brown, solid, brick-like mass (marketed form) obtained is cutch.

### **Extraction of katha**

- Cutting of heartwood into chips.
- Boiling with water.
- Pouring of reboiled thick liquid into moulds dug in fine sand.
- Absorbing the tannic acid and leaving a residue of catechin to crystallize out into the katha of commerce.
- Katha is, therefore, similar to cutch, but with the most of the tannic acid extracted in to it.

### **Modified method of extraction of cutch and katha**

- The heartwood is chipped in the ordinary manner. The chips are then placed in a vessel and boiled with water over a open fire.
- Time for which they are boiled depends on size of chips.
- The operation is best carried out in tinned copper vessels.
- The boiled liquid has to be further concentrated and for this it is poured into into another vessel.
- Then it is strained through muslin cloth to remove all traces of chips, sand etc.
- The liquid must be strained while still hot as otherwise there is a risk of katha crystallizing on the cloth and so being lost.
- In the meantime, fresh water is added to the chips and they are again boiled.

- The liquid obtained by straining is then concentrated over fire till the required density is obtained.

### **Improved method of Katha and cutch extraction (factory method)**

- The principle of manufacture is the same, except that all operation is carried out by machines.
- Woods chipped by chippers and extracted in copper vessels with hot water under pressure.
- The extract is concentrated in vacuum and cooled in refrigerated tank for week, when Katha crystallizes out.
- This is separated by filter process, cut into slabs and sliced into square which are then dried.

### **Use of Katha**

- An indispensable ingredient in the preparation of chewing of pans.
- katha is used in medicines as an astringent, digestive and throat soothing.

### **Uses of cutch**

- Cutch is an important commercial product and is used as a dyeing and preserving agent.
- Its industrial use is in dyeing cotton and silk and in calico-printing. Cutch is also used for dyeing canvas for boat sails in to a reddish brown colour.
- Materials treated with cutch are not affected by sea water.
- Cutch is valuable material for plywood adhesives.
- Cutch is also used in medicine as an astringent.

## **FIBRE, FLOSES AND COIR**

### **Fibre**

Fibre is the basic unit of raw material having sufficient length, pliability and strength for converting it into yarns and fabrics. Botanically, fibres consist of very long narrow cells, invariably thick walled with a small lumen. Fibres are non living may occur singly or in groups a. cemented to each other. The average length of fibre cell is 1-3 mm but the ramie fibres are among the longest cells in taller plants that are up to 55 cm in length. Fibre is obtainable from animal vegetable or mineral source. The chemical composition of vegetable fibres shows the presence of cellulose, though some of the fibres are associated with different amount of other substances like hemicellulose, lignin and pectin. Forests have been the traditional source for supply of fibres and flosses for the rural poor.

### **Classification of fibres**

The fibres are classified on the basis of their origin, texture, morphology and uses.

#### **On the basis of origin**

##### **Soft fibres:**

Obtained from inner bast or bark of the stem e.g. Jute, hemp, flax.

##### **Hard fibres**

Obtained from the leaves e.g. Manila hemp sisal etc.

##### **Surface fibres**

Fibres obtained from the surface of the plant parts e.g. surface of stem, leaves, seeds etc. (cotton, silk cotton).

#### **On the basis of general use**

- Textile fibres
- Brush fibres
- Plaiting and weaving fibres
- Paper making fibres
- Filling fibres
- Natural fibres

The major fibre yielding families are Sterculiaceae, Tiliaceae, Leguminosae, Asclepiadaceae, Urticaceae, Uimaceae, Moraceae. Various parts e.g. roots, stems, leaves of the plant yield fibre. Some of the important fibres yielding plants are as under:

Scientific name	Common name	Distribution	Uses
<b>Fibres from the roots</b>			
Butea monospema (Papilionaceae)	Dhak, Palas, Tesu, Flame of forest.	A small deciduous tree occurring throughout India. It bears bright, orange-red flowers.	Young roots of the plant yield fibre which is used for making ropes and cordage.
Pandanus odoratissimus (Pandanaceae)	Screw pine, Kewda, Ketki.	It is a densely branched shrub found along the Coastal regions and Andaman Islands.	The roots of this plant are fibrous used for making baskets, paint brushes, brushes for white wash. The leaves of this plant also yield fibre which is used for making ropes, mats, hats, baskets etc.
<b>Fibres from stems</b>			
Calotropis gigantea (Asclepiadaceae)	Ak, Madar.	These are moderate sized shrubs commonly found in dry tracts of the country on the waste land or as an associate in dry deciduous forests.	The bark of the stem yield white, silky, strong and durable fibre. It is extensively used for making fishing nets and lines, bow strings etc.
Bauhinia vahlii (Caesalpinaceae)	Camels foot climber, Maljhan, Taur, Malo	A large woody climber, occurring in Assam, Madhya Pradesh, Bihar, and Punjab. It is common in almost all forest types of India.	The fibre obtained from the bark of this plant is used making rough ropes for domestic purposes.
Hardwickia binata	Anjan	It is a large tree distributed in Peninsular India and Madhya Pradesh.	The young shoots and branches yield strong, Madhya reddish brown fibre used for making well ropes, ropes for cattle harness agricultural purposes.
Ougenia oojensis (Papilionaceae)	Sandan	A small to medium sized tree found in	The new branches yield fibre, which is

		outer fibre, Himalayas, northern and central India.	used for making ropes and cordage.
<i>Ficus benghalensis</i> F <i>Ficus religiosa</i> F (Moraceae)	Bargad, Barh, Banyan tree Pipal	These are large sized evergreen trees found almost throughout the country in tropical and subtropical regions.	The bark and aerial roots of this tree strong yield fibre which is suitable for ropes.
<i>Grewia tiliaefolia</i> G <i>Grewia vestita</i> G <i>Grewia oppositifolia</i> (Teliaceae)	Dhaman Dhaman Biul	The bark of the branches trees, generally grown for fodder leaves in mixed forests in outer Himalayas.	The bark of the branches yield coarse, strong, yellow fibre. It is used locally for making and domestic purposes.
<i>Sterculia villosa</i> (Sterculiaceae)	Udal	It is a small to medium sized tree found in tropical deciduous forest.	A coarse, strong, whitish pink fibre obtained from the inner layers of the bark is extensively used for making elephant harness, drag ropes, for tying grafts.
<b>Fibres from the leaves</b>			
<i>Agave americana</i> sp. (A. <i>Agave sisalana</i> , <i>Agave wrightii</i> ) (Agavaceae)	Sisal, Agave	Xerophytic, perennials with short, thick stems, native Mexico and Central Africa found in Assam, Bihar, West Bengal, Maharashtra and South India.	Hard fibre obtained from the leaves, utilize for the manufacture of ropes, cordage and the soft fibre is used for making and ropes brushes. used for making and ropes brushes.
<i>Caryota urens</i> (Palmae)	Indian. Sagopalm, Kittul	This is found in moist regions of Western and Eastern coasts in cool and shady places.	The leaves of this plant yield strong fibre which is used for making ropes, fishing nets fishing lines and soft and brooms.
<i>Musa textilis</i> (Musaceae)	Manila hemp	Native of Philippines, but cultivated in South	The fibre extracted from the leaf sheaths is used for marine ropes,



		India.	bagging wrapping papers etc.
M. paradisiaca (Musaceae)	Banana, Kela	It is found along the West Coastal regions.	Plant yields fibre, but cannot be used commercially.

### Fibre from grasses

The grasses namely *Eulaliopsis binata*, *Desmostachya bipinnata*, *Sacharum bengalense* *S. spontaneum*, *Themeda arundinacea*, *Phragmites* spp. *Arundo*, *donax* yield fibre which is used for making ropes, nets, cordage, mats, finishing nets etc.

### Flosses

The fruits of many trees and shrubs occurring in various forests of India produce silky flosses. The following are principal floss yielding plants

Scientific name	Common name	Distribution	Uses
<i>Bombax ceiba</i> (Bombacaceae)	Semul, silk cotton	A tall tree distributed throughout the country.	The floss obtained from the inner side of the capsule. The floss is used for stuffing quilts mattresses, cushions and pillows. It is also used as an insulating material for refrigerator, sound proof covers and walls.
<i>Calotropis gigantea</i> (Asclepiadaceae)	Ak, madar	A perennial under shrub distributed throughout plains of India.	The seeds bear cream colored fine soft glossy floss which is used for stuffing mattresses, pillows etc. It has a good buoyancy and water repellants properties, hence used in life saving appliances.
<i>Ceiba pentandra</i> (Bombacaceae)	Kapok, Safed simol	It is a medium sized deciduous tree found widely distributed in hotter parts of Western and Southern India.	The floss obtained from the pods is used for making padded surgical dressings, life saving jackets and belts, waist coats, fishing and aviation suits and other deciduous tree found widely distributed in hotter parts

			of Western and Southern India. Naval life saving devices.
Cochlospermum religiosum (Cochlospermaceae)	Pili kapas	A tree native to India, Occurring in the dry forests of country.	The flosses are used for stuffing mattresses, cushions, pillows and life belts.

In addition, species of Populus, Salix, Wrightiatomentosa, Holarhena antidysentesica, Calotropis procera.

### Coir

The fibre obtained from the husk of fruit of the coconut tree, is termed as coir. *Cocas nucifera* (Palmae) commonly known as coconut tree is found in coastal regions of South India. A coarse stiff, elastic and buoyant fibre/coir is produced by the thick fibrous husk of the fruit. It is used for making mattresses, ropes, (Shins ropes) brushes and shock proof packing material.

## Medicinal plants

India is one of the oldest, richest and most diverse, cultural traditional systems of medicine. Like Ayurveda, Unani, Sidha, Amchi and Tibetans. Medicinal plants are used at the household, level by women taking care of their families, at the village level by medicine men or tribal, and by the practitioners of classical traditional systems of medicine such as Ayurveda, Chinese medicine or the Japanese Kampo system. According to the World Health organization, over 80% of the World's population, or 4.3 billion people, rely upon such traditional plant-based systems of medicine to provide them with primary health care (Bannerman at, al. 1983). Globally more than 70,000 species are used for medicinal purposes. In India, out of the 17,000 species of the higher plants, 8,000 are known for medicinal uses. Out of total number of higher plants 46% are endemic to the Himalaya region. Besides this, many plant species are used in animal husbandry. The world market value of pharmaceuticals derived from plants used in traditional medicines exceeds US\$ 71 billion. This includes 75% share of USA and Western countries, 3.0% of China and a meager 0.3% contribution of India. Though globally, India's share is very small, yet due to its rich biodiversity inheritance, it has great opportunity and potential in this sector. The total trade in medicinal plants in India during 2004-05 has been 4,530 crore, of which exports account for Rs 3,423 crore and imports to the tune of Rs 1,107 crore. In terms of the volume and value of medicinal plants exported, India ranks second in the world.

In the recent past there has been a renewed interest in the use of natural products leading to a growing demand for plant based medicines, health products, pharmaceuticals, food supplements, herbal cosmetics etc. in the national and international markets.

Medicinal plants can be defined as the plants which are primarily used as source of drug. These are said to be the plants which produce one or more active constituents capable of preventing. Relieving or curing an illness.

### Classification on the basis of plant organ from which the drug is derived

- Drugs obtained from roots and other underground parts
- Drugs obtained from barks
- Drugs obtained from woods
- Drugs obtained from leaves
- Drugs obtained from flowers
- Drugs obtained from fruits and seeds

Scientific name	Common name	Distribution	Uses
<b>Drugs obtained from roots and other underground parts</b>			
<i>sparagus adscendens</i>	Shatavari	A shrub in Western Himalayas from Muree to Kumaon.	A valued tonic useful in dysentery, diarrhoea and general debility.
<i>Berbens aristata</i>	Daru haldi	Occurs in the temperate Himalayas and Nilgiris up to 3000 m a.m.s.l.	Chief constituent of drug is berberine. Used in curing fever, as mild laxative, tonic, ophthalmia and piles.
<i>Dioscorea delloidea</i>	Singli- mingll	A climber In N-W Himalayas eastwards to Nepal.	Tubers yield diosgenin used in synthesis of steroidal drugs, sex hormones and also used in the treatment of rheumatism, fever, colitis etc.
<i>Podophyllum hexandrum</i>	Ban Kakri	At high altitude 3000-4000 m in inner range of Himalayas.	Rhizomes contain resin podophyllotoxin used as purgative, in many skin diseases tumors growth.
<i>Nardostachys grandillora</i>	Jatamansi	Occurs in Alpine Himalayas between 3000-4500 m altitude eastwards to Bhutan.	Used as stimulant spasmodic, laxative and tonic.
<i>Sáussurea costus</i>	Kuth	Confined to Kashmir but its cultivation has been started in some parts of Himachal Pradesh.	Used as stimulant and an aromatic plant useful in cough, asthma, fever. Keeps insects away from clothes.
<i>Rauvolfia serpentina</i>	Sarpgandha	Almost all parts of India up to an altitude of 1000 m.	Used as sedative, hypnotic and for reducing the blood pressure
<i>Abroma angusta</i>	Ulatambel	Throughout up to 3000 m elevation.	Used as urine tonic and in dysmenorrhoea.
<b>Drugs obtained from bark</b>			
<i>Alstonia scholaris</i>	Chatin	The tree is found Throughout the country in moister parts.	Chattan is dried bark of the tree, useful in skin diseases, as tonic and febrifuge.
<i>Cassia fistula</i>	Amaltas	Throughout India up to an as elevation of 1500 m.	Bark of the tree is known as Sona and is rich in tannins. Used as laxative and in the treatment of black water fever.

<i>Cinchona ledgeriana</i>	Ledger bark	Grown in Assam, West Bengal and South India.	Active principal is quinine. It is effective in malarial fever, in pneumonia and for eye lotions.
<b>Drugs obtained from leaves</b>			
<i>Atropa acuminata</i>	Angurshafa	Found in Kashmir at an altitude of 2000-3500 m.	It yield a drug belladonna helps to decrease secretion of sweat, salivary and gastric glands, also used for curing asthma.
<i>Azadirachta indica</i>	Neem	Occurs naturally in successfully cultivated in dry lands, south India, Gujarat and Rajasthan.	The leaves are used as an insect repellent and decoction is applied in the skin diseases and boils.
<i>Cassia angustifolia</i>	Sanai	Native to Arabia and successfully cultivated in dry lands, south India, Gujarat and Rajasthan.	Used as cathartic and as purgative.
<i>Datura metel</i>	Dhatura	Occurs throughout India.	Useful in bronchitis and asthma. It is a narcotic and antispasmodic.
<i>Siwertia chirayita</i>	Chirayata	Temperate Himalayas between 1200-3000m from Kashmir to Assam.	It has stomachic, febrifuge anthelmintic properties.
<i>Gaultheria fragrantissima</i>	Winter green oi Gandhpura katel	Hilly regions of North East and South India between 1500-2500 m altitudes.	It has stomachic, febrifuge and in treatment of rheumatism.
<i>Hyoscyamus niger</i>	Khurasani ajwain.	Occurs between 1500-3000 m in the Western Himalayas.	Useful for relieving certain painful spasmodic conditions of muscles, for pupil dilation of eyes, ajwain hysteria etc
<b>Drugs obtained from flowers</b>			
<i>Artemisia maritima</i>	Kirman Ajwain	Occurs from Kashmir to Kumaon at an altitude of 1200-4200 m.	Flowers Kirmani Ajwain Occurs from Kashmir to Flower buds contain santonin used in expulsion of worms, also useful in fever and as stimulant.
<i>Cannabis sativa</i>	Bhang, Hemp	Throughout Himalayas foothills from Kashmir to Assam and Pakistan.	Contain cannabiniol. It acts Hypnotic, exhilarant and Anodyne.

<b>Drugs obtained from fruits and seeds</b>			
<i>Egle marmelos</i>	Bael	Found wild or cultivated throughout India.	Acts as an astringent, Bael digestive and stomachic. Used in diarrhea, improves appetite and digestion.
<i>Cassia fistula</i>	Amaltas, Indian Laburnum	throughout India	It forms one of the ingredients of a cooling <i>Cassia fistula</i> laxative, especially for delicate women.
<i>Emblica officinalis</i>	Amla, Amalaka, Aonla, Indian Gooseberry	Occurs throughout tropical and sub tropical India.	Acts as good liver tonic, mild laxative useful in anaemia and jaundice. Fruit is edible and rich source of vitamin C. Dried fruits used as shampoo and hair dyes.
<i>Ricinus communis</i>	Arandi, Arind, Castor plant	Largely cultivated in the borders of the fields, gardens, wild plant in waste areas.	Seeds used in medicine for treatment of leprosy. Oil from seeds used in ointments, eye drops, cosmetics, dyeing. Calico printing and oil cake used as valuable manure.
<i>Strychnos nuxvomica</i>	Kuchala	Throughout tropical India.	A valuable oil and dye obtained from seeds.
<i>Citrullus colocynthis</i>	Bitter apple, Indrayan	Native to Asia & Africa, throughout India and sandy tracts of N-W Central and South India.	Constitute the drug colocynth, bitter fruits serve powerful purgative and roots are used in jaundice and urinary diseases.

## SPICES

India has been a traditional producer, consumer and exporter of spices immemorial and known as the land of spices. Indian spices are popularly known both domestic and international market for their value and taste. These properties are important The total ingredients value of so he daily diet and are also Known for their medicinal and curative properties. The total value of spices since produced in the country was about Rs. 22,000 during the year 2004-05. With variety of spices in its production list. Almost, one third of the worlds demand is being met by Indian exports The historical is a s changes in production were achieved due to changes in area expansion and yield Indian is a world largest producer, with a 44 per cent share in output and 36 percent in the global spices trade. India are likely to emerge as a leading global spice processing hub. About 9 percent of total production in the country is exported.

The spices are obtained from various plant parts like roots, leaves, flowers and seeds The Classification of spices is made on the basis of its economic part used. Spices are aromatic vegetable products used in cooking to add aroma or pungency to food and flavor to sauces cakes and puddings. Condiments to a great extent are similar to spices. They are usually pungent acid, salty or spicy and are added to or served with food to give it flavor or to increase the flavor e.g. turmeric, mustard and chilies.

Spices contain essential oil which undergoes chemical changes on exposure to light and air. Therefore, spices are usually stored and ground in small quantity as per the requirement. These are found to occur wild in a forest tract and are cultivated also. Common cultivated spices of India are given here under

<b>Scientific name</b>	<b>Common name</b>
Piper nigrum	Black pepper, kali mirch
Capsicum frutescens	Chilli, mirch
Curcuma longa	Turmeric, haldi
Zingiber officinale	Ginger, adrak
Coriandrum sativum	Coriander, dhania
Cuminum cyminum	Cumin, jeera
Foeniculum vulgare	Fennel, saunf
Elettaria cardamomum	Cardamom, chhoti elaichi

These spices are cultivated in large scale in agriculture lands. The group of seed spices account for about 36% and 17% of total area and production of spices in the country. Several species of spices are still found in the forests in natural form. Some of the spices found in forest areas under:

Scientific name	Common name	Distribution	Uses
<i>Alpinia galanga</i> (Zingiberaceae)	Bara Kulanjan	A robust herb, native to Indonesia, Malaysia and now distributed in Eastern Himalayas and S.W. India.	It is used as spice for flavoring food. Essential oil have well marked insecticidal property used as medicine for rheumatism, stomach disorder. Catarrhal affections and as carminative and stimulant.
<i>Cinnamomum Dalchini zeylanicum</i> (Lauraceae)	Dalchini	Evergreen tree, found wild in southern coastal regions of Western India.	Bark is used as a spice or found condiment. Medicinally used as astringent, stimulant and carminative. The essential oil is largely consumed in flavoring pharmaceutical and perfumery industry.
<i>Curcuma angustilolia</i> (Zingiberaceae)	East Indian arrowroot, Tikhur	The plant occurs wild in hilly tracts of HP, West Bengal, Maharashtra, Tamil Nadu and some of the lower Himalayan regions.	Rhizomes are source of starch.
<i>Curcuma aromatica</i>	Jangli haldi	It is a common wild plant found almost throughout India.	Rhizomes possess a camphoraceous odour and are used as dye or cosmetics. It is extremely used against bruises and sprains.
<i>Elettaria cardamomum</i> (Zingiberaceae)	Chhoti ilaichi, lesser cardamom	it is a tall, herbaceous perennial herb, native to India and now cultivated in Western Ghats, Karnataka, Kerala and Tamil Nadu.	The plant is commercially important for its fruits regarded as queen of spices. It is used for flavoring cakes, bread, pudding, liqueurs etc. It is also used as aromatic stimulant and carminative. The essential oil is used for flavoring liqueurs and butter.
<i>Amomum subulatum</i>	Badi ilaichi,	Grown in Swampy places	The seeds yield essential



(Zingiberaceae)	lesser cardamom	in West Bengal, Sikkim, Assam and Tamil Nadu.	oils are used in flavoring of food products. Also used as fragrant adjunct to stimulants, bitters and purgatives.
Piper longum (Piperaceae)	Long pepper Piplamul	Native of India and cultivated in Western Tamil Nadu and Karnataka.	Fruits possesses pepper like taste and produce salivation of mouth. It is used as a spice and condiment. It is used as a spice and condiment.
Piper nigrum (Piperaceae)	Black pepper, Kali mirch	Native of indo Malaysian Cultivated in Western Ghats Maharashtra, Karnataka, Assam and Kerala.	Also used in medicines as carminative Ghats, stomachic.
Syzygium aromaticum	Clove, laung	An evergreen tree, cultivated in Tamil Nadu, Kerala. it is found in wet evergreen forests.	Unopened flower buds which are green to pink in colour are picked for producing cloves of commerce. Essential oil is used for flavoring of food products Confectionery, pickles and fermented beverages. Oil is also ingredient of dentifrices, gargles, chewing gums, scented soaps etc. It is also used for preparing high grade eugenol and vanillin.
Murraya koenigii(Rutaceae)	Curry leaf, Gandhla	A large shrub found almost throughout India. Cultivated in Tamil Nadu, Maharashtra and North India.	Leaves are extensively used for flavoring curry and other food products. Medicinally these are used in diarrhoea and dysentery.

## POISONS

Poisons are defined as materials which by contact with an organism, interfere with its well being and function in a well way that causes disorder or death. Whether a substance is to be class as a medicine or a poison depends chiefly on the circumstances of its actions and on the amount used. Anything which is medicinal can become a poison if not judiciously used. The poisons in plants may be explained as its adaptation, in the process of evolution, to from its enemies such as grazing animals or even more dangerous and destructive insect fungi.

**Many forest plants yield poison of varying importance. A few poisons derived from plants are as under :**

Scientific name	Common name	Distribution	Uses
Abizia procera (Mimosaceae)	Safed Siris	It is planted as an avenue tree and distributed all over India.	The astringent bark of this tree is used as a fish poison.
Antiaris toxicaria (Moraceae)	Jasund, Sack tree	This tree is mainly distributed in Western Ghats.	The white milk or resin exuded from the bark yields a powerful poison, which is used for tipping arrows to kill game (wild animal).
Barringtonia acutangula (Barringtoniaceae)	Hijjal	A small tree grown as an ornamental.	Small piece of bark is used for killing, intoxicating fish before catching it.
Berberis aristata(Berberidaceae )	Daru haldi, Kashmal	It is a spiny shrub distributed in North Western Himalaya and Nilgiris.	The bark of this species yield fish poison.
Myrica esculenta (Myricaceae)	kaphal	A moderate sized evergreen tree, native of China and Japan, now found in sub Tropical Himalaya, Khasi hills and Assam.	It is also used as a fish poison.
Ougenia oojeinensis (Papilionaceae)	Sandan	A small to medium sized deciduous tree found in Sub Himalayan tracts, Northern and Central India.	Bark used as a fish poison.
Milletia	Jung	Tropical regions.	The roots contain the

pachycarpa(Papilionaceae)			Root content rotenone the well known insecticide and also used for poisoning fish and birds.
Abrus precatorius	Ratti, Gunja, Indian liquorice	A wood climbing herbaceous shrub occurring throughout country.	The seeds contain poison abrin, which is used for poisoning cattle and other livestock and for homicidal purpose.

Dr. Yogesh. Y. Sumthane

## BIOPESTICIDES

The green revolution in India which was heralded in 1960 was a mixed blessing. Ambitious use of agrochemicals not only boosted food production. But also destroyed the agricultural use ecosystem to a great extent. Excessive use of chemical pesticides has disturbed our ecosystem both above and below the ground. To overcome these problems, which are created by these pesticides, the use of biological agencies or produce of these can control the pests and produce, no harm to our health and environment.

### Botanical Pesticides

Source	Uses
Pyrethrum flowers (daisy) from <i>Chrysanthemum cinerarifolium</i>	On pests and humans to control fleas ticks lice, used with synergists as aerosol 'bombs' in humans and food yielding plants. It is mixed with more stable botanicals for field and garden uses.
Rotenone: Roots of <i>Derris lonchocarpus</i> and other tropical legumes.	Used in gardens and orchards against many insects especially beetles
Sabadilla: Seeds of tropical lily [ <i>Schoenocaulon officinale</i> ]	Used for vegetables and fruits particularly against squash bug, harlequin bug and citrus thrips.
Ryania: Woody stem of <i>Ryania speciosa</i> .	Useful for fruits and field crops particularly against caterpillars and thrips.
Neem: Leaves, bark and seeds of neem [ <i>Azadirachta indica</i> ] and chinaberry [ <i>Melia azedarach</i> ]	The kernel extract and oil is used on many crops and landscape plants, especially against soft bodied and sedentary pests.
Limonenal: Citrus oil [linalool is also used present in many other plants]	Mostly used to kill fleas and ticks.

## **BEEDI LEAVES**

Beedi is an indigenous cigarette made from rolled leaves without use of paper. These industries are based on Tendu leaves (*Diospyros melanoxylon*) and tobacco (*Nicotiana tobaccub*) India has a monopoly on its production. Tendu leaves as a non-timber has attained an important place in rural industries-and has become a source of large revenue off cuts State forest departments.. The leaves are, used for making beedi wrappers and the off cuts of leaves are burnt and the ash is a constituent of tooth powder, Lower and middle class people usually smoke beedi as they find it cheap and a convenient from smoke. The leaves dry up quickly Without developing cracks or fractures and without becoming brittle. It becomes soft moistening and has a good burn without emitting an offensive or unpleasant odour. Trees attain a height of about 25 and girth up to 2.3-2.5 m. Leaves are elliptical in shape, round at the base and vary in length from 10 to 30 cm while width varies from 7-15 cm.

### **Sources**

Tendu leaves are found readily in the forests of Chhattisgarh, Madhya Pradesh, Maharashtra, Orissa and Andhra Pradesh, sparsely in Rajasthan, Uttar Pradesh, Gujarat, Jharkhand, Bihar, West Bengal, Kerala. Tamil Nadu and Karnataka and sporadically in the Sub-Himalayan tract from Ravi to Nepal. Production of beedi is mostly confined to India, Pakistan, Bangladesh, Nepal and Sri Lanka: India's total production of beedi is estimated to be 85 per cent. It is one of the commonest trees of dry deciduous forests of Chhota Nagpur and characteristics tree of dry teak forests and dry plains sal forests.

### **Silvicultural characters**

- It is a medium sized tree and occurs naturally, in forests, wastelands and cultivated lands.
- It pollards extremely well, and pruning the tree is one of the accepted management practices to encourage the growth of new shoots and leaves.
- The species can be raised in arid and semiarid regions to avoid water logging conditions.
- The tree is a light demander and is susceptible to frost.
- It has capacity to establish by producing extensive root suckers.
- Seeds germinate in rainy season and seedling production is plenty.
- Leaves are larger in size, papery in texture, non-brittle and those with inconspicuous veins, and are considered to be of superior quality.
- Germination per cent is about 40, germination starts in about 36 days and concludes within 2 months.
- Seedlings are raised in long narrow baskets and polythene bags seedlings are transplanted in the field.
- Direct sowing is also done successfully.

**collection of leave** -In most parts of India, fresh by leaves appear during early February and mature for harvest 3rd week of April.. At the time of the harvesting, the colour changes from crimson green. The collection season continues up to a week prior to expected week date of the onset of the monsoon. Leaves could also be available for harvest even after 1st week of June.

The leaves are plucked manually from standing trees and bushes. The process of plucking the leaves essentially consists of following steps:

1. Walking to and from the tendu growing areas.
2. Plucking of leaves.
3. Sorting and tying the leaves in small bundles, popularly called "Pudas".

The number of leaves in each small bundle/Puda varies among the tendu growing states in India i.e. 20, 50, 70 and 100 leaves respectively for Madhya Pradesh, Orissa, Maharashtra and Andhra Pradesh.

For making beedis, the texture, venation, thickness of midrib and lateral veins is of great importance. Hence, the leaves are collected from small coppice shoots. Plants which are 15 cm in girth are cut near the ground to proliferate the coppice shoots as it yields the best quality leaves and also facilitates collection.

The leaves are collected by forest dwellers and brought to collection centers, where these are purchased by forest department. The collectors pluck the leaves, bring these to their houses for grading and arranging them into bundles. Plucking is done in early hours of the morning. An adult can collect about 25 kg of leaves in a period of 5-6 hours.

- Problems in collection
- Scarcity of labours
- Erractic rains
- Short period of collection
- Poor transport facilities

## **PROCESSING**

### **Drying and curing of leaves**

After collection, the leaves are sorted, graded and tied in bundles locally known as gaddies and Pudas. These bundles are spread on the ground and turned upside down often 3 days and are fully dried within 6-10 days. The normal period of drying is one week. The leaves need to be lead over dried because both conditions . I their moisture is not reduced, as a result they gets blackened and affected by moulds, carry foul odour, while over dried leaves are too brittle there by resulting loss in handling.

Recently, Solar driers are being used for drying the beedi leaves within 18-20 hours and also retains the green colour of leaves after drying.

### **Packaging and storage**

The dried leaves are processed and packed in gunny bags for storage in godowns, where they are kept till they are required for sale or for making beedi. Before filling in bags, water is sprinkled over the bundles (2-3 litres over 100 bundles). These are then spread out and bundles are collected to form a heap.

The purpose of wetting the leaves is to soften them and to facilitate packing and transit for storage. The tendu leaves are stored in damp godowns.

After being brought to godowns, the bags are opened and exposed to sun in order to dry the leaves fully. In their fully dried state, the level of moisture content in the leaves reduces to about 70 per cent. The leaf bags can be stored in properly ventilated godowns up to a period of 24-36 months, till the leaves are used for beedi manufacturing.

### **Grading of leaves**

Four AG MARK grades viz., Good, Standard, fair and general have been laid down, but some of the tendu growing states use their own grade names.

#### **Trade of Tendu Leaves in India**

It is under the control of State Government. Orissa was perhaps the first to bring tendu leaves under the control of state government in the year 1963. It fetches 2-3 times more revenue than those obtained from the timber and firewood.

Tendu leaves are generally divided into five quality classes:

Quality 1 Fairly large sized leaves, thin, smooth textured, weight of leaves over 80 kg standard bag.

Quality 2 Fairly large sized leaves, thin, smooth textured, weight of leaves- 65-80 kg standard bag.

Quality 3 Medium sized leaves, fairly thin, smooth textured, weight of leaves - 50-65 kg standard bag.

Quality 4 Small sized leaves, thin and smooth textured weight of leaves - 40kg standard bag.

Quality 5 Small sized leaves, thin to moderate textured, weight of leaves- below 40 kg/ standard bag.

### **Annual production for Tendu leaves**

The annual production of tendu leaves in India is estimated to be over three lakh tone which varies from year to year depending upon climatic and other factors and is valued at no 600 crores (Tewari, 1994). The tobacco used in beedi leaves offers the government a annual Excise duty of over Rs. 60 crores, beside a Sale tax of over Rs. 9 crores of rupees.

**Estimated annual production of Tendu leaves in India**

States	Production ('000MT)	% of total	Value (Million Rs.)
Madhya Pradesh	123.0	41.0	1845.0
Orissa	50.0	16.7	750.0
Maharashtra	45.0	15.0	690.0
Andhra Pradesh	39.0	13.0	585.0
Bihar	24.0	8.0	360.0
Rajasthan	6.5	2.2	97.5
Uttar Pradesh	5.0	1.6	75.0
Gujarat	5.0	1.6	75.0
Tamil Nadu	2.0	0.7	30.0
West Bengal	0.5	0.2	7.5

Measures for improvement of Tendu leaf production

There are two important factors in Tendu leaf production:

- I. Production of leaves in larger quality in the forests.
- II. Collection of tendu leaves in larger quantity.

**These measures are as under:**

- Increased wages to labourers and growers.
- Long leases.
- Adjusting the period of coppicing/pruning so that the damage to the new leaves on account of insects and fungi is minimized.
- Improving storage and transport facilities in interior areas.
- Increasing the period of collection i.e. from March to June.

**Utilization of leaves**

Tendu leaves are utilized for beedi rolling. It is practiced as a cottage industry and does not require any special training. Before rolling beedi, the leaves are kept covered with moist gunny clothes for about 12 hours or overnight. The leaves are cut into rectangular shape according to size of beedi to be rolled viz. May be 5 cm. 6.25 cm and 7.2 cm in length. A ranges person between can roll as be many as 1000-1200\_becdis/day and wage paid for rolling 1000 beedis ween Rs. 15-20. One ka of leaf can make about 750-1,000 beedis. After that the beedis are dried in oven.

**Other beedi leaves**

Generally Diospyros melanoxylon and D. tonmentosa are used, but other important species are often used i.e.:

Kuda leaves	Holorrherna antidysenterica
Bauninia leaves	Bauhinia recemosa
Penas eaves	Artocarpus integrifolia
Bahana leaves	Musa paradisiaca



## **ANIMAL, MINERAL AND MISCELLANOUS PRODUCTS**

### **Animal Products**

Animals provide us food and other useful products in large quantities. The important animal products obtained from forests are as follows:

1. Wild life
2. Hunting
3. Hides and skins
- 4 Horns and ivory
5. Edible bird nests
6. Fish and pisciculture
7. Silkworm and sericulture
8. Lac insect and lac culture
9. Honeybee and apiculture
10. Fur and feathers

### **Wild Life**

Wild life refers to the animals, beautiful birds and insects of forests. Nature has endowed India with abundant flora and fauna. The animal wealth of India is over 67,371 species which include:

60000	-Species of insects.
1973	-Species of fish.
240	- Species of reptiles.
1200	-Species of birds.
372	-Species of mammals

About 30% of the animals are supposed to be endemic to Indian forest.

### **Some of the animals found in India:**

Tiger, Lion, Panther, Cheetah, Snow Leopard, Jungle Cat, Sambhar, Spotted Deer, Swamp Deer, Hog Deer, Barking Deer, Musk Deer, Kashmir Stag, Bison, Indian Buffalo, Indian Elephant, One Horned Rhinoceros, Sheep, Goat, Civets, Mongooses, Dogs, etc.

#### **Aves:**

Great Indian Bustard, Crane, Dove, Jungle Fowl, Pigeon, Crow, etc.

National Parks and Wildlife Sanctuaries have been established where these animals are protected and managed for their survival and development. These parks and sanctuaries are the focal points which attract many tourists and add to the national economy.

### **Hunting**

- Hunting has been one of the most popular sports since ages.
- Hunting was also resorted for food, Skins, horns, ivory and hairs.

- Hunting is regulated by Indian Wild Life Act, 1972. Hunting of animal is now prohibited under this Act.

**Wild animals etc. hunted Or for meat:** -Spotted Deer, Sumbhar, Black Buck, Barking Deer etc.

**Wild birds hunted for meat-** Jungle fowl, ducks etc.

**Hides & Skins** Hide and camels, refers etc. to outer covering of large animals such as cows, buffaloes, bullocks, horses and camels, etc.

### **Horns and Ivory**

- Homs and ivory are source of forest revenue. They are carved to make different products.
- Horns of Samhhar (*Cervus unicolor niger*) and Spoiled Dear (*Axis axis*) are largely marketed are used for making buttons, knife handles, combs etc.
- Homs of Rhinoceros are used as a valuable medicine.
- The ivory of elephants is used for making bracelets, combs, beads, buttons etc.

### **Edible Bird Nest**

- *Collaia inexpectata* -bird found in Indo-Australian region.
- *C. frencica* and *C. innominata* are found in indian Oceani.e. in the rocks of Andaman and Nicobar Islands.
- These birds are capable of constructing nests exclusively from its saliva. Several industries collect and consign these highly prized nests to the markets.

### **Fish and Pisciculture**

- Forest includes several kinds of water bodies such as rivers, streams, lakes, ponds etc. These water bodies contain various kinds of aquatic animals. It includes fish, some of them are delicious table delicacies.
- Pisciculture has been tried in many such water bodies in several states. In Sunderbans, cultivation of several varieties of fishes has been tried along with the cultivation of trees

### **Lac and Lac Culture**

Lac is a resinous, protective, secretion of the any lac insect (*Kemia lacca*), which is a parasite on a number of wild and cultivated plants like *Butea monosprema* (Palas), *Schleichera olensa* (Kusum), *Ziziphus mauritiana* (Ber), *Acacia nilotica* (Babul), *Albizia lucida* (Taprina Siris), *Cajanus cajan* (Arhar) etc.

India is one of the largest lac producing countries of the world. Among the states, bulk of the lac production comes from Bihar and Madhya Pradesh.

### **Honey and Apiculture**

Beekeeping, when tried commercially on large scale is termed as species apiculture. Different species of honeybees are *Apis cerana indica*, *A. mellifera*,) *A. florae* and *A. dorsata*.

### **Honey**

Honey is a sweet viscid fluid obtained from the comb of honey bees. It is the nectar collected by the bees from flowers and used by bees as food.

#### **Use of honey:**

- As food.
- For preparation of different medicines.
- Lotus honey is used in eye troubles.
- Used to cure sore throat, cough cold and constipation.
- Used as antifreeze solution in automobile radiators.

### **Silk and sericulture**

- The breeding of silkworm for the production of raw silk is termed as sericulture.
- Silk is a fine, soft, lustrous, natural fibrous substance, obtained in the form of long filaments from cocoons, spun by a large variety of the moth caterpillar known as silkworm.
- It is one of the most integrated rural industries serving the nation's economy by gaining a huge foreign exchange.
- India is the fourth largest producer of raw silk in the world. Species of silk moth are *Bombyx mori*, *B. textor*, *B. croesi*, *B. fortunatus*, *B. sinensis* etc.

### **Fur and Feathers**

- Fur is the term used for the dressed coats of certain mammals used as trimming or lining for garments.
- The important fur bearing animals are bears, cats, foxes, seals, tigers, musk rats, rabbits and squirrels.
- The fur is used for making gloves, coats, caps, purses and other fancy articles.
- Many light fringed structures that grow from a bird's skin and cover its body are called feather. Feathers of peacock and other birds are used for making decorative items.

### **MINERAL PRODUCTS**

Among the mineral products found in forests may be mentioned building stones, road metal, mica, limestone and other similar materials.

Collection of mineral products from the forests areas may be done in four ways.

By mining, i.e., sinking a shaft below the ground surface and excavating the minerals from underground.

By quarrying, i.e., excavating on the surface of the ground from the pits or quarries.

By collection from the surface of ground covered with free growth.

By collection from river beds and other open spaces. Limestone brought down the rivers by floods is often collected in this way.

**MISCELLANEOUS PRODUCTS**

<b>Scientific Name</b>	<b>Common Name</b>	<b>Uses</b>
<b>Leaves</b>		
Bauhinia racemosa (Caesalpinaceae)	Kachnar, Guriar	The leaves are used for wrapping bidis.
Bauhinia vehlii (Caesalpinaceae)	Malijhan, Jaliur	The leaves are used for thatching and for making cups and plates.
Borassus flabellifer (Palmae)	Tar, Tal	The leaves are used for thatching, making baskets and matting.
Butea monosperma (Papilionaceae)	Dhak, palas,	The leaves are used for making cups and plates.
Diospyros melanoxyton (Ebenaceae)	Tendu leaves	The leaves are used for wrapping bidis.
<b>Soap Nuts</b>		
Sapindus trifoliatus S. mukorosil (Spindaceae)	Ritha, Soap nut	There are used as a substitute for soap.
Acacia concinna (Mimosaceae)	Shikakai	Shikakai pods are very good for washing hairs silk and wollen goods
Aeschynomene aspera (Papilionaceae)	Sola	The stem consists of very light soft pith which is extensively used in making toys, artificial flowers and models.
Abrus precatorius (Papilionaceae)	Ratti	Goldsmith used the seeds for weighing seeds are also used for necklaces and for ornament purposes.
Coix lachrymal- jobi (Poaceae)	Balansa	The fruits are used for making rosaries, bead.
Elaeocarpus sphaericus (Elaeocarpaceae)	Rudraksh	The drupe has a slone, which is cleaned, polished and stained. These are made beads for rosaries and bracelets.
Putranjiva roxburghii (Euphorbiaceae)	Putranjiva	The stones of the fruits have the belief of warding off evil spirits and protecting the life of children these are strung into amulets and are worn around the neck.

**Assignment...**

**Q.1. Collection of different NWFP's from your village, town, cities, of your own or nearby areas.**

**Q.2. Execute the plan of NWFP's marketing for an enhancement of grassroots.**

**Q.3. Write down and importance of following NWFP's**

**1- Mahua (*Madhuca longifolia*)**

**a. Essentiality of mahua flowers, seed, bark, leaves.**

**2. Tendu (*Diospyros melanoxylon*)**

**a. Utilization of tendu leaves, fruit, bark.**

**3. Palash (*Butea monosperma*)**

**a. Necessity of palash flowers for livelihood.**

**4. Imli (*Tamarindus indica*)**

**a. Utilization of imli pods**

**5. Jamun (*Syzygium cumini*)**

**6. Ber (*Ziziphus mauritiana*)**

**7. Arjuna (*Termenalia arjuna*)**

**8. Moringa (*Moringa oleifera*)**

**9. Babool (*Acacia nilotica*)**

**10. Neem (*Azadirachta indica*)**

**Q.4. Enlist and write an appropriate use of medicinal aromatic plants available in Bundelkhand region.**

**Q.5. Enlist the main bamboo species utilize for handicraft and furniture making.**