

## Natural Products

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#### Introduction:

The **natural products** are all those materials, which are obtained by the man, from other **living** and **non-living** components of the biosphere. These natural products can be in the form of **animal products**, **plant products** and **mineral products**, and all of them are utilized by the man for various purposes.

To meet the increasing needs, the man started using different natural plant products for various purposes. These natural products are basically produced by the plants, either for some definite role in the life of plants itself or they are produced as **waster products** or **by products of metabolism**. The most important and useful groups of such products are

- |                           |                             |  |                           |
|---------------------------|-----------------------------|--|---------------------------|
| <b>a. essential oils,</b> | <b>b. pigments and dyes</b> | <b>c. tannins</b>                        | <b>d. gums and resins</b> |
| <b>e. latex</b>           | <b>f. waxes</b>             | <b>g. alkaloids and glycosides. etc.</b> |                           |

In these groups, **latex** is industrially useful as the important source of **rubber**, the **essential oils** and **alkaloids** are industrially important for **medicines** and as plant **insecticides**, while the **pigments** which are stable, can be extracted are used as **dyes** in **textile** and other industries.

#### Rubber: Plant source and Economic importance

Rubber is obtained from **milky juice** or **latex**, or various erect or climbing woody plants of tropics and subtropics. Latex is a gunny white liquid full of **minute globules**. It is a mixture of many substances like **water**, **hydrocarbons**, **resins**, **oils**, **proteins**, **acids**, **salts**, **starch**, **sugars** and **caoutchouc**. Out of this the most important is caoutchouc, which is the substance, used as the source of rubber. Latex occurs in special cells or vessels in different plant parts like **bark**, **leaves** and other **soft regions** in the tree. Usually the latex from the **lower part of the tree trunk** is of importance, for the commercial production of rubber.

Rubber of industrial importance can be classified into two categories

- Natural rubber:** Natural rubber is a product found in the form of latex of many plants, such as Indian Rubber, Russian dandelion etc., but the major source of natural rubber is ***Hevea brasiliensis***.
- Synthetic rubber:** It is prepared from the chemicals yielding a material having rubber like properties e.g. Buna-S, Thiokol Poly-iso butylenes etc.

#### Plant Sources:

A number of plants yield rubber, out of which ***Hevea brasiliensis*** is most important. The plant is considered indigenous to the **Amazon valley** or **Brazil**, **Venezuela**, **Peru**, **Equator** and **Columbia**. The plant has been introduced into India. **Kerala**, **Tamilnadu**, **Karnataka** and **Andaman** islands are

important states where rubber plants are cultivated. *Hevea* is the source of about 95 to 98 per cent of the rubber produced in the world.

1. **Botanical name:** *Hevea brasiliensis* Wild. ADr. de Juss. Mull.



**Family:** Euphorbiaceae

**Common name:** Para Rubber Tree or *Hevea* Rubber Tree.

**Vernacular name:** Rubber

**Source:** Bark on the lower part of tree trunk.

**General Morphology:** *Hevea* is a large, tall tree, attaining the height of about 60 to 100 feet and a girth of about 8 to 20 feet, with a smooth, straight trunk. The main trunk is unbranched to a height of 10 to 15 feet; while in the portion above it is much branched forming a leafy crown. The leaves are compound, trifoliate, dark green. Flowers small, unisexual in axillary branched panicles, fruits few, relatively large, three seeded.

**Economic Importance:**

1. The natural latex rubber is used in preserved and concentrated form for manufacture of rubber articles such as balloons, gloves, foam rubber, fabric coating and moulded goods.
2. The rubber solution or adhesive used in footwear industry is made from uncured latex.
3. The unprocessed rubber or latex is used in making insulation tapers, erasers, shoe soles and different types of adhesives.
4. The vulcanized rubber having temperature tolerance is used in automobile industry for manufacture of tyres and tubes.
5. Normal as well as vulcanized rubber both are used in footwear industry.
6. Various household and commercial articles like water-proof materials, nipples, toys, rollers, gaskets, tubes, hose pipes, rubber bands, ice bags, hot water bags, rubber sheets, mattresses and pillows are made using rubber.

7. Various **sport goods** like different types of **balls** (foot ball, volley ball, Basket ball, Cricket ball etc.) and **gloves** are made using rubber.
8. Rubber is also used in manufacture of **battery boxes**, **telephone instruments**, **combs**, **fountain pens** and for lining and **insulating machine parts**.
9. Discarded rubber articles can be reutilized for production of rubber which can be used for manufacture of **tyres**, **heels** and **soles of footwear**, **carpet** lining and flooring materials.
10. Metal parts are **coated** with rubber to protect them from corrosion.

In addition to **Hevea** several other plant species are cultivated and utilized as sources of rubber, are as follows.

2. ***Ficus elastica***: Indian rubber



3. ***Manihot glaziovii***: Ceara rubber



4. ***Castilla elastica***: Panam rubber



5. ***Taraxacum kok-saghyz***: Russian Dandelion



6. ***Landolphia heudelotii***: African rubber



***Parthenium argentatum***: Guayule rubber



## PLANT INSECTICIDES

The plants sources which are used to control pests and insects on crop plants are called as plant insecticides. Millions of chemicals have been estimated from plants, of which about several thousands are secondary metabolites whose major role is to provide defense to plants especially against insect pests. These chemicals have now been identified and categorized into terpenoids, alkaloids, glycosides, phenols polyacetylene etc. which have diverse biological effects on variety of pests.

### Advantages of using plant origin insecticides:

1. They, after application do not have adverse effect on ecosystem and therefore, not harmful to herbivores and human.
2. They are much safer than conventionally used synthetic insecticides.
3. They are not responsible for killing naturally conserved enemies of insect and pests.
4. They show usually, more than one type of biological activity against insect, pest.
5. These can be used against insect pests of crops and they do not show residual effects in plant products or in soil.

Some insecticidal plants are as



#### 1. Neem

Botanical name : *Azadirachta indica* A. Juss.

Family : Meliaceae

Common name: Margosa

Vernacular name: Neem, Limb

Source : Leaves, Seeds, Seed oil, leaf extract, flowers, bark.

Chief Chemical constituents: Alkaloids azadirachtin, nimbin, Nimbidine, nimbosterine, nimbecetin etc.

#### Morphology:

It is large and perennial tree about 40-50 feet high, with a straight trunk, much branched. Leaves alternate, imparipinnate, crowded near the ends of the branches, leaflets obliquely lanceolate, dark green above, paler beneath; flowers in axillary panicles, white, fragrant, fruit one seeded drupe with bitter-sweet pulp.

#### Uses:

1. Azadirachtin is used as insect repellent, insecticidal and sterilant.
2. Nimbin, nimbidine, nimbibin and nimbosterine are also used as insect repellent.
3. All of the alkaloids are useful against several leaf eating pests of crops. e. g. white ants, striped cucumber beetle, horse flies, Japanese beetle etc.
4. Now-a-days, leaf extract or seed decoction with other plants extract mixed in it, a formulation prepared which is used by farmers to repel insects pests (aphides, hoppers, jassids) of vegetable crops.

5. **Dried leaves** are used as insect repellent and added in **stored grains**.
6. **Azadirachtin** repel insects, inhibits their feeding practices; **affects hormonal balance** by mimicking an insects hormone and thereby preventing insects to complete their further life cycle stages.
7. **Oil cake** gives protection to crops from **grain moth**, lesser **grain borer** and red **flour beetle**.
8. **Oil cake** along with **Pongamia** (Karanja) oil cake application in soil **kills nematodes** from soil. It is usually applied to avoid nematode infestation.

## 2. Shevanti:



**Botanical name** :

***Chrysanthemum cinerariaefolium***  
(Trev.) Schultz.

**Family** : Asteraceae

**Common name**: Dalmatian pyrethrum

**Vernacular name**: Shevanti

**Source** : **Flowers** (dried and powdered)

**Chief Chemical constituents**: Pyrethrin I (35%), pyrethrin – II (32%), cinerolone esters – cinerin – I (10%), cinerin – II (14%).

**Morphology**: it is a perennial herb with suckers, stem bushy, much branched with glaucous stem; leaves alternate incised, glaucous; branches ending into flower heads with ring of white, cream coloured ray florets, seeds minute or small. It is propagated by suckers.

### Uses:

1. **Pyrethrin** is a contact poison and highly **toxic to pests** in horticulture plants and agriculture crops.
2. **Pyrethrin** is found effective against **bedbugs**, **cockroaches**, **house flies**, **mosquitoes** etc.
3. **Pyrethrin** insecticides are used in dust formulations against **tobacco thrips**, potato leaf hopper.
4. **Pyrethrin** insecticides in spray form are applied against pea **aphides**, leaf **hoppers**, green house **white flies**.
5. **Pyrethrins** in spray form effective results against tobacco **moth**, **pumpkin beetle**, **cucumber beetle**, **blister beetle**.
6. **Pyrethrin sprays** application kills **beetle leaf hoppers** (98%).

### 3. Tobacco



**Botanical name:** *Nicotiana tabacum* Linn.

**Family :** Solanaceae

**Common name:** Tobacco

**Vernacular name:** Tambakhu

**Sources:** Leaves – fresh, dried and powdered

**Chief Chemical constituents:** Nicotine.

#### **Morphology:**

It is stout, annual, viscid herb, about 5 feet high, with a slender stout main stem having lateral branches, young branches are with viscid sticky hairs; leaves large, alternate broadly lanceolate, dark or pale green above, paler beneath, with prominent nerves on underside; leaves broad and with sticky tomentum on lower side, inflorescence axillary or terminal branched raceme with white campanulate flowers; seeds very small, light in weight, many in each capsule.

#### **Uses:**

1. It is used as contact insecticide, acts as contact poison in leaf inhabiting larvae, adults of various insects pests of crops.
2. Sometimes it acts as stomach poison to those pest chewing leaves and tender shoots of different crops.
3. Nicotine is effective against aphids of vegetable crops and various beans.
4. Nicotine foliar application is effective against leaf hoppers of vegetable crops and cabbage butterfly larvae.
5. Nicotine in the form of nicotine sulphate is effective against thrips, red mites, white flies of crops and green house ornamentals.



### 4. Davna

**Botanical name:** *Artemisia annua* Linn.

**Family :** Asteraceae

**Common name:** Sweet worm weed, sweet Annie.

**Vernacular name :** Davna

**Sources:** Leaves, flower buds, flowers, main stem, side shoots, roots.

**Chief Chemical constituents:** Artemisinin, essential oils – alpha pinene, camphene, beta-pinene, myrcene, 1-8 cineole, borneol, beta caryophyllene, linalool.

#### **Morphology:**

It is an **annual strongly scented** or **aromatic herb**, 2 m high with single main stem, with branched shoots. Main stem is with alternating branching, with glandular hairs. Leaves alternate, incised, **fern** like with strong aroma, 2.5 – 5 cm in length, green above, paler beneath, glandular hairy. **Inflorescence** solitary, or racemose or **panicled**, lobed glandular hairy, heterogamous, involucre ovoid to campanulate or capitate with yellow to **bright yellow ray** florets, centrally disc florets; seeds/achene very small with pappus.

#### Uses:

1. It is used to **repel fleas** and **moths**.
2. It is used to repel moths (**pests of cloths in storewells**).
3. **Powder of dry leaves** in packet kept in book shelves to **repel book mites** and in storewells to repel **pests** (called kasar in marathi) of cloths

#### Essential oils:

1. **1, 8 – cineole** is used as pesticide against leaf pest of crops.
2. **Alpha-pinene** is used as **insecticide**.
3. **Artemisic acid** used as pesticide e.g. **pests of cloth**.
4. **Artemisinin** from flowers leaves used as **pesticide, schizonticide, herbicide** etc.
5. **Beta-pinene** is used as **herbicide, insectifuge** and **pesticide**.
6. **Beta-sitosterol** is used as **pesticide** and **antifeedant** (as earlier application on crops avoids insects to feed on them)
7. **Camphene** is used as leaf **antifeedant, insect repellent, insectifuge** and **pesticide**.
8. **Caryophyllene oxide** used as **antifeedant, insecticide**.
9. **Cuminaldehyde** from leaves is **larvicidal** and **pesticidal**.
10. **Deoxyateminin** from entire plant, is used as **pesticide**.
11. **Camphor** from leaf, used as **antifeedants, insect-repellant insectifuge** and **pesticide**.
12. **P-cymene** from entire plant is used as **insectifuge**.
13. **Terpinen-4-ol** from entire plant is used as **insectifuge, pesticide** and **herbicide**.
14. **Borneol** from entire plant is used as **insectifuge, insect repellent pesticide**.

## DYES

The coloured **substances** which are used to **impart colour**, when applied to a substrate, are known as **dyes**. All the colouring materials that occur in all coloured organs are manufactured by plant itself, in the form of **pigments** having diverse chemical and functional nature. In all these pigments only **stable pigments** can be extracted and such extracted pigments are useful as dyes. So natural dyes are the stable plant pigments, which can be extracted and used for imparting colour to various substrates. Before the discovery of synthetic dyes, the natural or plant dyes were of great industrial importance.

#### Uses of dyes:

1. Natural dyes are used in dyeing **woolen clothes, cotton clothes, silk** etc.

2. Some of the dyes from certain plants, used in dyeing **blankets, carpets**.
3. Some of the natural dyes are used for colouring **food products, cosmetics** etc.
4. Certain natural dyes are used in **calico-printing**.
5. In **leather industry**, these dyes are used for dyeing leather.
6. Some natural dyes are used for dyeing **nails, hairs**.
7. Certain natural dyes are used as **cytological stains**.
8. Few dyes from leaves are used in dyeing **fingers, palms, toes, eye-brows** etc.
9. They are also used for dyeing **baskets** and **furniture**.
10. Some dyes are used for dyeing natural and **synthetic fibres** like **wool, silk, rayon, nylon** etc.
11. Certain natural dyes are used for colouring the **medicines, syrups, sweets, bakery** products etc.
12. Several dyes are used for colouring **paints, varnishes papers** etc.



a) Dyes from **Rhizome**

### 1. Turmeric:

**Botanical name** : *Curcuma longa* Linn.

**Family** : Zingiberaceae

**Common name**: Turmeric

**Vernacular name**: Haldi

**Source** : **Rhizome** – fresh, dried or powdered.

**Chemical constituents**: Rhizome contains colouring matter **curcuma**, and other components like **β** - phellandrene, d-sabinene, boreol, cineol, zingiberene.

**Morphology**: It is perennial herb, about 2 feet high with pulpy, orange-yellow rhizome, leaves very large in tufts, 4 feet in length, sheathing; flower on a central thick squat spike, yellowish to pale green tinged with pink.

### Uses:

1. Fresh or in dried powder form yielding yellow dye which is used for **colouring food stuffs**, preparation of **curries; flavouring butter, cheese, margarine, fruit drinks** and **juices** as well as **beverages**.
2. It is widely used for colouring and **flavouring medicines**.
3. For **colouring** with various safety shades to **toys for kids**, turmeric is used; for dyeing **leather goods**, turmeric dye is used.
4. Turmeric powder and dye is used **flavouring and colouring food stuffs** in **confectioneries**.
5. It is widely used in **cosmetics** like **creams, ointments, lotions, facials, pastes for fairness of skin**.

6. In many Indian traditional ceremonies **haladi** is applied to both groom and the bride to look good with fresh glowing skins.



b) Dyes from **leaves**

## 2. Henna

**Botanical name** : *Lawsonia inermis* Linn.

**Family** : Lythraceae

**Common name**: Henna

**Vernacular name**: Mehendi

**Source** : **Leaves** and **young shoots**.

**Chemical constituents**: leaves contain **lawsone, mannite tannic acid, gallic acid, mucilage naphthaquinone**.

**Morphology**: It is small tree. It is much branched glabrous perennial plant. The branches often spinescent, leaves opposite, entire, glabrous, elliptical, broadly lanceolate, flowers numerous in terminal paniced receme; white or rose- white; fragrant; fruits small globose capsule with many; small seeds.

### Uses:

1. Henna is used in hair **shampoos, dyes conditioners** and rinses.
2. Henna dye is mixed with indigo to obtain a greater colour range to stain **wood articles, drift woods, fabric** and **textiles**.
3. It is most common being as a dye for **hairs, skin** and **finger nails**.
4. It is also used for dyeing **wool, silk clothes**.
5. It is also applied for dyeing **leather goods**.
6. Henna is used in **tattoos** as henna is considered as safe, painless and non-permanent alternative of body ornamentation.



c) Dyes from **Flowers**

### 3. **Butea**

**Botanical name:** *Butea monosperma* (Lack) Taubert.

**Family :** Fabaceae (Papilionaceae)

**Common name:** Flame of the forest, Butea

**Vernacular name:** Palas

**Source :** Flowers.

**Chemical constituents:** Flowers yield bright yellow dye.

**Morphology:** It is erect perennial, erect tree, 40-50 feet high with crooked trunk, irregularly branched, young branches tomentose and downy, leaves 3-foliolate, leaflets coriaceous broadly obovate, glabrous green above; firmly silky beneath; flowers large showy in axillary or terminal raceme / apaniced. 2-3 flowers together on tumid nodes of rachis.

**Uses:**

1. Flowers yield bright yellow dye used in **dyeing silk** and **woolen clothes**.
2. Dye is also used for dyeing **food stuffs**.
3. Dye is used for dyeing **pants, varnishes** etc.



### 4. **Saffron**

**Botanical name:** *Crocus sativus* Linn.

**Family :** Iridaceae

**Common name:** Saffron

**Vernacular name:** Kesar

**Source :** Stigmas from flower.

**Chemical constituents:** Saffron contains more than 150 volatile and aroma yielding compounds, non-volatile active compounds, many of which are carotenoids like **zeaxanthin, lycopenes,  $\alpha$  and  $\beta$  carotenes**.

**Morphology:** Saffron is a perennial herb about 30 cm high with globular underground corm. The stem shows about five to eleven narrow, linear, radical leaves up to 40 cm in length; flowers solitary, lilac (bluish) to purple coloured; each flower inside shows a tree partite style terminating with a crimson or orange-yellow stigma about 25-30 mm in length.

**Uses:**

1. Saffron is a tow esterified gentiobioses make a  $\alpha$ -crocin ideal for **colouring water based non-fatty foodstuffs – rice dishes, sweets** etc.
2. It is also used for dyeing **baked foodstuffs** in **confectioneries**.
3. Saffron oil obtained from stigmas, used in perfumes, essence, ointments, mascaras, divine offerings.
4. Saffron is used in body washes.
5. Saffron threads used in **textiles** for **weaving** and ritually offered to **divinities**.
6. Saffron can be used to **aromatize wine**.
7. Saffron is used for **flavouring and colouring creams, ointments** etc.
8. Saffron is used in **medicines** (syrops, tablets) for flavouring and for **pleasant colours**.
9. It is used as **fabric dye** in India and china.