

4.6. RESINS

4.6.1. Introduction

Resins are synthetic products but are in use since time immemorial. Philosophers like **Theophrastus** (of Greece) and **Pliny** (the Elder of Rome) mentioned the use of resins in the form of **myrrh** and **frankincense**. Since, they are used in religious ceremonies as incense and perfume, they are quite costly.

Natural and synthetic resins possess the same properties, i.e., they are viscous liquids that get hardened on cooling. The manufacturing of synthetic resins is done by esterifying or soaping the organic compounds.

Epoxy resin (a classic variety) is manufactured by using polymerisation techniques such as polyaddition or polycondensation, which yields thermoset polymer used as composites and adhesives.

Since the 1960s, **epoxy resin** is used for flooring purposes in industries because it is double in strength when compared to concrete. It forms a waterproof coating and gives seamless finish. However from 2000 AD, epoxy and polyurethane resins are used for coating interiors, especially in the Western Europe.

Unsaturated polyester resin is another category of resins, which makes up around 75% of the total resins used. Another important resin is the **ion exchange resin** applied in purifying water and in catalysis of some specific organic reactions. Another synthetic polymer is the **acetal resin** which in comparison to other synthetics has a simple chain structure with repeated units of $-\text{[CH}_2\text{O]}-$.

Resins can be defined as, “**the hydrocarbon secretion of various plants (especially the coniferous trees)**”. They are considered valuable because of its chemical constituents and various uses like adhesives, varnishes, perfumes, incense, nail polish, etc. Apart from this, resins are also used as a raw material for synthesising organic compounds. On getting fossilised, i.e., the **fossilised resins** act as a source of amber.

4.6.2. Occurrence and Distribution

Below are the examples of different plants whose different structures or secretion zone contain resins:

- 1) **Ginger** (*Zingiber officinale* Roscoe) belonging to family *Zingiberaceae* has resin cells.
- 2) **Pine Wood** (*Pinus polustris* Miller) belonging to family *Pinaceae* contain resins in the schizogenous ducts or schizolysogenous ducts or cavities.
- 3) **Cannabis** (*Cannabis sativa* Linn.) belonging to family *Moraceae* contain resins in their glandular hair.

In plants, the formation of resins takes place as a result of their normal physiological functions. Though, their yield can be increased in certain plants like pinus by inducing an injury to the plant. Moreover, there are some plants that do not produce resin on their own until and unless an injury to the plant is deliberately made in the form of an incision. These incisions lead to oozing of plant secretions and exudates which are carefully tapped, e.g., Balsam of Tolu and Balsam of Peru.

It can be said that these resins are produced because of pathological conditions. There is a theory which suggests that resins obtained naturally from the secretory structures are considered as **primary flow**, while the one obtained by artificial means, manmade incisions, or abnormally formed structures are **secondary flow**.

Usually, the production of resins takes place in the ducts and cavities present in the plant. In some plants, resins are not present in the especially modified secretory structures but get imbibed in the adjoining tissues, for example, guaiacum resin is obtained from the heartwood of *Guaiacum officinale* Linn, and *Guaiacum sanctum* Linn., (family *Zygophyllaceae*), which means they are present in vessels (xylem and phloem), fibres, parenchyma, medullary rays, etc.

In this case, the conduction system of plants or trees is chopped off to obtain resin in the form of tyloses. This chopping enhances the utilisation of root pressure and capillary action to force the nutrition and water for reaching the top end of tall trees. There are rare cases in which the resins are obtained by the sucking of plant juice by scale insects. This juice is then converted into a resinous substance which covers the insect body and plant twigs, e.g., Shellac (*Laccifer lacca*) belonging to family *Coccidae*.

The resins and resinous substances are distributed throughout the plant kingdom, particularly in *Spermatophyta* (the seed plants). Their presence is rare and negligible in the *Pteridophyta* (the ferns and their allies). The presence of resins is not reported in the *Thallophyta* (the sea-weeds, fungi, etc.).

So the conclusion drawn is that resins are the resultant product of metabolism occurring in the higher plants, as most of them belong to the phylum angiosperm (seed-enclosed flowering plants) and gymnosperm (naked-seed non-flowering plants). Most extensively studied resin-containing families are Pinaceae (colophony), Leguminosae (Tolu balsam and balsam of Peru), Dipterocarpaceae (Garijan- α balsam substitute for copaiba), Burseraceae (myrrh), and Umbelliferae (asafoetida).

4.6.3. Isolation

Method for the preparation of resins is not yet laid down. The two categories of resinous products include **natural resins** and **prepared resins** are taken into account. Thus, this classification forms the basis of preparation method involved in the above mentioned resins. The two categories of resins are discussed here:

- 1) **Natural Resins:** These resins are obtained in the form of exudates from various plants either naturally or by making artificial punctures, such as mastic, sandarac.

They can also be collected by making deep incisions or cuts in the trunk of the plant, such as turpentine. They can also be obtained by hammering and scorching, such as balsam of Peru.

- 2) **Prepared Resins:** The prepared resins are obtained by the following methods:
- i) The resin-containing crude drug is powdered and extracted using ethanol. Extraction is repeated a number of times until the drug get exhausted completely. The combined alcoholic extract can be either slowly evaporated on an electric water bath in a fuming cup-board or is poured slowly into cold distilled water. The resin precipitates out and is collected, washed with cold water and dried under shade or in vacuum desiccators. Podophyllum, scammony, and jalap are the resinous drugs prepared by this method.
 - ii) For extracting **alco-resins**, lower boiling point organic solvents, e.g., solvent ether (b.p. 37°C) and acetone (b.p. 56.5°C) are used. In this, the volatile oil fraction is conveniently eliminated through distillation under vacuum.
 - iii) For extracting **gum-resins**, 95% v/v ethanol is used. The insoluble gum residue is left in the flask (or soxhlet thimble).

4.6.4. Identification Tests

The resins can be qualitatively analysed as follows:

- 1) **Colophony Resin:** The tests recommended for colophony resins are:
 - i) 100mg of resin powder is dissolved in 10ml acetic anhydride. To this solution, few drops of sulphuric acid is added which results in purple violet colouration of the solution.
 - ii) Powdered resin is agitated with petroleum ether and then filtered. To the filtrate, double volume of copper acetate (dilute) solution is added and again agitated. The solution obtained is allowed to stand for some time after which the ethereal layer attains an emerald green colour.
- 2) **Guaiacum Resin:** A solution of resin is prepared in ethanol and to this solution ferric chloride is added. This results in deep blue colouration of the solution.

4.6.5. Therapeutic Effects

Resins have the following therapeutic effects:

- 1) **Drugs comprising resins include:**
 - i) Podophyllum acts as a purgative,
 - ii) Colocynth, gamboge, and ipomoea have cathartic action,
 - iii) Asafoetida acts as laxative,
 - iv) Jalap has hydragogue properties,
 - v) Cannabis acts as sedative,
 - vi) Capsicum and turpentine have counter-irritant property,
 - vii) Aspidium shows anthelmintic action, and
 - viii) White Pine, copaiba, storax, Tolu balsam, benzoin, etc. are used as expectorants.
- 2) Resins possess mild antiseptic property, hence are used topically in the form of plaster, ointments, and cerates.
- 3) They are also used for preparing emulsions.

4.6.6. Pharmaceutical Applications

Resins are being used since ages in various cultures and are used as herbal medicine for several diseases in the Eastern countries. Since these are traditional medicines, much emphasis is laid on their research for increasing their efficacy. This purpose can be attained by using scientific methods for evaluating the medicines used in Western

countries. Resin can only be marketed as a prescription drug when the physician shows interest in the pharmacological properties of resins. **For example**, gugalipid an extract obtained from resin *Commiphora wightii* became commercially available by the year 1987 for treating atherosclerosis and hyperlipidaemia.

The products of resins which are under research and those which are already in the market holds the entrapped potential of enhanced medical uses in the Western countries as well as the native countries where they are being used traditionally. *Commiphora wightii*, a plant found in India is under threatened condition, due to which agronomists and horticulturists are developing new methodologies for obtaining the resin. This plant, native in the arid areas, has been overexploited by the poor people living there. Therefore, research is being done for increasing production of this plant as it is considered to be medicinally important and in turn it will give monetary gain to the natives, which is basically an arid region.

Eremophila, an Australian shrub yields resins from its various species. The evaluation of these resins so obtained is done for various pharmacological actions such as anti-hypertensive, analgesic, and cardioactive.

The roots and rhizomes of Podophyllum species yield **podophyllotoxin** which acts as a precursor for semi-synthetic antineoplastic drugs. The major amount of podophyllotoxin is extracted from *P. emodi*, a Himalayan species, which is so valuable that its overexploitation has led to its status of being endangered species. In the year 2000, **Moraes et al.** obtained large amount of podophyllotoxin from the leaves of *Podophyllum peltatum* (American mayapple). Since, podophyllotoxin obtained from mayapple uses leaves, which are renewable and do not cause any harm to the plant, therefore, they are being considered as an alternate crop by the American farmers. Still, research is under process for finding new species from which podophyllotoxin can be obtained and their variation in the resin content.

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