PHARMACOGNOSY

Nature has always provided a lot of remarkable resources for the benefit of mankind, most of which comes from the plant kingdom. Nature has provided a complete store-house of remedies to cure almost all ailments of mankind. The knowledge of drugs has accumulated over thousands of years as a result of man's inquisitive nature so that today we possess so many effective means of ensuring health-care.

In the ancient times, almost all the medicines used were from the plants, the plant being man's only chemist for ages. Today, a vast store of knowledge concerning therapeutic properties of different plants has accumulated. All the different divisions of plants, from thallophyta to spermatophyta contain species that yield official and unofficial products of medicinal importance.

The history of herbal medicines is as old as human civilization. One of the most famous surviving remnants is *Papyrus Ebers*, a scroll some 60 feet long and a foot wide, dating back to the 16th century. The text of documents is dominated by more than 800 formulae and 700 different drugs. Most of the medicinally active substances identified in the later centuries were used in the form of crude extract. Acharya Charaka made fifty groups of ten herbs each, which according to him, would suffice any ordinary physician's need. A large portion of the Indian population even at present still depends on the Indian system of Medicine – Ayurveda – 'Ancient Science of Life'. The well-known treatises in Ayurveda are the Charaka Samhita and the Sushruta Samhita. Sushruta is better known as the 'Father of Indian Surgery'.

In the 19th century, the term '*Materia Medica*' was used for the subject now known as 'Pharmacognosy'. It was Seydler, a German scientist, who coined the term 'Pharmacognosy' in 1815 in the title of his work 'Analecta Pharmacognostica'. Pharmacognosy is derived from two Greek words – *Pharmakon* means a drug and *Gignosco* means 'to acquire the knowledge of'.

Pharmacognosy may be defined as a branch of bioscience which treats in detail medicinal and related products of crude or primary type obtained from plant, animal and mineral origins. In short, it is an objective study of crude drugs from natural sources treated scientifically and it encompasses the knowledge of the history, distribution, cultivation, collection, processing for market and preservation, the study of sensory, physical, chemical and structural characters and the uses of crude drugs.

Pharmacognosy as an applied science has played a crucial role in the development of different disciplines of science. The knowledge of plant taxonomy, plant breeding, plant pathology and plant genetics is helpful in the development of cultivation technology for medicinal and aromatic plants. Plant chemistry, also called phytochemistry has undergone significant development in the recent years as a distinct discipline. The technology involving extraction, purification and characterization of pharmaceuticals from natural sources is a significant contribution to the advancement of natural and physical sciences. The knowledge of chemotaxonomy, biogenetic pathways for formation of medicinally active primary and secondary metabolites,

plant tissue culture and other related fields is essential for complete understanding of pharmacognosy. The basic knowledge of biochemistry and chemical engineering is essential for development of collection, processing and storage technology of crude drugs.

In a nutshell, pharmacognosy is an important bridge between the pharmaceutical and basic sciences. Pharmacognosy is a vital link between Ayurvedic and Allopathic systems of medicines. It provides a system wherein the active principles of crude drugs derived from natural origin could be dispensed, formulated and manufactured in dosage forms acceptable to allopathic system of medicine.

Ayurveda is believed to be prevalent since the last 5000 years in India. It is one of the most noted systems of medicine in the world. It is based on the hypothesis that everything in the universe is composed of five basic elements, namely space, air, energy, liquid and solid. They exist in the human body in combined forms like *vata* (space and air), *pitta* (energy and liquid) and *kapha* (liquid and solid). These three are together called as *tridoshas* (three pillars of life). When *tridosha, saptadhatu* (seven forms / tissues in body) and *mala* (excretory matter) are in balance with each other, it is called as healthy condition, while an imbalance causes a pathological condition. It is hypothesized that the five characters of medicinal herbs, namely *rasa, guna, virya, vipak* and *prabhava* can be applied to treat various pathological conditions. Authentic information on Ayurveda has been compiled by ancient Indian Medicine practitioners in forms called *Samhita* and other similar books. A number of dosage forms like *churna, avaleha, ghrita, sandhana kalpa, bhasma,* etc are prepared from them. Mostly, all of them are polyherbal formulations. Some important herbs from Ayurveda are as follows:

- *Rauwolfia serpentina* – sarpgandha
- *Asparagus racemosus* – Shatavari
- *Cassia angustifolia* – Senna
- *Sesamum indicum* – Sesame
- *Holarrhena antidysenterica* – Kuda
- *Withania somnifera* – Ashwagandha
- *Piper longum* – Pepper, etc.

- Root – *moola*
- Bark – *valcra*
- Heartwood – *koshti*
- Secretions – *niryasaha*
- Stalk – *naalika*
- Extracted juice – *ras*
- Tender leaves – *mrdu patra*
- Alkali – *ksharaha*
- Latex – *niryasa*
- Fruit – *phalam*
- Flower – *pushpam*
- Ash - *bhasma*
- Oil – *taila*
- Thorn – *kantaka*
- Leaves – *patra*
- Leaf buds – *patra-mukula*
- Tubers – *kandaha*
- Sprouts – *ankuraha*
- Pedicel – *manjari*
- Petals – *dalam*
- Stamen – *pankesara*
- Seed – *beejam*
- Whole plant - *gulma*

The other traditional systems of medicines practised worldwide are homeopathy, Unani, Bach flower remedies, aromatherapy, massage therapy, etc.

Classification of Crude Drugs

The term 'crude drug' generally applies to the products from plant and animal origin found in a raw form. The term is referred in relation to the natural product that has not been advanced in value or improved in condition by any process or treatment beyond that which is essential for its proper packing and prevention from deterioration. Crude drugs can be organized (cellular) or unorganized (acellular). In pharmacognosy, crude drugs can be classified into various ways as follows:

I. Alphabetical classification

The crude drugs are arranged according to their alphabetical order of their Latin and English names. Some pharmacopoeias and reference books classify crude drugs according to this system. For example, Indian Pharmacopoeia, British Herbal Pharmacopoeia, British Pharmaceutical Codex, European Pharmacopoeia, etc.

II. Taxonomical (Biological) classification

The drugs are classified according to plants or animals from which they are obtained in phyla, orders, families, genera, species, etc. This method is based on the consideration of natural relationship or phylogeny among plants or animals. The crude drugs of plant origin are classified on the basis of one of the accepted systems of botanical classification. Eg. *Glycyrrhiza glabra* belongs to sub-family Papilionaceae.

III. Morphological classification

The crude drugs are grouped according to the part of the plant from which the active chemical constituents are derived. The organized drugs are divided into parts of plants like leaves, flowers, fruits, seeds, wood, bark, rhizomes, etc. The unorganized drugs are dried lattices, gums, extracts, etc. Some examples are as follows.

1. Seeds- Castor, Nux-vomica
2. Leaves- Senna, Adulsa, Eucalyptus
3. Bark- *Cinchona*, Cinnamon
4. Wood- Sandalwod, *Quassia*
5. Roots- *Rauwolfia*, Aconite
6. Rhizomes- Turmeric, Ginger
7. Flowers- Saffron, Clove
8. Fruits- Coriander, Fennel
9. Gums- *Acacia*, Guar gum
10. Resins- Asafoetida
11. Dried juices- *Aloe*, Kino

V. Chemical classification

The crude drugs are divided into different groups according to the chemical nature of their most important component. Since the pharmacological activity and therapeutic significance of crude drugs are based on the nature of their chemical constituents, it would appear that chemical classification of crude drugs is the preferred method of study. Examples are as follows:

1. Glycosides – *Digitalis, Senna*
2. Alkaloids – *Nux vomica, Cinchona*
3. Tannins – Ashoka
4. Volatile oils – Peppermint, clove, Eucalyptus
5. Lipids – Castor oil, Kokum butter
6. Carbohydrates and derived products – *Acacia,* Agar, Guar gum
7. Resins – Jalap
8. Vitamins and Hormones – Yeast

VI. Pharmacological / Therapeutic classification

This system of classification involves the grouping of crude drugs according to the pharmacological action of their chief active constituent or their therapeutic uses. The drugs differing in mechanism of action, but with the same pharmacological effect are grouped together. Examples:

1. Drugs acting on gastro-intestinal tract – emetics, carminatives, laxatives, etc.
2. Drugs acting on respiratory system – expectorants, bronchodilators, etc.
3. Drugs acting on cardio-vascular system – vaso-constrictors, antihypertensives, etc.
4. Drugs acting on CNS – hallucinogens, depressants, etc.
5. Antispasmodics
6. Anticancer
7. Antirheumatics
8. Astringents
9. Local anaesthetics, etc.

Scheme for pharmacognostic studies of a particular drug: -

A systematic study of a crude drug under pharmacognostic scheme involves its description on the following lines:

1. Official title, synonyms or vernacular names, if any
2. Biological source and family
3. Geographical source or habitat
4. History and introduction of crude drug

5. Cultivation, collection, processing for market and commerce in crude drug
6. Morphological or macroscopical characters
7. Microscopic or histological studies
8. Chemical constituents and qualitative chemical tests
9. Pharmacological actions, therapeutic and other pharmaceutical uses and formulations
10. Commercial varieties, substitutes and adulterants
11. Quality control of crude drugs and phytopharmaceuticals derived from them

PHARMACOPOEIA

A pharmacopoeia is a legal and official book/guide issued by recognized authorities appointed by the Govt. of the country. It comprises of a list of pharmaceutical substances, their formulation, with their description and standards. It is derived from the Greek word *Pharmakon* (drug) and *poeia* (to make).

It is an important statutory component in the control of medicines which assists in licensing and inspection processes of MHRA (Medicines and Healthcare Products Regulatory Agency) of the country. Pharmacopoeial standards provide method for an independent judgement with reference to the quality of the drugs which applies throughout the shelf life of the product.

Characteristics of pharmacopoeia in India: -

1. Drugs of outstanding therapeutic values are standardized in the National Pharmacopoeias.
2. The drugs are arranged in alphabetical order of their Latin / English names in Pharmacopoeias.
3. Pharmacopoeias are revised in 5 – 10 years of time.
4. Pharmacopoeias also include a “Usual Dose Range”.
5. Pharmacopoeias are designated by the federal, state “Food and Drug Laws” as official standard for their contents.
6. Drugs that have been recognized in Pharmacopoeia but are not presently found in the current issues are designated as unofficial.
7. Drugs that have never appeared in Pharmacopoeia are called non-official.
8. The descriptive material referring to any of the drugs or its preparation in Pharmacopoeia is known as “Monographs”.
9. In the first edition of Indian Pharmacopoeia 1955, all official titles were in Latin while in the second edition all the titles are given in English.
10. It should be noted that the official title of few crude drugs, as they appear in both the editions of Indian Pharmacopoeia, their names have been totally changed. Eg., *Acacia* is the official title of the drug in Indian Pharmacopoeia 1955, but is changed to ‘Indian Gum’ in Indian Pharmacopoeia 1966.

In general, the following Acts and rules framed thereafter are consulted:

- Drugs and Cosmetics Act, 1940 (Amendments in 1964 and 1982)
- The Dangerous Drugs Act, 1930
- Poison Act, 1919

The standards of drugs included therein are official. As and when required, these standards can be amended and officially published by the Chairman, Ayurvedic Pharmacopoeia Committee.

INDIAN PHARMACOPOEIA: -

Indian Pharmacopoeia Commission (IPC) is an autonomous institution of the Ministry of Health and Family Welfare which sets standards for all drugs that are manufactured, sold and consumed in India. These set of standards are published under the title Indian Pharmacopoeia (IP).

The first official pharmacopoeia of India appeared in 1868 and was edited by Edward John Waring. In the pre independence days, British Pharmacopoeia was used in India. In 1946, Govt. of India issued a document called “The Indian Pharmacopeial list”. This document was later converted into the actual pharmacopoeia in 1948.

Characteristics of IP:

- Written in English and official titles of monographs given in Latin.
- Contains a total of 2000+ monographs.
- Doses expressed in metric system.
- Standard formulations of drugs are mentioned along with dose strengths.
- Most recent edition is IP 2018- 4 volumes.
- Seventh edition (IP 2014) published by IPC under the Ministry of Health and Family Welfare, Govt of India.
- IP 2014 deals with requirements of the Drugs and Cosmetics Act, 1940.
- Contributes to the control and assurance of the quality of medicines.
- Standards of IP authoritative and legally enforceable; so standardizes the drugs produced and marketed in India.
- Significant inputs received from regulatory, industrial houses, academic institutions, national laboratories, individual scientists and others.
- IP 2014 published to continue the mission of IPC to improve health of people through ensuring quality, safety and efficacy of medicines.
- Publications at regular and short intervals is one of the main mandates.

Significance of IP:

1. Prescribes standards for identity, purity and strength of drugs essentially required from health care perspective of humans and animals.
2. Promotes rational use of generic medicines by publishing National Formulary of India.
3. Provides IP Reference Substances (IPRS) which acts as finger print for identification of an article under test and its purity.
4. IP is an official document meant for overall Quality Control and Assurance of Pharmaceutical products marketed in India.
5. IP standards are authoritative. Enforced by regulatory authorities for quality control. Accepted legally even during law court disputes.
6. IP contains collection of trustworthy procedures for analysis and specification of drugs, adopted widely by a large section of pharmaceutical industry. Latest sophisticated instruments also been widely adopted.
7. Details of each pharmaceutical drug mentioned in the IP as 'monographs'.
8. IP not only detects all possible impurities, it also focusses on impurities which need more attention, besides setting the tolerance limits and to indicate methods to ensure absence of the undesirable ones.

HERBAL PHARMACOPOEIA: -

A herbal may also classify the plants it describes, may give recipes for herbal extracts, tinctures, or potions, and sometimes include mineral and animal medicaments in addition to those obtained from plants. Herbals were often illustrated to assist plant identification. Herbals were widely used before the advent of synthetic drugs and antibiotics.

- New edition was brought out by Indian Drug Manufacturers Association (IDMA) was released under the Food and Drug Administration of Maharashtra in Mumbai. Revised edition of IHP 2002 brought out in collaboration with Regional Research Laboratory (RRL), Jammu.
- Unique contribution of a scientific publication by IDMA for the benefit of industry.
- Consists of two volumes.
- Covers 52 monographs on Indian medicinal plants of immense therapeutic uses in India as well as world over.
- Authentic data based on scientific studies and investigation carried out in institutions and research laboratories published in this book.
- Publications available on individual plants also referred under each monograph.

AYURVEDIC PHARMACOPOEIA: -

- Official book for ayurvedic preparations in India.

- 1st established in 1962 by Govt. of India- AYUSH department.
- Aim: to prescribe working standards for Ayurvedic formulations including tests for purity, identity, strength, shelf life and quality to ensure uniformity.
- To standardize method of preparation, dosage, toxicity profile, etc.
- The Ayurvedic Pharmacopoeia of India (API) is a unique book of standards describing the quality, purity and strength of selected drugs that are manufactured, distributed, and sold by the licensed manufacturers in pan India.
- It is developed in two parts; the part one comprises of monographs of medicinal substances of natural origin and part two includes selected compound formulations.
- Descriptions of each single drug yielding plant/formulations are called monographs.
- India is one of the few countries who has taken initiative to establish pharmacopoeial standards of its traditional medicines of ancient origin.
- For ensuring manufacturing quality of Ayurvedic drugs the Drugs and Cosmetics Act, 1940 was amended in 1964.
- Ayurvedic Pharmacopoeia is an Indian book of standards to state quality of manufactured drugs distributed and sold by licensed drug manufacturers.
- The Ayurvedic Pharmacopoeia Committee (API) under Ministry of AYUSH, Govt of India has published standards for about 550 single drugs and 152 classical compound formulations.
- Recently API has published Part I – Vol IX comprising of 45 monographs of frequently used plants. It comprises of standards of the source plant, hydro-alcoholic extract and aqueous extracts with chromatographic finger-prints.
- The consultation is sorted from:
    - The Drugs and Cosmetics Act, 1940
    - The Dangerous Drugs Act, 1930
    - The Poison Act, 1919
    - Drugs and Magic Remedies (Objectionable Advertisement) Act, 1954
    - Narcotic and Psychotropic Substances Act, 1985
    - Biodiversity Act, 2002
- The drug is tested for its identity, purity and strength. Identification by prescribed methods in the monograph; testing on the basis of quantitative parameters such as total ash, acid-insoluble ash, water-soluble ash, etc.
- The drug is also tested for its limits of presence of heavy metals, against given International and National Standards.
- TLC is used as one of the important qualitative tests depending upon spots, colour of the spots and Rf values.

- Assays and tests carried out for weight, moisture content and dry weight contents, constituents of the drugs and its solubility in various solvents for the purpose of extraction, temperature, therapeutic uses and important formulations, doses to be given.

MONOGRAPHS: -

- Monograph means a detailed written study of a single specialized subject or an aspect of it.
- Monographs in relation to botany mean a comprehensive study of a particular taxonomic group.
- They are always taxon based, never geography based. A monograph can be of an order/a family/a genus/ a species, etc.
- They try to cover each and every fact about the taxonomic group in question.

Points to be considered in a monograph:

1. Names include Sanskrit name based upon Ayurvedic classics and / or in the Ayurvedic Formulary of India along with Latin (taxonomic) name as well as Ayurvedic name.
2. Introductory paragraph indicating the part, scientific name of the drug in Latin (taxonomic) with its habit, distribution and collection.
3. There are also synonyms mentioned in all possible regional languages.
4. The drug has to be tested on the basis of odour and its taste, avoiding poisonous drugs as suggested in the monograph.
5. The metric system of weights and measures is implemented.

General methods of description of any monograph of a medicinal plant product:

1. Name of the drug
2. Introduction
3. Extraction procedure
4. Standards
5. Added substances
6. Temperature
7. Odour and taste
8. Powder
9. Weights and measures
10. Identity, purity and strength
11. Results

12. Heavy metals, microbial load, pesticide residues and Aflatoxins
13. TLC
14. Reference standards
15. Assays
16. Solubility
17. Reagents
18. Doses
19. Therapeutic uses
20. Storage
21. Packaging
22. Labelling

STUDY OF MONOGRAPH FROM PHARMACOPOEIA

I. *Saraca asoca*: -

Asoka consists of dried stem bark of *Saraca asoca* (Rose.) De. Willd, syn. *Saraca indica* Linn. (Fam. Leguminosae, sub-fam. Caesalpinaceae). They are collected in spring from mature, wild or cultivated trees found in Central and Eastern Himalayas, Western Ghats and Deccan. 'Shoka' means 'grief'. 'Ashoka' means /one that relieves pain and grief of women'. 'Hemapushpa' as flowers of golden colour; 'Tamrapallava' as tender leaves have coppery red colour.

Classical categorization –

- **Charaka Samhita** – Kashayaskandha (astringent tasting group of herbs); Vedanasthapana (group of herbs that help to relieve pain)
- **Sushruta and Vagbhata** – Rodhradi group of herbs

Synonyms –

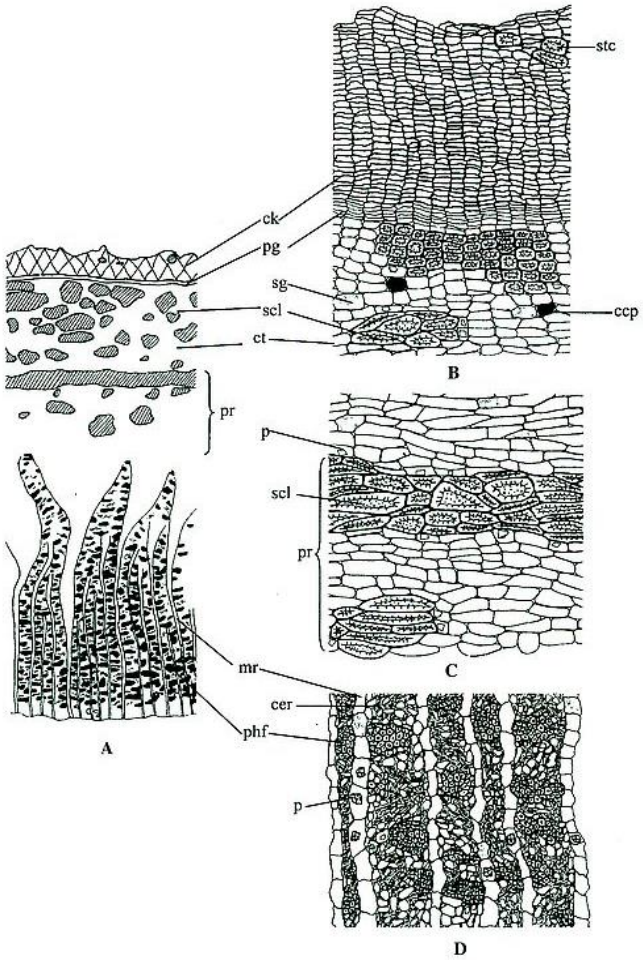
- **Sanskrit** : Ka'keli
- **Assamese, Bengali, Gujarati, Hindi, Kashmiri, Marathi, Oriya** : Ashoka
- **English** : Asok tree
- **Kannada** : Ashokadamara, Ashokamara, Kankalimara
- **Malayalam**: Asokam
- **Punjabi** : Asok
- **Tamil** : Asogam, Asogu, Asokam
- **Telugu** : Ashokapatta

Parts used - Stem bark and seeds. Stem bark usually used in decoction (Kashayam) form.

Macroscopic characters –

- Small evergreen tree, occuring upto 750 m.
- Leaves paripinnate, drooping, 15-20 cm, oblong-lanceolate with intra-petiolar stipules
- Bark dark brown or almost black with warty surface and uneven due to rounded or projecting lenticels
- Fracture splinting exposing thin whitish and continuous layer
- Flowers apetalous, yellowish orange, in axillary corymb; deciduous; calyx petaloid
- Stamens 7-8, exerted, anthers purple, versatile
- Ovary hairy, style curved
- Seeds ellipsoid-oblong and compressed

Microscopic characters –



Microscopy of *Saraca asoca* stem bark – A: Diagrammatic TS of stem bark; B: T.S of stem bark showing cork and cortex; C: T.S of stem bark showing pericycle; D: T.S of stem bark showing phloem region. [ccp – cell containing pigment; ck – cork; ct – cortex; mr – medullary rays; p – prism; pg – phellogen; phf – phloem fibres; pr – pericycle; scl – sclereids; sg – starch grains; stc – stone cells]

- Periderm consisting of wide layer of cork, radially flattened narrow cork cambium
- Secondary cortex wide with one or two continuous layers of stone cells with many patches ofsclereids
- Parenchymatous tissue contains yellow masses and prismatic crystals
- Secondary phloem consists of phloem parenchyma, sieve tubes with companion cells
- Phloem fibres occuring in groups, crystal fibres present

Identity, purity and strength –

- Foreign matter not more than 2 per cent
- Total ash content not more than 11 per cent
- Acid-insoluble ash not more than 1 per cent
- Alcohol (90%) not more than 15 per cent
- Water-soluble extractive not more than 11 per cent

Chemical constituents –

Bark contains condensed tannins, catechol, sterol, haematoxyline, phlobaphanes, organic calcium compound and a ketosterol. Recently one phenolic and another non-phenolic glycosides have also been isolated.

Properties and Action –

- Guna (qualities) = Laghu (light to digest), Rooksha (dryness)
- Rasa (taste) = Kashaya (astringent), Tikta (bitter)
- Vipaka (taste conversion after digestion) = Katu (pungent)
- Veerya = Sheeta (cold potency)
- Effect on Tridosha = Balances Kapha and Pitta

Ayurvedic medicines / Formulations –

- Ashokarishtam – very famous liquid medicine used in bleeding disorders, menorrhagia and diarrhea
- Ashoka Ghrita – Herbal ghee medicine used in menstrual pain, bleeding, anemia, etc
- Chandanadi Thailam – Used in treatment of nasal bleeding, dizziness, jaundice, herpes, etc
- Nyagrodhadi Kashayam – Herbal decoction used in bleeding disorders, obesity treatment, etc

Pharmacological / Therapeutic uses –

1. Various extracts (chloroform, methanol, aqueous, ethanol) of stem bark were evaluated for antibacterial and antifungal activity against different strains like *Staphylococcus aureus, E. coli, Pseudomonas aeruginosa, Bacillus cereus, Proteus mirabilis, Streptococcus pneumoniae* and fungi like *Candida albicans* and *Cryptococcus albidus*. Methanolic extract was found to possess the strongest activity.
2. Flowers investigated for anti-cancer activity. Results indicated 50% cytotoxicity against (*in vitro*) Dalton's lymphoma ascites and Sarcoma-180 tumour cells at concentrations of 38 mug and 54 mug respectively.
3. Oxytocic activity seen in human isolated uterine preparations. Estrogen primed or gravid uterus more sensitive to alcoholic extract. Thus, it is termed as a uterine tonic.
4. Antidiabetic activity / Hypoglycaemic effect of methanolic bark extracts in normal and streptozotocin induced diabetic rats evaluated. Significant activity seen through oral route at a dose of 400 mg/kg.
5. CNS depressant activity of leaves extract in various organic solvents as well as in water depending upon the polarity. Phenobarbitone induced sleeping time by using actophotometer method used to determine the activity. Leaves of *Saraca asoca* significantly decreased the locomotor activity by 67.33%.
6. Antiulcer activity observed in aqueous suspension of flowers in albino rats. Antiulcer potential might be due to inhibition of gastric secretion, stimulation of mucous secretion and endogenous gastric mucosal prostaglandin synthesis.
7. Anti-inflammatory activity of *Saraca asoca* leaves in ethanolic extract evaluated in animal model and found to be effective.
8. Bark extract improves skin complexion; a natural detoxifier, cleanser, relieves thirst, burning sensation, tiredness and bloating.
9. Bark extract useful in cardiac disorders and also acts as cardiac tonic.

II. *Centella asiatica*: -

The botanical name of the plant is *Centella asiatica* Urbap. Syn. *Hydrocotyle asiatica* L. belonging to Family Umbelliferae. It is a perennial herbaceous creeper found throughout India in moist places up to 1800 m in swampy areas in most tropical and subtropical countries. About 20 species are found all over. It is a tasteless, odourless plant that thrives in and around water.

Classical categorization –

- Charaka Samhita – Vayasthapana (Group of herbs used for anti-ageing treatment); Tiktaskandha (Bitter tasting group of herbs); Prajasthapana (Useful to protect pregnancy)
- Sushruta Samhita – Tiktavarga (Bitter tasting group of herbs)

Synonyms –

- **Sanskrit** : Mandukaparni, Brahmi, Mandukig, Divya
- **Hindi** : Brahma manduki, Khulakhudi, Mandookaparni
- **English** : Indian pennywort, Centella, Gotu Kola
- **Marathi** : Brahmi

Parts Used – Entire plant, especially the leaves and stems.

Macroscopic characters –

- Stem slender, rooting at nodes
- Leaves 1-4 at each node, orbicular to reniform shape, base cordate, petiole channelled, adnate stipules forming sheathing base
- Flowers in fascicled umbels; each umbel with 3-4 flowers
- Calyx teeth zero; petals five, imbricate
- Five stamens
- Ovary inferior, 2-celled, 1-ovuled
- Fruit 8 mm long, mericarps longer than broad, ovoid, hard with thickened pericarp, mericarps reticulate-rugose, often crowned with primary and secondary ridges
- Seeds compressed laterally

Chemical constituents –

- Samples of Indian plants from different places shows following glycosides: indocentelloside, brahmoside, brahminoside, asiaticoside, thankuniside, isothankuniside.
- Corresponding triterpene acids obtained on hydrolysis are indocentoic, brahmic, asiatic, thankunic and isothankunic acids.
- Except last two, others present in free form in plant apart from isobrahmic and betulic acids.
- Presence of mesoinositol, a new oligosachharide ‘centellose’, kaempferol, quercetin and stigmasterol have also been reported.

Properties and Action –

- Guna (qualities) = Laghu (light to digest)
- Rasa (taste) = Tikta (bitter)

- Vipaka (taste conversion after digestion) = madhura (sweet)
- Veerya = Sheeta (cold potency)
- Effect on Tridosha = Balances Kapha and Pitta
- Prabhava (special effect) = Medhya (improves intelligence)

Ayurvedic Medicines / Formulations –

- Karimbirumbadi Kashayam – used in jaundice, anorexia, etc
- Brihat Guduchi Taila – used in gout, arthritis, etc
- Gotu Kola – used as an ingredient for Udvartana (Ubtan / powder massage). Useful in treating obesity.

Dosage –

- Gotu Kola juice extract: 10-30 ml, powder: 3-6 grams
- Gotu Kola extract used in dose of 60-180 mg to relieve venous insufficiency (to improve blood circulation)
- As per Charaka Samhita Chikitsa Sthana 1.3, regular intake of 5-10 ml of juice extract of Gotu Kola explained as an excellent brain tonic and rejuvenator (Medhya Rasayana); so used in many Ayurvedic medicines like Saraswatarishta, Shankhapushpi, etc.
- Drug found to be non-toxic up to a dose of 350 mg/kg[3].

Pharmacological Activities / Therapeutic uses –

1. Used extensively as Rasayana i.e. anti-ageing and rejuvenating agent. Also used extensively as Medhya i.e. excellent brain tonic and improves intelligence.
2. Improves Bala (strength); Varna (skin quality), Svara (voice strength) and Agni (digestive power)
3. Useful in Raktapitta i.e. bleeding disorders like menorrhagia, nasal bleeding, bleeding from rectum, etc.
4. Good for heart, so used as cardiac tonic (Hrudya)
5. Used on skin diseases (Kushta), on diabetes (Prameha), on urinary tract disorders, on COPD, on fever (Jwara), on asthma, wheezing, breathing difficulty (Shwasa), on cough and cold (Kasa)
6. Used on Aruchi (Anorexia – lack of interest in taking food) and as Smrutiprada (improves memory)
7. It is Vishahara i.e. useful in treating poisoning and Shothahara i.e. relieves inflammation
8. In Thailand, plant used in detoxification of *Opium* poisoning. Plant paste or water decoction administered in higher doses for few months.
9. Plant extract used in dose of 60 – 180 mg to relieve venous insufficiency and improve blood circulation

10. Recent researches showed it is an effective herb against depression. Rich in antioxidants like superoxide dismutase. Known to have healing effect over gastric ulcers.
11. Great power to stimulate nail and hair growth.
12. Plant used as an ingredient for Udvartana, also known as Ubtan for powder massage. Useful in treating obesity.

Side Effects –

Over-dosage may cause drowsiness. If one is taking sedatives along with medicines prepared from this plant, may feel excessively sleepy. Then one should consider consulting doctor for reduction in sedatives dosage. It is considered safe during pregnancy and lactation, but best to use this herb under medical supervision.