UNIT-I

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HERBAL SCIENCE

UNIT- I

General Intoduction: Definition, source of herbal raw materials , identification, authentification , standardization of medicinal plants as per WHO guidelines & different herbal pharmacopoeias.

UNIT-III

Organoleptic evaluation of drugs – Microscopic evaluation of drugs – Physical evaluation of drugs – Active and inert constitutions of drugs – drug adulteration. Detailed organoleptic study of *Adadhoda vasica*. *Andrographis paniculata*. *Azadirachta indica*. *Coriandrum sativum* and *Datura metal*.

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UNIT-I

Introduction

Herbal science medicinal plants and their uses. Plants have been the basis for medical treatments through most of human history, and such traditional medicine is still widely practiced today. Modern medicine makes use of many plant-derived compounds as the basis for evidence-based pharmaceutical drugs. Although herbalism may apply modern standards of effectiveness testing to herbs and medicines derived from natural sources, few high-quality clinical trials and standards for purity or dosage exist.

History

Archaeological evidence indicates that the use of medicinal plants dates back to the Paleolithic age, approximately 60,000 years ago. Written evidence of herbal remedies dates back over 5,000 years to the Sumerians, who compiled lists of plants. Some ancient cultures wrote about plants and their medical uses in books called *herbals*. In ancient Egypt, herbs are mentioned in Egyptian medical papyri, depicted in tomb illustrations, or on rare occasions found in medical jars containing trace amounts of herbs. Among the oldest, lengthiest, and most important medical papyri of ancient Egypt, the Ebers Papyrus dates from about 1550 BC, and covers more than 700 compounds, mainly of plant origin. The earliest known Greek herbals came from Theophrastus of Eresos who, in the 4th century BC, wrote in Greek *Historia Plantarum*, from Diocles of Carystus who wrote during the 3rd century BC, and from Krateuas who wrote in the 1st century BC. Only a few fragments of these works have survived intact, but from what remains, scholars noted overlap with the Egyptian herbals. Seeds likely used for herbalism were found in archaeological sites of Bronze Age China dating from the Shang Dynasty (c. 1600–1046 BC). Over a hundred of the 224 compounds mentioned in the *Huangdi Neijing*, an early Chinese medical text, are herbs. Herbs also commonly featured in the traditional medicine of ancient India, where the principal treatment for diseases was diet. *De Materia Medica*, originally written in Greek by Pedanius Dioscorides (c. 40–90 AD) of Anazarbus, Cilicia, a Greek physician, pharmacologist and botanist, is one example of herbal writing which was used for 1500 years until the 1600s.

Definition of herbal science

Herbal Science is the **Science** of **Herbal Medicinal** Products, Functional Foods and Natural Products applied to Healthcare and Medicine.

Herb is drug composed usually of the tender parts of the plants axis.

It is different from botanic term "herb": It refers to a plant or plant part valued for its medicinal, aromatic or savory qualities. Herb plants produce and contain a variety of chemical substances that act upon the body. It is the use of herbs for their therapeutic or medicinal value.

Complementary/Alternative Medicine

They refer to a broad set of health care practices that are not part of that country's own tradition and are not integrated into the dominant health care system. In fact both the terms are interchangeable.

Traditional Medicine

Traditional medicine is the sum total of the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness.

Medicinal Plant/Medicinal Herb

It includes crude plant material such as leaves, flowers, fruit, seed, stems, wood, bark, roots, rhizomes or other plant parts, which may be entire, fragmented or powdered.

Herbal Medicines

They include herbs, herbal materials, herbal preparations and finished herbal products, which are contained as active ingredients in parts of plants, or other plant materials, or combinations. Traditional use of herbal medicines refers to the long historical use of these medicines. Their use is well established and widely acknowledged to be safe and effective, and may be accepted by national authorities.

Herbal Materials

They include, in addition to herbs, fresh juices, gums, fixed oils, essential oils, resins and dry powders of herbs. In some countries, these materials may be processed by various local procedures, such as steaming, roasting, or stir-baking with honey, alcoholic beverages or other materials.

Herbal Preparations

They are the basis for finished herbal products and may include comminuted or powdered herbal materials, or extracts, tinctures and fatty oils of herbal materials. They are produced by extraction, fractionation, purification, concentration, or other physical or biological processes. They also include preparations made by steeping or heating herbal materials in alcoholic beverages and/or honey, or in other materials.

Finished Herbal Products

They consist of herbal preparations made from one or more herbs. If more than one herb is used, the term mixture herbal product can also be used. Finished herbal products and mixture herbal products may contain excipients in addition to the active ingredients. However, finished products or mixture products to which chemically defined active substances have been added, including synthetic compounds and/or isolated constituents from herbal materials, are not considered to be herbal.

Active Ingredients

They refer to ingredients of herbal medicines with therapeutic activity. In herbal medicines where the active ingredients have been identified, the preparation of these medicines should be standardized to contain a defined amount of the active ingredients, if adequate analytical methods are available. In cases where it is not possible to identify the active ingredients, the whole herbal medicine may be considered as one active ingredient.

Marker Compound

A constituent of a medicinal herb used for quality control and assurance of herbal product. A marker compound may or may not have therapeutic activity.

Difference between Herbal and Conventional Medicines

Conventional medicine	**Herbal medicine**
Contains one active principle in high concentration Is simple with single indication	Contains several active principles in low concentrations. Is complex promoted for several divergent uses.

Herbal Drug Preparation

Herbal preparations are the basis for finished herbal products and may include comminuted or powdered herbal materials, or extracts, tinctures and fatty oils of herbal materials. They are produced by extraction, fractionation, purification, concentration or other physical or biological processes.

Standardization of herbal drugs crude plant parts /plant material

Definition:

- name of plant
- part of plant used
- Nature/condition of material: whole, powdered, fresh, dried, etc

Authentication/confirmation of:

- Correct geographical origin
- Correct stage of growth

Absence of foreign matter:

- other plant parts or materials
- soil, stones, dust
- insects and other animal matter (as determined by microscopy, macroscopy, chromatography)

Microscopic characteristics confirming identity:

- qualitative features
- quantitative features, (e.g. stomatal number, Palisade ration, stomatal index)

Radioactive contamination limits: arising from environmental pollution or microbial decontamination procedures

Assay: for materials containing constituents of known therapeutic activity, or known unique (marker) compounds. Non-specific assay methods for groups of compounds may be used where specific assay methods are not available for single compounds.

Collection of drugs

- Medicinal plant materials should be collected during the appropriate season or time period to ensure the best possible quality of both source materials and finished products.
- It is well known that the quantitative concentration of biologically active constituents varies with the stage of plant growth and development.
- The best time for collection (quality peak season or time of day) should be determined according to the quality and quantity of active constituents.
- In general, the collected raw materials should not come into direct contact with the soil. If underground parts (such as the roots) are used, any adhering soil should be removed from the plants as soon as they are collected.
- Collected material should be placed in clean baskets, mesh bags, other well aerated containers.
- After collection, the raw medicinal plant materials may be subjected to appropriate preliminary processing, including elimination of undesirable materials and contaminants, washing (to remove excess soil), sorting and cutting.
- The collected medicinal plant materials should be protected from insects, rodents, birds and other pests, and from livestock and domestic animals.
- If the collection site is located some distance from processing facilities, it may be necessary to air or sun-dry the raw medicinal plant materials prior to transport.

- If more than one medicinal plant part is to be collected, the different plant species or plant materials should be gathered separately and transported in separate containers. Cross-contamination should be avoided at all times.
- Collecting implements, such as machetes, shears, saws and mechanical tools, should be kept clean and maintained in proper condition.
- Those parts that come into direct contact with the collected medicinal plant materials should be free from excess oil and other contamination.

Harvesting

- Medicinal plants should be harvested during the optimal season or time period to ensure the production of medicinal plant materials and finished herbal products of the best possible quality.
- Care should be taken to ensure that no foreign matter, weeds or toxic plants are mixed with the harvested medicinal plant materials.
- Medicinal plants should be harvested under the best possible conditions, avoiding dew, rain or exceptionally high humidity.
- If harvesting occurs in wet conditions, the harvested material should be transported immediately to an indoor drying facility so as to prevent any possible deleterious effects due to increased moisture levels, which promote microbial fermentation.
- Cutting devices, harvesters, and other machines should be kept clean and adjusted to reduce damage and contamination from soil and other materials.

As per WHO Guidelines

1. Medicinal plants/herbal drugs should be harvested when they are at the best possible quality for the proposed use.
2. Damaged plants or parts need to be excluded.
3. Medicinal plants/herbal drugs should be harvested under the best possible conditions avoiding wet soil, dew, rain or exceptionally high air humidity. If harvesting occurs in wet conditions possible adverse effects on the medicinal plant/herbal drug due to increased moisture levels should be counteracted.
4. Cutting devices or harvesters must be adjusted such that contamination from soil particles is reduced to a minimum.
5. The harvested medicinal plant/herbal drug should not come into direct contact with the soil. It must be promptly collected and transported in dry, clean conditions.
6. During harvesting, care should be taken to ensure that no toxic weeds mix with harvested medicinal plants/herbal drugs.
7. All containers used during harvesting must be clean and free of contamination from previous harvests. When containers are not in use, they must be kept in dry conditions free of pests and inaccessible to mice/rodents, livestock and domestic animals.
8. Mechanical damage and compacting of the harvested medicinal plant/herbal drug that would result in undesirable quality changes must be avoided.
9. Freshly harvested medicinal plants/herbal drugs must be delivered as quickly as possible to the processing facility in order to prevent thermal degradation.
10. The harvested crop must be protected from pests, mice/rodents, livestock and domestic animals. Any pest control measures taken should be documented.

Drying

When medicinal plant materials are prepared for use in dry form, the moisture content of the material should be kept as low as possible in order to reduce damage from mould and other microbial infestation.

Medicinal plants can be dried in a number of ways

1. The most common method for preserving plant material is drying.
2. In the open air (shaded from direct sunlight)
3. Placed in thin layers on drying frames, wire-screened rooms or buildings.
4. By direct sunlight, if appropriate.
5. In drying ovens/rooms and solar dryers.
6. By indirect fire; baking; lyophilization; microwave; or infrared devices.
7. Vacuum drying
8. Spray dryer: Examples: Papaya latex and pectin's, etc.

- The most common method for preserving plant material is drying.
- The plant material is spread out on shallow trays, which are placed on mobile racks and passed into a tunnel where they meet a stream of warm air.
- The air temperature is kept at 20-40 °C for thin materials such as leaves, but is often raised to 60-70 °C for plant parts that are harder to dry, e.g. roots and barks.

Storage of crude drugs

1. Storage facilities for medicinal material should be well aerated, dry and protected from light, and, when necessary, be supplied with air-conditioning and Humidity control equipment as well as facilities to protect against rodents, insects.
2. The floor should be tidy, without cracks and easy to clean. Medicinal material should be stored on shelves which keep the material a sufficient distance from the walls; measures should be taken to prevent the occurrence of pest infestation.
3. Continuous in-process quality control measures should be implemented to eliminate substandard materials, contaminants and foreign matter prior to and during the final stages of packaging.
4. Processed medicinal plant materials should be packaged in clean, dry boxes, sacks, bags or other containers in accordance with standard operating procedures and national and/or regional regulations of the producer and the end-user countries.

Preservation of plant material

The plant material must first be preserved so that the active compounds will remain unchanged during transport and storage.

The cells of living plants contain not only low molecular-weight compounds and enzymes, but they also have many kinds of barriers that keep these constituents apart**.**

When the plant dies, the barriers are quickly broken down and the enzymes then get the opportunity to promote various chemical changes in the other cell constituents, e.g. by oxidation or hydrolysis.

Pharmacopoeia

- It is a legal and official book issued by recognized authorities usually appointed by Government of each country.
- It comprises list of pharmaceutical substances, formulae along with their description and standards.

List of Pharmacopeias:

a) Argentine b) Austrian c) Belgian d) Brazilian e) British f) Chinese g) Egyptian h) European i) French j) German k) Hungarian 1) Indian m) International n) Italian o) Japanese p) Yugoslavian q) Mexican r) Netherlands s) Nordic t) Polish u) Portuguese v) Rumanian w) Russian x) Spanish y) Turkish z) United state.

Indian Pharmacopoeia

- First official Pharmacopeia of India appeared in 1868 which was edited by Edward John Waring.
- In pre independence days, British Pharmacopeia was used in India.
- In 1946 Government of India issued one list known as 'The Indian Pharmacopeial list'.
- Committee under chairmanship of Sir R. N. Chopra alongwith other nine members prepared 'The Indian Pharmacopeial list
- It was prepared by Dept. of Health, Govt. of India, Delhi in 1946.
- In 1948 Government of India appointed an Indian Pharmacopeia committee for preparing 'Pharmacopeia of India'.
- Tenure of this committee was five years.
- Indian Pharmacopeia committee under chairmanship of Dr. B. N. Ghosh Published first edition of IP in 1955.

Indian Pharmacopoeia

- It is written in English & official titles of monographs given in Latin.
- It covers 986 monographs. Supplement to this edition was published in 1960.
- Second edition of IP was published in 1966 under the chairmanship of Dr. B. Mukkerji.
- Official titles of monographs given in English.
- Dose were expressed in Metric system.
- For Tablets and Injections "USUAL STRENGTH" have been given.
- Formulations of the drugs were given immediately after the monograph of drugs.
- 274 monographs from IP 55 & their supplement were deleted.
- 93 new monographs were added. • Supplement to this edition was published in 1975.
- 126 new monographs have been included & 250 monographs have been amended.
- Cholera vaccine has been deleted.
- Fifth edition of IP was published in 2007 & IP 2007 is presented in Three Volumes.
- Volume One contains general notices & general chapters.
- Volume Two & Three contains general monographs on drug substances, dosage forms & Pharmaceutical aids.

Indian Pharmacopoeia 2010

- 6th edition of IP is published in 2010.
- The 6th edition of the Indian Pharmacopoeia 2010 is published by the Indian Pharmacopoeia Commission (IPC) Ghaziabad in accordance with a plan and completed through the untiring efforts of its members, Secretariat and Laboratory over a period of about two years.
- This edition would be effective from 1st September, 2010.

- The Indian Pharmacopoeia 2010 is presented in three volumes.
- Volume I contains the Notices, Preface, the Structure of the IPC, Acknowledgements, Introduction, and the General Chapters.
- Volume Il contains the General Notice, General Monographs on Dosage Forms and Monographs on drug substances, dosage forms and pharmaceutical aids (A to M).
- Volume Ill contains Monographs on drug substances, dosage forms and pharmaceutical aids (N to Z).
- Followed by Monographs on Vaccines and Immunosera for Human use, Herbs and Herbal products, Blood and blood related products, Biotechnology products and Veterinary products.
- The number of monographs of Excipients, Anticancer drugs, Herbal products and antiretroviral drugs has been increased in this edition.
- Monographs of Vaccines and Immunosera are also upgraded in view of development of latest technology in the field.
- A new chapter on Liposomal products and a monograph of Liposomal Amphotericin B injection is an added advantage in view of latest technology adopted for drug delivery.
- A chapter on NMR is incorporated in Appendices.
- The chapter on microbial contamination is also updated to a great extent to harmonise with prevailing international requirements.

British Pharmacopoeia

- BP 2008 contains approximately 3100 monographs for substances, preparations and articles used in practice.
- It has been made effective from 1st January 2008. • BP 2007-2009 were given in Six Volumes i.e. Volume I to Volume VI.
- Volume I & Il contains medicinal substances.
- Volume III contains formulated preparations, blood related products, immunological products, radiopharmaceutical preparations, surgical materials & homoeopathic preparations.
- Volume IV contains supplementary chapters, IR spectra etc.
- Volume V contains veterinary.
- Volume VI contains CD ROM version.
- Current edition of BP 2010 is in process.

The British Pharmacopoeia 2010

TSO The British Pharmacopoeia (BP) is the official collection of standards for UK medicinal products and pharmaceutical substances. Published annually, the BP contains monographs for pharmaceutical substances, formulated preparations and other articles used in the practice of medicine. The standards in the BP 2010 are legally effective in the UK from 1 January 2010. The BP has been providing authoritative, official standards for pharmaceutical substances and medicinal products since 1864. Today, it is used in almost 100 countries worldwide and remains an essential reference for any individual or organisation working within pharmaceutical research and development, manufacturing and testing across the globe.

New to the BP 2010 are 40 monographs for formulated preparations, including veterinary medicines and additional standards for widely used unlicensed formulations. All European Pharmacopoeia

6th edition material up to and including Supplement 6.5 is integrated into the text of the BP 2010. In addition to the expanding number of monographs for licensed formulated products, the BP supports the regulatory work in the fields of herbal and complementary medicines by providing additional new and revised monographs for herbal medicinal products and for homeopathic stocks and mother tinctures. The print edition of the BP 2010 comprises four volumes of the BP 2010 and a single volume of the BP (Veterinary) 2010.

The British Pharmacopoeia (BP) 2013

41 new BP monographs

40 new European Pharmacopoeia monographs

619 amended monographs

6 new and 1 amended Infrared Reference Spectra

The British Pharmacopoeia 2014

The only official source of British pharmaceutical standards Produced by the British Pharmacopoeia Commission Secretariat of the Medicines and Healthcare Products Regulatory Agency, and updated annually, the British Pharmacopoeia (BP) is the official, authoritative collection of standards for UK medicinal substances for human and veterinary use. The 2014 edition includes almost 3500 monographs which are legally enforced by the Human Medicines Regulations 2012.

Global standards

Now used in over 100 countries, the BP remains an essential reference for all individuals and organisations working within pharmaceutical research and development, manufacture and testing around the globe.

United State Pharmacopoeia

- First edition of United state Pharmacopeia was published on 15th December 1820 in both Latin & English.
- From 1820 to 1942 it was published at Ten years intervals.
- From 1942 to 2000 it was published at Five years intervals.
- From 2002 it was published annually.
- First National Formulary of the united state appeared in 1888.
- USP21-NF16 have eight supplements.
- First appeared in January 1985 & last in November 1988.
- USP22-NF17, 1990 is the third revision that consolidates USP & NF into a single volume.
- Electronic version of USP-NF on floppy disks was introduced in 1992.
- USP23-NF18, was published in Mumbai as an Asian edition at the end of 1994.
- USP23 has ten supplements.
- First supplement was published in January 1995 & Last in May 1999.
- USP24-NF19, appeared from first January 2000.
- USP30-NF25, appeared from May 2007.
- It contains Scientific standards for drugs, dietary substances, biological products & Excipients used in dosage forms.

- It contains 4,100 monographs and 200 general chapters.
- It has been printed in three volume set.
- Volume I contains general chapters & Volume II & III contains monographs.
- First supplement to USP30-NF25, appeared from August 2007 & second supplement from November 2007 which will be considered official from May 2008.
- From 2006, Spanish edition of USP is also being published.
- Current edition of USP 2014 is in process.

United States Pharmacopoeia 30 – National Formulary 25

- New heavier paper stock
- Complete table of contents and index in each volume
- Special 'Using the New USP-NF Print' tutorial CD
- Convenient slipcase for easy access and storage (English edition only).

United States Pharmacopoeia 31 – National Formulary 26

The USP-NF is a single-volume combination of two official compendia, the United States Pharmacopeia (USP) and the National Formulary (NF). Monographs for drug substances and preparations are featured in the USP, with monographs for dietary supplements and ingredients appearing in a separate section of the USP. Excipient monographs are included in the NE.

United States Pharmacopoeia 32 - National Formulary 27

The USP 32-NF 27 Contains :

- More than 4,200 monographs
- Includes over 200 general chapters, covering general tests and assays
- Displays helpful guides and charts that make it easy to find focus-specific information
- Includes information on emerging areas of science and medicine
- Helps ensure compliance with official standards
- Enables validation of test results against proven benchmarks
- Creates in-house standards for operating procedures and specifications
- Expedites new product development and approvals.

United states pharmacopeia 34 – national formulary 29:

USP 34-NF 29 features more than 4,500 monographs for drug substances, dosage forms, excipients, biologics, dietary supplements, and other therapeutics. USP 34-NF 29 also offers harmonized material and more than 230 General Chapters with current guidelines for the full range of laboratory tests and established processes for validating methods.

United states pharmacopeia 35 - national formulary 30: The 'United States Pharmacopeia 35 - National Formulary 30' (USP-NF) is a combination of two official compendia: the 'United States Pharmacopeia (USP)' and the 'National Formulary (NF)' and is officially applicable from 1 May, 2012 to 30 April, 2013.

UNIT-III

Evaluation Of Crude Drugs Evaluation of a drug ensure the identity of a drug and determines the quality and purity of drugs. The main reasons behind the need for evaluation of crude drugs

are biochemical variation in the drug, effect of treatment and storage of drugs, and the adulterations and substitutions.

Organoleptic evaluation: Organoleptic evaluation means the study of drugs using organs of senses. It refers to the methods of analysis like colour, odour, taste, size, shape and special features, such as touch, texture, etc. Obviously, the initial sight of the plant or extract is so specific that it tends to identify itself. If this is not enough, perhaps the plant or extract has a characteristic odour or taste. The study of form of a crude drug is morphology while description of the form is morphography. Eg. The fractured surfaces in cinchona, quillaia and cascara barks and quassia wood are important characteristics. Aromatic odour of umbelliferous fruits and sweet taste of liquorice. The wavy shape of rauwolfia, pungent taste of capsicum and ginger, brown colour of cinnamon, odour and taste of spice-drugs like, asafoetida, black pepper, nutmeg, caraway, cumin etc. are important diagnostic organoleptic characteristics.

Microscopic evaluation : This method allows more detailed examination of a drug and it can be used to identify the organised drugs by their known histological characters. It is mostly used for qualitative evaluation of organised crude drugs in entire and powdered forms. Every plant possesses a characteristic tissue feature. Microscope can be used to confirm the structural details of the drugs from plant origin. For the effective results, various reagents or stains can be used to distinguish cellular structure. A drop of phloroglucinol and concentrated hydrochloric acid give red stain with lignin. Mucilage is stained pink with rhuthenium red and also, when treated with corallin soda and few drops of sodium carbonate solution, cellulose swells and dissolves in cuoxam, while N/50 iodine solution stains starch and hemicellulose blue. Eg. Lignified trichomes in nux vomica, warty trichomes of senna, wavy medullary rays of cascara bark, glandular trichomes of mint etc. The powdered cloves do not contain sclereids or calcium oxalate crystals, but both of them are present in powdered clove stalks.

Physical evaluation : Physical standards are to be determined for the drugs, wherever possible. These are rarely constant for crude drugs, but may help in evaluation, specifically with reference to moisture content, specific gravity, density, optical rotation, refractive index, melting point, viscosity, and solubility in different solvents.

1) Moisture content- The moisture content of a drug will be responsible for decomposition of crude drugs either producing chemical change or microbial growth. So, the moisture content of a drug should be determined and controlled.

Solubility: Drug specific behaviour towards solvents are taken into consideration. Eg. Solubility of colophony of colophony in light petroleum, the solubility of balsam of Peru in solution of chloral hydrate **.**

Viscosity : Viscosity of a liquid is constant at a given temperature and is an index of its composition. Eg.pyroxylin kinematic viscosity, 1100-2450 centistokes.

Melting point: Plant constituents have very sharp and constant melting points. As far as crude drugs are concerned, melting point range has been fixed due to the mixed chemicals.

Ultraviolet light: Certain drugs fluoresce when the cut surface or the powder is exposed to ultraviolet radiation, and it is useful in the identification of those drugs.

Ash value: The determination of ash is useful for detecting low grade products, exhausted drugs, and excess of sandy or earthy matter. Different types of ash values are used in detection of crude drugs like, total ash, acid insoluble ash, water- soluble ash and sulphated ash.

10) Extractive values: The extracts obtained by exhausting crude drugs with different solvents are approximate measures of their chemical constituents. Various solvents are used according to the type of the constituents to be analysed. Water soluble extractive is used for crude drugs containing water-soluble constituents like glycosides, tannins, mucilage etc; alcohol- soluble extractive is used for crude drugs containing tannins, glycosides, resins, etc; and ether-soluble extractives are used for drugs containing volatile constituents and fats.

11) Foreign organic Matters- The parts of the organ or organs other than those parts of drugs mentioned in the definition and description of the drug are known as foreign organic matters. They may be insect, moulds, earthy material, animal excreta, etc. Eg. Garlic should not contain more than 2%, saffron should not contain more than 2%.

Active Ingredient

An **active ingredient** is the ingredient in a pharmaceutical drug or pesticide that is biologically active. The similar terms **active pharmaceutical ingredient** and **bulk active** are also used in medicine, and the term **active substance** may be used for natural products. Some medication products may contain more than one active ingredient. The traditional word for the active pharmaceutical agent is **pharmacon** or **pharmakon** (from Greek: from pharmacos) which originally denoted a magical substance or drug.

The terms **active constituent** or **active principle** are often chosen when referring to the active substance of interest in a plant (such as salicylic acid in willow bark or arecoline in areca nuts), because the word *ingredient* in many minds connotes a sense of human agency (that is, something that a person combines with other substances), whereas the natural products present in plants were not added by any human agency but rather occurred naturally ("a plant doesn't have ingredients").

In contrast with the active ingredients, the inactive ingredients are usually called excipients in pharmaceutical contexts. The main excipient that serves as a medium for conveying the active ingredient is usually called the vehicle. Petrolatum and mineral oil are common vehicles. The term 'inactive' should not be misconstrued as meaning inert.

ADULTERATION

A treatise published two centuries ago (in 1820) on adulterations in food and culinary materials is a proof for this practice as an age-old one. Due to adulteration, faith in herbal drugs has declined. Adulteration in market samples is one of the greatest drawbacks in promotion of herbal products. Many researchers have contributed in checking adulterations and authenticating them. It is invariably found that the adverse event reports are not due to the intended herb, but rather due to the presence of an unintended herb. Medicinal plant dealers have discovered the 'scientific' methods in creating adulteration of such a high quality that without microscopic and chemical analysis, it is very difficult to trace these adulterations.

Definition: The term adulteration is defined as substituting original crude drug partially or wholly with other similar-looking substances. The substance, which is mixed, is free from or inferior in chemical and therapeutic property.

Types of Adulterants: Adulteration in simple terms is debasement of an article. The motives for intentional adulteration are normally commercial and are originated mainly with the intension of enhancement of profits. Some of the reasons that can be cited here are scarcity of drug and its high price prevailing in market. The adulteration is done deliberately, but it may occur accidentally in some cases. Adulteration involves different conditions such as deterioration, admixture, sophistication, substitution, inferiority and spoilage. Deterioration is impairment in the quality of drug, whereas admixture is addition of one article to another due to ignorance or carelessness or by accident. Sophistication is the intentional or deliberate type of adulteration. Substitution occurs when a totally different substance is added in place of original drug. Inferiority refers to any substandard drug, and spoilage is due to the attack of microorganisms.

Adhatoda Vasica

Adhatoda Vasica (also called Vasaka) is an ayurvedic medicinal plant used for a cough, asthma, breathing trouble, nasal congestion, bleeding disorders, allergic conditions, upper respiratory infections, excessive uterine bleeding, heavy menstruation, and epistaxis .

Description: Adhatoda vasica is a small evergreen plant, of the Acanthaceae family, with broad, lanceolate (sharp and pointed like a lance) leaves measuring 10 to 16 centimeters in length and 5 centimeters wide. They become greenish-brown when dried and have a bitter taste. They have a smell similar to strong tea. The wood of the stem is soft, and makes a great charcoal for gunpowder. The flower has large, attractive, white petals, streaked with purple on the lower lip. The fruit is a small capsule with four seeds.

Phytochemical Composition: Adhatoda Vasica (Vasaka) contains following active principles, which might responsible for its therapeutic properties.Vasicine (quinazoline alkaloid),Vasicine acetate,asicinone,Vasicinolone,2-acetyle benzyle

Medicinal Properties

Adhatoda Vasica (Vasaka) has following medicinal properties.

- Antitussive – relieves a cough,Expectorant – promotes expectoration,Bronchodilator – dilates bronchi,Anti-bacterial,Anti-microbial,Anti-viral,Anti-inflammatory – reduces inflammation of airways,Antihemorrhagic (styptic) – checks bleeding,Antioxidant
- Antispasmodic – Helps in abdominal spasms and relaxes muscles (its action is confirmed due to the presence of Vasicinone alkaloid in Vasaka)
- Antifungal – Works against ringworm
- Mild Sedative – Calms the mind
- Anti-allergic – Fights off allergies
- Anthelmintic – Anti-parasite or removes worms
- Appetite stimulant – Improves appetite

Andrographis paniculata

Andrographis paniculata, commonly known as **creat** or **green chiretta**, is an annual herbaceous plant in the family Acanthaceae, native to India and Sri Lanka. Other common names for the plant include *King of Bitter* and *hempedu bumi* (Malay). It is widely cultivated in Southern and Southeastern Asia, where it has been traditionally been believed to be a treatment for bacterial infections and some diseases. Mostly the leaves and roots were used for such purposes. The whole plant is also used in some cases.

Description

The plant grows as an erect herb to a height of 30–110 cm (12–43 in) in moist, shady places. The slender stem is dark green, square in cross-section with longitudinal furrows and wings along the angles. The lance-shaped leaves have hairless blades measuring up to 8 cm (3.1 in) long by 2.5 cm (0.98 in). The small flowers are pink, solitary, arranged in lax spreading racemes or panicles. The fruit is a capsule around 2 cm (0.79 in) long and a few millimeters wide. It contains many yellow-brown seeds. The seeds are subquadrate, rugose and glabrous. The flowering time is September to December.

Uses

A. paniculata has been used in Siddha and Ayurvedic medicine, and is promoted as a dietary supplement for cancer prevention and cure. There is no evidence that it helps prevent or cure cancer. In the traditional medicine of India, *A. paniculata* has also been used for jaundice therapy.

Amid flareup of COVID-19 pandemic outbreak in December 2020 in Thailand, the country's health ministry had approved the usage of the plant extract for a pilot and alternative treatment program for early stages of the coronavirus infection to reduce the severity of the outbreak and cut treatment costs. The treatment was initially made available in five state-owned hospital on a voluntary basis for those in the age group of 18 to 60 years old with minor symptoms and should be within 72 hours of confirmed infections. The ministry cited that the plant extract can curb virus and reduce severity of inflammation, of which at the time, human trials showed patient conditions improved within three days of the treatment without side effects if the medicine is administered within the said confirmed infections hours.

Phytochemicals

Andrographolide is the major constituent extracted from the leaves of the plant and is a bicyclic diterpenoid lactone. This bitter principle was isolated in pure form by Gorter (1911). Systematic studies on chemistry of *A.paniculata* have been carried out. 14-Deoxy-11-dehydroandrographolide, Plant , 14-Deoxy-11-oxoandrographolide, Plant,5-Hydroxy-7,8,2',3'-Tetramethoxyflavone,Plant,5-Hydroxy-7,8,2'-Trimethoxyflavone,Tissue Culture,Andrographine, Root,Andrographolide,Plant,Neoandrographolide,Plant,Panicoline,Root,PaniculideA,Plant,Panic ulide-B, Plant,Paniculide-C, Plant

Azadirachta indica

Azadirachta indica, commonly known as **neem**, **nimtree** or **Indian lilac**, is a tree in the mahogany family Meliaceae. It is one of two species in the genus *Azadirachta*, and is native to the Indian subcontinent. It is typically grown in tropical and semi-tropical regions. Neem trees also grow in islands located in the southern part of Iran. Its fruits and seeds are the source of neem oil.

Description

Neem is a fast-growing tree that can reach a height of 15–20 metres (49–66 ft), and rarely 35–40 metres (115–131 ft). It is evergreen, but in severe drought it may shed most or nearly all of its leaves. The branches are wide and spreading. The fairly dense crown is roundish and may reach a diameter of 20–25 metres (66–82 ft). The neem tree is very similar in appearance to its relative, the Chinaberry (*Melia azedarach*).

The opposite, pinnate leaves are 20–40 centimetres (7.9–15.7 in) long, with 20 to 30 medium to dark green leaflets about 3–8 centimetres (1.2–3.1 in) long. The terminal leaflet often is missing. The petioles are short.

The (white and fragrant) flowers are arranged in more-or-less drooping axillary panicles which are up to 25 centimetres (9.8 in) long. The inflorescences, which branch up to the third degree, bear from 250 to 300 flowers. An individual flower is 5–6 millimetres (0.20–0.24 in) long and 8–11 millimetres (0.31–0.43 in) wide. Protandrous, bisexual flowers and male flowers exist on the same individual tree.

The fruit is a smooth (glabrous), olive-like drupe which varies in shape from elongate oval to nearly roundish, and when ripe is 1.4–2.8 centimetres (0.55–1.10 in) by 1.0–1.5 centimetres (0.39–0.59 in). The fruit skin (exocarp) is thin and the bitter-sweet pulp (mesocarp) is yellowish-white and very fibrous. The mesocarp is 0.3–0.5 centimetres (0.12–0.20 in) thick. The white, hard inner shell (endocarp) of the fruit encloses one, rarely two, or three, elongated seeds (kernels) having a brown seed coat.

Uses

Neem leaves are dried in India and placed in cupboards to prevent insects eating the clothes, and also in tins where rice is stored.These flowers are also used in many Indian festivals like Ugadi. *See below: Association with Hindu festivals in India*.

As a vegetable

The tender shoots and flowers of the neem tree are eaten as a vegetable in India. A souplike dish called *Veppampoo charu* (Tamil) (translated as "neem flower rasam") made of the flower of neem

is prepared in Tamil Nadu. In Bengal, young neem leaves are fried in oil with tiny pieces of eggplant (brinjal). The dish is called *neem begun bhaja* and is the first item during a Bengali meal that acts as an appetizer. It is eaten with rice..

Coriander (/ˌkɒriˈændər, ˈkɒriændər/;[1] *Coriandrum sativum*) is an annual herb in the family Apiaceae. It is also known as **Chinese parsley**, **dhania** or **cilantro**. All parts of the plant are edible, but the fresh leaves and the dried seeds (as a spice) are the parts most traditionally used in cooking.

Coriander

Most people perceive the taste of coriander leaves as a tart, lemon/lime taste, but to nearly a quarter of those surveyed, the leaves taste like dish soap, linked to a gene which detects some specific aldehydes that are also used as odorant substances in many soaps and detergents.

Coriander is native to regions spanning from Southern Europe and Northern Africa to Southwestern Asia. It is a soft plant growing to 50 cm (20 in) tall. The leaves are variable in shape, broadly lobed at the base of the plant, and slender and feathery higher on the flowering stems. The flowers are borne in small umbels, white or very pale pink, asymmetrical, with the petals pointing away from the center of the umbel longer (5–6 mm or 0.20–0.24 in) than those pointing toward it (only 1–3 mm or 0.039–0.118 in long). The fruit is a globular, dry schizocarp 3–5 mm (0.12–0.20 in) in diameter. Pollen size is approximately 33 microns.

Uses

All parts of the plant are edible, but the fresh leaves and the dried seeds are the parts most traditionally used in cooking, Coriander is used in cuisines throughout the world.

Leaves

The leaves are variously referred to as coriander leaves, fresh coriander, dhania, Chinese parsley, or (in the US and commercially in Canada) cilantro.Coriander potentially may be confused with culantro (*Eryngium foetidum* L.), in the same family (Apiaceae) as coriander (*Coriandrum sativum* L.), but from a different genus. Culantro has a distinctly different spiny appearance, a more potent volatile leaf oil[18] and a stronger aroma.The leaves have a different taste from the seeds, with citrus overtones.

The fresh leaves are an ingredient in many foods, such as chutneys and salads, salsa, guacamole, and as a widely used garnish for soup, fish and meat.As heat diminishes their flavour, coriander leaves are often used raw or added to the dish immediately before serving. In Indian and Central Asian recipes, coriander leaves are used in large amounts and cooked until the flavour diminishes.The leaves spoil quickly when removed from the plant, and lose their aroma when dried or frozen.

Seeds

Dried coriander fruits, often called "coriander seeds" when used as a spiceThe dry fruits are coriander seeds. The word "coriander" in food preparation may refer solely to these seeds (as a spice), rather than to the plant. The seeds have a lemony citrus flavour when crushed, due to terpenes linalool and pinene. It is described as warm, nutty, spicy, and orange-flavoured.

Outside of Asia, coriander seed is used widely in the process for pickling vegetables. In Germany and South Africa (see *boerewors*), the seeds are used while making sausages. In Russia and Central

Europe, coriander seed is an occasional ingredient in rye bread (e.g. Borodinsky bread), as an alternative to caraway. The Zuni people of North America have adapted it into their cuisine, mixing the powdered seeds ground with chili and using it as a condiment with meat, and eating leaves as a salad.

One preliminary study showed coriander essential oil to inhibit Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus*, *Enterococcus faecalis*, *Pseudomonas aeruginosa*, and *Escherichia coli*.[24]

Coriander is listed as one of the original ingredients in the secret formula for Coca-Cola.[25]

Roots

Coriander roots

Coriander roots have a deeper, more intense flavor than the leaves, and are used in a variety of Asian cuisines, especially in Thai dishes such as soups or curry pastes.

Nutrition

Raw coriander leaves are 92% water, 4% carbohydrates, 2% protein, and less than 1% fat (table). The nutritional profile of coriander seeds is different from the fresh stems or leaves. In a 100-gram (3.5 oz) reference amount, leaves are particularly rich in vitamin A, vitamin C and vitamin K, with moderate content of dietary minerals . Although seeds generally have lower vitamin content, they do provide significant amounts of dietary fiber, calcium, selenium, iron, magnesium and manganese.

Taste and smell

The essential oil from coriander leaves and seeds contains mixed polyphenols and terpenes, including linalool as the major constituent accounting for the aroma and flavor of coriander.[27]

Different people may perceive the taste of coriander leaves differently. Those who enjoy it say it has a refreshing, lemony or lime-like flavor, while those who dislike it have a strong aversion to its pungent taste and smell, characterizing it as soapy or rotten.Studies also show variations in preference among different racial groups: 21% of East Asians, 17% of Caucasians, and 14% of people of African descent expressed a dislike for coriander, but among the groups where coriander is popular in their cuisine, only 7% of South Asians, 4% of Hispanics, and 3% of Middle Eastern subjects expressed a dislike.

Studies have shown that 80% of identical twins shared the same preference for the herb, but fraternal twins agreed only about half the time, strongly suggesting a genetic component to the preference. In a genetic survey of nearly 30,000 people, two genetic variants linked to perception of coriander have been found, the most common of which is a gene involved in sensing smells.The gene, *OR6A2*, lies within a cluster of olfactory-receptor genes, and encodes a receptor that is highly sensitive to aldehyde chemicals. Flavor chemists have found that the coriander aroma is created

by a half-dozen or so substances, and most of these are aldehydes. Those who dislike the taste are sensitive to the offending unsaturated aldehydes and at the same time may be unable to detect the aromatic chemicals that others find pleasant. Association between its taste and several other genes, including a bitter-taste receptor, have also been found.

Allergy

Some people are allergic to coriander leaves or seeds, having symptoms similar to those of other food allergies.In one study examining people suspected of food allergies to spices, 32% of pin-prick tests in children and 23% in adults were positive for coriander and other members of the family Apiaceae, including caraway, fennel, and celery.The allergic symptoms may be minor or life-threatening.

Datura metal

Datura metal known as pricklyburr,recurved thorn-apple,downy thorn-apple, Indian apple, lovache, moonflower, nacazcul, toloatzin, toloaxihuitl, tolguache or toloache, is a species of flowering plant in the family Solanaceae. It is more rarely called sacred datura, a common name which is applied more often to the closely related *Datura wrightii*.It is native to the SouthwesternUnitedstates, Central and SouthAmerica,and introduced in Africa, Asia, Australia and Europe. The scientific name is often cited as *D. innoxia*.When English botanist Philip Miller first described the species in 1768, he misspelled the Latin word *innoxia* (inoffensive) when naming it *D. inoxia*. The name *Datura meteloides* was for some time erroneously applied to some members of the species, but that name has now been abandoned.

Description

Datura metal is a tuberous-rooted, subshrub that typically reaches a height of 0.6 to 1.5 metres.Its stems and leaves are covered with short and soft grayish hairs, giving the whole plant a grayish appearance.It has elliptic smooth-edged leaves with pinnate venation.The flowers are white, trumpet-shaped, 12–19 cm (4.5–7.5 in) long.They first grow upright, and later incline downward. It flowers from early summer until late fall.The fruit is an egg-shaped spiny capsule, about 5 cm in diameter. Like those of other species belonging to section *Dutra* of the genus Datura, it splits open irregularly when ripe to disperse its seeds.

Toxicity

All parts of *Datura* plants are toxic, containing dangerous levels of tropane alkaloids and may be fatal if ingested by humans and other animals, including livestock and pets. In some places it is prohibited to buy, sell or cultivate *Datura* plants.

Uses

When cultivated, the plant is usually treated as an annual to be grown from seed, but its tuberous roots (somewhat reminiscent of those of the cultivated Dahlia) can be kept from freezing and planted in the spring of the following year.

Datura metal, like other *Datura* species, contains the highly toxic alkaloids atropine, hyoscine (scopolamine), and hyoscyamine. The Aztecs called the plant by the Nahuatl names *toloatzin* and *toloaxihuitl* (trans. "the plant with the nodding head" - in reference to the nodding seed capsules) and used it long before the Spanish conquest of Mexico for many therapeutic purposes, such as poultices for wounds where it acts as an anodyne.