Semester- 6th

Subject: Herbal Drug Technology

Subject code: BP603

Module -1

Herbs as Raw materials

Objectives: upon compilation of this module the student should be able to:

1. Understand raw material as source of herbal drugs from cultivation to herbal drug product
2. Know the WHO guidelines for cultivation of herbal drugs
3. Understand about the methods for selection, identification and authentication of herbal drugs
4. Know about the processing of herbal and medicinal plants.

Learning outcomes: the student will be able to:

1. Learn the definition of herbs as raw material, herbs, herbal medicinal products and sources of herbs**.**
2. Learn about the methods for selection, identification and authentication methods for herbal materials.
3. Learn about the processing methods of herbal drugs.
4. Learn about the safety parameters for herbal drugs.

Introduction:

Medicinal and aromatic plans constitute a major part of the flora, which provides raw materials for use in the pharmaceuticals, cosmetics and drug industries. In one of the studies by WHO, it is estimated ha 80 percent of the population of developing countries relies on traditional plant based medicines for their health requirements. India and China are the two major producing countries having 40 percent of the global biodiversity and availability of rare species. These are well known as the home of medicinal and aromatic crops that constitute a segment of the flora and provide raw materials to the pharmaceutical, cosmetics, fragrance, flavor etc. industries. From the trade data available, it is clear that the global market for medicinal plants has always been large and has been on increase in the recent past. The trade of medicinal plants from India is estimated Rs. 550crores.

Herbs: It is defined as any plant with leaves, seeds or flowers used for flavoring, food, medicine or perfume.

Herbal medicine: Practice of using herbs and herbal preparations to maintain health and to prevent, alleviate or cure disease or a plant or plant part or an extract or mixture of these used in herbal medicine.

Herbal medicinal products: these are medicinal products where the active ingredient consists mainly of herbal substances.

Herbal drug preparations: They are prepared from herbal materials by different process, which is extraction with various solvents, purification, concentration and other processes. It includes such as powders, extracts and juices.

Finished herbal products: Finished herbal products consist of one or more herbal preparations made from one or more herbs (i.e. from different herbal preparations made of the same plant as well as herbal preparations from different plants. Products containing different plant materials are called “mixture herbal products”.

Selection, identification and authentication of herbal drugs: Where applicable, the species or botanical variety selected for cultivation should be the same as that specified in the national pharmacopoeia or recommended by other authoritative national documents of the end-user's country. In the absence of such national documents, the selection of species or botanical varieties specified in the pharmacopoeia or other authoritative documents of other countries should be considered. In the case of newly introduced medicinal plants, the species or botanical variety selected for cultivation should be identified and documented as the source material used or described in traditional medicine of the original country**.**

Identification tests should be specific for the herbal material and are usually a combination of three or more of the following:

- macroscopic characters
- microscopic characters
- chromatographic procedures
- chemical reactions

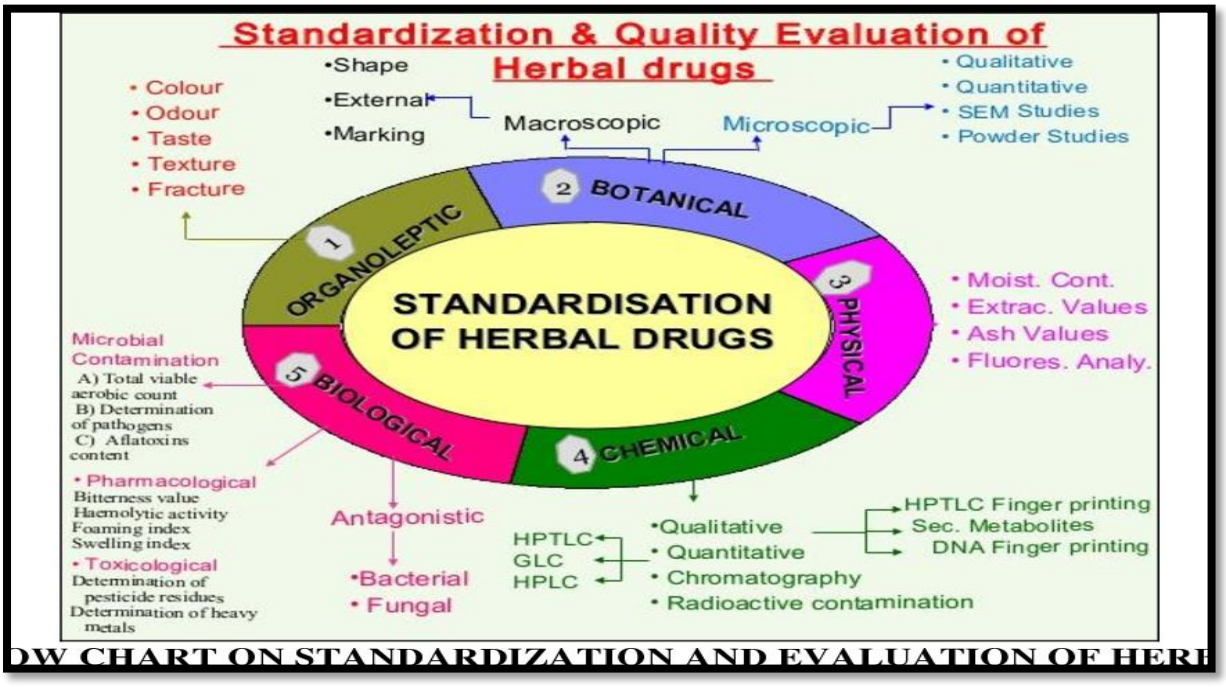
Authentication is especially useful in cases of drugs that are frequently substituted or adulterated with other varieties which are morphologically and chemically indistinguishable. Several herbal drugs in the market still cannot be identified or authenticated based on their morphological or histological characteristics. Use of wrong drugs may be ineffective or it may worsen the condition.

Processing of herbal materials: Depending on the intended use, herbal materials could be regarded as starting materials and herbal preparations could be regarded as intermediates in the process of producing finished herbal products, or as herbal dosage forms for therapeutic applications. In the latter case, simple herbal dosage forms may be prepared either from herbal

materials (such as unprocessed seeds or plant exudates) or herbal preparations (such as ground powders and dried extracts) ready for administration to patients. These herbal dosage forms, produced under GMP conditions, include decoctions, tea bags, granules, syrups, ointments or creams, inhalations, patches, capsules, tablets and pills, among others**.**

1. Collection of drugs:
2. Time of collection
3. Harvesting
4. Primary processing
5. Drying
6. Specific processing
7. Garbling
8. Packing
9. Storage

Safety management of toxic herbs: Among the herbal medicines (and their source medicinal plants) being used in traditional medicine contexts in di!erent parts of the world, some are known to contain toxic substances that may lead to severe side-e!ects or even death. In general, these toxic herbal materials and their preparations or dosage forms have narrow therapeutic windows between elective dose and lethal dose. Examples of such toxic/e!ective therapeutic agents are cardio-active herbal preparations such as Powdered Digitalis and Digitalis Capsules which at the proper dosages, are excellent therapeutic cardio-tonic agents, but are lethal when an overdose is taken.



DW CHART ON STANDARDIZATION AND EVALUATION OF HERB

Biodynamic Agriculture

Objectives: upon compilation of this module the student should be able to:

1. Understand about the biodynamic agriculture
2. Know about the Good agricultural practices in cultivation of medicinal plants
3. Know about the concept of organic farming
4. Know about the pest management methods
5. Understand about the bio-pesticides and bio-insecticides

Learning outcomes: the student will be able to:

1. Learn the definition of biodynamic agriculture and its advantages
2. Learn about the good agricultural practices in cultivation of medicinal plants.
3. Learn the definition and significance of organic farming
4. Learn about the nutrients in organic farming
5. Learn about the pest management methods
6. Learn about the definition of bio-pesticides and bio-insecticides

Introduction:

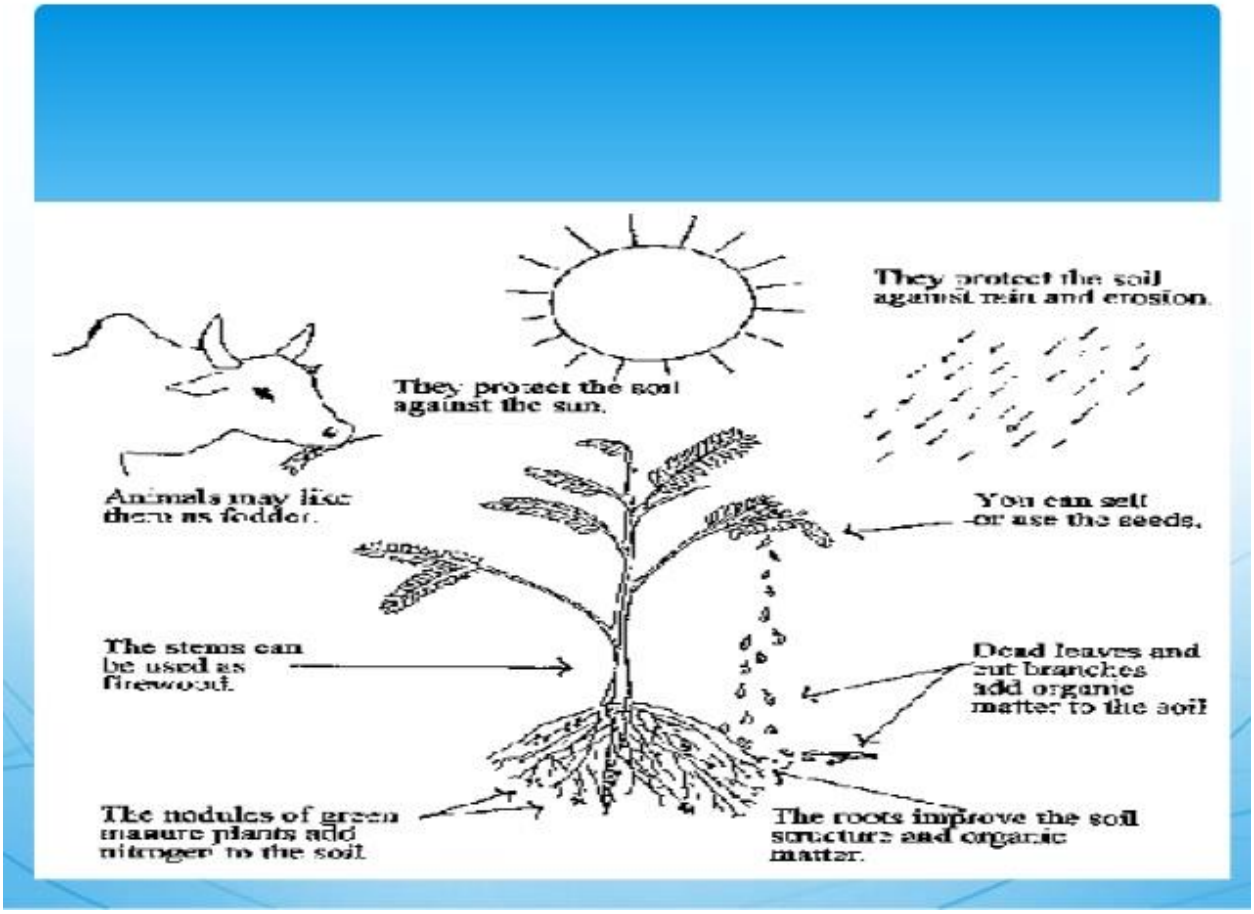
Biodynamic agriculture was developed during the 1920s by Rudolf Steiner. Steiner argued that spirituality lays the foundation for the renewal of agriculture. In particular, he encouraged farmers to develop a personal relationship with plants, animals, soil, and even with manure in order to think more holistically about agriculture. Since then, biodynamic agriculture has been experimented with and implemented by farmers around the world. Biodynamics has much in common with other organic approaches – it emphasizes the use of manures and composts and excludes the use of synthetic (artificial) fertilizers on soil and plants. Methods unique to the biodynamic approach include its treatment of animals, crops, and soil as a single system, an emphasis from its beginnings on local production and distribution systems, its use of traditional and development of new local breeds and varieties. Biodynamic agriculture uses various herbal and mineral additives for compost additives and field sprays. WHO has developed a series of technical guidelines relating to the quality control of herbal medicines of which these WHO guidelines on Good agricultural and collection practices (GACP) for medicinal plants based.

In contrast, crop rotation and an assortment of animal life are an **important** part of sustainable **agriculture**. The practice of rotating crops from field to field and raising varied animal species, along with cover crops and green manures, encourages healthy soil, reduces parasites and controls weeds and pest.

Good agricultural practices in cultivation of medicinal plants: It describes general principles including quality control measures and provides technical details for cultivation of medicinal plants.

Identification/ authentication of cultivated medicinal plants

- Selection of medicinal plants
- Botanical identity
- Specimens
- Seeds and other propagation materials
- Cultivation
- Site selection
- Ecological environment and social impact
- Climate
- Soil
- Irrigation and drainage
- Plant maintenance and protection
- Harvest
- Personnel



Organic farming: an integrated farming system that strives for sustainability, the enhancement of soil fertility and biological diversity whilst, with rare exceptions, prohibiting synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones. Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

Organic farming is primarily of two types, namely: Pure organic farming and integrated organic farming

Pure organic farming involves avoiding all artificial chemicals. Every fertilizer and pesticide that is used are derived from completely natural sources such as blood meal or bone meal.

Integrated organic farming involves integrating techniques aimed at achieving ecological requirements and economic demands such as integrated pest management and nutrients management.

Nutrients Management in Organic Farming: Organic farming follows a healthy way of farming for both crops as well as consumers. In this method, composted organic manure is used for nutrition of crops and thus, improves the organic content and fertility of the soil. Apart from manures, bacterial and fungal biofertilizers are also used for enhancing the soil nutrients.

Pest and pest management in medicinal plants:

Crop rotation, mixed cropping, organic control, hand weeding are the other techniques used in organic farming to maintain soil fertility and for pest- weed control. These systems of pest and weed management and soil protection make organic farming the best method. Sometimes, natural or other organically approved insecticides like neem pesticides are also used.

Disease Management: Diseases can be a major concern for organic farmers as it might reduce crop yields. So, supplying important macro and micronutrients and adopting crop rotation is crucial to prevent various plant diseases. Even the soil is enriched with useful microbes, fungi, and bacteria to prevent harmful organisms in check.Organic fruits and vegetables are not the only examples of successful organic products. Recently, dairy products which are organic are noticeable. Livestock is another example of organic farming. Here, they follow a strict means of farming like animals feed on organic food only. Hormones or other genetic engineering practices for high yield are not allowed on animals.

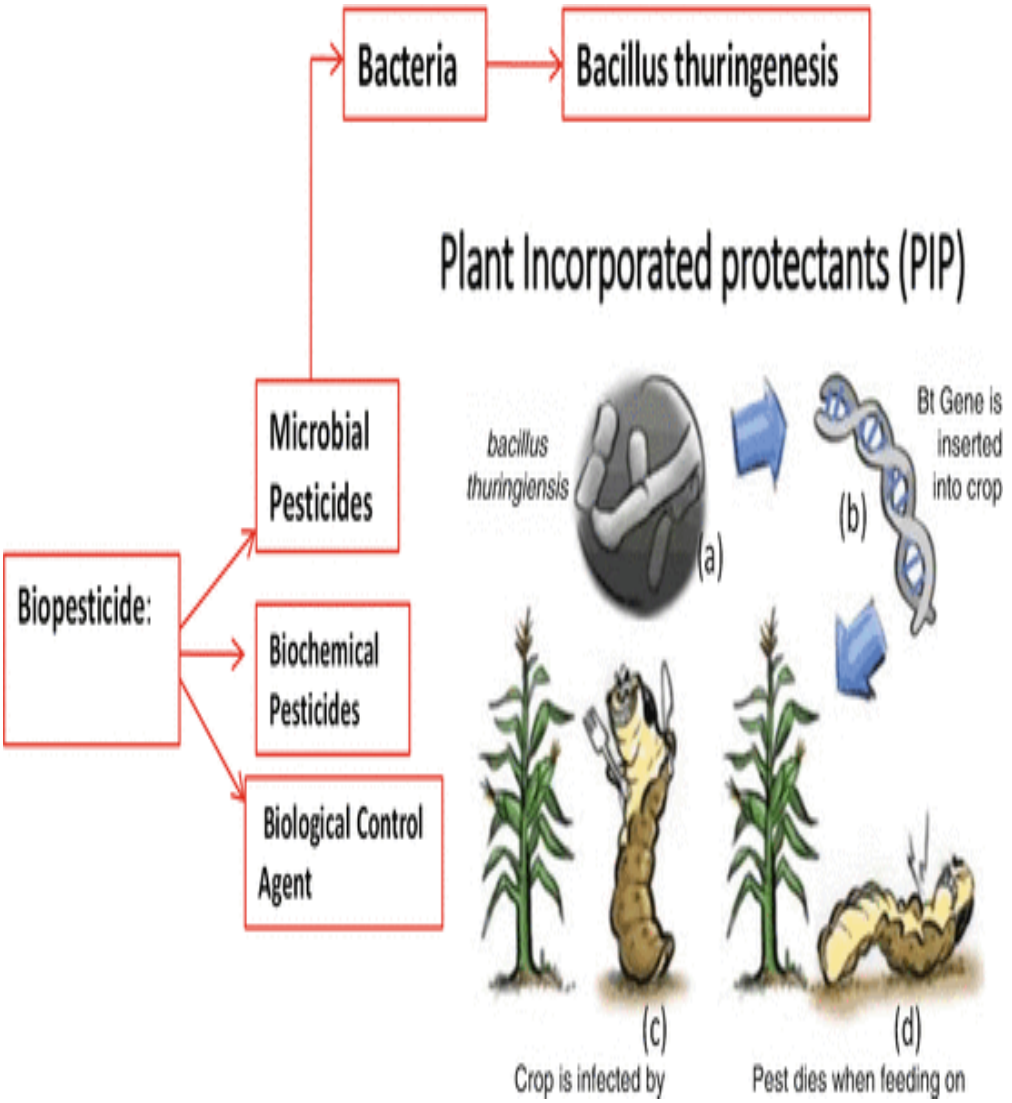
Advantages of Organic Farming:

- Improves soil fertility and maintain biological diversity.
- Good for the environment and yields are healthy for human and animal consumption.
- Prevents soil erosion, degradation and crop failure
- Decrease pollution and the whole farming can easily rely on renewable energy sources.
- Improves the soil fertility and enhances its chemical and physical properties**.**

Bio-pesticides: The term bio-pesticides define compounds that are used to manage agricultural pests by means of specific biological effects rather than as broader chemical pesticides. It refers to products containing bio-control agents – i.e., natural organisms or substances derived from natural materials (such as animals, plants, bacteria, or certain minerals), including their genes or metabolites, for controlling pests. According to the FAO definition, bio-pesticides include those bio-control agents that are passive agents, in contrast to bio-control agents that actively seek out the pest, such as parasitoids, predators, and many species of entomo-pathogenic nematodes. The latter bio-control agents used to manage potato pests. Thus bio-pesticides cover a wide spectrum of potential products that can be classified as follows:

Microbial pesticides: pesticides that contain microorganisms, like bacteria, fungi, or virus, which attack specific pest species, or entomo-pathogenic nematodes as active ingredients. Although most of these agents attack insect species (called entomo-pathogens; products referred to as bio-insecticides), there are also microorganisms (i.e., fungi) that control weeds (bio-herbicides).

Plant-Incorporated Protectants (PIPs): these include pesticidal substances that are produced in genetically modified plants/organisms (GMO) (i.e., through the genetic material that has been incorporated into the plant). Both the protein and its genetic material are regulated by Environmental protection agency, the plant itself is not regulated. The production of transgenic plants that express insecticidal endo-toxins derived from the soil bacterium.



Biochemical pesticides: pesticides based on naturally occurring substances that control pests by non-toxic mechanisms, in contrast to chemical pesticides that contain synthetic molecules that directly kill the pest. Biochemical pesticides fall into different biologically functional classes, including pheromones and other semi-chemicals, plant extracts, and natural insect growth regulators.

Examples:

1. Bacillus thuringiensis, a bacteria capable of causing disease of Lepidoptera, Coleoptera and Diptera, is a well-known insecticide example. The toxin from B. thuringiensis (Bt toxin) has been incorporated directly into plants through the use of genetic engineering. The use of Bt Toxin is particularly controversial. Its manufacturers claim it has little effect on other organisms, and is more environmentally friendly than synthetic pesticides.

2. Entomo-pathogenic fungi (e.g. Beauveria bassiana, Isaria fumosorosea, Lecanicillium and Metarhizium spp.), plant disease control agents: include Trichoderma spp. and Ampelomyces quisqualis (a hyper-parasite of grape powdery mildew).

3. *Bacillus subtilis* is also used to control plant pathogens and beneficial nematodes attacking insect (e.g. Steinernema feltiae) or slug (e.g. Phasmarhabditis hermaphrodita) pest's entomopathogenic viruses (e.g. Cydia pomonella granulovirus) weeds and rodents have also been controlled with microbial agents. Various naturally occurring materials, including fungal and plant extracts, have been described as biopesticides. Products in this category include.

4. Insect pheromones and other semi-chemicals
5. Biopesticides may include natural plant-derived products, which include alkaloids, terpenoids, phenolics and other secondary chemicals. Certain vegetable oils such as canola oil are known to have pesticidal properties.

Indian systems of Medicine

Objectives: upon compilation of this module the student should be able to:

1. Understand about the Indian systems of medicine
2. Know about the Ayurveda system of medicine
3. Know about the Unani system of medicine
4. Know about the Siddha system of medicine
5. Know about the Homeopathy system of medicine
6. Know about the basic methods of standardization and evaluation of ayurvedic preparations

Learning outcomes: the student will be able to:

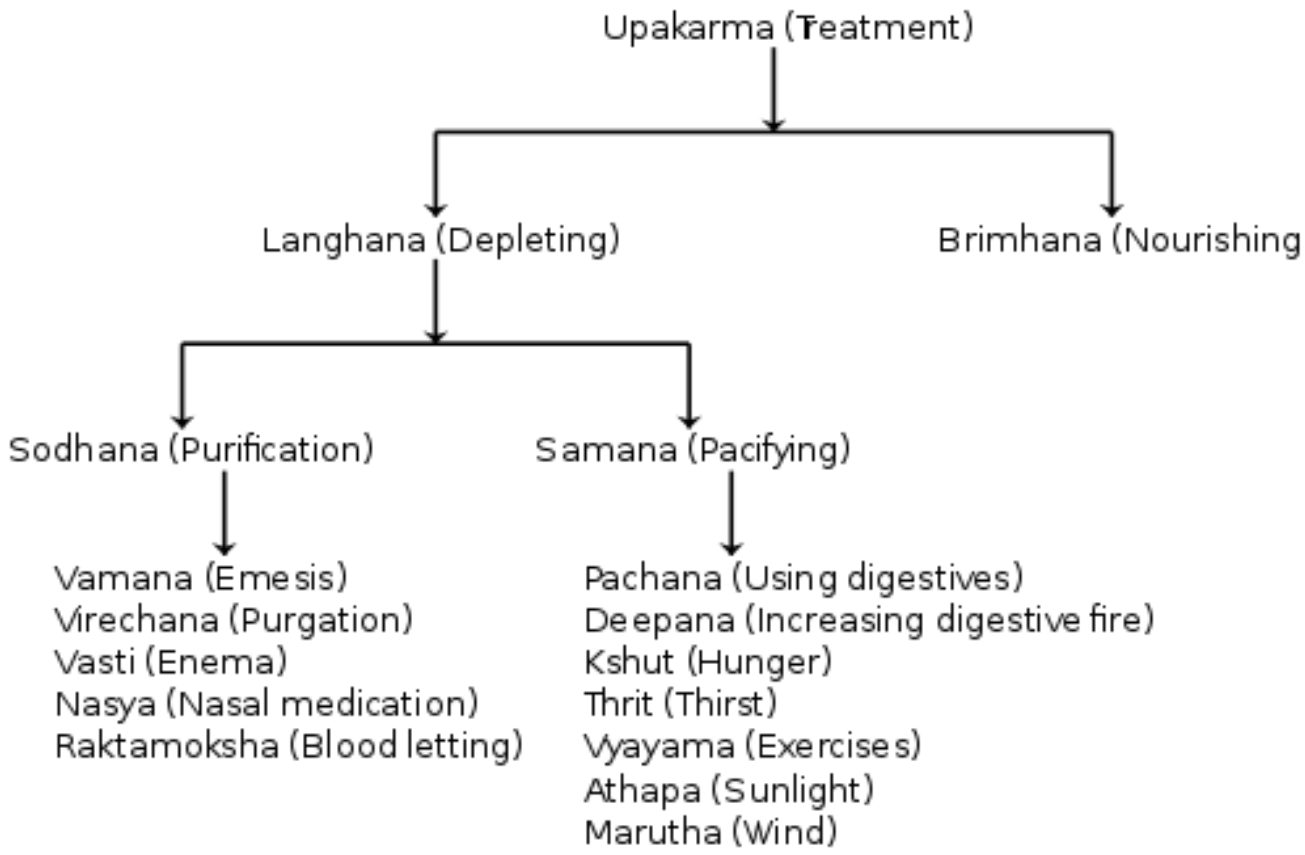
1. Learn the basic principles involved in Ayurveda
2. Learn the basic principles involved in Siddha
3. Learn the basic principles involved in Unani
4. Learn the basic principles involved in Homeopathy
5. Learn about the methods of standardization and evaluation of aristas, asvas, churanas, lehyas and bhasmas as an ayurvedic preparation.

Introduction: The Indian systems of medicine consists of ayurveda, unani , siddha and homeopathy and therapies such as Yoga and Naturopathy. Some of these systems are indigenous and others have over the years become a part of Indian tradition. A separate department of Indian systems of medicine and homeopathy was set up in 1995 to ensure the optimal development and propagation of AYUSH an abbreviation for Ayurveda, Yoga and Naturopathy, Unani, Siddha systems of health care.

Ayurveda: The word 'Ayurveda' has derived out of fusion of two separate words- Áyu' i.e. life and 'veda' i.e. knowledge. Thus in literal meaning Ayurveda is the science of life. Ayurveda is a classical system of preventive, promotive and curative healthcare originating from the Vedas documented around 5000 years ago and currently recognized and practiced in India and many countries in the world. It is one of the most ancient healthcare systems having equal scientific relevance in the modern world, that take a holistic view of the physical, mental, spiritual and social aspects of human life, health and disease.

Diagnosis:

Ayurveda has eight ways to diagnose illness, called Nadi (pulse), Mootra (urine), Mala (stool), Jihva (tongue), Shabda (speech), Sparsha (touch), Druk (vision), and Aakruti (appearance). Ayurvedic practitioners approach diagnosis by using the five senses. For example, hearing is used to observe the condition of breathing and speech. The study of the lethal points or *marman marma* is of special importance.



Siddha: The Siddha System of medicine is one of the ancient systems of medicine in India having its close bedd with Dravidian culture. The term Siddha means achievements and Siddhars are those who have achieved perfection in medicine. Eighteen Siddhars are said to have contributed towards the systematic development of this system and recorded their experiences in Tamil language. The Siddha system of Medicine emphasizes on the patient, environment, age, sex, race, habits, mental frame work, habitat, diet, appetite, physical condition, physiological constitution of the diseases for its treatment which is individualistic in nature Diagnosis of diseases are done through examination of pulse, urine, eyes, study of voice, colour of body, tongue and status of the digestion of individual patients.

Unani: Unani system of medicine is a comprehensive medical system, which provides Preventive, promotive, curative and rehabilitative health care. The system is holistic in nature and takes into account the whole personality of an individual rather than taking a reductionist approach towards disease. The fundamentals, diagnosis and treatment modalities of the system are based on scientific principles. The basic frame work of this system is based on the Hippocratic theory of four Humours, according to which any disturbance in the equilibrium of humours causes disease and therefore the treatment aims at restoring the humoral equilibrium.

Yoga: The word "Yoga" comes from the Sanskrit word "yuj" which means "to unite or integrate." Yoga is about the union of a person's own consciousness and the universal consciousness. It is primarily a way of life, first propounded by Maharshi Patanjali in systematic form Yogsutra. The discipline of Yoga consists of eight components namely, restraint (Yama), observance of austerity (Niyama), physical postures (Asana), breathing control (Pranayam), restraining of sense organs (Pratyahar), contemplation (Dharna), meditation (Dhyan) and Deep meditation (Samadhi). These steps in the practice of Yoga have the potential to elevate social and personal behavior and to promote physical health by better circulation of oxygenated blood in the body, restraining the sense organs and thereby inducing tranquility and serenity of mind and spirit. The practice of Yoga has also been found to be useful in the prevention of certain psychosomatic diseases and improves individual resistance and ability to endure stressful situations. Yoga is a promotive, preventive rehabilitative and curative intervention for overall enhancement of health status. A number of postures are described in Yoga literature to improve health, to prevent diseases and to cure illness. The physical postures are required to be chosen judiciously and have to be practiced in the correct way so that the benefits of prevention of disease, promotion of health and therapeutic use can be derived from them.

Naturopathy: Naturopathy is rooted in the healing wisdom of many cultures and times based on principal of natural healing. The principles and practices of Naturopathy are integrated in the life style, if the people observe living close to nature. Naturopathy is a cost effective drugless, non-invasive therapy involving the use of natural materials for health care and healthy living. It is based on the theories of vitality, boosting the selfhealing capacity of the body and the principles of healthy living. Naturopathy is a system of natural treatment and also a way of life widely practiced, globally accepted and recognized for health preservation and management of illnesses without medicines. Naturopathy advocates living in harmony with constructive principles of Nature on the physical, mental, social and spiritual planes. It has great promotive, preventive, curative as well as restorative potentials. Naturopathy promotes h healing by stimulating the body’s inherent power to regain health with the help of five elements of nature – Earth, Water, Air, Fire and Ether.

Homoeopathy: "Homoeopathy" was introduced as a scientific system of drug therapeutics by a German Physician, Dr. Christian Frederick Samuel Hahnemann in 1805. While translating a medical treatise by Scottish physician and chemist, William Cullen, from English to German, in 1790, he came across a foot note under Cinchona that attributed its fever curing property to the astringent (decongestant) qualities of the drug. Being sceptical of Cullen's remarks concerning the effect of Cinchona for curing malaria, Hahnemann experimented its effect on himself by taking repeated doses of cinchona tincture and experienced fever, shivering and joint pains: symptoms similar to those of malarial fever. After series of experiments, Hahnemann concluded that a drug that could produce certain symptoms in healthy individuals could also cure similar disease symptoms, in accordance with some hidden, natural laws of similars as had been vaguely perceived by ancient physicians. This led to the coining of the word "homoeo-pathy" (which comes from the Greek: hómoios, "-like" and páthos, "suffering"). Based on this, Hahnemann postulated the key principle of Homoeopathy, the Law of Similars, logically evolving it as an experimental science, according to the method of inductive reasoning after exact observation, correct interpretation, rational explanation and scientific construction.

Preparation and standardization of ayurvedic formulations:

Aristas and Asvas: These are self generated herbal fermentations of traditional ayurvedic system. They are alcoholic medicaments prepared by allowing the herbal juices or their decotions to undergo fermentation with the addition of sugars. **Aristas** are made with decoctions of herbs in boiling water while **Asavas** are prepared by directly using fresh herbal juices. Fermentation of both preparations is brought about by the addition of a source of sugar with flowers. They are moderately alcholicand mostly sweetish with slight acidity and aggreable aroma. These medicinal wines have several advantages like better keeping quality, enhanced therapeutic properties, improvement in drug delivery into the human body sites.

Method of Preparation:

Preparation of Aristas: The drug is coarsely powdered and Kasaya is prepared. The Kasaya is strained and kept in fermentation vessel. Sugar, jaggery or honey, as required, is dissolved, boiled and added. The mouth of the vessel is covered with an earthen lid and the edges sealed with clay- smeared cloth wound in seven consecutive layers.

A constant temperature is maintained for fermentation by keeping the container either in a special room, in an underground cellar or in a heap of paddy. After a specified period the lid is removed and the contents examined to ascertain whether fermentation has been completed. The fluid is first decanted and then strained after two or three days. When the fine suspended particles settle down, it is strained and bottled.

Preparation of Asavas: The Jaggery or sugar is dissolved in the required quantity of water, boiled and cooled. This is poured into the fermentation vessel. Fine powder of the drugs is added in the container which is covered with a lid and the edges are sealed with clay smeared cloth wound in seven consecutive layers.

A constant temperature is maintained for fermentation by keeping the container either in a special room, in an underground cellar or in a heap of paddy. After a specified period the lid is removed and the contents examined to ascertain whether fermentation has been completed. The fluid is first decanted and then strained after two or three days. When the fine suspended particles settle down, it is strained and bottled.

Precaution:

1. The filtered Asavas or Aristas should be clear without froth at the top.

2. It should not become sour.

3. The preparation has the characteristic aromatic alcoholic odour.

Standardization of asava and arista Formulation: Asavas and Aristas are alcoholic preparations, prepared either by soaking the powdered drugs or the decoction of a drug, in a solution of jaggery along with a fermenter for a specified period of time, during which it undergoes fermentation to produce alcohol. These self-generated alcohols facilitate the extraction of active principles present in the drug and also serve as a preservative.Various methods applied for standardization of herbal drugs are depicted in figure. Due to complexity of most Ayurvedic formulations, use of only conventional methods for standardization are not adequate for their evaluation. The Ayurvedic Pharmacopoeia of India and Pharmacopoeial standards for Ayurvedic formulations mention only the study of physico-chemical parameters.

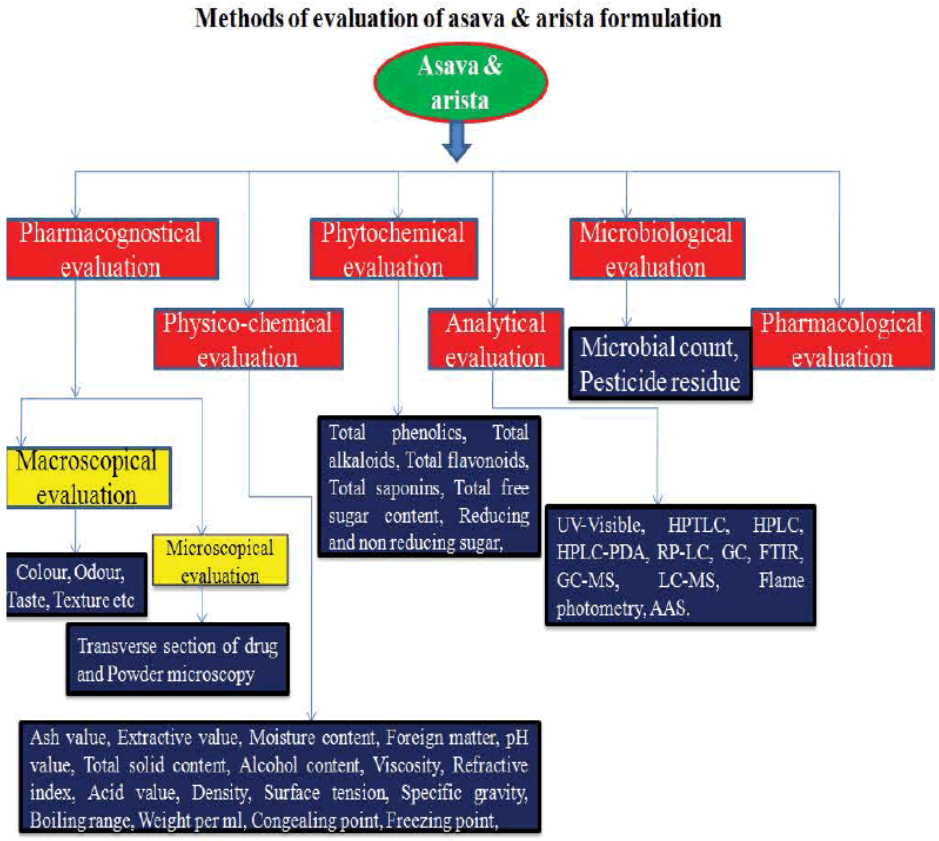


Fig. 1: Methods of evaluation of *asava* and *arista*

Churna: It is defined as a fine powder of a drug or drugs in ayurvedic system of medicine. Drugs mentioned in formula are cleaned properly, dried thoroughly, pulverized and then sieved. The churna is free flowing and retains its potency for one year, if preserved in air tight containers.

Evaluation of physical parameters:

- Total Ash value
- Acid insoluble ash value
- Water soluble extractive extractive value
- Alcohol soluble extractive value
- Determination of crude fibre content
- Determination of heavy metal contamination

Lehyas: It is a semi-solid preparation of the drugs meant for licking by tongue. It acquires the consistency of a thick paste. After strained decotions are boiled down, sugar or jiggery is added to it. The other similar forms are known as modaka, guda, khanda etc. Market formulation of Lehya are Chyanvanprakash, Dashmoola rasayan, ashwagandhadi Lehyam.

1. The Avaleha preparation involves following:
2. Kaṣaya or other liquids
3. Jaggery, sugar or sugar-candy
4. Powders or pulps of certain drugs
5. Ghee or oil and
6. Honey

Jaggery, sugar or sugar-candy is dissolved in the liquid and strained to remove the foreign particles. This solution is boiled over a moderate fire. When pressed between two fingers if paka becomes thready (Tantuvat), or when it sinks in water without getting easily dissolved, it should be removed from the fire. Fine powders of drugs are then added in small quantities and stirred continuously to form a homogenous mixture. Ghee or oil, if mentioned, is added while the preparation is still hot and mixed well. Honey, if mentioned is added when the preparation becomes cool and mixed well.

Characteristics: The Avaleha or Lehyam should neither be hard nor be a thick fluid. When pulp of the raw herbs is added and ghee or oil is present in the preparation, this can be rolled between the fingers. The growth of fungus over it or fermentation is signs of deterioration. When metals are mentioned in the formula, the bhasmas of the metals are used. In the case of specific drugs like Bhallataka, Vatsanabha etc. purified drugs alone are included in the preparation. The colour and smell of the prepared Avaleha depend on the drugs or herbs used as ingredients.

The Avaleha or Lehyam should be kept in glass or porcelain jars. It can also be kept in a metal container or pet bottles which do not react with it.

Bhasmas: These are unique metal based drugs and they are suggested with herbal juices, fruits for treating variety of chronic diseases. Bhasmas are obtained by repeated calcinations and incineration of liquid products by special process. During incineration metals are converted into mixed oxides. Bhasmas are most ancient form of administration having pharmacological activities loike analgesic, anti-inflammatory, anti-oxidant activities. In addition to the major constituent element found at % level, several other essential elements such as Na, K, Ca, Mg, V, Mn, Fe, Cu, and Zn have also been found in μg/g amounts and ultratrace (ng/g) amounts of Au and Co. These seem to remain chelated with organic ligands derived from medicinal herbs. The bhasmas are biologically produced nanoparticles and are taken along with milk, butter, honey, or ghee (a preparation from milk), thus, this makes these elements easily assimilable, eliminating their harmful effects and enhancing their biocompatibility.

Various steps involved in the preparation of bhasma(or bhasmikaran) are:

Shodhana -Purification,

Maraṇa - Powdering,

Chalana- Stirring,

Dhavana - Washing,

Galana- Filtering,

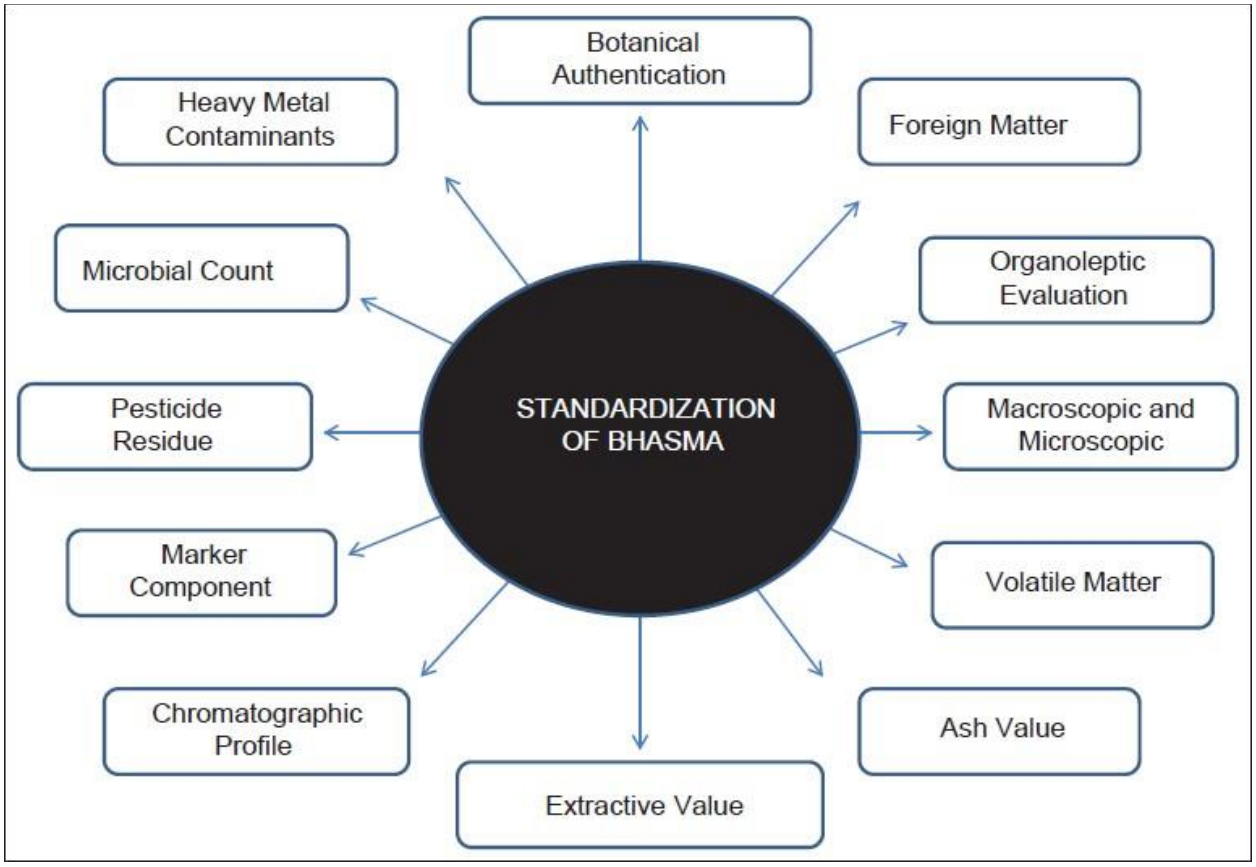
Puttana- Heating,

Mardana- Triturating,

Bhavana- Coating with herbal extract,

Amṛtikaraṇa - Detoxification and

Sandharana- Preservation


STANDARDIZATION OF BHASMA
Botanical Authentication
Foreign Matter
Organoleptic Evaluation
Macroscopic and Microscopic
Volatile Matter
Ash Value
Extractive Value
Chromatographic Profile
Marker Component
Pesticide Residue
Microbial Count
Heavy Metal Contaminants

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