Name of Unit	Herbs as a Raw material
Subject/ Course Name	Herbal Drug Technology
Subject/ Course ID	BP603T
Module no.	1
Class B. Pharmacy Sem.	VI
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Learning outcome of Module-1

LO	Learning Outcome (LO)	Course Outcome Code
LO1	To understand raw material as source of herbal drugs from cultivation to herbal drug product	BP603.1
LO2	To know about the methods for selection, identification and authentication of herbal drugs	BP603.1
LO3	To know about the processing of herbal and medicinal plants.	BP603.1
LO4	To know about the organic farming and biodynamic agriculture and biopesticides.	BP603.1
LO5	To understand about the Indian systems of traditional medicines and standardization of various ayurvedic formulations.	BP603.1

Content Table

Topic
• Introduction of herbs as a raw material • Sources of herbs • Methods for selection, identification and authentication of drugs • Processing of Herbal raw materials • Biodynamic Agriculture • Good agricultural practices • Organic farming and its advantages • Pest and pest management • Introductions of traditional systems of Indian medicines • Ayurveda, Siddha, Unani, Homeopathy, Naturopathy and Yoga • Various Ayurvedic formulations and their standardization

HERBS AS RAW MATERIALS

INTRODUCTION

Herbal medicine is the fulcrum of complementary and alternative medicine, which in recent times is increasingly gaining widespread popularity all over the world and gradually streaming toward integration into the mainstream healthcare systems. Herbal medicines includes preparations of biologically active natural products that consist largely of herbs or herbal materials, some recipes may contain materials such as fungal and bee products, as well as minerals (kaolin, bentonite), ash, shells, insects and animal parts, and are used for the maintenance of health and management of various diseases. Herbal medicines can elicit numerous benefits just as some can cause adverse effects. The pharmacologic and most of the toxic effects that are elicited by herbal medicines have been linked to the activities of the secondary metabolites.

Medicinal and aromatic plants 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. Herbal medicines include herbs, herbal materials, herbal preparations and finished herbal products that contain as active ingredients parts of plants, or other plant materials, or combinations and are used especially for the prevention and treatment of diseases.

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.

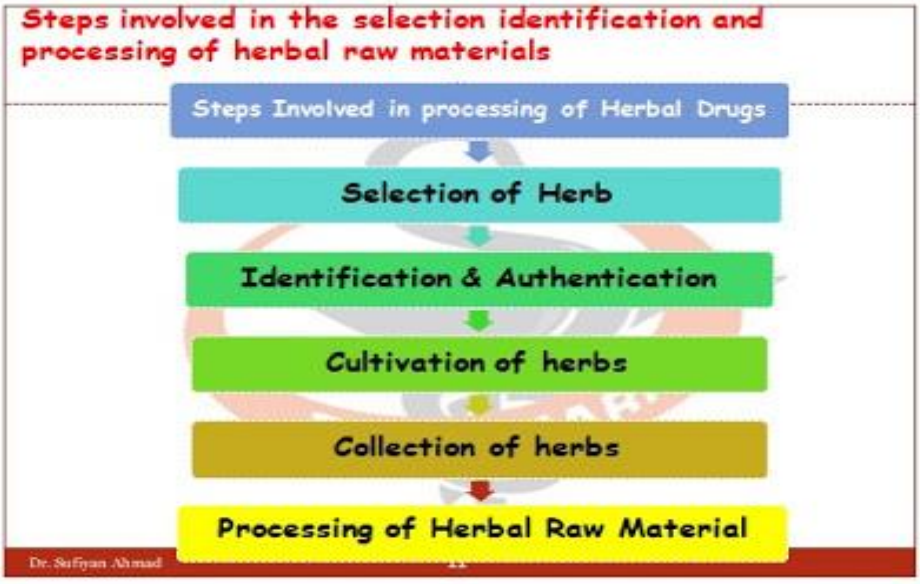
Finished herbal products: Finished herbal products consist of one or more herbal preparations made from one or more herbs (i.e. from different herbal preparations made of the same plant as well as herbal preparations from different plants. Products containing different plant materials are called "mixture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

- Collection of drugs:
- Time of collection
- Harvesting
- Primary processing
- Drying
- Specific processing
- Garbling
- Packing
- Storage

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. This also applies to non-targeted toxic or poisonous indigenous plant ingredients. The best time for collection (quality peak season or time of day) should be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts. In general, the collected raw medicinal plant 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 or drop cloths that are free from foreign matter, including plant remnants from previous collecting activities. 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.

Time of collection:

S. No.	Plant parts	Time of collection
1	Bulbs	Late autumn, long after the plant has flowered and fruited is usually best.
2	Barks	Autumn (after leaf fall) or spring (before development of the leaves) is generally selected.
3	Root and rhizomes	From annuals: Shortly before flowering. From Biennials: during the autumn or winter following the first year growth. From perennials: During the autumn or winter following the second or third year's growth.
4	Leaves	Collection should be affected in dry weather whilst the plant is flowering. It is often preferable to collect the stems bearing the leaves, and then separate them; collection in the morning is important in some cases, *e.g.*, Solanaceous leaves.
5	Flowers	Collection should be affected in dry weather and towards the middle of the day, after dew has dissipated.
6	Seeds and fruits	Collection should be affected when fully, grown and ripe, or nearly ripe. Weather active dispersal of the seeds occurs on the completion of ripping; it is advantageous to collect slightly earlier, *e.g.*, Cardamom and Strophanthus.

The period of growth or development at which medicinal activity is highest has been carefully determined for many plants. The proportion, of alkaloid in the leaves of Hyocyamus Niger and of belladonna is largest at the beginning of flowering, whilst with Stromonium the peak coincides with full bloom. Example: Stromonium leaves, gathered in the morning, contain a higher proportion of alkaloids than those collected in the evening.

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. The time of harvest depends on the plant part to be used. Detailed information concerning the appropriate timing of harvest is often available in national pharmacopoeias, published standards, official monographs and major reference books.

However, it is well known that the concentration of biologically active constituents varies with the stage of plant growth and development. This also applies to non-targeted toxic or poisonous indigenous plant ingredients.

The best time for harvest (quality peak season/time of day) should be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts during harvest, 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 to expedite drying so as to prevent any possible deleterious effects due to increased moisture levels, which promote microbial fermentation and mould.

Cutting devices, harvesters, and other machines should be kept clean and adjusted to reduce damage and contamination from soil and other materials. They should be stored in an uncontaminated, dry place or facility free from insects, rodents, birds and other pests, and inaccessible to livestock and domestic animals.

Contact with soil should be avoided to the extent possible so as to minimize the microbial load of harvested medicinal plant materials where necessary, large drop cloths, preferably made of clean muslin, may be used as an interface between the harvested plants and the soil.

If the underground parts (such as the roots) are used, any adhering soil should be removed from the medicinal plant materials as soon as they are harvested.

The harvested raw medicinal plant materials should be transported promptly in clean, dry conditions they may be placed in clean baskets, dry sacks, trailers, hoppers or other well-aerated containers and carried to a central point for transport to the processing facility.

All containers used at harvest should be kept clean and free from contamination by previously harvested medicinal plants and other foreign matter. If plastic containers are used, particular attention should be paid to any possible retention of moisture that could lead to the growth of mould.

When containers are not in use, they should be kept in dry conditions, in an area that is protected from insects, rodents, birds and other pests, and inaccessible to livestock and domestic animals. Any mechanical damage or compacting of the raw medicinal plant materials, as a consequence, for example, of overfilling or stacking of sacks or bags that may result in composting or otherwise diminish quality should be avoided. Decomposed medicinal plant materials should be identified and discarded during harvest, post-harvest inspections and processing, in order to avoid microbial contamination and loss of product quality.

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 plants 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. In this respect, attention must be paid to

(a) Overfilling of the sacks,

(b) Stacking up of sacks.

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.

Primary processing: Harvested or collected raw medicinal plant materials should be promptly unloaded and unpacked upon arrival at the processing facility. Prior to processing, the medicinal plant materials should be protected from rain, moisture and any other conditions that might cause deterioration. Medicinal plant materials should be exposed to direct sunlight only where there is a specific need for this mode of drying.

Medicinal plant materials that are to be used in the fresh state should be harvested/collected and delivered as quickly as possible to the processing facility in order to prevent microbial fermentation and thermal degradation. The materials may be stored under refrigeration, in jars, in sandboxes, or using enzymatic and other appropriate conservation measures immediately following harvest/collection and during transit to the end-user. The use of preservatives should be avoided if used, they should conform to national and/or regional regulations for growers/collectors and end-users.

Medicinal plant materials that are to be employed fresh should be stored under refrigeration, in jars, in sandboxes, or using enzymatic or other appropriate conservation measures, and transported to the end-user in the most expeditious manner possible.

The use of preservatives should be avoided. If used, this should be documented and they should conform to national and/or regional regulatory requirements in both the source country and the end-user country.

All medicinal plant materials should be inspected during the primary-processing stages of production, and any substandard products or foreign matter should be eliminated mechanically or by hand.

For example, dried medicinal plant materials should be inspected, sieved or winnowed to remove discolored, moldy or damaged materials, as well as soil, stones and other foreign matter. Mechanical devices such as sieves should be regularly cleaned and maintained.

All processed medicinal plant materials should be protected from contamination and decomposition as well as from insects, rodents, birds and other pests, and from livestock and domestic animals.

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

When possible, temperature and humidity should be controlled to avoid damage to the active chemical constituents. The method and temperature used for drying may have a considerable impact on the quality of the resulting medicinal plant materials.

For example, shade drying is preferred to maintain or minimize loss of colour of leaves and flowers; and lower temperatures should be employed in the case of medicinal plant materials containing volatile substances. The drying conditions should be recorded. In the case of natural drying in the open air, medicinal plant materials should be spread out in thin layers on drying frames and stirred or turned frequently.

In order to secure adequate air circulation, the drying frames should be located at a sufficient height above the ground. Efforts should be made to achieve uniform drying of medicinal plant materials and so avoid mould formation.

Drying medicinal plant material directly on bare ground should be avoided. If a concrete or cement surface is used, medicinal plant materials should be laid on a tarpaulin or other appropriate cloth or sheeting. Insects, rodents, birds and other pests, and livestock and domestic animals should be kept away from drying sites. For indoor drying, the duration of drying, drying temperature, humidity and other conditions should be determined on the basis of the plant part concerned (root, leaf, stem, bark, flower, etc.) and any volatile natural constituents, such as essential oils. If possible, the source of heat for direct drying (fire) should be limited to butane, propane or natural gas, and temperatures should be kept below 60°C. If other sources of fire are used, contact between those materials, smoke and medicinal plant material should be avoided.

Vacuum drying: This is conducted in steam- heated ovens with perfect closure, and a pump is used to exhaust the air. The low pressure maintained within the oven ensures rapid and complete drying. Example: Digitalis

Advantages of vacuum drying:

(i) Rapid drying.
(ii) Relatively low temperature.
(iii) Cleanliness and freedom from odour and dust.
(iv) Independence of climate conditions.
(v) Control of temperature.
(vi) Elimination, of risk of fire.
(vii) Compactness.

Specific Processing: Some medicinal plant materials require specific processing to: improve the purity of the plant part being employed; reduce drying time; prevent damage from mould, other microorganisms and insects; detoxify indigenous toxic ingredients; and enhance therapeutic efficacy.

Common specific processing practices include pre selection, peeling the skins of roots and rhizomes, boiling in water, steaming, soaking, pickling, distillation, fumigation, roasting, natural fermentation, treatment with lime and chopping. Processing procedures involving the formation of certain shapes, bundling and special drying may also have an impact on the quality of the medicinal plant materials.

Antimicrobial treatments of medicinal plant materials (raw or processed) by various methods, including irradiation, must be declared and the materials must be labelled as required.

Only suitably trained staff using approved equipment should carry out such applications, and they should be conducted in accordance with standard operating procedures and national and/or regional regulations in both the grower/collector country and the end-user country. Maximum residue limits, as stipulated by national and/or regional authorities, should be respected.

Storage:

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 and livestock.

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, mould formation, rotting or loss of oil; and inspections should be carried out at regular intervals.

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. 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.

4. Materials used for packaging should be non-polluting, clean, dry and in undamaged condition and should conform to the quality requirements for the medicinal plant materials concerned. Fragile medicinal plant materials should be packaged in rigid containers.

5. Dried medicinal plants/herbal drugs, including essential oils, should be stored in a dry, well-aerated building, in which daily temperature fluctuations are limited and good aeration is ensured

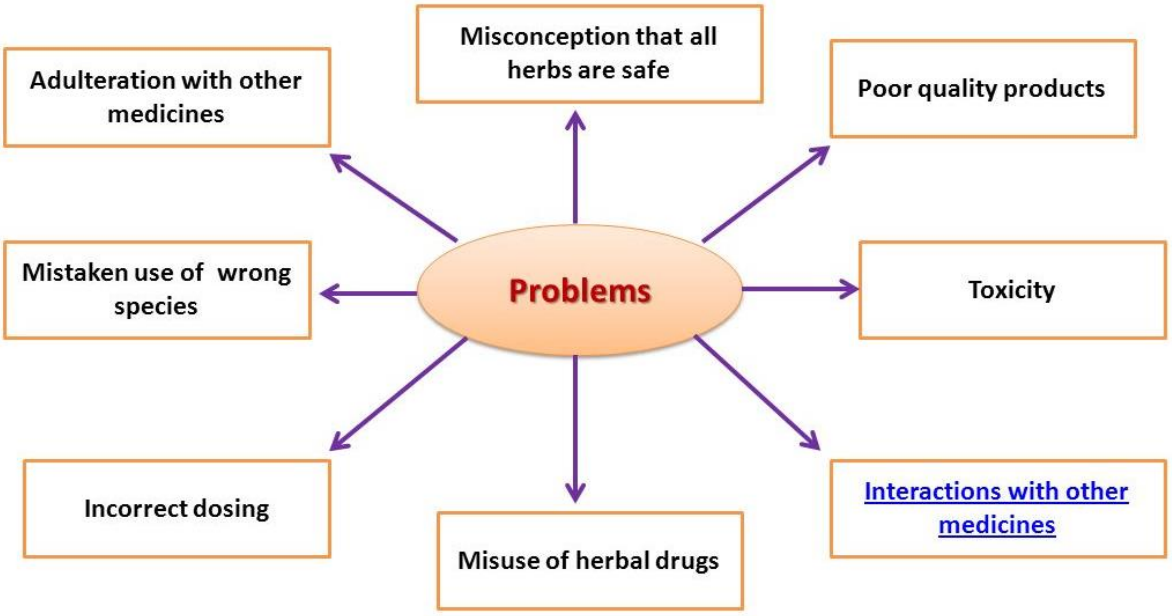
6. Fresh medicinal plant materials should be stored at appropriate low temperatures, ideally at 2-8°C; frozen products should be stored at less than -20°C.

7. Small quantity of crude drugs could be readily stored in air tight, moisture proof and light proof container such as tin, cans, covered metal tins or amber glass containers.

8. Wooden boxes and paper bags should not be used for storage of crude drugs.

Safety management of toxic herbs: Among the herbal medicines (and their source medicinal plants) being used in traditional medicine contexts in different parts of the world, some are

known to contain toxic substances that may lead to severe side-effects 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/effective 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.



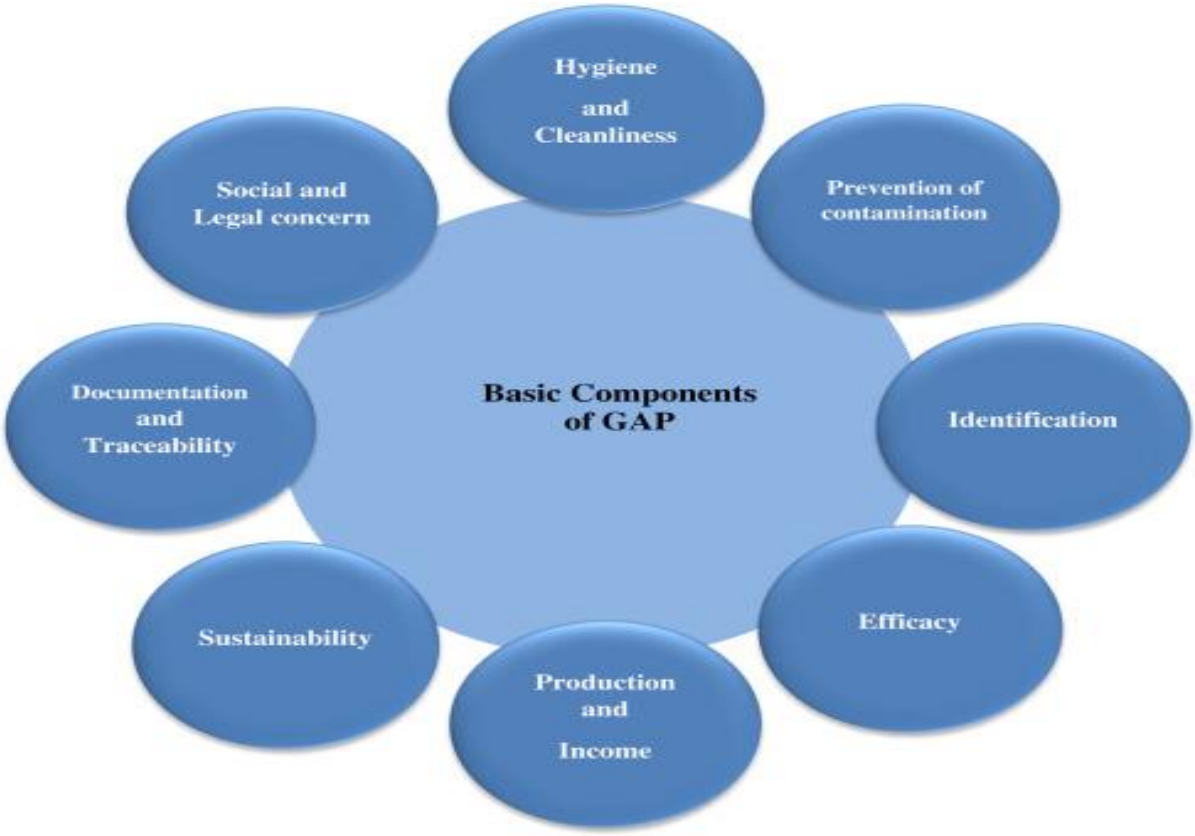
BIODYNAMIC AGRICULTURE

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. Biodynamic 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 plant based.

Biodynamic agriculture

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 (GAP) in cultivation of medicinal plants: It describes general principles including quality control measures and provides technical details for cultivation of medicinal plants.

WHO Guidelines on good agricultural and collection practices (GACP) for medicinal plants

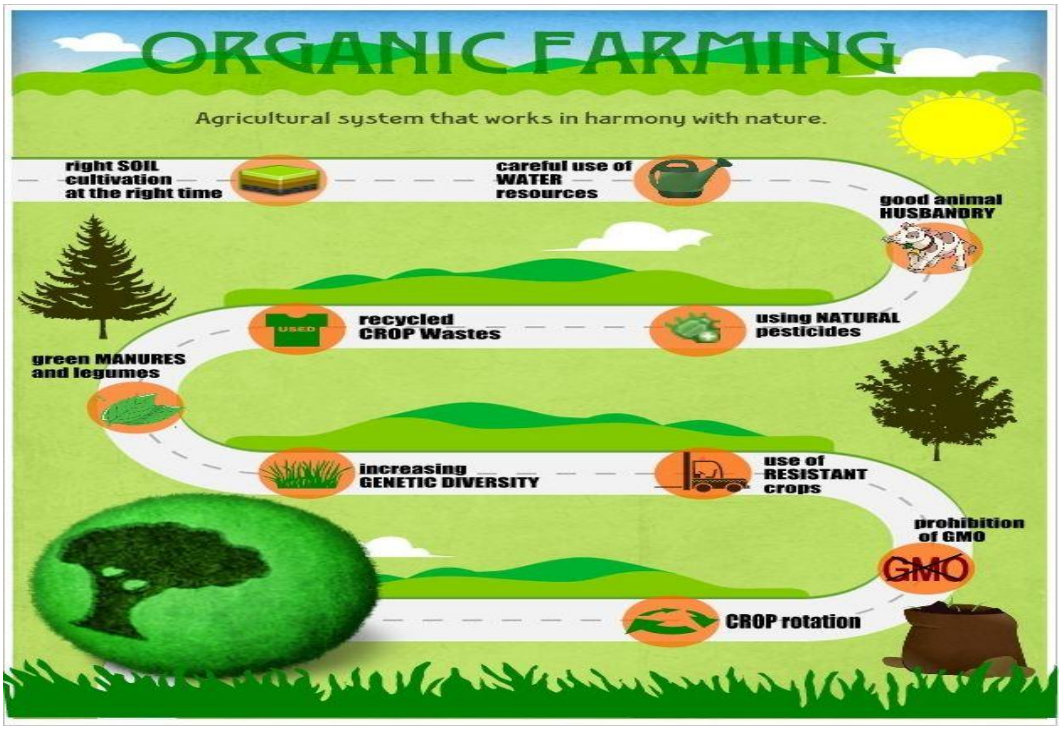
These guidelines are intended to provide technical knowledge on obtaining medicinal plant materials of good quality for the sustainable production of herbal products classified as medicines.

They apply to the following :

- Identification, authentication, cultivation and harvest of medicinal plants
- Good collection practices for medicinal plants
- Common technical aspects of good agricultural practices for medicinal plants in terms of personnel, packaging, storage and transportation.
- Relevant issues of ethical/ legal considerations and research

ORGANIC FARMING

Organic farming system in India is not new and is being followed from ancient time. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco friendly pollution free environment.



As per the definition of the United States Department of Agriculture (USDA) study team on organic farming "organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection".

FAO suggested that "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil

biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs".

Need of Organic farming: With the increase in population our compulsion would be not only to stabilize agricultural production but to increase it further in sustainable manner. The scientists have realized that the 'Green Revolution' with high input use has reached a plateau and is now sustained with diminishing return of falling dividends. Thus, a natural balance needs to be maintained at all cost for existence of life and property. The obvious choice for that would be more relevant in the present era, when these agrochemicals which are produced from fossil fuel and are not renewable and are diminishing in availability. It may also cost heavily on our foreign exchange in future.

The key characteristics of organic farming include:

- Protecting the long term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention
- Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms
- Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures
- Weed, disease and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, resistant varieties and limited (preferably minimal) thermal, biological and chemical intervention

The extensive management of livestock, paying full regard to their evolutionary adaptations, behavioral needs and animal welfare issues with respect to nutrition, housing, health, breeding and rearing. Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

It is 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.

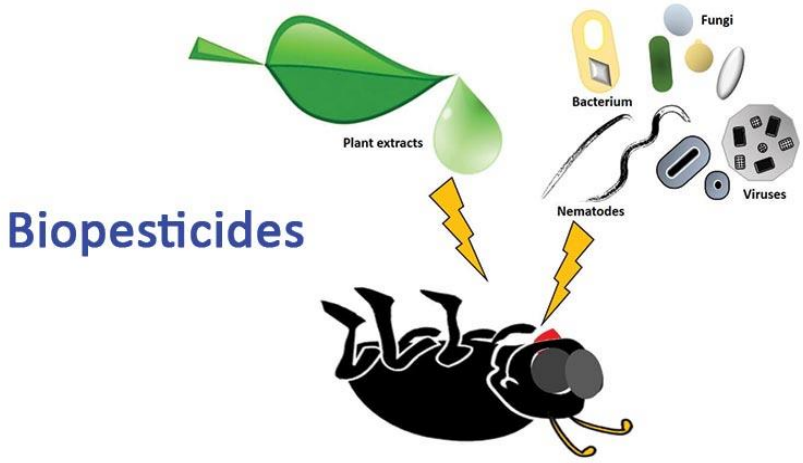
Advantages of Organic Farming

- 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.

Diagram shows basic steps of Organic farming

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

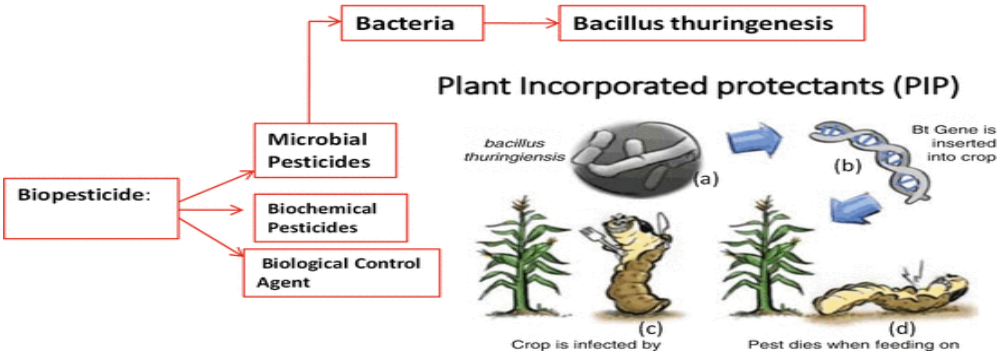
natural materials (such as animals, plants, bacteria, or certain minerals), including their genes or metabolites, for controlling pests.



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: ***Bacillus thuringiensis,*** a bacterium 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. Its manufacturers claim it has little effect on other organisms, and is more environmentally friendly than synthetic pesticides.

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).

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.

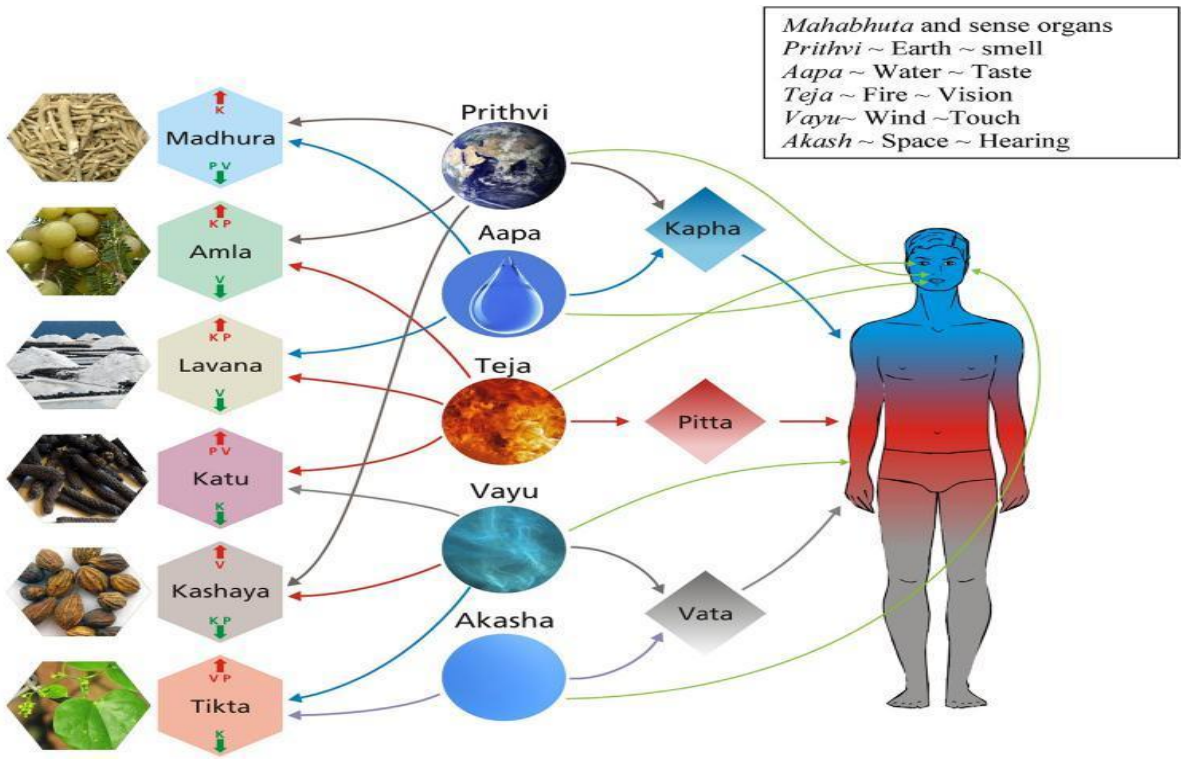
Insect pheromones and other semi-chemicals: Biopesticides may include natural plant-derived products, which include alkaloids, terpenoids, phenolics and other secondary chemicals. Certain vegetable oils such as canola oil are known to have pesticidal properties.

INDIAN SYSTEMS OF MEDICINE

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. Ayurveda identifies three basic types of energy or functional principles that are present in everyone and everything. Since there are no single words in English that convey these concepts, we use the original Sanskrit words **vata, pitta and kapha.** These principles can be related to the basic biology of the body. Energy is required to create movement so that fluids and nutrients get to the cells, enabling the body to function. Energy is also required to metabolize the nutrients in the cells, and is called for to lubricate and maintain the structure of the cell. Vata is the energy of movement; pitta is the energy of digestion or metabolism and kapha, the energy of lubrication and structure. All people have the qualities of vata, pitta and kapha, but one is usually primary, one secondary and the third is usually least prominent. The cause of disease in Ayurveda is viewed as a lack of proper cellular function due to an excess or deficiency of vata, pitta or kapha. Disease can also be caused by the presence of toxins.

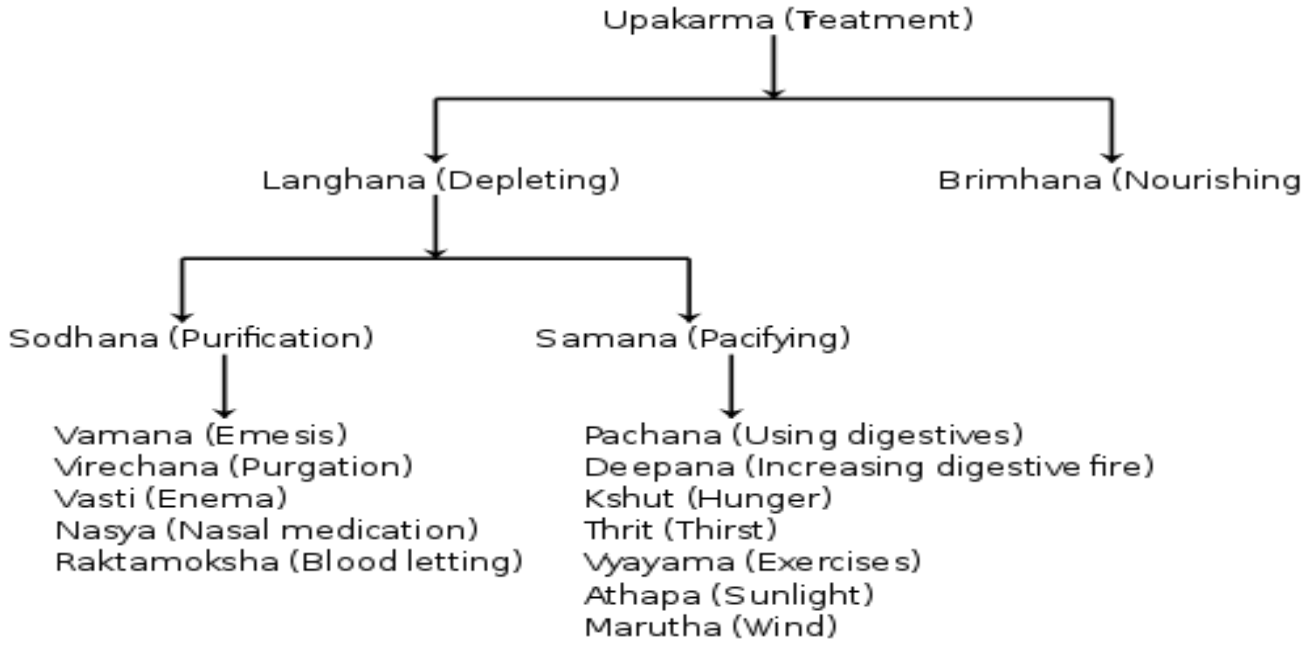
In Ayurveda, body, mind and consciousness work together in maintaining balance. They are simply viewed as different facets of one's being. To learn how to balance the body, mind and consciousness requires an understanding of how vata, pitta and kapha work together. According to Ayurvedic philosophy the entire cosmos is an interplay of the energies of the five great elements—Space, Air, Fire, Water and Earth. Vata, pitta and kapha are combinations and permutations of these five elements that manifest as patterns present in all creation. In the physical body, vata is the subtle energy of movement, pitta the energy of digestion and metabolism, and kapha the energy that forms the body's structure.

Vata is the subtle energy associated with movement — composed of Space and Air. It governs breathing, blinking, muscle and tissue movement, pulsation of the heart, and all movements in the cytoplasm and cell membranes. In balance, vata promotes creativity and flexibility. Out of balance, vata produces fear and anxiety.

Pitta expresses as the body's metabolic system — made up of Fire and Water. It governs digestion, absorption, assimilation, nutrition, metabolism and body temperature. In balance, pitta promotes understanding and intelligence. Out of balance, pitta arouses anger, hatred and jealousy.

Kapha is the energy that forms the body's structure — bones, muscles, tendons — and provides the "glue" that holds the cells together, formed from Earth and Water. Kapha supplies the water for all bodily parts and systems. It lubricates joints, moisturizes the skin, and maintains immunity. In balance, kapha is expressed as love, calmness and forgiveness. Out of balance, it leads to attachment, greed and envy.

Life presents us with many challenges and opportunities. Although there is much over which we have little control, we do have the power to decide about some things, such as diet and lifestyle. To maintain balance and health, it is important to pay attention to these decisions. Diet and lifestyle appropriate to one's individual constitution strengthen the body, mind and consciousness.



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.

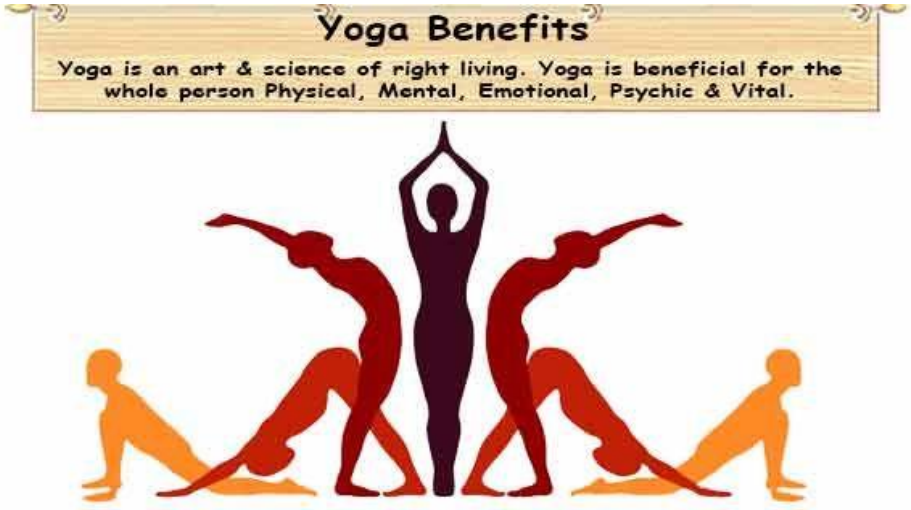
Unani: Unani system of medicine is a comprehensive medical system, which provides Preventive, promotive, curative and rehabilitative health care. The system is holistic in nature and takes into account the whole personality of an individual rather than taking a reductionist approach towards disease. 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.

According to practitioners of Unani medicine, achieving a balance of the bodily fluids known as "the four humors" (blood, phlegm, yellow bile, and black bile) is essential to health. Another key principle of Unani medicine is that disease results from an imbalance in air, earth, water, and fire, four elements thought to comprise all that exists in nature, including the human body. In addition, Unani medicine is partly based on the principle that environmental conditions, including the quality of water and air,) can significantly impact health. Unani medicine is largely based on principles proposed by such physicians as Hippocrates and Galen.

In addition, a number of Arab and Persian scholars (including the Arab philosopher and physicist Avicenna) have contributed to the development of Unani medicine.

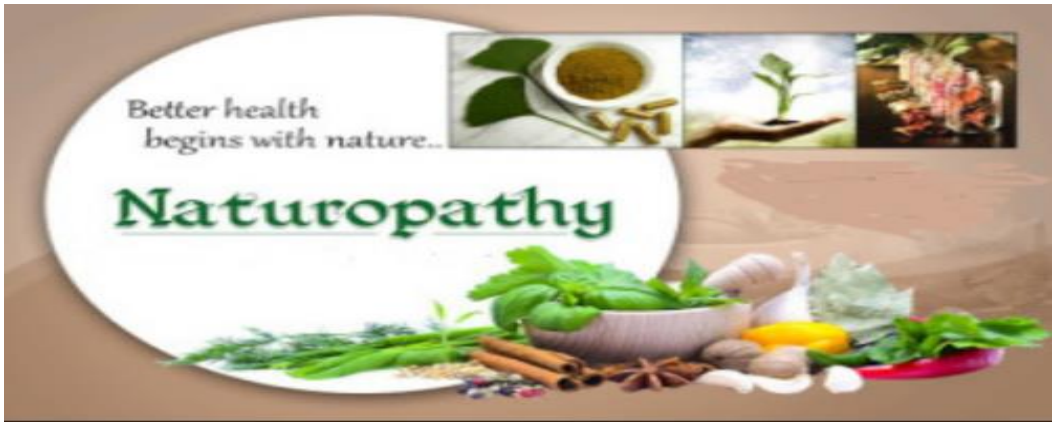
Unani medicine was introduced in India around the tenth century. Unani medicine is somewhat similar to ayurvedic medicine, a form of alternative medicine that originated in India.

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

1. **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 alcoholic and 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.

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.

Precautions:

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.

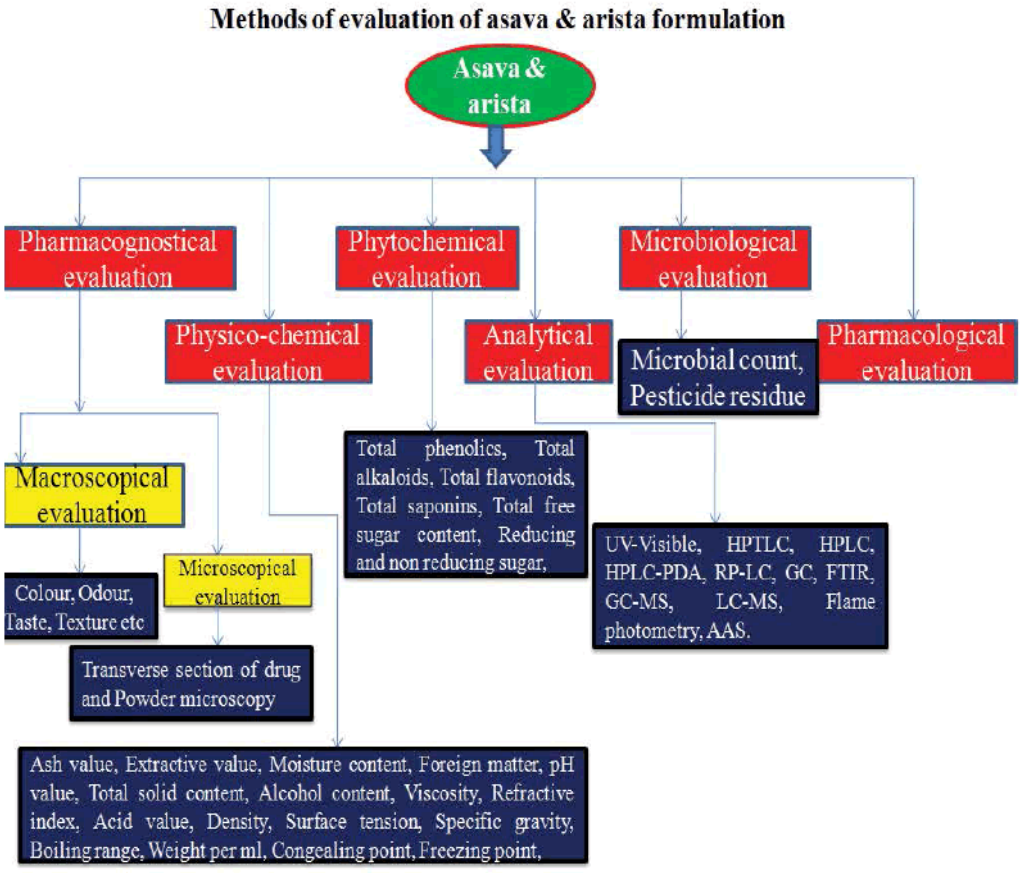


Fig. 1: Methods of evaluation of *asava* and *arista*

2. **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. Triphala churna, Trikatu churna, Drakeshadi churna and Sudharsana churna are some of examples. Churna formulation are similar to powder formulations in Allopathic system of medicine. In recent days churna is formulated into tablets in order to fix the dose easily. These forms of medicament are prescribed generally because of their particle size. Smaller the particle size greater is the absorption rate from GIT and hence the greater is bioavailability.

Evaluation of physical parameters:

1) Determination of pH: The pH of 1% solution of formulated churna was determined using pH meter (Elico pH meter).

2) Determination of Moisture content: The moisture content of churna was found using halogen moisture determining apparatus.

3) Determination of Ash Values:

I. Total Ash Value 2gms of churna was weighed accurately in a previously ignited and tarred silica crucible. The material was then ignited by gradually increasing the heat to 500- 600° C until, it appeared white indicating absence of carbon. It is then cooled in a dessicator and total ash in mg per gm of air dried material is calculated.

II. Acid Insoluble Ash Value To the crucible containing total ash, 25ml of Hcl was added and boiled gently for 5minutes, then about 5ml of hot water was added and transferred into crucible. The insoluble matter was collected on an ashless filter paper. This was then washed with hot water until filterate is neutral and the filter paper along with the insoluble matter was transferred into crucible and ignited to constant weight. The residue was then allowed to cool and then weighed.

4) Determination of Extractive Values

I. Water Soluble Extractive Value 5gms of churna was accurately weighed and placed inside a glass stoppered conical flask. It is then macerated with 100ml of chloroform water for 18hours. It was then filtered and about 25ml of filterate was transferred into a chinadish and was evaporated to dryness on a waterbath. It was then dried to 105° C for 6hours, cooled and finally weighed.

II. Alcohol Soluble Extractive Values Ethanol was used as solvent in place of chloroform water and remaining procedure was the same as that of watersoluble extractive value.

5) Determination Of Crude Fibre Content : 2gms of accurately weighed churna was placed in a round bottom flask and then 100ml of 0.128 M sulphuric acid was added and refluxed for 1

hour then filtered through ashless filter paper and the residue was washed with water until filterate becomes neutral. The residue was then weighed (a), ignited to ash and finally the weight of ash (b) was determined. The difference between a and b represented the crude fibre content and was calculated on dry weight basis.

6) Determination of Heavy Metal Contamination

Arsenic Content: Preparation of Standard Solution (10PPM) 0.33gms of arsenic trioxide was dissolved in 5ml of 2M Sodium hydroxide solution and then diluted to 250ml with water. One volume of this was then diluted to 100 volumes with water.

7) Determination of microbial content: 1gm of churna was dissolved in lactose broth and volume adjusted to 100ml with the same medium. About 10ml of sample was transferred into 100ml of Macconkey broth and incubated for 18-24 hours at 43-45° C. A subculture was prepared on a plate with Macconkey agar and incubated at 43-45° C for 18-24 hours. The growth of red, generally non-mucoid colonies of gram negative rods appearing as reddish zones indicates the presence of *E.coli* if not then it indicates the absence of *E.coli*.

3. Lehyas/ Avaleha: 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.

The Avaleha preparation involves following ingredients:

- Kaṣaya or other liquids
- Jaggery, sugar or sugar-candy

- Powders or pulps of certain drugs
- Ghee or oil and
- Honey

Method of preparation: 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.

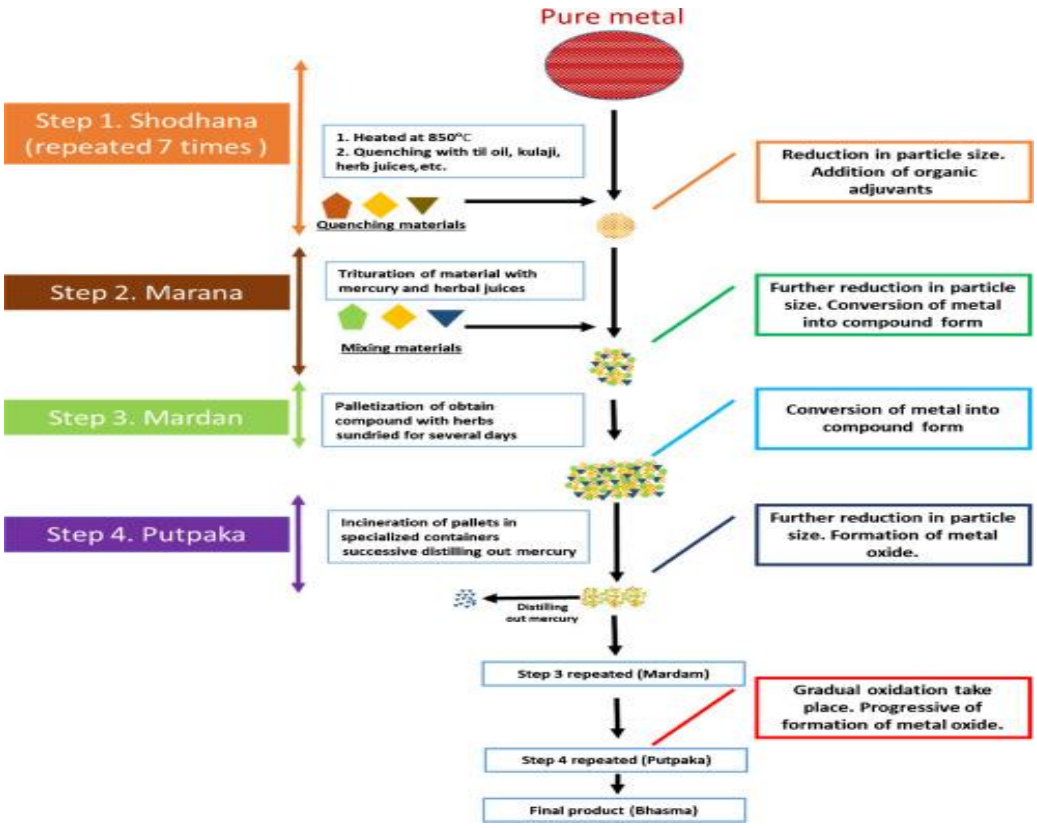
Characteristics: The Avaleha or Lehyam should neither be hard nor be a thick fluid. When pulp of the raw herbs is added and ghee or oil is present in the preparation, this can be rolled between the fingers. The growth of fungus over it or fermentation is signs of deterioration. When metals are mentioned 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.

3. 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:



Standardization techniques: The standardization process include following methods:

Preliminary tests:-

(i) **Floating test:** If a small quantity of bhasma is sprinkled on water surface it should float on the surface.

(ii) **Fineness test:** On rubbing a small quantity of the sample between the fingers it should enter into the lines on the fingers.

(iii) **Loss of metallic luster:** When visually examined preferably in presence of sun light no metallic luster should be observed.

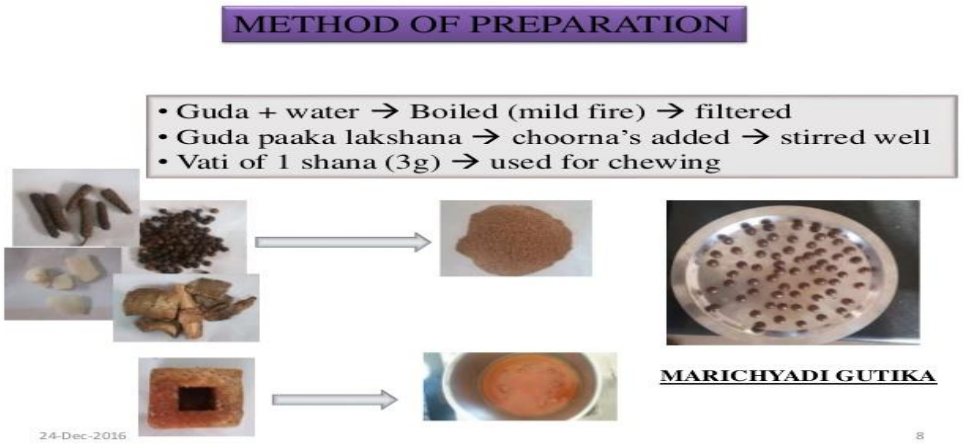
(iv) **Loss of metallic state:** This involves heating of a very thin silver sheet (600 nm thickness) along with a small quantity of bhasma to red hot for about 5 min. After

cooling the sheet to room temperature, no traces of this sample should permanently stick to the silver sheet indicating no alloy formation takes place, thus confirming the metal has totally transformed into bhasma, its oxide form

Physicochemical evaluation:- The various physicochemical evaluation include colour, odour, pH, taste, fineness, loss on drying at 1050C, total ash, acid insoluble ash, water soluble ash and particle size mesh test. Tests for heavy/toxic metals should be carried out for standard formulation and their permissible limits as per WHO / FDA.

5. **Gutikas/ Vati:** Vati is a preparation where different medicinal substances are used to make tablets (vati) and pills (gutika). This is done either by cooking the powdered herbs with jaggery or guggulu or without cooking by macerating the powder with any liquid like honey and guggulu and then rolled into pills. They are made of one or more drugs of a plant, animal or mineral origin.

General method of preparation: The drugs of plant origin are dried and made into fine powders separately. The minerals are made into Bhasma or Sindura, unless otherwise mentioned. In case where Parada and Gandhaka are mentioned, Kajjali is made first and other drugs are added with it one by one according to the formula. These are put into a Khalva and ground to a soft paste with the prescribed fluids. When more than one liquid is mentioned for grinding they are used in succession. When the mass is properly ground and is in a condition to be made into Pills, Sugandha dravyas are added and ground again. The criteria to determine the final stage of the formulation before making pills is that, it should not stick to the fingers when rolled in between two fingers. Pills may be dried in the shade. In case where sugar or Jaggery is mentioned, paka of these should be made on mild fire and removed from the oven. The powders at these ingredients are added to that Paka and briskly mixed. When still warm, Vatakas should be rolled and dried in Shade.



Preservation: Pills made of plant drugs when kept in air tight containers can be used for two years. Pills containing minerals can be used for an indefinite period. (The Ayurvedic Formulary of India)

Important Definitions

1. **Herb:** It is defined as any plant with leaves, seeds or flowers used for flavoring, food, medicine or perfume.
2. **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.
3. **Herbal medicinal products**: these are medicinal products where the active ingredient consists mainly of herbal substances.
4. **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.

5. **Organic farming:** Organic farming combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.
6. **GAP:** It describes general principles including quality control measures and provides technical details for cultivation of medicinal plants.
7. **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.
8. **Asvas and Aristas:** Aristas are made with decoctions of herbs in boiling water while Asavas are prepared by directly using fresh herbal juices.

Very short Answer type Questions (2)

1. Define Herbal medicine.
2. Define Herbal medicinal product.
3. Give sources of Herbs.
4. What is primary processing?
5. What are Biopesticides?
6. Give examples of Vacuum drying?
7. Define Asvas and Aristas.
8. Define Churnas.
9. Define Pest.
10. Name five elements involved in Ayurveda.
11. Define GAP
12. Give advantages of Organic Farming.
13. Give examples of Gutikas.
14. What are Lehyas.
15. Name Indian Systems of medicines

Short Answer type Questions (5)

1. Write about the selection, identification and authentication of herbal drugs.
2. Discuss briefly about GAP's in cultivation of medicinal plants.
3. Give short review on Unani system of medicine.
4. Write about the basic principles involved in Homeopathy.
5. Define Bhasmas. Discuss the various methods for preparation and evaluation of Bhasmas.
6. Discuss method of preparation and standardization of Gutikas.

Long Answer type Questions (10)

1. Write the various steps involved in the processing of herbal raw material. What precautions are to be taken while processing of herbal drugs?
2. Write an exhaustive note on: a) Organic Farming b) Biodynamic Agriculture

3. Write in brief about pests causing degradation of medicinal plants? How pest management is to be done?
4. What do you mean by safety parameters of herbal drugs?
5. Describe the basics principle involved in Ayurveda .