CULTIVATION, COLLECTION, PROCESSING & STORAGE OF CRUDE DRUGS

Cultivation of Crude Drugs: Cultivation of medicinal plants requires intensive care and management. The conditions and duration of cultivation required vary depending on the quality of medicinal plant materials required.

Methods of Propagation

I. Vegetative propagation (Asexual propagation):

Vegetative propagation can be defined as regeneration or formation of a new individual from any vegetative part of the plant body. The method of vegetative propagation involves separation of a part of plant body, which develops into a new plant.

1. Cutting: These are the parts of the plant (stem, root or leaf) which, if grown under suitable' conditions, develop new plants. Stem cutting are generally used to obtained new plants. Examples: Sugarcane and rose, etc.

2. Layering: Roots are induced on the stem while it is still attached to the parent plant. This part of stem is later detached from the parent plant and grown into a new plant. Examples: Jasmine plant

3. Grafting: New variety is produced by joining parts of two different plants. The rooted shoot of one plant, called stock, is joined with a piece of shoot of another plant known as scion. Examples: Rose, citrus and rubber, etc.

Advantages of Asexual Propagation

As resultant species formed through asexual process are genetically identical, useful traits can be preserved among them. Asexual propagation allows propagation of crops that do not possess seeds or those which are not possible to grow from seeds. For e.g. Jasmine, sugarcane, potato, banana, rose etc. Plants grown through vegetative propagation bear fruits early. In this type, only a single parent is required and thus it eliminates the need for propagation mechanisms such as pollination, cross pollination etc. The process is faster than sexual propagation. This helps in rapid generation of crops which in turn balances the loss.

Disadvantages of Asexual Propagation

Diversity is lost in asexual propagation which is the main reason behind occurrence of diseases in future plant species. As many crops are produced with this process, it leads to overcrowding & lack of nutrients. New varieties of crops cannot be developed in this type of propagation. Asexual propagation is an expensive process that requires special skills for successful cultivation of crops.

Crops produced through this process have shorter life-span than those grown through sexual process. Species involved in this process are less likely to resist pests and diseases.

Importance of Asexual propagation 1. It is a cheaper, easier and rapid method of multiplication. Many fruit trees usually require 4-5 years to bear the fruits when developed from seeds. The plants developed by vegetative methods, take only a year to bear fruits. 2. Plants like roses and chrysanthemum, etc do not form viable seeds. Thus, vegetative propagation is the only method of propagation is the only method of reproduction and continuation of species in such plants. 3. All the plants developed by these methods will be generally similar to the parent plant.

II. Sexual Propagation

The process of sexual propagation:

(i) Pollination: This is the transfer of pollen grains from the anther to the stigma. (ii) Fertilization: Fusion of male and female gametes takes place, resulting in the formation of zygote (iii) Seedling: Multiplication of plants by using seed is called as seed propagation Dormancy: It is term used to describe a seed that will not germinate because of any condition associated either with the seed itself or with existing environmental factors such as temperature and moisture. Rest Period: Some seeds will not germinate immediately after harvest even if conditions are favourable. This failure to germinate is due to physiological condition. This is said to be the seeds are in the rest period. Seed viability and longevity: Viability means the presence of life in the seed. Longevity refers to the length of time that seeds will retain their viability. Some seeds are short lived. (Citrus).

Pre – germination Seed Treatments to improve germination rate

1. Chemical (Acid scarification) The purpose is to modify hard or important or impermeable seed covering generally soaking seed in concentrated sulphuric acid is an effective method. The time of treatment may vary from 10 minutes to 6 hour according to species sometimes phytohormones like gibberellins, ethylene, Cytokinins are also used. Other chemicals like Potassium nitrate, Thiourea, Sodium hypochlorite also used.

2. Mechanical (Scarification): Seeds of a few species with impermeable seed coat. i.e. hard seed coat can be rendered permeable to water and gases their germination is greatly improved by mechanical scarification in taking care that seeds should be injured not be injured heavily. This can be achieved by i) Placing the seeds between two sand paper doses, one station and other revolving. ii) Passing seeds through machine that scratches the surface. iii) Filling and notching to make the seed coat permeable to water.

3. Seedling (Boiled Water Treatment): Pouring boiling water over seeds and getting it to cool gradually for about 12 hour to soften hard shelled seeds. E.g. Coffee.

4. Soaking in Water: The purpose of soaking seeds in water is to modify hard seed coats, to remove inhibitors to soften seed and to reduce the time of germination. The time of soaking seeds in cold water depend upon the hardness of the seed coat. E.g beans.

5. Moist Chilling: Seed of many woody trees or shrubs are exposed to low temperature to bring about prompt and uniform germination. Germination rate measured by 1. Rolled towel test 2. Excised embryo test

Advantages of Sexual Propagation

Simplest, easiest and the most economical process. Some plants, trees, vegetables or fruits species can propagate only through sexual propagation. E.g. – marigold, papaya, tomato. This type of propagation leads to better crop species that are stronger, disease- resistant and have longer life-span. Viral transmission can be prevented in this type of propagation. It is the only propagation process in which resultant offspring have genetic variation and exhibit diversity of characters from parent crops. This genetic variation is responsible for continuous evolution that keeps on producing better & better offspring. Easy storage and transportation of seeds.

Disadvantages of Sexual Propagation - Seeds take a long time to turn into mature plants i.e. time interval between sowing and flowering is longer. Seedlings propagated through sexual propagation are unlikely to have same genetic characteristics as that of parent plants Some plant species do not produce viable seeds through sexual propagation and hence are unsuitable to propagate for the same. Plants that do not have seeds can’t be propagated through this process. There are many factors that can affect the viability of seeds, including moisture, air, temperature, and light.

III. Micro propagation / Plant Tissue Culture This method consists of growing cell, tissue and organ in culture. Small pieces of plant organs or tissues are grown in a container with suitable nutrient medium, under sterilized conditions. The tissue grows into a mass of undifferentiated cells called callus which later differentiates into plantlets. These are then transferred into pots or nursery beds and allowed to grow into full plants. Plant tissue culture is widely used to produce clones of a plant in a method known as micropropagation to conserve rare or endangered plant species. Micro propagation is useful in raising disease free plants, homozygous diploids, and those without viable seeds.

COLLECTION OF DRUGS

Medicinal plant materials should be collected during the appropriate season or time period to ensure the best possible quality of both source materials and finished products. It is well known that the quantitative concentration of biologically active constituents varies with the stage of plant growth and development. The best time for collection (quality peak season or time of day) should be determined according to the quality and quantity of 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.

After collection, the raw medicinal plant materials may be subjected to appropriate preliminary processing, including elimination of undesirable materials and contaminants, washing (to remove excess soil), sorting and cutting. The collected medicinal plant materials should be protected from insects, rodents, birds and other pests, and from livestock and domestic animals. If the collection site is located some distance from processing facilities, it may be necessary to air or sun-dry the raw medicinal plant materials prior to transport. If more than one medicinal plant part is to be collected, the different plant species or plant materials should be gathered separately and transported in separate containers. Cross-contamination should be avoided at all times. Collecting implements, such as machetes, shears, saws and mechanical tools, should be kept clean and maintained in proper condition. Those parts that come into direct contact with the collected medicinal plant materials should be free from excess oil and other contamination.

HARVESTING

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

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. 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 domestic animals. 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.

The following general rules for collection of crude drugs: Roots and rhizomes are collected at the end of the vegetation period, i.e. usually in the autumn. In most cases they must be washed free of adhering soil and sand. Bark is collected in the spring. Leaves and herbs are collected at the flowering stage. Flowers are usually gathered when fully developed. Fruits and seeds are collected when fully ripe.

Methods of collection: Medicinal plants must be largely collected by hand. With cultivation on a large scale, it may be possible to use modern agricultural harvesters, but in many cases, e.g. barks, manual collection is unavoidable. Thus, the cost of drug production is largely the cost of the labour involved.

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.

9. Freshly harvested medicinal plants/herbal drugs must be delivered as quickly as possible to the processing facility in order to prevent thermal degradation.

10. The harvested crop must be protected from pests, mice/rodents, livestock and domestic animals. Any pest control measures taken should be documented.

DRYING

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

1. 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. Vacuum drying

7. Spray dryer: Examples: Papaya latex and pectin’s, etc.

When the crude drug has been collected under primitive conditions, without access to a drier, it must be dried in the open. The air temperature is kept at 20-40 °C for thin materials such as leaves, but is often raised to 60-70 °C for plant parts that are harder to dry, e.g. roots and barks. The plant material is spread out on shallow trays, which are placed on mobile racks and passed into a tunnel where they meet a stream of warm air. To stop the enzyme processes, the water content must be brought to about 10 %. Leaves may contain 60-90% water, roots and rhizomes 70-85%,and wood 40-50%. The lowest percentage, often no more than 5-10%, is found in seeds. Drying also decreases the risk of external attack, e.g. by moulds. Enzymatic processes take place in aqueous solution. Rapid removal of the water from the cell will, therefore, largely prevent degradation of the cell constituents. The most common method for preserving plant material is drying.

STORAGE OF CRUDE DRUGS

1.Storage facilities for medicinal material should be well aerated, dry and protected from light, and, when necessary, be supplied with air-conditioning and Humidity control equipment as well as facilities to protect against rodents, insects.

2. The floor should be tidy, without cracks and easy to clean. Medicinal material should be stored on shelves which keep the material a sufficient distance from the walls; measures should be taken to prevent the occurrence of pest infestation.

3. Continuous in-process quality control measures should be implemented to eliminate substandard materials, contaminants and foreign matter prior to and during the final stages of packaging.

4. Processed medicinal plant materials should be packaged in clean, dry boxes, sacks, bags or other containers in accordance with standard operating procedures and national and/or regional regulations of the producer and the end-user countries.

5. 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.

6. 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

7. 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.

8. 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.

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

PRESERVATION OF PLANT MATERIAL

The plant material must first be preserved so that the active compounds will remain unchanged during transport and storage. The cells of living plants contain not only low molecular-weight compounds and enzymes, but they also have many kinds of barriers that keep these constituents apart. When the plant dies, the barriers are quickly broken down and the enzymes then get the opportunity to promote various chemical changes in the other cell constituents, e.g. by oxidation or hydrolysis.

Further readings

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INTRODUCTION

Lipids constitute a broad group of naturally occurring molecules which include waxes, fats, sterols, fat-soluble vitamins, monoglycerides, diglycerides, phospholipids and others.

Fixed oils are esters of fatty acid with glycerol. Fixed oils are Non-irritant Odorless Tasteless Non-volatile Insoluble in water and soluble in organic solvents Produce greasy mark on paper Upon heating strongly, undergo decomposition Upon hydrolysis, yield glycerol and fatty acid. Fixed oils are esters of fatty acid with glycerol. These May be; Monoglycerides Diglycerides Triglycerides. On the basis of their ability to absorb oxygen from air; Drying oil Non-drying oil Semi-drying oil.

a) Drying oil: Drying oil When exposed to air, undergo oxidation and form tough and hard film. These are usually used in paints and varnishes. For example; Linseed oil

b) Non-Drying oil: These oils neither undergo oxidation nor form tough and hard film. For example; Olive oil

c) Semi-Drying oil: Semi-Drying oil When exposed to air, undergo little bit oxidation and form tough and thin film. For example; Cottonseed oil.

VOLATILE OILS VS FIXED OILS

Fixed oils Volatile oils Don't get volatiles at room temperature Volatilize at room temperature Obtained by extraction Obtained by distillation After evaporation, do leave spot Leave no spot after evaporation Can be saponified Cannot be saponified Esters of fatty acid with glycerol Mixtures of oleoptenes and stereoptenes Low refractive index High refractive index

FATS VS FIXED OILS

Fixed oils Fats Liquid at room temperature Solid at room temperature Contain unsaturated glycerides e.g. glyceryl oleate Contain saturated glycerides e.g. glyceryl stearate

OIL EXTRACTION

Extraction by Expression

Generally screw presses are used because they afford a better yield than the older hydraulic presses: they operate at higher pressures and continuously, not in batches, which is an added advantage. Prior to expression, oilseeds rich in proteins undergo cooking at around 90°C, which frees the oil by bursting cell structures, but also coagulates the proteins. Most often a fast drying step follows.

Extraction by Solvents

It is applicable to intact seeds as well as to seeds partially extracted by expression. The solvent, generally hexane (bp 65°C), is added to the cleaned, hulled, and rough-milled seeds. An organic phase is recovered which is a solution of the oil in the solvent called miscella, and also a solvent-soaked defatted meal.

Refining the Crude Oil

Crude oils obtained by distillation of the miscella may contain water, free fatty acids, lecithins, resins, pigments (carotenes, chlorophyll), sterols, waxes, substances with odors and tastes, and external contaminants (pesticides).

Refining includes the following sequence:
Degumming (mucilage removal)
Its role is to eliminate lecithins, proteins, and other constituents present in the oil in colloidal suspension. To accomplish this, the hot oil is hydrated, whereupon the colloids form a dense gel which separates from the lighter oil. The gel is discarded and the oil dried under vacuum. In most cases, this treatment is replaced by an injection of phosphoric acid into the hot oil: the phospholipids then precipitate upon neutralization by sodium hydroxide;

Neutralization
The free fatty acids, always present in the crude oil, are neutratized by dilute sodium hydroxide. The soap formed (soap stock) adsorbs part of the impurities: coloring matter, phenols, sterols, wax esters, traces of metals, and miscellaneous oxidation products. The excess soap and sodium hydroxide are removed by washing with hot water.

Bleaching
This is done by passing the oil through diatomaceous earths or activated charcoal. The bleaching agent is removed by filtration.
Waxremoval
From crude oils rich in waxes (sunflower, corn, cotton): by cooling (winterization): the crystallized waxes are removed by filtration.
Deodorizing: The aldehydes and ketones of unpleasant odor are eliminated: by injecting steam into the very hot oil (200 °C) under high vacuum.

Subsequent treatments of the oils:
mainly in the food industry: including hydrogenation and interesterification in the margarine industry. The cattle cake recovered is treated (solvents removed), and if needed detoxified and directed toward animal feeding (with some exception specific uses).

CASTOR OIL

Botanical origin: Ricinus communis; Family: Euphorbeaceae Part used: seeds
Castor seed contains little water, 15-20% proteins, and 40-60% lipids. ricin: a toxic glycoproteinic lectin; ricinine: a cyano derivative of pyridone.
Castor oil has a very peculiar composition, in that its major constituents (90%) are triacylglycerols containing ricinoleic acid→ an unsaturated and hydroxylated C18 fatty acid: (R)-(+)-12-hydroxy-Z-octadec-9-enoic acid. The other castor oil fatty acids are also C18 compounds: oleic (3%) and linoleic (3-4%).
Castor oil is a dense, viscous, and non-drying oil.
Uses: Purgative Emollient Preparation of zinc and castor oil ointment Sterilized castor oil as soothing agent in eye Oily vehicle for eye drops
Toxicity: Excessive oral administration in larger doses results in toxicity. Symptoms include; Nausea Colic vomiting severe purgation Electrolyte imbalance

OLIVE OIL
Botanical origin: obtained by cold expression or other suitable mechanical means from the ripe drupes of Olea europea L.
Family: Oleaceae;
Part used: Ripe fruit, contains water (40-45%), carbohydrates (10-20%), and lipids (~ 30%).
Constituents: Glycerides of; Oleic acid Linoleic acid Stearic acid Arachidic acid Palmitic acid

Uses: Mild Laxative, Nutrient, Emollient Demulcent, cholagogue and as a solvent for drugs (externally).
Refined olive oil is used as a solvent for parenteral preparations.

ARACHIS OIL
Botanical origin: Arachis hypogaea; Family: Leguminosae; Part used: Seeds
Constituents: Glycerides of; Oleic acid Linoleic acid Stearic acid Arachidic acid Palmitic acid Behenic acid Lignoceric acid
Uses: Vehicles in emulsions, liniments, plasters, soap Ink manufacture Preparation of hydrogenated vegetable oil.

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Natural Fibres and Surgical Dressing

DEFINITION

Surgical dressing is a term applied to a wide range of materials used for dressing wounds or injured or diseased tissues. A dressing is designed to be in direct contact with the wound, which makes it different from a bandage, which is primarily used to hold a dressing in place.

NEED OF SURGICAL DRESSINGS

1. Provide an environment for moist wound healing. Desiccation of a wound is a major factor in retarding wound healing and increasing scarring. Dressing that prevent desiccation provide an optimal environment for autolysis cell migration, granulation and reepithelialization.
2. Prevent maceration by permitting evaporation or absorption. In highly exudative wounds, excessive moisture and autolytic enzimes will damage repairing tissue and will provide a perfect culture medium for microbes.
3. Promote hemostasis.
4. Protect the wound from further damage (mechanical damage, microbial invasion, dehydration , maceration , chemical damage, alteration in pH)
5. Reduce heat loss.
6. Control microbial growth (by incorporation of antimicrobial drugs).
7. Promote autolysis.
8. Promote healing.
9. Provide compression, promoting hemostasis and reducing edema.
10. Provide support.
11. Reduce pain , increase patient comfort , and improve functional use of wound site.
12. Improve the appearance ofthe wound site.
13. Reduce odor.
14. Reduce over all costs associated with wound treatment.

SOURCES OF FIBRES

Plant - Cellulose + Lignin Eg. Cotton, Jute, Hemp, Flax
Animal – Proteinous Eg. Silk, wool
Mineral – Eg. Glass, Asbestos

COTTON

Synonyms : Raw Cotton Wool, Absorbent Cotton
Biological source: Absorbent cotton consists of epidermal hair of the seeds of *Gossypium herbaceum* Linn, *Gossypium hirsutum* Linn, *Gossypium arboreum* Linn and *Gossypium barbadence* Linn
Geographical source: Egypt , India , South America , USA , South Africa , Pakistan
Prepration of Raw Cotton : Bolls of cotton are collected from the ripe and dehisced fruits of Gossypium . Raw cotton thus prepared contains impurities, chiefly colouring matter and about 0.6 percent of wax and oil which form a thin flim around the fibres and render then non-absorbent.
Prepration of Absorbent Cotton Wool: Absorbent cotton wool is prepared from the various cotton wastes obtained during the processing of raw cotton for making yarns . The wastes are loosened and then boiled for 10 to 15 hours under a pressure of about 30 lbs in a dilute solution of caustic soda and soda ash .
Macroscopical and Microscopical Characters: Absorbent cotton wool is whiter than the raw cotton. The cotton trichhomes are tablar , flattened and twisted with large lumen .

Constituents: Raw cotton contains about 90 percent of cellulose and small amounts of wax, fat , remains of protoplasm and ash. Absorbent cotton is almost pure cellulose.
Uses : Cotton is used as the chief material for many surgical dressings . It is also used as a filtering medium and an insulating material.

JUTE
Synonym : Gunny
Biological Source : Corchorus olitorius Linn and Corchorus capsularis Linn
Geographical source : Extensively cultivated as a cash crop in Bangladesh . Also cultivated in small quantites in some parts of India .
Preparation of Jute fibre : Jute plants are normally stright and unbranched . They are cut from the base when the plants are in flowers , tied into small bundles , stacked and soaked in stagnant water for about three weeks for retting.
Constituent : Jute fibres are composed of 53 percent cellulose and 22 percent hemeicellulose and contain 11 percent of lignin , 1 percent of fat and waxes and 1 percent of ash .
Uses : In Pharmacy Jute is used for the manufacture of medicated tows.

FLAX
Biological Source : Linum usitatissum Linn
Geographical source : Russia, Northern Ireland U.S.A. and Argentina
Preparation of Flax : The plants are uprooted by hand just about the time ripening of the fruits , tied in shaves and left to dry in field .
Constituents : Flax is made up of pecto-cellulose .
Uses : Flax is used asa filtering medium for some preparations . It is used in the manufacture of this lints.

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