

# **RESEARCH ARTICLE**

# HARVEST AND POST HARVEST MANAGEMENT FOR ENSURING QUALITY OF MEDICINAL PLANTS

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Manuscript Info	Abstract
Manuscrint History	The instant rising demand of plant-based drugs is unfortunately.
Received: 20 March 2021 Final Accepted: 24 April 2021 Published: May 2021	creating heavy pressure on some selected high-value medicinal plant
	population in the wild. The safety, quality and efficacy of these
	products have become a major concern for health authorities and the
Key words:-	consumers. Unavailability of proper production technology and suitable
Plant Based Drugs, Medicinal Plants,	area of cultivation, post-harvest processing, market constraints and low
Safety, Efficacy, Cultivation, Post	economic returns as compared to major cereal crops, are the main
Harvest Processing	problems in cultivation of these herbs and spices. Safe, efficacious and
	a high-quality product showing batch to batch consistency can be
	maintained by following harvesting and post harvesting standard
	guidelines for MAPs (Medicinal & Aromatic Plants).

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#### Introduction:-

India is a reservoir of varied vegetation in general & supports a large no. of MAPs in particular, which are extensively used by the local peoples and pharmaceutical industries for preparation of drugs <sup>[1]</sup>. The resurgence of herbal drugs is mainly due to realization of harmful side effects of many modern drugs <sup>[2]</sup>.

Medicinal plants industrial growth is curtailed by a distinct lack of understanding of the specific post harvest handling and packaging needs of the broad range of species and varieties. Recent surveys indicate that poor post harvest handling and lack of knowledge on suitable packaging systems for herbs as the major factors contributing to wastage, poor quality and limited market opportunities.

The instant rising demand of plant-based drugs is unfortunately creating heavy pressure on some selected high-value medicinal plant population in the wild due to over harvesting. Due to this the safety, quality and efficacy of these products have become a major concern for health authorities and the consumers. Application of post harvest techniques at the optimum stage of development of medicinal plant to obtain a high-quality efficacious herbal drug, drying and storing at temperatures and conditions that do not decrease the active ingredients, processing appropriately to maximize phytochemical recovery needs to be followed strictly for batch to batch consistency of final product.

#### Harvest management:-

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 <sup>[3]</sup>. Harvesting of MAP species should be done as and when they attain the maturity in case of medicinal plants and maximum biomass in case of aromatic plants <sup>[1]</sup>. Following are the general guidelines need to be practiced while harvesting/collection of medicinal plants:

i) 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 <sup>[3]</sup>.

**ii)** In general, the collected/harvested plant materials should not come into direct contact with the soil. If underground parts (such as the roots or rhizomes/bulbs) are harvested, any adhering soil should be removed from the plants as soon as they are harvested/ collected <sup>[2]</sup>.

**iii)** Collected / harvested plant material should be placed in clean baskets, mesh bags, other well aerated containers or cloths that are free from foreign matter, including plant remnants from previous collecting activities. After collection, the plant materials may be subjected to appropriate preliminary processing, including elimination of undesirable materials and contaminants (by hand picking), washing (to remove excess soil), sorting and cutting <sup>[2]</sup>.

iv) If more than one part of the medicinal plant is to be collected, the different plant materials should be gathered separately and transported in separate containers <sup>[2]</sup>.

v) Cutting devices, harvesters, and other machines should be kept clean and adjusted to reduce damage and contamination from soil and other materials <sup>[3]</sup>.

Different plant parts such as roots, rhizomes, bulbs, bark, leaf, fruit and seeds are collected, processed and used in preparation of herbal drugs. Techniques and time to harvest varies with the species and plant parts:-

**a) Bulbs:** Late autumn, long after the plant has flowered and fruited. Bulbs should be dug from considerable distance from the main plant. Collect mature big bulbs and leave small bubs for regeneration. Bulbs/roots should be collected only after the seed shedding unless otherwise specified <sup>[2]</sup>.

**b) Bark:** From annuals shortly before flowering. From biennials during the autumn or winter following the first-year growth. From perennials during autumn or winter following the second- or third-year's growth <sup>[2]</sup>.

**c) Root:** The roots of annual plants must be dug when the plants are well developed and mature. Roots of perennials should be harvested late in the fall or early in the spring. Roots of biennial should be collected in either the fall of the first year or spring of the second year <sup>[4]</sup>.

**d)** Leaves: Collection should be made in dry weather whilst the plant is flowering. Leaves should be harvested before or at the time of initiation of flowering unless otherwise specified <sup>[2]</sup>.

e) Flowers: Flowers must be harvested (or if specified, flowering tops) when they have just opened or shortly afterwards to capture its aroma <sup>[4]</sup>.Collection should be made in dry weather and in early hours of the day, after due has dissipated. Flowers must be harvested when they have just opened or shortly afterwards to capture its aroma <sup>[2]</sup>.

**f)** Seeds and fruits: Collection should be made when fruits are fully grown and ripe or nearly ripe until otherwise it is required <sup>[2]</sup>.

**g) Annual herbs/ whole plant:** When collecting whole herbaceous plant, or its aerial parts, the harvesting should be done at flower bud or flowering stage but prior to any visual decline in any of the plant parts. Whole population in a given area should never be harvested. Adequate population should be left in nature for regeneration to facilitate future collections<sup>[4]</sup>.

#### Post harvest management:-

The collected medicinal plant materials should be protected from insects, rodents, birds and other pests as well as from livestock and domestic animals <sup>[2]</sup>.

i) **Primary processing:** Timely and right processing of medicinal plant produce after it has been harvested is imperative to preserve the quality and enhance shelf life of the produce. After harvesting, the produce should be separated from any organic or inorganic matter stuck to it. Any part of the mother plant, that does not constitute official medicinal plant produce. (e. g. immature lateral roots where taproot is the officially recognized produce), should be removed <sup>[5]</sup>.

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 <sup>[2]</sup>.

**ii) Washing:** The harvested material should be washed with clean water <sup>[2]</sup>. Washing is important activity to remove soil & other debris or residue. The washing is generally applied on the medicinal plants whose roots, rhizomes, tuber or fruits are used as raw material. Besides cleanliness, water used for washing improves the appearance and prevents their wilting <sup>[1]</sup>. In some cases, the harvested produce may need to be scraped, peeled or brushed. Such processed produce should be washed with potable water before drying the same <sup>[5]</sup>.

**iii)** Drying: Drying is basically defined as the decreasing of plant moisture content, aimed at preventing enzymatic and microbial activity, and consequently preserving the product to extend shelf life<sup>[2]</sup>.

Medicinal plant produces when in wet condition requiring drying in shade, may be dried initially under sunlight to get rid of external moisture, before being transferred to shade <sup>[4]</sup>. The excessive moisture causes fungi, moulds and pests to develop in the plant. To control the risk, moisture must be eliminated either from the plant or from the atmosphere. Medicinal herbs must be dried thoroughly, until they contain only 10-12% moisture, which is considered to be the safe percentage.  $\Box$  15% moisture content is permissible in the case of roots (radices) or sugar-containing herbs <sup>[6]</sup>.

When the harvested produce is morphologically thick, fleshy or of bigger size, it should be cut or sliced into small/ thin pieces to ensure proper drying of the produce <sup>[5]</sup>. The maximum temperature for drying most herbs is between  $45^{\circ}$ C (113°F) and 50°C (122°F). If the air is very humid then the temperature can be increased by 10°C to lower the humidity. Aromatic herbs that contain volatile oils should be dried at lower temperature; ideally at around 30°C (86°F), and not more than 35°C (95°F). <sup>[7]</sup>.

Medicinal plants can be dried in a number of ways<sup>[2]</sup>:

**a.** In the open air (shaded from direct sunlight);

**b.** Placed in thin layers on drying frames, wire-screened rooms or buildings.

**c.** By direct sunlight, if appropriate (fleshy material).

d. In drying ovens/rooms and solar dryers.

e. By indirect fire; baking; lyophilization; microwave; or infrared devices.

f. Vacuum drying

**g.** Spray dryer <sup>[2]</sup>

#### Packaging:

Proper packaging has a great significance in reducing the wastage and it also provides protection from mechanical damage, undesirable physiological changes and pathological deterioration during storage, transportation and marketing. Through proper packaging, freshness, succulence and flavor can be maintained for a longer period <sup>[1]</sup>. The following steps should be followed:

**a.** After removal of damaged material and foreign matter, the good dried crop should be packed in clean, dry sacks, bags or boxes, preferably new <sup>[2]</sup>.

**b.** Reusable packaging materials such as jute sacks, plastic bags, etc., should be well cleaned and dried before reuse  $^{[2]}$ .

**c.** The packed crop should be stored in a dry place away from the wall and off the ground and be protected from pests and farm and domestic animals [2].

**d.** The label should contain all the required information of medicinal plant produce <sup>[4]</sup>.

#### Storage:

Packed dried crop should be stored in a dry, well ventilated building, with minimal variation in temperature and with good air ventilation <sup>[2]</sup>.

Fresh medicinal plant materials should be stored at appropriate low temperatures, ideally at  $2^{\circ}$ C -8°C. High temperature evaporates the essential oils contained in herbs and also decomposes lipid-containing herbs, giving them a sharp bitter taste<sup>[6]</sup>.

The floor should be tidy, without cracks and easy to clean. Plant 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. It is recommended that packed dried crops should be stored: - in a building with concrete floors; - away from the wall; - well separated from all other crops<sup>[2]</sup>.

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 <sup>[2]</sup>.

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<sup>[2]</sup>.

Inflammable produce like resins, gum-resins, oils etc. should be stored at isolated place in closed containers (flammable materials should be clearly labeled as such on each container)<sup>[5]</sup>.

For storage of waste and unusable materials, facilities should be provided for the storage of waste and unusable materials prior to removal from the premises. These facilities should be designed so as to prevent access to the waste or unusable materials by pests and to avoid contamination of medicinal plant materials, potable water, equipment and buildings of the premises. Clearly marked waste bins should be provided and emptied daily <sup>[8]</sup>.

## Personnel:

They should not be permitted to work in the herbal material handling area if they are known to be suffering from, or to be carriers of, a disease likely to be transmitted through medicinal plant materials, including diarrhea<sup>[2]</sup>.

Personnel with open wounds, sores, and skin infections should be transferred away from herbal materials handling areas until completely recovered <sup>[2]</sup>.

Growers and producers should have adequate knowledge of the medicinal plant concerned. This should include botanical identification, cultivation characteristics and environmental requirements (soil type, soil pH, fertility, plant spacing and light requirements), as well as the means of harvest and storage<sup>[8]</sup>.

Smoking & eating should not be permitted in medicinal plant processing areas. Personnel who handle medicinal plant materials should refrain from behaviors that could result in contamination of the material for example, spitting, sneezing, or coughing over unprotected material <sup>[9]</sup>.

vii) According to National medicinal Plants Board, here are some Do's and Don'ts of Post Harvest management for MAPs<sup>[10]</sup>:

Do's	Don'ts	
Post-Harvest processing		
Transport harvested material quickly to processing	Do not transport bags along with pesticides, fertilizers	
site/unit in clean vehicle		
Use clean cemented floor or good tarpaulin sheet for	Do Not select a processing site/unit at a long distance	
laying out the harvested material	from the place of harvest	
Remove all weeds and other foreign matter	Do Not handle medicinal plant material if you have	
	wounds or infectious disease	
Washing & Drying		
Wash the harvested material in clean water	Do Not use contaminated water for washing	
Create air flow over the plant material	Do Not wash seeds & delicate flowers	
Drain the water off the herbs before drying	Do Not dry herbs in direct sunlight	
Packaging & storage		
Pack the material into good quality clean & dry bags	Do Not use fertilizers/pesticides bags for storage	
Store harvested material in a clean and dry room	Do Not pack herbs unless they are completely dry	
Raise the bag off the ground & keep them away from the	Do Not stack the bags so high that the material in the	
wall	lower bags gats damaged	

# **Conclusion:-**

Medicinal herbs constitute as one of the major group of plants with recognized socio-economic value, which is not only ethno botanically important but also pharmacologically useful. The instant rising demand of plant-based drugs is unfortunately creating heavy pressure on some selected high-value medicinal plant population in the wild due to over harvesting. Due to this the safety, quality and efficacy of these products have become a major concern for health authorities and the consumers. Unavailability of proper production technology and suitable area of cultivation, post-harvest processing, market constraints and low economic returns as compared to major cereal crops, are the main problems in cultivation of these herbs and spices. Application of post harvest techniques to obtain a high-quality efficacious herbal drug, drying and storing at temperature and conditions that do not decrease the active ingredients, needs to be followed strictly to maximize phytochemical recovery and batch to batch consistent efficacy of final product.

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