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REVIEW ARTICLE

Collection Practices of Medicinal Plants - Vedic, Ayurvedic and Modern Perspectives

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ABSTRACT

Medicinal plants form the major natural resources base of the Indian indigenous health care tradition. Approximately 10% of the organic constituents of plants are reported to be known and remaining 90% are yet to be explored. Due to global popularity of Ayurveda there is constant increase in demand of herbal drugs in last few decades thus exerting huge pressure on natural resources. In the medicinal plants, the secondary metabolites or active principle are made available through properly executed harvesting techniques. The scientificity behind ancient Ayurvedic harvesting techniques narrated by *Acharya Charaka*, Sushruta etc. are also proven by modern scientific methods. To attain a good requisite therapeutic result it is mandatory to collect the drug bestowed with optimum *Rasaveeryadi* qualities. In *Ayurvedic* literature, drug collection has been mentioned according to different parts of the plant in respective seasons, *Nakshatras*, *Veeryas* on the basis of therapeutic uses. According to Modern science, drugs possess highest potentiality during its collection period. The climate, temperature, rain fall, duration of day light, altitude, methods of cultivation, effect of lunar cycle, collection from wild area, soil condition and methods of collection, processing and storage have impact on the secondary metabolites of the plant ultimately which affect the therapeutic efficiency of the drug.

Key words: Ayurveda, collection practices, lunar cycle, chemical constituents.

INTRODUCTION

Use of medicinal plants is as old as human civilization. India is bestowed with rich plant diversity. The growing pressure of population and vast expansion of urban area lead to development of roads to remote areas which have become a major cause for rapid deforestation and loss of natural plant resource. According to World Bank 2014, trade in medicinal plant is estimated to be worth $60 billion per year and increasing at the rate of 7% per annum. About 20,000tons of medicinal and aromatic plants worth US$18-20 million are traded every year in Nepal alone about which 90% are harvested in uncontrolled fashion. According to the analysis done by National Medicinal Plants Board it is clear that roots/rhizomes and the whole plant based raw drugs make for more than half of the total raw drugs in trade. This analysis also brings up the issue of 'destructive harvesting' (harvesting of whole plants, roots, wood and bark) involved in respect of botanicals in trade. More than 90% of the species used in trade continue to be sourced from wild of which about 2/3rd are harvested by destructive means leading to rapid decline in the availability of many of the medicinal plant species [1]. Thus with ongoing degradation of ecosystem through ruthless exploitation of natural resources and erratic collection practices, one should plan collect the drug with highest pharmacotherapeutic activity so that the dosage required for prescription will be reduced, thereby reducing the number of plants to be chopped off for medicinal purpose specially medicinal plants whose roots are used.

Acharya Charaka emphatically describes an excellent design of drug research and given much importance for season of collection along with place and method of collection.He describes the technical excellence in the field of pharmacognostical, pharmaceutical and pharmatherapeutical sciences as"*Tasyapium pariksha idamevam Prakruti*"etc. Here "*evam rutu*" the season for collection of drug plays an important role in the field of drug research [2]. In *Ayurvedic* classics, drug collection has been described in four major steps i.e. *Bhumi pariksha*

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(Selection of land),*Sangrahaniya dravyas*(Selection of drug), *Sangrahaniya Vidhi*(Method of cultivating) and *Sangrahaniya Kala*(Time for collection).To procure best qualities of drug the proper place of collection ,part, method and time for collection are more important. While collecting the factors such as *Guna, Desha, Kala, Pakva-apakva avastha, nav-purana avastha, Prayojyanga, karma* and *Disha* should be given importance.

MATERIALS AND METHODS

Ayurvedic classics, compendia, lexicons, literature on modern methods of harvesting practices and papers documented research data about these techniques are considered while compiling the information.

OBSERVATION AND RESULTS

Collection *Vedic* and Ayurvedic view:

The art of collection had its origin in the prehistoric period, the written evidences starts from *Vedic* period suggesting its prime importance. Abundance, applicability, utility in multifarious modes and richness of quality these four are said to be the retard of desiderata in drugs [2]. In order to obtain a drug in its most active state, the particular part to be collected from the proper place at proper time with suitable methods. The proper collection aims to procure a genuine drug with highest potentiality & purity which will improve the quality of the medicaments derived from them.

The abnormalities in the season produced by abnormal conditions of stars, planets, moon, sun, air, fire, direction causes improper manifestation of *Rasa, Veerya, Vipaka, Prabhava* in *Aushadhi* .Hence, it should be collected before the manifestation of abnormality[2].

The unaffected drug collected properly in "*Avyapanna rutu*" exalates the *Prana, Ayu, Bala, Veerya* and *Ojas* when it is administered [2]. It is the *Kala*, responsible for *Rasavyapat* and *Sampat*[3].Many of the *Aacharyas* and lexicon written advised to take the medicaments in their fresh condition. Irrespective of the fact whether they are new or old the drugs which do not bear bad odour and whose tastes etc. have not undergone deterioration should be considered worth collecting [3]. Due to seasonal variation , alteration is brought in the properties of fruits etc. which in turn produces sour, sweet etc. tastes and other ripening qualities like maturity, growth etc [4].

In *Atharvaveda*, it has been mentioned that plant used as food and medicine should be collected in their fully grown stage [5]. It has also mentioned that in *Sharad rutu* majority of the plants possess highest therapeutic potency and it is the season during which most of the medicinal plants attain maturity [5]. According to botanical research, temperature can dramatically change membrane fluidity, nucleic acid and protein structures, as well as metabolite and osmolyte concentrations. At a molecular level, this is illustrated by the thousands of transcriptional changes observed in seedlings, leaves, roots, and pollen as plants reprogramme cellular processes to adapt temperature variations. Thus heat alters the multiple aspects of cellular physiology [6]. The *Jala*, *Megha*, *Surya*,*Aagni*, *Vayu* and *Pruthvi* directly affect the production, growth and development of plants [5]. Ayurveda attributes *Mahabhautik* configuration and composition of a drug to its pharmacological properties. The plant under cultivation and plant growing in wild gets different light hours (*Agni*),soil condition(*Prithvi*), climatic condition(*Vayu*) and water supply(*Jala*) which may foster a change in *Mahabhautik* composition and consequently alteration in medicinal properties and values. From the research experiment it has been proved that wild variety of *Ashwagandha* possess qualitative phytochemical superiority than cultivated species though the yield of both is same [7]. As per modern research, the chemical processes that occur in plant metabolism and some of the physical processes are regulated by temperature. Each species has its own optimum temperature requirement in which it grows optimally. In additions, some of the other environmental factors like humidity, duration of light, soil, soil structure, water, air, flora and fauna can also affect plant growth directly or indirectly. Thus, collection should be by considering all these factors. *Bhumi* of different types according to the nature of soil are described and advised to collect the plants which are growing on hills for their supremacy in quality [8]. *Sushruta* has explained importance of *Bhumipariksha* in context of collection of plants products. The effect of ecological conditions on properties of plants were decipherable from the opinion of *Charaka* which states that plant of *Himalayas* are qualitatively better than those of *Vindhyas.* The concept of *Vanya* & *Gramya* varieties of some medicinal plants like *Masha* mentioned in *Nighantus* possess different medicinal properties and it reveals a clandestine

notion of effect of ecosphere on plants. Thus, with changing trend it can be rationally postulated that cultivated field is an extended type of *Bhumidesha* that should be taken into consideration while ascertaining drug qualities.

There is vivid description about collecting the *Aahara (food)* and *Aushadhi Dravyas* (drugs) which are fully grown are to be collected [8]. There is also description that the "*Saratkalina megha*" produces highest curative potency in the *Aushadhi* [8]. *Varsha rutu* is mentioned as the growing season of all plants [8]. The collection period for *Virudha* (pulses) mentioned as *Varsha rutu*[8]. *Sayana Madhav* pointed that the *Aushadhi*es are maturing in *Vasant rutu*, dries and looses in the water content in *Grishma rutu*, where as *Paka* (full maturity) takes place in *Sharad rutu* [8]. In *Shathapatha brahmana* the *vasant rutu* is mentioned as the time for maturation of plants [8]. The *Aranya aushadhi*es (drugs growing in wild) are considered the best [8] and the fresh root or rhizome should be collected after drying of the stem portion [8].
From the research experiment it has been proved that the total alkaloidal contents of *Guduchi satva* was found slightly higher in *Varsha* and *Vasanta* while the minimum yield was obtained in Grishma ritu [9].

Charaka quotes the importance of *Rutu* in germination and growth of medicinal plants [2]. Proper season has been qualified as the season during which the plant intended for collection should have *Rasa* in abundance (at level of one *Rasa*), *Veerya*, and *Gandha*. *Charaka* has discussed the effect of stars, planets, moon, sun, and air, fire on manifestation of *Rasa*, *Veerya*, *Vipaka* and *Prabhava* of drugs [2]. He highlighted the role of '*Kala*' in the formation of drug properties and mentioned specific seasons for the collection of different parts [2]. He also describes the direct effect of seasonal disturbances on the *Aharadravya Sangraha.*He categorically pointed out that the drugs growing seasonally are only to be collected [2]. *Acharya Chakrapani* further cleared that, root of medicinal plant with *Ushna Veerya* should be collected in *Greeshma Rutu* and *Sheeta Veerya* drugs should be collected in *Shishir rutu*.

Sushruta and *Vagbhata* opines that in view of the *Agnisomiya* nature of world, he suggested *Ushna* and *Sheeta Veerya* drugs should collected in *Agneya rutu* and *Saumya rutu* respectively [3]. *Ashtanghrudya*, quoted about the collection of drugs in their fully matured condition on *Pushya*, *Mrugshira* and *Ashwini Nakshatra* and on auspicious time in a day [10]. *Sharngdhara* quotes the *Sharad* as the best period to collect the drug for all therapeutics uses and also drugs intended for *Shodhana karma* .In case of *Vamana* and *Virechana* drugs can be preferably collected at the end of *Vasant rutu* [11]. *Bhavprakash* and *Nighanturatnakara* quoed the same opinion and specified the collection on auspicious day that to in the early morning [12].

It is the *Raj nighantu*, the lexicon which mentioned the specific *rutu*s for the collection of different parts of the plant [13].The herbs growing in the muddy ponds and lakes should be collected during *Sharad rutu* may be due to natural cleansing of water [13].

Table 1: *Dravyasamgrahan kala*(collection period) according to part of plant used [14]

Prayojyanga (Useful part)	*Charak* [a]	*Sushruta* [b]	*Ashtang sangraha* [c]	*Raj* [d] *Nighantu*	*Bruhat nighantu ratnakara* [e]
Kanda (tuber)	*Sharad*	--	*Sharad*	*Hima*	*Sharad*
Ksheera (latex)	*Sharad*	--	*Sharad*	--	*Sharad*
Moola (root)	*Greeshama Shishira*	*Pravrutta*	*Greeshma*	*Shishira*	*Grishma Shishira*
Patra (leaves)	*Varsha, Vasant*	--	*Varsha,Vasant*	*Nidagha*	*Varsha, Vasant*
Phala (fruit)	*Yatha rutu*	*Greeshma*	*Yatha rutu*	--	*Yatha rutu*
Pushpa (flower)	*Yatha rutu*		*Yatha rutu*	*Vasanta*	*Yatha rutu*
Shakha(branches)	*Varsha,Vasant*	--	*Varsha,Vasant*	--	--
Sara(heartwood)	*Hemant*	*Vasant*	*Hemant*	--	*Hemant*
Twak (bark)	*Sharad*	*Sharad*	*Sharad*	--	--

Sangrahakala of various parts in different seasons shows a systemic scientific reason of transportation of secondary metabolites from one part to another to live fit in ecological condition. The *Dravyasangrahakala* as per all *Acharyas* mentioned has similarity except *Sushruta* suggested *phala* collection in *Greeshma* and *Raj Nighantukara* mentioned *Pushpa* collection in *Vasanta* while others have suggested it as *Yatharutu* (fruit and flowering season). The *Sara* collection is mentioned in *Vasant Rutu* by *Sushruta* where others have mentioned it in *Hemant*. The *Moola* during hot season, *Kanda* in *Sharad* (after rainy) season shows the storage of nutrients and chemical constituents in those parts, indicating the self protecting phenomenon of plants also. Collection of drugs in modern texts also suggests the same to

procure the drug with its highest potentiality.

Table 2: Collection of vegetation based on soil biogeographical perspective

S. No	*Mahabhuta* (Elemental composition)	Soil nature	Colour	Vegetation
1	*Prithvi*	Pebbly	Dark blue or black	Rich vegetation
2	*Jala*	Unctous, cool	White	Grass
3	*Agni*	Stony	Multicolour	Small sized tree
4	*Vayu*	Rough	Grey	Small trees
5	*Akash*	Soft	No colour	Trees of no value

According to type of soil the specified vegetation can be procured to get maximum benefits.

Table 3: Collection practices according to therapeutic uses

S. No	Therapeutic uses	Season of collection	Type of soil	*Mahabhuta* dominance
1	*Virechan* (Therapeutic induction of purgation)	Spring	Dry white,Hilly areas	*Agni &Akash*
2	*Vaman*(Therapeutic induction of emesis)	Spring	Black soil enriched with big trees herbs and grasses and marshy watery soil with small trees.	*Parthiv and jala*
3	*Nasya* (Nasal administration of drugs)			
4	*Basti*(Rectal administration of drugs)			
5	Other pallitative therapies	Winter	Black soil, Hilly areas	*Akash*

Specific useful parts collection methods in *Ayurvedic* literature:

1) *Charaka* advocates to collect mature fruits of *Madanaphala* (Randia dumetorum),commonly known as emetic nut in between *Vasanta (*spring) and *Greeshma*(summer)season on *Pushya,Ashwini* or *Mrigashira Nakshatra*.

2) The tender leaves of *Ikshwaku(Lagenaria cicerea)*(*Katukalabu*)should be collected before flowers appear on the climber.

3) *Trivrutta (Operculina turpethum)*should be collected for purgative therapy during the lunar cycle of full moon phase.

4) Latex of *Snuhi*(Euphorbia species)should be collected at the end of *Shishira Rutu*(winter season)from the plant which is two or three years old.

Collection practices of some important medicinal plants:

Recent researches confirmed that the active principle content varies depending upon the period of collection. **Ashwa*gandha*{***Withania somnifera*** (Linn.)Dunal}: harvesting starts from January and continues till March .The maturity of crops is judged by the drying out of the leaves and berries turning red.

Kumari*{Aloe vera*(Linn.)}:A Burm.f. *Aloe vera* plant takes about 3 years to attain harvestble size and then leaves can be harvested for 7 years. Leaves less than 25cm size are not suitable for collection due to less gel content.

***Kebuka*(**Costus species): The plant should be collected when it is about 16-17 months old as Diosgenin content is maximum.

Dhattura(*Datura metel)*: The plant attain highest percentage of alkaloids after 5 months of sowing. It is recommended to collect the leaves in early morning or late afternoon .In certain studies in India it was found that mature leaves of about the middle of the stem of *D. metel* had the maximum alkaloid content.

Vidanga(*Embelia ribes*.): Research studies showed that the immature fruits collected in October contain an average of 1.67% embelin whereas mature fruits collected in December has average contain 4.64% embelin.

Pippali* (Piper longum* Linn.):The spikes will be ready for collection 2 months after their formation on plants. The spikes should be picked when they are blackish-green and most pungent. The thick parts of stem and roots which have medicinal value should be harvested 18 months after planting.

Nimba*(Azadirachta indica* A.Juss).: The trees shed their leaves during Feb-March and fully grown trees produces 350kg of leaves. The fruit matures in June-July.

Ahiphena*(Papaver somniferum* Linn.): The lancing operation is performed by skilled labour, usually on bright sunny days between noon and 4pm.

Sarpagandha*(Rauvolfia serpentina* Linn.) Benth.ex Kurz: It is reported that roots dug out in winter (December), when plants shed out their leaves are rich in total alkaloid content.

Tulsi*(Ocimum sanctum* Linn.):The oil and eugenol content is maximum at flower initiation and seed setting stage.

Modern concepts of drug collection:

In recent Pharmacognosy texts books, one can find a considerable importance given for the season during collection of different parts of economical plants as it governs not only the total quantity of active constituents produced but also the relative proportions of the components of the active mixture.

Table 4: Seasons for the collection of specific parts according to modern botany

S. No	Plant part	Season/ Time of collection	
		Textbook pharmacognosy	
		Dr.C.S.Shah [16a]	T.C.Dunston[16b]
1	Leaf and flowering top	When they reached flowering (maturity).	During the flowering time of the plant, in the morning time and dry weather.
2	Flower	a)Just before pollination. B)Before their full expansion c) Dry weather d)Morning hour	During its season, petals just expanded middle of the day and in dry weather.
3	Bark	a)Spring b)Early summer when cambium is active	Autumn-After leaf fall / Spring-Before the development of leaves.
4	Fruit	As per season, ripe fruit	Fully grown and ripe or nearly ripe.
5	Root	In Spring, before vegetative process stops	a) From annuals :- Shortly before flowering b) From biennials:- Autum/Winter following the first year growth. c) From perennials:- Autum/Winter following the second year growth.
6	Unorganized part(resin, gum, latex)	As they ooze out of the plant.	In dry weather.
7	Rhizome	When their tissue are fully stored with reserve	a) From annuals :- Shortly before flowering b) From biennials:- Autum/Winter following the first year growth. c) From perennials:- Autum/Winter following the second year growth.
8	Herb	--	When the plant attains its flowering stage.

Physiological and phytochemical basis of collection [16a]**:**

Leaves are collected from the plants during the flowering period, as plant is very active at this time. The sap movement and photosynthetic activity are maximum and leaves contain maximum percentage of active constituents. As the moisture decreases their constituents, they are collected in dry weather.

Bark is collected in spring or early summer as the cambium is very active and due to thin cell wall bark gets easily separated. In some other cases bark is collected in other season. Wild cherry bark is collected in autumn as it contains maximum percentage of active constituents at this season while Chincona bark is collected in rainy as it gets easily separated.

The usual time for collection of leaves is when flowers are beginning to expand. At this time it is rational to assume that the leaves are in the healthiest state and contain optimum of the product of plant metabolism to produce desirable therapeutic action. Collection of flower must always be done in dry weather because the petals which are damp when gathered become badly discolored during drying.

Roots and rhizome are usually collected when their tissue are fully stored with reserve food being assumed that the phytoconstituents will be high during this season .In temperate region autumn is therefore the season of collection. The bark should be collected in spring or early summer when sap is rising in the stem and the cambium is active therefore more easily torn than at other season.

The phenomenon of seasonal variation is relatively well known for many crops, especially those whose value is derived from essential oils. Many species have shown a rhythmic increase in oil production throughout the growing season and then a steady decline towards the winter. One study on blueberries (*Vaccinium angustifolium*, Ericaceae), harvested biweekly in Canada, reported significant seasonal variation in the phenolics and anti-glycation effects. The authors recommended late summer as the optimal collection time with maximum bioactivity. It has been proved from the study that the leaves of *Parijataka* should be collected in *Varsha Rutu*. The leaves show that loss on drying is minimum when they are fully grown. This indicates that new leaves have more tendencies to absorb more moisture helping in proper storage of the drug. When majority of leaves dries up and new leaves are coming. The iron content if leaves were found to be highest during varsha ritu. The potassium content was lowest in the peak flowering season and highest when new leaves started growing [5].

A study of kudzu (*Pueraria lobata*, Fabaceae) root, a traditional Chinese medicine, revealed seasonal variation in overall isoflavonoid content, as well as variation among different compounds. This is an exceedingly valuable finding if roots are being grown for individual compounds or if manufactured products are harvested at different times and standardized to a specific compound that varies from month to month, week to week, or even day to day.

Apart from seasonal variations, daily changes have also been reported. Studies on *Virola*

surinamensis (Myristicaceae), an endangered tree from South America that is valued for medicinal and economic purposes, showed daily circadian fluctuations in the constituents of essential oils distilled from leaves. Specifically, levels of monoterpenes dropped by 50% from 6 a.m. to noon, and then increased to their original levels by 9 p.m. Additionally, levels of the sesquiterpene caryophyllene in *Virola* doubled in samples taken in October versus those harvested in June.

Daily fluctuations were also seen in the essential oil of wild basil herb, or *Ocimum gratissimum* (Lamiaceae), where levels of eugenol in the essential oil were observed to drop from 98% at 12 a.m. to 11% at 5 p.m. Circadian rhythms are also known to control stomatal opening, gene expression, transcription, timing of photoperiodism, and to drive growth and development, although the control mechanisms remain unknown.Studies have found that disruption of normal circadian function in *Arabidopsis thaliana* (Brassicaceae) has lead to reduced leaf chlorophyll levels, reduced growth, and increased mortality [17].

Lunar plantation-an upcoming concept:

Isaac Newton established the laws of gravity, which proves the tides are affected by the gravitational pull of the moon. The pull of the moon is stronger than the sun because, even though the sun is larger, the moon is closer to the earth. The strongest effect is felt when the moon and sun pull from the opposite sides of the earth, at the full moon phase, although it also creates high tides when they are on the same side (at the new moon) as well. These same forces affect the water content of the soil, creating more moisture in the soil at the time of the new and full moon days. This increased moisture encourages the seeds to sprout and grow.

From the laboratory experiments, it is known that light intensities as low as 0.1lux (approx 0.01 foot candle) during the night can influence the photoperiodic time measurement in some plants and animals. Yet the intensities of light from a full moon on a cloudless night may reach 0.3times this value in tropical regions. This fact lead E. Bunning and his colleagues to inquire whether moonlight can disturb time measurement and surprisingly their investigations revealed that some plants have adaptive mechanisms that apparently prevent moonlight from interfering with photoperiodism. Some of the night plants (short day plants) flower most potentially when grown with low intensity light (approximately 0.5lux) rather than complete darkness during the night. In these plants, moonlight probably increases the number of flowers produced by short day regime.

Previously Roman farmer used to pick fruit at full moon as it would weigh more and pick at new moon for personal consumption, as the fruit would store better. Traditionally in Europe ,the collection of soft wood during waxing and hard wood during wanning for the wood usage and cottage industries for preparing wooden instruments. Whenever plant material are required to be strong and resistant to the enviournment, they are harvested during a wanning moon and medicines are harvested following new moon during waxing period.

In the middle of pacific ocean, ancient hawalians belived that tubers of Sweet potato (Ipomea batatas,Convolvulaceae) and taro(Colacasia esculenta,Araceae) should be collected during third,fourth days following full moon.

The macroscopic observation of these physiological processes suggests that the moon controls the sap flow in plants and at nighttimes draws the healing attributes of the plant into the roots.

Percentage oil of *Acorus calamus* Linn. within the rhizome vary with intensity of lunar phases. The total constituents, osmotic pressure in Sap (root) and plant growth have relatively high during full moon phase when compared to new moon phases. Growth of plants recorded in 10 replicates with one control was set in during experimentation. The maximum growth was seen during the month of October and chemical constituents were found to be high in percentage during this month. Garlic, cloves were found to contain maximum percentage of oil during full moon day(Karnick,1976)}.*Adhatoda vasica* was found to contain maximum quantity of chemical constituents and for developing maximum osmotic pressure in sap root in day preceding ,during and immediately after full moon day. Thus the moon rays have a profound effect on the cell sap within the plants which in turn affect the transpiration, root-pressure and presence of active principles [18].

The clinical trials conducted by Dr Shridhar Bairy to observe the effect of *Parijata* leaves on *Gridhrasi* showed the incidence of recurrence of disease wanes if drug are properly administered & action of the compound was maximum when plant is fully grown with larger leaves [5].

CONCLUSION

The description of collection practices are well documented in *Vedic*, *Ayurvedic* literature and its utility is validated by modern chemical tools for obtaining maximum quantity of active principles. Therapeutic efficiency is presumed to depend on the quality and quantity of the secondary metabolites which in turn are influenced by the method of collection. The data analyzed in this communication highlight the importance of application of collection practices to achieve desired therapeutic effect as herbs without good potency become useless weapon of physician as well as pharmaceuticals industries.

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