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A REVIEW ON EFFECT OF SEASONAL VARIATION ON PHYTOCHEMICALS OF MEDICINAL PLANTS

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ABSTRACT

Herbs are used as a source of medicine in Ayurveda and also in some traditional systems of medicine as having lesser side effects and cost when compared with the synthetic drugs. Plants live on a planet with days and seasons, and that affects their phytoconstituents. Availability of active principles in medicinal plants change by seasonal fluctuations, so their dose pattern for therapeutic efficacy also gets influenced. The best duration for the harvesting of specific secondary metabolites for better yield is not fixed. Seasonal impact show changes in important constituents like polyphenol, flavonoids, glycosides, alkaloids and essential oil. Late summer is the best collection time for essential oil component. Winter is a best season for harvesting of secondary metabolites containing plant parts. The results of these studies may help to the researcher those are involved in exploring the isolation of valuable chemicals from the plants for treatment of various diseases. Therefore, current review aims to focus on best possible season for the harvesting of pharmaceutically important plant materials.

KEYWORDS

Secondary metabolites, Herbal medicines, Season and Constituents.

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INTRODUCTION

The plants have adapted themselves to live with the cycles that change accordingly. The earth is covered in plants. There were plants before there were ever humans, and before there were other animals. The plants on Earth evolved on Earth. And while those plants were evolving they were experiencing a 24 hour day, with dark and light. They were also experiencing seasons that varied across the 365 day year. Plants might not be able to create gadgets, but the very way their internal chemistry works is affected by the daily and seasonal cycles of the earth. Plants create energy from sunlight, water and carbon dioxide gas in a process called photosynthesis. So the times of day when there is plenty of light has an effect on that photosynthesis. Plants release different chemicals depending on the time of day. When summer is approaching, the plant prepares itself to absorb the light and create energy. Photosynthesis also requires carbon dioxide gas from the atmosphere. But at night, since it has no light and cannot photosynthesize, there's little point absorbing carbon dioxide gas either. Because of this, many plants close their leaf pores, called stomata, to reduce water loss during the night[1].

Some plants will close their flowers during the night for similar reasons, and plants use the length of day as a way of figuring out what time of year it is. When winter is approaching, they can tell is the days are getting shorter, and they can start to adapt to that. The seasonal cycles of plants are probably more well-known. As the days get shorter, some plants use this as a signal that it's time to change their behaviour. As winter is approaching, plants like trees will shed the leaves. This process is quite beautiful to humans, producing trees full of orange, red, and yellow leaves. Since there isn't a lot of light to absorb the cold winter, some plants have realized that it is more efficient to keep as much of the moisture as they can inside and wait until there is more sunlight again. So they pull the moisture from the leaves into the trunk, letting them dry out and fall.

Plants need food, water, and sunshine. Plants get their food from the soil. Animals need food and water, and the most of them love sunlight, but there are some that hide away from it. Many of the animals get their food from plants, but some feed upon other animals that they can kill. Most plants and some of the animals sleep a part of each year. The time which they take to sleep depends upon the climate of the place in which they live. The most of the animals sleep a part of each day or night. Plants do not grow as fast at night as they do in the daylight. In cold countries plants sleep in the winter. We know they are going to sleep when their leaves begin to fall. When the cold winter comes they stand so bare that they look as though they were dead. When the trees begin to feel the warmer days of spring the sap starts again from their roots. It goes up the trunk of the tree and into each tiny branch. The waiting buds soon commence to swell. Almost before we know it the trees are again dressed in green[2]. As per the changes in Season yield also get changed, because the response of yield depends on which seasons receive additional water and which seasons receive less water. Increases in spring precipitation led to growth reductions, whereas increases in summer precipitation led to increases in growth[3].

Many plants do not live through the winter. Each spring a new plant grows from the little seed. Very soon we see it blossom. When it is fall and the cooler weather drives away the summer, the seeds are ripe and the first frosts kill the mother plant. In warm countries plants sleep during the dry season. If summer is the dry season, then they grow in the winter. Such a country is green and beautiful in the winter. In summer the ground becomes dry and the whole world seems dead.

Every plant and every animal is suited to the place in which you find it living. Plants which is used to having a great deal of water will not live where there is little water Plants can respond to the change of season by losing their leaves, flowering, or breaking dormancy. By detecting the differences in day length plant constituents show seasonal changes. In autumn shortened length of the day leaves changes color. During the winter certain flowers bloom, like poinsettias. In the spring, leaves start to grow because of the winter buds on the trees break open. Photoperiod means plants determine the time of year by the length of daylight. During winter days, tilt of the earth occurs so there are less hours of light than during summer days. So that, it starts getting dark very early in the evening, and then stays dark the next morning. In the winter. It will be bright early in the morning and the sun will not set until late that night in the summer, Plants are able to sense the differences in day length with the help of light-sensitive chemical present in them.

Photoperiodism is the reaction of plants, to the length of day and night or light and dark periods of the season. Plants sense there is less sunlight when the days start to get shorter in the fall. So that Im this season plant gets stimulated, and it transmits messages to the leaves to change colors and fall. Herbs sense the length of night, a dark period, as a signal to flower. Each plant has a different photoperiod, or night length. Plant gets flowers when it senses the appropriate length of darkness, occurs because of appropriate length of daylight. Long-day or short-day plants are two classes of flowering plants. As the length of daylight exceeds the necessary photoperiod long-day plants get flower eg. Carnations, clover, lettuce, wheat, and turnips. As the daylight length is shorter than the necessary photoperiod short-day plants get flower eg. Cotton, rice, and sugar cane.

Plant species influence ecosystem processes. Slope position affects soil PO4- and microbial P. Plant litter chemistry helps to gain a mechanistic, study of plant species effects on ecosystems.

OBJECTIVE

Study gives an idea about cultivation and collection pattern of different type of phytoconstituents which are medicinally important. Variation in phytochemicals arises due to specific environmental conditions including biotic and abiotic factors. With increase in altitude, environmental conditions such as UV radiation, temperature, rainfall, moisture etc. changes occur rapidly.

NEED OF WORK

Medicinal plants diversity is important factor for pharmaceutically active substances. Plant growth and secondary metabolites affected by environmental factors. The medicinal plants show a marked variation in active ingredients during different seasons; as these have been widely attributed to variations in environmental variables such as temperature and rainfall. There are several assumptions regarding the time and season for the collection of various parts of the medicinal plants like spring is suitable for the collection of bark, winter for essential oils etc. The locations falling between 1742 and 2260 m altitude representing temperature climatic condition are likely to be associated with higher contents of photochemicals.

Reasons of high yield

- In winter carbon assimilation and biomass production increasing leads to high yield.
- During winter, most of the herbs complete their life cycle and start drying up. As are the end products of metabolic reactions in drying shoots. They are naturally higher at this stage. Results in maximum energy during the winter season. Eg. fats and proteins.
- Long photoperiods increased the content of essential oils in the foliage and of phenolic monoterpenes in the oil.
- High humidity, temperature and availability of large amount of water during monsoon period which are favourable conditions for the growth.
- Terpenoid compounds (essential oils) and secondary metabolites secreted by plants during summer drought as protecting agents to physical and chemical stress on plant.
- Phenolic compounds increases with increasing light intensity.
- Adequate sunlight gives high yield.

Reasons of low yield

- During summer, plant phytoconstituents subjected to thermal (atmospheric as well as soil) and moisture stresses ended up producing low biomass yield because of reduction in levels of photosynthesis and damaging effects of solarisation.
- Setting of seeds during autumn that may deteriorate the oil glands leads to low yield.
- Micro-environment (sun or shade) in which the plant is growing is important.
- Plant ontogeny and environmental regulation, seasonal variations affects genetic expression for oil production in plants.
- The environmental conditions of temperature and precipitation, probably affected the volatile oil content.
- High temperature in summer leads to partial evaporation of some constituents of oil.

- Biosynthesis of phenolic compounds can be effectively induced by sunlight.
- Low temperature stress as well as maturity of the plants might indicate some sort of nutritional stress in this season or a complex interaction between soil and environment.
- The lower contents of phenolic compounds in winter could be due to decreased active biosynthesis during cooler weather
- At the beginning of the flowering stage, there is a lack of phytoconcentration, which again increases when the plant begins with the formation of fruit.

LITERATURE REVIEW

Table No.1: Data of Medicinal Plants and Effect of Seasonal Variation on Phytochemicals

S.No	Medicinal plant	Content evaluated	Season optimized
1	*Eugenia uniflora* leaves Myrtaceae	Spathulenol and caryophyllene oxide	Summer[4]
2	*Rosmarinus officinalis* Rosmerry *Lamiaceae*	Rosmarinic and Carnosic acids	Summer[5]
3	*Lycopersicum esculentum* Mill Solanaceae	Flavonoids	Autumn[6]
4	*Melittis melissophyllum* L. (Lamiaceae).	Flavonoid	Autumn[7]
5	*Glycyrriza glabra* Liquorice Leguminosae	liquiritin and glycyrrhizin	Summer[8]
6	*Glycyrriza glabra* Liquorice Leguminosae	Glabridin and glabrene	Winter[8]
7	*Chelidonium majus* L Papaveraceae	Total phenolic content, polyphenols and flavonoid	Winter[9]
8	*Bacopa monneiri* Plantaginaceae	Bacoside-A	Rainy[10]
9	St. John's Wort (*Hypericum perforatum*) Hypericaceae	Hypericin and pseudohypericin	Summer[11]
10	*Mentha longifolia* Labiatae	Alkaloid, flavonoid and phenolic contents.	Winter[12]
11	*Adhatoda vasica* Vasaka Acanthaceae	Flavonoids	Winter[13]
12	*Camellia sinensis* Theaceae	Total phenolics	Rainy[14]
13	*E. camaldulensis and E. cinerea* Myrtaceae	Camellin	Summer[14]
14	*Origanum cyrenaicum* (Labiatae)	Monoterpenes hydrocarbon oxygenated sesquiterpene hydrocarbon	Spring [15]
15	*Apis mellifera* (Apidae)	Phenolic	Winter [15]
16	*Catharanthus roseus* (Apocynaceae)	Flavonoids	Winter [16]
17	*Convolvulus microphyllus* (Convolvulaceae)	Chlorophyll, proline, alkaloids and phenols	Winter[17]

18	*Datura metel* (Solanaceae)	Isofraxidin, Scopatone	Rainy[17]
19	*Withania somnifera* (Solanaceae)	Withanin	Rainy[17]
20	*Ipomoea pes Caprae* (Convolvulaceae)	Total phenolic content flavonoids	Summer[18]
21	*Mellitus melissophyllum* (Lamiaceae)	Flavonoid	Spring [19]
22	*Parkia biglobosa* (Mimisaceae)	Flavonoids	Spring[20]
23	*Phyllanthus amarus* (Lamiaceae)	Total alkaloids, flavonoids	Summer [21]
24	*Prunus amygdalus* (Rosaceae)	Total phenolic content	Summer [22]
25	*Pseudobombax marginatum* (Bombacaceae)	Total polyphenols	Winter[22]
26	*Guapira graciliflora* (Nyctaginaceae)	Total polyphenols, flavonoids	Summer [22]
27	*Aegle marmelos* Rutaceae	Flavonoids	Winter[22]
28	*Syzygium cummini* Myrtaceae	Tannins, Gallitanins	Rainy[23]
29	*Alstonia scholaris* Apocynaceae	Essential oil	Winter[23]
30	*Thymus vulgaris* L. Thymol Lamiaceae	Essential oil, P-cymene	Summer[24]
31	*Origanum syriacum* Lamiaceae	Essential oil,	Spring[24]
32	*Mentha canadensis* Lamiaceae	Menthol	Winter[24]
33	*Melissa officinalis* Lamiaceae	Essential oil	Summer[25]
34	*Thymus serpyllum* L Lamiaceae	Essential oil	Summer[26]
35	*Pelargonium graveolens* Geraniaceae	Essential oil	Winter[27]
36	*Ocimum basilicum* basil Lamiaceae	Essential oil	Winter[28]
37	*Eucalyptus globulus* Myrtaceae	Volatile oil	Summer[28]
38	*Achillea filipendulina* (Asteraceae)	Volatile oil	Summer [29]
39	*Artemisia annua* (Asteraceae)	Volatile oil	Autumn[30]
40	*Cistus monspeliensi* (Cistaceae)	Essential oil	Spring[31]
41	*Clinopodium pulegium* (Lamiaceae)	Essential oil	Summer [32]
42	*Mentha longifolia* (Lamiaceae)	Volatile oil	Summer[33]
43	*Micromeria fruticosa* (Lamiaceae)	Limonene, menthone, menthol	Summer[34]
44	*Ocimum gratissimum* (Lamiaceae)	Volatile oil	Spring [34]
45	*Pelargonium graveolens* (Geraniaceae)	Volatile oil	Summer [35]
46	*Pistacia atlantica* (Anacardiaceae)	Volatile oil	Spring[36]
47	*Plectranthus amboinicus* (Lamiaceae)	Essential oil	Spring[37]
48	*Santolina chamecyparissus* (Asteraceae)	Limonene, pinene, caryophylline oxide	Summer[38]
49	*Sclerocerya birrea* (Anacardiaceae)	Volatile oil	August[39]
50	*Thymbra spicata* (Labiatae)	Volatile oil	Summer[40]
51	*Thymus vulgaris* (Lamiaceae)	Volatile oil	Winter[41]
52	*Valeriana jatamansi* (Caprifoliaceae)	Volatile oil	Autumn[42]
53	*Ocimum sanctum* (Lamiaceae)	Volatile oil	Rainy[43]
54	*Azadirachta indica* (Meliaceae)	Essential oil	Summer[44]
55	*Lauris nobilis* (Lauraceae)	Essential oil	Summer[44]
56	*Micromeria fruticosa* Lamiaceae.	Essential oil	Summer[44]
57	*Laurus nobilis L.* Lauraceae	Essential Oil	Summer[45]

Table No.2: Data of Medicinal Plants and Effect of Seasonal Variation on Pharmacological activity

S.No	Name of plant	Activity determined	Season Optimised
1	*Glycyrrhiza glabra* liquorice extracts Fabaceae	Antioxidant and gastroprotective	Summer and Winter[8]
2	*Momordica charantia* fruits. Cucurbitaceae,	Antidiabetic activity	Spring[46] season
3	*Bellis perennis* flowers Asteraceae	Antioxidant activity	Spring to autumn[47]
4	*Ocimum basilicum* Lamiaceae	Antioxidant activity	Winter[48]
5	*Nothapodytes nimmoniana* Bark Icacinaceae	Antioxidant potential	Winter[49]
6	*Ginkgo biloba* Ginkgoaceae	Antioxidant activity	Autumn[50]
7	*Alstonia scholaris* (Apocynaceae)	Anti diabetic Antineoplastic	Summer[51]
8	*Azadirachta indica* Meliaceae	Anti diabetic	winter[51]
9	*Aegle marmelos* Rutaceae	Anti diabetic	Autumn[51]
10	*Adhatoda vasica* Acanthaceae	Anti diabetic	Summer[51]
11	*Athrixia phylicoides* (Asteraceae)	Anti diabetic Antioxidant	Winter and Summer[51]
12	*Baccharis dentate* (Asteraceae)	Antioxidant	Summer and Winter[52]
13	*Combretum roxburghii* (Combretaceae)	Antioxidant	Winter and spring[53]
14	*Melilotus indicus* (Fabaceae)	Antioxidant activity	Autumn[53]
15	*Myrtus communis* (Myrtaceae)	Antioxidant	Rainy[54]
16	*Pistacia lentiscus* L (Anacardiaceae)	Antioxidant	Rainy[54]
17	*Porcelia macrocarpa* (Annonaceae)	Antimicrobial	Winter[55]
18	*Rhoicissus tridentate* (Vitaceae)	Uterotonic	Summer and Autumn[56]
19	*Rosmarinus officinalis* (Lamiaceae)	Antioxidant activity	Winter[57]
20	*Salvia sclarea* (Lamiaceae)	Antioxidant	Summer[57]
21	*Syzygium cummini* Myrtaceae	Anti diabetic	Rainy[58]
22	*Tulbaghia violacea* (Alliaceae)	Antibacterial	Winter and Autumn[58]
23	*Hypoxis hemerocallidea (Hypoxidaceae)*	Antibacterial	Winter and Autumn[58]
24	*Drimia robusta (Hycinthaceae)*	Antibacterial	Winter and Autumn[58]
25	*Merwilla plumbea (Hyacinthaceae)*	Antibacterial	Winter and Autumn[58]
26	*Zizyphus spina* christi (Rhamnaceae)	Antihyperglycaemic	Summer[58]

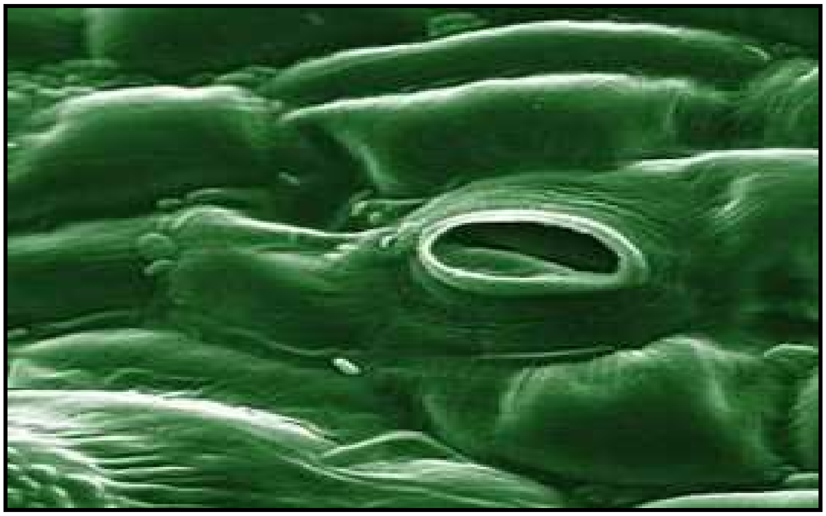

Figure No.1: Stomata are openings on the bottom of leaves that let in carbon dioxide and close during the night

Figure No.2: Morning glory flowers close at night

Figure No.3: In winter, many trees lose their leaves to conserve water

Figure No.4: Seasonal Changes

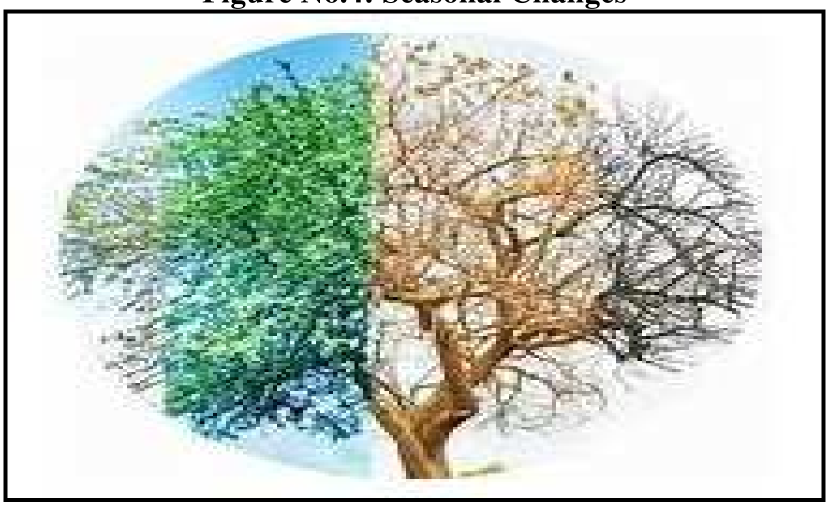

Figure No.5: Seasonal variation in plants

CONCLUSION

From the study it is concluded that as the seasonal variation is associated with the vegetative and reproductive stages of the plant, it has direct influence with the variation in chemical constituents of the plants. In the plant, the concentration of active principles is high in full bloom period, it is the best period for collection for high percentage and this is contradictory to the statement given in classical texts, according to which the roots should be collected only after the completion of seed shedding. This might be mentioned by the Acharyas in the conservation point of view. So while collecting the plants it is better to keep some plants undisturbed for the seed shedding for the sustainable use of that particular plant. All the plants are perennial in nature and that may be the reason for this type of variation.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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