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A REVIEW ON THE EFFECT OF GEO-CLIMATIC CONDITIONS ON PHYTOCONSTITUENTS OF THE MEDICINAL PLANTS MENTIONED IN SAMHITAS

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ABSTRACT

Ayurveda emphasizes the profound relationship between plants, geography, and therapeutic efficacy. Classical *Ayurvedic Samhitas* such as *Charaka*, *Sushruta*, and *Ashtanga Hridaya* provide detailed descriptions of medicinal plants, their habitats, and ideal regions for collection, highlighting the importance of ecological factors in drug quality. Plants are categorized based on *desha* (terrain) into *Anoopa* (marshy and water-abundant), *Jangala* (arid and dry), and *Sadharana* (moderate) regions. Each terrain possesses distinct soil composition, moisture, temperature, and climatic conditions that significantly influence plant growth and potency. Variations in geographical climate and environmental stressors directly affect phytochemical profiles, leading to qualitative and quantitative differences in active constituents of herbs and trees. *Anoopa desha* plants often show enhanced unctuous and cooling properties, while *Jangala* desha plants exhibit increased concentration and potency. Understanding these ecological and phytochemical variations is crucial for authentic drug selection, standardization, and effective clinical application in *Ayurvedic* research and practice.

KEYWORDS: *Desha*, Soil, Plants, Climate, Phytoconstituents.

INTRODUCTION

Geography has its roots in ancient times, and India has played a crucial role because of its strategic location. The Indian subcontinent served as an important corridor for cultural exchange between Southeast Asia and Europe, connecting the East and the West. The contributions of ancient Indian geographers are comparable to those of the Chinese, Greeks, and Romans. Texts such as the Vedas and Upanishads, with their focus on nature and humanity, laid the foundation for many indigenous knowledge systems. Ancient India possessed a rich and advanced intellectual tradition that was often more developed than that of the contemporary world. Many ideas and practices that the Western world studies and applies today had earlier origins in ancient Indian scholarship, which reflects a long and prosperous intellectual heritage spanning nearly 2,000 years. After independence, Indian geography made significant progress and sought to revive and reclaim its ancient heritage and scholarly tradition.

Geography plays an important role in shaping climate around the world. Climate is the long-term pattern of weather, including temperature and rainfall. It is affected not only by the Sun but also by Earth's features, such as mountains and oceans. By understanding how land and water interact with the atmosphere, we can better explain why different places experience different climates, showing the strong connection between geography and climate. Geography affects climate in several ways. Mountain ranges can prevent moisture from moving into certain areas, and different latitudes receive different levels of sunlight. As a result, a region's location helps decide whether it develops into a dense rainforest or a vast dessert.

Geologic factors involve the arrangement of mountains, valleys, and ocean basins. These features influence wind movement and rainfall patterns, which in turn affect local climates. Mountains especially play a strong role in determining precipitation. As moist air is pushed upward over a mountain range, it cools and condenses, producing rainfall. This results in rich plant growth on the windward side, while the leeward side often becomes much drier. Geographic and geologic factors shape Earth's major climate zones: tropical, temperate, and polar. Elements such as latitude, elevation, and closeness to oceans or mountains all contribute to how these zones develop.

Tropical Zones: Located near the equator, these regions receive direct sunlight throughout the year, keeping temperatures consistently warm. Frequent rainfall supports rich ecosystems, including rainforests.

Temperate Zones: Situated between the tropical and polar regions, these areas usually experience moderate temperatures and four distinct seasons.

Polar Zones: Found near the North and South Poles, these regions receive sunlight at a low angle, leading to extremely cold conditions. Polar climates have short growing seasons and very little precipitation.[1]

Types of Soil and Their Characteristics in Geography[1,2]

Soil is a vital natural resource that supports plant growth and plays a key role in maintaining Earth's ecosystems. It is the basis of agriculture and forestry and significantly affects water movement, climate regulation, and biological diversity. In geography, soils are classified into different types based on factors such as climate, parent rock, organic content, landforms, and the length of time over which the soil has developed. This discussion focuses on the major soil types and their key features.

Sandy Soil

Coarse-textured with quick drainage, low water and nutrient retention, but good aeration. Suitable for well-drained crops like carrots and potatoes; fertility improves with organic matter.

Clay Soil

Fine-textured, sticky when wet and hard when dry. High water and nutrient retention but poor drainage and aeration. Suitable for rice and sugarcane; structure improves with sand or organic matter.

Silty Soil

Smooth texture with good nutrient retention and moderate drainage. Highly fertile and suitable for crops like wheat, soybeans, and vegetables.

Peaty Soil

Rich in organic matter, dark and spongy, with high water-holding capacity. Often acidic; after drainage and treatment, suitable for gardening and acid-loving plants.

Loamy Soil

Loamy soil is the most productive soil, consisting of a balanced mix of sand, silt, clay, and humus. It has good drainage, rich nutrients, proper aeration, and balanced water retention, making it ideal for most crops and garden plants.

CONCEPT OF DESHA[3,4] In Ayurveda, *Desha* refers to a geographical region with relatively uniform natural and biological features, including climate, soil, and water, as described in Charaka Samhita. It influences drug administration, diet planning, and adaptability (*Satmyata*), and is considered a key factor in disease causation within the tenfold examination (*Dashavidha Pariksha*). *Acharya Charaka* emphasized its link to human health, noting that a person's birthplace and living conditions guide personalized lifestyle and therapeutic interventions. *Desha* is broadly classified into *Jangala* (dry, arid, sandy), Anupa (wet, fertile with abundant water), and *Sadharana* (mixed features of both) regions.

***Jangala Desha* (Dry/Arid Land)**[5]

Jangala Desha is a dry, arid region characterized by rocky and sandy land, scanty rainfall, hot climate, dry winds, and limited water sources. Vegetation is sparse and mainly thorny. Crops such as cotton, groundnut, and *Bajra* are commonly grown.

The land is elevated with few trees and animals like deer and antelopes are common. People living in *Jangala Desha* generally have ***Vata–Pitta* predominant constitution** and are more prone to diseases related to ***Vata, Pitta*, blood and *Maruta***.

Plants Found in *Jangala Desha*[5]

Jangala Desha is characterized by a variety of forest trees and shrubs. Important plants of this region along with their botanical names include:

Badari (*Ziziphus mauritiana* Lam.),

Khadira (*Acacia catechu* L.),

Asana(Pterocarpus marsupium)

Tinisha(Ogeinia dalbergioides)

Vat(Ficus benghalensis)

Kakubha(Terminalia arjuna)

Ashwakarna(Dipterocarpus turbinatus)

Dhava (Anogeissus latifolia)

Tinduka (Diospyros tomentosa Roxb.),

Ashvatha (Ficus religiosa L.),

Amalaki(Phyllanthus emblica L.),

Shami(Prosopis cinera L.),

Shallaki (Boswellia serrata),

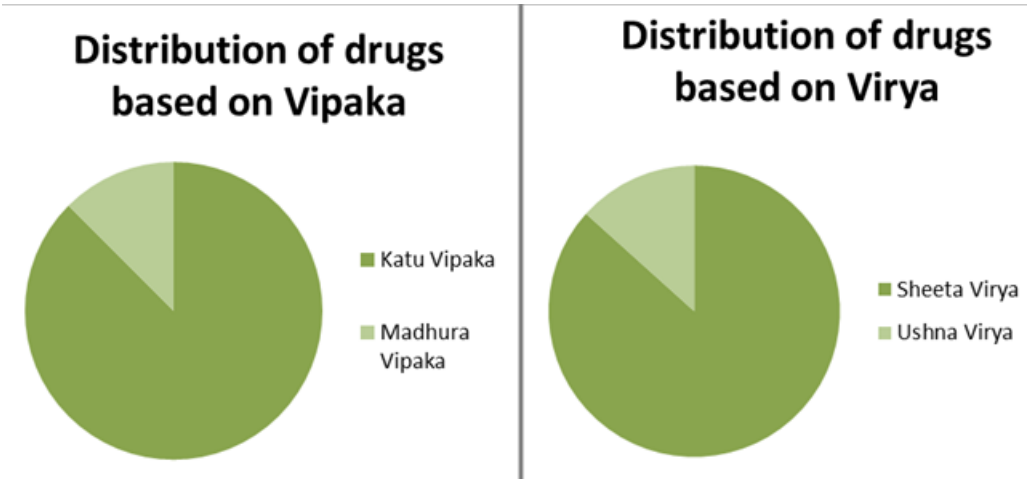
Shimshapa (Dalbergia sissoo Roxb.),

Sal(Shorea robusta)

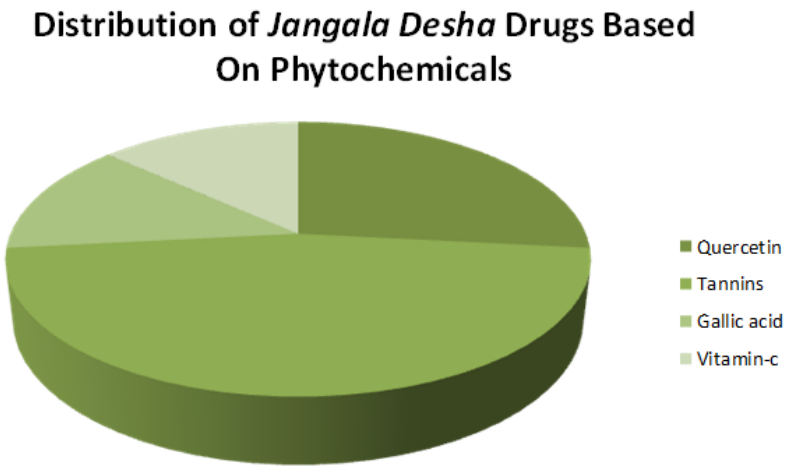
Brief introduction of *Dravyas* found in *Jangala Desha*[8]

DRUG	BOTANICAL NAME	*FAMILY*	*RASA*	*GUNA*	*VIRYA*	*VIPAKA*	*Phyto-chemicals*
Badar	*Ziziphus jujuba*	Rhamnaceae	*Madhur,amla*	*Guru, snigdha*	*Sheeta*	*Madhura*	Vitamin-c, rutin, beta-sitosterol, Sucrose[17]
Khadir	*Acacia catechu*	*Mimosoideae*	*Tikta, kashaya*	*Laghu, rooksha*	*Sheeta*	*Katu*	Acacatechi, Quercetin[16],
Asana	*Pterocarpus marsupium*	*Fabaceae*	*Kashayatikta*	*Laghu, ruksha*	*Sheeta*	*Katu*	Catechin, pterocarpol, tannic acid[16]
Tinisha	*Ougeinia dalbergioides*	*Fabaceae*	*Kashaya*	*Laghu, ruksha*	*Sheeta*	*Katu*	Isoflavonoids, quercetin, tannins[19]
Vat	*Ficus benghalensis Linn.*	*Moraceae*	*Kashaya*	*Guru, ruksha*	*Sheeta*	*Katu*	Flavonoids (quercetin, kaempferol, rutin), Phenolics(gallic acid),Tannins, Alkaloids[18]
Kakubha	*Terminalia arjuna*	*Combretaceae*	*Kashaya*	*Rookshalaghu*	*Sheeta*	*Katu*	Calcium, Tannin, Magnesium[18]
Ashva-karna	*Dipterocarpus turbinatus Gaertn.f*	*Dipterocarpaceae*	*Katu, tikta*	*Laghu, snigdha*	*Ushna*	*Katu*	Resin acids Terpenoids Phenolics[19]
Dhava	*Anogeissus latifolia Wall.*	*Combretaceae*	*Kashaya*	*Laghu, ruksha*	*Sheeta*	*Katu*	Tannins(high content) Flavonoids Gallic acid Glycosides[19]
Tinduka	*Diospyros embryopteris Pers.*	*Ebenaceae*	*Kashaya*	*Laghu, ruksha*	*Sheeta*	*Katu*	Tannins, Essential oils Pectin [18]
Ashvatha	*Ficus religiosa Linn.*	*Moraceae*	*Kashaya,Madhura*	*Guru, ruksha*	*Sheeta*	*Katu*	Flavonoids (quercetin, kaempferol) Tannins Saponins Steroids Phenolic

							compounds[19]
Amalaki	*Emblica officinalis Gaertn.*	*Euphorbiaceae*	*Amla pradhanpanchrasa*	*Guru*	*Sheeta*	*Madhura*	Vitamin C(ascorbic acid) Tannins (emblicanin A & B)Gallic Acid[18]
Shami	*Prosopis cineraria*	*Fabaceae*	*Katu, Kashaya,tikta*	*Laghu, ruksha*	*Sheeta*	*Katu*	Alkaloids Flavonoids Tannins Saponins Sterols[19]
Shallaki	*Boswellia serrata Roxb.*	*Bursuraceae*	*Kashayatikta*	*Laghu, ruksha*	*Sheeta*	*Katu*	Boswellic Acid, Terpenoids[16]
Shimshapa	*Dalbergia sissoo Roxb.*	*Fabaceae*	*Kashayatikta, katu*	*Laghu, ruksha*	*Ushna*	*Katu*	Essential oils, Tannins[18]
Sal	*Shorea robusta*	*Dipterocarpaceae*	*Kashaya,madhur*	*Ruksha, ushna*	*Sheeta*	*Katu*	Triterpenoids, Resin compounds, Flavonoids, Phenolics[19]



Distribution of *Jangala desha* drugs based on *virya* and *vipaka*.



***Anupa Desha* (Marshy Land)**[6,9] *Anupa Desha* is a moist and humid region with uneven land and abundant water sources such as rivers, lakes, ponds, and coastal areas. Vegetation is rich, with trees like coconut, banana, date palm, and flowering climbers. Crops such as paddy, sugarcane, and plantain are commonly grown.

Animals and birds are plentiful. People living in *Anupa Desha* generally have a ***Kapha–Vata* predominant constitution**, are gentle and delicate in nature, and are more prone to ***Kapha and Vata disorder***s.

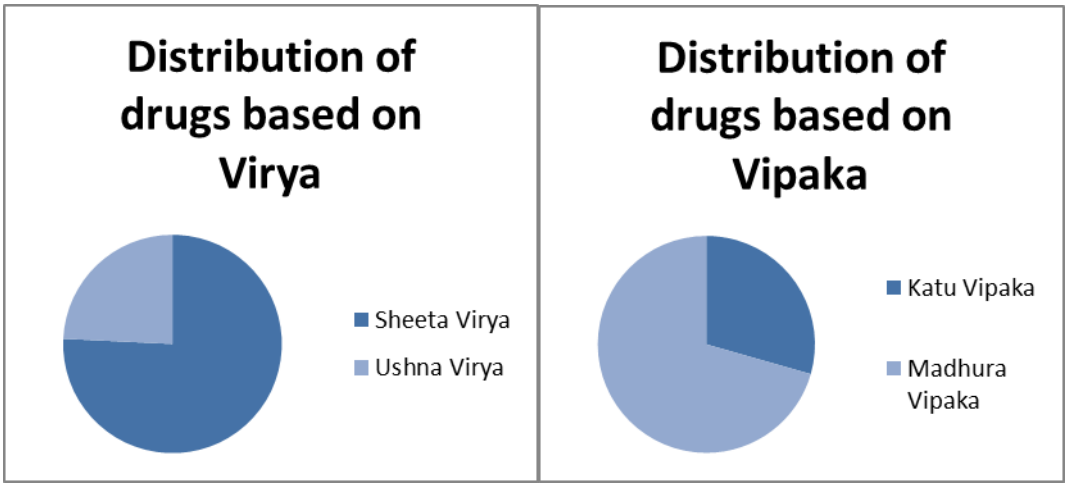
Plants Found in *Anupa Desha*[6,7,9]

- ***Hintala*** – *Phoenix paludosa* Roxb.
- ***Kankushta*** – *Garcinia morella* Gaertn.
- ***Narikela*** – *Cocos nucifera* L.
- ***Kadali*** – Musa paradisiaca Linn.
- ***Bhringraj*****-** Eclipta alba
- ***Pundreek*****-** Nelumbo nucifera Gaertn
- ***Kadamba*****-** Neolamarckia cadamba
- ***Shatpatra*****-** Amaranthus cruentus
- ***Mudga*****-** Vigna radiate
- **Sugarcane –** Saccharum officinarum Linn.
- **Paddy –** Oryza sativa
- ***Vetas*** – Salix caprea
- ***Vannira*** – Wrightia tinctoria Roxb.
- ***Kusha*** – Demostachya bipinnata Stapf.
- ***Kasha*** – Saccharum spontaneum Linn.
- ***Nala*** **-** Phragmites karka
- ***Darbha*** – Imperata cylindrica
- ***Gundra*** – Typha augustifolia

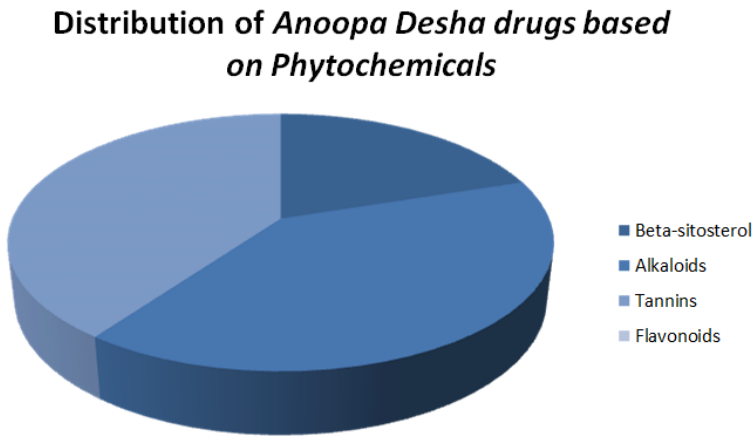
Brief introduction of *Dravyas* found in *Anoopa Desha*[8]

DRUG	**BOTANICAL NAME**	**FAMILY**	***RASA***	***GUNA***	***VIRYA***	***VIPAKA***	**PHYTO-CHEMICALS**
Hintala	Cycas circinalis	Cycadaceae	*Tikta, madhura*	*Guru, snigdha*	*Sheeta*	*Madhura*	Beta-sitosterol, Gallic acid, tannins[19]
Kankushth	Garcinia morella	Guttiferae	*Katu,tikta*	*Laghu, ruksha*	*Ushna*	*Katu*	Morellin, resin[18]

Narikela	Cocus nucifera Linn.	Arecaceae	*Madhura*	*Guru, snigdha*	*Sheeta*	*Madhura*	Protein, phosphorous, vitamin-c[18]
Kadali	Musa paradisiaca Linn.	Musaceae	*Madhura, kashaya*	*Snigdha*	*Sheeta*	*Madhura*	Alkaloids, flavonoids, steroids, saponins[19]
Bhringraj	Eclipta alba	Asteraceae	*Katu, Tikta*	*Ruksha, Laghu*	*Ushna*	*Katu*	Beta-amyrin, stigmasterol, ecliptal[16]
Pundreek	Nelumbo nucifera	Nelumbonaceae	*Kashaya, tikta*	*Laghu, snigdha, pichhila*	*Sheeta*	*Madhura*	Nelumbine, Metarbin, glucose, tannin[18]
Kadamba	Neolamarckia kadamba	Rubiaceae	*Tikta, kashaya*	*Ruksha*	*Sheeta*	*Katu*	Alkaloids, steroids, tannins[19]
Sugarcane	Saccharum officinarum	Gramineae	*Madhura*	*Snigdha*	Sheeta	*Madhura*	Glucose, fructose, leucine, glutamic acid, arginine[19]
Paddy	Oryza sativa	Gramineae	*Madhura*	*Laghu, snigdha*	Sheeta	*Madhura*	Beta-sitosterol, Flavonoids, phenolic acid[19]
Vetas	Salix caprea	Salicaceae	*Tikta, kashaya*	*Laghu, snigdha*	*Sheeta*	*Katu*	Albumin, resin, essential oils[18]
Vannira	Wrightia tinctoria Roxb.	Apocynaceae	*Katu, Tikta, kashaya*	*Laghu, Snigdha, tikshna*	Ushna	*Katu*	Terpenoids, steroids, flavonoids[19]
Kusha	Desmostachya bipinnata Stapf.	Gramineae	*Madhura, kashaya*	*Laghu, snigdha*	Sheeta	*Madhura*	Flavonoids, phenolic compounds, alkaloids.[19]
Kasha	Saccharum spontaneum Linn.	Gramineae	*Madhura, kashhaya*	*Laghu, snigdha*	*Sheeta*	*Madhura*	Glucose, xylose, galactose, rhamnose[19]
Nala	Phragmites karka	Poaceae	*Madhura, tikta, kashaya*	*Laghu, snigdha*	*Sheeta*	*Madhura*	Quercetin, flavonoids, alkaloids, steroids[19]
Darbha	Imperata cylindrica	Poaceae	*Madhura, kashaya*	*Laghu, snigdha*	*Sheeta*	*Madhura*	Cylindrin, arundroine[19]
Gundra	Typha augustifolia	Typhaceae	*Kashaya, madhura*	*Laghu, snigdha*	*Sheeta*	*Madhura*	Flavonoids, phenolic compounds, tannins[19]



Distribution of *Anoopa desha* drugs based on *virya* and *vipaka*



***Sadharana Desha* (Dry and Marshy land)[7]**

Sadharana Desha is the region that possesses combined features of both *Jangala* (dry) and *Anupa* (marshy) *Desha*. It maintains a proper balance between dry and moist seasons, with the presence of open areas as well as forests. The plants, animals, and agricultural produce show characteristics of both regions. Since heat, cold, rainfall, and wind are present in equal measure, the *doshas* remain well balanced. Therefore, people living in *Sadharana Desha* usually have a **balanced *(Sama) doshic* constitution**, and this type of land is considered the best.

Plants and Crops Found in this region[9,10,11]

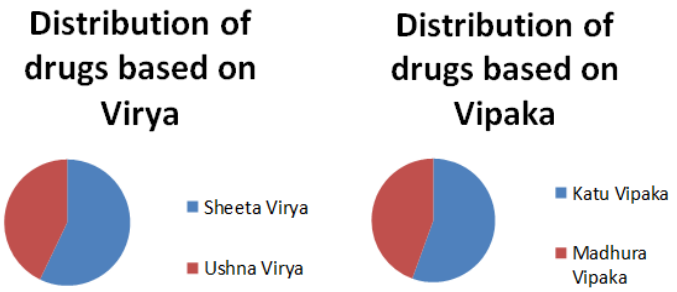
- ***Godhuma*** – Triticum aestivum
- ***Yava*** (Barley)- Hordeum vulgare
- ***Ulbana*****(maize)-** Zea mays
- **Jasmine –** Jasminum grandiflorum Linn.

- **Bougainvillea –** Bougainvillea glabra
- **Garlic vine –** Mansoa alliacea
- ***Aparajita* –** Clitoria ternatea
- ***Shankhapushpi* –** Convolvulus pluricaulis Chois
- **Betel leaf –** Piper betle
- ***Kundru* –** Coccinia indica
- **Pumpkin –** Cucurbita pepo
- ***Giloy* –** Tinospora cordifolia
- ***Shatavari* –** Asparagus racemosus
- ***Vruddhadaru* –** Argyreia speciosa
- ***Ashwatha* -** Ficus religiosa
- ***Udumbara* –** Ficus racemosa
- ***Amla* –** Emblica officinalis
- ***Kutaja* –** Holarrhena antidysentrica
- ***Trivrit* -** Operculina turpethum L.
- ***Tulsi* –** Ocimum sanctum
- ***Neem* –** Azadirachta indica

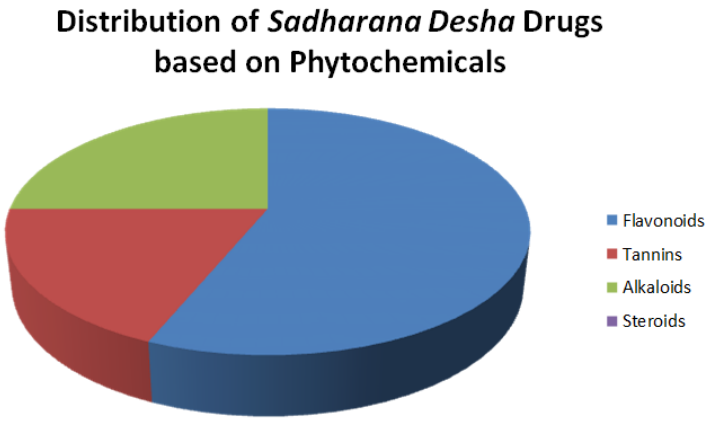
Brief Introduction Of *Dravyas* Found In *Sadharana Desha*[8]

Dravya	**Botanical name**	**Family**	***Rasa***	***Guna***	***Virya***	***Vipaka***	**PHYTO-CHEMICAL**
Godhuma	Triticum aestivum	Poaceae	*Madhura*	*Guru, snigdha*	*Sheeta*	*Madhura*	Ferulic acid, vanillic acid[19]
Yava	Hordeum vulgare	Poaceae	*Kashaya, madhura*	*Guru, ruksha*	*Sheeta*	*Katu*	Phenolics, flavonoids, beta-glucan[19]
Maize	Zea mays Linn.	*Poaceae*	*Kashaya, madhura*	*Laghu, ruksha*	*U*shna	*Katu*	Phenolic acid, carotenoids[19]
Jasmine	Jasminum grandiflorum Linn.	Oleaceae	*Tikta, Kashaya*	*Laghu, snigdha*	*Ushna*	*Katu*	Flavonoids, iridoids[19]
Bougainvillea	Bougainvillea glabra	Nyctaginaceae	*Madhura*	*Guru, snigdha*	*Sheeta*	*Madhura*	Beta cyanins, flavonoids[19]
Garlic vine	Mansoa alliacea	Bignoniaceae	*Katu, tikta*	*Laghu, Ruksha, tikshna*	*Ushna*	*Katu*	Flavonoids, tannins, organo sulfur-compounds[19]
Aparajita	Clitoria ternatea	Fabaceae	*Katu, tikta, kashaya*	*Laghu, ruksha*	*Sheeta*	*Katu*	Anthocyanins, triterpinoides, flavonoids[19]
Shankhapushpi	Convolvulus pluricaulis Chois	Convolvulaceae	Tikta	Snigdha, pichhila	Sheeta	*Madhura*	Alkaloides, flavonoids, coumarins[16]

Betel leaf	Piper betle	Piperaceae	*Tikta, Katu*	*Kshara, Laghu*	*Ushna*	*Katu*	Eugenol, essential oils[19]
Kundru	Coccinia indica	Cucurbetaceae	Tikta	*Laghu*	*Ushna*	*Katu*	Flavonoids, triterpeniods, alkaloids[19]
Pumpkin	Cucurbita pepo	Cucurbitaceae	*Madhura*	*Grahi, Ruksha, Vishtambhi*	*Sheeta*	*Madhura*	Beta carotene, sterol, tocopherols[19
Giloy	Tinospora cordifolia	Menispermeaceae	*Kashaya, tikta*	*Laghu, snigdha*	*Ushna*	*Madhura*	Alkaloids , glycosides[16]
Shatavari	Asparagus racemosus	Liliaceae	*Madhura, tikta*	*Gurur, snigdha*	*Sheeta*	*Madhura*	Steroidal saponins, isoflavones[16]
Vruddhadaru	Argyreia speciosa	Convolvulaceae	*Katu, Tikta, kashaya*	*Laghu, snigdha*	*Ushna*	*Madhura*	Alkaloids, flavonoids, resin glycosides[19]
Ashwattha	Ficus religiosa Linn.	Moraceae	*Kashaya, madhura*	*Guru, ruksha*	*Sheeta*	*Katu*	Flavonoids, tannins, steroids[19]
Udumbar	Ficus racemosa	Moraceae	*Kashaya*	*Guru, ruksha*	*Sheeta*	*Katu*	Tannins, flavonoids, glycosides[19]
Amla	Emblica officinalis	Euphorbeaceae	*Five tastes except lavana*	*Guru*	*Sheeta*	*Madhura*	Vitamin c, polyplenoles[19]
Kutaja	Holarrhena antidysentrica	Apocynaceae	*Tikta, kashaya*	*Laghu, Ruksha*	*Sheeta*	*Katu*	Alkaloids, steroids[16]
Trivrit	Operculina turpethum L.	Convolvulaceae	*Tikta, katu*	*Laghu, ruksha, tikshna*	*Ushna*	*Katu*	Resin glycosides, sterols[16]
Tulasi	Ocimum sanctum Linn.	Lamiaceae	*Katu, tikta*	*Laghu, Ruksha, tikshna*	*Ushna*	*Katu*	Eugenol, ursolic acid[16]
Neem	Azadirachta indica	Meliaceae	*Tikta, kashaya*	*Laghu, ruksha*	*Sheeta*	*Katu*	Azadirachdin, nimbin, quercetin[16]



Distribution of *Sadharana desha* drugs based on *virya* and *vipaka*



India has a tropical monsoon climate with diverse weather, from Rajasthan's deserts to himalayan foothills and humid coasts, shaped by latitude, altitude, proximity to the sea, and the Himalayas, resulting in heavy northeastern rainfall, desert aridity, and northern snowfall.

Factors Influencing India's Climate[13]

India's climate is shaped by geographical and atmospheric factors that create regional and seasonal variations:

Latitude: Spanning 8°4′ N to 37°6′ N, India's tropical south is warmer and stable, while the north experiences greater seasonal variation.

Himalayas: Act as a barrier, blocking cold Central Asian winds and keeping northern India warmer in winter.

Monsoon Winds: Southwest monsoon provides most rainfall, crucial for agriculture; northeast monsoon brings rain to southeastern regions.

Altitude: High-altitude areas are cold and snowy; plains and coasts are warmer.

- **Proximity to Water:** Coastal areas have moderate climates, while interior regions face extremes.
- **Western Disturbances:** Bring winter rainfall and snowfall to northwestern India, aiding Rabi crops.
- **Jet Streams:** Influence seasonal weather and the timing and strength of monsoon

  The interaction of these factors produces a dynamic climate in India marked by strong regional and seasonal variations. Understanding these influences is crucial for weather forecasting Agricultural planning, and managing the effects of climate change. Together,

they highlight India as one of the most climatically diverse regions in the world. Phytochemicals help plants survive extreme environments by regulating physiological and biochemical stress responses.

Desert plants: Produce alkaloids, phenolics, flavonoids, and tannins to conserve water, prevent UV- and heat-induced oxidative damage, and defend against herbivores and pathogens.

Hilly/Mountainous plants: Synthesize flavonoids, terpenoids, and phenolic acids that act as UV shields, antioxidants, and cryoprotectants, supporting cellular stability and stress tolerance.

Coastal/Sea shore plants: Produce osmo-protective phytochemicals, phenols, and terpenes to maintain ionic and osmotic balance, protect against oxidative stress, and enhance resistance to environmental and microbial stressors.[1]

Biodiversity and Climate Change[14-15]

The impact of climate change on the diversity of Himalayan medicinal plants was evaluated through an analysis of climatic variability recorded across Himalayan states, a review of recent scientific literature and journals, and personal observations made during medico-ethnobotanical surveys in the north-western Himalayan region. Changes in plant altitudinal distribution and phenological patterns were also documented by comparing historical and recent herbarium records, along with repeated field surveys conducted by the Regional Research Institute of Himalayan Flora, Tarikhet, Uttarakhand, India. In addition, the relationship between Ayurveda and the medicinal plant diversity of the Himalayan region, and its connection to climate change, was examined through an extensive review of existing literature.

Climate change refers to long-term variations in the Earth's global or regional climate patterns. It is projected that global temperatures may rise by approximately 1.4 °C to 5.8 °C by the year 2100, which is expected to have serious implications for biodiversity. Climate change is already compelling ecosystems and biological diversity to respond through habitat shifts, alterations in life cycles, and the development of new physiological and morphological traits. Rapid climatic changes may favour species that are capable of quickly expanding their

geographic ranges or tolerating a wide range of environmental conditions—characteristics commonly observed in many invasive plant species.

Anticipated changes in vegetation patterns could result in extensive forest dieback and significant biodiversity loss, particularly in ecotonal zones between forest types. Rising temperatures at higher elevations are likely to cause lower-altitude sub-temperate and temperate forests to shift upward into sub-alpine and alpine zones, potentially leading to the extinction of certain temperate vegetation types. Mountain forest ecosystems, including sub-alpine and alpine forests, Himalayan dry temperate forests, and Himalayan moist temperate forests, are especially vulnerable to the adverse effects of climate change. This heightened vulnerability is largely due to the fact that climate change impacts are predicted to be more pronounced in regions of higher elevation. It has been observed that, the Himalaya and surrounding areas have warmed by approximately 0.68°C since the middle of the 19th century. There are various issues related to climate change affecting the existing resources of medicinal plants used by the Ayurvedic practitioners such as; Changes of alpine ecosystem, Habitat fragmentation and the arrival of new medicinal plant genotypes may adversely influence current resources and threaten the Ayurvedic system over time.

DISCUSSION

The relationship between geo-climatic conditions and phytoconstituents, as described in classical Ayurvedic texts such as the Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya, demonstrates a sophisticated understanding of how environmental factors influence the therapeutic properties of medicinal plants.

In Jangala Desha (arid regions), harsh conditions like low moisture, high temperature fluctuations, and nutrient-scarce soils create environmental stress that stimulates plants to produce higher levels of **secondary metabolites** such as **tannins, flavonoids, alkaloids, terpenoids, and phenolic compounds**. As a result, the drugs found in these regions tend to be more potent, predominantly exhibiting ruksha (dry) and sheeta virya (cool potency). Among the listed examples, 13 drugs possess sheeta virya while only 2 exhibit ushna virya, and a significant majority (14 drugs) show katu vipaka, with only 2 demonstrating madhura vipaka—indicating strong metabolic, drying, and catabolic effects. These phytochemicals are known for antioxidant, astringent, and anti-inflammatory actions, supporting the intense therapeutic activity of Jangala plants.

In contrast, Anupa Desha (marshy or water-rich regions) is characterized by abundant moisture, fertile soil, and relatively stable climatic conditions. These factors support the development of **primary metabolites** such as **carbohydrates, proteins, and lipids**, along with milder secondary compounds like **glycosides, flavonoids, and phenolics**.

Consequently, the drugs from this region are milder in action, with 10 showing sheeta virya and 3 showing ushna virya. Furthermore, only 5 drugs exhibit katu vipaka, whereas a dominant 12 drugs display madhura vipaka, reflecting a tendency toward tissue-building, nourishing, and stabilizing effects on the body. The presence of sugars, amino acids, and nutritive phytochemicals contributes to their brimhana (anabolic) and restorative properties.

Sadharana Desha (moderate or balanced regions) presents intermediate environmental conditions, with neither excessive dryness nor moisture. This ecological balance is reflected in the phytochemical composition of plants, resulting in a more moderate and balanced pharmacodynamic profile. These plants contain a combination of **primary and secondary metabolites**, including **alkaloids, flavonoids, glycosides, essential oils, and phenolic compounds**, which provide both nourishing and therapeutic effects. Among these drugs, 12 exhibit sheeta virya and 9 exhibit ushna virya, while 10 show katu vipaka and 8 demonstrate madhura vipaka, indicating a relatively even distribution of metabolic effects.

Overall, these observations strongly support the Ayurvedic principle that environmental factors such as climate, soil composition, rainfall, temperature, and ecological stress directly influence the quality, potency, and therapeutic actions of medicinal plants. From a modern Phytochemistry perspective, dry and resource-limited environments enhance the production of potent secondary metabolites (tannins, alkaloids, terpenoids), while moist and fertile regions favor the accumulation of primary metabolites and nourishing compounds. This highlights the importance of geo-climatic context in the selection, application, and efficacy of Ayurvedic medicines.

CONCLUSION

The Ayurvedic concept of *Desha* (geo-climatic habitat) provides a nuanced framework for understanding how environmental factors—such as soil type, altitude, rainfall, and temperature—shape not only the physical characteristics of medicinal plants but also their internal biochemical profiles. Classical texts distinguish between regions like *Jangala* (arid), *Anupa* (marshy), and *Sadharana* (moderate), implicitly recognizing that plants grown in

different ecosystems develop varying potencies (*Veerya*) and therapeutic actions (*Karma*). Modern phytochemical research supports this view, showing that environmental stressors can influence the concentration of phytochemicals such as alkaloids, flavonoids, and essential oils. For instance, plants grown in harsher climates often produce higher levels of secondary metabolites as adaptive mechanisms, which may enhance their medicinal value. In the face of climate change, shifting weather patterns and habitat degradation threaten both the availability and consistency of these bioactive compounds, posing challenges for efficacy and standardization in herbal medicine. Therefore, integrating Ayurvedic ecological insights with contemporary tools like metabolomics, geospatial analysis, and conservation biology can enable more precise cultivation practices, ensure quality control, and support biodiversity conservation, ultimately fostering a sustainable and scientifically robust approach to medicinal plant utilization.

REFERENCES

1. Dixit RD. *Geographical thought: a contextual history of ideas*. New Delhi: PHI Learning, 2006; p. 300.
2. Dube B. *Geographical concepts in ancient India*. Varanasi: National Geographical Society of India (NGSI)., 1967.
3. Mitra J. Geographical data of Charaka Samhita. **SHM J.,** 1978; 2: 206–214.
4. Bahadur SRR. *Shabdakalpadruma*. 2nd part (Dvitiya Khanda). New Delhi: Naga Publishers, 2002; p. 747.
5. Sharma RK, Dash B. *Caraka Samhita*. Vol. II. Reprint ed. Varanasi: Chowkhamba Sanskrit Series Office, 2018; p. 251.
6. Sharma RK, Dash B. *Caraka Samhita*. Vol. II. Reprint ed. Varanasi: Chowkhamba Sanskrit Series Office, 2018; p. 126.
7. Bahadur SRR. *Shabdakalpadruma*. 2nd part. Re-edition. New Delhi: Naga Publishers, 2002; p. 747.
8. Sharma PV, Dravyaguna vigyana Varanasi: Chowkhamba Sanskrit Series Office.
9. *Vagbhata. Ashtanga Hridaya. Sutrasthana, Chapter 1, Verse 23.*
10. *Agnivesha, Charaka Samhita. Kalpasthana, Chapter 1, Verse 8.*
11. *Sushruta. Sushruta Samhita. Sutrasthana, Chapter 35, Verse 42-43.*
12. *Agnivesha, Charaka Samhita. Kalpasthana,* Chapter 1, Verses 7.
13. Rawat M. India's policies regarding global warming and climate change. *Shodhkosh J* Vis Perform Arts. 2024.

14. Khare N, editor. Climate change in India: impacts and assessments. 1st ed. CRC Press, 2025.
15. Rinawati, F., Stein, K., and Lindner, A.(2013). Climate change impacts on biodivdersity – the setting of a lingering global crisis. Diversity, 5(1): 114-123.
16. Dr. Desh Raj Thakur, Dravyaguna Vijnana. Vol. II. , Page No 254. , 72, 28, 426, 229, 421, 272, 402, 162, 397, 88, 388.
17. Dixit R et al. J Pharmacogn Phytochem., 2019; 8(6): 950-955.
18. Chunekar KC Bhavaprakash Nighantu (Indian Materia Medica) of Bhavamishra Edited by Pandey GS. Varanasi: Chaukhambha Bharati Academy, 2010; Page 10, 176, 467, 501, 510, 511, 523, 547, 555.
19. Kirtikar KR, Basu BD. Indian Medicinal Plants. Dehradun: International Book Distributors; Reprinted ed.