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RESEARCH ARTICLE

E-DATABASEINFORMATION OF INDIAN MEDICINAL PLANTS AND ITS ACTIVE INGREDIENTS

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Abstract

India is a land of indigenous medicinal plants and diverse wildlife. Since ancient time, Indians are usingthese plants and their extracts as medicine for the treatment of human diseases, and termed as traditional medicine (TM). Ayurveda, an alternative TM system, is well known across the Indian subcontinent. The oldest manuscript on Ayurveda practice is SushrutaSamhitabySushruta,written in 6th century BCE. It emphasises the use of medicinal plants and its parts with healing properties for health practices. The phytochemicals of a medicinal plant encompasses essential oils, flavonoids, saponins, steroids, phenylpropanoids and waxes. These phytochemicals are synthesized by plants as secondary metabolites, but, have numerous industrial applications. Though, we have these ancient medical practicing systems, but their documentation, dosage, inhibitory concentrations, where-abouts and the origin of medicinal plants is still not up to date. Therefore, there is a need for a repository where all the information regarding the medicinal plants and its properties should be listed. Here, we are discussing all the comprehensive information regarding all these databases of indigenous medicinal plants, which will apprehend our knowledge and understanding about India's vast diverse medicinal flora.

Introduction:-

India possesses a vast repertoire of greenlands distributed in different geographical regions with abundant and diverse indigenous medicinal flora. Indians developed a closed relationship with nature since ancient times. Nature has always nurtured our ancient civilizations and permitted higher levels of adaptation to new threats of evolution.

Our civilization, till now are totally dependent on plants, either for food or for therapeutic remedies. Therapeutic advances in medical field allowed us to propel our knowledge in retrieving information about the medicinal plant and it has escalated over time to develop into a new genre named as traditional medicine (TM). Ayurveda, Unani, Siddha and Folk are some of the ancient as well as prevailing TM system (Pandey, Rastogi, and Rawat 2013). Ayurveda and Unani TM systems are well developed and accepted across the Indian subcontinent. During the recent pandemic, Covid-19 posed incurable threats to co-morbid populations, here also Ayurveda and Unani TM systems came as saviours. Although TM is an integral part of our culture from ancient time,Chinese are also using it from ancient time.Although TM has been a part of our culture since the ancient time, Chinese people have also been utilising it since the beginning of their civilization.

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A healthy mind abode in a healthy individual. Thus, Ayurveda is believed to be called as "Science of life" and "Science of longevity", which depicts living a healthy long life through diet and nutrition. However, it is believed that Ayurveda came into practice around 2500 and 500 BC in India (Subhose, Srinivas, and Narayana 2005). The oldest manuscript on Ayurveda practice is SushrutaSamhita by Sushruta, written on medicine and surgery during 6th century BCE (Hoernle 1907; Dwivedi and Dwivedi 2007). Another revolutionized script was written by Charaka known as CharakaSamhita during 100 BCE and 200 CE (Valiathan 2003). Both the scripts are considered as fundamental text on Ayurveda, which emphasises the use of plants and their parts as medicine with healing properties for health practices (Ravishankar and Shukla 2007). These ancient scripts were the first known evidence of documenting medicinal plants, health practices and are preserved since ancient times. Nowadays also, these scripts are referred and cited in many naturopathies, cosmetology journals, articles, nutritionomics and research purposes. Other than medicinal perspectives, humans are well supported by plants, their parts in the form of nutritional food products to stay healthy and fit. Plants were unchallengeable and are inevitable in terms of their unending uses and human consumption.

The active ingredient present in plants is collectively termed as phytochemicals or bio-active components which are supposed to perform secondary function in plant's life cycle. Nevertheless, we all know them as secondary metabolites and they are vast and quite different from primary metabolites. The very existence of secondary metabolites and their diverse role have paved a way for researchers and developed a totally new branch of science called metabolomics.Secondary metabolites are compounds that play important role in the interaction of the plant with its environment. Some of them also protect the plant against biotic and abiotic stresses. Broadly, the naturally occurring phytochemicals or secondary metabolites are under five different classes. They are terpenoids, steroids, fatty acid derived compounds and polyketides, alkaloids, non-ribosomal polypeptides and enzyme co-factors. Among these five classes, you must have read about organosulfur compounds, limonoids, lignans, furyl compounds, polyines, thiophenes, flavonoids, coumarins, saponins, essential oils, phenylpropanoids and waxes. Some of these active phytochemicals are synthesized by plants as secondary metabolites, but, have numerous industrial applications (Hussain et al. 2021). These active phytochemicals are developed and produced as nutraceuticals, nutrition products, biofuel, insecticides, flavouring agents, colouring agents, smelling agents or fragrance, and many more (McChesney, Venkataraman, and Henri 2007; Wany et al. 2013; Wang et al. 2016).

This article will provide information about the medicinal plant databases, e-books, all types of information available on internet about medicinal plants and its active ingredients, and also how to know about plant metabolome. Till date, due to lack of awareness and publically available repositories, the entire information about a medicinal plant is very scarce. Though our knowledge regarding the indigenous medicinal plants is very less, various public and government agencies are trying to create knowledge centres through e-books, e-portals and databases. Here, we are trying to enlist all the available information about medicinal plants and its properties.

Revival of Ayurveda- Faith and Revitalization

Although, we have a rich knowledge of plant based therapeutics in the form of Ayurveda, but in recent time we are more relaying on synthetic drugs due to their well define mechanistic understanding (Pandey, Rastogi, and Rawat 2013). Ayurveda as we discussed earlier, is an indigenous, comprehensive scientific medicinal system. It is formed from two Sanskrit words, Ayu (life) and Veda (knowledge or science). The natural remedies are catalogued in the Four Vedas and it is considered as the oldest Indian literature (5000–1000 BC). The strength behind Ayurveda is derived from its rooted connection with nature. It's a system of knowledge that has existed since long time and most is still unexplored. Today, in the 21st century, Ayurveda has made a global impact as an emerging trans-disciplinary field. Government has developed world class educational institutions practicing Ayurveda, on the basis of three product oriented disciplines such as pharmaceutical, nutraceutical and cosmeceutical products collectively called as the Golden Triangle-A CSIR initiative (Shankar 2018).

However, in the current scenario, despite of its strengths, Ayurveda has some curative limitations. It still cannot give solutions to emergency cases, chronic conditions and changes in the molecular level of the organism. With the current technologies available, this TM system still struggles with modern day surgical methods. Today there is an urgent need to prepare such a platform or algorithm which can intertwine Ayurveda with molecular biology, information technology to organize multifaceted data and other formats. The documented clinical practices must be interpreted through Ayurveda which will deepen modernization of healthcare in India. Previously, pre-COVID-19 era has shown the rapid growth of pharmaceutical industries, which has slowed down the usage of herbal medicines. Moreover, with the advent of science and technology (in the form of techniques, instrumentation, automation in

isolation, and structural characterization), synthesis of more and more therapeutic active chemical compounds have taken place (Hussain et al. 2021).

During the pandemic era, there were enumerable challenges to all the advanced health care systems across the globe. COVID-19 has proven its potential in terms of epidemiology in global populations, medical therapeutics and how to address the symptoms of viral infection. All the researchers, medicos, pharmacists, scientists either focused on the pathogenic virus, its structural make-up, mutated variants or the environmental factors to combat COVID-19. Altogether, we focused on the efforts to strengthen the host immunity to prevent disease spread and decrease the pathogenicity of the virus. Nevertheless, an attenuated virus (vaccine) was the only way to induce specific immunity inside the host, whereas, non-specific way of strengthening immunity via Ayurveda, Yoga came into light. Practicingyogasanas for good respiratory health, immune-boosting Ayurvedic kadhas not only revived TM systems but also revived the mental health of an individual. This was the most putative prophylactic measure and acted as an add-on option for treating the current pandemic (Umesh et al. 2022).

This has changed the people's perception towards herbal medicine after the pandemic, where Ayurveda revived, rebuild faith on our traditional medical practice and gained significant momentum. Another facet of the synthesized drugs has been exposed during the COVID-19 period, which showed its side effects and long term health hazards. Our knowledge about functional mechanism of herbal medicines are very less, though we are using these ancient indigenous herbs. Deciphering the medicinal properties of plants and their underlying functional mechanisms evolved our in-depth knowledge and set a fundamental step for revival of Ayurveda. The knowledge about the indigenous medicine and medicinal plants are only available in Ayurveda MateriaMedica(Payyappallimana 2004), which needs to be popularized. Hence, digitalization of this knowledge, in the form of databases etc., will enable researchers to do comprehensive studies and make it effective for drug designing and discovery.

Ayurveda-Need of the hour!

Earlier, the Government of India established "The Department of Indian Systems of Medicine and Homeopathy" (ISM&H) in 1995 under the Ministry of Health and Family Welfare. Later, in 2003, it was renamed, from the names of the alternate medicine systems, as department of Ayurveda, Yoga & naturopathy, Unani, Siddha, and Homeopathy (AYUSH) (https://main.ayush.gov.in/background/). Now, it is Ministry of AYUSH, GoI, responsible for developing education, research and propagation of indigenous and alternative medicine systems in India. Till now approx. 8,000 herbal remedies have been categorized by AYUSH. Under the aegis of Ministry of AYUSH, National Medicinal Plants Board (NMPB) is set up in the year 2000. The primary role of NMPB is to coordinate between various ministries/departments/organizations in India and implements support policies/programs (conservation, cultivation, trade and export) growth of medicinal plants sector both at the Central/State and International level (https://nmpb.nic.in/content/introduction). NMPB involves in in-situ and ex-situ conservation and augmentation of local medicinal plants and aromatic species of medical significance.

Research priorities is the need of the hour and pre-selected themes are now pursued from ten or more years includes chronobiology; theories in nutrition science; principles of immunity; theories in regenerative biology; interactive microbiome; olfactory biology; bio-energetic metabolism; pharmacokinetics and pharmocodynamics of herbo-mineral formulations; therapies of detoxification; new principles for bio-regulation and pathogenesis; modern ethno-veterinary sciences; science of wellness; revival of local health traditions and in-situ conservation of medicinal botanicals and their gene-pools.

The design and development of Ayurveda and biology should be executed by policy makers, non-profit institutions in the private sectors, health services and research.Takentogether, the actual health need is to amalgamate TM systems,Allopathy, Ayurveda, Siddha, Sowa Rigpa, Unani, Homeopathy and Yoga to cure disease. The Indian Medical Council should practice and implement this at once. The annual health expenditure after this pandemic has risen to 67% in spite of heavy investments in western medicine in urban as well as rural areas. Due to this disappointment, public turned their faiths to Ayurveda and this pushed TM systems largely.

In 1998, to achieve health security, equity, increased healthy life expectancy and to ensure access to essential quality healthcare for all, WHO came up with a new global policy named "Health for All in the 21st Century". Majority of the world's population is struggling for modern medicine and relies on time-tested TM systems. After 2000, unhealthy lifestyle, environmental toxins and pollution increases the risk of diseases. In 2013, to integrate traditional and complementary medicine to promote universal healthcare and to ensure the quality, safety and effectiveness,

WHO developed and launched 'WHO Traditional Medicine Strategy 2014–2023'. Thus, the world is still looking for easily available, compatible, convenient, cost effective, better physiological traditional systems of medicine and holistic approaches to amend problems and provide fundamental healthcare to each one of us.

Information in the form of e-books

Various government agencies are releasing e-books very often summarising the on-going developments. The available e-books are briefly described here:

Medicinal Plants Of '21 for Covid-19 Care

Recently, on the International Biodiversity Day 2021, NMPB released an e-book, providing information about the 20 medicinal plants which might be having strong effectiveness on COVID-19 prevention and management. The current pandemic has taught us to improve our immunity to survive. Therefore, usage of these listed 20 medicinal plants may provide immunity boosters or act as antiviral drug to fight COVID-19.This e-book provides detailed information regarding the medicinal plant used for COVID-19 treatment, such as Chemical Constituents, Pharmacological principle, Therapeutic Uses etc., the e-book is available on https://www.nhp.gov.in/NHPfiles/Final_e-book.pdf.

Medicinal Plants Research

Central Council for Research inAyurvedic Sciences, Ministry of AYUSH, Government of India has released the e-book in 2018, stating about the Medico- Ethno Botanical Survey Programme. This survey demonstrated about the pan-India cultivation of medicinal plants and their propagation (included *in vitro* methods and Pharmacognosy research). Though India has a vast biodiversity, but the cultivation of medicinal plants are not taken up. Therefore, initiatives have been taken for their cultivation by setting medicinal plant gardens/Forms and scaling up their produces through experiments. This e-book also stated about the availability of adequate quantity of quality drug material for research or pharmaceutical purposes. It also reported about the Medico-Ethno Botanical survey which estimated the potential of medicinal plant research (http://www.ccras.nic.in/sites/default/files/viewpdf/Publication/CCRAS_Glimpses%20Volume-3.pdf).

Database on Medicinal Plants used in Ayurveda

Central Council for Research in Ayurveda and Siddha, formerly under the Dept. of ISM & H, Ministry of Health and Family Welfare, Govt. of India released the e-book in 2001. This e-book has detailed information regarding thirty medicinal plants, with their components which might be used for possible treatment of diseases (https://www.gbv.de/dms/bs/toc/387748814.pdf).

Indian Medicinal Plants: An Illustrated Dictionary

A comprehensive e-book by Khare (2007), citated more than 2800 indigenous medicinal plants, has been released. The authenticity of the work is undoubtable, as the data is collected from more than 2000 plant information resources of Ayurvedic, Unani and Siddha systems. This e-book has detailed information of medicinal plants, such as their synonymous names, classification, action, key application and dosage. Additionally, this e-book also contained 215 pictures of crude herbs along with the list of active chemical compounds (http://gbpihedenvis.nic.in/PDFs/Glossary_Medicinal_Plants_Springer.pdf).

Digital information in the form of Databases

Although, books are indispensable source of information, now databases are providing organized and comprehensive information. In this digital era, the databases are inevitable due to their easy maintenance and accessibility. Therefore, many databases are developed either by individual efforts or by government funded projects. Many databases are available online on medicinal plants world widely (listed at https://www.loc.gov/rr/scitech/selected-internet/herbalmedicine.html). Here, we are enlisting the online available databases on indigenous medicinal plants.

IMPPAT: Indian Medicinal Plants, Phytochemistryand Therapeutics

IMPPAT is a manually curated online database of Indian medicinal plants(Mohanraj et al. 2018). IMPPAT is developed through literature mining from more than 7000 published research articles, books and other available databases.This database contains a comprehensive knowledge about the phytochemicals of medicinal plants and their therapeutic uses.IMPPAT has information about 1742 Indian medicinal plants, non-redundant *in silico*library of 9596 phytochemicals (with standard chemical identifiers and structure information), and 1124 therapeutic uses. It

also contains 27074 plant-phytochemical associations and 11514 plant-therapeutic associations. The 9596 phytochemicals has been subjected for physicochemical, drug-likeliness and ADMET characterization, where 960 phytochemicals are found to be possible template for novel drug(Mohanraj et al. 2018). The database IMPPAT is publically available onlineat: https://cb.imsc.res.in/imppat (Figure-1).

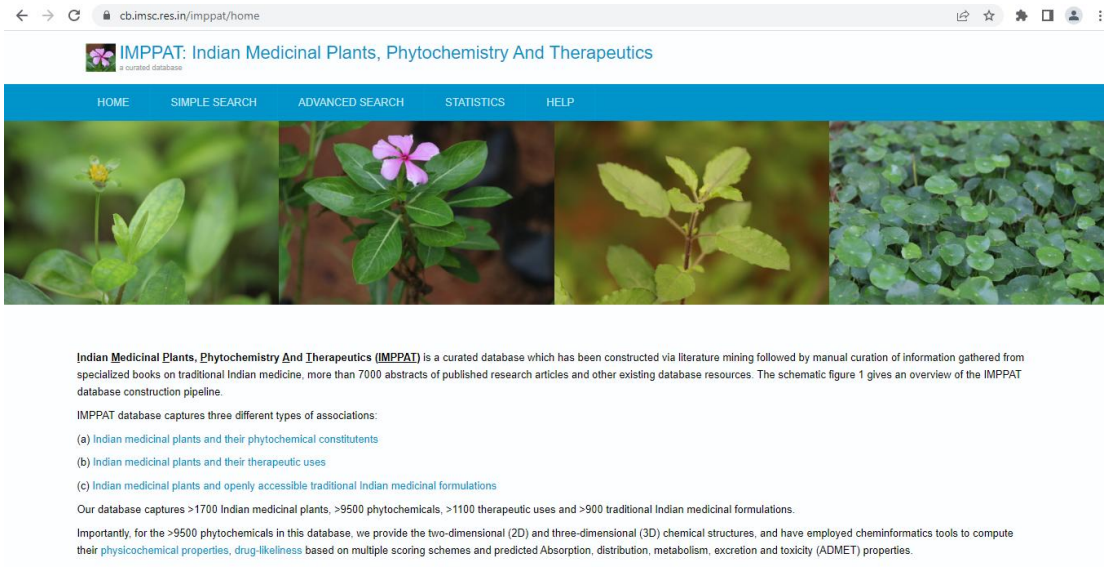

Figure 1:- Screenshot of GUI of the IMPPAT database.

AromaDb: A Database of Plant's Aroma Molecules

AromaDb is a database of aromatic molecules of medicinal and aromatic indigenous plants (Kumar et al. 2018). It contains detail data about aroma plants. The database describes plants varieties, accessions, chemotypes, essential oils, oil yields and constituents. It also contains chromatograms of aromatic molecules, their compounds, elucidated structural 2D and 3D data. AromaDB has 1321 chemical structures of aromatic molecules, and classified the aroma types, 357 as fragrance like, whereas 166 plants are used commercially along with their high yielding 148 chemotypes(Kumar et al. 2018). It also comprises the use of aromatherapy for the treatment of diseases related to cell signalling pathways through interacting human genes. Additionally, it has reported volatile molecules of various sizes, their physico-chemical properties, and information about their biological pathways with cross references. The aromatic compounds are categorized by structure as esters, linear terpenes, cyclic terpenes, aromatic, amines, alcohols, aldehydes, ketones, lactones, thiols and miscellaneous compounds. The AromaDb is freely available on public domain online at: http://bioinfo.cimap.res.in/aromadb/(Figure-2).

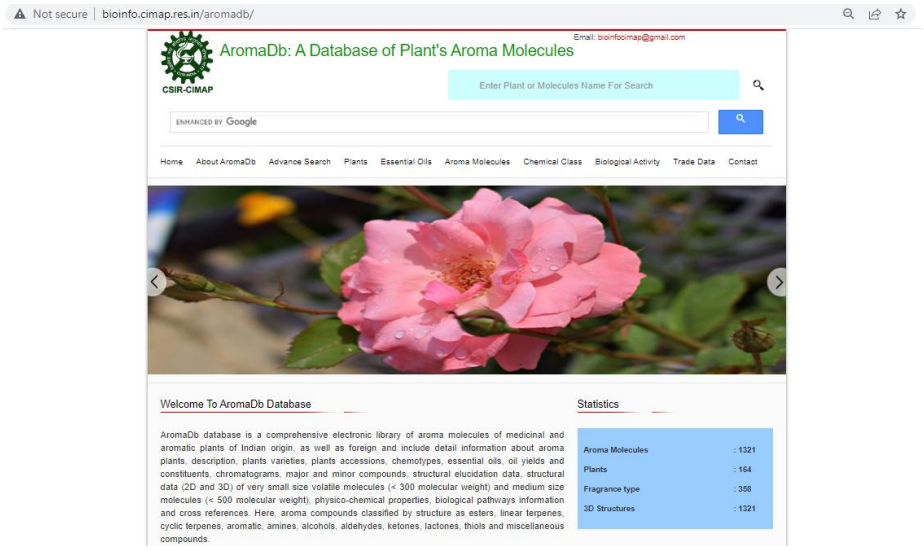

Figure 2:- Screenshot of GUI of the AromaDB database hosted by CSIR-CIMAP, Lucknow, India.

Phytochemica: A platform to explore phytochemicals of medicinal plants

The Phytochemica database is an organized library of phytochemicals from some of the important medicinal plants of Himalayan region. The plants are *Atropa belladonna*, *Catharanthusroseus*, *Heliotropiumindicum*, *Picrorhizakurroa*, and *Podophyllumhexandrum*(Pathania, Ramakrishnan, and Bagler 2015). Phytochemica contains 963 Plant-derived molecules (PDMs) from the above mentioned medicinal plants. Here, it encompasses information about the plant parts used for medication, chemical classification of PDMs, their IUPAC names and SMILES notations with physicochemical properties, and 3D chemical structures. This database is providing direct accessibility to ZINC database for identifying putative natural molecules analogs for *in silico* drug discovery. The database is freely available in public domain: http://faculty.iiitd.ac.in/~bagler/webservers/Phytochemica/ (Figure-3).

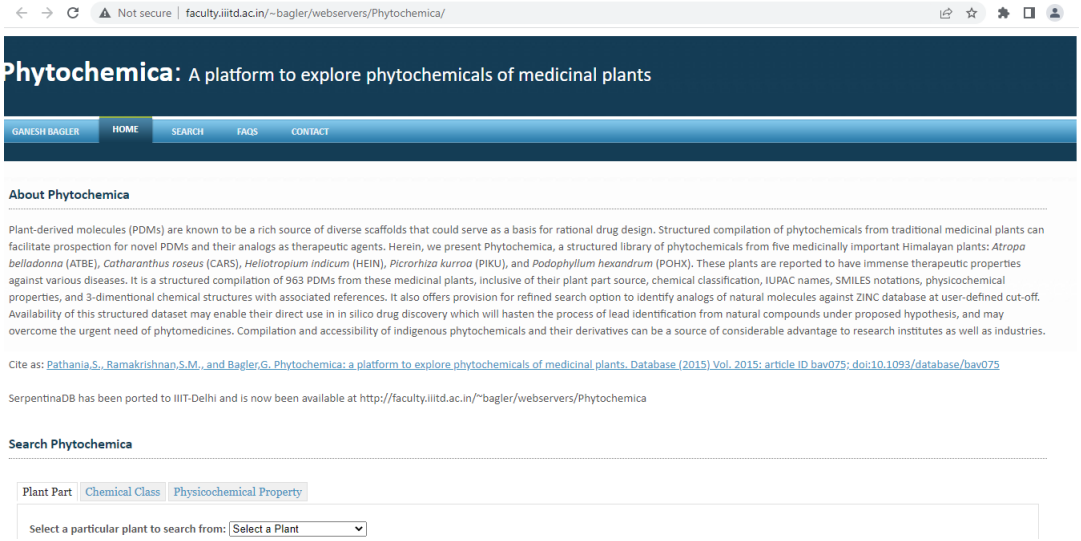

Figure 3:- Screenshot of GUI of the Phytochemia database.

NPACT

The database NPACT is of Plant derived natural compounds that exhibit anti-cancerous activity (Mangal et al. 2013). It is a curated database having 1574 entries. Each entry has information about the structure of recorded compound, and their physical, elemental and topological properties. This database also has information of likely cancer types which might be treated by plant derived natural compounds, their inhibitory values (IC50, ED50, EC50, GI50), commercial suppliers. NPACT is uniquely providing information regarding bioactivities of recorded 353 natural compounds which may be used against different cancer cell lines and their putative molecular target/s. currently, this database contains experimentally validated 1980 compound-target interactions. Further, it also provides links of other similar databases. The NPACT is publically available at http://crdd.osdd.net/raghava/npact/ (Figure-4).

Figure 4:- Screenshot of GUI of the NPACT database.

ENVIS centre on medicinal plants

Ministry of Environment and Forests, Government of India has established an environmental information system (ENVIS) with the help of World Bank. ENVIS is also the Asia's sub-regional nodal centre of INFOTERRA (the global network of United Nations Environment Programme), which serves the purpose of providing access to highly equipped libraries and network systems to the needy people. This data source is hosted by Foundation for Revitalisation of Local Health Traditions (FRLHT), Bengaluru, India. It provides unique platform and one stop access point for collection, curation and dissemination of authentic multi-dimensional information about Indian Medicinal Plants through media. This centre's success relies on the large number of visitors (8331670 lakhs hits and 699404 visitors' per annum). This database is well referenced dynamic database based on peer reviewed scientific publications. It contains information regarding 6198 medicinal plants species with their 7637 botanical names and 119183 vernacular names in 12 languages. It also has approximately 2688 images of medicinally important plants. The database is accessed publically through http://envis.frlht.org/implad (Figure-5).

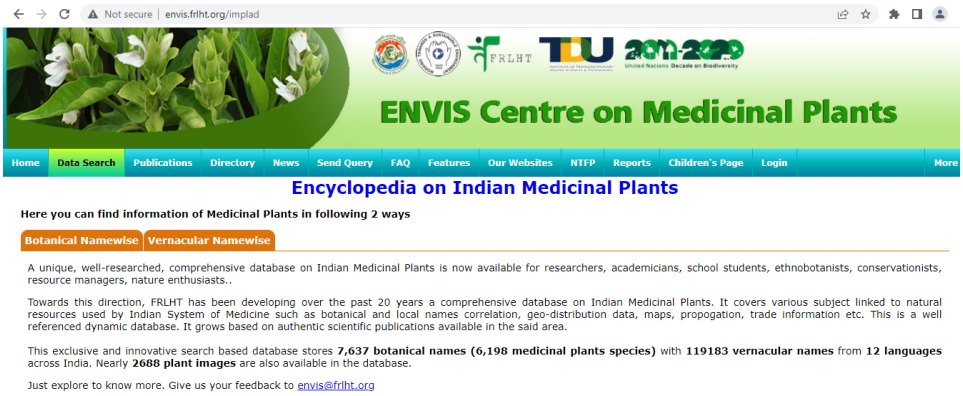

Figure 5:- Screenshot of GUI of the ENVIS Centre on Medicinal Plants database hosted by FRLHT, Bengaluru, India.

ENVIS Resource Partner on Biodiversity

Another ENVIS centre on "Plant Ecology", hosted by Botanical Survey of India, Kolkata, India is collecting, managing and disseminating information about "Floral Diversity" across the various states of India. The database has all published bibliography on flora, list of endemic and threatened taxa from different states of India. The database displays comprehensive information about the medicinal plant such as their synonymous names, English name, Vernacular names and Trade name along with traditional and modern use, phytography, distribution, ecology and cultivation, and chemical contents. The database is accessed publically through http://www.bsienvis.nic.in/database/medicinalplants_3939.aspx (Figure-6).

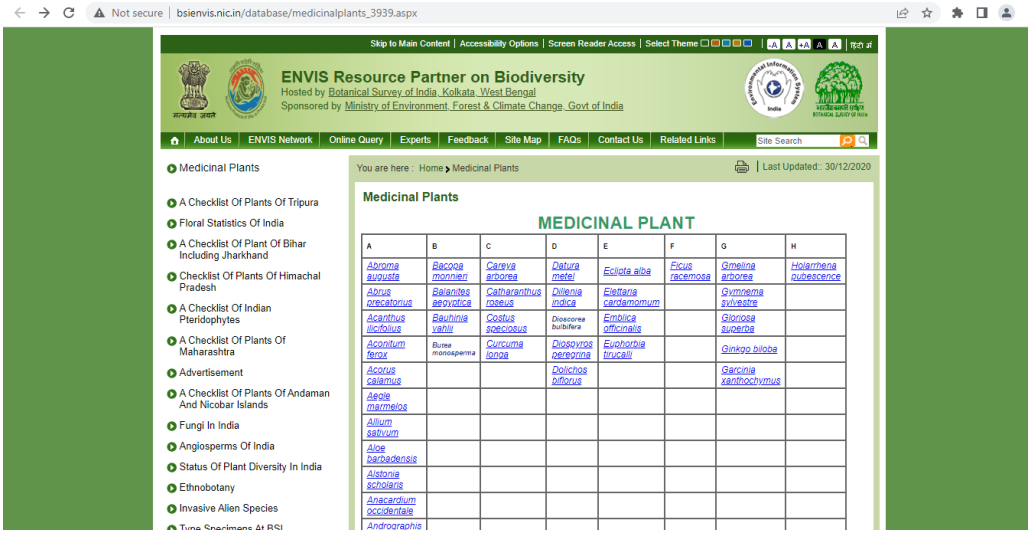

Figure 6:- Screenshot of GUI of the ENVIS Resource Partner on Biodiversity hosted by Botanical Survey of India, Kolkata, India.

Medicinal Plant database

Medicinal Plant database is hosted by National Medicinal Plant Board, Ministry of Ayush, Govt. of India. Currently, this database is unable to reach might be due to some technical reason (http://www.medicinalplants.in/). Though, NMPB fact sheet reports about that the around 7000 indigenous medicinal plants out of 17000-18000 flowering plants species are known (Figure-7).

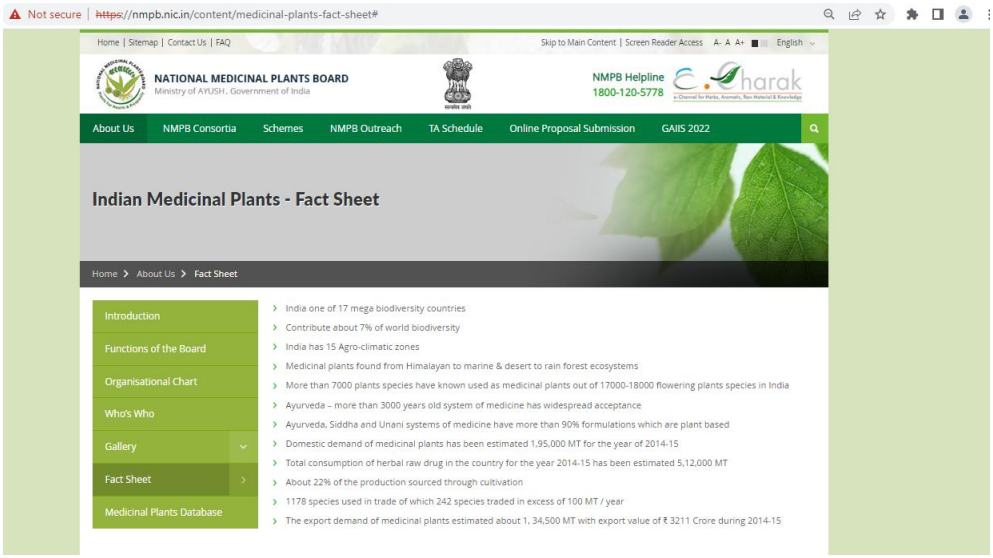

Figure 7:- Screenshot of the webpage of NMPB.

Database on Medicinal Plants

It was an all-inclusivedatabase of medicinal plants with high trade value sponsored by NMPB, Department of AYUSH and implemented by Central Council for research in Ayurvedic Sciences, New Delhi, India (http://www.ccras.nic.in/sites/default/files/viewpdf/Core%20Research%20Activities/Database-on-Medicinal-Plants.pdf).It was curated from 33,700 references and supposed to be a common platform which provides easy access to the published information of specific medicinal plant.

Ayurvedic& Medicinal Plants

The "Ayurvedic& Medicinal Plants" is an informative webpage (https://www.dabur.com/amp/in/en-us/about/science-of-ayurveda/herbal-medicinal-plants) of Dabur India Limited, which is the fourth largest FMCG private company in India (Figure-8).It is an Ayurvedic and Natural Health Care company which produces only Herbal/Ayurvedic products. This webpage listed and provides information about some of the most potent and popular medicinal plants and their usage along with their common, English and Botanical name.

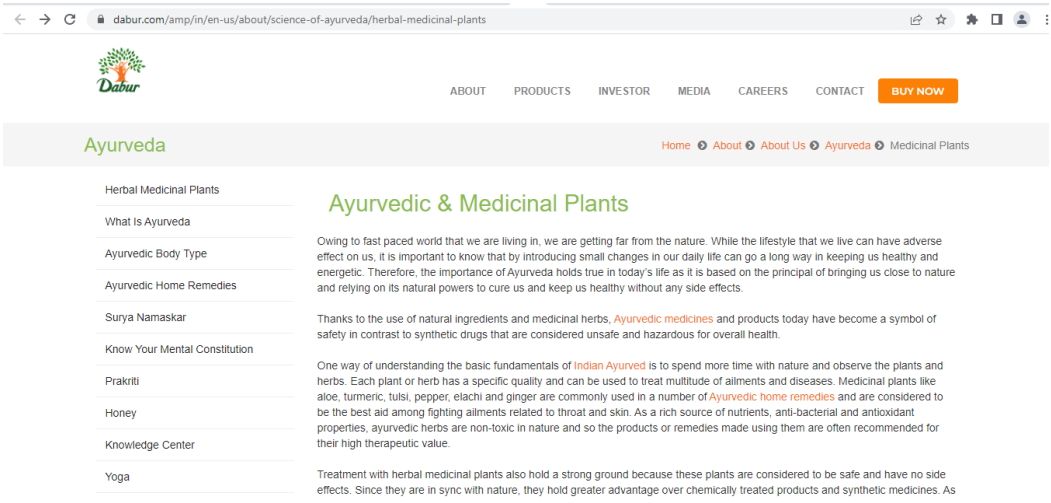

Figure 8:- The webpage of Dabur India Limited.

Active ingredients of indigenous medicinal plants

The phytochemicals which are synthesized by plants are most important for the use as a medicine. Though, we have large repository of flora and knowledge about their usage as medicine, but the information regarding their active ingredients are very scanty(Polur et al. 2011).However, absence of dedicated database on active ingredients has hindered the development of novel drugs and treatment strategies(Wangkheirakpam 2018). Lack of 3D structure of plant based active chemical ingredients and their related databases have bottlenecking the *in silico* studies for ligand- and target based virtual screening (Polur et al. 2011; Dürig et al. 2010). Therefore, we have very less knowledge about plant based active chemical ingredients due to the unavailability of scientific research and related literatures. Here, we have tried to enlist available information about the plant based active chemical ingredients (Table 1).

Table 1:- List of some therapeutically active ingredients in common medicinal plants (Adapted from the e-books http://gbpihedenvis.nic.in/PDFs/Glossary_Medicinal_Plants_Springer.pdf and https://www.nhp.gov.in/NHPfiles/Final_e-book.pdf)

Active Component	Medicinal Plants
Alantolactone	*Inularacemosa*
	Saussurealappa
Andrographolide	*Andrographispaniculata*
Atropine	*Atropa belladonna*
	Scopoliaanomala
	Daturastramonium
	Lyciumbarbarum
	Mandragoraautumnalis S
	Physochlainapraealta
	Scopoliaanomala
	Solanumtuberosum
Azadirachtin	*Azadirachtaindica*
β-Carotene	*Justiciaadhatoda*
	Barbarea vulgaris
	Calendula officinalis
	Cappariszeylanica
	Citrus limon
	Citrus paradisi
	Daucuscarota
	Enhydrafluctuans
	Ipomoea aquatica
	Menthapiperata
	Rosa damascena
	Thujaorientalis
Champhor	*Cymbopogonjwarancusa*
Chiratol	*Swertiachirata*
Cinnamaldehyde	*Cinnamomumverum*
	Cinnamomum cassia
Kaempferol	*Sesbaniagrandiflora*
	Acalyphaindica
	Allemandacathartica
	Lyciumbarbarum
	Allium porrum
	Bryophyllumpinnatum
	Cassia angustifolia
Kutkiol	*Pichrorhizakurroa*
Limonene	*Citrus limon*
	Ocimumtenuiflorum L.
	Apiumgraveolens
	Cinnamomumtamala
	Cymbopogoncitratus
	Dracocephalummoldavica
	Elettariacardamomum
	Juglansregia
	Melissa axillaris
	Menthaarvensis
	Nigella sativa
Linalool	*Ocimumbasilicum*L.
	lliciumverum
	Achilleamillefolium
	Cinnamomumcamphora
	Coriandrumsativum
	Elettariacardamomum
	Jasminumofficinale
	Lavandulaofficinalis
Linolic acid	*Phyllanthusemblica*L

	Cinnamomumburmannii
Citronellol	*Cymbopogonnardus*
	Zingiberofficinale Roscoe
	Rosa damascena
Curcumene	*Zingiberofficinale Roscoe*
	Curcuma longa L.
	Valerianawallichii
	Curcuma aromatica
	Limoniacrenulata
Coumarins	*Atropa belladonna*
	Daturastramonium
	Agrimoniaeupatoria
	Anethumsowa
	Citrus limon
	Coriandrumsativum
	Feronialimonia
	Ferula assafoetida
Eugenol	*Syzygiumaromaticum*
	Cinnamomumverum
	Ocimumtenuiflorum L.
	Curcuma longa L.
	Cinnamomumcamphora
	Cinnamomum cassia
	Jasminumofficinale
	Juglansregia
	Ocimumbasilicum L.
Flavonoid	*Acacia arabica*
	Ocimumbasilicum L.
	lliciumverum
	Atropa belladonna
	Daturastramonium
	Citrus limon
Furfural	*Menthaarvensis*
	Verbascumthapsus
	Saccharummunja
	Syzygiumaromaticum
	Adansoniadigitata
Geraniol	*Cymbopogonjwarancusa*
	Citrus limon
	Cymbopogoncitratus
Picroside	*Pichrorhizakurroa*
Shikimic acid	*Rhus succedanea*
	Euphorbia hirta
	Phoenix dactylifera
	lliciumverum
	Rhus succedanea
Sitosterol	*Swertiachirata*
	Azadirachtaindica
	Inularacemosa
	Abromaaugusta
	Acacia pennata
	Aesculusindica
	Asparagus racemosus
	Asphodelusfistulosus
Tannins	*Vinca major*
	Daturastramonium
	Castaneasativa
	Acacia arabica
	Acacia catechu
	Agrimoniaeupatoria
	Anchusaitalica
	Anogeissuslatifolia
	Bassialongifolia
	Buchananialanzan
Terpenes	*Calendula officinalis*
	Achilleamillefolium
	Andrographispanicultata
	Artemisia vulgaris
	Calendula officinalis
	Centipeda orbicularis
Tinosporin	*Tinosporacordifolia*
Vasicine	*Justiciaadhatoda*
Vanillin	*Syzygiumaromaticum*
	Agropyronrepens
	Ferula foetida
	Liquidambar orientalis
	Styrax benzoin
Vinblastine	*Vincarosea*
Vitamin C	*Barbarea vulgaris*
	Citrus limon

	Cymbopogonmartinii
	Melissa axillaris
	Rosa alba
	Thymus serpyllum
Gingerol	*Zingiberofficinale Roscoe*
	Aframomummelegueta
	Alpiniaofficinarum
Glycyrrhizin	*Abrusprecatorius*
	Glycyrrhizaglabra L
	Citrullus vulgaris
Glucuronides	*Clerodendrumindicum*
	Clerodendrumserratum L
Hyoscyamine	*Scopoliaanomala*
	Brugmansiasuaveolens
	Daturainnoxia
	Daturametel
	Daturastramonium
	Hyoscyamusniger
	Lactucavirosa
	Lyciumbarbarum
	Physochlainapraealta
	Phyllanthusemblica L
	Justiciaadhatoda
	Capsicum annuum
	Curcuma longa
	Emblicaofficinalis
	Flacouritaindica
	Hordeumvulgare
	Ipomoea batatas
Withanone	*Withaniasomnifera*
	Physalisphiladelphica
	Discopodiumpenninervium
	Daturastramonium
Hispidulin	*Clerodendrumindicum*
	Clerodendrumserratum L
	Millingtoniahortensis
	Salvia officinalis

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