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REVIEW ARTICLE

## CRITICAL REVIEW ON DATABASES RELATED TO THE FIELD OF AYURVEDA

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### ABSTRACT

Currently the world is getting digitalized day by day after the incursion of information technology (IT). It became the source of information for many fields such as science, technology, research, education, and commerce, etc. including healthcare. The internet has become an increasingly anticipated medical information resource. While considering involvement of IT and Artificial intelligence and its applications in various filed of medical science, the oldest traditional system of medicine, Ayurveda seems to be upgraded with ongoing competition. The area of Ayurveda like academic, clinical, Pharma and research where we can use IT, so that the system will get benefited and the things will move more calculated and faster. Hence, evidence base documentation, data safety, easy accessibility, worldwide propagation and many more are possible by using IT. Many new things like software's, websites, blogs, and applications are upcoming with knowledge. These all gadgets are well utilized by the different group of people for their different needs. Ayurveda, being a data rich science, this enormous data should needed to be stored and can be utilized for various purposes. Database is an asset to resolve such issues. Many databases were created related to Ayurveda, unfortunately very few of them contains core / conceptual Ayurveda information. So the present article is an attempt to make a critical review on the databases available in the field of Ayurveda.

**KEY WORDS:** Ayurveda, Information Technology, Informatics, Database.

### INTRODUCTION

The information technology (IT) revolution is being hailed as the most significant breakthrough in human history since the

industrial revolution, with the potential to transform man and society in ways that are unimaginable. The computer, which was originally designed to process data, evolved



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into a data repository over time. It grew more sophisticated and powerful, eventually connecting with others of its sort to form a formidable network. IT has evolved into a global collaborative medium and a rich repository of information of science, technology, research, education, and business, among others and it has the potential to transform healthcare as well.

Significant advancements of information and communication technology in medicine have exploded in recent years. With its broad reach and scalability, the Internet has grown in popularity as a source of medical knowledge. Doctors, researchers, and other healthcare practitioners are building a new vision of work in areas such as patient care, medical and health education, and research by re-designing the workplace around computer-based technology. On-line journals, telemedicine, as well as advances in health screening and assessment, international chatting, computer-based training and education in various fields of medicine, and centralization of cyberspace information are some of the technological advances that will nurture our interests.

Journals, reports, conference proceedings, and other sources of knowledge abound in the healthcare field. Because of the Internet, information resources (on-line databases, CD-ROM manufacturers, full-text papers from various societies and commercial organizations, news groups, directories, individual home pages, and corporate resources) are now at one's fingertips. Literature search can be done on databases such as MEDLINE, EMBASE and BIOSIS as well as on other Web sites in no time.

*Ayurveda* is one of the oldest traditional medical systems, having grown extensively throughout Vedic period and having its own knowledge as a foundation. The use of technology in *Ayurveda* will help to establish this ancient science's global recognition. The incorporation of technology into *Ayurveda* has been a long-awaited move, and now is the moment to fully embrace it. When it comes to the utilization of technology, we need to make sure that *Ayurveda* is on level with other medical sciences.

Bioinformatics is a branch of information science concerned with the development and improvement of systems for storing, retrieving, organizing, and analyzing biological data. *Ayur-informatics* is a branch of bioinformatics that works with plant data sets and databases, medicinal plant databases, *Ayurvedic* medical informatics, medicinal plant genomes, pharmacogenomics, Pharmacoproteomics, and *Ayurvedic* drug discovery, among other things<sup>1</sup>.

Various *Nighantus* as well as *Samhitas* are there and which contain enormous information. Being a data rich science, this huge amount of data should needed to be stored. Digitalization is one way to go about the problem which makes it accessible to those who needs to know about it. It could be mere online web resources or software for information and decision making. This is a critical necessity since computers can store and retrieve vast amounts of data that would be difficult to do manually. This can be used for several purposes be it present or future.

Soft-wares, Databases, etc. were considered quite different in earlier times,

however, over the time, they became a preferable term. These are convenient system to properly store, search and retrieve any type of data. It is easy to handle and helps to share large amount of data and supports large scale analysis by easy access and data updating. This would aid in evaluating the research for future planning, exploration and collaboration, as well as avoiding duplication. Several efforts have been done from various segments to build some of the most user-friendly digital versions/software of this oldest and traditional system of medicine, but it still has a long way to go to keep up with the speed of time<sup>ii</sup>.

In India, such type of revolution started and many new things like software's, websites, blogs, and applications are upcoming with knowledge. These all gadgets are well utilized by the different group of people for their different needs. In a review it is observed that there are more than five thousand Websites, five thousand Blogs around 1,000 software's and more than 90 mobile Applications are currently used by various consumers. There are more than 7 National and more than 18 database are available at international desk related to medicinal plants<sup>iii</sup>. There is lacking or short fall in the presentation of many database for *Ekaladravya* Information. The information demonstrated is a mix-information, which is partial and not fruitful for exact clinical as well as other conceptual application for Ayurvedic community. So the present article is an attempt to make a critical review on the databases available in the field of Ayurveda.

## MATERIALS AND METHODS

In this regard, a concerted effort has been undertaken to analyze recent IT breakthroughs in Ayurveda and related fields such as Bioinformatics and Ayur-informatics. For data collection, databases containing Ayurveda-related information were also searched. Based on the substance of the acquired data from multiple databases, it was compiled, analyzed, and presented in tabular form.

### Online databases available for Ayurveda

**At present there are almost 46 databases for Ayurveda, among these five are updating regularly<sup>iv</sup>. They mainly contain research articles published in various field of medical science including Ayurveda.**

1. DHARA (Digital Helpline for Ayurvedic Research Articles) exclusively for research articles published in the field of Ayurveda<sup>v</sup>.
2. AYUSH RESAERCH PORTAL purely meant for academic purpose<sup>vi</sup>
3. ABIM (Annotated Bibliography of Indian Medicine) contains more than 50000 items related to Ayurveda<sup>5</sup>.
4. PubMed also contain information regarding previous done research works<sup>5</sup>.
5. DOAJ (Directory of Open Access Journals)<sup>5</sup>

**Other databases which contain research articles published in various field of medical science including Ayurveda are;**

1. IndMED- Contain bibliographic information of journals, not updated regularly<sup>5</sup>.
2. NISCAIR (National Institute of Science Communication and

Information Resources) - Indian journal of traditional knowledge, no information specific to *Ayurvedic* clinical research available<sup>5</sup>.

3. MEDKNOW (Medical Knowledge) - Peer reviewed online and print-plus-online journals in medicine with a focus on emerging markets<sup>5</sup>.
4. ICMR (Indian Council of Medical Research) - Contain journal for medical research published<sup>5</sup>.

#### **Databases which contain details of Ayurvedic formulations are,**

1. CSIR (Council of Scientific and Industrial Research) - Information of different formulations<sup>5</sup>.
2. TKDL (Traditional Knowledge Digital Library) - Pioneering initiative of India to protect Indian traditional medicinal knowledge and prevent its misappropriation at International Patent Offices. Traditional Knowledge Digital Library has overcome the language and format barrier by systematically and scientifically converting and structuring the available contents of the ancient texts on Indian Systems of Medicines i.e. Ayurveda, Siddha, Unani and Sowa Rigpa as well as Yoga, into five international languages, namely, English, Japanese, French, German and Spanish. As on date, more than 4.54 lakh formulations/ practices have been transcribed into the TKDL database. Its main purpose is to protect traditional medicines of *Ayurveda* from patenting by individual scientists<sup>5</sup>.

CAM Base- Contains information regarding complementary health products and practices<sup>5</sup>.

1. **Databases which contain details of thesis related to Ayurveda are,** Vidyanidhi- Indian digital library of electronic theses. The *Vidyanidhi* project based at the University of Mysore and sponsored by India's National Information System for Science and Technology (NISSAT)<sup>vii</sup>.
2. Shodhganga- Shodhganga stands for the reservoir of Indian intellectual output stored in a repository hosted and maintained by the INFLIBNET (Information and Library Network) Centre. It contains digital repository of Indian Electronic Theses and Dissertation accessible to all institutions and universities<sup>viii</sup>.
3. Ayurveda Research Database (ARD) - It is repository of 1000 complete PG thesis (searchable like Google Search) of Gujarat Ayurveda University (GAU) Jamnagar. In current edition, besides thesis from IPGT&RA, Jamnagar, Govt Akhandanand Ayurveda College, Ahmedabad, thesis from M.Sc (Ayurvedic Medicinal Plants) and M. Pharma (Ayurveda) more than 200 theses have been added from year 2011-2018<sup>ix</sup>.

#### **Some of databases are exclusively for Indian medicinal plants, containing information of Ayurveda and their detailed explanation as follows:**

1. Encyclopedia of Indian Medicinal Plants- This is a well referenced dynamic database. It grows based

- on authentic scientific publications available in the said area<sup>x</sup>.
2. Database on Medicinal Plants- Comprehensive Database on Some Important Medicinal Plants having High Trade Value, a project sponsored by National Medicinal Plants Board, Department of AYUSH has been executed by Central Council for research in Ayurvedic Sciences successfully and the data have been displayed in the form of an e-portal entitled “Database on Medicinal Plants”<sup>xi</sup>.
  3. AYURMEDBASE (Ayurvedic Medicinal Database) - The database provides 147 plants information and their uses. The common name, scientific name and other details with ayurvedic uses have been presented. This database is highly useful to people in the treatment and cure of diseases naturally from plants of Andhra Pradesh<sup>xii</sup>.
  4. National Library of Ayurveda Medicine (NLAM) - First online database of *Ayurveda* formulations, medicines or drugs. The goal of the National Library of *Ayurveda* Medicine is to make *Ayurveda* available to everyone<sup>xiii</sup>.
  5. Aushadhi Kosh Software- Aushadhi Kosh is unique database of Ayurvedic medicines & Herbs from more than 50 Ayurvedic texts.

**Table No.1. Detailed explanation of databases are exclusively for Indian medicinal plants, containing information of *Ayurveda*;**

Sr. no.	Name	Contents	Special features
1.	Encyclopedia of Indian Medicinal Plants	This exclusive and innovative search based database stores 7,637 botanical names (6,198 medicinal plants species) with 119183 vernacular names from 12 languages across India. List of 960 medicinal plant species forming source of 1289 botanical raw drugs in trade in the country. Nearly 2688 plant images are also available in the database. These pertain to 2273 unique species. Digital herbarium of 1807 species. There are geo-distribution maps of 1969 number of species. Raw drug gallery consists of 368 species of parts used/traded. State wise checklist and conservation required medicinal plants species are also enlisted in this database. The medicinal plant species included in the database have	A unique, well-researched, comprehensive database on Indian Medicinal Plants is now available for researchers, academicians, school students, ethno-botanists, conservationists, resource managers, nature enthusiasts <sup>xiv</sup> . FRLHT (Foundation for Revitalization of Local Health Traditions) has been developing over the past 20 years a comprehensive database on Indian Medicinal Plants. It covers various subject linked to natural resources used by Indian System of Medicine such as botanical and local names correlation, geo-distribution data, maps, propagation, trade information

		been compiled and arranged under the six Indian Systems of Medicine namely Ayurveda, Siddha, Unani, Homeopathy, Sowa-Rigpa and Folk.	etc. This is a well referenced dynamic database. It grows based on authentic scientific publications available in the said area.
2.	Database on Medicinal Plants	Nearly 33,700 references are collected pertaining to the 16 selected medicinal plants. Out of these, approximately 22,000 reprints / abstracts could so far have been collected. Collected data includes the classical literature from Ayurveda, Unani, Siddha and Homeopathy system of medicine as well as modern literature from various books and journals covering basic and applied science like Botany, Chemistry, Pharmacology, Pharmacy, Medicine, etc. The e-portal “Database on Medicinal Plants” will act as a common platform at which maximum possible published information on a particular medicinal plant can be accessed. <sup>xv</sup>	Comprehensive Database on Some Important Medicinal Plants having High Trade Value, a project sponsored by National Medicinal Plants Board, Department of AYUSH has been executed by Central Council for research in Ayurvedic Sciences successfully and the data have been displayed in the form of an e-portal entitled “Database on Medicinal Plants”.
3.	AYURMEDBASE	The database provides 147 plants information and their uses. The common name, scientific name and other details with Ayurvedic uses have been presented. This database is highly useful to people in the treatment and cure of diseases naturally from plants of Andhra Pradesh <sup>xvi</sup> .	In recent times focus on plant research has increased all over the world and a large body of evidence has been accumulated to highlight the immense potential of medicinal plants used in various traditional system of medicine. AyurMedBase is a medicinal plant database providing information and treatment of diseases.

<p>4.</p>	<p>National Library of Ayurveda Medicine (NLAM)</p>	<p>NLAM is a not-for-profit service that is funded entirely through donations. The present project is in phase-3 development. Database currently contains only Herbo-Metallo-Mineral preparation or <i>Rasaushadhi</i> and <i>Churnas</i> (Herbal powders). Other preparations like <i>Aasava/ Arishta</i> (Medicated Wines, Tinctures) etc. are to be updated.</p> <p>It contain 3 sections</p> <ul style="list-style-type: none"> <li>• Section 1- Allows dynamic searching of <i>Ayurveda</i> formulations which are categorized by their ingredients and their methods of preparation.</li> <li>• Section 2- This section provides the visitor with a direct search on information about various ingredients used in <i>Ayurveda</i> formulations.</li> <li>• Section 3-This section provides the visitor with a direct search on <i>Ayurveda</i> treatises and authors recorded in the NLAM database.</li> </ul>	<p>First online database of <i>Ayurveda</i> formulations, medicines or drugs. Contains thousands of <i>Ayurveda</i> herbs, minerals, metals and formulations, preparation methods, mineral and metal purification procedures links to <i>vedic</i> texts and botanical references, glossaries and all the extensive cross-referencing. The goal of the National Library of <i>Ayurveda</i> Medicine is to make <i>Ayurveda</i> available to everyone. The NLAM database contains botanical information about 700 plants which form an integral part of <i>Ayurveda</i> formulations. These herbs can be searched through the search box or can be accessed through individual formulation descriptions<sup>xvii</sup>.</p>
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5.	Aushadhi Kosh Software	<p>It gives detailed information about;</p> <ul style="list-style-type: none"> <li>• <i>Adhikara</i> (Title under which medicine is described)</li> <li>• <i>Phalashruti</i>(Uses)</li> <li>• <i>Kalpana</i> (Form of medicine) <i>Churna</i> (Powder) / <i>Ghrita</i> (Medicated Ghee) / <i>Taila</i> (Medicated Oils) / <i>Guggulu</i>, etc.</li> <li>• <i>Prayoga Vidhi</i> (Mode of Application) – <i>Anjana</i> (Collyrium) / <i>Abhyantara</i> (Internal) / <i>Gandusha</i> (Gargle) etc.</li> </ul> <p><u>Contents</u></p> <ul style="list-style-type: none"> <li>✓ (With Latin/English/Vernacular names) – <i>Guduchi</i>(<i>Tinospora cordifolia</i>) / <i>Suvarna</i>(Gold) etc.</li> <li>✓ <i>Avastha</i> (Specific condition) Parallel allopathic terms for different<sup>xviii</sup>.</li> </ul>	<p>Aushadhi Kosh is unique database of Ayurvedic medicines &amp; Herbs from more than 50 Ayurvedic texts. Database of 10,000+ Ayurvedic remedies &amp; 350+ medicinal plants (with various search options). It helps to narrow down the choice of remedies/herbs for different Symptoms/Diseases (Alopecia/Acne/Heart disease/Diabetes etc.) using various drug filters such as Powder (<i>Churna</i>), Decoction (<i>Kwatha</i>), Medicated Ghee (<i>Ghrita</i>), Medicated Oil (<i>Taila</i>) etc.</p>
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## DISCUSSION

Information Technology (IT) plays a vital role in every aspect of life. It can be used to perform the essential tasks that people need and use on the everyday basis and helps the consumers to generate maximum possible output within a short period of time. It provides electronic security, storage, and efficient communication.

Despite advances in science and technology, the desire to obtain information still exists in today's world. The contemporary community makes extensive use of technical gadgets to simplify information for many applications in the twenty-first century of technology.

Bioinformatics/System Pharmacology etc. are the example in biological science.

In the modern era, when the conventional medicine reached almost at every doorstep, there is an urgent need of techno-friendly gadget used in *Ayurvedic* system for present generation. Many IT related softwares, mobile applications, websites, databases are emerging now. Some software tool have been developed for clinical use, with regular improvements in availability, speed, and ease to use. They are Body Tune-Computerized Ayurvedic Medicare (CAM), Prakes, Prakriti, Madhava, Rasex<sup>xix</sup> etc.

Databases are useful in many different scenarios for storing data. It is typical to use a database when different sets

of data needs to be linked together. Large volumes of data can be stored in one place and multiple users can read and modify the data at the same time using a database.

Many indexed biomedical journal databases such as AYUSH research portal, Annotated Bibliography of Indian Medicine, Digital Helpline for *Ayurveda* Research Articles (DHARA), PubMed, Directory of Open Access Journals and Ayurvedic Research Database (ARD) which contain articles on biomedicine and Ayurvedic studies. Vidyanidhi, Shodhganga, Ayurvedic Research Database are mainly containing PG and PhD theses. NAMASTE-portal is for ASU standardized terminologies. TKDL and CSIR mainly contain details of formulations including *Ayurveda*. Medicinal plant information containing databases such as Encyclopedia of Indian Medicinal Plants, NLAM and Database on medicinal plants by CCRAS, etc. are observed with ayurvedic information. But in everywhere it was a generalized information, a compiled information from various classical texts with specific reference format is missing in all of these databases.

So by reviewing the databases available for *Ayurveda*, it is clear that there are few databases accessible and that more are being developed. Some databases were created, however they were not upgraded. Controversy, ambiguity, poor documentation, differing viewpoints, variations in word meanings across citations, drug identity, incomplete manuscripts, and so on are some of the basic limitations that are widening the communication gap not only among researchers but also among *Ayurveda*'s various stakeholders.

The future of technical gadgets appear bright with possibilities because of the huge systems that are appearing and will require novel means of handling and analyzing the data. Ever changing and improving technology has made people to expect all information in handy. Perhaps the day is not too far when databases will become advanced enough to store digital replicas of ourselves.

## CONCLUSION

Technology is becoming increasingly prevalent, and it may be a powerful instrument for bringing the power and science of *Ayurveda* to people all around the world. Unfortunately the upcoming technological gadgets make an effort to incorporate *Ayurvedic* information, but still it found to be below expectation.

It was discovered that while few stalwarts of *Ayurveda* use and share numerous revolutionary approaches and concepts related to information technology, the majority of the fraternity is still oblivious of them. Academic, clinical, pharmacy industry, and research fields in *Ayurveda* are all areas where we may apply IT to help the system. As a result, IT can be used for evidence-based documentation, data security, quick accessibility, global propagation, and much more.

*Ayurveda* is the most suitable system of medicine in which Information Technology can be applied, provided both the IT experts and *Ayurveda* experts have very clear idea about the potentiality of both systems. The fear of *Ayurveda* practitioners is that if we alter the traditionality, the system will perish. So they are reluctant to apply new technologies in the Ayurvedic system. To change their mindset, they must

realize that Ayurveda has global chance in this century as the most useful alternate system of medicine with vast opportunities.

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