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## Databases in Indian biology: The state of the art and prospects

Vishwas Chavan and D. Chandramohan

*Only 0.85% of the scanned 7500 database titles are related to biology and biotechnology developed in India. Of these, 73% are either bibliographic or directory type and the rest are textual, numeric or multimedia in nature. This paper reviews the Indian biology and biotechnology databases and their relation to international databases on the subject. It highlights their limitations and throws more light on their potential for subject experts and information managers in the country to build informative and interactive databases.*

THE amount of information being generated in the field of biology and biotechnology all over the world is unprecedented, and its management calls for an efficient system of databases. The present paper reviews the biology- and biotechnology-oriented Indian databases and their relation to the internationally available data

titles on the subject; it discusses their shortcomings and prospects for database developers, information providers and subject experts in creating more informative, user-friendly data titles.

### The study

Detailed information about the international databases was gathered through various published and unpublished

Vishwas Chavan and D. Chandramohan are in the Bioinformatics Centre, Biological Oceanography Division, National Institute of Oceanography, Dona Paula, Goa 403 004, India.

sources. Searches were also made on databases like the 10th CDROM edition of the TPFL database, which contains information about more than 4600 CDROM titles. Information about Indian data titles was gathered through a survey of more than 400 major R & D and academic institutions of the country.

Information gathered was managed in a databank developed employing dBase III+. This databank contains information on various aspects of data titles such as acronym, information provider and developer, subject and time coverage, update frequency, output mode, operating systems, computer and software required, languages, access policy and prices.

### Databases in biology: A global status

Of the 7500 databases available worldwide, 75% are related to biology and biotechnology, of which more than 60% are bibliographic or directory type and the rest are numeric, textual, image or multimedia in nature. Majority of these databases, with few exceptions are available in print, CDROM, tape and online mode.

These databases cover almost every aspect of biology and biotechnology. Though many of them deal with specific branches of the biological sciences, few are multidisciplinary. Few of the data bases are compilations of more than one database, giving broader subject access to the user. Along with the environment-sensitive aspects of biology, these data titles include aspects like medicine, pharmacology, health, hygiene, occupation, agriculture, biodiversity and current awareness in the field of biology and biotechnology. Though most of them address the global need of users, those developed especially in USA, UK, Canada, Australia and European countries satisfy the local user needs too. Many of the multimedia databases in biology discuss the fundamentals in biology and thus prove to be a useful tool in teaching.

### Indian biology databases: The facts

Only 64 (0.85%) of the scanned 7500 database titles are related to biology and biotechnology developed in India. Out of these 64 Indian biology-biotechnology databases, about 73% (47) are bibliographic or directory type in nature (Table 1). Only 17 (27%) databases are numeric, textual, image or multimedia type (Table 2).

Majority of these database titles are developed as a part of the BTIS Network (Department of Biotechnology, Government of India), whereas contribution from other networks like ENVIS (Ministry of Environment and Forest), SIRNET (Council of Scientific and Industrial Research), etc., are marginal in the development of widely circulated databases. The only exception is the 'Paryavaran Abstract' of ENVIS.

Lack of commercial approach in database development

leads to non-uniformity in terms of database pattern and retrieval programmes. As many bibliographic databases are not supported by search and retrieval programmes, they are available only in print form.

Many of the available bibliographic titles cover only the information published after 1970. Thus, searching older literature by traditional ways takes a lot of time. The use of these databases is restricted due to a lack of electronic data transfer facility as well as of distributed information networks.

### Indian biological databases: Their potential

A major advantage for the database developers in the country is the easily available manpower for data collection and management. Proper deployment of manpower and coordination with experts can result in databases of international standard.

As majority of the bibliographic titles are developed in CDS/ISIS or in dBase, they can easily be brought together and compiled subjectwise. Current awareness data titles must be developed along with the databases providing information about research work, projects completed, those ongoing and in pipeline in different fields of biology and biotechnology. This type of information can easily be gathered from various funding agencies like ICMR, ICAR, CSIR, DBT, DST, DSIR, DOD, DoEn, DAE, UGC and many other private organizations. It would be very useful if a comprehensive database of the available postgraduate, doctoral and postdoctoral dissertations and theses can be built, as our universities and other institutions contribute significantly through such publications.

More and more subject-specific, interactive, textual, numeric, descriptive and multimedia databases need to be developed. Database on profiles of subject experts involved in various fields of biology and biotechnology could be developed. Subject experts have a vital role to play in developing such multi-locational-seasonal-componental-elemental databanks with data generated in ecology and pollutional studies. Databases covering aspects of biodiversity and distribution of natural resources would be of great significance.

Third World countries have a great potential in information generation, which has been overlooked or ignored until now. International database-generating houses in collaboration with appropriate Indian National Bodies can jointly take up the task of collating this vast and valuable information.

Databases should be developed for target end-users such as specific kinds of patients, farmers, students, industries, etc. Databases by National Cancer Institute of USA and many other biomedical databases are of this type.

Databases/databanks providing information about the

Table 1. Bibliographic, directory databases in Indian biology

Database title	Provider	Subject coverage	Period	Geographic cover	Output mode
Abstracts of Current Literature in Toxicology	Indian Toxicological Research Institute, Lucknow, India	Toxicology, pollution, biomedical sciences, medicine, environment, health, life sciences, chemical sciences	1984-	India	Print
BTIS-BOSE	Bioinformatics Centre, Bose Institute, Calcutta	Genetic engineering, biotechnology, biological sciences	1989-	India	Floppy, print
Bibliography of Indian Agriculture	Indian Agricultural Research Institute, New Delhi	Agricultural sciences, life sciences, environment, resources management, crop production, pollution	1944-	India	Print
Bibliography of Indian Zoology (BIBLPHY INDIAN ZOO)	Zoological Survey of India, Calcutta	Zoology, life sciences, pollution, environment, conservation, biodiversity	1958-	India	Print
Biotechnology Research Centres Address	Bioinformatics Centre, National Environmental Engineering Research Institute, Nagpur	Biotechnology, research centre, mailing details, contact persons, India	—	India	Floppy, print
Blood of CRI Personnel	Bioinformatics Centre, Cancer Research Institute, Bombay	Biomedical sciences, blood, mailing details	—	India	Floppy, print
Citrus Tissue Culture	Bioinformatics Centre, Assam Agricultural University, Jorhat	Agricultural sciences, biotechnology, tissue culture, citrus	—	—	Floppy, print
Communicable Diseases	Bioinformatics Centre, National Institute of Immunology (NII), New Delhi	Biomedical sciences, medicine, pharmacology, communicable diseases, virology, environment, health, safety, hygiene,	—	—	Floppy, print
Crystal Structure Database	Bioinformatics Centre, Aligarh Muslim University, Aligarh	Biological sciences, crystallography, proteins, genetics, biochemistry	1973-	—	Floppy, print
Current Literature on the Science of Science (CLOSS)	National Institute of Science, Technology & Development, New Delhi	Basic and applied sciences, technology and engineering	—	India	Print
Current Research in Plant Sciences	National Botanical Research Institute, Lucknow	Life sciences, biotechnology, environment, botany, pollution, toxicology, conservation	1990-	India	Floppy, print
DICLIS	Bioinformatics Centre, Indian Institute of Science (IISc), Bangalore	Biological sciences, biotechnology, bioinformatics, computer sciences, catalog, serials	—	India	Floppy, print
Enzymology Database	Bioinformatics Centre, Aligarh Muslim University, Aligarh	Enzyme kinetics, immunological techniques, biomembranes, microbial toxins, hormone action, nuclear magnetic resonance, complex carbohydrate, protein purification	1983-	—	Floppy, print
Fmdpack	Bioinformatics Centre, Indian Veterinary Research Institute (IVRI), Izatnagar	Foot diseases, mouth diseases, animal sciences, veterinary sciences, live stocks	1955-	India	Floppy, print
Food Technology Abstracts	Central Food Technological Research Institute (CFTRI), Mysore	Food sciences, processing technology, storage	1987-	India	Print
Food Science & Technology Abstracts	Central Food Technological Research Institute (CFTRI), Mysore	Food sciences, food processing technology	1987-	India	Print
Indian National Bibliography	Central Reference Library, Calcutta	Science & technology, arts & commerce, humanities & social sciences	—	India	Print
Indian Patents in Biotechnology	Patents Division, Council of Scientific & Industrial Research (CSIR), New Delhi	Life sciences, biotechnology, patents, India	1972-	India	Floppy, print

# GENERAL ARTICLES

Table 1. (Contd)

Database title	Provider	Subject coverage	Period	Geographic cover	Output mode
Indian Science Abstracts	Indian National Scientific Documentation Centre (INSDOC), New Delhi	Science & technology, biology, physics, electronics, geology, geography, biotechnology, life sciences, technology, engineering, computer sciences	—	India	Floppy, print
Library Database	Bioinformatics Centre, Indian Agricultural Research Institute (IARI), New Delhi	Agricultural sciences, food sciences, life sciences, biotechnology, India	—	India	Floppy, print
Ligpack	Bioinformatics Centre, Indian Veterinary Research Institute (IVRI), Izatnagar	Lignin, biotechnology, animal sciences, veterinary sciences, life sciences, live stocks	1955–	India	Floppy, print
METHANOG	Bioinformatics Centre, Bose Institute, Calcutta	Life sciences, biotechnology, microbiology, energy resources	1947–	India	Floppy, print
Membrane Biology 3.0	Bioinformatics Centre, University of Delhi, South Campus, New Delhi	Life sciences, chemical sciences, biochemistry, membrane biology, liposome, toxins, immunology	1975–	India	Floppy, print
National Union Catalogue of Science Serials in India	Indian National Scientific Documentation Centre (INSDOC), New Delhi	Science, technology, biology, physics, geology, geography, environment, electronics, computer sciences	—	India	Print
Database on <i>Agrobacterium tumefaciens</i>	Bioinformatics Centre, School of Biological Sciences, Madurai	Life sciences, microbiology, agricultural sciences	—	—	Floppy, print
Database on <i>Bacillus thuringiensis</i>	Bioinformatics Centre, School of Biological Sciences, Madurai	Life sciences, microbiology, bacteria	—	—	Floppy, print
Database on CRI Staff Publications	Bioinformatics Centre, Cancer Research Institute, Bombay	Biomedical sciences, medicine, pharmacology, toxicology, pathology, cancer, carcinogens, treatment	—	India	Floppy, print
Database on Indian Experts in Biotechnology	National Centre for Science Information, Indian Institute of Sciences (IISc), Bangalore	Life sciences, biological sciences, experts, biotechnology	—	India	Online, floppy, print
Database on Serials of Biotechnology in India	Indian National Scientific Documentation Centre, New Delhi and DBT, New Delhi	Biological sciences, biotechnology, periodicals, books, journals, libraries	—	India	Floppy, print
Database on Theses of CRI Students	Bioinformatics Centre, Cancer Research Institute, Bombay	Biological sciences, biomedical sciences, medicine, pharmacology, cancer, carcinogens, toxic chemicals, mutagens, environment, health, treatment	—	India	Floppy, print
Directory of Biotechnology Institutions	Bioinformatics Centre, Biotechnology Consortium Ltd., New Delhi	Biological sciences, biotechnology, Indian experts	—	India	Floppy, print
Directory of Biotechnology Resources	Bioinformatics Centre, Biotechnology Consortium India Ltd., New Delhi	Life sciences, biotechnology, resource persons, India	—	India	Floppy, print
Directory of NRI Experts	Bioinformatics Centre, Biotechnology Consortium Ltd., New Delhi	Life sciences, biotechnology, experts, non-resident Indians	—	—	Floppy, print

Table 1. (Contd.)

Database title	Provider	Subject coverage	Period	Geographic cover	Output mode
Environmental Biotechnology	Bioinformatics Centre, National Environmental Engineering Research Institute, Nagpur	Environment, management, conservation, pollution, toxicity, engineering, legislation, monitoring, quality restoration, resources utilization, treatment	1986-	—	Floppy, print
Environmental Biotechnology Journal Holdings	Bioinformatics Centre, National Environmental Engineering Research Institute, Nagpur	Life sciences, pollution, environment, journals, periodicals,	—	—	Floppy, print
Enzyme Database	Bioinformatics Centre, Aligarh Muslim University, Aligarh	Life sciences, chemical sciences, enzymes, catalyzes, biochemistry	1983-	—	Floppy, print
Oceanline	National Institute of Oceanography (NIO), Goa	Marine sciences, oceanography, physics, chemistry, geology, biology, remote sensing, natural resources, biodiversity, pollution, ecology, environment	1989-	India	Print
Paryavaran Abstracts	Environmental Sciences Information System (ENVIS), Ministry of Environment and Forest, New Delhi	Life sciences, biology, pollution, toxicity, management, conservation, biodiversity, environment, protection, India	1984-	India	Floppy, print
Patents (Vaccines/Immunology)	Bioinformatics Centre, National Institute of Immunology (NII), New Delhi	Biology, life sciences, biotechnology, immunology, vaccines, health, patents	—	—	Floppy, print
Plant Tissue Culture Database	Bioinformatics Centre, Delhi University, New Delhi	Life sciences, biotechnology, plant, tissue culture	1989-	Worldwide	Floppy, print
Pubpack	Bioinformatics Centre, Indian Veterinary Research Institute (IVRI), Izatnagar	Veterinary sciences, animal sciences, life sciences, India	1955-1990	India	Floppy, print
Quick Access Biotechnology Project Information System	Bioinformatics Centre, National Environmental Engineering Research Institute (NEERI), Nagpur	Environment, biotechnology, research projects, India	—	India	Floppy, print
REFERA 11	Bioinformatics Centre, School of Biological Sciences, Madurai	Biology, environment, rotifera, life sciences	1696-1900	Worldwide	Floppy, print
Research Profile of Biotechnology Activities in India	Biotechnology Information System (BTIS), Department of Biotechnology (DBT), New Delhi	Life sciences, biotechnology, institutions, experts, projects, research, India	—	India	Online, floppy, print
Rumpack	Bioinformatics Centre, Indian Veterinary Research Institute (IVRI), Izatnagar	Rumen, bacteria, fungi, protozoa, rumen microbiology, animal nutrition, animal physiology	1955-1990	India	Floppy, print
Sequence Analysis Database	Bioinformatics Centre, Aligarh Muslim University, Aligarh	Genetics, sequence analysis, biotechnology, amino acids, protein, nucleic acid, antigenicity, hydrophobicity	1983-	—	Floppy, print
Thespack	Bioinformatics Centre, Indian Veterinary Research Institute (IVRI), Izatnagar	Life sciences, veterinary sciences, theses	1955-	India	Floppy, print

Note: Dash sign (-) against the year in 'Period' column indicates the continuing nature of the database

## GENERAL ARTICLES

Table 2. Textual, numeric and multimedia multisubject databases in Indian biology

Database title	Provider	Subject coverage	Period	Geographic cover	Output mode
Animal Virus Databank	Bioinformatics Centre, University of Poona, Poona, India	Animal viruses, biological sciences, systematics, computer-aided identification	—	—	Online, floppy, print
Crop Productivity Database	Bioinformatics Centre, Indian Agricultural Research Institute (IARI), New Delhi	Agricultural sciences, crop production, life sciences, economics	—	India	Floppy, print
Databank on Toxic Chemicals	Indian Toxicological Research Institute, Lucknow	Life sciences, toxicology, environment, chemistry, toxic chemicals	1986—	—	Print
Database on Carcinogens/Mutagens	Bioinformatics Centre, Cancer Research Institute, Bombay	Biomedical sciences, pharmacology, medicine, pathology, health, environment, toxicology, cancer, carcinogens, mutagens	—	—	Floppy, print
INODC Biological Database	Indian National Oceanographic Data Centre (INODC), National Institute of Oceanography, Goa	Life sciences, natural living resources, biology, oceanography, zooplankton, biomass, chlorophyll, primary productivity, Indian seas	1960—	Indian Ocean, Arabian Sea, Bay of Bengal	Tape, floppy, print
Indian National Database on Marine Biology and Marine Biotechnology	Bioinformatics Centre, National Institute of Oceanography (NIO), Goa	Marine biology, biotechnology, publications, research projects, patents, experts, workshops, conferences, India	1990—	India	Floppy, print
Land Use Database	Bioinformatics Centre, Indian Agricultural Research Institute (IARI), New Delhi	Agricultural sciences, land use pattern, India	—	India	Floppy, print
Marine Products Database	Bioinformatics Centre, Central Drug Research Institute (CDRI), Lucknow	Natural resources, marine biotic resources, India, biological activity, environment	—	India	Floppy, print
Meteorological Database	Bioinformatics Centre, Indian Agricultural Research Institute, (IARI), New Delhi	Agricultural sciences, meteorology, climate, atmosphere, India	—	India	Floppy, print
Methanog 2 0	Bioinformatics Centre, Bose Institute	Methanogenic bacteria, sequences, coenzymes, microbiology	1974—	India	Floppy, print
Monoclonal Antibodies to Cryptokeratins	Bioinformatics Centre, Cancer Research Institute, Bombay	Cancer, antibodies, biomedical sciences, medicine, pharmacology, carcinogens	—	—	Floppy, print
NIO's Database on Marine Life of India (NIODMLI)	Bioinformatics Centre, National Institute of Oceanography (NIO), Goa	Life sciences, oceanography, biology, biodiversity, ecology, biogeography, economy, utilization, conservation, management, pollution, taxonomy, biology	—	Indian seas	Floppy, print
Natural Products Database	Bioinformatics Centre, Central Drug Research Institute (CDRI), Lucknow	Life sciences, chemical sciences, environment, natural biotic resources, toxicity, biological activity	—	India	Floppy, print
Rice Germplasm	Bioinformatics Centre, Assam Agricultural University, Jorhat	Agricultural sciences, rice, germplasm, crop production	—	India	Floppy, print
SeqPDB	Bioinformatics Centre, Indian Institute of Science (IISc), Bangalore	Genetics, protein sequences, life sciences	—	—	Floppy, print
Soils Database	Bioinformatics Centre, Indian Agricultural Research Institute (IARI), New Delhi	Agricultural sciences, soil sciences, pollution, productivity, deterioration, environment, irrigation, natural resources	—	India	Floppy, print
Wet Land 1 0	Bioinformatics Centre, Bose Institute, Calcutta	Wetland, environment, life sciences, degradation, pollution, use, management, abuse, socioeconomics, prevention, conservation, sustainable development	1977— 1986	West Bengal, India	Floppy, print

Note: Dash sign (—) against the year in 'Period' column indicates the continuing nature of the database.

manufacturers of equipment/technical products such as agricultural equipments, fisheries, instruments, biology-biotechnology instruments/chemicals, food and scientific appliances, etc., need to be developed.

Usage of the databases can be encouraged by providing translation facility from English to vernacular language and vice-versa. In fact, in the Indian situation this is the most important and appropriate solution towards spreading biological knowledge to the community at the grass-roots level.

Our national networking agencies should start developing databases in areas which have not been touched so far and for which an in-depth treatment is lacking in global databases. Some of these areas are biostatistics, local living resources and chemistry, medicinal and aromatic plants, traditional systems of medicine, etc. CSIR's recent collaboration with the IDRC, Canada, to develop Asian Information on Health and Environment is a step towards this. These conventional STI programmes should extend their activities to areas of business and financial information as well, by promoting generation of a whole new set of databases and services that the business people also require.

India has emerged as the frontier nation among the Third World countries having its own effective, efficient information network. With the setting up of NICNET (Network of the National Informatics Centre, New Delhi) and its reaching to Taluka level by the end of the Eighth Five Year Plan, it would be possible to disseminate biological knowledge practically to every nook and school of the country. In fact, the success of biomedical information dissemination using NICNET is highly encouraging and databases and databanks related to other

fields of biology developed within the country can also be put on the network. It has been felt that NICNET or NICNET-supported BTISNET can play a major role in disseminating the information of current interest.

However, decentralized delivery options such as floppy disks, CD ROM and magnetic tapes are still of significance in our situation. These would minimize the use of telecom services, thereby saving the expenditure on online communications.

### Conclusion

It has been felt that more and more subject-specific, textual, numeric, multimedia and interactive databases addressing the local, national as well as global needs must be developed. Though we need to use online media to disseminate these databases, decentralized delivery options can also be utilized with advantage in our situation. It has become evident from our past experience that more and more participation of subject experts and collaboration with international database-developing houses are a must. Uniform formats for acquisition, storage, retrieval and dissemination need to be developed. India has great potential in developing more informative and interactive subject-specific and broad-ranged databases in biology and biotechnology which needs to be tapped.

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### REVIEW ARTICLES

## The chemistry of a non-natural product: Tröger's base\*

**Braja Gopal Bag**

Department of Organic Chemistry, Indian Institute of Science, Bangalore 560 012, India

Tröger's base was the first amine to be resolved where the chirality was solely due to very high inversion barrier around nitrogen atom(s). Though the molecule was known over a century, work done during the past one decade has shown that Tröger's base and its analogues could be used as chiral solvating agents, DNA-binding ligands and for the construction of biomimetic molecular receptors and clathrate hosts.

Asymmetric synthesis of Tröger's base analogues has also been achieved recently. Because of the rigid, 'V'-shaped chiral nature of this molecule, there is a growing interest for use of this unit in the design of potential host systems. This review article focuses on the chemistry of Tröger's base along with the possible future utilities.

OVER the centuries chemists have tried to understand nature. Synthetic organic chemists took it as a challenge to synthesize natural products in the laboratory. The

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