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GUIDELINES FOR SETTING UP DATA BASES ON MEDICINAL PLANTS*

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* The views expressed in this paper are the author's and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

** Publishing Director, B.I. Churchill Livingstone, New Delhi

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Introduction

As a follow-up action to the recommendations of the Third Consultation on the Pharmaceutical Industry held in Madrid, Spain, from 5 to 9 October 1987, and in order to facilitate collection of information by interested countries, an attempt has been made by UNIDO to draw up guidelines for the setting-up of data bases on medicinal plants.

The document provides a short account of existing data bases on the international level. It also describes the evolution of computer readable data bases from traditional abstracting and indexing journals.

The importance of establishing data bases on medicinal plants has been explained. The document provides pertinent information with regard to criteria and infrastructural requirements for setting up a data base at the national level, it also includes proposals on how to proceed with regional networking of national data bases. It also gives a schedule for design development and requirements for hardware and software, personnel requirements, budget planning, etc.

Additionally, steps involved in the preparation of a monograph on medicinal plants have been described and examplified by giving details on Senna.

1. EXISTING MAJOR DATA BASES

There are today several hundred data bases of different size, scope and function, the majority of them being based in the USA. Many of these information systems and data bases have developed as a result of mechanization of traditional abstracting and indexing journals, e.g. BIOSIS from Biological Abstracts, Chemical Abstracts Service from Chemical Abstracts and MEDLINE from Index Medicus. Others are new creations and some of them, for instance those developed by FAO and IAEA, are international in organization, input and use.

Some of the systems have limited their function to the production of data bases and abstracting/indexing journals, and encourage other organizatons to purchase their data bases and run services from specially created systems at national, regional, or international levels. A commercial vendor may hold several data bases which can be accessed online by users anywhere in the world depending uon the availability of telecommunication facilities. The services are charged mostly on the basis of connection time to the computer.

Information networks on geographical pattern such as national, regional and international, are now coming up more in number. This trend towards national and international co-operation in information sharing is basically due to economic factors.

The majority of computer-readable data bases are very broad-based, covering several related fields. There are only few that deal exclusively with medicinal and aromatic plants.

The more important information services and their products (data bases, abstracting/indexing journals) relevant to the fields of medicinal and aromatic plants are described here (1.1, 1.2, 1.3).

1.1 Biosciences Information Service (BIOSIS)

(a) Scope and description

BIOSIS is a broad-based secondary information service covering worldwide literature in biological and biomedical sciences. Input is derived from some 9000 periodicals published in over 100 countries, and books, monographs, reviews, research reports and symposia proceedings.

Information services and products, inter alia, are:

(i) Biological Abstracts. This is a semi-monthly periodical containing about 19,000 abstracts and citations per annum. It is indexed by author, broad taxonomic category, genus-species, broad subject concept, and specific subject. The contents are grouped into a number of sections. The sections of interest to the field of medicinal plants are: Agronomy, Botany, Economic Botany, Pharmacognosy and Pharmaceutical Botany, Pharmacology, Plant Physiology, Biochemistry and Toxicology.

(ii) Mechanized data base and services. BIOSIS data base is made available through tapes and diskettes, SDI services, and online access.

BIOSIS Previews service offers four tapes per month containing citations and index terms from Biological Abstracts. The BAT service provides semimonthly tapes of abstracts appearing in Biological Abstracts. Another product of the BIOSIS data base is a monthy current awareness service termed B-I-T-S.

Online searching of this data base is available worldwide through several vendors including DIALOG Information Services, Biblographic Retrieval Service (BRS), CAN/OLE (Canadian On-Line Enquiry), DIMDI (German Institue for Medicinal Documentation and Information), Data-Star, ESA/IRS, JICST. Offline services are provided by some other organizations.

(b) Utility

Information from this data base is mainly on R&D work and the areas of interest to the subject under discussion are mentioned above under Biological Abstracts.

(c) Address: 2100 Arch Street
Philadelphia, PA 19103-1399
USA

1.2 Chemical Abstracts Service (CAS)

(a) Scope and description

CAS uses advanced computer-based systems for providing information on scientific and technical literature and patents relating to all aspects of chemistry. The contents of over 12,000 journals from 150 countries are scanned for its input. CAS also covers patents issued by 28 national patent offices, books reviews, monographs, conference proceedings, and technical reports.

Information services and products of CAS include:

(i) Chemical Abstracts (CA). Issued weekly, this secondary journal publishes annually over 450,000 abstracts These are grouped in a number of sections and those containing items on medicinal and aromatic plants are: Terpenes and Terpenoids, Alkaloids, Steroids, Amino Acids, Peptides and Proteins, Fats and Waxes, Pharmaceutical Analysis, Pharmacology, and Plant Biochemistry.

(ii) CA Selects. A series of subject-specific current awareness bulletins containing relevant abstracts from CA, are issued every two weeks.

(iii) Chemical Titles (CT). This is another current awareness service issued semimonthly. Each issue includes important research articles, a KWIC index, bibliographdy, and author index.

(iv) Mechanized data bases and services.

CAS Registry Number. This is an important feature of CAS. The computerized Chemical Registry System identifies chemical substances by structure and assigns each substance a unique number for identification. The Registry File contains records for chemical substances cited in CA since 1965.

CAS Search and SDI services. The computerized file of CA Search is based on sources scanned by the basic Chemical Abstracts Service. The data elements include keywords, keyword phrases, CA subject index terms, bibliographic terms and CAS Registry Numbers. This service conducts searches of the CAS ONLINE files on fee basis.

CAS ONLINE. It provides both subject-oriented and structure-oriented searching of chemical literature through three CAS files, viz. (1) CA file from 1967 onwords, (2) CAOLD file containing bibliographic data cited in Chemical Abstracts prior to 1967, and (3) Registry file. The data elements that can be searched are given under CA search.

Substances in the Registry file can be identified by entering a molecular structure, a sub-structure diagramme, a chemical name, a common name, or Registry number. Structure queries can be created by typing commands on any standard keyboard terminal, selecting items from a menu, or drawing on special graphics terminals, then specifying atoms, bond types and bond values.

The users of CAS ONLINE can order prints of bibliographic data identified in their search, as also original documents of the citation retrieved.

Online vendors of CAS include DIALOG, ESA/IRS, BRS, CAN/OLE, Data-Star, Telesystemes Questel, and Pergamon-Infoline.

(b) Utility

CAS is very strong as regards R&D work in chemistry. Literature pertaining to industrial applications of medicinal plants and patents relating to chemistry and chemical engineering are also covered. Specific areas of interest are enumerated under Chemical Abstracts.

(c) Address: American Chemical Society
2540, Olentangy River Road
P.O. Box 3012
Columbus, OH 43210
USA

1.3 MEDLINE (MEDLARS Online)

(a) Scope and description

The Medical Literature Analysis and Retrieval System (MEDLARS) of the US National Library of Medicine covers pre-clinical and cinical medical sciences, life sciences and other subjects related to health sciences. Input is obtained from 3200 journals published in over 70 countries.

Information services and products include:

(i) Index Medicus. It is a computer-produced secondary serial issued monthly. Items are indexed using controlled vocabulary termed MeSH (Medical Subject Headings), developed by the National Library of Medicine (NLM). Authors, titles, abstracts, MeSH terms and other bibliographic elements can be searched. Over 25,000 items are added annually. Entries relating to medicinal plants occur under the following sections: Plant Extracts, Plant Poisoning, Plants, medicinal, and Plants, toxic.

(ii) MEDLINE. It is an interactive data base of MEDLARS providing access to biomedical journals literature of the world. It is based on citations prepared for Index Medicus, and other files such as TOXLINE (Toxicology Information Online) and Toxicology data base of NLM.

(iii) CHEMLINE. The file consists of over 1 million chemical substances cited in MEDLINE and TOXLINE. It is searchable by names and corresponding CAS Registry number, molecular formulae and segments, synonyms, ring analysis and other structural elements.

MEDLARS is available through NLM, DIALOG, BRS and some online services outside the USA. WHO provides online services from its regional offices.

(b) Utility

The sections of interest in this data base are mentioned under Index Medicus. Items relating to pharmacologically active substances isolated from plants can be searched from CHEMLINE.

(c) Address: National Library of Medicine
8600 Rickville Pike
Bethseda, MD 20209
USA

1.4 CAB Abstracts

(a) Scope and coverage

The computer-readable data base of the Commonwealth Agricultural Bureaux (CAB) is the leading information service in the world in the agricultural sciences and related applied biology areas. Input for the data base is derived from over 10,000 journals, books, reports, patents and other relevant material. Annually over 18,000 items are added to the data base, which is updated monthly.

Information services and products of CAB include:

(i) Abstracting journals. Nearly 50 abstracting journals are being produced from the data base. Of these, Horticultural Abstracts is the most relevant one for this report. Entries on medicinal and aromatic plants occur in the section on Minor Temperate and Tropical Industrial Crops which is further sub-divided into Medicinal Plants, Condiments and Spice Plants, Essential Oils Plants and Insecticidal/Pesticidal Plants.

(ii) Data base. Total file or sub-files corresponding to individual abstracting journals are searchable using titles, abstracts, keywords, name of the authors and organizations, document language, publisher, journal name and subject codes, corresponding to the headings in the CAB journals.

The data base is available online through several vendors including DIALOG, ESA/IRS, DIMDI. Computer tapes are also availabe from CAB.

(b) Utility

Areas that are of interest are mentioned above under Horticultural Abstracts. Information is naturally more on agricultural aspects.

(c) Address: Commonwealth Agricultural Bureaux
Farnham House - Farnham Royal
Slough SL2 3BN
UK

1.5 AGRIS

(a) Scope and description

International Information System for Agricultural Sciences and Technology (AGRIS) is a decentralized system designed by FAO to carry out the collection, storage and retrieval of information in the field of agricultural and related sciences. National and regional input centres, throughout the world, 130 in number, provide bibliographic patents, etc. to the Coordinating Centre in Rome for integrating and computer processing.

Information services and products include:

(i) AGRINDEX. It is the printed publication issued monthly.

(ii) AGRIS data base. The data base is updated monthly from the inputs received from the AGRIS centres. It holds about 1 million records.

Online access and SDI services are available through ESA/IRS, DIMDI and some national/regional AGRIS centres.

(b) Utility. The records relating to medicinal and aromatic plants are limited and are mainly on agrotechnology of these plants.

(c) Address: Food and Agricultural Organization (FAO)
AGRIC Coordinating Centre
Via delle Terme di Caracalla
I-00100 Rome
ITALY

1.6 CARIS

(a) Scope and description

Current Agricultural Research Information System (CARIS) is another decentralized system of FAO designed to collect, process, store and disseminate information on agricultural research, institutions, workers and current projects in the developing countries. Inputs are received at the Coordinating Centre, Rome, from regional and national centres.

(b) Utility

Information on medicinal plants is very limited in this data base.

(c) Address: Food and Agricultural Organization (FAO)
CARIS Coordinating Centre
Via delle Terme di Caracalla
I-00100 Rome
ITALY

1.7 Institute for Scientific Information (ISI)

(a) Scope and description

ISI maintains a multi-disciplinary data base and the input is derived from more than 7000 journals.

Information services and products include several printed publications and computer-readable files available online or on magnetic tapes.

(i) Current contents. This is issued weekly in seven editions, each covering 1000 journals. Editions of interest to the field of medicinal and aromatic plants are: Life Sciences, Chemical Sciences, Agriculture & Biology, Clinical Practice.

(ii) Current Abstracts of Chemistry and Index Chemicus. This is a weekly, covering 1100 chemical journals.

(iii) Science Citation Index (SCI). It appears bimonthly and covers 4000 journals. SCI contains sources, citations, corporate and title keyword indexes. It is also considered an important tool to determine impact factors of the journals it covers, which in turn indicate world ranking of these journals.

(iv) SCISEARCH. This data base holds all records published in SCI, with additional records from editions of Current Contents. It contains over 6 million records since 1974.

SCISEARCH is available online through DIALOG. Computer tape leasing services are available for selected ISI data bases.

(b) Utility

The disciplines of interest in this data base are mentioned above under Current Contents. The weekly issues keep one abreast of the latest researches.

(c) Address: 3501 Market St.
Philadephia, PA 19104
USA

1.8 Excerpta Medica (EM)

(a) Scope and description

EM covers worldwide literature on basic and clinical research in biomedical fields. Input is derived from 3500 biomedical journals, besides books, conference proceedings, etc.

The products include 44 abstracting journals, indexes and computer readable data bases.

(i) EMBASE. This data base has records from 44 EM abstracting journals and indexes. It holds about 4 million records, with an annual addition of 250,000 items. It is available online through BRS, Data-Star, DIALOG and DIMDI.

(ii) The sub-file EMDRUGS (also known as DRUGDOC) provides information from EM's abstract sections on pharmacology and from Drug Literature Index. It is available online through DIMDI and ESA/IRS.

(b) Utility

EM is of very limited use for the subject of this report, except for the pharmacology sections.

(c) Address: Elsevier Science Publishers B.V.
Biomedical Division
P.O. Box 1527, Molenvarf I
NL-100 BM Amsterdam
THE NETHERLANDS

1.9 NAPRALERT

(a) Scope and description

NAPRALERT (Natural Products Alert) covers worldwide literature on the chemical constituents and pharmacology of plant, microbial and animal (primarily marine) extracts. The scope includes chemistry and pharmacology of secondary metabolites of known structure, derived from natural sources.

Input of this data base is obtained from about 200 important primary journals in this field, and through scanning of several abstract journals, including Chemical Abstracts, Biological Abstracts, Index Medicus, Medicinal and Aromatic Plants Abstracts, and Current Contents (Life Sciences edition). Report on ethnomedical (folklore) traditional uses of plants are also processed.

NAPRALERT is available to the users on a scheduled fee basis, applicable to ethnomedical, experimental biological activity, and/or chemical constitutent profiles. Besides these three profiles, several other types of data on medicinal plants are provided, including Biosynthesis; Plant tissue culture; Information sources on the various spectroscopic means for identifying natural products, e.g. IR, UV, MS, CMR, NMR, X-ray and DRD; Agronomic studies, review articles, etc.

NAPRALERT is supported, in part, by National Science Foundation (USA), National Cancer Institute (USA) and WHO.

(b) Utility

NAPRALERT is one of the few data bases in the world covering literature mainly on medicinal plants. It is strong on the chemistry and pharmacology of the plants.

(c) Address: Programme for Collaborative Research
in the Pharmaceutical Sciences
College of Pharmacy
University of Illinois at Chicago
P.O. Box 6998
Chicago, Illinois 60690
USA

1.10 MAPIS

(a) Scope and description

Established in 1976, Medicinal and Aromatic Plants Information Service (MAPIS) is one of the few data bases in the world devoted exclusively to medicinal and aromatic plants. All aspects of such plants, occurring in India, are covered. Input is derived from 650 primary journals from over 50 countries, besides proceedings of conferences. Input is also received from collaborating organizations in Japan, Thailand, New Zealand, Australia and Indonesia.

Information services and products include:

(i) Medicinal and Aromatic Plants Abstracts (MAPA). This abstracting journal is issued bimonthly. Each issue contains 600 abstracts, besides a selective bibliography from the MAPIS data base on one important medicinal or aromatic plant. Broadly, the abstracts are grouped into: Agronomy, Botany (general and systematic), Ethnomedicine, Clinical, Pharmacological, Antimicrobial, and Phytochemical studies. Since January 1988 MAPA has been computer produced.

(ii) Data base. It is a combination of manual and machine readable files. Items from 1985 onwards are machine searchable from MAPIS file. The pre-1985 records in its collection are searched manually.

(b) Utility

Bibliographies, current and retrospective, are supplied on all aspects of medicinal plants. Information relating to botanical nomenclature, agrotechnology, chemical constituents, ethnomedicinal, clinical and pharmacological evaluation, uses, industrial processing, marketing, etc. is also provided on request. Nominal fees are charged for different services, which include supply of documents (4).

(c) Address: Publications & Information Directorate (CSIR)
Hillside Road
New Delhi 110 012
INDIA

1.11 Computerized Information on Chinese Medicinal Plants

(a) Scope and description

The system provides online information on widely used Chinese medicinal plants. The scope includes botanical, chemical, pharmacological, toxicological and clinical aspects, and usage. Input was initially obtained from selected recent treaties on Chinese medicine. The data base (titles, authors, sources of publication, keywords and abstracts) is being updated with items from 100 important Chinese journals.

The items are translated into English and stored into the mainframe computer using the IBM Stairs (Storage and Information Retrieval System) software. Subject heading vocabularies of Index Medicus and the Chemical Abstracts nomenclature are used for storing the information. For Chinese herbal names, the Pin-Yin transliteration system is used in addition to the Latin scientific names (5).

(b) Utility

The data base is a valuable repository of information on Chinese medicinal plants. However, it is not yet available outside the Chinese University of Hongkong.

(c) Address: Chinese Medicinal Material Research Centre
Chinese University of Hongkong
HONGKONG

1.12 INPADOC

(a) Scope and description

Owned by the Austrian Government, the International Patent Documentation Centre (INPADOC) is operated in collaboration with World Intellectual Property Organization (WIPO). The patent documentation is compiled on a worldwide basis, mainly through an international network of co-operative agreements with patent offices in 49 countries, and European patent office.

INPADOC Data Base (IDB) is the world's largest on patents and holds over 10 million patent documents. Annual input is of nearly 1 million documents. IDB offers computer searches and weekly magnetic tape services, besides document supply service. Bibliographic elements for each patent document include owner, invention title, national classification symbol, International patent classification symbol (if present), country of publication, publication date, number of the application, and priority date.

The microform product includes the INPADOC Patent Gazette. This patent journal is published weekly on microfiche.

IDB is accessible online through INPADOC's online service, INKA, and Pergamon-Infoline.

(b) Utility

INPADOC can provide comprehensive information on patents relating to pharmaceutical processing.

(c) Address: Ministry of Finance
International Patent Documentation Centre
Möllwaldplatz 4
A-1040 Vienna
AUSTRIA

1.13 Derwent's Patent Documentation Services

(a) Scope and description

The system covers worldwide patents in general, mechanical, electrical and chemical subject areas. Input is derived from patent documents received from 30 patent offices. The data base has 6 million items and some 11,000 patent documents are processed weekly.

Among the Derwent publications are the World Patent Index (WPI), which provides titles and bibliographical details of the subjects covered, World Patent Abstracts (WPA), which makes available abstracts with drawings of patents by country and technology, and Central Patents Index (CPI) of chemically related patents. These are issued weekly and are also available on magnetic tapes. Records are searchable by patent number assigned, subject classification (with Derwent code and International Patent Classification), priorities and title terms.

The data base is searchable online through DIALOG, System Development Corporation (SDC), and Telesysteme Questel.

RINGDOC is another service offered by Derwent which provides access to world's journal literature on pharmaceuticals. The products include abstract publications, indexes, magnetic tapes and an online data base. Input is derived from over 800£journals. The data base contains 750,000£records from 1964 onwards, and monthly input is of 4500£records. It is available through SDC.

(b) Utility

The pharmaceutical class of the chemical patents contains entries on patents on medicinal plants. Drug information from scientific journals is quite comprehensively covered in RINGDOC.

(c) Address: Derwents Publications Ltd.
Rochdale House
128 Theobalds Rd.
London, WC1 8RP
UK

1.14 APINMAP

(a) Scope and description

The Asian and Pacific Information Network on Medicinal and Aromatic Plants (APINMAP) is a voluntary co-operative programme for countries in the Asian and Pacific region, with the objective of promoting information exchange in the field of medicinal and aromatic plants. It was formally launched by UNESCO in 1987 with eleven participating countries from this region.

APINMAP is a specialized information network which seeks to achieve its objectives by:

(i) Making available and using to the maximum extent possible information in this field, either acquired from abroad or generated by research and development activities in the region;

(ii) Assisting its member countries to develop or strengthen their specialized information services and information handling capabilities in this field;

(iii) Promoting resource sharing activities and services, and providing guidance in the development of information products and services;

(iv) Providing linkages to other regional and international networks or services in the field of medicinal and aromatic plants.

The structure of this network is a combination of centralized and decentralized approaches. The national node of each participating country is responsible for data input and information provision. The Agricultural Information Bank for Asia (AIBA) based in Los Baños (Philippines) has been designated the Network Centre which is responsible for consolidating and redistributing the information provided by the national nodes. In addition, AIBA co-ordinates the overall technical information activities of APINMAP. It has developed the model, APINMAP application and its manual, using the UNESCO-developed mini-micro CDS/ISIS software. Double sided daisy diskettes (5.25") are recommended for data exchange. Some countries, however, send data on specially designed work sheets. Submission and distribution of the data base is in ISO°2709 format using ISISxCH. ASCII format is also accepted by the Network Centre if it is in a format acceptable to MINISIS being used by the Network Centre.

APINMAP has a Management Board which is concerned with policy making, planning and review of the network's activities, with a back-up provided by the Bangkok-based Secretariat (6).

The following information services and products are currently being provided:

(i) Bibliographic data bases prepared by each National Node of the participating countries, and consolidated as a regional data base. They are available in diskette, but printed form in whole or part may be requested.

(ii) Referral data base of information sources, research institutions and experts.

Other activities under preparation include:

(iii) Information packages on specialized topics for different target groups.

(iv) Factual and numerical data bases for decision makers and planners, researchers, scientists, and potential entrepreneurs.

(v) Online access to commercial data bases, on request.

(b) Utility

APINMAP is designed to assist its member countries to improve their capability to collect, process, disseminate, and use research information and data on medicinal and aromatic plants, from within the country and from Network Centre. Service for data retrieval from any database within the Network is on no-profit, no-loss basis.

(c) Address: APINMAP Secretariat
c/o Ministry of University Affairs
328 Sri Ayutthya Road
Bangkok - 10400
THAILAND

2. SIGNIFICANCE OF A DATA BASE ON MEDICINAL PLANTS

2.1 Introduction

Mankind has a long history in using herbal medicine. The ancient civilizations in India, China and Egypt had rich knowledge of medicinal plants and their uses.

In modern times, the use of natural products as drugs declined with the advent of synthetic compounds, especially in the developed countries. In the developing countries, the low-cost traditional herbal curatives continued to be used extensively in the health care of the people, particularly in the rural areas, side by side with modern high-cost medicine. Lately there has been an all round revival of interest in the use of medicinal preparations based on plants. This happened because of the observed efficacy of many traditional medicines and their generally being free from serious toxic effects associated with synthetic drugs (7). Health care products, health foods and cosmetics, based on herbs, are becoming more and more popular.

Quinine, morphine, atropine, reserpine and other valuable drugs were discovered through scientific study of herbal medicines. With the discovery of vincristine and vinblastine from Vinca spp. as clinically useful anti-tumour agents in 1960, a major effort was started by the National Cancer Institute (USA) in screening plant extracts for anticancer activity (8). Likewise, search for anti-microbials, antifertility, antidiabetic, antistress principles, etc. from plants has made significant contributions to literature on medicinal plants. Some believe that research on natural products has the best chance for discovering clinically useful new prototype drugs (9).

The new interest in the medicinal plants has prompted some UN development agencies to stimulate research in this field in the developing countries. UNIDO has been assisting in the development of pharmaceutical industry based

on medicinal plants on scientific lines. UNESCO has sponsored two regional networks for promoting co-operation among research institutions concerned with chemisty of medicinal and aromatic plants, in South Asia and South-East Asia. More recently, it has launched the Asian and Pacific Information Network on Medicinal and Aromatic Plants (APINMAP).

In the declaration of WHO about primary health care for everybody by the year 2000, medicinal plants have been assigned an important role. WHO is encouraging developing countries to intensify research on medicinal plants so that traditional and new herbal medicines could be put to better use. A comprehensive inventory of several thousand medicinal plants species used in the world has been compiled, based on literature from 91°countries (10).

As a consequence of greater interest in the use of herbs in medicine, cosmetics and health foods, and as a source of new organic compounds, research efforts and the pertinent literature have increased enormously during the last two decades. Scientists and technologists in the developed countries have access to massive data bases and make use of current awareness services to keep themselves abreast of the latest worldwide developments in the fields of their interest but their counterparts in the developing countries lack these facilities.

2.2 Need for a data base

In view of the large volume of information being generated in this field and the inability of the users to access it, the setting-up of a mechanized system for collection, processing, storage, retrieval and dissemination of information on medicinal plants assumes considerable importance in developing countries. Such a computer-searchable system would be of invaluable assistance in the R&D work on and industrial exploitation of local medicinal plant resources. The user of the data base may be a research scientist needing bibliographic or factual information on what work has already been undertaken on a particular plant to avoid repetitive research, or an entrepreneur wanting to know details of the cultivation practices for growing scientifically certain medicinal plants, or a pharmaceutical firm in search of a technology, patented or otherwise, for the extraction of a clinically useful compound from a herb. Most of other types of users can avail of this data base on various aspects of medicinal plants.

2.3 Specific services

The purpose of a data base on medicinal plants and the services it provides include:

(a) Information on research in this field being carried out in the country through:

(i) Bibliographic and research publications;

(ii) A register of research institutions, researchers, on-going research projects, and research equipment;

(iii) Compilation of scientific data resulting from research.

(b) Information from international documentation and data bases covering research being done outside the country (if equipped for this purpose), through:

(i) Compilation of specialized bibliographies;

(ii) Current awareness services including selective dissemination of information;

(iii) A technical enquiry service including bibliographic searches on request;

(iv) Access to scientific data available in international data compilations;

(v) Document delivery service for research and technology publications.

(c) Provision of support in the preparation of critical reviews, information analyses and consolidation activities in priority areas.

The services of interest to industry include:

(a) Information on the availability and local distribution of medicinal plants of proven medicinal value.

(b) Techniques of isolating extracts and active substances of medicinal plants and the equipment required for the purpose.

(c) Information on formulation of drug delivery forms.

(d) Quality control and packaging.

(e) Information on patented processes (if any), their specifications.

(f) Trade and marketing, and many other aspects.

For the above-mentioned services, each country needs to create its own data base for capture of required documents and data being generated within the country. The data base has to be compatible with relevant international/regional data bases to facilitate exchange of information in the form of magnetic tapes or diskettes. This two-way exchange, through entering into co-operation agreements, would help the country to have access to international documentation and data bases, and also contribute to the data bases outside the country.

3. GUIDELINES FOR SETTING UP A DATA BASE

3.1 Criteria and pre-requisites

The main criteria for establishment of a data base in a particular field in a developing country are:

(a) There is a sufficient level of research and development activities in the field.

(b) The workers in this field, in the country, are finding it difficult to keep up with the information being generated, or even unaware of it.

The basic requirements for a data base include:

(a) Premises (space);

(b) Infrastructural facilities like hardware and software;

(c) Personnel - competent management and staff;

(d) Close relationship with the generators of information and the users of information;

(e) Requisite funding.

The data base will ensure that all the information relating to the particular field is made available at one access point. It will be possible from the data base to provide the following services and products:

(a) Subject bibliographies;

(b) Specialized current indexing and abstracting services, including SDI (selective dissemination of information) service;

(c) Information retrieval on request;

(d) Information on patent specification and standards;

(e) Business and marketing information, etc.

3.2 Infrastructural requirements

The minimum infrastructural requirements are:

3.2.1 Equipment

The equipment required for establishing a data base includes hardware (electronic data processing devices), i.e. the computer and its peripheral equipment, and software, i.e. the programme or sets of instructions by which the machines are made to execute each of the specific tasks involved. The selection of these elements depends upon the type and size of the data base.

The minimum computer configuration required to run a small data base will be one IBM PC/XT personal computer or its compatible, with at least 512 KB of RAM, a floppy disk drive, a 20 MB hard disk and a printer.

The software may include DOS or UNIX as the operating system. The data base management system (DBMS) package such as D Base III Plus, CDS/ISI mini-micro version, with PASCAL and Lotus 1-2-3, may be used for storage and retrieval of information from the data base.

In selecting an information storage and retrieval software, one has to evaluate its capability for -

- entering, modifying;
- indexing;
- searching;
- sorting; and
- displaying/printing

bibliographic data, and, of course, the data base design and set-up facilities.

3.2.2 Personnel

The personnel required for the data base includes a manager (head of the data base) assisted by an information specialist, one data base analyst, one software specialist, one system analyst or programmer, one data entry operator, and some library and general administrative staff. Depending on the size of the system, certain functions may be performed by the same person, for example an analyst-programmer for a small data base. Also, the manager may be an information specialist or a system analyst, in addition to his managerial tasks.

It is ideal to have the data base in a research institute/centre in the same discipline. In addition to proper environment, the host organization will provide space, and the general administrative, accounts and maintenance staff. In addition, the data base can possibly utilize some of the existing facilities, such as the hardware (if available), document collection, thus saving cost on these items.

3.3 Schedule

An important factor in the setting-up of a data base is to formulate a schedule for design development and implementation of the system. A time schedule is helpful not only in implementation but also as a spur to follow-through. A target date should be fixed for completion of each phase of the programme, setting an estimated elapsed time for each phase. Pert charting techniques often include three sets of time schedules: optimistic time, most likely time, and pessimistic time. Completion of phases may be scheduled in months or weeks (11, 12, 13).

To set up a data base, the system may be scheduled in the following three phases:

3.3.1 Phase I - Development of design

The development of design for the data base is of crucial importance in achieving the specific needs the centre is expected to fulfil. The considerations in designing the system can be broadly divided into:

A. Background study of need and feasibility

Information on the environment that requires the data centre needs to be studied by the designer. He should obtain information on the resources already available and what more is needed to make a viable system. This background knowledge will determine the parameters and components of the system. A feasibility report for designing of the desired data base is then prepared.

B. Definition of objectives, scope and the user community

It would be pertinent to define the objectives, scope and coverage of the system, both on a short-term basis and on a long-term basis (see 3.1). The user community needs to be clearly delineated, as it will determine the types of service required.

C. Determination of services

The fundamental parameter of the system design is services. And the services it performs, as is stated earlier, are directly related to user needs. Thus user community needs to be closely involved in determining the services. Broadly the data base should be able to provide current awareness services and subject bibliographies, backed up by a good document delivery system.

D. Determination of organization structure

The organizational placement of a data base may vary in practice: (a) it may be an autonomous department within the parent organization, or (b) as part of the department it services, e.g. a research and development centre. Ideally, it should have organizational freedom so that it can cater to the needs of the full community of users it has been designed to serve. The manager of the data base should be given full responsibility for management and operation of the system.

It is very useful to have an Advisory Council of the system. It helps in relating the data system to the various components of its community of users, provides a mechanism for gaining budgetary support, and helps in delineating the scope and evaluating the activities.

E. Determination of resources required

The resources required can be categorized as follows:

(i) Facilities

The facilities of a data base include, inter alia, the space for its housing, the internal arrangement and basic installations (lighting, electricity, water, safety devices, etc.), furniture, and various types of equipment. The amount of space required varies with the magnitude and complexity of the function, the number and types of documents to be acquired and processed, the amount and type of equipment necessary, the number of staff, and the type of services. Selection and acquisition procedures should therefore be based on a detailed functional list of requirements for each job covering all the duties involved and the equipment and supplies needed. Proper facilities for the functioning of data base and staff are important considerations in the selection of the location.

(ii) Equipment

The range of office equipment includes typewriters, storage cabinets and shelves, kardex for periodicals, printing and duplicating machines, and reprographic machines.

Computer hardware includes the basic processing unit and peripheral equipment. Special attention has to be given to ensure good running order of the machines: air conditioners, protection from dust and fire, voltage regulators, etc.

Details of hardware and software and other equipment required are given in Annex 3.1.

(iii) Materials

A data base requires a great many supplies such as cards, forms, registers, paper, pencils, and computer stationery including floppy diskettes. There should always be enough stock to avoid the risk of a job hold-up for lack of material.

The documents/journals in the relevant filed that need to be acquired and processed are also placed by some under this heading.

(iv) Personnel

The data base will be managed by a manger, appropriately qualified and respected in his field, besides possessing managerial capability for the organization and coordination of the various operations of the centre, personnel, and equipment into an effectively functioning system. He will be assisted by various professionals. The manpower requirement for a data base is given in Annex 3.2; the recruitment of the personnel may be done in phases.

F. Analysis of background studies and definitions

The next step in the designing of a data base is to analyse the background studies enumerated above and the feasibility report, including the system definition. The common analytical tools are (a) flowcharts, which use standardized symbols to provide a graphic representation of the operations concerned and their sequencing, and (b) decision tables, which give a detailed explanation of the flowchart in the form of matrix.

G. Design of system and operating procedures

The design of the system is prepared after the analysis has been complted. It takes into consideration the resources available and services required, besides other components.

Detailed manuals and guidelines are formulated for application software/operating procedures.

3.3.2 Phase II - Development of operation capability

In this phase, a pilot operation is set up to check out the system and operating procedures. The pilot operation is set up in the following stages:

A. Recruitment and training of staff

Before recruitment, essential requirements of each staff job (the highest professicnal level as well as the lowest non-professional level) need to be carefully specified. In many developing countries, it may be difficult to find appropriately qualified specialists. Provision should therefore be made for training of staff, parallel with their selection.

B. Acquiring of materials and equipment

The purchase of equipment and materials is carried out side by side with the recruitment.

C. Preparation of physical facilities

The physical facilities, such as space, fixtures and fittings, need to be prepared before installation of computer and other equipment.

D. Pilot operation

After installation of the system and placement of personnel, pilot operation of the data base is undertaken.

E. Evaluation of design and procedures based on pilot operation

Pilot operation helps in evaluating the entire system, whether it is performing satisfactorily, and if not, detecting and correcting the fault(s).

F. Revision as necessary and as feasible

The design and operating procedures are redesigned and revised in the light of the results of the pilot operation to improve effectiveness.

3.3.3 Phase III - Operation of the system

This is the final phase in which the data base is made operational. The various steps are:

A. Implementation by set stages

Implementation of the system is taken up in stages as per design set-up.

B. Check-up and evaluation of each implementation stage and revision as necessary

C. Full operation of the system

After the above steps have been taken, the data base becomes fully operational.

Detailed description of the design development, pilot set-up, and operation of the system is not within the scope of this report. The intention here is to provide the data base manager with some helpful hints as he considers these aspects. Manuals and instructions for starting the computer and installing the software, and subsequent operation are provided by the suppliers of equipment and software packages, respectively.

UNESCO has issued guidelines and manuals describing the successive steps and rules (standards to be followed) for creation of data bases and their evaluation (15).

It may take a year for the data base to be fully operational. The schedule of implementation is shown graphically in Fig. 3.1.

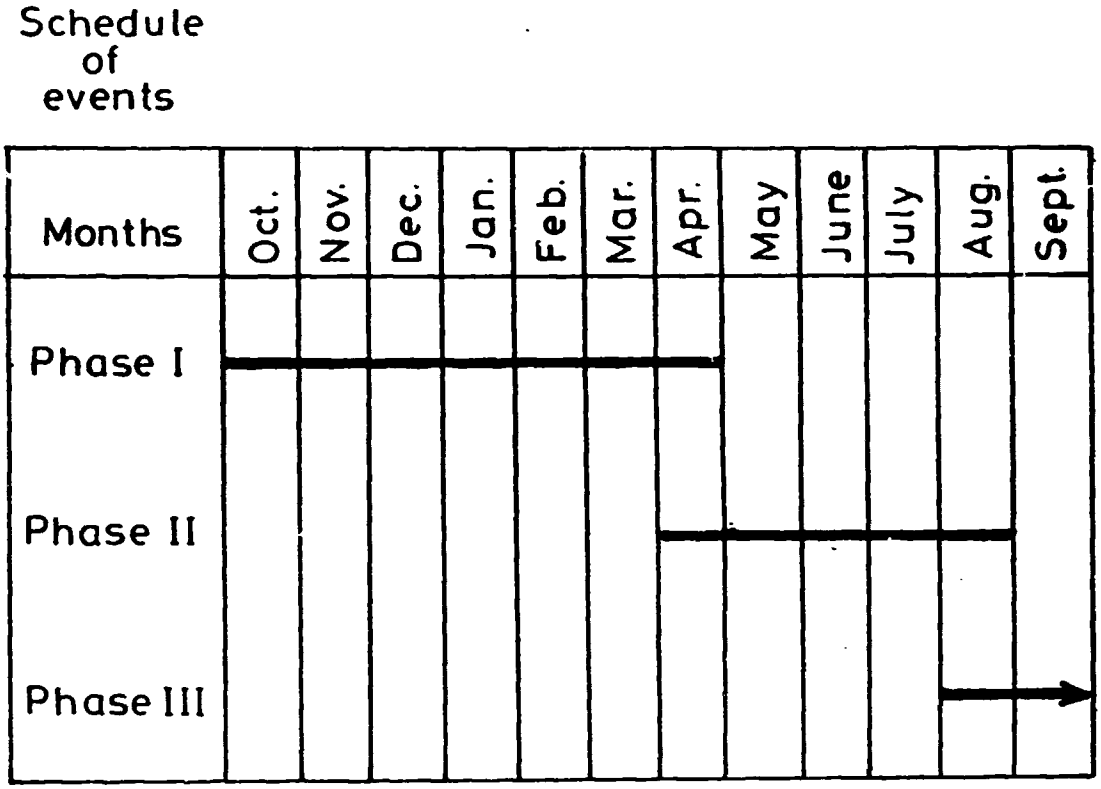

Fig. 3.1 Schedule of implementation

D. Periodic review

A data base needs some form of control. It is therefore necessary to review the system periodically so as to evaluate its effectiveness and to enhance its usefulness to the user community. Modification may be required if there are changes in objectives and requirements. An Advisory Council is an effective instrument for this purpose.

3.4 Budget planning

The expenditure on a data base can be categorized into (a) initial costs in its establishment, (b) annual operating budget, and (c) future needs.

(a) Initial costs include (i) preparation of space facilities, (ii) purchase of equipment, (iii) purhcase of document collection, materials and supplies, and (iv) salaries of initial staff and consultants.

(b) After the system has been established, the operating budget should cover salaries of personnel, rental of space and renovation, new equipment, maintenance supplies and material, addition to the collection of documents, and miscellaneous expenditure (telephone, stationery postage, etc.). Budget provision should be made for the training of personnel. and their expenditure on attending of professional seminars and meetings.

(c) Future needs will include replacement of equipment, addition of equipment, creation of new facilities, increases in costs of supplies and materials, and salaries of personnel, extension of scope, etc.

3.5 Maintenance of a data base

To ensure continuous and successful operation of a data base, properly planned and co-ordinated support structures have to be created in the technical, financial, logistical, and managerial areas (16).

3.5.1 Technical support

Support and maintenance of existing files, software and hardware are prerequisites. Back-up files for data as well as software have to be created, and back-up of hardware secured. Updating of data can be done on a recurrent basis as well as on an ad-hoc basis.

Of major concern are the quality and suitability of data. The manager of the data base has to guard against the entry of data of questionable quality.

3.5.2 Financial support

The availability of adequate funds is a major factor in the success of a data base. Ensured regular funding enables long-range, well-planned activities, and effective utilization of information.

3.5.3 Logistic support

In most of the developing countries it is important that all necessary technical facilities for the operation of the system (such as sapre parts, repairs, stationery, communication, etc.) are available.

It means that each element of the system should have adequate logistical back-up, supported by appropriate skills from within the country.

3.5.4 Management

One of the managerial functions in the maintenance of the system is that the manager should be prepared for new developments, expected or unexpected. The goals may have to be reformulated when required. Within the system, provision should therefore be made to ensure modifications with changing needs of the users and adaptability to new methods and technologies. Such changes would also require updating and retraining of the staff, or recruitment of new staff.

3.6 Data base on medicinal and aromatic plants

The steps outlined above are applicable to the establishment of a bibliographic data base in any discipline. Some special features relating to a national data base on medicinal and aromatic plants are now presented.

3.6.1 Location

The data base is best located in an academic research or information centre whose fields of competence include the area of medicinal and aromatic plants. This would give appropriate environment to the data base and also reduce the overall cost in its establishment owing to the existing facilities in terms of space, documents, administrative and maintenance staff.

3.6.2 User groups

The basic user groups that need to be kept in mind when designing the system, are:

(a) Research scientists
(b) Academics
(c) Pharmaceutical firms
(d) Flavouring industry
(e) GHrowers of medicinal and aromatic plants
(f) Information centres, compilers
(g) Decision makers, planners, government departments.

3.6.3 Scope and coverage

The data base will acquire and process documents/records on medicinal and aromatic plants growing in the country, containing biologically active compounds and/or used essentially for medicinal, pharmaceutical, flavouring or colouring purposes. The coverage would include agriculture and forestry, plant biology, chemistry, pharmacology, pharmacognosy, medicine, industrial processing and applications, ethnology, trade and marketing, policies nad legislation, extension, etc.

Depending on the finances, configuration of the computer and other facilities, the data capture in this field may be restricted to local research publications, research institutions, research projects and equipment, or the system may have access to international documentation and data bases, in which case it can provide much wider range of information services.

3.6.4 Co-ordination with other organizations

The centre where the data base is housed needs to co-ordinate with generators and users of information (research institutions, information centres, etc.) in this field for comprehensive data collection at the national level. These linkages will help to achieve optimum efficiency and data integrity, besides complete coverage to the extent possible. Since this data base would be at the national level, a national co-ordination committee may be constituted to ensure adequate linkages. This would also help in getting regular feedback of the services provided.

3.6.5 Hardware and software

In the field of medicinal and aromatic plants, generation of records from local research and development efforts would be of a level that can be managed with a micro-computer, like IBM PC/XT or PC/AT, with peripherals. Software recommended is micro CD/ISIS, which is maintained by UNESCO. It includes a collection of software that can cope with most of the needs of a bibliographic data base on medicinal plants. For information storage and retrieval this system utilizes several different programmes for file creation, storage and correction, extraction, printing, deletion (of data not required for printing), and a retrieval programme (17, 18).

3.7 Aspects of medicinal plants

The type of information that the user community may be able to obtain from the data base on medicinal plants is presented herewith. Each aspect is annotated briefly as applicable to India, using senna (Cassia spp.) as an example.

A. Botanical aspects

(a) Complete Latin name, with synonyms as appropriate, and family name:
Cassia angustifolia Vahl (Leguminosae)
Cassia acutifolia Delile

(b) Habitat: Indigenous to Sudan and Egypt.

(c) Distribution in the country: In India, it is cultivated in Tamil Nadu.

(d) Local names, English names, Trade names: Tamil: Nilavasai; English: Senna; Trade: Alexandrian senna pods, Tinnevally senna pods.

(e) Pharmacognosy of the parts of the plant used:

Senna fruit: Flattened pods, brownish yellow at the edge, dark brown in the central area, about 40-50 mm long and at least 20 mm wide (Alexandrian senna pods), or 35-60 mm long and 14-16 mm wide (Tinnevally senna pods).

Senna leaf: Alexandrian senna occurs as greyish green, thin fragile leaflets, 20-44 mm long and 5-15 mm wide. Tinnevally senna occurs as yellowish green leaflets, 30-55 mm long and 7-20 mm wide at the centre.

B. Ethnopharmacological aspects

(a) Uses, plant parts employed: Fruits and leaflets used as laxative.

(b) Traditional methods of preparation: For preparation of infusion, 0.6 - 2.0 g of leaves or fruits are soaked in 125 ml of warm water for about 12 hours.

(c) Mode of administration and dosage in the traditional system: In the form of infusion, decoction. In allopathic system, sennosides extracted from leaves and fruits are used as salts.

C. Chemical aspects

(a) Characteristic phytochemicals isolated: Sennosides A and B ($C_{42}H_{38}O_{20}$)

(b) Class of principles: Hydroanthracene glycosides

(c) Standards: According to Indian Pharmacopoeia, dried fruits must contain not less than 1.5% and dried leaflets not less than 2.0% sennosides. European Pharmacopoeia specifies not less than 2.5% sennosides in Tinnevally senna pods and not less than 4% sennosides in Alexandria senna pods.

(d) Chemotaxanomic aspects.

D. Pharmacological aspects

(a) Biological activity of the plant parts (natural drug), extracts, chemical constituents: pods, leaves, exgtracts and sennosides have laxative action.

(b) Toxic properties, if any: none recorded.

(c) Clinical aspects: Senna preparations act on the intestine by exciting peristalsis, without affecting the functions of the stomach and duodenum.

E. Agrotechnology

(a) Methods of propagation, climate and other requirements: Senna is grown from seeds in spring.

(b) Soil, irrigation, fertilizer requirements: Friable red loam soils in drylands and sandy loams in wet lands are most suited. Requires irrigation, does not stand water logging. Fertilization beneficial.

(c) Harvesting, time of the year, conditions: Leaflets harvested after three months, pods after 5 to 6 months. Alexandrian senna harvested from September throughout the winter.

(d) Post-harvest preparation: Leaflets dried in the open under sheds or indoors. Dried leaflets packed into bales. Pods are hung in well-ventilated sheds for drying. Dried pods packed in cartons.

F. (a) Methods of processing: Sennoside concentrate extract is prepared by the use of organic solvents. Extract treated with calcium chloride to prepare calcium sennoside.

(b) Formulation of drug delivery forms: Calcium sennoside is dispensed in the form of tablets and syrups.

(c) Patents: Patents for the preparation of extracts and isolation of sennosides taken in the U.K. (British Patent No. 1 135 528 (1968) to Notterman and Cie.), India (Indian Patent No. 131 493-A (1972) Mansa Ram to CSIR), Japan and Germany.

G. Marketing aspects

(a) Status of raw material market (global, regional, local), importing/exporting countries: India is the main supplier on the international market (over 4000 tonnes per annum). Other countries are Sudan (700 tonnes) and Thailand (70 tonnes). The Federal Republic of Germany, USA, Japan, and UK are among the importing countries.

(b) Market for processed or semi-processed products: Calcium sennosides, dried fruits and leaflets are in demand.

(c) Quality requirements, quality of local products: Standards for pods and leaves specified in European Pharmacopoeia, Indian Pharmacopoeia, US National Formulary (mentioned earlier under item B). In trade the green leaves are graded as Prime Quality, and the yellowish green leaves as Fair Average Quality (FAQ). Pods have three major grades. About 80% of leaves and pods on the international market fall into the FAQ grade.

(d) Commercial practices, tariffs: Alexandrian pods and leaves fetch higher price than Tinnevally pods and leaves owing to their higher sennoside contents. Information on the prices prevailing in important trade markets.

Table 3.1: Manpower requirements for a data base

Sl. No.	Designation	First year	Second year	Third year	Total
1.	Manager	1	-	-	1
2.	Information Specialist	1	-	-	1
3.	Database Analysts	-	1	1	2
4.	Documentation Assistants	1	1	-	2
5.	Software Specialist	1	-	-	1
6.	System Analyst/Programmer	1	-	-	1
7.	Data Entry Staff	1	1	-	2
8.	Library & General Administrative staff	2	1	-	3
		8	4	1	13

Table 3.2: Requirement for hardware/software, and other equipment

Hardware

1. IBM PC/AT or Compatible - one
   - 40 MB Hard Disk
   - 1 MB RAM
   - 1.2 MB Floppy Disk Drive
   - 10/16 MH Intel 80286 processor
   - 80287 Math Co-processor
   - Colour monitor
   - Keyboard
   - CGA Card
   - Serial port - two
   - Parallel port - two
   - Terminals - four
2. 300 cps with NLQ facility
   Dot Matrix Printer - one
3. DPT system with Scanner Laser Printer, Apple 2NT, Post script
4. UPS - one

Software

1. UNIX and DOS operating systems
2. D Base III Plus
3. Micro CDS/ISIS ver. 2.3 of UNESCO
4. PASCAL
5. Lotus 1-2-3
6. Microsoft Word
7. Page Maker
8. Ventura

Consumables

1. Computer stationery
2. Printer Ribbon
3. Floppy Diskettes HDDS - 10x10 boxes

Other Equipment

1. Plain Paper Copier with Zoom facilities - one
2. Fax machine - one
3. Electronic Typewriter - one
4. Microfilm/Microfiche Reader - Printer - one

4. REGIONAL NETWORKING OF NATIONAL DATA BASES

Recently there has been a trend towards regional co-operation in information and resources sharing. Regional networking contributes to overall economy of cost and time in information services and helps in avoiding duplication of research and technology efforts. As stated earlier, the output of information in the fields of medicinal and aromatic plants has been increasing fast during the last two or three decades. Scientists in the advanced countries are making more and more use of data bases and modern information technology. scientists in many developing countries, however, are at a discadvantage in this regard, for they have limited access to this expanding information. There is thus an urgent need for the developing countries to establish not only national data bases, but regional information networks so that information available in the particular region is shared by all the participating countries and put to maximum use.

It is relevant to mention here the Asian and Pacific Information Network on Medicinal and Aromatic Plants (APINMAP) sponsored by UNESCO (see 1.14). This network, perhaps the only regional network in this field, can serve as a possible model for the design of similar networks in other regions or in other subject areas. The scheme that follows is based largely on this model (6).

4.1 Objectives

A regional network is by its very nature a voluntary association of the member states. The primary objective of a regional network would be to provide a framework for the development of co-operation among the participating countries so that the user communities in the region have access to information they need in the field of medicinal and aromatic plants. Among the general objectives would be to:

(a) Ensure that information in this field, either generated by research and development activities of the region or acquired from countries outside the region is made available and used to the maximum extent possible in the region;

(b) Assist in the establishment of member states' own information handling capabilities and data bases;

(c) Ensure compatibility and co-ordination of efforts of the participating countries;

(d) Provide resources sharing services;

(e) Provide linkages with relevant international data bases and other regional networks in this field, if any.

4.2 User groups

The basic user groups for the network would be the following:

(a) Research scientists and technologists;
(b) Academics;
(c) Information centres;
(d) Pharmaceutical firms;
(e) Compilers of monographs and pharmacopoeiae;
(f) Decision makers, planners, government departments.

The areas covered would broadly include:

(a) Botany;
(b) Chemistry;
(c) Pharmacology;
(d) Ethnomedicine;
(e) Agriculture;
(f) Process technology;
(g) Other aspects of medicinal plants.

4.3 Network structure

The concept of a regional information network would invariably be associated with a distributed type of information system. The degree of decentralization of its data and data processing functions, and the degree of integration of these two basic elements at a network centre need to be carefully considered. Suffice it to say here that the structure should be a combination of both centralization and decentralization.

In this system, the national data bases (nodes) are responsible for input of data and provision of information from their respective countries. To centralize the data in one location, a network centre is designated in one of the participating countries. The network centre is responsible for consolidation and redistribution of data received from the national nodes, as also for the general co-ordination of the network. Communication between the national nodes and the network centre may be via telecommunication links, or physical transfer of input forms or computer-readable media. The centre should have a computer with sufficient capacity to store and integrate data, adequate number of trained personnel and suitable geographical location.

As noted above, each participating country will have its own national node which will be responsible for the organization and management of the information flow within the country and co-ordination at the regional level. In this way, the national node acts as the interface between local users and information obtained locally or from the data bases of the network centre. The national node will co-ordinate with different sources or users of information in the country for the overall data collection activity in order to achieve optimum efficiency and data integrity. The concept of participating management at the national level should be adopted to elicit optimum co-operation and interaction. A national co-ordinating committee may be made responsible for the establishment of a national co-ordinating mechanism.

With the distribution of data and data processing functions to the national nodes, a set of standards for hardware, software, data base structure and data transmission needs to be formulated. This would serve as the basis for the detailed system design for the network and the national information systems. The manuals and guidelines are prepared to describe the procedures and standards to be followed to create data bases and document clearing houses. International standards (ISO, UNISIST) should be adopted as far as possible to facilitate data exchange with data bases outside the network.

4.4 Organization and management

The network organization is structured so as to cover the distributed nature of governance, operations and user services to ensure the effectiveness and acceptance to network concept by the participating countries. In other words, as at the national scale, the concept of participating management at the regional scale should be to achieve optimum co-operation and interaction.

For the overall management and control of the network, a management board should be set up. The management board would be responsible for the major issues of network organization, planning the projects, setting the priorities and their implementation in the participating countries on an equitable basis. It shall be guided by the long-term objective of making the network operational and financially self-sufficient.

The management board may constitute working groups, task forces or advisory groups to assist in the activities of the network. In particular, advisory groups may be needed (a) for the development of hardware, software, data base and interface standards and (b) for assessing the needs of the user communities in the region and accordingly devising the network services. The location of the network centre would be decided by the board. Each participating country is eligible to nominate one representative to the management board. The board should have a chairman by rotation and be serviced by a secretariat for administrative work. Financial and technical assistance could be sought from the United Nations and other international agencies for the establishment of the regional network.

4.5 Computer system configuration

The design of the computer configuration at the network centre would depend upon the volume of information and information retrieval services. The number of records on different aspects of medicinal and aromatic plants that may be gathered annually in a region may be perhaps around 3000 (the actual number will depend on the research output in this field in the countries of the region and records gathered from outside the region). With a cutoff period of one decade prior to the year of establishment of the network, the initial volume of input data for the network centre will be about 30,000 records. With an average record length of 512 characters (for an abstract), the initial volume of input would be about 15 megabites or 15 million characters. Assuming an initial network strategy of about five years, the volume of data is estimated at about 40 MB.

For data of this volume, the system at the network centre should have a computer with main memory size of at least 512 KB expandable to IMB, and secondary storage capacity of 50 MB, and other requisite peripherals and software (see Table 3.2). The operating system should be capable of handling multi-programming and multi-tasking activities, and be able to handle batch and interactive processing. For software requirements see Table 3.2.

4.6 Subject control

A set of standards for software, data base structure and data base transmission should be developed for the network. The manuals and guidelines for the preparation of records, definition of the fields and data elements, keyword selection need to be formulated along with a detailed subject classification scheme. This would provide the basis for subject control. ISO Guidelines for Thesaurus Construction will be of help in framing rules for keyword selection. An outline of the subject classification scheme formulated by APINMAP is presented in Table 4.1. (19,20).

Process technologies relating to medicinal plants occurring in the region are of vital interest. It is imperative that the system is capable of processing, storage and retrieval of such information, in addition to research and development results. The type of information of use to the industry has been mentioned earlier (see 2.3).

Table 4.1: APINMAP Subject Classification (outline)

A00 Agriculture and Forestry
- A10 Crop husbandy (including Agronomy and Sylviculture)
- A20 Plant propagation
- A30 Plant breeding, Introduction and Domestication
- A40 Farms and Plantations
- A50 Irrigation
- A60 Soil cultivation and Improvement
- A70 Plant pests
- A80 Plant diseases
- A90 Harvest and pest-harvest techniques

B00 Plant biology
- B10 Plant taxonomy
- B20 Plant morphology and anatomy
- B30 Plant physiology
- B40 Plant genetics and Biotechnology
- B50 Plant ecology and Geography
- B60 Biological activity - Plant protection and pest control
- B70 Biological activity - Medicinal purposes

C00 Chemistry. Chemistry of natural products
- C10 Phytochemistry
- C20 Biochemistry

D00 Pharmacy. Health and Medicine
- D10 Pharmacognosy
- D20 Pharmcology and Toxicology
- D30 Clinical Studies

E00 Ethnology
- E10 Ethnobotany
- E20 Ethnomedicine

F00 Industrial applications
- F10 Pharmaceutical and Medicinal preparations
- F20 Essential oils
- F30 Spices and Spice Oils

R00 Economics
- R10 Organization, administration and management of medicinal and aromatic plant enterprises
- R20 Finance
- R30 Trade and Marketing

S00 Policies and Legislation
- S10 Public policies; acts, laws, statutes, regulations; patent and trademark law; regulatory agencies

T00 Education. Extension and Information
- T10 Technlogy transfer, education and training extension and advisory services; activities of information services.

Z00 General Aspects
- Z10 Medicinal and aromatic plants in general
- Z20 Information products

5. OUTLINE FOR THE PREPARATION OF MONOGRAPHS ON MEDICINAL PLANTS

5.1 Scope

The information on medicinal plants is voluminous and lies scattered in books, journals and reports, and in various countries. The literature in this field is increasing at a fast pace. The purpose of a monograph is to consolidate the dispersed information on a particular plant at one place.

The first step in the preparation of a monograph is to plan its size and scope, specifying the aspects to be covered and those which require special emphasis. For a monograph to be comprehensive, the following aspects of the medicinal plants are usually described.

A. Botany
B. Ethnopharmacology
C. Chemistry including chemotaxonomy
D. Pharmacology
E. Agrotechnology
F. Technology, industrial processing
G. Marketing, etc.

5.2 Collection of information

The literature to be consulted consists of standard reference works, primary journals, secondary journals (abstracting and indexing journals), existing monographs, reports, theses and unpublished documents.

5.2.1 Reference works

There are a large number of reference works and books on medicinal plants and their uses, and it is not feasible to list here even the more important ones. National pharmacopoeiae, pharmaceutical codex, and formularies contain useful information on officinal medicinal plants of the respective countries. Besides specifications and methods of assaying, this type of literature gives information on active constituents and pharmacological properties and uses of the drugs. Floras of the countries give the botanical names of the plants and their distribution in the country. In some countries, books have been published on indigenous medicinal plants (7).

A useful bibliography which includes national pharmacopoeiae, formularies, relevant legislative texts and other important books on medicinal plants from 91 countries, is appended to the WHO document No. DPM/80. 3 (10).

An encyclopaedic work, entitled The Wealth of India, deserves special mention as it is a very comprehensive and authentic source of information on medicinal plants and is of use to most countries of the world. The raw materials series of this encyclopaedia, completed in 11 volumes, contains monographic articles on some 5000 plant species of economic importance, including all those used medicinally. The monograph on each plant includes the correct botanical name in English and local names, areas of occurrence, agrotechnology, medicinal properties (both folklore and proven), active constituents and pharmacological action, production and trade data (where available), along with relevant references to facilitate further study. The work has been compiled through an exhaustive world-wide literature survey.

The Wealth of India is an excellent reference work for the compilers of monographs on medicinal plants (21). Its last volume appeared in 1976, hence the information needs to be updated. This work is now under revision.

5.2.2 Primary journals

There are some 500 journals in the world which publish research work on medicinal and aromatic plants. Of these, there are only a few which carry research communications exclusively on medicinal plants and drugs. In view of the enormous literature, primary, secondary and tertiary, which needs to be consulted, it is rewarding to search for review articles on the plant on which the monograph is being written. A review will provide relevant information in a concise form, up to the year of its publication, along with useful references. Thus only those documents need to be referred which appear after the date of publication of the review article, thereby saving considerable time in literature survey. Moreover, consultation of the selected references cited in the review article will provide additional information.

5.2.3 Secondary journals

Abstracting and indexing jounals, and citation indexes are the tools for locating relevant research papers published in the primary journals. Browsing of a large number of individual primary journals is very time-consuming and not all the relevant journals may be available in one library. The secondary journals are therefore of tremendous help in cutting down the time taken in the collection of information and at the same time making it more comprehensive.

The more important abstract journals and their sections of interest in the field of medicinal plants, are mentioned in Chapter 1.

5.2.4 Data bases

Bibliography of recent research work appearing the world over on the concerned medicinal plants, can be obtained from international/regional data bases on payment basis. However, a national data base, if existing, should be first searched for the work done within the country. Important data bases are described in Chapter 1.

5.2.5 Patents

Information on the patented process can be searched in the abstracting journals and the official journals of the national patent offices. Derwent publications and INPADOC are very comprehensive sources of patent records.

5.3 Compilation of a monograph

Once all the relevant information has been collected on the patent (book by book, and journal by journal), the next step is to present this information in a proper sequence in the form of a monograph. It involves analysis and critical evaluation of the compiled information; contradictary data need to be resolved. It is then to be decided what to discard and what to inlcude and how much to include, depending on the original plan of the monograph. Finally, consolidation is done after having undertaken these activities.

5.3.1 Illustrations

The parts of the plant used medicinally need to be illustrated suitably with line drawings, half-tones or colour transparencies of good quality. For instance, the leaves can be illustrated with a line drawing, the roots with a half-tone and the flowering part with a colour transparency. This would enhance the value of the monograph to the reader.

5.3.2 References

References cited in the monograph are given at the end. References must be complete in all respects. There should be uniformity in their citation by following an existing standard system. Additional references consulted, though not cited in the text but containing useful information on the topic, may also be appended.

5.3.3 Example of a monograph

A monograph on senna (Table 6.1) is presented to examplify the preparation of a monograph. It is not a comprehensive monograph, there being no scope for it in this report. It is only meant to be illustrative and can be regarded as a monographic article. India is the major exporter of this drug, hence most of the information presented is from this country.

Table 5.1: Monograph on Cassia

A. Botanical aspects

A.1 Cassia acutifolia Delile
and
Cassia angustifolia Vahl

Cassia acutifolia and Cassia angustifolia have been reclassified as Cassia senna Linvv. var. senna, but distinction between the two is still maintained in the trade. (Ref. No. (1))

A.2 C. acutifolia is a herbaceous shrub indigenous to Sudan and Egypt, and is also found growing wild in other parts of Africa. It is known in the trade as Alexandrian senna. Originally, it was obtained principally from Sudan, where it was collected from wild stands, but it is now cultivated in both Egypt and Sudan.

C. angustifolia is a smaller sub-shrub, cultivated mainly in Tirunelveli (Tinnevally) and Ramanthapuram districts of Tamil Nadu in India. It is also cultivated in Thailand. It is known in the trade as Tinnevally senna.

A.3 C. angustifolia

Bengali - Sona-mukhi; Gujarati - Met-Ki-sena
Hindi - Sunna-maki; Kanarese - Nelavarike;
Malayalam - Nila vaka; Marathi - Sona-mukhi;
Sanskrit - Svarnamuki, Bhumiari; Tamil - Nilavarai;
Telugu - Sunamukhi.

A.4 Pharmcognostic features, according to Indian Pharmacopoeia, are as follows:

Senna Fruit - Flattened reniform pods, brownish yellow at the edges, dark brown in the central area, 40-50 mm long and at least 20 mm wide (Alexandrian senna pods) or about 35-60 mm long and 14-18 mm wide (Tinnevally senna pods). At one end is stylar point and at the other a short stalk. The pods contain 5-8 flattened and obovate seeds, green to pale brown, with a continuous network of prominent ridges on the testa. Odour and taste, slight.

Examined under a microscope the pods present an epicarp with strongly cuticuralized isodiametrical cells, occasional anomocytic or paracytic stomata, and very few conical, unicellular and warty hairs; hypodermis with colenchymatous cells; mesocarp with parenchymatous tissue and a layer of prisms of calcium oxalate; endocarp consisting of thick-walled and inter-lacing fibres.

The seeds present a sub-epidermal layer of palisade cells with thick outer walls. The endosperm has polyhedral cells with mucilaginous walls.

The senna fruit powder is brown in colour and consists of epicarp with polygonal cells and a small number of conical warty hairs and occasional anomocytic or paracytic stomata. Fibres in two crossed layers accompanied by a crystal sheath of calcium oxalate. Characteristic palisade cells in the seed and stratified cells in the endosperm; clusters and prisms of calcium oxalate.

Senna Leaf - Unground Alexandrian Senna

(C. acutifolia) occurs as greyish-green, thin fragile leaflets, lanceolate, mucronate, asymmetrical at the base, 20–40 mm long and 5-15 mm wide, the maximum width being at a point slightly below the centre, lamina slightly undulant, both surfaces covered with fine short hairs. Pinnate venation with lateral veins, leaving the midrib at an angle of about 60° and anastomosing to form a ridge near the margin.

Unground Tinnevally Senna (C. angustifolia) occurs as yellowish green leaflets, enlongated and lanceolate slightly asymmetrical at the base, 30-50 mm long and 7-20 mm wide at the centre. The two surfaces are smooth, with a very small number of short hairs, and frequently marked with transverse or oblique lines. Odour, slight and characteristic; taste, mucilaginous at first and then slightly bitter and unpleasant.

Examined under a microscope, senna leaf shows polygonal epidermal cells with straight walls and frequently containing mucilage; numerous, broadly elliptical stomata mostly from 20 to 35 um in length, usually bordered by two neighbour-cells with their long axes parallel to that of the stoma, and rarely, though more frequently in Alexandrian Senna, a third epidermal cell at the end of the stoma. The hairs are nonglandular, one-celled, conical, often curved, with thick papillose walls, from 100 to 350 um in length. Palisade cells in a single layer underlie both surfaces except in the midrib region where they occur only beneath the upper epidermis. A meristele occurs in the midrib composed of several radially arranged fibrovascular bundles, the latter separated by narrow vascular rays and supported above and below by arcs of pericyclic fibres. Calcium oxalate occurs in rosette aggregates in the spongy parenchyma and in six to eight-side prisms in the crystal fibre, which lie in the outer surface of each group of pericyclic fibres.

The powder is light green to greenish yellow in colour and consists of polygonal epidermal cells showing stomata of the paracytic type. Unicellar hairs, conical in shape, with warted walls, isolated or attached to fragments of epidermis. Fragments of vascular bundles with a crystal sheath prismatic crystals of calcium oxalate. Cluster crystals isolated or in fragments of parenchyma. Ref. No. (3)

Microscopic tests reveal that it is possible to utilize the greater hairiness of the Alexandrian senna as a means of distinguishing the two species. A fragment of the epidermis of Alexandrian leaf is said to contain twice as many hairs as does a similar size shred of epidermis from Tinnevally senna. Ref. No (4)

Alexandrian pods are generally pale to greenish or yellowish brown with darker brown central zone where the positions of the seeds are indicated by slight swelling; Tennevally pods are usually darker, slightly narrower (not more than 18 mm wide) and somewhat straighter. The testa of Alexandrian seeds is reticulately wrinkled whilst that of Tinnevally seeds has transverse ridges. Ref. No. (1)

B. Ethnopharmacological aspects

B.1 Senna is used as a stimulant laxative. It is especially useful in habitual constipation.

B.2 In the Unani and Ayurvedic system of medicine, senna is usually administered in the form of an infusion; 0.6 - 2.0 g of leaves or fruits are soaked in 125 ml of warm water for about 12 hours. The disagreeable odour is masked by the addition of ginger or clove. Senna leaf and fruit are also used in India in the form of decoction, powder confection and many other household preparations. In Europe, most senna is used for infusions or medicinal teas.

In the allopathic system, sennosides extracted from leaves and pods as calcium salts are dispensed in the form of tablets and syrups. Ref. No. (5).

C. Chemical constituents

C.1 The laxative activity of senna is accounted for by anthraquinone glycosides, mainly sennosides A and B. Traces of sennosides C and D are also present, together with various aloe-emodin and rhein glycosides. Sennosides a and B ($C_{42}H_{38}O_{20}$) are stereo-isomers of rhein dianthrone with two glucose molecules.

Alexandrian fruits contain 2.5-4.5% sennosides A and B, whereas Tinnevally pods contain only 1.2-2.5% of sennosides A and B, with smaller amounts of other glycosides.

C.2 Analytical methods

The pharmacopoeiae describe the methods of chemical assay of sennosides in detail. TLC - spectrophotometric and spectrocolorimetric methods have been described for assay of sennosides. The colorimetric method is better. It is based on quantitative elution of sennosides from silica gel^{G} plates after separation. TLC and column chromatography have also been used for analysis. Ref. No. (5)

High pressure liquid chromatography is the latest instrumental technique that has been used fro the analysis of senna compounds. Ref. No. (6)

Standards - Standards laid down by Indian pharmcopoeia for the two varieties of senna fruits and leaf are as follows:

Fruit - Hydroxyanthracene derivatives, calculated as Sennoside B	- not less than 1.5%
Foreign organic matter	- not more than 1.0%
Sulphated ash	- not more than 6.0%
Acid-insoluble ash	- not more than 2.0%

Leaf - Hydroxyanthracene derivatives, calculated as Sennoside B	- not less than 2.0%
Foreign organic matter	- not more than 1.0%
Stalks	- not more than 2.0%
Sulphated ash	- not more than 12.0%
Acid-insoluble ash	- not more than 2.0%

Ref. No. (3)

The European Pharmacopoeia specifies that the drug-senna leaf can consist of either or both species and must contain not less than 2.5% of hydroxyanthracene derivatives, calculated as sennoside B; other specifications are the same as in I.P. In the United States National Formulary XX, the maximum of 8% stems and 2% foreign organic matter is allowed for senna leaf.

Alexandrian senna pods must contain not less than 4.0% of hydroxyanthracene derivatives, calculated as sennoside B, while Tinnevally senna pods must contain not less than 2.5% of such derivatives, according to the European Pharmacopoeia. The other standards for pods for the two varieties are the same as specified in Indian Pharmacopoeia. The Pharmaceutical Codex 1979 gives a figure of 35 to 40% water extractive for Alexandrian pods, with 18-35% water extractive for Tinnevally pods. Ref. No. (1)

The United Kigdom is known to have had difficulty in finding Alexandrian senna pods with a sennoside content that satisfies pharmacopoeial requirements, even though such material does appear to be available in Europe. Some manufacturers in the U.K. use older pharmacopoeial standards that specify a lower sennoside content, e.g. 3.6% but even this material may be difficult to find.

Senna leaves and pods should be protected from light and moisture and stored in airtight containers. Leaves and pods must be kept clean, hygienic and fumigated, and protection against insects and rodents is necessary. Ref. No (1)

D. Pharmacological Aspects

D.1 Senna preparations have a laxative action. They act on the intestine by exciting peristalsis without affecting the functions of the stomach and duodenum, and in normal use, the intestine does not become habituated to these preparations. The laxative action depends on the amount of free hydroxyanthraquinones and ease of decomposition of glycosides. Ref No. (1)

Sennosides A and B produce stable and nonhygroscopic crystals and are readily formulated into a range of tablets and syrups for laxative use that are particulary used in the United States.

Though sennosides A and B are the main glycosides responsible for the laxative property of senna, the presence of other glycosides exerts a synergistic effect. (7) Sennosides are probably breakdown products from primary glycosidal compounds occurring in the drug. Ref. No. (8)

Certain liquid extracts lose their biological activity although the total sennoside content remains similar; this has been ascribed to photochemical degradation of active sennosides into less active glycosides which give the same chemical assay figure. Ref. No. (9)

E. Agrotechnology

E.1 Senna is grown from seed, using 6.5 to 7.5 kg per acre; the hard seedcoat is abraded with sand to speed germination. In the past, the seed was scattered freely, but is better planted in rows, about 30 cm apart. Senna will grow in a variety of soils, but red loams give a higher yield and better quality than black soils. Friable red loam soils in drylands and sandy loams in wetlands are the most suitable although senna is also grown in clayey paddy fields, between rice crops. In India, the seed may be sown in spring, or after the monsoon has wet the ground; thus the crop may be grown under irrigated or rainfed conditions but even though some irrigation may be needed for the rainfed crop, it does not stand waterlogging or continuous rain. The land needs only rough preparations. For the autumn crop, the first leaflets may be harvested after two months but they are usually left for at least three months until they are more mature; a second crop is taken at four months and a third at five to six months, at which time pods are also collected. Up to five cuts may be taken from the spring sown crop - two before the monsoon and three after. Alexandrian senna is generally harvested from September through the winter.

Senna is generally grown as an annual, but it may be left for several years if no alternative crop will grow. The first flowering shoots are generally removed to encourage lateral branching as this treatment is understood to increase sennoside content. Although it is a legume, senna does not fix atmospheric nitrogen and some fertilization may be beneficial. Ref. No. (1)

Varying yields have been reported. On an average, yields of about 700 kg of leaves and 100 kg of pods per acre are obtained under rainfed conditions; the yields are 1400 kg of leaves and 150 kg of pods under irrigated conditions. Ref. No. (5)

Higher yields of pods may be obtained if the plants are grown specifically for pods rather than for leaves. Ref. No (4)

E.2 The leaflets are either dried in the open under shade, or indoors on a shed floor; they are kept in very thin layers and stirred frequently to ensure uniform drying. The drying takes 7 to 10 days, by which time the leaflets are yellowish green in colour. They are packed into bales under hydraulic compression. The pods are hung in well-ventilated sheds for 10 to 12 days after which they are packed in cartons. Ref. No. (11)

F. Technology

In a British patent, Nottermann and Cie. have used 90% methanol/ 80% acetone for 6 hours followed by cold water for 3 hours, for the preparation of sennoside concentrate extract. The extract on drying yields 14% of original drug and contains 17.7% sennosides. By this process, 62% of sennosides are extracted. Ref. No. (10)

Mansa Ram et al. in a process patented in India, have suggested macerating of drug with a solution of citric acid in methanol and then extraction with methoanoltoluene (69:31) mixture with ammonia. The extract is treated with calcium chloride to obtain calcium salts of sennosides A and B. Ref. No. (11)

Patents have also been taken in Japan and Germany for the extraction of the drug.

Gupta et al. have reported the extraction of active principles by 90%, then 80% and finally with 70% ethanol. The extract was stable in amber coloured bottles for 96 hours. Ref. No. (12)

Solution of non-ionic surfactants and polythylene glycols in 70% ethanol have also been used for the extraction of sennosides. Ref. No. (13)

G. Market aspects

G.1 Most of the senna leaves and pods in international trade come from India, which claims to account for 90% of world production with the balance of 10% said to come from Sudan. Thailand is reported to be exporting annually 70 tonnes C. angustifolia pods to the Federal Republic of Germany through a joint venture project. Ref. No. (1)

Current Indian production is estimated at 5,000 - 7,000 tonnes of leaves and pods per annum. The crop comprises 67% leaves and 33% pods.

India supplies senna principally to the Federal Republic of Germany, the USA, Japan, the Netherlands, France, Switzerland and the U.K. During 1980-81, India exported 3,490 tonnes of senna to Germany, 189 tonnes to the United States, and 521 tonnes to Japan. Ref. No. (1)

Sudan is reported to export about 700 tonnes of senna per annum. Ref. No. (5)

G.2 In the Federal Republic of Germany, Indian senna leaves and pods are mostly marketed in the form of tea; senna is first cleaned, fumigated and uniformly cut. Senna pods from Sudan, which have a higher sennoside content than Indian senna, are used for the manufacture of calcium sennosides. Germany also imports calcium sennosides from India.

Some 90% of senna imported into the United States is utilized for the extraction of calcium sennosides, while about 10% is sold in health stores for direct use. A very small amount is used for prepared tea.

While India is the world's largest exporter of senna, its capacity to produce calcium sennosides continues to increase, and is believed to have reached 50 tonnes in 1981, the estimated target is 60 tonnes for 1983-84. Ref. No. (1)

G.3 Leaves that are green to pale green in colour with a fine texture are preferred to yellow leaves or yellowish green with a rougher texture. The green leaves are known in the trade as of "prime quality" and the yellowish green leaves as of "fair average quality" (F.A.Q.). The largest consumers of the F.A.Q. grade are France, Belgium, Germany, and Switzerland, while Japan, the U.K. and the U.S.A. are the major consumers of the prime quality. Pods have three major grades in the trade: "hand-picked extra green special" is the second quality; and "fair average quality" is the third quality. About 80% of senna falls into the F.A.Q. grade. Ref. No. (1)

Standards laid down by various pharmacopoeiae are mentioned under C.2.

G.4 Alexandrian pods fetch a higher price than Indian senna pods owing to their higher content of sennosides.

Senna prices listed in The Chemical Marketing Report, New York, on 2 October 1982, were as follows:

Product	price $/lb
Alexandrian senna leaves	0.6-0.7
Tinnevally senna leaves	
No. 1	0.3-0.35
No. 2	0.32
No. 3	0.25
Tennevally senna pods	0.40

In the Federal Republic of Germany, a major trader in Hamburg quoted Alexandrian senna leaves, whole, at 1.9; Alexandrian senna pods, whole, F.A.Q., at 1.70; Tinnevally senna leaves, whole, No. 2 prime, at 1.90; and Tinnevally senna pods, 1.65 DM/kg.

The Chemist and Druggist quoted Alexandrian hand-picked pods at L 1.80/kg. in December 1981.

SUMMARY

This document deals with (a) the type of information on medicinal plants that is available in existing data bases and the significance of its use for the developing countries, (b) criteria and guidelines for setting up a national data base on medicinal plants, (c) regional networking of such national data bases, and (d) how to prepare monographs on medicinal plants.

Chapter 1 of the document gives an account of the evolution of computer-readable data bases from traditional abstracting and indexing journals. The major data bases in the world whose areas of coverage include medicinal and aromatic plants are described, highlighting the extent of their utility in this field. Of special interest is the regional network, namely the Asia and Pacific Information Network on Medicinal and Aromatic Plants (APINMAP) sponsored by UNESCO.

Chapter 2 deals with the importance of establishing data bases on medicinal plants in developing countries in view of the large volume of information being generated in this field, and inability of the user community to access it. The specific services a data base can provide for research and development work as also to industry are presented.

The criteria and infrastructural requirements for setting up a data base on medicinal plants are enumerated in Chapter 3. A schedule for the design development and implementation of the system is outlined, including the requirement for hardware, software, personnel, budget planning, and maintenance. The user community is identified and information on different aspects of medicinal plants which the users can extract from the data base is illustrated, using senna as an example.

Chapter 4 describes how to proceed with the regional networking of national data bases. It gives an account of the network structure, organization and management, subject control and responsabilities of the national data bases in this system, using APINMAP as a model. An outline of APINMAP subject classification is annexed.

The steps taken in the preparation of a monograph on medicinal plants are described in Chapter 5, giving the sources of information, such as reference works, primary and secondary journals, review articles and existing monographs. A monographic article on senna is included to exemplify the compilation of a monograph.

References cited in the document are given at the end.

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