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PHCOG MAG.: Research Article
Development of a Computerized Database for Identification of Indigenous Drugs

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ABSTRACT

Information about the diagnostic features of the various crude drugs belonging to different morphological groups namely starch, barks, leaves, woods, seeds, fruits, roots, rhizomes and galls were collected. In this regard, textbooks prescribed for Pharmacognosy for B. Pharm syllabus were consulted for collecting information regarding the various crude drugs. A computerized database was developed in Oracle 8*i* for storage and retrieval of all relevant information about the diagnostic features of the various crude drugs. This database can be of immense use to students, teachers and researchers for microcomputerised identification of indigenous drugs.

KEYWORDS: Diagnostic features, morphological groups, Oracle 8*i*, Database

INTRODUCTION

Herbal medicines are currently in demand and their popularity is increasing day by day. In the health care sector WHO recommends, promotes and encourages the use of traditional herbs and remedies because they are easily available in large quantities, comparatively safer due to their low toxicities and relatively cheaper than the synthetic drugs. Natural products are also becoming a source of drug discovery and development in the new millennium. Over the years, physicians, pharmacists and patients have come to rely on plant drugs found in urban markets that are supplied by professional plant collectors, who commonly adulterate these drugs with other plant drugs and thereby undermine drug quality and the credibility of the system.

The need for greater quality control and quality assurance is widely recognized and efforts have been increasing within the Ayurvedic medical community and the Indian Government to develop standards for preparing drugs from plant sources. Continuing problem in this field is misidentification (either unintentional or intentional) of plant drug by collectors and their subsequent use in Ayurvedic formulations. Reasons for continued difficulties in this area is due to lack of precision in the description of medicinal plants in the traditional texts upon which Ayurvedic Practitioners rely and lack of expertise in plant identification between some plant collectors and a much larger proportion of Traders, Pharmacists and Practitioners. There is, therefore an increasing need for a systematic and scientific study of medicinal plants. However, this requires development of a database which can be used for the retrieval of relevant information about the various medicinal plants. The available computerized database is based on age old DBMS (Database Management System), FORTRAN and is not used often due to some loopholes and unfriendly nature. In the present scenario, there is no such computerized database available which is modern, user friendly, ready to use , handy and easily accessible from the internet.

In view of these problems and in continuation of our earlier work (1) the objectives of the present work was to develop an improved computerized database which could serve as (i) a teaching aid and as a tool for systematic and scientific study of medicinal plants by various researchers and scientists (ii) as a back end for development of software for microcomputerised identification of indigenous drugs.

MATERIALS AND METHODS

Information about the diagnostic characters of the various crude drugs of the different morphological groups namely starch, barks, leaves, woods, seeds, fruits, roots , rhizomes and galls were obtained from the Textbooks of Pharmacognosy (2,3) prescribed for B. Pharm syllabus. A personal computer with Pentium-IV processor and 256 MB RAM was used as the hardware. The software used was MS Windows 98 as Operating System and ORACLE 8*i* as RDBMS for the development of the database (4).

Collection of data

All the drugs, which fall in each particular category, were selected. Data Tables (Tables 1-7) were prepared to accommodate all the diagnostic characteristics of the various crude drugs of the different morphological groups namely starch, barks, leaves, woods, seeds, fruits, roots ,rhizomes and galls.

Development of database

Oracle 8*i* was used for the development of a database. The unique strings were selected. The relational strings were next selected. The type and length of all the attributes were determined. The name of the table and all the attributes were selected.

SQL statements were written for creating tables for each morphological group as follows:.

SQL statement written for Starch:

```
CREATE TABLE STARCH
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(25),
shape varchar2(75),
hilum varchar2(75),
striations varchar2(75),
dimensions varchar2(75),
aggregration varchar2(75),
polariscope_etc varchar2(75)
);
```

SQL statement written for Barks:

```
CREATE TABLE BARKS
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(25),
fibres varchar2(75),
calcium_oxalate varchar2(75),
stone_cells varchar2(75),
cork varchar2(75),
starch varchar2(75),
special_features_$_tests varchar2(75)
);
```

SQL statement written for Leaves:

```
CREATE TABLE LEAVES
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(25),
calcium_oxalate varchar2(75),
upp_surf_stomata varchar2(75),
low_surf_stomata varchar2(75),
cover_trichomes varchar2(75),
gland_trichomes varchar2(75),
upp_epidermis varchar2(75),
low_ epidermis varchar2(75),
mesophyll varchar2(75),
special_features varchar2(75),
```

SQL statement written for Woods:

```
CREATE TABLE WOODS
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(25),
annual_rings varchar2(75),
medullary_rays varchar2(75),
vessels varchar2(75),
fibres varchar2(75),
parenchyma varchar2(75),
contents varchar2(75),
pecularities_$_tests varchar2(75),
```

SQL statement written for Seeds and Fruits:

```
CREATE TABLE SEEDS AND FRUITS
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(50),
starch varchar2(175),
aleurenone varchar2(175),
calcium_oxalate varchar2(175),
epicarp varchar2(175),
mesocarp varchar2(175),
endocarp varchar2(175),
testa_epidermis varchar2(175),
testa_other_layers varchar2(175),
stone_cells varchar2(175)
featuresntests varchar2(175)
);
```

SQL statement written for Rhizomes and Roots:

```
CREATE TABLE RHIZOMES AND ROOTS
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(50),
starch varchar2(175),
aleurenone varchar2(175),
calcium_oxalate varchar2(175),
fibers varchar2(175),
vessels varchar2(175),
stone_cells varchar2(175),
cork varchar2(175),
parenchyma varchar2(175),
special_features_$_tests varchar2(175)
);
```

SQL statement written for Galls:

```
CREATE TABLE GALLS
(
bio_name varchar2(50)UNIQUE,
common_name varchar2(50),
family varchar2(25),
fibers varchar2(75),
calcium_oxalate varchar2(75),
stone_cells varchar2(75),
cork varchar2(75),
```

```
starch varchar2(75),
special_features_$_tests varchar2(150)
);
```

SQL statements for data insertion into tables were written for all morphological groups as follows:

Starch

```
INSERT INTO STARCH
VALUES(
'& bio_name',
'& common_name',
'& family',
'& shape',
'& hilum',
'& striations',
'& dimensions',
'& aggregrations',
'& polariscope_etc'
);
```

Barks

```
INSERT INTO BARKS
VALUES(
'& bio_name',
'& common_name',
'& family',
'& fibres',
'& calcium oxalate',
'& stone_cells',
'& cork',
'& starch',
'& special_features_$_tests '
);
```

Leaves

```
INSERT INTO LEAVES
VALUES(
'& bio_name',
'& common_name',
'& family',
'& calcium oxalate',
'& upp_surf_stomata',
'& low_surf_stomata',
'& cover_trichomes',
'& gland_trichomes',
'& upp_epidermis',
'& low_ epidermis',
'& mesophyll',
 '& special_features'
);
```

Woods

```
INSERT INTO WOODS
VALUES(
'& bio_name',
'& common_name',
'& family',
'& annual rings',
'& medullary_rays',
'& vessels',
'& fibres',
'& parenchyma',
'& contents',
'& low_ epidermis',
'& mesophyll',
'& pecularities_$_tests'
);
```

Seeds and Fruits

```
INSERT INTO SEEDS AND FRUITS
VALUES(
'& bio_name',
'& common_name',
'& family',
'& starch',
'& aleurone',
'& calcium oxalate',
'& epicarp',
'& mesocarp',
'& endocarp',
'& gland_trichomes',
'& testa_epidermis',
'& testa_other_layers',
'& stone_cells',
 '& featuresntests'
);
```

Rhizomes and Roots

```
INSERT INTO RHIZOMESnROOTS
VALUES(
'& bio_name',
'& common_name',
'& family',
'& starch',
'& calcium oxalate',
'& fibres',
'& vessels',
'& stone_cells',
'& cork',
'& parenchyma',
'& special_features_$_tests '
);
```

Galls

```
INSERT INTO GALLS
VALUES(
'& bio_name',
'& common_name',
'& family',
'& fibres',
'& calcium oxalate',
'& stone_cells',
'& cork',
```

```
'& starch',
'& special_features_$_tests '
);
```

Both programmes were run. Data was entered. General and specific queries were entered for retrieval of results as follows:

General Queries

SQL general query statements were entered to obtain the result as shown by few examples .

To get the name of tables present in the database in a tabular form

SELECT * FROM TAB

To look into a table

SELECT * FROM <TABLE NAME>;

To know the name and data type of the coloumns present in a table

DESC <TABLE NAME>;

To drop a table

DROP < NAME OF TABLE>;

To fix a set of data in the database permanently

COMMIT ;

To update a row with new data but unique character remaining same

UPDATE <TABLE NAME>;
SET <COLOUMN NAME 1> = '<New data>'
<COLOUMN NAME 2> = '<New data>'
……..
……..
WHERE <PRIMARY COLOUMN>='Name of the character';

Specific queries

The database also provided answers to specific queries for different crude drugs. Few examples for each morphological group are provided as follows:

Starch

To know the shape of starch present in Wheat
Query : SQL>SELECT shape FROM STARCH WHERE common_name = 'Wheat';
Result : SHAPE

Lenticular, Outline circular,oval or sub-reinform

Barks

To know the name of bark drug which has isolated fibres present in it.
Query : SQL>SELECT bio_name common_name FROM BARKS WHERE fibres= 'Isolated';
Result :BIO_NAME

COMMON_NAME

Alstonia scholaris
Alstonia

Leaves

To know the type of calcium oxalate present in *Datura Stramonium*
Query : SQL>SELECT calcium_oxalate FROM LEAVES WHERE bio_name = 'Datura Stramonium';
Result : CALCIUM_OXALATE

---

cluster in crystal layers

Woods

Query : SQL>SELECT vessels FROM WOODS WHERE bio_name = 'Santalum_album';
Result : VESSELS

Mostly isolated and showing oil containing thyloses

Seeds and Fruits

To know about the type of aleurone present in Linseed
Query : SQL>SELECT aleurone FROM SEEDSnFRUITS WHERE common_name = 'Linseed';
Result : ALEURONE

Well found grains about 15 microns with crystalloid and globoid

Rhizomes and Roots

To know about the type of cork present in *Podophyllum emodi*
Query: SQL>SELECT cork FROM RHIZOMESnROOTS WHERE bio_name = 'Podophyllum_emodi';
Result : CORK

Thin walled, Polygonal , Tabular cells

Galls

To know the botanical name and common name of a gall drug in which there is no fiber present.
Query : SQL>SELECT bio_name common_name FROM GALLS WHERE fibres= 'null';
Result :BIO_NAME

COMMON_NAME

Quercus Infectoria
Oak galls

RESULTS AND DISCUSSION

Our earlier work focused on the development of program in Oracle 8*i* which was used to enter and view data of the diagnostic characters of each morphological group in tabular form only. In

Table 1- Data Table for Starch

Name and source	Shape	Hilum	Striations	Size	Aggregations	Polariscope
Wheat *Triticum sativum*	Lenticular.Outline circular, oval or sub reniform.	A central point appearing as a line when a grain is on its edge.	Concentric. Faintly Marked in commercial starch.	Smaller grains 0 to5 to 10 microns.	Mostly simple.Very few compound grains of 2-4 components.	Faint. Maltese cross. Grains on their edge show a clearly defined "cross"
Maize *Zea mays*	Polyhedral or subspherical.	A central triangular or 2 to 5 Stellate split.	None in polyhedral grains. Rare in the rounded grains.	5 to 10 to 15 to 25 microns.	In commercial starch, all simple.	Well marked cross.
Rice *Oryza sativa*	Polyhedral.	A central point.	None.	3 to 5 to 8 to 12 microns.	Ovate compound grains.	Well marked cross.
Potato *Solanum tuberosum*	Ovoid ; Irregularly ovoid of Subspherical. Some what flattened.	A point at the narrower end. Usually eccentric 1/3 to ¼.	Concentric. Well Marked; some rings darker than others.	Rounded, 10 to 35 microns. Ovoid 30 to 100 microns.	Smaller number of compound grains of to 2-3 components.	Well marked cross. Some Grains are gelatinized.
Tapioca *Manihot utilissima*	Mostly subspherical. Separated components, muller shaped.	Round linear or stellate. Central or up to ½ eccentric.	Concentric.	Large components 25 to 35 microns. Small components 5-12 or 25 microns.	Mostly compound, 2-8 components, mostly 2,3 or upto 6 components.	Well marked cross. Some Grains are gelatinized.

Table 2- Data Table for Barks

Name And Source	Fibres	Calcium Oxalate	Stone Cells	Cork	Starch	Special Features And Tests
Alstonia *Alstonia scholaris*	Isolated.	Prismatic crystals only.	Groups of rather thin walled, rectangular cells. Yellow in colour.	Thin walled.	In the medullary rays. Rounded grains 7-15 microns.	Latex tubes present.
Soap Bark *Quillaia saponaria*	In bundles, tortuous and irregularly enlarged at intervals.	Large prisms, 50-170 microns long and upto 30 microns wide.	Few, sub-rectangular singly or in small groups.	Very little.	Abundant grains about 6-10 microns in diameter.	Powder is stirnulatory. Froths when shaken with water.
Slippery Elm *Ulmus fulva*	In bundles of 6-30 ; about 20 microns in diameter ; only slightly lignified.	Prisms upto 10-25-60 microns long, surrounding the bundles of fibres.	None.	None.	Abundant, spheroidal or polygonal 10-15-25 microns in diameter.	Mucilage stains with ruthenium red. Odour recalling that of fenugreek.
Cascara Sagrada *Rhamnus pershiana*	In bundles of upto 30 fibres about 8-15 microns in diameter.	Clusters in the cortex and parenchyma; prisms in sheath surrounding the groups of stone cells and fibres.	In ovoid groups.	Thin walled ; with yellow-brown contents.	Scantly. In very small grains found in the chloroplastids.	Yellow cell contents are coloured purple by solution of caustic alkali.

Table 3- Data Table for Leaves

Name And Source	Calcium Oxalate	Stomata		Trichomes		Epidermis		Mesophyll	Special Features
		Upper Surface	Lower Surface	Covering	Glandular	Upper	Lower		
Belladonna *Atropa belladonna*	Microsphenoids in idioblasts (sandy crystals)	Cruciferous Few.	Cruciferous Numerous.	Uniseriate 4-5 cells long.	Club shaped solanaceous.	Slightly sinous walls, stiated cuticle.	More sinous walls, striated cuticle.	One row of palisade.	None
Coca *Erythroxylum Coca*	Prisms and a few cluster crystals	None	Rubiaceous.	None.		Straight Walls.	Straight Walls. papillose	One row of palisade.	Numbing taste.

			Numerous.						
Senna *Cassia angustifolia* *Cassia accutifolia*	Prisms near at the fibres. Clusters in palisade and spongy tissue.			Unicellular thick walled. Strong cuticular walls.	None	Straight Walls. Mucilage in lower part of many cells.	Straight Walls. Mucilage in lower part of many cells.	One row of palisade. (Iso bilateral)	Gives the hydroxyl – - methyl - anthraquinone test.
Foxglove *Digitalis purpuria*	None	Ranuncul aceous Few.	Ranuncul aceous Numerous.	3-5 cells long. Uniseriate, finely warty.	Few : mostly with a unicellular stalk and head of 2 cells.	Walls slightly wavy.	Walls markedly wavy.	One row of palisade.	One large water pore, rarely 2 on each side.

Table 4- Data Table for Woods

Name And Source	Annual Rings	Medullary Rays	Vessels	Fibres	Parenchyma	Contents	Peculiarities And Tests
Pine *Pinus sylvestris*	Well marked.	Heterogeneous and uniseriate. A few multiseriate and including a resin duct.	None except of the primary xylem.	None.	Few thin walled cells near the resin ducts.	Resin in the ducts. Occasional starch grains in the medullary rays.	Consists mainly of rectangular prismatic tracheids with tapering ends.
Quassia (Jamaica) *Picrasma excelsa*	None, shows storied arrangement.	About 80 % are 2-5 cells wide ; 20 % are uniseriate. A few prisms of calcium oxalate are present.	Isolated or 2 to 11 in a group ; thickly covered with minute bordered pits.	Thin walled. Pits slit like.	Abundant, chiefly metatracheal. Long cells without Ca. oxalate prisms.	Calcium Oxalate prisms I the files of short celled parenchyma. A few starch grains.	Bitter taste. No colour with ferric chloride. No change with lime water.
Sandal Wood *Santalum album*	Not clearly marked. there are alternating darker and lighter concentric bands.	Usually 2-4 cells wide.	Mostly isolated and showing oil containing thyloses.	Thick walled.	Enriching the vessels. A few files of cells contain Calcium Oxalate prisms.	Oil in all the elements. Oil soluble in alcohol.	Characteristic odour.

Table 5- Data Table for Seeds and Fruits

Name And Source	Starch	Aleurone	Calcium Oxalate	Pericarp			Testa		Stone Cells	Special Features and Tests
				Epicarp	Mesocarp	Endocarp	Epidermis	Other Layers		
Almond *Prunus Communis*	None.	Large grains, each with a small cluster crystal of calcium oxalate.	Cluster crystal in the testa.	None.	None.	None.	Contains stone cells, isolated and in small groups. Remainder is thin walled parenchyma.	Parenchyma.	See epidermis. Rather thin walled with with simple pits.	Fixed oil in the cotyledons.
Linseed *Linus Usitatissimum*	None.	Well formed grains, about 15 microns, with crystalloidal and globoids.	None.	None.	None.	None.	Thin walled filled with mucilage, which stain with ruthenium red.	Hypodermis of collenchyma. Inner epidermis of very flat, quadrangular cells with brown pigment.	Outer epidermis of the inner coat formed of small longitudinally elongated stone cells, lignified.	Thin walled narrow-celled parenchyma crossing the sclerenchyma at right angles. Fixed oil in endosperm and cotyledons.
Nux Vomica *Stryhnos nux vomica*	None.	Grains of irregular shape.	None.	None.	None.	None.	Thick walled lignified and pitted cells, each prolonged into a trichome with many lignified ribs.	Collapsed cells	See epidermis.	Endosperm of thick, hemicellulosic walls and showing plasmodesma. Intensely bitter taste.
Pepper *Piper nigrum*	Small polyhedral grains in large polyhedral masses.	Very small amorphous grains chiefly in the outer layer of the pericarp.	Small prisms in the epidermis of endocarp.	Straight walled cells. Occasional stoma.	Thin-walled parenchyma with vascular bundles and oil cells.	Single layer of beaker cells, Lignified.	Brown pigment layer.	Hyaline layer.	In hypodermis of pericarp ; in groups, mostly 1 layer only.	None.

Table 6- Data Table for Rhizomes and Roots

Name And Source	Starch	Calcium Oxalate	Fibres	Vessels	Stone Cells	Cork	Parenchyma	Special Features And Tests
Senega *Polygala senega*	None.	None.	Short xylem fibres	Small vessels, often with lateral openings.	Cells of the lignified medullary rays.	Thin walled ; yellow to brown.	Moderately thick walled cells containing droplets of oil.	Numerous trachieds. Froths with water. Irritating odour.
Gentian *Gentiana lutea*	Occasional simple grains.	Needles upto 0.1 by 8.0 microns, scattered in the parenchyma.	None.	Large reticulate.	None.	Thin walled ; polygonal tabular cells ; walls slightly waved	Abundant ; rather thick walled ; cells containing droplets of oil and calcium oxalate needles.	Very bitter taste. Characteristic odour.
Ginger *Zingiber officinalis*	Abundant ; granules sack shaped.	None.	Non- lignified, thin walled, septate, surrounding the vascular bundles.	Non lignified, reticulate, accompanied by narrow pigment cells.	None.	Thin walled ; absent from scraped Jamaica ginger.	Abundant ; thin walled, slightly elongated polygonal prisms ; filled with starch.	Secretion cells, like the parenchyma, thin suberised walls, containing oleo-resin.
Belladonna *Atropa belladona*	Simple and 2-4 compounds. Granules 15-30 microns.	Sphenoidal micro-crystals in parenchymous idioblasts.	Few thin walled and irregularly thickened, from the xylem.	Fairly numerous, pitted with rounded bordered pits.	None.	Thin-walled, polygonal, tabular cells.	Somewhat abundant, walls slightly thickened ; filled with starch a few cells with sandy calcium oxalate.	Interxylary phloem cells absent.

Table 7- Data Table for Galls

Name And Source	Fibres	Calcium Oxalate	Stone Cells	Cork	Starch	Special Features and Tests
Oak Galls *Quercus infectoria*	None.	Clusters and prisms in fairly thick walled and pitted parenchyma.	Abundant ; also "lignin bodies" and a few small vessels.	No cork ; but the outer layer are suberised (metaderm).	Few grains about 20 microns in diameter.	Tannin flakes in all the parenchyma, solution of $FeCl_3$ gives a bluish black colour. Occasional insect fragments. Astringent taste.

continuation of this preliminary work(1), the present program was developed in Oracle 8*i* such that results could be obtained from the database on providing general as well as specific queries about the diagnostic characters for each morphological group.

The following database stores all the relevant information regarding the diagnostic features of the various morphological groups viz. starch, barks, leaves, woods, seeds, fruits, roots, rhizomes and galls. According to our requirement on providing particular queries about the above-mentioned morphological groups the database provides us with particular information regarding the diagnostic characters of that particular drug. This database is quite useful for identification of the medicinal plants and can also be used as a teaching aid for UG and PG students. It can be updated from time to time for teaching and research purposes and can be used as a good tool for rapid identification of powdered crude drugs.

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