Medicinal Plants

Traditional Knowledge

Editor

P.C. Trivedi

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MEDICINAL PLANTS
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Dedicated to

Shri Purushottam Upadhyay:

A Sanskrit Scholar & Supporter of Indian Traditional Drugs

Preface

Nearly all cultures, from ancient times, have used plants as a source of medicine. In many developing countries traditional medicine is still the mainstay of healthcare, and most of the drugs and cures used come from plants. In developed countries too people are turning to herbal remedies. Besides, modern scientific medicine still depends on plants, and the knowledge gained from them, for some essential drugs. People in India and China are known to have used plants for healthcare for over 5,000 years.

India is one of the world's 12 regions having the largest biodiversity. It has 16 agroclimatic zones and 45,000 plant species, of which 15,000-20,000 possess proven medicinal value. According to the World Health Organization (WHO) more than one billion people rely on herbal medicine to some extent. The WHO has listed 21,000 plants worldwide, reported to have medicinal uses. It also has a rich medicinal plant flora of some 2,500 species, of which at least 150 are used commercially for pharmaceutical purposes on a fairly large scale. There are four well recognized systems of traditional medicine, namely, Ayurveda, Unani, Siddha and Yoga & Naturopathy. Medicinal plant species are, still to a large extent, gathered and collected from the wild and relatively few genera are cultivated on a commercial scale. This exploitation, coupled with increasing urbanization, has lead to a steady erosion and loss of diversity from the natural habitats of these plants.

Traditional medicine is the sum total of the knowledge and practices based on theories, beliefs and experiences indigenous to different cultures and used in the maintenance of health, as well as in the prevention, diagnosis and treatment of physical and mental illness. Traditional medicines have a long history and have been field tested for centuries by thousands of people, resulting in the accumulation of much empirical knowledge in the communities, passed on by generations of healers. Traditional medicine is perceived as efficient, safe and cost effective. Moreover, it is accessible to the poor and those living in remote areas. In view of this broad appeal, the general lack of research on the safety and efficacy of traditional medicines is of great concern. International, national and nongovernmental agencies continue to make efforts to ensure that safe, effective and affordable treatments for a wide range of diseases are available where they are most needed.

The present book, *Medicinal Plants*: *Traditional Knowledge* is a well documented and comprehensive review of significant investigations on traditional medicinal plants. This volume contains 17 chapters covering holistic information on medicinal plants, their uses, ethnobotanical importance, commercial potential and standardization of herbal formulations, with special reference to India. Articles on antidiabetic drug, antibacterial therapy, antilithiatic activity,

antioxidant and thypolipidemic activity of plants provide detailed information on herbal traditional drugs. Topics covering various subjects viz. mosquito larvicidal activity of some medicinal plants, plants in pest control in agriculture and commercial uses of medicinal plants and traditional knowledge have been included. Information on medicinally important leguminous plants of Kumaon Himalayas, ethno-medico-botany of some sacred plants of Assam, herbal medicinal plants for skin diseases in Baster region, medicinal plants of Hadoti Plateau of Rajasthan etc. provide information collected from these regions. An article on some sacred trees and their medicinal uses has added value to the book.

The 17 chapters in this book, contributed by specialists who have devoted long years to teaching and research in tribal areas of India, share the experience of many tribes in India. The objective of the book is to find ways not just to explore and exploit, but also preserve the availability and sustainability of medicinal plants for the benefit of mankind.

This book provides adequate background and current information on traditional knowledge of medicinal plants. It will be very useful for a variety of scholars—practitioners of medicine, ayurvedic, homoeopathic and other traditional healers; researchers in botany, phytochemistry and pharmacology, and also phytogeographers and conservationists.

This book is dedicated to Shri Purushottam Ji Upadhyay, a strong supporter of traditional Indian drugs for the cure of various ailments. A Sanskrit scholar, follower of traditional values, gentle person of considerable charm, solicitous and caring for all who come in his orbit, I wish that he and his wife will sail together happily, peacefully and in sound health for many more years to come.

I am grateful to all the contributors for writing anthoritative and informative articles for this volume. The publication of the present work could not have been possible without the sincere co-operation and hard work of the contributors. I have tried to honour their ideas in the original shape. While dealing with such a voluminous work, errors are likely to occur despite my best efforts. However, the onus of technical content rests with the contributors.

I pay my humble regards to my late mother, Mrs. Kamla Trivedi, and thank my wife Kusum, daughter Priyanka and son Rohit for their co-operation during the preparation of this book.

P.C. Trivedi
Jaipur

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Herbal Formulations and their Standardization

Aswatha Ram H.N.

INTRODUCTION

The World Health Organization estimates that about 80% of people living in developing countries rely almost exclusively on traditional medicines for their primary health care needs. Since the medicinal plants are the backbone of the traditional medicine, this means that, 3300 million people in the under developed countries utilize medicinal plants on a regular basis (Dobriyal and Narayana, 1998).

Over the years herbal medicines have become popular in the Western countries, partly due to disenchantment with modern synthetic drugs. Even in the allopathic medicine, substances derived from higher plants constitute 25% of the prescriptions. The WHO also appreciated the importance of medicinal plants for public health care in developing nations and evolved guidelines to support the member states in their efforts to formulate national policies on traditional medicine and to study their potential usefulness including evalution, safety and efficacy (Venkata Rao, 1997).

The Indian traditional medicines can be classified into two groups. In the first group are the medicinal preparations belonging to the Ayurvedic, Siddha and the Unani systems. The folk medicines belong to the second group. The medicines of the first group are generally of plant, mineral or animal origin or mixtures of two or three of them. There are well laid down procedures to make these preparations as a result of which it is claimed that their bioavailability is enhanced. The medicines of the second group, on the other hand, are herbal household remedies (Sane, 2002).

STANDARDIZATION

Standardization is a very important aspect of manufacture and supply of herbal drugs. It is only in recent years the importance of standardization of herbals is realized and efforts are being made to

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satisfy the regulatory requirements. Many of the manufacturers export herbal extracts without proper standardization and the importers also accept them since it is very expensive to check the purity by modern standards at their end. However, this cannot go on for long and regulations will be strictly applied to herbal products in all developed nations although it may not be possible to apply the quality control and standardization parameters for herbal drugs as applicable to modern synthetic drugs. The use of medicinal herbs in combination has to be limited to facilitate analysis of herbal formulations. Internationally the use of medicinal herbs in combination has been limited up to 3 herbs in 90% of the formulations and only 10% of those marketed contain more than 3 herbs keeping in view the difficulty in analyzing a complex formulation for all the active ingredients present in it. Since water or hydro-alcoholic solvents are used frequently for extraction of crude raw materials, limits for microbial counts have to be strictly adhered to as also for toxic heavy metals (Venkata Rao, 2000).

The purpose of standardizing traditional remedies is obviously to ensure therapeutic efficacy. The Indian Council of Medical Research (ICMR) has adopted a disease oriented strategy for validating the claims of efficacy of traditional herbal remedies, and have initiated clinical trials of such drugs in the areas of anal fistula, bronchial asthma, viral hepatitis, urolithiasis, diabetes and filariasis. The only center established in the country by the ICMR for the purpose of formulation, standardization and maintaining quality of such drugs inducted in clinical trials in these areas is the ICMR Centre for Advanced Research at the Department of Pharmaceutical Sciences, Panjab University, Chandigarh (Handa, 1995).

The World Health Organization in a number of resolutions has emphasized on the need to ensure the quality control of herbs and herbal formulations by using modern techniques. Internationally and in our country too, several pharmacopeias have provided monographs stating quality parameters and standards of many herbs and herbal products (Dobriyal and Narayana, 1998).

Quality assurance is an integral part of allopathic formulations, which ensures that it delivers the required quantity of medicament when used before its expiry. Every allopathic product enters the market with a quality assurance seal. On the contrary, with other systems of medicines such as Ayurveda, Homeopathy this aspect is not stressed.

The major reasons for this are: In the olden days ayurvedic formulations were prepared by *Vaidyas* as and when necessary in fresh form for administration.

Active constituents vary from species to species, geographic and seasonal variations. They were not manufactured for mass consumption.

The combination of drugs and the dosage differ from person to person depending on intensity of disease. (The diseases may arise from Vata dosha, Pitta dosha or Kafa dosha or combination of any two or three.)

Most of the ayurvedic preparations have to be consumed with specific vehicles such as ghee, milk, honey, water etc., prior to consumption. In many cases, even though medicine is the same, vehicles are different for different conditions (e.g. If kafa is prominent the doctor may recommend medicine with honey or less the same medicine is recommended with milk or warm water/cold water etc.).

Ayurveda treatment consists of not just medicines but also restricted and recommended diet. Which food is to be consumed and which one is not to be consumed again varies in different ailments.

Major Forms of Ayurvedic Formulations Include

Churnas: Powders of crude drugs in purified forms.

Bhasmas: The ashes of medicinal substances.

Liquid Orals: As syrups, solutions, mixtures, asavas and aristas etc.

Lehas: As poultices and semi solid preparations.

Quality Assurance for Churnas

At the stage of selection of plant, during mixing, parameters such as weight content, ash content, active constituent in the extract, palisade ratio, stomatal index, fiber content etc., are some of the criteria which can be adopted as standards.

Quality Assurance for Liquid Orals

Titrimetry, gravimetry, colorimetry are some of the criteria that can be adopted and standardized.

Quality Assurance for Bhasmas

Water soluble ash/insoluble ash, Acid soluble ash/insoluble ash are some of the criteria which can be adopted as standards.

Quality Assurance for Leha (Pastes)

Extraction with solvents and their analysis by suitable techniques as titrimetry, gravimetry, fluorimetry, nephlometry are some of the criteria which can be adopted as standards. Generally, many ayurvedic formulations do not have expiry date hence accelerated stability studies can be included (Kamalapurkar *et al*, 2000).

Standardization of Herbs using Marker Compound Analysis (Dobriyal and Narayana, 1998)

One of the best methods of standardizing herbs and herbal formulations based on the modern scientific tools is chromatography. It not only helps in establishing the correct botanical identity but also helps in regulating the chemical sanctity of the herbs. One such technique is marker compound testing and fingerprint 1010 analysis.

Different chromatographic methods are used to analyze the marker compounds in herbs with the help of modern sophisticated tools. High Performance Thin Layer Chromatography (HPTLC) is most frequently used where only fingerprinting of the herbs is required without quantifying the compounds, though the same can also be quantified with the help of a densitometer. For quantitative work, it is generally High Pressure Liquid Chromatography (HPLC) which is preferred. But the method of standardization is a tedious exercise in this technique as the availability of literature for individual compound analysis is too sparse. Gas Chromatograph is used mainly for volatile material like essential oils and perfumes. So far the phytochemical studies are concerned the medicinal

plants in India have been substantially studied and at least the major components have been identified. Hence, there exists an opportunity to select the compounds which can be used for standardization purpose based on the methods of isolation of these compounds. Table 1.1 shows the

Table 1.1: Marker work achieved and required in medicinal plants

S.No.	*Name of the herb*	*Marker Compounds*
1	*Acacia arabica*	Arabic acid
2	*Acacia catechu*	Catechin
3	*Aconitum heterophyllum*	Aconitin
4	*Aegle marmelos*	Aegelin
5	*Andrographis paniculata*	Andrographolides
6	*Asparagus racemosus*	Shatawarine
7	*Boerhaavia diffusa*	Punarnavine
8	*Boswellia serrata*	Boswellic Acids
9	*Cassia angustifolia*	Sennosides
10	*Cassia fistula*	Fistuline
11	*Centella asiatica*	Asiaticoside
12	*Cinnamomum tamala*	Eugenol
13	*Commiphora mukul*	Guggulusterones
14	*Crocus sativus*	Crocetin
15	*Curculigo orchioides*	Lycorine
16	*Curcuma longa*	Curcuminoides
17	*Cyperus rotundus*	Cypeerotundone
18	*Embelia ribes*	Embelin
19	*Eugenia caryophylata*	Eugenol
20	*Evolvulus alsinoides*	Evolvine
21	*Ferula asafoetida*	Ferulic acid
22	*Glycyrrhiza glabra*	Glycyrrhizin
23	*Holarrhena antidysenterica*	Kurchine/Kurchicine
24	*Hyoscyamus niger*	Hyoscyamine
25	**IPOMOEA DIGITATA**	
26	*Melia azadirachta*	Nimbidine
27	*Mentha arvensis*	Menthol
28	*Ocimum basilicum*	Eugenol
29	*Phyllanthus emblica*	Phylembelin
30	*Phyllanthus niruri*	Phyllanthin
31	*Picrorrhiza kurrroa*	Kutkin
32	*Piper longum*	Piperine

(Contd.)

(Contd.)

33	*Piper nigrum*	Piperine
34	*Plantago ovata*	
35	*Santalum album*	Santalol
36	**SARACA ASOCA**	
37	*Saussurea lappa*	Saussurine
38	*Solanum indicum*	Solanidine
39	*Solanum xanthocarpum*	Solanocarpine
40	*Swertia chirata*	Chiratin
41	*Terminalia arjuna*	Arjunine
42	*Terminalia chebula*	Chebulinic acid
43	*Tinospora cordifolia*	Giloin
44	*Trigonella foenum-graecum*	Trigonalline
45	*Valeriana wallichi*	Valerine
46	*Withania somnifera*	Withanolides
47	**WOODFORDIA FRUTICOSA**	
48	*Zingiber officinale*	Gingerol

Note: Shaded herbs are those where marker work is achieved, **BOLD** ones represent where further chemical studies are required to establish the chemical profile of the herbs. In rest of the herbs though marker compounds can be designated based on the exhaustive chemical studies done on the herbs, the testing is not being carried out extensively due to various bottlenecks.

current status of marker testing in various herbs and also enlists the plants where these tests can be done to ascertain the quality and purity of the herbs.

QUALITY CONTROL OF RAW MATERIAL (Handa, 1995)

General protocols followed for the standardization of raw materials are shown in Figure 1.1.

Authentication

The plant material collected from an appropriate region of the country at an appropriate stage of its growth is well authenticated by detailed taxonomical study and the correct botanical identity is established, e.g., a number of *Phyllanthus* species like *P. simplex, P. maderaspatensis, P. amarus, P. fraternus* and *P. urinaria* grow in almost same agroclimatic conditions in India and out of these only *P. amarus* with its distinct taxonomical characters has been selected for clinical trials.

Foreign matter

Plant drugs other than what constitutes the drug are considered as foreign matter. Medicinal plant material should be entirely free from soil, stones, dust, insects and other animal contamination including animal excreta.

Organic evaluation

Organoleptic examination refers to evaluation by means of organs of sense and includes the macrosopic appearance of the drug, its odor and tastes, occasionally the sound or “snap” of its

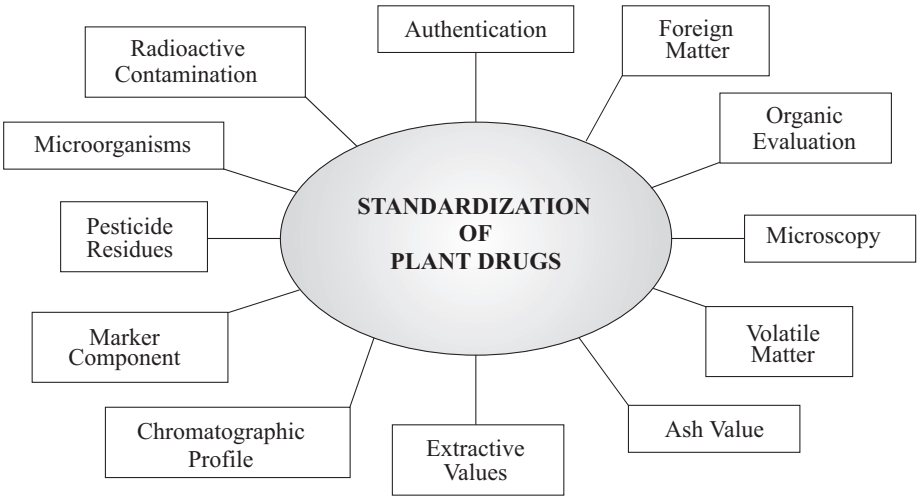

Fig. 1.1: Authentication and standardization of herbal raw material

fracture and the feel of the drug to the touch *P. amarus* leaves are very bitter in taste, *P. maderaspatensis* has mild bitterness whereas *P. fraternus* is not bitter.

Microscopical examination

Microscopical examination of the plant drugs is not only essential to the study of adulterants but also is indispensable in the correct identification. Epidermal peel study of the leaves of *Phyllanthus* species reveals wavy walled epidermal parenchyma in *P. amarus* and *P. fraternus* and straight walled epidermal parenchyma in *P. maderaspatensis*. Furthermore, only anisocytic type of stomata in *P. fraternus* and *P. maderaspatensis* and both paracytic and anisocytic stomata in *P. amarus* have been observed. Such diagnostic microscopic features are of immense value in plant drug standardization. Quantitative microscopy like stomatal number, stomatal index and palisade ratio is of help in differentiating closely allied species.

Volatile matter

The volatile matter, if present is determined by steam distillation of the plant drug.

Ash value

The presence of ash in medicinal plant materials is determined as total ash, acid insoluble ash and sulphated ash. When vegetable drugs are incinerated, they leave an inorganic ash which in the case of many drugs varies within fairly wide limits and these values are of significance for the purpose of plant drug evaluation.

Extractive values

The determination of extractable matter refers to the amount of constituents in a given amount of medicinal plant material extracted with solvents. Such extractive values provide an indication of the extent of polar, medium polar and non-polar components present in the medicinal plant material.

Chromatographic profile and marker component

Of the many chromatographic methods, presently available, thin layer chromatography (TLC) has become widely adopted for the rapid and positive analysis of plant drugs since the time required for the demonstration of most of the characteristic constituents by TLC is very short and in addition to qualitative detection, TLC also provides semi-quantitative information on the chief constituents of the plant drug and thus, enables an assessment of drug quality. Furthermore, TLC provides drug fingerprint. It is therefore, suitable for monitoring the identity and purity of drugs, and for detection of adulteration and substitution. TLC profile of extracts of *Phyllanthus* and *Curcuma* has been exhibited. TLC-densitometer scanner was used for obtaining fingerprint profile of extracts of many drugs inducted into clinical trials and the representative fingerprint profile of *P. amarus*, *P. maderaspatensis*, Ksharsootra, Shereesh, Varun, etc., have been developed. High Performance Liquid Chromatography (HPLC) was employed to plant drugs like *Andrographis paniculata* where hepatoprotective bioactive compound andrographolide is known and the same has been quantitatively estimated. Similarly, two lignans phyllanthin and hypophyllanthin in *P. amarus* have been quantitated in different parts of the plant. A reverse phase HPLC method of estimating vasicine, the major bioactive alkaloid of *Adhatoda vasica* has been employed to standardize two polyherbal formulations used for the treatment of bronchial asthma in Ayurvedic system of medicine.

Pesticide residues

The use of biocidal agricultural chemicals collectively known as pesticides has greatly reduced the presence of insects, fungi and molds in food. Medicinal plants are therefore, liable to be affected by pesticide residues which accumulate from agricultural practices of spraying, treating soils during cultivation and through the administration of fumigants during storage. Since many medicinal plant preparations are taken over long periods of time, limits for pesticide residues should be established following the recommendations of the Food and Agriculture Organization (FAO) and the W.H.O. These recommended guidelines include analytical methodology of pesticide residues. Pesticides of persistent nature containing Hg, DDT, HCH (BHC) aldrin, dieldrin, melipax and toxaphene are not allowed for medicinal plants.

Determination of heavy metals

Contamination of medicinal plant materials with arsenic and heavy metals like cadmium and lead can be attributed to many causes such as environmental pollution and traces of pesticides. The limits (parts per million) of such heavy metals in medicinal plants should remain within specifications.

Microbial contamination

Medicinal plant materials normally carry a great number of bacteria and molds, often of soil origin. While a large range of bacteria and fungi from the naturally occurring microflora of herbs, aerobic spore-forming bacteria frequently predominate. Current practice of harvesting, handling and production often causes additional contamination and microbial growth. The determination of *E. coli* and mold may indicate good production and harvesting practices. In addition, the presence of aflatoxins in plant material can cause health hazards if absorbed even in very small amounts. Therefore, they should be determined after using a suitable clean-up procedure.

Radioactive contamination

Irradiation may have been used as a procedure for microbial decontamination and sterilization of plant materials (after harvest), packaging materials, intermediate products, bulk materials and finished products. W.H.O. guidelines may be followed for this aspect.

PRODUCTION OF STANDARDIZED HERBAL DRUGS

Quality assurance of traditional remedies rely upon good manufacturing practices with adequate batch analysis and standardized methods of preparation. Various processes used in the manufacture of herbal drugs lack standardized methods. Thus, the same traditional drug prepared by two different manufacturers may vary in its potency and even the physical appearance. Many vaidyas and hakims have their own miniature manufacturing facilities. Creating uniform standards for the processes of manufacturing has, thus become all the more difficult. Large scale commercialization of herbal drugs necessitates scientifically evolved standardized methods of plant drug production. General protocols of standardized plant drug production are given in Figure 1.2.

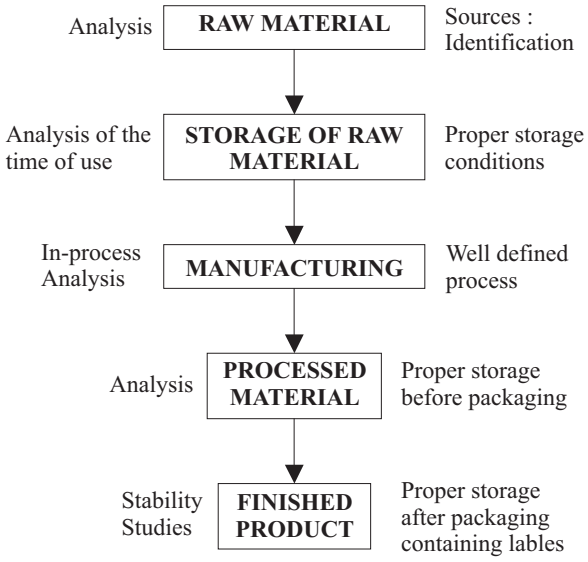

Fig. 1.2: General protocol for standardized production of plant drugs

VALIDATION OF AYURVEDIC PRODUCTS AND PROCESS (Chowdary *et al*, 1997)

Validation is a relatively new concept in pharmaceutical manufacturing evolved in 1980's. Validation is establishing documented evidence which provides a high degree of assurance that a specific process will consistently produce a product meeting its pre-determined specifications and quality characteristics. Validation is thus, the action of providing that any procedure, process,

equipment, material, activity or systems actually leads to the expected results and produce a quality product. The concept of validation has expanded to encompass a wide range of activities from analytical methods used for the quality control of drug substances and drug products to equipment, facilities and process for the manufacturing of drug substances and drug products. Validation will ensure commitment, to product quality.

Standardization Based on Various Parameters

Generally, Ayurvedic medicines are the combination of selected herbal/crude drugs and are manufactured under different pharmaceutical processes to result in various dosage forms such as extracts, tinctures, decoctions, pills, powders, tablets and capsules and semisolid pastes, jellies etc. Validation of Ayurvedic products and process should include: I. Raw Material Validation, II. Process Validation, and III. Finished Product Validation.

Some of the recent examples for Standardization based on various parameters are follows:

Lalla *et al*, (2002) developed the standards for Shankha Bhasma available in the market and simultaneously prepared in the laboratory according to Ayurvedic Formulary in order to compare the results using analytical techniques. The tests include physicochemical characterization, IR spectroscopy and chemical analysis involving determination of calcium carbonate. Determination of bioburden levels and pharmacological (antacid) activity testing were also included in evaluating safety and efficacy of the formulations.

Mohammed Ali *et al*, (2001) standardized Chyawanprash on the basis of organoleptic characters, chemical analysis including nitrogen, sugars and ascorbic acid contents and some pharmacological activities such as Open Field Test (OFT) and Behavioural Despair Test (BDT).

Thankamma *et al*, (1995) showed the presence of piperine in unchanged form in various marketed ayurvedic preparations by TLC.

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2

"*Gymnema sylvestre*"–A Wonderful Antidiabetic Drug

Aswatha Ram H.N.

INTRODUCTION

Gymnema sylvestre (Retz,) R.Br. Asclepiadaceae

Eng: Periploca of the woods

Hin: Gudmar, Merasimgi

Kan: Kadhasige

Mal: Cakkarakkolli, Madhunasini

San: Mesasrngi, Madhunasini

Tam: Sirukurumkay, Sakkaraikkolli

Tel: Podapatra

Distribution

Throughout India, in dry forests upto 600 mt height.

Parts used

Whole plant (Longman, 1995).

Description

A large woody much-branched climber running over the tops of high trees; young stems and branches pubescent, often densely so, terete.

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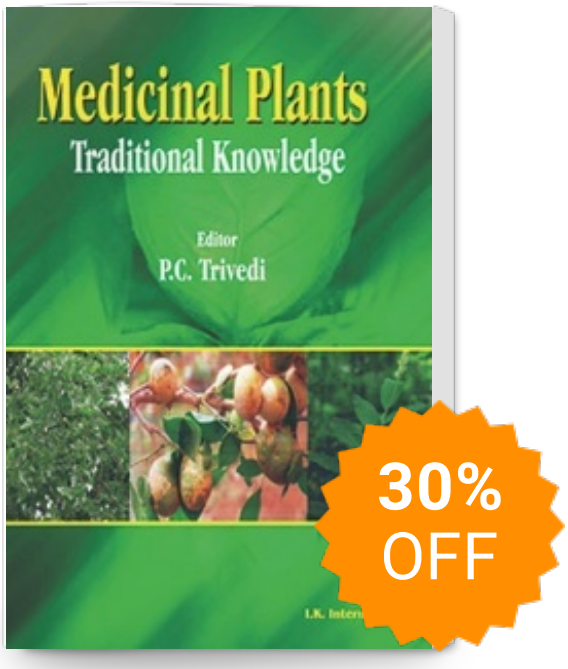
Medicinal Plants Traditional Knowledge



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