DATABASE ON MEDICINAL PLANTS USED IN AYURVEDA

VOLUME 8

Kailash Chandra
B.G. Chaudhari
B.P.Dhar
G.V.R.Joseph
A.K.Mangal
Rajesh Dabur
Tushar K. Mandal
Arun M. Gurav
M.B. Yelne
S.P. Singh

Assisted by

R. Koditkar, A. Hole, V. Shinde, M.V. Sathe and G. Deshmukh

Central Council for Research in Ayurveda & Siddha
(Department of AYUSH, Ministry of Health & Family Welfare)
Government of India
Jawaharlal Nehru Bhartiya Chikitsa Avam Homoeopathy
Anusandhan Bhavan, 61-65 Institutional Area, Opp. “D” Block,
Janakpuri, New Delhi – 110058.

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(Deptt. of AYUSH, Min. of Health & Family Welfare),
Govt. of India
Jawaharlal Nehru Bhartiya Chikitsa Avam Homoeopathy
Anusandhan Bhavan, 61-65 Institutional Area, Opp. "D" Block,
Janakpuri, New Delhi – 110058.
E mail: **ccras@vsnl.net.in**

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Cover page designed by
Dr. Rajesh Dabur, RRI(Ay.), JNAMPGH, Pune

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FOREWARD

Ayurveda, the ancient Indian system of health care and medicine, has well organized *materica medica* in which plants form a dominant part. The green wave has affected the whole world very strongly. The closeness to the nature, the sensitivity to the cleanness of environment, the renaissance of folk medicine, the popularity of alternative healing methods inspire the use of more and more plant based preparations. The number of organizations and institutions which are involved in some aspects of research into medicinal and aromatic plants range from inter-governmental agencies to international, national and local organizations.

Keeping in view present scenario, there was an urgent need to compile the series of books containing all the combined information of Ayurveda texts as well as the modern literature on the plants. This eighth volume of series presents an account of 30 species of important plants widely used in Ayurvedic formulations. A few of them are less known and under exploited, i.e. *Annona squamosa* and *Leucas cephalotes*. This book is a comprehensive volume detailing the characteristics of 30 important plant species. The documentation is exhaustive including nomenclature, botanical description, distribution, Ayurvedic properties, actions and uses, pharmacogonosy, chemical constituents, pharmacological and toxicological properties, therapeutic evaluations, cultivation and tissue culture. In other words this volume contains oldest medical science (Ayurveda) of world as well as modern science. The information on these plants has been obtained from various sources. The various books along with the latest journals related to the plant sciences were the main source to collect the information on the plants described in this book. All the references are up to date and provided in the text to make this volume friendlier to the readers.

Collection and compilation of enormous data presented in this volume was a very painstaking job. The Central Council for Research in Ayurveda and Siddha (CCRAS), Department of AYUSH, has rightly started compilation of **"Database on Medicinal Plants used in Ayurveda"** and 7 volumes covering 220 medicinal plants have already been published. I take great pleasure in presenting **8th volume** of this series brought out by CCRAS, under the excellent guidance of Dr. G.S. Lavekar, Director of the Council. This volume comprises 30 important medicinal plants. The guidance, encouragement and interest imparted by Dr. G.S. Lavekar and the efforts put in the team of scientists lead by Sh. K. Chandra, Assistant Director Incharge of the Regional Research Institute (Ay.) at Pune deserve all appreciation.

I am confident that this volume, a prestigious expertise publication of the Department of AYUSH, would prove to be of immense utility to all who are interested in medicinal plants.

New Delhi

January, 2007.

(Anita Das)

Secretary
Department of AYUSH
Ministry of Health and Family Welfare
Government of India

PREFACE

Traditional systems of medicine continue to be widely practiced. Global estimates indicate that 80 per cent of population cannot afford the products of the western pharmaceutical industry and have to rely upon the use of traditional indigenous medicines mainly derived from plants. An inventory of 20,000 medicinal plants species has been compiled for the entire world.

According to survey report by WHO, about 25 per cent of prescribed human medicines are derived from plants and 80 per cent people still depend on traditional system of medicines.

The herbal wealth of India and the knowledge of their medicinal properties have a long tradition, as referred in Rigveda and other ancient literature. The topography of India in the tropical belt with its varied climatic zones made it a vast storehouse of medicinal plants.

In recent years, a few developments in the drug industry have brought Indian medicinal wealth at their ecosystem into world focus. In particular, the clinical reports on many native plants like **Sarpagandha (*Rauvolfia serpentina*), Guggulu (*Commiphora wightii*), Chirayata (*Swertia chirayita*), Tagar (*Valeriana jatamansi*), Arjuna (*Terminalia arjuna*), Yashtimadhu (*Glycyrrhiza glabra*), Vasa (*Adhatoda zeylanica*), Kalmegh (*Andrographis paniculata*)** and many more have supported their claim of containing specific pharmacological activity for which they are used in Indian System of Medicines.

I am delighted to present the **8th Volume** of **"Data Base on Medicinal Plants used in Ayurveda & Siddha"**, which has been compiled comprehensively in time bound manner. This volume incorporates an account of 30 plant species used in Ayurveda. Like earlier volumes, it presents a brief and concise account of parts used, classical and vernacular names, botanical characters, distribution in India as well as abroad, important actions and uses, Ayurvedic properties, pharmacognostic characters, chemical constituents, pharmacological activities, toxicology, therapeutic evaluation, trade and commerce, substitutes and adulterants, formulations and preparations, propagation and cultivation etc. along with photographs of the plants and parts used. Efforts have been made to collect up to date references from all available sources which has been incorporated in the texts and the same are also incorporated at the end of each species under the subhead References, Bibliography.

I am confident that this volume will also be welcomed by the researchers of various disciplines like Botany, Chemistry, Pharmacology, Pharmacognosy, Agriculture, Forestry apart from Ayurveda and other traditional systems of Medicine as well as Modern Medicine. It would be useful for the persons/agencies interested in Medicinal Plants and Ayurveda including Pharmaceutical Industries.

I appreciate Sh. K. Chandra, Assistant Director, Incharge, Regional Research Institute (Ay.), Pune, Sh. B.G. Chaudhari, Research Officer (Pharmacognosy),Dr. Rajesh Dabur, Research Officer (Biochemistry), Dr. T.K. Mandal, Research Officer (Ayurveda), Dr. A.M. Gurav, Research Officer (Botany), Sh. M.B. Yelne Research Officer (Pharmacognosy) and Dr. S.P. Singh, ex. Assiatant Research Officer (Chemistry) for their dedicated efforts and hard work in compiling the manuscript. I am also thankful to Dr.(Mrs.) B.P.Dhar, Research Officer (Pharmacognosy), Dr. G.V.R.Joseph, Research Officer (Botany), Dr. A.K.Mangal Research Officer (Pharmacognosy), for their sincere efforts in bringing this volume. Thanks are also due to Smt. Rohini Koditkar, Shri Ganesh Deshmukh and Smt. Vinaya Shinde, Senior Research Fellows and Smt. Archana Hole (Herbarium Assistant) and Shri M.V. Sathe (Laboratory Technician) for their sincere assistance and devotion to work, which has made it possible to collect and compile the data in shortest possible time. I also thank to Sh. P.M. Kharawalikar, Artist and Sh. C.M. Erande Field Technician RRI (Ay.), Pune for extending co-operation in preparation of photographs. A word of appreciation is due to Sh. Nilesh V. Shirke, Computer Operator cum Typist for his painstaking work of loading the data with minimum errors and to all the Technical and Administrative staff of the Institute for extending co-operation directly or indirectly.

I am thankful to the Director, National Chemical Laboratory, Pune for providing Library facilities for referencing and collection of data.

I would like to express my sincere gratitude to Smt. Anita Das, Secretary and Shri Shiv Basant, Joint Secretary, Department of AYUSH, Ministry of Health and Family Welfare, Govt. of India, for their keen interest, encouragement and appreciation of the work.

**Place : ** New Delhi (G.S. Lavekar)

**Dated : ** 01-10-07 Chief Editor

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EXPLANATORY INTRODUCTION

The literature on medicinal plants is quite vast. It is scattered and not available at one place even in big libraries. Therefore, a great necessity was felt to have relevant literature providing multidisciplinary information of such resources at one place in the form of Data Base. So far seven volumes of "**Data Base on Medicinal Plants used in Ayurveda & Siddha**" have been published. This publication being eighth in the series includes 30 medicinal plants included in the Ayurvedic Formulary of India. Like the earlier volumes, it presents a brief and concise account about each species covering the selected aspects pertaining to Botanical / Ayurvedic nomenclature, Vernacular names, Distribution, Botanical description, Flowering and fruiting period, parts used of the plants along with photographs, Actions and uses, including Ayurvedic properties and Dose have been given. The Pharmacognosy, Chemical constituents, Pharmacological activities, Toxicology, Trade and commerce, Substitutes and Adulterants have also been included. Brief information about Formulations and preparations, Propagation and cultivation is provided. An exhaustive Bibliography containing upto date references is incorporated.

It is worth mentioning that the textual matter contains only important characters and findings concisely under each sub head, to give a general and broad idea of the whole plant and its properties. The species described in the book are arranged alphabetically based on Ayurvedic nomenclature of the medicinal plant. A latest valid botanical name along with synonym and Natural order has been given. Classical names include only those mentioned in ancient Ayurvedic literature. Vernacular names of important regional languages have been incorporated to locate the species in different geographical areas of the country. Botanical description includes habit of the plant and important morphological features, which would help in the identification of the plant. Distribution of the plant in India and World wide is meant to give a broad idea of the availability of the species in different geographical and eco-climatic zones.

Parts used, Actions and uses and Ayurvedic properties are based on ancient as well as recent Ayurvedic literature.

Pharmacognosy mostly includes important macro and microscopic characters and physical constants. Major chemical constituents, important pharmacological activities, findings related to toxicology and therapeutic evaluation wherever available have been included.

Data on trade and commerce however available has been given along with current retail market price. Substitutes and adulterants which has been reported has been incorporated. Data on propagation and cultivation of medicinal and methodology related to *in vitro* propagation wherever available has been incorporated.

Under references sub heading all the references has been mentioned which are cited in the text. Other references has been given under the Bibliography sub heading. The sources of References and Bibliography include Medicinal and Aromatic Plants Abstracts, Chemical Abstracts, Biological Abstracts, Journals of National and International repute, Important books and Monographs as well as global Internet.

Indices of Classical (Sanskrit) and vernacular names have been appended to enhance the usefulness of the Data Base to the readers of all categories.

G.S.Lavekar, K. Chandra, B.P.Dhar, G.V.R.Joseph,
A.K.Mangal, B.G. Chaudhari, Rajesh DaburT.K. Mandal,
A.M. Gurav, M.B. Yelne, Dr. S.P. Singh

ABBREVIATIONS

LANGUAGES

Arab.-	Arabic
Beng.-	Bengali
Burm.-	Burmese
Eng. -	English
Gond.-	Gondia
Guj. -	Gujarati
Kan. -	Kannada
Kash.-	Kashmiri
Kon. -	Konkani
Mar. -	Marathi
Mal. -	Malayalam
N.W.P.	North West Provinces
Pers. -	Persian
Punj. -	Punjabi
Raj. -	Rajasthani
Santal.-	Santali
Sind. -	Sindhi
Sing. -	Singhalese
Tam. -	Tamil
Tel. -	Telgu

BOOKS

B.N. – Bhavprakash Nighantu
D.N. – Dhanvantari Nighantu
R.N. – Raj Nighantu

USED IN REFERENCES RELATED TO *BRHATTRAYI*

C.S.-	*Charak Samhita*
S.S.-	*Sushruta Samhita*
A.H.-	*Astanga Hridayam*
Su. -	*Sutrasthana*
Ni. -	*Nidanasthana*
Vi. -	*Vimanasthana*
Sa. -	*Sharirasthana*
In. -	*Indriyasthana*
Ci. -	*Chikitsasthana*
Ka. -	*Kalpasthana*
Si. -	*Siddhisthana*
U. -	*Uttarasthana or Uttaratantra*

AHIPHENA

BOTANICAL NAME: *Papaver somniferum* L.

FAMILY: **Papaveraceae**

SYNONYMS

Ahiphellaka, Aphenak, Aphuka, Chosa, Kaskhas, Khakasa, Khasa, Khasbija, Khasphalakshira, Khastila, Lasatphala, Sukshmabijaa, Sukshmatandula, Tilabheda (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES

Eng.- Opium poppy, White poppy, Opium poppy capsules, Poppy seeds, Bale-wort, Peony poppy, Carnation poppy, Joan silverpin, White garden poppy. **Hindi-** *Afim, Afiun, Afyan, Postekebeej, Post, Pest, Khas-khasa, Afin, Sufeed srah*. **Beng.-** *Posto-dheri, Pasto, Post.* **Guj.-** *Aphina, Khuskhus, Posta*.**Kan.-** *Afim, Biligasgase, Khasakhasi, Gasagase, Kasakase, Biligasge*. **Mal.-** *Afiun, Kashakhasa, Avin, Karappu, Kasakasa*. **Mar.-** *Khuskhus, Aphu, Pasta* **Punj.-** *Afim, Doda, Khashkhash, Khaishkhash, Post.* **Tam.-** *Abini, Gashagasha, Gashgashatol, Kasakasa, Pothakkai, Postaka, Postakatol*. **Tel.-** *Abhini, Gasalu, Kasakasa, Gasagasalu, Nallamandu, Posta-katol, Nallamanthu*. **Arab.-** *Abunom, Afiun, Bizrulkhashkhash, Khashkhashulbaiza, Qishrulkhashkhash*. **Pers.-** *Afiun, Khashkhash, Koknar, Khashkhashsufaid, Postekoknar, Tukhmekoknar.* **Urdu-** *Khashkhashsufaid* (Nadkarni, 1976; Kirtikar and Basu, 1933; Anonymous, 1966; Yoganarasimhan, 2000; Watt, 1972; Anonymous, 1995; Chatterjee and Pakrashi, 1994; Anonymous, 2000a; Mukerji, 1953; Chopra *et al.*, 1986; Sharma, 1978).

BOTANICAL DESCRIPTION

An erect, usually glaucous, annual robust herb, 60-120 cm high. Leaves simple, sessile, alternate, 15-25 x 8-15 cm, ovate-oblong, shallowly pinnatifid, lobed, base cordate, irregularly toothed margin, acute, amplexicaule. Flowers attractive, bisexual, large, 5-6 cm across, white or purplish variegated with a dark stain at the base. Capsule globose or ovoid, glabrous, upto 4 cm in diameter, stalked. Seeds white or greyish-brown to black, reniform. Flowering and Fruiting: April-August (Gamble, 1967;

AHIPHENA ***Papaver somniferum*** Linn.

Anonymous, 1966; Anonymous, 2000b; Mukerji, 1953; Hooker, 1973; Chauhan, 1999; Collett, 1971).

DISTRIBUTION

Cultivated for its fruit and seed in some parts of India, particularly Madhya Pradesh, Rajasthan, Uttar Pradesh (Anonymous, 1966) and in small quantity in Jammu & Kashmir (Anonymus, 1995), Himachal Pradesh, Punjab etc. under control of Government. The centre of origin of opium poppy lies in the Western Mediterranean (middle east) region to various parts of the world from where it spread to Balkan Peninsula (Watt, 1972). Cultivated as medicinal herb in South Europe, South Eastern Asia, China including Turkey, Russia, Yugoslavia, Bulgaria, North Africa, Afghanistan, India, Pakistan, Japan, Iran etc (Kirtikar and Basu, 1933). It is also grown as ornamental plant in some gardens in South Asia and warm countries of Europe and America (Mukerji, 1953; Chadha and Gupta, 1995).

PART(S) USED

Latex of fruit (capsule exdudate), seed, empty capsules, seed oil, unripe capsules and flower (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The opium obtained from the fruits is bitter, astringent, sweet, constipating, aphrodisiac, sedative, somniferous, narcotic, myotic, antispasmodic, sudorific and nervine tonic. It is useful in cough, fever, inflammatory affections of eye, otitis, proctalgia and low back pain due to diarrhoea and dysentery. It is good for internal haemorrhages, decrease secretions, restrain tissue changes and used as analgesic.It beneficial in migraine, malaria, dysmenorrhoea, cystitis, menorrhagia and other painful conditions (Chatterjee and Pakrashi, 1994; Thakur *et al.*, 1989). Opium (the inspissated milky juice from immature capsules) is a soporific drug, given either alone or as an adjunct, in the preparation of various medicines. It acts on the CNS, induces sleep, relieves pain, develops euphoria and highly toxic in large doses. Opium available in the market is purified by steeping in cold water for 5-6 hr. The insoluble brown latex finds application in the Ayurvedic medicine. It is prophylactic in post-operative period (50-60 mg/day). Vapours of boiling water mixed with small doses of opium, is useful in conjunctivitis. Camphorated opium (1:1) is an excellent pain killer in sprain. However, it is contraindicated for people suffering from asthma, cardiac and urinary bladder diseases. Seed oil, freed from narcotic principles is useful in diarrhoea and dysentery (Chopra *et al.*, 1958). At the present time opium in combination with other drugs is used in diabetes. An infusion of the capsules is used as a soothing application for bruises, inflammatory swellings, some times in painful conjunctivitis, inflammation of ear, irritant cough and sleeplessness. The petals are bitter, expectorant, sudorific, diaphoretic, analgesic and sedative (Anonymous, 1995; Kirtikar and Basu, 1933).

The plant is astringent, stimulant, fattening, aphrodisiac, tonic and beautifies the complexion (Nadkarni, 1976).

AYURVEDIC PROPERTIES

Rasa **–** *Tikta, Kashaya.*

Guna **–** *Laghu, Ruksha, Sukshma, Vyavayi, Vikashi.*

Veerya **–** *Ushna.*

Vipaka **–** *Katu.*

Prabhava **–** *Madaka.*

Doshaghnata **–** *Kaphavatashamaka* (Sharma, 1978; B.N., 1982).

Karma **–** External – *Vedanasthapana, Shothahara* (Sharma, 1978; B.N., 1982).

Internal – *Kaphaghna, Madaka, Vyavayi, Vikashi, Nidrajanana, Akshepahara, Vamaka, Stambhaka, Shoolaprashamana, Vishamajwaraghna, Shothahara, Raktastambhaka, Shwasahara, Madhuryashamana, Punsatwoghati, Shukrastambhana, Swedajanana, Vrishya, Balya, Gurupaki, Prasekawarodhaka, Vajikarana, Kantiprada, Jwaraghna* (Sharma, 1978; B.N., 1982).

Rogaghnata **–**

External – *Sandhishotha, Phuphphusavaranashotha, Karnashotha, Netrashotha, Arsha, Gudaroga.*

Internal – *Kaphavatajavikara, Udarashoola, Ashmari, Gridhrasi, Parshwashoola, Apasmara, Apatantraka, Kampavata, Dhanustambha, Kupiluvisha, Pralapa, Visuchika, Hridayashoola, Hridvikara, Shwasa, Kasa, Phuphphusavranashotha, Pratishayaya, Ikshumeha, Garbhapata, Prasavottara vedana, Vishama jwara, Shleepadajwara* (Sharma, 1978; B.N., 1982).

Dose : Opium 30-125 mg (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name ***- ABINI***

Suvai **(Taste)** - *Kaippu* (Bitter).

Veeriyam **(Potency) -** *Veppam* (Hot).

Vibakam **(Transformation) -** *Kaarppu* (Pungent).

***Gunam* (Pharmacological action) -** *Thuyaradakki* (Analgesic), *Isivagattri* (Anti-spasmodic).
Siddha pharmaceutical preparations – *Siropaga nivarana thylam*, *Kabata mathirai,Uzhikalan, Uzhimathirai,Van mezhugu.*
Uses- Used in the treatment Rhumatism & Diarrhoea.

PHARMACOGNOSY

Macroscopic

Capsule- Fruits ovoid or nearly globular, sometimes depressed at the base and apex, 5-7.5 cm diam., crowned with a large stellate stigma with 12-15 rays and contracted at the base to a neck, which is enlarged near the penduncle. Colour pale yellowish-brown, often marked with darker spots. From the inner surface of the thin brittle pericarp membranous placenta equal in number to the rays of the stigma project into the cavity of the fruit but do not meet at the centre; dehiscence by pores just beneath the stigma. Capsule unilocular, with 8-15 parietal placentae, which extends the centre of the locules in the form of thin plates; odourless; taste slightly bitter (Mukerji, 1953; Wallis, 1967).
Seeds -1-1.25 mm long, almost white to slate-grey in colour, reniform to sub-reniform and marked with conspicuous, raised polygonal reticulations with straight edges and about 120 μ in width. The hilum and micropyle are situated in the slight depression near the smaller end. The embryo is curved and is embedded in an abundant oily endosperm, odourless; taste oily (Mukerji, 1953; Wallis, 1967).
Opium occurs in cubical pieces, weighing about 900 gm, varying from hard and brittle to plastic, internally dark brown, smooth and homogenous. Odour strong and characteristic; taste bitter.

Microscopic

It shows a few fragments of the outer epidermis of the poppy capsule. Epidermal cells are unlignified, tabular, polygonal small, five or six-sided with strongly thickened anticlinal walls, about 15-40 μ. Stomata few, large, ranunculaceous. Fragments of the poppy leaf shows upper epidermis of thin walled polygonal cells; stomata absent. Lower epidermal cells with slightly wavy walls, stomata numerous, large, ranunculaceous. Also shows fragments of mesophyll and vascular bundles (Mukerji, 1953; Wallis, 1967).

Physical constants

Opium – Morphine content - Not less than 9.5%
Poppy capsules – Morphine – 0.1 – 0.3%
Moisture content – About 13% (Mukerji, 1953).

Powder microscopy

Powdered opium mid-brown in colour and bitter in taste, consists of abundant brown granular amorphous masses of dried latex, the masses being irregular in shape, particles of vegetable tissue, consisting of fragments of outer epidermis of the capsule, pieces exhibiting a sectional view show the greater thickness of the outer wall; occasional stomata of ranunculaceous (anomocytic) type are present, some of these epidermal cells from the stigma strongly pitted lumen, small traces of starch from the capsule also present which are rounded, about 4-8 μ diameter.; pollen grains occur rarely which are spherical, smooth with 3 pores and about 20-32 μ in diameter and fragments of lignified inner epidermis of the capsule wall (Wallis, 1967; Jackson and Snowdon, 1992).

CHEMICAL CONSTITUENTS

Plant: Morphine, codeine, thebaine, narcotine, narceine, papaverine (Blazsek, 1959), reframidine, N, O-dimethyloridine (Wen, 1980), laudanine (Toske *et al.*, 2006), 6-acetonyl dihydrosanguinarine, cryptopine, allocryptopine, β-allocryptopine, berberine, canadine, codeinone, captisine, coreximine, corytuberine, dihydroprotopine, glaudine, gnoscopine, hydrocotarine, 10-hydroxycodeine, lanthopine, magnoflorine, 6-methylcodeine, N-methyl-14-O-dimethylepiporphyroxine, imide, neopine, normorphine, nornarceine, norsanguinarine, orientaline, oripavine, 13-oxo-cryptopine, oxysanguinarine, palaudine, papaveraldine, papaveramine, papaverrubines C and D, protopine, pseudomorphine (Chatterjee and Prakashi, 1994), phospholipase D isoenzymes (Lerchner *et al.*, 2005), S-adenosyl-L-methionine, (R,S)-3'-hydroxy-N-methylcoclaurine 4'-O-methyltransferase (Ziegler *et al.*, 2005), morphine, codein (Wold, 1978), salutaridinol-7-O-acetyltransferase (Lenz and Zenk, 1995), oripavine, laudanosine, isothebaine, cryptopine, alpinigenine, narceine, protopine, gnoscopine (Vincent and Engelke, 1979).

Poppy: Thebaol (Reisch *et al.*, 1974), reticuline, salutaridine, (–) codeine (White *et al.*, 1983), narcotine-methoxyhydroxide, choline, oxydimorphine, pacodine, albumin, pectin, sugar and minerals, glucose, fructose, sucrose, sedoheptulose, mannoheptulose (Eli-Ottestal *et al.*, 1959), porphyroxine, somniferine (Pfeifer and Teige, 1962), α-narcotine, (-) laudanosin (Ohta *et al.*, 1963), narcotoline, (+) laudanidine, (+) reticuline, (+) laudanosin, codamine (Hanssen *et al.*, 1964, 1965), cotarnoline (Mamochkina *et al.*, 1976), 14-hydroxycodeinone, codeinone (Terui *et al.*, 1975), o-methylsomniferine, methylation product of somniferine (Dragar *et al.*, 1988), nareotine, codamine, catarnoline, (–)codeine (White *et al.*, 1983), (s)-(–)-

carnegine, la(R)-(–)-calycotomine, (+) laudanosine (Czarnocki and Maclean, 1986), meconic, lactic, malic, tartaric, citric, acetic, succinic, sulphuric, phosphoric, proteins, free amino acids, pectin, meconin, meconoisin, opionin, protease, oxydases, maltase, invertase, urease, emulsin (Annette and Bose, 1921-23), (S)-N-methylcoclaurine-3'-hydroxylase, berberine bridge enzyme, codeinone reductase (Alcantara *et al.*, 2005), phospholipase D (Oblozinsky *et al.*, 2005), Sanguinarine, (S)-norcoclaurine-6-O-methyltransferase, (S)-3'-hydroxy-N-methylcoclaurine-4'-O-methyltransferase, and (S)-coclaurine N-methyltransferase (Facchini and Park, 2003), phosphatidylcholine and phosphatidyl-p-nitrophenol (Oblozinsky *et al.*, 2003), norcoclaurine (Samanani and Facchini, 2001), acyltransferase [hydroxycinnamoyl-CoA: tyramine N-(hydroxycinnamoyl) transferase (Yu and Facchini, 1999).

Seed: Cystine, lysine, histidine, arginine, aspartic acid, serine, glutamic acid, valine, isoleucine, proteins (Bhown *et al.*, 1965), isoboldine, stigmasterol, β-sitosterol, nonacosanol, cyclolaudenol, cycloartenol, cycloartenone, cyclolaudenone and esters of cyclolaudenol and cycloartenol, narcotine and popavarine (Ramanathan and Chandra, 1981), bismorphine A and B (Morimoto *et al.*, 2003), morphine-N-oxide and codeine-N-oxide, (Chatterjee and Pakrashi, 1994), papaverine (Pi *et al.*, 2005), 1,2-dehydroreticuline (Hirata *et al.*, 2004), codeine, morphine, narcotine (noscapine), papaverine, thebaine (Paul *et al.*, 1996).

Seed oil: 1-pentanol, 1-hexanal, 1-hexanol, 2-pentylfuran, caproic acid (Krist *et al.*, 2005), triglyceride composition (Sengupta and Mazumder, 1976).

Tissue: Morphine, tetrahydrobenzylisoquinoline, benzo (c) phenanthridine and phthalideisoquinoline (tissues of Tasmanian P. somniferum L.) (Frick *et al.*, 2005).

Root: Thebain (Joachim *et al.*, 1981), sanguinarine/10-hydroxysanguinarine and dihydrosanguinarine/10-hydroxydihydrosanguinarine, narcotoline, annoscapine (Frick *et al.*, 2005).

Flowers: Kaempferol, quercetin (Baleaeva and Evdokimovs, 2004).

PHARMACOLOGICAL ACTIVITIES

The plant is found to have anticonvulsant, analgesic (Calixto *et al.*, 2001; Serranillos-Gomez *et al.,* 1998; Royer, 1978), antitissuve, cardiovascular, synergistic, antinociceptive (Aceto *et al.*, 1999), anorectic, locomotor, hypotensive, sedative, antispasmodic (Shrivastava, 2004), hydrolytic (Oblozinsky *et al.*, 2003), antitumour (Singh *et al.*, 1990), hypoglycaemic, carcinogenesis protective (Aruna and Sivramkrishnan, 1992) and antidiarrhoeal activities.

TOXICOLOGY

Morphine causes side effect like vomiting, nausea and dizziness (Retsagi, 1978). Two workers (Patients) working in a factory producing opium alkaloids from *P. somniferum* straw reacted positive to opium alkaloids codeine phosphate, codein hydrochlorides, morphine hydrochloride, morphine bitartarate etc. and also gave positive results to para group substances (Conde-Salazar *et al.*, 1991). In case of opium poisoning chiefly suicidal tendency is very frequent. It has been shown that potassium permanganate salt completely oxidizes the alkaloid and render it void of toxic properties (Dey and Raj Bahadur, 1984). In longer doses it cause *vatavriddhi and ojahkshay* and in higher dose cause dizziness, sedative, respiratory and cardiovascular failure.

Contra indications – Child, Pregnancy, Kidney disease, Brain disease.

THERAPEUTIC EVALUATION

Seven grams of Safood Khashkhash containing seeds of *Lactuca sativa*, *Portulaca oleracea*, *Papaver somniferum;* flowers of *Nymphaea lotus*; dried fruits of *Coriandrum sativum* and 24 grams of Sharbat Bazoori Moatadil (root and seeds of *Cichorium intybus*, seeds of *Cucumis utilissimus, C. sativus, C. melo* and root of *Foeniculum vulgare*) were given twice daily to 30 hypertensive patients for 60 days. After 8 weeks of medication systolic and diastolic blood pressure were observed 159.4 and 92.00 mm' Hg respectively (Alam *et al.*, 1994).

Morphine is one of the most important analgesic drugs employed in clinical practice even today (Calixato *et al.*, 2000). Two sustained-release morphine products, Oramorph SR® and Contin® are available in the United States for the treatment of chronic pain requiring opioid analgesic medication for more than a few days (Schobelock *et al.*, 1993; WHO, 1996).

Papaver somniferum was used to treat insomnia, anxiety, or excitement as a complementary method (Alonso Osorio**,** 2004).

A study on twenty eight workers of a pharmaceutical factory suggest that *P. somniferum* allergy is mediated by an IgE mediated mechanism and not by a pharmacological or toxic effect of the alkaloids or polyphenols (Moneo *et al.*, 1993). Recent placebo-controlled studies have shown that codeine is effective to suppress cough caused by either allergy of upper respiratory disorders or chronic obstructive pulmonary disease (Bolser and Davenport, 2007).

Codeine is a mild analgesic used in the relief of mild to moderate pain which is not relieved by a non-opiate analgesic. Because of differing mechanisms of action, codeine and aspirin or acetaminophen in combination probably produce additive analgesic effects. Combinations containing codeine, aspirin, and caffeine are effective but produce no more analgesia than a combination of aspirin and codeine (http://www.medscape.com/).

TRADE AND COMMERCE

India has been producing opium for many centuries and at present it is the largest source of raw opium to the world. Turkey, Russia are the next main opium producing countries. The trade and the prices of opium and other allied products are entirely controlled by Govt. of India. The selling price is fixed by the Govt. authority taking in to account the cost of production, the demand for opium in international market and the price offered by other opium producing countries. Opium is exported for scientific and medicinal purposes chiefly to U.K., U.S.A., France, Italy (Anonymous, 2005).

Retail Market Price- Poppy seed- Rs. 200/- per Kg; Morphine (BHC)- Rs.5750/- per Kg (Anonymous, 2005).

FORMULATIONS AND PREPARATIONS

Asava And Arista – *Ahiphenasava.*

Vati And Gutika – *Astakshari gutika, Dugdhavati, Akarkarabhadi vati, Grahani sharduta vatika, Nidrodaya vati.*

Bhasma – *Trivanga Bhasma.*

Rasayoga – *Nidrodaya rasa, Swalpa Grahani Kapat rasa, Karpur rasa, Mahavatarog rasa* (Anonymous, 1978; 2000).

SUBSTITUTES AND ADULTERANTS

Opium is adulterated with fresh green parts of the plants, ashes, seeds such as linseed, poppy seeds, leguminous seeds, tubers, roots, extracts of poppy, dhatura, hemp, *Lactuca virosa* Linn, *Glycyrrhiza glabra* Linn ,*Glaucium flavum* Crantz., gum arabic, tragacanth, salep, aloes, small stones, flowers of *Madhuca longifolia* Linn, Saccharine matter, vegetable oils, ghee, minute pieces of lead and iron (Anonymous, 1966).

The inspissated Juice of *Euphorbia royleana* Boiss and the plant juice of *Hypecoum proumbens* Linn. used as adulterant. Dried latex of *Lactuca indica* Linn. used as substitute; juice of flowers of *Madhuca longifolia* (Koenig.) Macbride var *latifolia*, as an adulterant, decoction of *Scoparia dulcis* Linn. as substitute or adulterant; extract of leaves and fruits of *Sophora japonica* Linn. used as an adulterant; seeds of *Sterculia alata* Royle used as substitute. Leaves and bark of *Mitragyna speciosa* Korth.; roots of *Saussurea lappa* Clarke are chewed as substitute of opium (Garg, 1992).

Hyoscyamus niger Linn., seeds of *Sterculia alata* Royle Linn., dried latex of *Lactuca indica* Linn., roasted seeds of *Pterygota alata* R. Br. are used as substitute (Anonymous, 2000a).

PROPAGATION AND CULTIVATION

Popularly known as ‘Poppy’, the plant is cultivated as a rabi crop on fertile, medium loamy, sandy loam-to-loam textured soils with good structure and having well drained subsoil. Land is prepared in September by repeated ploughing and harrowing. It should be enriched with FYM, compost and green manure. Application of NPK fertilizers increases the yield. Sowing is done in the month of November when the temperature is preferably in the range of 20-23°C. Broadcasting method of sowing requires about 6-7 kg seeds/ha whereas row sowing method requires 5-6 kg seeds/ha.

Optimum moisture, proper irrigation along with weeding and hoeing are necessary for successful cultivation of the crop. Harvesting is done by incising the capsules at a particular phase of plant growth. Collection period extends from January to April or sometimes to June (Anonymous, 1966; Wallis, 1967; Singh *et al.,* 1995). Application of 100 kg/ha of sulphur significantly increases yield of latex, seed and capsule husk of opium poppy. IAA and thiourea increase significantly the N, K, S contents in leaves as well as the girth of capsules, latex yield and morphine contents (Intodia and Sahu, 2003).

The cultivation of opium poppy in India is entrusted to cultivators under licences issued by the District Opium Officers of different areas. The licensed cultivators undertake, on behalf of the Government, to sow the poppy, lance the capsules, collect the latex and deliver it to the centers at a price fixed by the Government (Anonymous, 1966).

Somatic embryogenesis of *P. somniferum* was reported using hypocotyl part of *in vitro* grown seeds. Callus was initiated by culturing the explant on solidified Gamborg's (B5) medium within 6 weeks. Embryos were observed when 4 gm of callus was cultured on 40 ml of plain B5 medium after 5 days. The entire plantlet was formed within 10 weeks. High yield of embryogenesis was induced by subculturing the callus on plain B5 medium at an interval of 5 days as reported by Schuchmann and Wellmann, (1983).

Organogenesis and plant regeneration was achieved in *P. somniferum* through anther culture. Anthers from closed buds were selected as explants and cultured on A19 medium supplemented with 2 mg/L 2,4-D, 0.5 mg/L IAA, 0.5 mg/L BA and 1 mg/L Kn to form callus. Before callusing the anthers were given cold treatment at 7°C which proved effective for plantlet regeneration. Calli when transferred to MS medium with 0.1 mg/L BAP and

0.5 mg/L Kn showed multiple shoot formation. These calli when placed on hormone free medium showed enhanced shoot differentiation, Dieu and Dunwell, (1988).

Regeneration and *in vitro* flowering in *P. somniferum* was also reported by Yoshikawa and Furaya, (1983). Secondary metabolites *i.e.* codeine was obtained through tissue culture (Furuya *et al.*, 1984).

Tyler *et al.*, (1988) reported effect of ethylene on sanguinarine production in cell cultures of *P. somniferum*. Cell cultures were established from hypocotyl explants cultured in B5 medium containing 1 mg/L 2, 4-D and 1g/l casein hydrolysate. Callus raised was used in suspension cultures (approx 4g callus inoculated into 75 ml 1B5C) and subcultured weekly. The suspensions were elicited by adding 0.2 ml Botrytis homogenate to 7-day old cultures. Cells for sanguinarine were harvested after 2 days of cultures.

Similarly, Songstad and Coworkers (1989), reported the effect of ethylene and ACC on production of sanguinarine in liquid or solid culture medium in presence or absence of elicitors. They also observed that cells utilized ACC (1-aminocyclopropane carboxylic acid) in their early stage of development.

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BALA

BOTANICAL NAME : S*ida cordifolia* Linn.

FAMILY : Malvaceae

CLASSICAL NAMES
Sahadeva, Vatyalika, Vatyapushpi, Vatyayani (C.S.; S.S.; A.H.).

SYNONYMS
Audanika, Badiyalaka, Baladhya, Balini Bhadra, Bhadrabala, Bhadrodani, Brela, Jayanti, Kalyanini, Kanaka, Kathorayashtika, Kharakakashtika, Kharayashtika, Krura, Motapati, Nilaya, Odanavha, Odani, Odanika, Phanijivaka, Prahasa, Raktatandyla, Samanga, Samansha, Shitapaki, Suvarna, Svetberela, Variga, Vataghni, Vatyalaka, Vatyali, Vilala Maharamanga, Shotapaki, Sumangana, Vati, Vatyabhidhana, Vatyaha, (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Country mallow. **Hindi-** *Kungyi, Bariyaar, Khiratee, Kharantee, Khareti, Barial, Bariar. Bariyara, Kharenti.* **Beng.-** *Swetberela, Brela, Bala, Bedela, Barila.* **Guj.-** *Mahabala, Khapat, Bala, Kharatee, Baladana, Janelimethi.* **Kan.-** *Hettuthi, Hettugigada, Kisangi, Chittuharalu.* **Mal.-** *Kurunthott, Vellurum, Kathuram, Katturam.* **Mar.-** *Chikana, Khiranti.* **Punj.-** *Kowar, Simak, kharent, kharyati, kharanhatee.* **Tam.-** *Nilatutti, Paniar-tuthi, Akhil mnapundu, Mayir manikham, Arivalmanaippundu.* **Tel.-** *Tellantisa, Tellagorra, Chiribenda, Suvarnamu, Muttav, Chitimutti, Tutturabenda.* **Oriya-** *Badianaula, Bisvokopari.* **Sind.-***Burrayra.* **Mundari.-** *Marang, Lupaaraba, Huringmindilata.* **Gwalior.-** *Kharenti.* **Konkani.-** *Kobirsir-bhaji, Muttava.* **Sinhalese.**– *Hiradona, Valbevila* (Sharma, 1978; Nadkarni, 1976; Singh and Chunekar, 1972; Kirtikar and Basu, 1933; B.N., 1982; Anonymous, 2000a; Chopra *et al.*, 1958, 1986; Chatterjee and Pakrashi, 1992; Anonymous, 1972; Ayer and Kolammal, 1993; Agharkar, 1991; Vaidya, 1968).

BALA *Sida cordifolia* Linn**.**

BOTANICAL DESCRIPTION

An annual or perennial short, erect, greyish-green, softly hairy or pubescent woody undershrub, 0.5-1m high. Leaves simple, very downy, alternate, 2.5 – 5 X 1.8- 3cm, orbicular, ovate, ovate- oblong or cordate, margin crenate, base cordate, petioled, stipulate, stipules linear. Flowers bisexual, light or sulphur yellow to cream white, axillary and solitary but appears crowded in the upper part and towards tips of the branches, without an epicalyx. Fruit depressed, globose schizocarp, 6-8 mm dia, each carpel having two long straight linear to setaceous scabrous awns. Seeds smooth, flattened, reniform, brown or black. Flowering and Fruiting: October-February (Cooke, 1967; Anonymous, 2000b; Kirtikar and Basu, 1933; Hooker, 1973; Ayer and Kolammal, 1993).

DISTRIBUTION

Found throughout the tropical and subtropical regions of India (Kirtikar and Basu, 1933) upto an elevation of 1800m in Himachala Pradesh (Chauhan, 1999). Bengal, Maharashtra, Gujarat, Andhra Pradesh, Assam, Jammu and Kashmir, TamilNadu, Uttar Pradesh, Coromandel, Karnataka and Kerala are the chief regions of its occurance (Kurup *et al.,* 1979; Mukerji, 1953). Also occurs in Sri Lanka (Nadkarni, 1976).

PART(S) USED

Root, leaf, seed, whole plant (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Root is astringent, diuretic and tonic. It is useful in nervous and urinary diseases. It is also used in cystitis, strangury, chronic dysentery, leucorrhoea, gonorrhoea and asthma. Decoction of the root in combination with ginger cures intermittent fever. Oil prepared from the decoction of root mixed with milk and sesame oil used in nervous diseases (Chatterjee and Pakrashi, 1992). Seeds are aphrodisiac, astringent, useful in blood diseases, bleeding piles, throat diseases, pthisis and insanity (Kirtikar and Basu, 1933). The juice of the whole plant is beneficial in spermatorrhoea (Chopra *et al.*, 1958).

AYURVEDIC PROPERTIES

Rasa – *Madhura*
Guna –*Laghu, Snigdha, Pichhila*
Vipaka – *Madhura*
Veerya – *Sheeta*

Doshaghnata – *Pittavatanashaka* (S.S.Su.38.4); *Kaphavatanashaka* (A.H.Su.6.169), *Vata pitta shamaka* (Sharma, 1978; B.N., 1982).
Karma –
External – *Lepa is vedanasthapana, Shothhara.*
Internal – *Brinhana* (C.S.Su.4-9.2), *Balya* (C.S.Su.4.9-7), *Prajasthapana* (C.S.Su 4-9.49), *Vatasanshamana* (S.S.Su.39.7), *Nadibalya, Vatahara, Grahi, Raktapittashamaka, Shukrala, Mootrala, Jwaraghana, Ojhovardhaka* (Sharma, 1978; B.N., 1982).
Rogaghanata –
External – *Lepa used in Vranashoth, Netraroga and Daha* (C.S.Ci.25.63)
Internal – *Vatavyadhi* (C.S.Ci.28.106; A.H.Su.15.5), *Pakshaghat, Adrita and other Vatavikara* (C.S.Ci.29.104; A.H.Ci.14.13; 22.8), *Grahani* (C.S.Ci.26.87), *Hriddaurbalya* (C.S.Ci.29.56), *Raktapitta* (C.S.Ci.4.78; A.H.Ci.2.18,32), *Rajayakshma* (C.S.Ci.8.75,90; S.S.Su.38.4; A.H.Ci.5.15), *Urhakshata* (C.S.Ci.11.20; 28.47), *Pradara, Garbhashaya Daurbalya, Yoniroga,* (C.S.Sa.8.28; C.S.Ci.30.59,106), *Sutikaroga* (S.S.Su.15.28), *Mootrakrichchhra* (C.S.Ci.26.69; S.S.U.58.44), *Jwara* (C.S.Ci.3.183; S.S.U.39.171; A.H.Ci.1.94,123), *Daurbalya, Kshayroga, Krishata* (C.S.Ci.1-1.42), *Vatarakta* (C.S.Su.3.21; S.S.Ci.5.12), *Anuvaman vashi in vatavyadhi* (C.S.Si.4.3), *Vasti* (C.S.Si.3.35), *Gulma* (C.S.Ci.5.106; S.S.Su.38.4; A.H.Ci.14.55), *Udararoga* (C.S.Ci.12.169), *Panduroga* (C.S.Ci.16.53; S.S.Su.44.29), *Arsha* (C.S.Ci.14.200; A.H.Ci.8.109), *Shwasa* (A.H.Ci.4.22), *Hikka* (C.S.Ci.17.96), *Kasa* (C.S.Ci.19.115; 28.147; A.H.Ci.3.60,80,95), *Atisara* (C.S.Su.2.20; Ci.19.26; S.S.U.40.114; A.H.Ci.9.56), *Madataya* (C.S.Ci.24.165), *Vranaropana and Shodhana* (C.S.Ci.25.88; S.S.Ci.2.65; 17.19), *Galaganda* (S.S.Su.18.47; A.H.U.22.68), *Nasaroga* (S.S.U.23.9); *Shukrameha* (Sharma, 1978; B.N., 1982).
Doses : 10-20 ml juice; 3-6 gm powder (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES
Siddha Name - *CHITRAA MUTTI*
***Suvai* (Taste) -** *Thuvarppu* (Astringent).
***Veeriyam* (Potency) -** *Thatpam* (Cold).
***Vibakam* (Transformation) -** *Inippu* (Sweett).
***Gunam* (Pharmacological action) -** *Varatchi agatri* (Emollient).
Siddha pharmaceutical preparations - *Vaatha sura kudineer, Chitramutti - thylam,Sarapunga vilvaathi ilagam, Dhirakshathi chooranam*.
Uses - Used in Fever, Rheumatism & Piththaa diseases.

PHARMACOGNOSY

Macroscopic

Root- Occurs in variable sized pieces, 5-15cm long with few lateral slender rootlets of smaller size, tap root branched at the tip; outer surface buff to greyish-yellow minutely striated or smooth; odourless; taste slightly bitter.

Microscopic

Transverse section is circular with a very wide central woody part and a thin outer bark. Cork consists of 4-6 rows of thin-walled, tangentially elongated cells, outer 1-2 rows light brown in colour; phellogen consisting of single row, cortex very narrow comprising of 3-4 rows of comparatively large polygonal or slightly tangentially elongated thin walled cells, containing few clustered crystals of calcium oxalate and small starch grains. Bast or secondary phloem occurs in the form of conical strands, each strand composed of 5-6 or more tangential bands of thick walled fibres groups alternating with thin-walled phloem elements, some of the phloem parenchyma cells at the outer region contain small cluster crystals, almost all the phloem rays cells contain cluster crystals of calcium oxalate. Cambium is distinct. Wood or secondary xylem consists of vessels, xylem parenchyma, xylem fibres and medullary rays. Vessels are many, occurs solitary or in groups of 3 or 4 and vary in size and shape. Xylem parenchyma surrounding the vessels, but not form distinct concentric rings and contain starch grains; fibres are abundant and very thick walled in greater proportion than xylem perenchyma. Medullary rays many, mostly uni-or biseriate, cells radially elongated and most of them contain small crystals of calcium oxalate. Four groups of primary xylem are present at the centre of the wood (Yelne and Sharma, 1994; Ayer and Kolammal, 1993; Kurup *et al.,* 1979).

Macroscopic

Stem – Occurs in variable sized pieces, cylindrical in shape, strong, dull green covered with stellate hairs, branches 2-3 mm thick, light brown or greenish grey in colour, softly, hairy; fracture fibrous; odour no any specific odour; taste slightly bitter.

Microscopic

Transverse section circular in outline with stellate trichomes on epidermis, followed by conspicuous zone of collenchyma, parenchyma, conducting elements and central pith. Epidermis is composed of oval to oblong, radially elongated, thin-walled cells covered by a thin cuticle. Trichomes are stellate or glandular. Epidermis followed by 1-2 layers of chlorenchyma followed by 4-6 layers of collenchyma consisting of round to oval cells, 14-12-7 μ diam. Within this are polygonal large parenchymatous cells, 47-67-82 μ diam, containing isolated large calcium oxalate crystals, 15-17-26 μ diam. Band of fibres lying next to parenchyma and covering the phloem consists of thick-walled sclereids in groups of 6-8 or more, many phloem cells contain calcium oxalate crystals. Xylem consists of xylem parenchyma, vessels and uni-to multiseriate medullary rays containing starch grains. Vessels are usually small, 200-140-75 X 17-14-11 μ. Pith large, composed of large parenchyma cells, 26-37-42μ diam, fully loaded with starch grains and calcium oxalate crystals. Large air spaces also present (Yelne and Sharma, 1994).

Macroscopic

Leaf – They are 2-3 cm long, cordate, crenate, obtuse or sub acute, hairy on both surfaces but more on lower surface, nerves prominent on ventral surface, dorsal surface darker. Petiole hairy and shining brightly because of stellate hairs; fracture clear; odour no any specific odour; tasteless.

Microscopic

Transverse section of leaf shows very thin cuticle with stellate and glandular trichomes on upper and lower epidermis. Stellate trichomes present on lower epidermis possess eight or more rays while those on upper epidermis consists of 5-6 rays. Stomata are anisocytic, average stomatal index of lower surface 27.03 while 22.4 at upper surface. Single layered upper epidermis consists of oval to oblong cells followed by compactly arranged, rectangular elongated palisade cells, spongy parenchyma oval to round and loosely arranged. Mid-rib shows thin cuticular epidermis with different types of trichomes, cells tangentially elongated on upper and radially elongated on lower epidermis. Next to the upper epidermis 4-5 rows of collenchyma with round to oval cells, followed by parenchymatous cells encircling the vascular strand which is crescentric and collateral enclosed by endodermis. Xylem elements are radially elongated and followed by phloem containing calcium oxalate crystals. Several types of trichomes include short, capitate, long stalked, multicellular, glandular and stellate (Yelne and Sharma, 1994).

Physical constants

Constant	Root	Stem	Leaf
Total ash	6.69%	9.73%	15.62%
Acid insoluble ash	2.74%	2.43%	7.57%
Alcohol soluble extractive	2.78%	2.86%	4.51%
Water soluble extractive	4.36%	6.52%	12.02%

(Yelne and Sharma, 1994)

Thin Layer Chromatography

TLC of the methanol extract on precoated silica gel 60 plate (5 X 15 cm) using chloroform: methanol (7:3) and on spraying with anisaldehyde sulphuric acid reagent shows brown spot at Rf. 0.76 corresponding to ecdysterone and also shows five spots at Rf. 0.93 (violet), 0.89 (violet), 0.83 (blue), 0.15 (bluish green) and 0.06 (dark blue) (Handa *et al.*, 1999).

CHEMICAL CONSTITUENTS

Root: C_{28} phyto-ecdysones viz, sidasterone A, sidasterone B (Ghosal *et al.*, 1979), carboxylated tryptamines, quinazoline alkaloids, sympathomimetic amines, β-phenethylamine (Ghosal *et al.*, 1975). β-sitosterol, acylsteryglycoside sitoindoside (Ghosal *et al.*, 1988), ephedrine (Begerhotta and Banerjee 1985), S-(+)-Nb-methyltryptophan methylester (Ghosal *et al.*, 1975), hypaphorine (Ghosal *et al.*, 1970), vasicinone (Mehta *et al.*, 1963), vascicine, vasicinol (Bhatnagar *et al.*, 1965), ψ ephedrin, choline, betaine, phytosterol, resin acids (Ghosal *et al.*, 1975).

Seed: Proteins, steroids, resin, resin acid, mucin, phenethylamine, ephedrine pseudoephedrine, fatty oil, potassium nitrate, linoleic acid, malvalic acid, sterculic acid, coronaric acid (Sunder Rao and Lakshminarayana, 1984; Farooqui and Ahmed, 1985).

Aerial parts: Palmitic, stearic, hexacosanoic acids, β-sitosterol (Khan *et al.*, 1989).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have anti-inflammatory, analgesic (Franzotte *et al.*, 2000), anti-oxidant, CNS inhibitory action on lipid peroxidation (IC_{50} 126.78 μg/ml), thyroregulatory (Tihiliani and Kar 2000), hepatoprotective (Kotoky and Das, 2000-2001; Rao and Mishra, 1997), immunostimulatory, antispasmodic, antiamoebic, antiurinary filariasis, antiasthmatic, antihypertensive, hypoglycaemic (Kanth and Diwan, 1999), adaptogenic (Amarnath *et al.*, 2006), antibacterial (Alam *et al.*, 1991), antiplaque (Namba *et al.*, 1985) and antifungal (Muauza *et al.*, 1994) activities. It increases the production of antisalmonella typhi 'O' antibodies (Dixit *et al.*, 1978). Sitoindoside X has adaptogenic, immunostimulant (Ghosal *et al.*, 1988), cardiovascular (Medeiros *et al.*, 2006) and antioxidant (Auddy *et al.*, 2003) activities.

TOXICOLOGY

Aqueous extracts of leaves showed low acute toxicity in mice (Franzotte *et al.*, 2000). The hydro alcoholic extract of leaves was found to be toxic at high i.p. doses. The LD_{50} values were 2639 mg/kg bw with 95% confidence limits of 2068-3367 mg/kg bw for i.p. administration.

THERAPEUTIC EVALUATION

Arthnex forte was tried in 80 patients in the dose of 2 tabs. t.i.d. 1 month, 2 tabs b.i.d. for 1 month and 1 tab/t.d. from then onwards, with warm water. Anthnex forte contain 8 plants which are reputed vatahara drugs namely, *Pluchea lanceolata*, *Tinospora cordifolia*, *Ricinus communis*, *Cedrus deodara*, *Zingiber officinale*, *Sida cordifolia*, *Vitex negundo* and *Commiphora myrnha* gum. Out of 80 patients, 74 patients (92.5%) improved remarkably and 6 (7.5%), showed moderate improvement (Krishnamurthy *et al.*, 2003).

Another study was conducted on patients of confirmed diabetic neuropathy, attending the diabetic clinic by adopting new physiological parameters. The results obtained after the completion of clinical study revealed that the drug *Sida cordifolia* has proven its efficacy in managing diabetic neuropathy (Hazra *et al.*, 2000).

In a clinical prospective study the efficacy of Ayurveda treatment (a concoction in cow's milk of powdered *Mucuna pruriens, Hyoscyamus reticulatus* seeds, *Withania somnifera* and *Sida cordifolia* roots) in 18 clinically diagnosed parkinsonian patients was evaluated. As per Ayurvedic principles, 13 patients underwent both cleansing (for 28 days) and palliative therapy (56 days), 5 patients underwent palliative therapy alone (84 days). Only the former group showed significant improvement in activities of daily living and on motor examination as per UPDRS rating. Symptomatically, they exhibited better response in tremor, bradykinesia, stiffness and cramps as compared to the latter group. Excessive salivation worsened in both the groups. Analyses of powdered samples in milk, as administered in patients, revealed about 200 mg of L-DOPA per dose. The study establishes the necessity of cleansing therapy in Ayurveda medication prior to palliative therapy. It also reveals contribution of L-DOPA in the recovery as observed in Parkinson' disease following Ayurveda medication (Nagashayana et al., 2000).

FORMULATIONS AND PREPARATIONS

Asava and Arista *–Kumaryasava, Sarivadyasava.*

Avaleha and Paka *– Agastya haritaki rasayana, Chavanaprasha, Brahma rasayana.*

Kvatha Churna *– Rasnadi kvatha churna (Maha), Masabaladi kvatha churna, Balajirakadi kvatha churna.*

Ghrita *– Amritaprasa ghrita, Dadhika ghrita, Brihat ashvagandha ghrita.*

Taila *– Chandanabalalakshadi taila, Triphaladi taila,Dhanvantara taila, Narayana taila, Prameha mihira taila, Bala taila, Balaguduchyadi taila, Balahathadi taila, Brihat masa taila, Bhringaraja taila, Maha vishagarbha taila, Musikadya taila.*

Lepa *– Dasanga lepa.*

Vati and Gutika *– Manasamitra vataka.*

Rasayoga *– Maha vatagajankusa rasa, Manmathabhra rasa, Manikya rasa*

Churna *– Gandhaka rasayana churna, Rasnadi churna* (Anonymous, 1978; 2000).

Other classical formulations – *Vasishta haritaki* (A.H.Ci.3.133), *Gaurarista, Baladi Rasayana, Padmakadileha, Nilinadya ghrita, Kantikari ghrita* (A.H.Ci.3.60), *Mayur ghrita, Rasna taila, Mulakdya taila, Amritadya ghrita* (A.H.Ci.3.95), *Shatapaka bala taila, Brinhani gutika, Bala taila* (S.S.Ci.15.29), *Baladi ghrita* (S.S.Ci.40.77), *Anutaila* (A.H.Su.20.38); *Bhutarava ghrita* (A.H.U.5.19), *Shatavariadi ghrita* (A.H.U.34.37), *Vidarikandadi rasayana yoga* (A.H.U.39.60).

TRADE AND COMMERCE

Retail Market Price (Root) – Rs. 30 per kg. (Prajapati, 2006).

SUBSTITUTES AND ADULTERANTS

The plants most commonly used as the source of Bala belongs to the genus Sida. *Sida retusa* Linn. syn *S. rhombifolia* var. retusa Linn., *S. rhombifolia* Linn.; *S. rhomboidea* Roxb; *S. spinosa* Linn., *S. acuta* Burm.; *S. veronicaefolia* Lamk and *Abutilon indicum* G. Don, *Urena lobata* Linn., *U. sinuata* Linn.; *Pavonia odorata* Wild., *P. zeylanica* Cav. are being used under the name of Bala in different part of the country (Anonymous, 2000a; Handa, 1999; Ayer and Kolammal, 1993).

Abutilon indicum (L.) Sweet., *S. retusa* Linn, *Pavonia odorata* Wild. and *Urena lobata* Linn. are used as an adulterants (Garg, 1992).

PROPAGATION AND CULTIVATION

Cultivation of the plant is done through seeds (Chauhan, 1999).

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BRIHATI

BOTANICAL NAME: **S*olanum anguivi* Lam.**
Syn. *S. indicum* Linn.

FAMILY: **Solanaceae**

CLASSICAL NAMES
Brihati, Mahad vyaghri, Vartaki, Sinhi (C.S.; S.S.; A.H.).

SYNONYMS
Akranta, Alpaphala, Asparsi, Bahupatri, Bhantaki, Brihatika, Dovadi, Dusparsa, Hinguli, Kantakarika, Kantakini, Kanthalu, Kantatanu, Kranta, Kshudrabhanta, Kshudrabhantaki, Kshudravartaki, Kuli, Lata, Mahati, Mahatikranta, Mahotika, Paravedi, Prasaha, Raktapaki, Rashtrika, Sinhi, Sinhika, Sthulabhandaki, Sthulakantha, Torani, Vanavrintaki, Vartaki, Vyaghri, Vrihati, Bhantaki, Vanavrintaki, Brihati, Shudrabhantaki, Sinhi (Sharma, 1978; B.N., 1982; D.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Poison-berry, Indian Night Shade. **Hindi-** *Badi kateri, Barhanta, Birhatta, Badikateree, Banabhanta, Anjada, Badikataee, Barhata, Bhat kataiya, Bhutkataiya, Kattarha, Vadikadheri*. **Beng.-** *Byakura, Gurkamai, Vyakuda, Bagaun, Titveguna, Titbaigum.* **Guj.-** *Ubhi ringani, Mhoti ringni, Mota ringni, Vada ringni.* **Mal.-** *Cheru-chunda, Cheruvazhudhena, Nilavalutina, Cheruchunta, Cheruvalutina, Chunta.* **Mar.-** *Ringani, Dorli, Dolimoola, Moti ringani, Ran ringni, Thorli dorli.* **Punj.-** *Katang-kari, Kandyari.* **Tam.-** *Mulli, Pappara-malli, Karlmulli, Kandal, Uruvi, Vattu, Kuttuchadikkandangattarai, Naymulli, Mundagam, Siruvalvdaloyi, Siruval Udunai, Valudalai, Varttagi.* **Tel.-** *Tella-mulaka, Kakamunchi, Chittimulaga, Adaviyuchinta, Challamulaga, Kakimachi, Nallamulaka, Tellamulaka.* **Assam-** *Tidbhagnri, Tidbhaghuri.* **Oriya-** *Bryhoti, Bonobryhoti, Nunnuniyakoli.* **Pers.-** *Badengawejangali, Ustargar, Kataikala.* **Santhal-** *Tibbatu.* **Urdu-** *Janglibringan.* **Kumaon-** *Banbhatta*. **Canarese-** *Kiriguligida, Badane, Gulla, Habbagulla, Kachi, Vayase Kadusonde, Kamanja, Kempugulla, Kirigulla, Sonde*. **Kon.-** *Kallanta.* **Central Provinces-** *Ringli.* **N.U.P.-** *Katangkari* (Sharma, 1978; Kirtikar and Basu, 1988; Nadkarni, 1976; Chopra *et al.*, 1958, 1986; Anonymous, 1972;

BRIHATI ***Solanum anguivi*** Lam.

Anonymous, 2000a; Anonymous, 1996; Watt, 1972; Chatterjee and Pakrashi, 2003; Anonymous, 1999).

BOTANICAL DESCRIPTION

A much branched stout, prickly undershrub, 30-150 cm high, prickles large with a long compressed base, slightly recurved, branches covered with minute stellate hairs. Leaves simple, alternate, 3-10 X 1.5 – 6 cm, ovate, oblong, shallowly lobed, spiny on nerves beneath, densely tomentose, base cordate, petiole upto 3cm long, prickly. Flowers bisexual, regular, blue in extra axillary recemose cymes. Berry globose, dark yellowish-red or orange colour, when ripe, glabrous. Seeds many, orange, spherical, flat and minutely pitted. Flowering and Fruiting: July-February (Cooke, 1967; Anonymous, 2001; Anonymous, 1972; Bole and Pathak, 1988; Hooker, 1973; Kirtikar and Basu, 1988; Ayer and Kolammal, 1992).

DISTRIBUTION

Throughout Tropical India from sea level to about 667m elevation growing in waste land, along roadsides (Anonymous, 1972). Also occurs in Sri Lanka, Malaya, China, Phillippines (Cooke, 1967; Kirtikar and Basu, 1988) and Indomalaysia and Tropical Africa (Yoganarsimhan, 1996, 2000).

PART(S) USED

Whole plant, root, fruit, seed, leaf (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The whole plant and roots are used as carminative and expectorant. These are beneficial in asthma, dry cough, colic, chronic fever and flatulence (Chopra *et al.*, 1958). It relieves pain arising from difficult parturition and also used as aphrodisiac and astringent. Root is diaphoretic and stimulant, useful in catarrhal affections, dropsy, toothache, dyspepsia, colic, verminosis, diarrhoea, pruritus, leprosy, skin diseases, bronchitis, cardiac disorders and vomiting. Fruits are bitter, pungent, digestive and laxative. It’s juice is beneficial in alopecia. Decoction of the seeds is useful in dysuria and vapour from seeds in odotalgia (Chatterjee and Pakrashi, 2003; Kirtikar and Basu, 1988). The juice of the leaves mixed with fresh ginger is given as antiemetic. The leaves are digestive, laxative, antibacterial and useful in ringworm (Anonymous, 1996).

AYURVEDIC PROPERTIES

Rasa – *Katu, Tikta.*

Guna – *Laghu, Ruksha, Tikshna.*

Vipaka – *Katu.*

Veerya – *Ushna.*

Doshaghnata – *Kapha vata shamaka, Pittavardhak* (A.H.Su.6.79), *Vatapittashamaka* (S.S.Su.38.66) (Sharma, 1978; B.N., 1982).

Karma – External – *Vedanastapana, Kandughna, Keshya, Uttejaka.*

External – *Deepana* (A.H.Su.6.79), *Pachana, Grahi, Krimighna, Hridayuttejaka, Raktashodhaka, Shothahara, Kaphaghna, Kasahara, Shwashahara, Mootrala, Kushthaghna, Jwaraghna, Asthapana* (C.S.Su.2.11), *Bhedana* (A.H.Su.6.79).

Seed: *Garbhashaya sankochaka, Vajeekarana* (Sharma, 1978; B.N., 1982).

Rogaghanta –

External – Paste of seed applied on penis in *Dhwajabhanga (Impotency)*, juice applied on head (scalp) in *Indralupta.*

Internal – *Agnimandya, Grahani* (C.S.Ci.15.106), *Udarshoola, Aruchi, Krimi* (S.S.Su.38.31), *Vamana, Hriddaurbalya* (C.S.Su.23.18), *Shotha* (C.S.Ci.12.73), *Raktavikara, Pratishaya, Kasa* (C.S.Ci.18.75), *Shwasha* (S.S.U.51.24), *Swarbheda, Hikka* (A.H.Su.14.26), *Mootrakrichchra* (C.S.Ci.26.54,55), *Ashmari* (S.S.Ci.7.5), *Rajorodha, Kashtaprasava* (C.S.Ci.29.55), *Sutika roga, Kushtha, Charmaroga* (C.S.Ci. 7.46, S.S.Ci.9.28), *Jwara* (C.S.Ci.3.213,267; S.S.U.39.219), *Netraroga* (S.S.U.12.10; 18.95), *Pratishaya* (S.S.U.24.31), *Yoniroga* (S.S.U.38.27), *Rajyakshama* (C.S.Ci.8.91), *Arsha* (C.S.Ci.14.50; S.S.Ci.6.30), *Urasthambha* (C.S.Ci.26.55), *Vatashonita* (C.S.Ci.29.55; S.S.Ci.5.10), *Slipada* (S.S.Ci.19.63), *Garbhasthapana* (A.H.Sa.2.56), *Panduroga* (S.S.U.44.22), *Atisara* (S.S.U.40.58,77), *Udavarta* (S.S.U.55.50), *Balaroga* (A.H.U.2.38), *Netraroga (Abhishardya)* (A.H.U.16.11), *Khalitya* (A.H.U.24.34), *Granthi roga* (A.H.U.30.12) (Sharma, 1978; B.N., 1982).

Doses - Decoction 40-80 ml; Powder 3-6 gm (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *KARI MULLI*

***Suvai* (Taste) -** *Kaarppu* (Pungent).

***Veeriyam* (Potency) -** *Veppam* (Hot).

***Vibakam* (Transformation)-** *Kaarppu* (Pungent).

***Gunam* (Pharmacological action) -** *Kozhaiyagattri* (Expectorant), *Aanmaip perukki* (Aphrodisiac).

Siddha pharmaceutical preparations- *Kari mulli kudineer.*

Uses - Used in Fever & General weakness.

PHARMACOGNOSY

Macroscopic

Root – Well developed, long, ribbed, woody, cylindrical, pale yellowish-brown, 1-2.5 cm in diameter, number of secondary roots and their branches present, surface rough due to presence of longitudinal striations and root scars; fracture short and splintery; no distinct odour and taste.

Microscopic

Transverse section shows thin cork composed of 5-15 layers of thin-walled, tangentially elongated, rectangular cells filled with yellowish-brown content, cork-cambium single layered; secondary cortex composed of 5-9 layers of thin-walled, oval and tangentially elongated cells; stone cells present in singles or in groups of 2-5 or more in this region; secondary phloem composed of sieve elements, parenchyma and stone cells, traversed by phloem rays; phloem parenchyma much abundant, thin walled; stone cells present in outer phloem region in singles or in groups of 2-5, varying greatly in shape and size; phloem rays 1-3 cells wide, isodiametric to slightly radially elongated in inner phloem region and radially elongated in outer phloem region, occasionally stone cells also found in medallary rays; wood occupies bulk of root and composed of vessels, tracheids, fibres and xylem parenchyma traversed by xylem rays, all elements being lignified, vessels occur singly or in groups of 2-5 with simple pits, xylem fibres moderately thick-walled with simple pits and pointed ends found in abundance; xylem parenchyma have simple pits or reticulate thickening; xylem rays uni to biseriate, thick-walled, cells redially elongated and pitted, microsphenoidal crystals of calcium oxalate as sandy masses and simple starch grains present in some cells of secondary cortex, phloem and medullary rays; simple and rounded to oval starch grains measuring 5.5 – 11.6 μ in diameter (Anonymous, 1999; Ayer and Kolammal, 1992).

Powder microscopy

Root powder cream in colour; shows groups of thin-walled parenchymatous cells, aseptate fibres, vessels fragments with simple pits, oval to elongated stone cells and simple, rounded to oval starch grains measuring 5.5-11.6 μ in diameter (Anonymous, 1999).

Physical constants

Total ash – Not more than 6.5%; Acid insoluble ash- Not more than 1%; Alcohol soluble extractive- Not less than 3%; Water soluble extractive – Not less than 4% (Anonymous, 1999).

CHEMICAL CONSTITUENTS

Plant: Gitogenin, tigogenin, dioscin, methyl protodioscin, methylyl protoprosapogenin A7 dioscin; demissidine, jorjubidine, leptinidine, neotigogenin, paniculidine, solanidine, solacongestine, soladulcidine, solafloridine, solaquitidine, tomatidine, jurjubidine, tomadidonal, yamogenin steroidal alkaloid-diosgenin, β-sitosterol, lanosterol, solanosine, solamargine, solasodine (Rathore *et al.*, 1978), β-sitosetrol, sapogenins, solasodene (Varshney and Aftab, 1971), tomatidenol (Verbist *et al.*, 1977), solavetivone, solafuranone, scopoletin, N-(p-trans-coumaroyl)tyramine, and N-trans-feruloyltyramine. (Syu *et al.*, 2001), β-sitosterol, β-sitosterol glucoside, dioscin, methyl protoprosapogenin A, methyl protodioscin, protodioscin (Chiang *et al.*, 1991).

Fruits: Enzyme, maltase, melibiose, saccharase, solanoside, solanine, diosgenin, proteolytic enzyme,trypsin (Chaudhary *et al.*,1958), indioside – A as (23S, 25R, 26R)-spirost-5-en-3β, 23, 26-triol 3-O-{α-L-rhamnopyranosyl-(1→2) – [β-xylopyranosyl-(1→3)-β-D-glucopyranoside, indioside B as (25 R)-26-O-B-D-glucopyranosyl-22α-methosy-furost-5-en-3β, 26-diol 3-O-{α-l-rhamnopyranosyl-(1→2)-(β-d-xylopyranosyl-(1→3)-β-D-gluopyranoside (Yahara *et al* 1996), anguiviosides A, B, C, characterized as 3-O-β-chacotrioside, 3-O-[4-O-maloyl-α-L-rhamopyranosyl (1→2)]-α-L-rhamnopyranosyl (1→4)-β-D-glucopyranoside, 3-O-α-L-rhamnopyranosyl (1 →2)-β-D-xylopyranosyl (1 →3)]-β-++glucopyranoide (Zhu *et al.*, 2000), steroidal saponins, anguiviosides (Honbu *et al.*, 2002), carpesterol, 3 beta-(p-hydroxy)-benzoyloxy-22 alpha-hydroxy-4 alpha-methyl-5 alpha-stigmast-7-en-6-one, indioside A [3 beta-O-[alpha-L-rhamnopyranosyl-(1-->2), beta-D-glucopyranosyl-(1-->4), beta-D-glucopyranosyl-(1-->3)-]alpha-L-rhamnopyranosyl-(-->2)]-beta-D- glucopyranosyl]-diosgenin], khasianine, dihydrosolasodine, capsimine, and capsimine-3-O-beta-D-glucoside (Gan *et al.*, 1993).

Seed oil: Solanocarpone, carpesterol (Gupta and Dutta, 1938), sitosterol, arachidiolein, arachidodilinolin, arachidooleolinolin, dioleolinolin, oleodilinolin, palmitodilinolin, palmitodiolein, palmitooleolinolin, stearodilinolin, stearodiolein, stearooleolinolin, trilinolin, lauric acid (Saran and Singh, 1942).

Leaf oil: Arachidic, lauric, linoleic, oleic, palmitic, stearic acid (Puntambekar and Kirshna, 1941), protodioscin, solanonine, solamargine (Rathore *et al.,* 1978).

Roots: Solamargine, anguivine, isoanguivine (Ripperger and Hummelreich, 1994), indioside–C–(25R)-26-o-β-D-glucopyranosyl-furost-en-3β-22ξ, 26– triol 3–0–{α–L–rhamnopyranosyl– (1 → 2)-{β-D-xylopyranosyl-(1 → 3)-β-D-galaetopyranoside, indioside D – (25R)-26-O-(β-D-glucopyranosyl)-furost-5-en-3β-22ξ, 26-triol 3-O-{α-L-rhamnopyranosyl-(1→2)-[B-D-gluopyranosyl-(1→3)]-β-D-galactopyranoside, indioside E – diosgenin 3-O-{α-L-rhamopyranosyl-(1-2)-[β-D-xylopyranosyl-(1→3)]-β-D-galactopyranoside (Yahara *et al.,* 1996).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have hypocholesterotaemic (Kalhoro *et al.,* 1997), anthelminitic, nematocidal (Qamar *et al.,* 1998), marginal choleristic, antihepatotoxic (Asha and Pushpangadan, 1998), anti-inflammatory wound-healing (Ma *et al.,* 2006) and cytotoxic (Gu *et al.,* 2004) activities.

TOXICOLOGY

The plant showed no toxicity to various cell lines although it exhibited 75% inhibition to the growth of PPR virus (Jabbar *et al.,* 2004).

THERAPEUTIC EVALUATION

Various preparations of whole plant of Brihati and Kantakari have been used in Shwasa and Kasa in ancient Ayurvedic literature. In a study, water decotion of Brihati and Kantakari were prepared to evaluate their efficacy in the patients of shwasa (Bronchial asthma) and Kasa (cough). Results of study suggest that the effect of Kantakari decotion was better than Brihati decoction to reduce different clinical symptoms of asthmatic attacks like dyspnoea and cough (Gupta *et al.,* 1999).

Herbal cough syrup containing eleven herbal ingredients including ***Solanum indicum,*** *Ocimum sanctun, Curcuma longa, Adhatoda vasica, Piper cubeba, Aloe barbadensis,* etc., showed efficacy in thining of bronchial secretion in cases of acute bacterial trachiobronchitis (Jayaram *et al.,* 1994).

FORMULATIONS AND PREPARATIONS

Asava and Arista *– Amritarista, Punarnavasava, Mritasanjivani sura, Dashmoolarista, Dantyadyarista.*

Avaleha and Paka *– Agastya Haritaki rasayana, Brahma rasayana, Bharangi guda, Chyavanprasha, Padmakadileha.*
Kvatha churna *– Dashamoola Kvatha churna, Nimbadi Kvatha churna, Rasnadi Kvatha churna, Vidaryadi Kvatha churna, Angamardaprasamana Kasaya churna, Darunagaradi kvatha churna.*
Ghrita *– Amritaprasa ghrita, Kalyanaka ghrita, Dashmoola ghrita, Dashamoolasatpalaka ghrita, Dadhika ghrita, Dhanvantara ghrita, Maha Kalyanaka ghrita, Maha Panchagavya ghrita, Sukumara ghrita, Indukanta ghrita, Brihachhagaladya ghrita.*
Churna *– Rajanyadi churna, Dashmoolapancakoladi churna.*
Taila *– Anu taila, Dhanvantara taila, Narayana taila, Visnu taila, Musikadya taila, Sahacaradi taila, Dashmoola taila, Madhyamanarayan taila.*
Vati And Gutika *– Khadiradi gutika (Kasa), Dhanvantara gutika.*
Rasayoga *– Shirahshooladivajra rasa.*
Lavana Ksara *– Abhaya Lavana* (Anonymous, 1978; 2000).

Other classical formulations – *Baladi ghrita, Kantakari ghrita, Mahamayur ghrita* (C.S.Ci.26.162; A.H.U.24.52), *Jiviniya ghrita* (C.S.29.55). *Ashwagandha taila, Kanakkshiri taila, Agurvadya taila*(C.S.Ci.3.267), *Kshargutika, Mahaneel gutika* (A.H.U.11.39). *Mritasanjivani agada, Ksharagada* (C.S.Ci.23.55).

TRADE AND COMMERCE

Retail Market Price – Rs. 25 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Solanum insanum Willd, *S. torvum* Swart, *S. melongena* Linn., *S. xanthocarpuma* Sc. and *S. aculeattissimum* Jacq. are used as a substitute in the country as well as in Kerala (Anonymous, 2000a; Ayer and Kolammal, 1992).

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DRONAPUSHPI

BOTANICAL NAME: *Leucas cephalotes* Spreng.

FAMILY: **Lamiaceae**

CLASSICAL NAMES
Dronapushpi, Kurubaka, Kutumbaka, Sugandhaka (C.S.; S.S.; A.H.).

SYNONYMS
Chhatraka, Chhatrani, Chitrakshupa, Chitrapatrika, Drona, Kaundinya, Kshavapatri, Kurumba, Kumbhayoni, Kumbhayonika, Kurumbika, Palindi, Phalepushpa, Shvasanaka, Supushpi, Vrikshasaraka (Sharma, 1978; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Hindi- *Deldona, Dhurpisag, Goma, Guma, Motapati. Goma madhupati.* **Beng.-** *Barahalkasa, Ghalaghase Darunaphula, Barahalkusa, Hulksha, Bholghasiya.* **Guj.-** *Doshi no kubo, Khetraukubo, Kubi, Kubo, Kulannuphul.* **Kan.-** *Tumbe.* **Mal.-** *Tumbe.* **Mar.-** *Deokhumba, Kumbha, Shetvad, Tumba, Bahuphul.* **Punj.-** *Chatra, Guldoda, Maldoda, Phuman, Sisalius, Guldora.* **Tam.-** *Tumbai, Tumbay-Keere.***Tel.-** *Peddatumni, Tumni, Pulatumni.* **Assam-** *Dronaphool.* **Oriya-** *Gaisa.* **Santhal-** *Andiadhuruparak.* **Sind.-** *Kubo.* **Konkani.-** *Tumbo.* **Bihar.-** Gumar. **Khandesh.-** *Kedari.* **Mundari.-** *Gomanaki ara* (Kirtikar and Basu, 1988; Chopra *et al.*, 2002; B.N., 1982; Nadkarni, 1976; Anonymous, 2000; Vaidya, 1985; Sharma, 1978; Anonymous, 1962; Anonymous, 1999; Anonymous, 1987; Anonymous, 1978; Watt, 1972; Duthie, 1960).

BOTANICAL DESCRIPTION
An annual erect, stout, hairy, pubescent, aromatic herb, 60-90 cm high. Stems and branches obtusely quadrangular, hairy with spreading hairs. Leaves simple, opposite, 3-8 x 1.5 –3 cm, ovate or ovate – lanceolate, subacute, membranous, crenate – serrate, base tapering, shortly petioled. Flowers white, zygomorphic, bisexual, sessile in large globose dense terminal whorls, 2.5 – 5 cm in diameter. Nutlets small, obovoid – oblong, rounded at the apex, the inner face angular, the dorsal face rounded, smooth and brown.

DRONAPUSHPI ***Leucas cephalotes*** Spreng.

Flowering and Fruiting : November – February (Cooke, 1967; Anonymous, 1962; Kirtikar and Basu, 1988; Anonymous, 2001; Chatterjee and Pakrashi, 1997; Bole and Pathak, 1988; Gamble, 1967; Hooker, 1973).

DISTRIBUTION

It is found as a weed in cultivated ground, road sides or waste places and through out the greter parts of India asending up to 1800m in Himalaya (Anonymous, 1962). Also found in West Bengal, Kashmir, Punjab, Assam, Rajasthan, Tamil Nadu, Gujarat, Maharashtra and Western Peninsula (Cooke, 1967; Hooker, 1973; Kirtikar and Basu, 1988). Also occurs in Afghanistan (Duthie, 1960).

PART(S) USED

Whole plant, flower and leaf (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The leaves and flowers are acrid, thermogenic, carminative, digestive, anthelmintic, anti-inflammatory, emmenagogue, sudorific, antipyretic, expectorant, antibacterial and depurative. They are useful in colic, dyspepsia, verminosis, arthralgia, chronic skin eruptions, psoriasis, cough and catarrh in children, amenorrhoea, dysmenorrhoea, intermittent fevers and ulcers (Chopra *et al.*, 1958) The juice of the leaves is highly recommendable as an eye drop in encephalopathy due to worm infestation in children and is useful as a nasal drops in catarrh and cephalgia. Bruised leaves applied locally in scabies; juice for cold and headache. The leaves are also useful in fever and urinary discharges. The whole plant is laxative, diaphoretic, useful in bronchitis, jaundice, inflammations, asthma, dyspepsia, paralysis and leukeamia. (Chatterjee and Pakrashi, 1997; Kirtikar and Basu, 1988; Anonymous, 1987).

AYURVEDIC PROPERTIES

Rasa *–Madhura*, *Lavana* (A.H.Su.6.93), *Tikta* (C.S.Su.27.96), *Madhura*, *Lavana*, *Katu* (Sharma, 1978; B.N., 1982).

Guna – *Guru*, *Ruksha* (A.H.Su.6.93).

Vipaka – *Madhura* (C.S.Su.27.96).

Veerya *–Ushna* (Sharma, 1978; B.N., 1982), *Sheeta* (A.H.Su.6.93; C.S.Su.27.96).

Doshagnata – *Kaphapittashamaka* (C.S.Su.27.96), *Kaphanashaka* (S.S.Su.38.18), *Vatashleshmakara* (A.H.Su.6.93).

Karma – *Vatakara, Pittakara, Vishtambha, Bhedani* (A.H.Su.6.93), *Ruchya, Kaphaghna, Jantughna, Vishaghna, Deepana, Anulomana, Pittasaraka, Rechana* (S.S.Su.46.274), *Krimighna, Raktashodhaka, Shothahara, Artavajanana, Jwarghana, Vranashodhaka* (S.Su.38.18) (Sharma, 1978; B.N., 1982).
Rogaghnata –*Tamakashwasa, Kasa, Shwasa* (S.S.Su.38.18), *Agnimandya, Kamala, Shotha, Aruchi, Krimi* (S.S.Su.38.18) *Vishamjwara, Amadosha, Shoola, Vibandha* (S.S.Su.46.274), *Raktavikara, Rajorodha, Kastartava, Skin diseases, Sarpavisha* (Sharma, 1978; B.N., 1982).
Doses – Powder 1-3 gm.; Juice 5-10 ml. (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *THUMBAI*
***Suvai* (Taste) -** *Inippu* (Sweet).
***Veeriyam* (Potency) -** *Seetham* (Cold).
***Vibakam* (Transformation)-** *Kaarppu* (Pungent).
***Gunam* (Pharmacological action)** - *Kozhaiyagattri* (Expectorant),*Ushna-mundaakki* (Stimulant).
Siddha pharmaceutical preparations - *Pitha sura kudineer, Sambirani poo pathangam,Seeraga chooranam.*
Uses - Used in treatment of Sinusitis & Coryza.

PHARMACOGNOSY

Macroscopic

Root – Cylindrical, zig-zag, smooth, elongated with numerous wiry, fine rootlets, size variable, fracture fibrous; taste characteristic.

Microscopic

Transverse section shows single layered epidermis composed of rectangular, thin walled cells; secondary cortex consists of thin-walled tangentially elongated, parenchymatous cells; secondary phloem consists of sieve elements and phloem parenchyma; secondary xylem consists of vessels, tracheids, fibres and xylem parenchyma; vessels long with spurs, vessels and tracheids have simple pits, xylem fibres much elongated with pointed ends and moderately thick walls, some having simple pits; medullary rays 1-2 seriate and upto 8 cells high (Anonymous, 1999).

Macroscopic

Stem – Light greenish-yellow, surface rough, hairy, quadrangular with four prominent furrows, upto 4 mm thick, nodes and internodes distinct; taste slightly bitter.

Microscopic

Transverse section shows squarish outline with four ridges and furrows consists of single layered epidermis, composed of oval to rectangular thin-walled cells having number of uni to tricellular trichomes; secondary cortex 5-9 layered consisting of 3-5 layers of circular, oval to irregular collenchymatous cells at the ridge and 2-4 layers of thin-walled, tangentially elongated, parenchymatous cells; endodermis single layered consisting of barrel-shaped, thin-walled cells; pericycle single layered of thin-walled cells comparetively smaller than the cells of endodermis, a few pericyclic cells converted into pericyclic fibres; phloem very narrow consisting of usual elements; xylem consists of vessels, tracheids, fibres, and large amount of xylem parenchyma; vessels mostly cylindrical with simple pits and spiral thickening, tracheids and xylem parenchyma have simple pits on their walls. Pith wide consisting of circular to oval thin-walled parenchymatous cells (Anonymous, 1999).

Macroscopic

Leaf- Yellowish-green, 3-9 x 1.2.5 cm., ovate or ovate - lanceolate, subacute, more or less pubescent, crenate, serrate; taste pungent.

Microscopic

Petiole in transverse section shows epidermis on either side with uni to tricellular trichomes with pointed ends, cortex consisting of single layered, round to angular collenchymas; parenchyma consists of thin-walled cells containing prismatic crystals of calcium oxalate, vascular bundles four, two smaller located towards each corner and two larger in centre. Mid-rib shows epidermis on either side with uni to tricellular trichomes, followed by 1-2 layers of collenchyma towards lower surface, 3-4 layers towards upper surface, followed by round to oval parenchyma, 4-7 layered, vascular bundle arc shaped present in the center. Lamina shows epidermis on either side with uni to tricellular trichomes rarely on upper surface; palisade single layered, spongy parenchyma 3-5 layered, irregular, thin-walled cells; a few veins present in this region; stomata diacytic, present on both surfaces; stomatal index 16.6-40.51 on lower surface, 16.6-30.7 on upper surface and palisade ratio 7-9 (Anonymous, 1999).

Powder microscopy

Whole plant powder dull yellow in colour; shows groups of round to polygonal parenchymatous cells, pitted and spiral vessels; aseptate fibres, uni-to tricellular trichomes and diacytic stomata (Anonymous, 1999).

Physical constants

Total Ash- Not more than 17%, Acid insoluble Ash - Not more than 6%, Alcohol soluble extractive – Not less than 5%, Water soluble extractive - Not less than 14% (Anonymous, 1999).

CHEMICAL CONSTITUENTS

Plant: β-Sitosterol and its glycoside (Bahadur and Sen, 1969), new labdane, norlabdane- and abietane-type diterpenes named leucasdins A, B and C, respectively, and two protostane-type triterpenes named leucastrins A and B, oleanolic acid, 7-oxositosterol, 7-oxostigmasterol, 7α-hydroxysitosterol, 7α-hydroxystigmasterol, stigmasterol, 5-hydroxy-7,4'-dimethoxyflavone, pillion, gonzalitosin I, tricin, cosmosin, apigenin 7-O-beta-D-(6-O-p-coumaroyl)glucopyranoside, anisofolin A and luteolin 4'-O-beta-D-glucuronopyranoside (Miyaichi *et al.*, 2006).

Seed oil: Laballenic acid (Octadeca-5, 6-dienoic acid), lauric acid, glutaric acid, tridecanoic acid, adipic acid (Sinha at al, 1978).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to be cardiac depressant, hypotensive (P.R.U., Jodhpur), anthelmintic, antiseptic (Anonymous, 1962), insectisidal (Chopra *et al.*, 2002), antiscabies (Purohit *et al.*, 1985) and anticoagulant (Sharma *et al.*, 1978a). Dhawan *et al.*, (1980) reported antispasmodic activity in 50% ethanolic extract of the plant. In contrast any such activity was reported to be absent in the 90% ethanolic extract (Sharma *et al.*, 1978a). The ethyl acetate extract of whole plant failed to protect carbon tetrachloride induced hepatotoxicity in mice and rats up to a dose of 300 mg/kg (Singh *et al.*, 1978).

Leucas cephalotes exhibited potent antifilarial activity against adult worms and the microfilariae of *Setaria cervi* (Parveen *et al.*, 2002).

TOXICOLOGY

The LD_{50} of 50% ethanolic extract was 750 mg/kg bw i.p. in mice (Dhawan *et al.*, 1980). The LD_{50} of 90% ethonolic extract was found to be 1000 mg/kg bw i.p. in rats (Sharma *et al.*, 1978). The LD_{50} of ethylaetate extract was 1680 ± 21 mg/kg bw i.p. in mice (Singh *et al.*, 1978).

FORMULATIONS AND PREPARATIONS

Churna – *Sudarshan churna*

Vati And Gutika – *Gorochanadi vati, Pleehari vatika* (Anonymous, 1978).

SUBSTITUTES AND ADULTERANTS

Leucas aspera Spreng and L. *lavandulaefolia* Rees are also called as Dronapushpi and used as substitute (Sharma, 1978; Anonymous, 2003; Kurup *et al.*, 1979; Garg, 1992).

PROPOGATION AND CULTIVATION

The plants are easily cultivated through seeds. The plant comes out during rainy season in field borders and waste places (Chauhan, 1999).

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GORAKSHGANJA

BOTANICAL NAME: ***Aerva lanata*** Juss. ex Schult.

FAMILY: **Amaranthaceae**

SYNONYMS

Aadan paki, Gorakhsganja (in South India it is considered as *Pashanabheda*) *Shatkabhedi, Silavari* (B.N., 1982).

VERNACULAR NAMES

Hindi- *Chaya, Gorakhganja, Gorkhabundi, Kapurijadi, Thikaritoda.* **Beng.-** *Chaya.* **Guj.-** *Bur, Kapurimadhuri, Gorakha ganjo.* **Kan.-** *Billhindisoppu.* **Mal.-** *Cerula,Valippo, Ceruvula, Cherupula.* **Mar.-** *Kapurmadhura, Kapurimadhuri, Kaparphuti, Kumrapindi.* **Punj.-** *Buikallan.* **Tam.-** *Poolai, Cerupulai, Pillai, Sirupulai. Sirrupulayvayr.* **Tel.-** *Pindichettu, Nilaphlai, Kaminulas, Pindicettu, Pindikonda, Thelagapindi Koora.* **Oriya-** *Paunsai.* **Sind.-** *Bui, Jari.* **Sinhalese**.- *Polkudupala.* **Deccan**.- *Khul, Kul.* **Porebunder**.- *Bhonyajdi, Gorkhaganjo.* **Rajputana**.- *Bhui.* **Spanish**.- *Sanguinaria de Cuba.* **Kerala**.- *Bhadram, Bhadrika, Cherula, Cherupula* (Kirtikar and Basu, 1988; Chopra, 1986; Nadkarni, 1976; Anonymous, 2000a; Vaidya, 1968; Sharma, 1978; Anonymous, 1994; Ayer and Kolammal, 1994).

BOTANICAL DESCRIPTION

Erect or prostrate herb with a long tap root, branched from near the base; branches many, terete, pubescent or wooly-tomentose, striate. Leaves alternate, simple 0.5-1.5 X 0.2-1.0 cm on the branches, elliptic or obovate or suborbicular, obtuse or acute, entire, pubescent above, more or less white cottony beneath; petioles often obscure. Flowers greenish white, very small, sessile, often bisexual, in small dense subsessile axillary heads or spikes, often, closely crowded and forming globose clustered heads. Fruit utricle, broadly ovoid, acute. Seed black, smooth and polished. Flowering and Fruiting : August-February (Cooke, 1967; Hooker, 1973; Guha Bakshi *et al.*, 1999; Anonymous, 1985; Kirtikar and Basu, 1988; Agharkar, 1991; Bole and Pathak, 1988; Anonymous, 1991; Ayer and Kolammal, 1994).

GORAKSHGANJA ***Aerva lanata*** **Juss. ex Schult.**

DISTRIBUTION

Common throughout tropical India, ascending upto an altitute 900m in the hills, along road sides, waste places, on walls of old forts, under the shade of trees and in open cleared areas (Anonymous, 2004). Also occurs in Sri Lanka, Arabia, Tropical Africa, Java, Philippines (Cooke, 1967; Gamble, 1967; Kirtikar and Basu, 1988), Pakistan and Bangladesh (Guha Bakshi *et al.,* 1999).

PART(S) USED

Whole plant, root, flower, leaf (Sharma, 1978; B.N., 1982)

ACTIONS AND USES

The plant is used as anthelmintic, cooling, lithotriptic and demulcent. It is beneficial medicine for cough, sore throat, indigestion, wounds and diabetes. Decoction of the plant is considered as efficacious in diuretic and useful in catarrh of bladder (Nadkarni, 1976; Chatterjee and Pakrashi, 1994). The plant is used to cure diarrhoea, cholera and dysentery. The root is diuretic, demulcent, tonic and given to pregnant women. The root and flowers are used to cure headache (Kirtikar and Basu, 1988). The flowers are used in gonorrhoea and for removal of kidney stones (Chopra *et al.,* 1986; Anonymous, 1985).

AYURVEDIC PROPERTIES

Rasa – *Tikta, Kashaya*
Guna – *Laghu, Tikshna*
Vipaka – *Katu*
Veerya – *Ushna*
Prabhav – *Ashmaribhedana*
Doshaghnata – *Kaphavata shamaka* (Sharma, 1978; B.N., 1982)
Karma – *Ashmaribhedana, Mootrala* (Sharma, 1978), *Snehana, Mootrajana, Vedanahara, Ashmarighna, Krimighna, Kasahara* (B.N., 1982)
Rogaghnata – *Ashmari, Mootrakrichchhra* (Sharma, 1978), *Ashmari, Mootrakrichchhra, Krimi, Kasa* (B.N., 1982)
Dose : Decoction 50 – 100 ml (Sharma, 1978; B.N., 1982)

SIDDHA PROPERTIES

Siddha Name - *SIRUGANPEELAI*
Suvai **(Taste) -** *Kaippu* (Bitter).
Veeriyam **(Potency) -** *Veppam* (Hot).
Vibakam **(Transformation) -** *Kaarppu* (Pungent).

***Gunam* (Pharmacological action) -** *Siruneer perukki* (Diuretic), *Karkaraichchi* (Lithotriptic).
Siddha pharmaceutical preparations - *Sirugan peelai chooranam, Nerunjil kudineer.*
Uses - Used in treatment of Renal stones, cystitis, Dysuria.

PHARMACOGNOSY

Macrocopic

Root – Well developed tap root system of creamy white colour. The main root is short upto 1 cm in thickness depending upon the age of plant, bearing many lateral slender rootlets; odour not characteristic; taste slightly astringent.

Microscopic

The transverse section shows phellem represented by 4 to 6 cells deep, tissue with hyaline lumen, phellogen consists of 1-2 layers, the phelloderm composed of large parenchyma cells containing many cluster crystals of calcium oxalate. The root show anomalous secondary growth, the primary xylem is very scanty consisting of 3-5 tracheary elements. The inner phloem of each strip is composed of sieve tubes and companion cells mostly, no sclerenchymatous cells in the phloem, the xylem composed of lignified prosenchyma with groups of vessels embedded in it, vessels in radial rows usually, narrow with lumen, 40-60µ in diameter, medullary rays not discernible. Pith is absent.

Microscopic

Stem – Transverse section of the young stem is roughly polygonal, single layered epidermis composed of barrel shaped cells with a fairly heavy cuticle, and abundant multicellular uniseriate, simple, unbranched trichomes. The cortical tissue is chlorenchymatous except below the ridges of collenchyma. Endodermis and pericycle within the six layered cortex. The vascular strands are slender and collateral. The large pith composed of bigger thin walled cells with intercellular spaces. In the older stem, the epidermal hairs fall off leaving their basal cells. The endodermis is distinct. The pericyclic sclerenchyma fibres are in groups of two or three fibres. Pith cells possess pitted walls. It shows anamolous secondary growth.

Leaf – It shows dorsiventral structure. The main vein shows two prominent humps consisting of collenchyma below the epidermis. The vascular strand is represented by a single collateral strand. The epidermal cells on the adaxial surface are larger than those of the abaxial surface, both the epidermis bear anomocytic (ranunculaceous) stomata. The lower epidermis is more densely trichomatous than the upper epidermis, trichomes are simple, unbranched, multicellular and uniseriate. The basal cells are short and small with smooth walls, the body cells are elongate, papillated, cylindrical ones with interlocking end walls, the apical cell gradually tapering into an acute nonpapillate end. The palisade cells are not regularly arranged, in some places it is two celled deep while one celled deep in other places. The spongy tissue composed of large cells in about four layers. Large crystalliferous idioblasts are present along the line where the palisade and spongy tissue meet, about 80 μ in diameter and contain a large cluster crystals almost filling up the lumen (Swamy and Ali, 1967; Afaq and Tajuddin, 1991).

CHEMICAL CONSTITUENTS

Plant: β-Sitosterol, free sugars, β-sitosteryl palmitate, palmitic acid, α-amyrin (Aiyar *et al.,* 1973), flavonoid glycosides (Zadorozhnii and Zapesochnaya, 1986), aervine (10-hydroxy-conthin-6-one), 10β-D-glucopyranosyl oxycanthine-6-one (aervoside), 3-β-carbolin-1-yl propionic acid, β-carboline-1-propionic acid, 6-methoxy-β-carboline-1-propionic acid (aervolanin), canthin-6-one, aervine- (10-ethoxy canthin-6-one), β-coumaroyl glycosides (Zapesochnaya *et al.,* 1991a, 1992), betulin, kaempferol-3-galactoside, kaempferol-3-rhamnogalatoside (Afaq *et al.*, 1991; Chandra and Sastry, 1990), chrysine, β- ecdysone, daucosterol, narcissin, syringic acid, vanillic acid, ascorbic acid, campesterol, chrysin, hemicellulose, starch, polysaccharides (acid and water soluble), aervitrin, aervolanine, aervoside, amysine (Yuldeshev *et al.,* 2002), aflatoxins (Abeywickrama and Bean, 1991).

Leaves: O-acylglycosides, feruloylthyramine (Zadorozhnyi and Zepesochnaya, 1986), 5-methoxycanthin-6-one (Yuldeshev *et al.*, 2002).

Roots: Feruloyl amides (Zapesochnaya *et al.*, 1991b, 1992), flavone glycoside – chrysin-7-O-β-galactoside, flavone-aervanone (8-C-β-galactosyl-7, 4′-dihydroxy flavone) (Yuldeshev *et al.*, 2002).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have antidiabetic (Vetrichelvan *et al.*, 2002), antimicrobial (Chowdhury *et al.,* 2002), hepatoprotective (Majmumdar and Shah, 1999), antilithic (Selvam *et al.*, 2001), antitumor (Nevin and Vijayammal, 2003) and nephroprotective (Shirwaikar *et al.*, 2004) activities. Roots were reported as diuretic, anti-inflammatory, anthelmintic, antibacterial and mild analgesic

(Prasad *et al.,* 1986; Vetrichelvan *et al.,* 2000). Leaf extract has angiotensin converting enzyme (ACE) inhibitory action in varying degrees (Somanadhan *et al.,* 1999). Administration of *Aerva lanata* aqueous suspension (2g/kg body wt/dose/day for 28 days) to CaOx urolithic rats was reported to reduce the oxalate synthesizing enzymes and diminished the markers of crystal deposition in the kidney (Soundararajan *et al.,* 2006).

TOXICOLOGY

Petroleum ether extract was proved to be cytotoxic to Dalton's lymphoma ascites (DLA), Ehrlich ascites (EA) and B16F10 cell lines *in vitro* (Nevin and Vijayammal, 2003). Ethylacetate and methanol extract were reported to have significant cytotoxic properties (Chowdhury *et al.*, 2002).

FORMULATIONS AND PREPARATIONS

Ghrita – *Shatavaryadi ghrita* (Anonymous, 2000)

SUBSTITUTES AND ADULTERANTS

Aerva javanica Juss, *A. tomentosa* Forsk, *Coleus aromaticus* Benth, *Nothosaerva bractiata* Wight, *Rotula aquatica* Lour, *Ammania baccifera* Linn, *Aerva sanguinolenta* Blume are used as substitute or adulterants of this drug (Anonymous, 2000a; Ayer and Kolammal, 1994; Vaidya, 1968; 1982).

PROPAGATION AND CULTIVATION

Found mostly in wasteland, even in poor soils and sun exposed places, locally abundant in arable and fallow fields (Guha Bakshi, *et al* 1999).

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HAMSAPADI

BOTANICAL NAME: ***Adiantum lunulatum*** Burm. f.
Syn. *A. philippense* Linn.

FAMILY: **Adiantaceae**

CLASSICAL NAMES
Hamsapadi (C.S.Su), *Hamshahvaya* (S.S.Ci), *Triparni* (C.S.Su) *Tripadi*, (A.H.Su), *Triparnika* (S.S.Su).

SYNONYMS
Brahmadani, Chitrapada, Dharttarashtrapadi, Ghritamandalika, Godhangri, Godhapadika, Hamsapadika, Hansaghri, Hansavati, Karnati, Kiramata, Kirapadika, Kitamari, Madhusrava, Padangi, Raktapadi, *Sancharini, Shitangi, Sutapadika, Suvaka, Tamrapadi, Tridala, Tripadi, Tripadika, Tripornika, Vanda, Vikranta, Vishvagranthi, Vrikshabhaksha, Vriksharuha, Vishagranthi* (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Maiden hair fern, Walking maiden hair fern. **Hindi-** *Hansapadi, Banda, Hansaraja, Samalpatti, Hansapagi, Kalijhamp, Kalijhant, Paresiyavasan, Hanspadee.* **Beng.-** *Goyalelata, Kalijhant.* **Guj.-** *Hansapadi, Mubarkha, Mubarkhinipalo, Hansraja.* **Kan.-** *Hamsapadi, Nayalad, Naralad.* **Mar.-** *Ghodkhuri, Hansraj, Hansaraj, Mubarak, Kamsaraj Rajkombada, Rajhans.* **Kash.**- *Dumtuli.* **Punj.-** *Harsraj* **Tel.-** *Nayalod, Hamsapadi.* **Assam-** *Sharul Arj, Sharujeena, Parsiyav.* **Santhal-** *Dodhali.* **Porebunder**.- *Hansraj, Kalohansraj*. **Philippines**.- *Culantrillo* (Kirtikar and Basu, 1989; Chopra *et al.*, 1958, 1986; Nadkarni, 1976; Sharma, 1978; Anonymous, 2001; Singh and Chunekar, 1972; Anonymous, 2000a; Vaidya, 1985; Anonymous, 1985).

BOTANICAL DESCRIPTION
A graceful fern, stipes 6-15 cm. long, tufted, wiry glabrous, polished, dark chest nut – brown; fronds 15-30 cm. long, simply pinnate, often elongated and rooting at the apex, pinnae sub-dimidate. Sori are in continuous line along the edge (Anonymous, 1985; Kirtikar and Basu, 1989; Chatterjee and Pakrashi, 1994; Bhattacharjee, 1998).

HAMSAPADI ***Adiantum lunulatum*** Burm.f.

DISTRIBUTION

Throughout greater part of India up to an altitude of 1200m on rocks and slopes of hills in moist places (Anonymous, 1985). The plant is native to tropics, commonly found at Mount Abu, Gwaparnath, Ajmer and Menal of Rajasthan (Bhattacharjee, 1998), Ceylon and Burma (Kirtikar and Basu, 1989).

PART(S) USED

Whole plant, rhizome, leaf (Sharma, 1978)

ACTIONS AND USES

The whole plant is pungent and used as antidysenteric, febrifuge, (Chatterjee and Pakrashi, 1994). It is used in blood diseases, burning sensation, epileptic fits, dysentery, strangury and elephantiasis (Kirtikar and Basu, 1989). The decoction of the rhizome given in throat affections and also used for febrile conditions in children (Anonymous, 1985). Fruits and leaves are beneficial in leprosy, fever and erysipelas (Chopra *et al.*, 1958; Nadkarni, 1976).

AYURVEDIC PROPERTIES

Rasa – *Kashaya, Tikta* (Sharma, 1978; B.N., 1982) *Madhura* (S.S.Su.46.274; C.S.Su.27.102-103).

Guna – *Guru, Sheeta, Ruksha* (S.S.Su.46.274).

Vipaka – *Madhura* (C.S.Su.27.102-103).

Veerya – *Sheeta* (C.S.Su.27.102-103).

Doshghanata – *Kaphapittashamaka* (S.S.Su.46.274; C.S.Su.27.102-103) (Sharma, 1978; B.N., 1982).

Karma – External - *Dahaprashamana, Vishaghna, Vranaropana.*

Internal – *Stambhana, Ashmaribhedana, Mootrala, Raktapittashamaka, Kantheya, Kasahara, Kaphaghna, Swarahara* (Sharma, 1978; B.N., 1982).

Rogaghnata – External - *Visarpa, Visha* (C.S.Ci.23.219), *Vrana.*

Internal –*Swarbheda, Pratishyaya, Kasa, Shwasa* (A.H.Su.15.9-10;.Ci.5.38; S.S.Su.38.4) *Mootrakrichchhra, Atisara* (S.S.Ci.18.47); *Galaganda (*A.H.U.22.68), *Raktapitta, Vatarakta* (C.S.Ci. 29.91; A.H.Ci.22.42.), *Apasmara, Visarpa,* (S.S.Su.38.4); *Shotha, Gulma (*A.H..Su.15.9-10), *Daha jwara* (A.H.Ci.5.38; 22.42) (Sharma, 1978; B.N., 1982).

Doses: Juice-10-20 ml; Powder 1-3 gm.; Decoction 50 – 100ml (Sharma, 1978B.N,1982).

PHARMACOGNOSY

Macroscopic

Root - Very thin, fibrous, about 10-15 cm long, reddish black in colour, soft and branched.

Microscopic

Transverse section of mature root shows single layered epidermis consisting of thin walled, small and irregular cells, followed by 3-4 layers of large thick walled, polygonal, parenchymatous cells of cortex; endodermis single layered composed of square or somewhat rounded cells; pericycle single layered composed of square shaped sclerenchymatous thick and dark reddish-brown wall; pericycle encloses a diarch stele with a few elements of xylem and phloem (Anonymous, 2001).

Macroscopic

Rhizome – Long, up to 2 mm thick, glabrous, prostrate or erect, dark reddish-brown or black in colour.

Microscopic

Mature rhizome consists of thick-walled, rectangular, small cells of epidermis, followed by 3-4 layers of sclerenchymatous cells of hypodermis, composed of thick-walled cells; cortex wide, made up of thin – walled, rounded or oval shaped parenchymatous cells, enclosing an amphiphloic siphonostele; endodermis present; vascular bundle with xylem consisting protoxylem towards both ends and metaxylem in the centre; phloem surrounds the xylem externally and also internally; tracheids with scalariform to reticulate thickening; a central pith consists of thick walled cells, fibres and is sclerenchymatous (Anonymous, 2001).

Frond – Rachis shiny black, simple pinnate, pinna roughly lunulate, subdimidiate, lower edge nearly in line and oblique with its black shiny petiole, upper edge bluntly rounded and more or less lobed, a few sori in a continuous line on the under surface along the edge, with a false indusium. Transverse section of petiole shows concave-convex outline; epidermis single layered; hypodermis consists of 2 or 3 layers, lignified, thick walled, sclerenchymatous cells; ground tissue composed of oval to polygonal, thin walled parenchymatous cells; stele single, slightly triangular in shape, located centrally and surrounded by pericycle and endodermis (Anonymous, 2001).

Pinnule – Shows single layered epidermis on either surface; mesophyll round to oval in shape and not differentiated into palisade and spongy parenchyma; a few stomata present only on lower surface and a few sori also present (Anonymous, 2001).

Powder microscopy

Whole plant powder dark reddish-brown in colour; shows dark reddish-brown pieces of sclerenchymatous cells and light coloured crushed cells of cortex, a few tracheids having reticulate thickening, fibres and a few spores (Anonymous, 2001).

Physical constants

Total Ash - Not more than 16%; Acid insoluble Ash – Not more than 11%, Alcohol soluble extractive – Not less than 3 %; Water soluble extractive – Not less than 5% (Anonymous, 2001).

Thin Layer Chromatography

TLC of the alcoholic extract on silica gel 'G' plate using n-Butanol: Acetic acid: water (4:1:5) shows under UV (366 nm) two fluorescent zones at Rf. 0.80 and 0.96 (both blue). On exposure to lodine vapour three spots appear at Rf. 0.19, 0.30 and 0.80 (all yellow). On spraying with 5% methanolic-sulphuric acid reagent and heating the plate for about ten minutes at 110°C three spots appear at Rf: 0.19, 0.30 and 0.80 (all yellowish – brown) (Anonymous, 2001)

CHEMICAL CONSTITUENTS

Plant: Chlorophyll degradation products, carotenoids (Bohara *et al.*, 1979), 22,29ψ-epoxy-30-norhopane-13β-ol, fern-9 (11)-en-6α-ol, fern-9(11)-ene, fern-9(11)-en-25-oic acid, fern-9(11)-en-28-ol, filicenol-B, adiantone and oxidation product of fern-9(11)-en-6α-ol obtained as 6-oxofern-9(11)-ene (Reddy *et al.*, 2001), 3β-acetoxy-6α-hydroxy-hop-15,17(21)-diene (Mukherjee *et al.*, 2003), flavonoids (Agrawal *et al.*, 1989).

PHARMACOLOGICAL ACTIVITIES

Plant was reported for antidysentric, ulcer healing, antidiarrhoeal, antifungal (Rai, 1988), hypotensive (Sharma *et al.*, 1978), antibacterial (Reddy *et al.*, 2001) and abortificient (Hosagoudar and Henry, 1993) activities. Plant was also reported for its contaceptive properties by Kumar (1998).

TOXICOLOGY

LD_{50} of ethanolic extract was found to be >500 mg/kg bw i.p. in rats (Sharma *et al.*, 1978).

FORMULATIONS AND PREPARATIONS

Taila - *Madhuyastyadi taila.*

Vati and Gutika – *Manasamitra vataka.*

Rasayoga – *Muktapanchamrita rasa, Svarnabhupati rasa, Kalakuta rasa* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

Retail Market Price – in the year 2006 was Rs.160/kg.

SUBSTITUTES AND ADULTERANTS

Adiantum capillusveneris Linn., *A aethiopium* Linn., *A. pedatum* Linn. and *A. venustum* G. Don. are used as substitute (Chauhan, 1999; Garg, 1992).

PROPAGATION AND CULTIVATION

Grows wild in moist places and under shade near swamps (Guha Bakshi *et al*. 1999).

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HAPUSHA

BOTANICAL NAME: *Juniperus communis* Linn.

FAMILY: **Cupressaceae**

CLASSICAL NAMES
Hapusha, Havusa, Vigandhika (C.S.; S.S.; A.H.)

SYNONYMS
Aparajita, Ashvathaphala, Atigandhika, Dhamkshnashini, Habusha, Kanchhughni, Kaphaghni, Matsyagandha, Plihahantri, Pleehashatru, Svalpaphala, Vipusha, Vishaghni, Visra, Visragandha (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Juniper, Common Juniper, Juniper berry. **Hindi-** *Aaraar, Haubera, Abhal, Havuber, Havubair.* **Beng.-** *Havusha, Hayusha.* **Guj.-** *Palash.* **Kan.-** *Padma beeja.* **Mar.-** *Hosha.* **Punj.-** *Langshur, Lassar, Lewar, Nuch, Pama, Pethra, Pethri, Pethar, Bethal, Betar, Dhup, Gugil, Chui, Chuch, Thelu, Haulber, Giashuk, Abhul haubera, Bentha.* **Tel.-** *Hapusha.* **Arab.-** *Abhal, Habbul-aarwar, Pethri, Samratul-arrar.* **Assam-** *Arar, Abahal, Habbul.* **Kash.-** *Bentha, Betar, Nuch, Pama, Pethra, Pethri, Chui, Haulber.* **Pers.-** *Hab-ul-ushara.* **Urdu-** *Abahal, Saru, Aarar* (Kirtikar and Basu, 1988; Anonymous, 2001; Nadkarni, 1976; Anonymous, 2000a; Mukerji, 1953; Anonymous, 1959; Watt, 1972; Sharma, 1978; Anonymous, 1987; Chopra *et al.,* 1986; B.N., 1982).

BOTANICAL DESCRIPTION
An evergreen dense diffuse, dioecious, shrub or a bush, 60-150 cm high, with upright branches. Leaves in whorls of 3, persistent, sharply pointed, scented, spreading or erect, linear, 5-13 mm long, base narrowed, upper surface pale or bluish-white, concave; lower green, convex. Catkins axillary. Male and female flowers are born on separate trees, flowers axillary. Fruit globose berries, blue-black, 1.5-2cm dia., glaucous, with scarious empty scales at the base. Seeds usually 3, ovoid. Flowering : March-April; Fruiting : Ripen in August-September of the second year (Kirtikar and Basu, 1988;

HAPUSHA ***Juniperus communis*** Linn.

Hooker, 1973; Collett, 1971; Mukerji, 1953; Husain *et al.*, 1988; Chauhan, 1999; Cooke, 1967; Bhattacharjee, 2000).

DISTRIBUTION

Found in Himalayas from Kumaon Westwards at an altitude of 1600-4600 m (Anonymous, 1959; 1987; Chopra *et al.*, 1986). In Himachal Pradesh, it is found in Chhota and Bara Bhangal, Kullu, Chounti, Kalga Pattan, Chansil, Chheradhank (Chauhan, 1999). Distributed in temperate and subarctic Europe, Asia, North Africa, North America (Hooker, 1973; Kirtikar and Basu, 1988; Watt, 1972). Commercially cultivated in Hungary, Czechoslovakia, Yugoslavia and America (Bhattacharjee, 2000).

PART(S) USED

Fruit, bark, wood oil (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Fruit is carminative, stimulant, styptic, stimulant, emmenagogue, digestive, diuretic, disinfectant, antiseptic and are useful in chronic bright's disease, dropsy, asthma, cough, respiratory affections, migraine, rheumatic and painful swellings, nephrotic dropsy of children, cattarah, gonorrhoea, pulmonary blennorhoea, arthritis, amenorrhoea, diabetes, infantile tuberculosis, bladder affections, chronic pyelonephritis, dysmenorrhoea, piles and abdominal disorders. The bark is applied in skin affections. The wood is resinous, sudorific, depurative. It is employed in gout, rheumatism and cutaneous diseases (Chopra *et al.*, 1958; Anonymous, 1987). Fruits are beneficial in scanty urine, chronic Brignt's disease, hepatic dropsy, pectoral affections, chronic gonorrhoea, leucorrhoea, locally rheumatic swellings and certain skin affections (Nadkarni, 1976). The plant is used as appetizer, carminative, anthelmintic, alexipharmic, laxative, useful in diarrhoea, abdominal pains, strangury diseases of the spleen and abdomen, ascites, tumours, piles, bronchitis, indigestion, constipation and vaginal discharges (Kirtikar and Basu, 1988).

AYURVEDIC PROPERTIES

Rasa – *Katu, Tikta.*
Guna – *Laghu, Ruksha, Tikshna.*
Vipaka – *Katu.*
Veerya – *Ushna.*
Doshaghnata – *Kaphavatashamaka* (Sharma, 1978; B.N., 1982).

Karma – *Sangrahi* (C.S.Ci.19.26), *Vrishya* (C.S.Si.8.7), *Virechaka* (C.S.Ka.7.59), *Ashmaribhedan* (C.S.Ci.26.60), *Santarpana* (C.S.Su.23.20), *Vasti* (C.S.Si.3.39), *Lekhana, Shothahara, Vranaropana, Admanahara, Uttejaka, Deepana, Anulomana, Krimighna, Upasarganashaka, Rasayana, Kaphanissaraka, Artavajanana, Garbhashaya shothahara, Mootrajanana, Swedajanana* (Sharma, 1978; B.N., 1982).
Rogaghnata – *Shotha* (A.H.Ci.15.22), *Vedana, Vrana, Dhwajabhagna* (C.S.Si.8.7), *Karnabadhirya, Pakshaghata, Vatavyadhi* (A.H.Ci.14.13), *Agnimandya* (A.H.Ci.15.22), *Udarashoola* (A.H.Ci.14.31), *Gulma* (A.H.Ci.14.11; C.S.Ci.5.70; S.S.Ci.5.28), *Arsha* (C.S.Ci.14.70; A.H.Ci.8.36), *Grahani* (A.H.Ka.4.8), *Krimi, Udararoga* (C.S.Ci.13.104), *Amavata, Hriddaurbalya, Kasa, Shwasa, Jeerna shwasanikashotha, Jeerna pooyameha,* (S.S.U.52.39; A.H.Ci.15.22), *Kastartava, Rajorodha, Anartava, Pradara, Shwetapradara* (A.H.Ci.14.11), *Madhumeha* (A.H.Ka.4.30), *Charmaroga* (A.H.Ci.15.22), *Pittodara, Mukhapaka, Yakritvikara* (A.H.Ci.15.22), *Pleeharoga* (A.H.Ci.8.62), *Ardhvabhedaka* (S.S.U.59.17), *Ashmari, Mootrakrichchhra* (C.S.Ci.26.60), *Adhmana, Vivandha* (A.H.Ka.4.10), *Atisara* (A.H.Ci.9.12; C.S.Ci.19.30), *Madataya* (C.S.Ci.24.121; A.H.Ci.7.13), *Medoroga* (A.H.Su.5.26) (Sharma, 1978; B.N., 1982).
Dose : Powder- 3-5 gm (Sharma, 1978; B.N., 1982)

PHARMACOGNOSY

Macroscopic: Fruit sub-spherical, berry like, purplish black, covered by a glaucous bloom; about 0.5-1.0 cm in diameter, apex shows triradiate mark and depression indicating the suture of three fleshy bracts. At the base six, small, pointed bracts arranged in two whorls, but occasionally three or four whorls present. Three hard, triangular seeds embedded in the fleshy mesocarp, each with a woody testa bearing large partly sunk oily glands; odour aromatic, terebinthine and taste warm bitter (Anonymous, 2001; Mukerji, 1953; Watt, 1972).
Microscopic: In transverse section outer layer of fruit shows 3-4 large, cubic or tabular cells having thick, brown porous walls externally covered by single layered, colourless cuticle. Sarcocarp consists of large, elliptical, thin walled, loosely coherent cells, containing drops of essential oil and prismatic crystals of calcium oxalate; oval to elongated, elliptical, triangular or irregular shaped cells abundant in this region. Seed coat shows two or three layers of tabular, thin-walled cells covered externally by a thin cuticle and followed internally by a wide zone of thick walled polygonal

sclerenchymatous cells. Endosperm and embryo not distinct (Anonymous, 2001; Henry and Collin, 1904).

Powder microscopy

Fruit powder brown in colour; shows oval to elongated, elliptical and irregular shaped, thick walled stone cells; walls pitted showing striations rectangular to hexagonal straight, thick walled epidermal cells in surface view; fragmented tracheids, fibres; prismatic crystals of calcium oxalate, aleurone grains and oil globules, groups of collenchymatous cells and endosperm cells (Anonymous, 2001; Henry and Collin, 1904).

Physical constants

Foreign organic matter- Not more than 3%; immature and discoloured fruits - Not more than 10%; (Mukerji, 1953), Total ash- Not more than 5%; Acid insoluble ash- Not more than 0.5%; Alcohol soluble extractive- Not less than 12%; Water soluble extractive- Not less than 9% (Anonymous, 2001); Volatile oil content – 0.8 –1.6%; Resin content: 8%; Fermentable sugar: 33% (Pruthi, 1976).

Volatile oil colourless or pale greenish-yellow having: Specific gravity at 20°: 0.862-0.892; Optical Rotation: +1° to -15°; Refractive index at 20°: 1.476-1.484 (Mukerji, 1953).

Thin Layer Chromatography

TLC of the alcoholic extract on silica gel 'G' plate using Toluene: Ethylacetate (9:1) shows under UV (366 nm) three fluorescent zone at Rf. 0.11 (light blue), 0.20 (light blue), and 0.58 (blue). On exposure to Iodine vapour ten spots appear at Rf. 0.17, 0.25, 0.30, 0.36, 0.46, 0.58, 0.64, 0.67, 0.90 and 0.96 (all yellow). On spraying with Vanillin Sulphuric acid and heating the plate for ten minutes at 110°C twelve spots appear at Rf. 0.11, 0.17, 0.25, 0.30 (all brown), 0.36 (light brown), 0.46, 0.52 (both brown), 0.58 (dirty yellow), 0.64 (brown), 0.73 (light brown), 0.90 (light brown) and 0.96 (brown) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Bark: Communic acid (Arya, 1962), juniperol (longiborneol), β-sitosterol, stigmasterol, diterpine phenol-totarol (Arya, 1962), oxalic acid (Hanson and Babcock, 1906), resin, juniperin (Casparis and Freund, 1938, 1939), d-α-pinene, terpinen-4-ol, juniperene, α-pinene, juniperol, silvestrene (Anonymous, 1959), macroperol (Erdmann and Thomas, 1955), ferruginol, Δ^6-ferruginol (Bredenberg, 1957), 6, 7, -diketoferruginol (Bredenberg, 1960).

Seeds and fruits: Formic acid, acetic acid, malic acid (Hanson and Babcock, 1906), cyclohexitol, terpene, fermentable sugars, proteins, wax, gum, pectins (Maymone *et al.,* 1935), glycolic, ascorbic, d-α-pinene, camphene, Δ^3-carene, β-pinene, Δ^4-carene, cadinene (Maizite, 1935), juniper, camphor, hydrocarbon-junene, dihydrojunene (Casparis and Freund, 1939).

Leaf: Biflavones- cupressuflavone, amentoflavone, hinokiflavone, isocryptomerin, sciadopitysin (Kishore *et al.,* 1989; Prakash *et al.,* 1993), monoterpene glucoside and three megastigmane glycosides (Nakanishi *et al.*, 2005).

Plant: Labdane diterpenoids and diterpenes as 3α-hydroxymanool, 3α-hydroxy-12, 13E-biformene and 3α, 15-dihydroxy labda-8(17), 13E-diene (Kagawa *et al.,* 1993; Medina *et al.,* 1994; Chatzopoulau and Katsiotis, 1993), labdane diterpene 15, 16-epoxy-12-hydroxy-8(17), 13(16), 14-labdatriene-19-oic acid (Martin *et al.,* 2006), sugiol (Bredenberg and Gripenberg, 1954), xanthoperol (Bredenberg and Gripenberg, 1956).

Wood: Umbelliferone, ascorbic acid, resin esters, sesquiterpene, polysaccharides-galactan, glucosan, mannan, araban, xylan, p-hydroxybenzaldehyde, sugiol (9-ketoferruginol) (Leopald and Matmstrom, 1952), junenol (Ajoy *et al.,* 1980), thujopsene, cuparene, humulene, cedrol, widdrol (Arya, 1962), longifolene (Akiyoshi *et al.,* 1960), monoterpenes (Erdtman and Kubota, 1961).

Essential oil: Neolignan glycosides: junipercomnoside A, junipercomnoside B, icariside E4, (2S, 3R)-2, 3-dihydro-7-hydroxy-3-hydroxymethyl-2-5-benzofuran propanal 3p-O-α-rhamnopyranoside, isoscutellarein 7-O-β-xylopyranoside, hypolaetin 7-O-β-xylopyranoside, kaempferol 3-O-α-rhamnopyranoside, quercitrin, nicotiflorin, naringenin 7-O-β-glucopyranoside, narigenin 4-O-β-glucopyranoside, (Nakanishi *et al.*, 2004), atropisomeric cupressuflavone glucoside (M)-and (P)-cupressufflavone 4-O-β-d-glucoside tannins, monoterpenic hydrocarbons, monoterpene, sesquiterpene, oxygenated monoterpane and oxygenated sesquiterpene (Barjaktavoric *et al.*, 2005), α-pinene, sabinene, limonene, terpinen-4-ol, myrcene, β-pinene (Kagawa *et al.,* 1993; Medina *et al.*, 1994; Chatzopoulau and Katsiotis, 1993), geigerone (trans-3-isopropenyl-4-methyl-4-vinglcyclohexanone) (Thomas, 1972; Sharma *et al.,* 1977).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antifungal (Cavaleiro *et al.,* 2006; Rao and Gupta, 1977; Aswal *et al.,* 1984), hypoglycaemic (Kagawa *et al.,* 1993; Medina *et* *al.,* 1994; Chatzopoulau and Katsiotis, 1993), antiscabies, antitumor, antidiarrhoeal, antirheumatic, antimalarial (Milhau *et al.,* 1997), anthelmintic, antiviral, antifertility, abortifacient (Aswal *et al.,* 1984), estrognic/antiestrogenic, antiprogestational, antiimplantation, abortifacient (Pathak *et al.,* 1990; Kishore *et al.,* 1989; Prakash *et al.,* 1993), antimicrobial (Pepeljnajak *et al.,* 2005) and platelet inhibitory (Schneider *et al.,* 2004) activities. Berries were found to be active against parasitic sarcoptic and psoroptic mange in sheep and fungal infections in cattle. The ether extract of berries in linseed oil was reported to be effective against sarcoptes scabies infection in sheep (Gayatri Devi and Sisodia, 1969).

TOXICOLOGY

The LD_{50} of the plant extract was 100 mg/Kg bw. *i.p.* in mice (Aswal *et al.*, 1984). The essential oil of juniper increases glomerules strain on kidneys. High doses of this plant when continuously taken induce the straining capabilities of kidneys, even produce nephritis (George, 2000).

THERAPEUTIC EVALUATION

For the study *in-vivo,* 45 volunteers were selected on the basis of having moderate gingival inflammation. As efficacy parameters the plaque index, modified gingival index and angulated bleeding index were assessed. The subjects were randomly divided among 3 experimental groups (2x test and 1 'minus active' control). The participants were requested to rinse with 10 ml of mouthwash twice a day for a period of three months. After 6 weeks and 3 months, the same clinical indices as at baseline were recorded. The results show no difference between the two test groups. The results of the have shown that the mixture of the 3 herbal extracts, *Juniperus communis, Urtica dioca and Achillaea millefolium* when used in a mouthrinse has no effect on plaque growth and gingival health (Van der Weijden *et al.,* 1998).

FORMULATIONS AND PREPARATIONS

Asava And Arista – *Kumaryasava, Takrarishta.*
Avaleha And Paka – *Eranda paka, Kalyanaka guda.*
Guggulu – *Trayodashanga guggulu, Saptavimshatika guggulu.*
Ghrita – *Dadhika ghrita, Hapushadyaghrita.*
Churna – *Hingvadi churna, Hingurachadi churna, Hapushadya churna, Narayan churna.*
Vati and Gutika – *Hingvadi gutika.*
Rasayoga – *Nityananda rasa.*
Lauha – *Pradarantaka lauha* (Anonymous, 1978, 2000).

Other classical formulation: Hapushadya ghrita (C.S.Ci.5.72).

TRADE AND COMMERCE

Dried fruits are sold in market of North India and are reported to be imported from Nepal. (Anonymous, 1959; Pruthi, 1976). Italy is the largest producer of berries (Bhattacharjee, 2000).

Retail market price- Juniper berry oil- Rs.2500 – 3000/- per Kg (Anonymous, 2005). Fruit – Rs. 22 per kg. (Prajapati, 2006).

SUBSTITUTES AND ADULTERANTS

Some other botanical entities *viz. Tamarix gallica* Linn., *Flueggea leucopyrus* Willd., *Juniperus macropoda* Boiss. *J. oxyeedrus* Linn. are used under the name of *Hapusha*. (B.N., 1982; Sharma, 1978; Pruthi, 1976; Watt, 1972).

Juniperus macropoda Boiss – essential oil from fruits used as a substitute of Juniper oil (Mukerji, 1953).

PROPAGATION AND CULTIVATION

It thrives best in sandy and loamy, moderately moist soil, but grow well even in rather dry, rocky and gravelly ground. It prefer sunny situations and can be propagated by seeds, cuttings, layers or by grafting. Seeds retain their viability, when stored in a cool dry place for several years. When sown it often takes a year to germinate, though sometimes it may vegetate in a few weeks. Germination may be hastened by soaking the seeds in hot water for a few minutes before sowing (Anonymous, 1959; Husain *et al.*, 1988).

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HINGU

BOTANICAL NAME: *Ferula assa-foetida* **Linn.**
Syn. *F. foetida* Regel.

FAMILY: **Apiaceae (Umbelliferae)**

CLASSICAL NAMES

Hingu, Bahlika, Ramatha (C.S.; S.S.; A.H.).

SYNONYMS

Agudhagandha, Atugra, Bableeka, Bahlika, Bhedana, Bhutari, Bhutnasan, Dipta, Gathukam, Grihini, Hingu, Hinguka, Jantughana, Jantunashana, Jarana, Jatu, Jatuka, Kesara, Madhura, Pinyaka, Rakshoghna, Ramatha, Ramathadhyani, Sahasravedhi, Shuladvit, Shulahrita, Shulanashaka, Sulanasan, Supadhupana, Ugragandha (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES

Eng.- Asafoetida. **Hindi-** *Hing, Hingra.* **Beng.-** *Hing, Hingra* **Guj.-** *Hing, Vadharni, Hingdo.* **Kan.-** *Hing.* **Mal.-** *Kayam, Rugdyam, Perungayam, Perungkayam, Hingu.* **Mar.-** *Hingra, Hing.* **Punj.-** *Hinge, Hing.* **Tam.-** *Rugdyam, Perungayam, Kayam, Perungkayam.* **Tel.-** *Idaguva, Inguva, Ingumo.* **Arab.-** *Heelatita, Tyib, Txib, Haltheeth.* **Assam**- *Hin.* **Burm.-** *Shinka, Singu.* **Kash.-** *Yang, Anjudan.* **Oriya-** *Hengu.* **Pers.-** *Aangajaha, Aangoj, Anghujeha-ilaree, Angustha gandla, Anguza, Anguzeh, Angadana.* **Sind.-** *Vaghayan, Vagharni.* **Urdu-** *Anjadana, Hing, Hitllet.* **Sinh.-** *Perunkayam.* **Malayase**- *Hingu.* **Canarese**- *Hingu* (Anonymous, 2001; Chopra *et al.*, 1956; Anonymous, 1956; Vaidya, 1968; Jain, 1968; Nadkarni, 1976; Anonymous, 1976; Sharma, 1978; Raghunathan and Mitra, 1982; B.N., 1982; Kirtikar and Basu, 1989; Chatterjee and Pakrashi, 1995; Anonymous, 1996; Anonymous, 2000a)

HINGU ***Ferula assa- foetida*** Linn.

BOTANICAL DESCRIPTION

A perennial odorous herb attaining a height of 60-300 cm, stem stout and much branched, tap root thick and branched. Leaves pinnately decompound, secondary and tertiary pinnae decurrent, entire or irregularly crenate-serrate, sheaths large, ovate; upper leaves much reduced. Flowers small, yellow in simple or scarcely compound umbels springing from within the sheaths. Fruit 8 x 5 mm., vittae manifest, broad, one (rarely 1-2) in dorsal furrows, usually occupying the whole furrow and as long as the carpel. Flowering and Fruiting : April – May (Anonymous, 1956; Kirtikar and Basu, 1989; Guha Bakshi *et al.,* 2001; Dastur, 1962; Chatterjee and Pakrashi, 1995; Anonymous, 1996; Jain and Defilipps, 1991; Mukerji, 1953).

DISTRIBUTION

Cultivated in the Northwest parts of India, also occurs in Kashmir. Found wild in Baltistan, Punjab, Western Afghanistan, Eastern Persia, Kabul, Hirat, Pharas, Khorasan, Kandahar (Kirtikar and Basu, 1989; Pruthi, 1976; Agarwal, 1997; Anonymous, 1956; Chopra *et al.,* 1958; Mukerji, 1953; Raghunathan and Mitra, 1982; Dastur, 1962; B.N., 1982; Guha Bakshi *et al.,* 2001; Chatterjee and Pakrashi, 1995).

PART(S) USED

Oleo-gum-resin, leaf, stem, root (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Oleo-gum-resin-(exudates from incisions in living root) is used as antispasmodic, aphrodisiac, diuretic, emmenagogue, expectorant, mild laxative and nervine tonic. It is also used in colic pain and spasmodic movement of the bowels and infantile convulsions. It is an important ingredient in compounding medicinal preparations prescribed in diarrhoea, flatulence, habitual abortion, indigestion, liver troubles and applied externally to ringworm. Leaves are used as anthelmintic, carminative and diaphoretic. Stem is used as brain and liver tonic, root as antipyretic (Chatterjee and Pakrashi, 1995). It is useful remedy for asthma, bronchitis, cough, flatulence (Anonymous, 1956).

AYURVEDIC PROPERTIES

Rasa – *Katu* (C.S.Su.27.299)
Guna – *Laghu, Snigdha, Tikshna, Sara.* (S.S.Su.46.38)
Vipaka – *Katu* (S.S.Su.46.38)
Veerya – *Ushna* (S.S.Su.46.38)

Doshagnata – *Kaphavatashamaka* (S.S.Su.46.38), *Pittavardhaka* (A.H.Su.6.152) (Sharma, 1978; B.N., 1982).
Karma – *Vedanasthapana, Vatahara, Uttejaka, Akshepahara, Deepana, Pachana, Rochana, Anulomana, Shoolaprashamana* (S.S.Su.38.22; 46.38), *Krimghna, Hridya, Jantughna, Kaphanissaraka, Shwashara, Mootrajanana, Vajeekarana, Artavajanana, Katupaushtika, Balya, Jwaraghna, Shirovirechana* (C.S.Vi.8.151; S.S.Su.39.6; A.H.U.6.22), *Vasti* (A.H.Ka.4.32), *Ksharpaka* (A.H.Su.30.21) (Sharma, 1978; B.N., 1982).
Rogaghata – *Pakshaghata, Ardita, Manyastambha, Gridhrasi, Apatantraka* (A.H.Ci.14.9), *Agnimandya, Gulma, Udarshoola* (C.S.Ci.5.68; 13.158; S.S.U.55.44; A.H.Su.6.152; Ci.15.70), *Vibandha, Krimi, Hridroga, Hridayashoola* (S.S.U.43.12; A.H.Ci.6.28), *Phuphphusashotha, Hikka, Kasa* (A.H.Ci.3.4), *Jeernakasa, Kukkarkhasi* (C.S.Ci.18.46; S.S.U.52.14), *Shawsa* (S.S.U.51.27; A.H.Ci.4.7), *Mootraghata, Mootrakrichchhra, Prameha* (C.S.Su.23.19), *Bastishoola, Kandu, Sheetajwara, Vishamjwara* (A.H.Ci.1.161), *Unmada* (C.S.Ci.9.74; S.S.U.62.30) *used as eye drop and nasal drop in Unmada* (A.H.U.6.22), *Apasmara* (C.S.Ci.11.33; S.S.U.61.31), *Sanyasa* (C.S.Su.25.40), *Arsha* (C.S.Ci.14.62; A.H.Ci.8.34), *Grahani* (C.S.Ci.15.96; A.H.Ci.10.11), *Atisara* (C.S.Ci.19.28; A.H.Ci.9.7), *Karnashoola* (C.S.Ci.26.222; A.H.U.18.15), *Nasaroga* (S.S.U.23.4; A.H.U.5.42), *Mukharoga* (A.H.U.22.21), *Shirashoola* (C.S.Ci.26.183) as *nashya* (A.H.U.24.16), *Netraroga-as Anjana in Sleshmaavishandya* (S.S.U.11.7), *Garbhadosha* (C.S.Ci.10.61), *Skandagraha* (S.S.U.29.6; A.H.U.5.10), *Lutavisha* (A.H.U.37.27) (Sharma, 1978; B.N., 1982).
Dose : 0.12 – 0.5 gm (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *PERUNGAYAM*
***Suvai* (Taste) -** *Kaippu* (Bitter).
***Veeriyam* (Potency) -** *Veppam* (Hot).
***Vibakam* (Transformation) -** *Kaarppu* (Pungent).
***Gunam* (Pharmacological action) -** *Soothagamundaakki* (Emmenogogue), *Isivagattri* (Antispasmodic).
Siddha pharmaceutical preparations - *Astta chooranam, Gunma kudori mezhugu, Thaleesathy chooranam.*
Uses - Used in treatment of indigestion gastritis & Menstrual disorders.

PHARMACOGNOSY

Macroscopic

Oleo – gum-resin.- It occurs in three forms, *viz.*, paste, tear and mass. Paste and tear are the pure forms. Tears are rounded or flattened, mostly 12-25 mm in diameter or in masses of agglutinated tears, grayish-white to dull yellow, some darkens on keeping becoming reddish-brown. The freshly exposed surface yellowish and translucent or milky-white and opaque, slowly becoming pink, red and finally reddish-brown; touched with sulphuric acid a bright red or reddish-brown colour is produced changing to violet when the acid is washed off with water; odour strong, alliaceous and persistent; taste bitter and acrid (Anonymous, 2001; Mukerji, 1953; Wallis, 1985).

Physical constants

Total ash – Not more than 15%; Acid insoluble ash – Not more than 3%, Alcohol soluble extractive – Not less than 50%, Water soluble extractive – Not less than 50% (Anonymous, 2001). Resin – 40 – 64%; Gum – 25%, Essential oil – 10-17% (Sharma, 1978; Mukerji, 1953; Wallis, 1985)

CHEMICAL CONSTITUENTS

Plant: (E)-3-methylsulfinyl-2-propenyl sec-butyl disulpide (foetisulfide-A), (Z)-3-methyl sultinyloxy-2-propenyl sec-butyl disulfide (foetisulfide B), (E)-3-methyl sulfinyloxy-2-propenyl sec-butyl disulfide (foetisulfide C), bis (-3-methylthio-2E-propenyl) disulfide (foetisulfide D), 3, 4, 5-trimethyl-2-thiophenecarboxylic acid (foetithiophene A), 3, 4, 5-trimethyl-2-(methylsulfinyloxy methyl) thiophene (foetithiophene, B) (Duan *et al.*, 2002), fotidones A and B (Appendino *et al.*, 2006).

Fruits: Luteolin and luteolin-7-O-β-D-glucopyranoside (Pangarova and Zepesochnaya, 1973).

Leaves: Asafoetida, colladonin 4-methoxycoumarin (Wenkert *et al.*, 1976).

Gum and resin: Coumarins-assafoetidin, ferocolicin (Banerji *et al.*, 1988), asadisuphide, asacoumarin A, asacoumarin B (Kajimoto *et al.*, 1989), dimethyl trisulphide (Brodnitz and Pascale, 1971), 2-butyl methyl disulphide, 2-butyl methyl trisulphide, di-2-butyl trisulphide, di-2-butyltetrasulphide (Rajanikanth *et al.*, 1984), di-2-butyl disulphide (Ten Noevei de Brauw *et al.*, 1980), kamolonol, mogoltadone, polyanthinin, polyxanthin, asaresinotamol, farnesiteral A, gummosin (Chatterjee and Pakrashi, 1995), saradaferin ([Decahydro-(3-alpha-hydroxy-4, 4, 10-trimethyl-8-methylene-9-naphthenyl)-alpha-hydroxymethyl]) (Bandyopadhyay *et al.*, 2006).

Essential oil: α-Pinene, phellandrene, monoterpene, sec-butylpropenyldisulphidegeranylacetate, bornyl acetate, α-terpineol, myristic acid, camphene, myrcene, limonene, longifolene, cadinene, β-caryophyllene, β-selinene, fenchone, eugenol, linulool, geraniol, isoborniol, borneol, guaiacol, cadinol, farnesol, undecyl sulphonyl acetic acid, unidentified bisulphide (Muhammad and Khurshid, 1979).
Volatile oil: (R)-2-butyl-1-propenyl disulphide as mixture of E and Z isomers (in 7:3 ratio) detected together with 1-(1-methythiopropyl)-1-propanyl disulphide and 2 -butyl-3-methylthioallyl disulphide (Abraham *et al.*, 1979).
Root: Sesquiterpene coumarin, foetidin (Buddrus *et al.*, 1985), 4 methoxycoumarin, colladonin, (Wenkert *et al.*, 1976; Pinar and Rodiguez, 1977; Hofer *et al.*, 1983), assafoetidnol A, assafoetidnol B, compounds, gummosin, polyanthin, badrakemin, neveskone, samarcandin and galbanic acid (Abd El-Razek *et al.*, 2001).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antispasmodic (Chopra *et al.*, 1956), abortifacient (Tiwari *et al.*, 1982), anti-implantation, emmenagogue, pungent (Malhi and Trivedi, 1972), antibacterial (Subrahmanyan *et al.*, 1957), CNS stimulant (Puri, 1971), molluscicidal (Kumar and Singh, 2005, 2006), larvicidal (Harve and Kamath, 2004), anticarcinogenic, antispasmodic and hypotensive (Fatehi *et al.*, 2004) activities. Luteolein and its 7-glucoside showed anti-inflammatory activity against dextran and yeast-induced rat paw oedema and cotton pellet inflammation. It showed anti-ulcer activity against reserpine and phenylbutazone induced ulcers. The plant was reported to reduce *Schistosoma mansoni* and *Trichomonas vaginalis* burden and egg count of the same in exterimental murine models (Ramadan *et al.*, 2004; Ramadan and Khadrawy, 2003). Ethanolic extract of the plant is reported to have pregnancy interceptive properties (Keshri *et al.*, 2004).

TOXICOLOGY (*Ferula communis* L.)

The acute LD_{50} of ferulenol were determined in albino mice by single i.p. as 2100 and 319 mg/kg bw respectively with male mice being more sensitive to intoxication than female mice (Anonymous, 1996).

THERAPEUTIC EVALUATION

A study was conducted with 30 patients of Gridhrasi and treated with Hingutriguna Taila along with Abhyanga and Sveda. The treatment provided prompt improvement in most of the patients within a short period and definite relief has been observed in the patients who completed three to four weeks of treatment. Complete relief has been noted in about 60% of the patients who completed the full course of treatment (Kishore and Padhi, 1985).

In another study 30 male patients between the age of 20-60 having abdominal discomfort, flatulence, weakness, fatigue, presence of ova of hook worm in stool were selected. They were divided in two groups A and B. Group A was given 5 ml of Hingutriguna taila for 5 days. Group B was given alcopar (*Bephenium hydroxynaphthanoate*). The 73.3% patients from Group A showed good response. Pain and tenderness were relieved, vomiting, anorexia, indigestion, constipation, fatigue, burning sensation in abdomen were also relieved completely. Hook worm ova was not seen after treatment in 80% of cases (Bhattathiri *et al.*, 1990).

A health food product consisting of cholic acid at a daily dose of 1 to 1,000 mg and *F. assafoetida* Regel is reported to keep the human body in a normal state at all times (Takao, 2004).

Sodium ferulate is reported to be a potent antioxidant purified from *F. assafoetida* L. Oxidative stress can induce apoptosis in lymphocytes, and this induction can be partly prevented by sodium ferulate (Lu *et al.*, 1998).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Ayaskriti.*

Avaleha and Paka – *Gudapippali.*

Kvatha Churna – *Shwasahara Kashaya churna*.

Ghrita – *Phala ghrita, Brihat Phala ghrita.*

Churna – *Hinguvachadi churna, Chitrakadi churna, Hingvastaka churna, Agnimukha churna, Laghulai churna.*

Taila – *Hingutriguna taila, Hingvadi taila.*

Vati and Gutika – *Mahashankha vati, Kankayana gutika, Chitrakadi gutika, Lasunadi vati, Shankha vati, Shoolavajrini vatika, Hingwadi vati, Rajahapravartani vati.*

Rasayoga – *Srinripativallabha rasa, Kalakuta rasa, Nripativallabha rasa.*

Lavana Kshara – *Abhaya lavana* (Anonymous, 1978, 2000).

Other classical formulations – *Hingusauvarchaladya ghrita* (C.S.Ci.5.68), *Kalyanakaghrita* (C.S.Ci.9.33), *Bhallataka ghrita* (C.S.Ci.5.146), *Dashamoola ghrita* (C.S.Ci.5.142), *Pipalyadi ghrita* (C.S.Ci.18.38), *Siddharthaka ghrita* (A.H.U.5.10), *Palankashadi taila* (C.S.Ci.10.34).

TRADE AND COMMERCE

Different grades of assa-foetida, *i.e.* Hingra, Hudda hing, Hira hing varying in prices are sold in bazaar (Pruthi, 1976). Herat and Kandahar are the centers of the asafoetida trade. The drug is exported from Bunder Abbas and other parts on the Percian gulf, partly from Bombay, mostly in large tin-lined cases but a small quantity arrives as a pasty mass in tins or hides. The total annual demand of the drug in India for medicinal purposes and other uses is estimated at over 6000 quintals (Jain, 1968; Wallis, 1985).

Retail market price for the year 2006 is Rs. 140-500 per kg. (Prices vary depending upon the grades or varieties).

SUBSTITUTES AND ADULTERANTS

Ferula alliacea Boiss, *F. persica* Willd, *F. jaeschkeana* Vatke, *F. rubricaulis* Boiss, *F. galbaniflua* Boiss, *F. narthex* Boiss and *F. szowitzianaoe* DC. are used as substitute or source plants (Asolkar, 1992; Anonymous, 2000a; Mukerji, 1953).

Sand particles, stones, slices of roots, gypsum, earthy matter, wheat grains, acacia gum, other gums, gandhabiraja, chalk etc. are often used as an adulterants to increase the weight (Sharma, 1978; Mukerji, 1953; B.N., 1982; Guha Bakshi *et al.*, 2001).

PROPAGATION AND CULTIVATION

The wild plant can be cultivated on light, medium, heavy, acidic, neutral and basic soils (Huxley, 1992). Hot climate enhance the crop development. The growth of the plant ceases after flowering in March-April (Komarov, 1968). At the age of 4-5 years, plant bears roots measuring 13-15 cms diameter. Asafoetida is collected from root exudates (Anonymous, 1956; Guha Bakshi *et al.*, 2001).

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JAYAPALA

BOTANICAL NAME: *Croton tiglium* Linn.

FAMILY: **Euphorbiaceae**

CLASSICAL NAMES
Dravanti (C.S.; S.S.; A.H.; Sambari C.S.Ka).

SYNONYMS
Dantibeeja, Jaypala, Jyepala, Kanakaphala, Naepala, Titteriphala (Sharma, 1978; B.N., 1982; D.N., 1982; R.N., 1982)

VERNACULAR NAMES
Eng.- Purging croton, *Croton oil seed.* **Hindi**– *Jamalgota, Patabahar.* **Beng.**– *Jayapala, Patabahar.* **Guj.**– *Nepala, Nepalo.* **Mal.**– *Nervalam, Chiduram, Valam, Dantibijam, Katala Vanakku, Nirvalam* **Mar.**– *Jamalgota, Jayapala, Geyapal, Arabierand, Jeyapal, Jaipa, Jepal.* **Punj.**– *Japolota, Jaipal.* **Tam.**– *Naganam, Nigumbam, Nirvalam, Sayabalam, Sambari, Tendi, Nervalam, Warchalam, Nevleema, Chiduram, Valam, Kattukkattai, Nagandi, Siduram, Sevalangottai.* **Tel.**– *Nepala, Nepalavemu, Nepala-vithalu, Nepalavitva, Nepalamu.* **Arab.**– *Habusalateen, Batu, Dand, Datun, Batu.* **Assam**– *Koneeveha.* **Burm.**– *Kanako.* **Oriya**– *Jaipalo, Joyopalo, Konika.* **Pers.**– *Bedanjirekhatai, Tukhmebedaajirkhatai, Dund, Habbekhatai.* **Kon.**– *Japal.* **Sinhalese**– *Jayapala.* **Khasi–** *Chicoc.* **Garo–** *Runibih.* **Canarese**– *Danti, Japala, Nepala.* **Chinese–** *Pa Teou, Pa Tou.* **Malaya–** *Bori* (Anonymous, 2000a; Chopra *et al.,* 1958, 2002; Anonymous, 1999; Sharma, 1978; B.N., 1982; Nadkarni, 1976; Kirtikar and Basu, 1988; Guha Bakshi *et al.*, 1999).

BOTANICAL DESCRIPTION
A small evergreen tree, 15-20′ high, the young shoots sprinkled with stellate hairs; bark smooth and ash colored. Leaves simple, alternate, thinly membranous, 5-10 cm long, glabrous, ovate, acuminate, serrate, glandular beneath, 3-5 nerved; petiole slender, 2.5-5.0 cm long. Flowers small, yellowish-green, unisexual, in 5-7.5 cm long racemes. Capsule obtusely

JAYAPALA ***Croton tiglium*** Linn.

trigonous, glabrous, turbinately ovoid, upto 2.5 cm long, white. Seeds oblong, pale, obtusely trigonous and about 2 cm long. Flowering and Fruiting : March-June (Cooke, 1967; Hooker, 1973; Kirtikar and Basu, 1988; Anonymous, 1950; Anonymous, 1995; Guha Bakshi *et al.*, 1999).

DISTRIBUTION

Naturalized and cultivated in West Bengal, Assam, Meghalaya and South India. Also occurs in Sri Lanka, Burma (Anonymous, 1950), China and Malaya island (Kirtikar and Basu, 1988).

PART(S) USED

Seed, wood, Seed oil, root (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Root is beneficial in dropsy, lead poisoning, cerebral haemorrhage or convulsions and congestions, apoplexy, intestinal obstructions, gout, rheumatism, arthritis, lock jaw, mania, chronic laryngitis, bronchitis and to increase manly vigour (Nadkarni, 1976). Croton seeds are used as a drastic and violent purgative in conditions like apoplexy, insanity and convulsions attended with high blood pressure. The expressed oil from the seed is given in paralysis and painful affections of joints and limbs. The oil from the seed is purgative, carminative, useful in diseases of the abdomen, mental troubles, fever and inflammations (Kirtikar and Basu, 1988; Chopra *et al.*, 1958; Bentley and Trimen, 1992).

AYURVEDIC PROPERTIES

Rasa *–Tikta* (S.S.Su.42.22), *Katu* (Sharma, 1978; B.N., 1982).
Guna *– Guru, Ruksha, Tikshna.*
Vipaka *– Katu.*
Veerya *– Ushna.*
Doshaghnata *– Kaphapittashamaka* (Sharma, 1978; B.N., 1982).
Karma *– Lekhana, Vidahi, Sphotajanana, Krimighna, Shothahara, Vishaghna, Virechan* (C.S.Su.1.78;2.9; Ka.Chpt. 12. full; S.S.Su.44.49). *Kushthaghna, Kaphaghna. Used as Tikshna Kshara* (S.S.Su.11.15) (Sharma, 1978; B.N., 1982).
Rogaghanta *– Root – Charmaroga, Kushtha* (C.S.Ci.7.124; S.S.Su.44.46; A.H.Ci.19.86) *Krimi* (S.S.Su.45.124), *Jalodara* (C.S.Ci.13.154), *Sarpavisha* (C.S.Ci.23.240), *Kasa* (S.Su.45.124; S.S.U.52.19). *Vranaropan* (S.S.Ci.2.89), *Seed oil – Udar roga* (A.U.Ci.15.77), *Vivandha* (C.S.Su.1.78;2.9; Ka.Chpt. 12. full; S.S.Su.44.49) (Sharma, 1978; B.N., 1982).

Doses : Seed powder 6-12 mg; Seed oil ½ - 1 drop (Anonymous, 1999; Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - ***NAER VALAM***
***Suvai* (Taste)-** *Kaippu* (Bitter).
***Veeriyam* (Potency) -** *Veppam* (Hot).
***Vibakam* (Transformation) -** *Kaarppu* (Pungent).
***Gunam* (Pharmacological action) -** *Neermalam pokki* (Hydrogogue).
Siddha pharmaceutical preparations - *Agathiyer kuzhamboo, Ashta birava mathirrai, Nanthi mezhugu, Kalarchi thylam, Meganatha kuligai.*
Uses - Used in treatment Vatha disorders, Skin diseases and in alopecia.

PHARMACOGNOSY

Macroscopic

Seed – Albuminose, ovate, oblong, slightly quadrangular, convex on dorsal and somewhat flattened on ventral surface, about 12-13 mm in length, 7-9 mm wide, 6-8 mm thick and resemble casor seed in shape, dull cinnamon-brown, often mottled with black due to abrasion in testa, caruncle easily detached and usually absent, hilum on ventral side less distinct than that of castor seed, raphe runs along ventral surface of seed, terminating in a dark chalaza at opposite extremity, kernel yellowish and oily consisting of a large endosperm, enclosing papery cotyledons and a small radicle; no marked odour; kernel gives at first oily taste followed by an unpleasant acridity (Anonymous,1999; Wallis, 1967).

Microscopic

Transverse section of seed shows a hard testa, consisting of an epidermal layer, covered externally with a thick cuticle and composed of oval and tangentially elongated cells, filled with brownish content; epidermis followed by a layer of radially elongated cells, slightly bent at middle, upper half portion filled with reddish-brown and lower half filled with yellow content, inner most zone consists of tangentially elongated thin-walled cells; endosperm consists of polygonal parenchymatous cells filled with oil globules, a few cells having rosette crystals of calcium oxalate, central region of endosperm shows a dicotyledonous embryo consisting of thin-walled parenchymatous cells (Anonymous, 1999; Wallis, 1967).

Seed oil – It is viscid; odour and taste nauseous, mild at first but sharp and acrid afterwards. The Indian oil pale yellow in colour while English croton oil is usually darkish-brown (Anonymous, 1950).

Powder microscopy

Seed powder white with black particles of testa, shows elongated cells containing reddish-brown content (Anonymous, 1999).

Physical constant

Total ash-Not more than 3%; Acid insoluble ash-Not more than 0.5%; Alcohol soluble extractive – Not less than 15%; Water soluble extractive – Not less than 7% (Anonymous, 1999); Fixed oil – about 50%; Protein – about 16% (Walls, 1967). Croton oil – Specific gravity 15° – 0.9320 – 0.9501; $n_D^{20°}$–1.4734 – 1.4810; Acid Value – 2 –55; Saponification value – 200 – 215; Iodine value – (Wijs) – 102 – 115; R.M. Value – 12.0 – 13.6 (Lewkowitsen), 6.4 –8.4 (Adriaens); Melting Point - 7° – 16° (Anonymous, 1950).

Thin Layer Chromatography

TLC of alcoholic extract of the drug on silica gel 'G' plate using n-Butanol: Acetic acid: water (4:1:5) shows under U.V. (366 nm) three spots at Rf. 0.34, 0.54, and 0.84 (all violet). On exposure to lodine vapour six spots appear at Rf 0.10, 0.29, 0.39, 0.49, 0.63 and 0.90 (all yellow). On spraying with 50% Methanolic – Sulphuric acid reagent and heating the plate at 105°C for ten minutes three spots appear at Rf. 0.34 (grey), 0.54 (yellow) and 0.84 (brown) (Anonymous, 1999).

CHEMICAL CONSTITUENTS

Seed and seed kernel: β-Sitosterol (Kupchan *et al.,* 1976), highly active tumor enhancing compound C-3 (Eugene and Holcomb, 1965).

Croton oil: Phorbol myristate, active principle-phorbol-12-tiglate-13-decanoate (Kupchan *et al.*, 1976), eleven short chain phorbol ester (Garry and Douglas, 1984), crotonoleic acid, tiglic acid or methyl crotonic acid, crotonal, several volatile acids and fatty acids, fatty fixed oil (Pillai, 1999), isoquanosine (Kim *et al.*, 1994), phorbol, isophorbol, deoxyphorbol, 4β, 9α, 20-trihydroxy-13-15-seco-1, 6, 15-tigliatriene-3, 13-dione; 4β, 9α, 20-trihydroxy-15 16-17-trinor-1, 6,-tigliadiene-3, 13-dione, 4β, 9α, 20-trihydroxy-14(13→12) –abeo 12α H-1, 6-tigliadiene-3, 13-dione (Abdel-Hafez *et al.*, 2002), crotophorbolone, tiglophorbol A, B (Crombie *et al.*,1968), 12-O-acetylphorbol-13-decanoate, 12-O-decanoylphorbol-13-(2-methylbutyrate) (El-Mekkawy *et al.*, 1999, 2000), toxic proteins-croton globulin, croton albumin, sucrose, glycoside crotoloside (Felter and Lloyd, 1898).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have insecticidal (Chui, 1950; Heal *et al.,* 1950; Crombie *et al.,* 1968), antileukemic (Kupchan *et al.,* 1976) and antitumour (Kim *et al.,* 1994; Garan *et al.,* 1972) activities. Expressed oil is toxic vasicant with drastic purgative properties (Crombie *et al.*, 1968).

The major active constituent *Croton tiglium* seed oil (croton oil) is 12–0-tetradecanoylphorbol-13-acetate (TPA), is an irritant and inflammatory agent that has been used widely as a tumor promoter on the skin of mice previously initiated with 7,12-dimethylbenz[a]anthracene or other polycyclic aromatic hydrocarbons (Berenblum, 1969; Van Duuren, 1969, Hecker, 1975; Boutwell, 1978; Hecker, 1978). Topical application of TPA alone to mouse skin twice a week for several months either has no tumorigenic effect or results in only an occasional nonmalignant papilloma. TPA is an extraordinarily potent stimulator of differentiation in HL-60 human promyelocytic leukemia cells *in vitro* (Huberman and Callaham, 1979; Lotem and Sachs, 1979; Rovera *et al.,* 1979; Rovera *et al.,* 1980). Concentrations of 0.1–15 nM TPA have been reported to stimulate differentiation and inhibit DNA synthesis or cell replication in cultured HL-60 cells (Huberman E, Callaham, 1979; Rovera *et al.,* 1979; Rovera *et al.,* 1980). Additional studies revealed that TPA stimulated differentiation *in vitro* when added to freshly obtained peripheral leukemia cells from patients with acute myelocytic leukemia (Pegoraro *et al.,* 1980; Koeffler *et al.,* 1980).

In studies with solid tumors TPA was reported to inhibit the growth, stimulate apoptosis, or enhance differentiation in human tumor cell lines derived from patients with melanoma or prostate, breast, colon, or lung cancer (Garzotto *et al.,* 1998; Guilbaud *et al.,* 1990; Arita *et al.,* 1994; Salge *et al.,* 1990; Rickard *et al.,* 1999). Treatment of prostate cancer LNCaP cells with clinically achievable concentrations of TPA (1–1.6 nM) resulted in growth inhibition, and treatment of these cells with a severalfold higher concentration of TPA caused apoptosis (Garzotto *et al.,* 1998; Powell *et al.,* 1996, Fujii *et al.,* 2000; Konno *et al.,* 1996).

TOXICOLOGY

Ingestion of 20 drops of croton oil is lethal in humans. The LD_{50} of crotonic acid in rats by oral ingestion is 1g/kg bw and in guinea pigs by subcutaneous injection is 600 mg/kg bw (www.library.thinkquest.org). Croton oil is powerful irritant and cathartic. In large doses it is dangerous poison, occasioning emesis and produce painful gripings, hypercatharsis and other serious symptoms (Felter and Lloyd, 1898; Crombie *et al.,* 1968). The crude protein from seeds were toxic to mice in different extents (Stirpe *et al.*, 1976).

THERAPEUTIC EVALUATION

Data sources BIOSIS, EMBASE, PubMed, TOXLIT, International Pharmaceutical Abstracts, manual searches, papers on file from peer-reviewed journals, textbooks available at Armana Research, Inc., and researchers in the field of South American botanical medicine were used to review the pharmacological evidences which may or may not support chemical and ethonomedical use of sap of the plant. The results of *in vitro* and *in vivo* studies largely support the majority of ethnomedical uses of sap including the treatment of diarrhoea, wounds, tumours, stomach ulcers, herpes infection, the itching, pain and swelling of insect bites, and other conditions. Clinical studies of sap products have reported positive results in the treatment of traveler's and watery diarrhea and the symptoms of insect bites. Because the sap has shown low toxicity and preparations used in clinical studies were well tolerated, further clinical and pharmacologic studies are anticipated (Jones, 2003).

Studies by several investigators have shown that TPA is an ex-traordinarily potent stimulator of differentiation of cultured human promyelocytic leukemia cells *in vitr*o. In a clinical study, TPA was administered to humans by i.v. infusion without irreversible toxicity, and it was shown to have pharmacological activity for the treatment of myelocytic leukemia in patients refractory to cytosine arabinoside (Ara C), retinoic acid, and other antileukemic drugs. Marked decreases in bone marrow myeloblasts as well as temporary remission of disease symptoms were observed when TPA was administered alone or in combination with vitamin D3 and Ara C (Zheng Tao Han *et al*., 1998).

FORMULATIONS AND PREPARATIONS

Vati and gutika – *Sukhavirecana vati, Maha Jvarankusa rasa.*
Rasayoga – *Asvakancuki rasa, Icchabhedi rasa, Jalodarari rasa.*
Lauha – *Yakrtplihari lauha* (Anonymous, 1978; 2000).
Other classical formulations: ***Churna*** – *Harenukadi Yoga, Danti Dravanti virechan yoga* (C.S.Ka.12).

TRADE AND COMMERCE

Retail market price – Rs. 40 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Seeds of *Baliospermum montanum* Muell. Arg. and *Croton oblongifolius* Roxb. are used as substitute and adulterant (Garg, 1992; Anonymous, 2000a; Dey and Rai Bahadur, 1984).

PROPAGATION AND CULTIVATION

It is the wild plant of tropical rain forest, propagated by seeds. It is cultivated as a sole crop or as a mix crop along with coffee (Guha Bakshi *et al.*, 1999; Reed, 1976). Seed set occurs 3 years after plantation and ripening takes place in November–December. Yield increases from 200-750 kg seeds / ha to 750-2000 kg/ha. at full bearing of seeds and is reported to be as high as 900 kg seeds /ha (Duke, 1978).

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KANCHANARA

BOTANICAL NAME: ***Bauhinia variegata*** Linn**.** [*]

FAMILY: **Caesalpiniaceae**

CLASSICAL NAMES

Karbudara, Kovidara (C.S.;S.S.;A.H.).

SYNONYMS

Apsara, Ashmantaka, Asphota, Chamari, Chamarika, Champavidala, Gandaree, Girija, Kanakaprabha, Kanakarak, Kanchaa, Kanchana, Kanchanala, Kanchnar, Kantar, Kanthapushpa, Karaka, Kuddal, Kuddara, Kuli, Kumbhara, Kundali, Mahapushpa, Mahayamalapatraka, Pakari, Pitapushpa, Raktakanchana, Raktapushpa, Shamya, Shonapushpaka, Suvarnara, Svalpakesara, Swalpakeshari, Tamrapushpa, Tarurangava, Uddalaka, Yamalachhada, Yamalapatraka, Yugapatraka, Yugmapatraka (Sharma, 1978; D.N. 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES

Eng.- Mountain ebony, Buddhist bauhinia, Camel's foot tree, Orchid Tree. **Hindi-** *Kachnar, Kachanal, Goriaava, Kanchanar, Khairwal, Barial, Gurial, Guiar, Kandan, Kural, Kaniar, Koliar.* **Beng.-** *Raktakanchan, Kanchan.* **Guj.-** *Champakathi, Kovidara* **Kan.-** *Kanchavala, Keyumandar, Kampumandana, Bilimandar, Ulipe, Kempu mandara, Ayata, Kanjivala, Karalabhogi.* **Mal.-** *Chuvannamandaram, Mandarum, Kovidaram, Suvarramandarum.* **Mar.-** *Kachnar, Coral, Kanchan, Rakta-kanchan, Chamol, Kanaraj, Kovidara.* **Punj.-** *Kanchnal, Kulada, Kovidara.* **Tam.-** *Segapumanchori, Mandare, Segapumunthari, Shemmandarai, Segappumandarai, Tiruvatti.* **Tel.-** *Mandara, Devkanchanamu, Bodanta, Kanjanamu, Mandari, Adavimandara.* **Burm.-** *Bwaycheng, Bwechin.* **Oriya-** *Barara, Kosonaru, Kanjoni, Rongakonjono.* **Santhal-** *Zinjar, Jingya, Buruju-*

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[*] In *Brihattrayi* (three texts) there is no mention of *Kanchanara. Kovidara and Karbudara* have useally been interpreted to be two varieties, what is now known as *Kanchanara*. But there is some confusion as regards the identity of *Karbudara*. It is therefore suggested that any of the two species *i.e. Bauhinia purpurea* Linn and *Bauhinia variegata* Linn (Prefarable the former) may be used for *Kovidara* and the other for *Karbudara* (Singh,1972). Synonyms, Property and Action of both plants considered as same.

KANCHANARA ***Bauhinia variegata*** Linn**.**

dare, Kouar. **Urdu-** *Kachal*. **Konkani**- *Kudo, Tembri, Kanchan, Kotra, Kachnal*. **French** – *Arbe de saint Thomas.* **Nepal** – *Taki, Koiralo* (Kirtikar and Basu, 1989; Nadkarni, 1976; Sharma, 1978; Chopra *et al.,* 2002; Anonymous, 2000a; B.N., 1982; Anonymous, 1988; Anonymous, 2001; Agarwal, 1997; Anonymous, 1976; Guha Bakshi *et al.*, 1999; Watt, 1972; Anonymous, 1994).

BOTANICAL DESCRIPTION

A medium sized deciduous tree upto 15 m high, with dark brown bark. Leaves simple, alternate, bifid, 6-15 cm across, broadly ovate, cordate at the base, pubescent beneath when young, subcoriaceous, 11-15 nerved; petiole 2.5-3.8 cm long. Flowers bisexual, large, fragrant, variegated, white or red in short axillary or terminal few flowered, grey-pubescent racemes or corymbs. Pods flat, hard, nearly smooth, 15-30x 1.8-2.5 cm, variegated with reddish-brown streaks. Seeds 12-16, flat, orbicular and brown. Flowering: February-April; Fruiting: May-June (Cooke, 1967; Kirtikar and Basu, 1989; Guha Bakshi *et al.*, 1999; Hooker, 1973; Anonymous, 2000b; Brandis, 1972; Blatter and Walter, 1977).

DISTRIBUTION

Found wild in the sub-Himalayan tract and outer Himalaya upto 1300 m. (Anonymous, 1988); in Punjab, dry forests of Eastern, Central and South India (Agarwal, 1997), Assam, Sikkim, Chota Nagpur, Western Peninsula, Kumaon. Also distributed in Pakistan, Nepal, Bhutan, Burma, Myanmar and China. Also cultivated largely as a garden and roadside ornamental (Watt, 1972; Kirtikar and Basu, 1989; Guha Bakshi *et al.*, 1999; Chopra *et al.*, 2002).

PART(S) USED

Stem bark, root, flower, flower buds, gum, leaf, fruit (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Bark is tonic, appetizer, astringent and anthelmintic. The emulsion of the bark powder with rice water and ginger used in scrofula and cutaneous affections. Decoction is carminative and used in dyspepsia and flatulence (Chatterjee and Pakrashi, 1994). Bark also cures biliousness, leucoderma, anal troubles, tuberculous glands, cough, asthma, strangury, thirst and burning sensation. The flowers are acrid, dry, sweet, cooling, astringent, galactagogue, cure diseases of the blood, bronchitis, consumption, vaginal discharges, biliousness, and headache (Anonymous, 1976; Kirtikar and Basu, 1989; Anonymous, 1994).

AYURVEDIC PROPERTIES

Rasa *– Kashaya*
Guna *–Ruksha, Laghu*
Vipaka *– Katu*
Veerya *– Sheeta*
Prabhava *– Gandamalanashna* (Sharma, 1978; B.N., 1982).
Fruit *– Madhur rasa, Madhur vipaka, Vatapitta shamaka* (S.S.Su.45.120)
Doshaghnata *– Kaphapitta shamaka* (Sharma, 1978; B.N., 1982).
Karma – External – *Vranashodhana, Vranaropana, Kushthaghna, Shothhara.*
Internal – *Stambhaka, Grahi, Arshaghna, Raktapittanashaka* (C.S.Su.27.104), *Vamanakaraka* (C.S.Vi.8.135; S.S.Su.39.3), *Vishaghna* (S.S.Ka.5.18), *Krimighna, Raktastambhaka, Lasikagranthi shothahara, Kasahara, Mootrasangrahaneeya, Artavanashana, Kushthaghna, Lekhana* (Sharma, 1978; B.N., 1982).
Rogaghnata – External – *Kwath* is used for cleaning and washing of *vrana* and *charmaroga.* Paste of bark applied on *Gandamala. Kwath* in used as *parisheka in Gudabhransha*.
Internal – *Kaphapittanashaka, Vamana* (C.S.Ka.1.16; 5.8; 6.8), *Atisara, Pravahika, Gudabhransha, Krimi, Vibandha, Gandamala and Lasikagranthivriddhi* (A.H.Ci.8.31), *Kasa, Prameha, Raktapradara, Kushtha, Medoroga,* used as *vasti in Rakta Pitta* (C.S.Vi.7.6), *Madataya* (S.S.U.47.46). Flower – used in *Raktapitta* (C.Su.27.104; Ci.4.39,70); *Arsha* (C.S.Ci.14.204) (Sharma, 1978; B.N., 1982).
Doses : Stem bark Powder – 3-6g; decoction – 40 – 80 ml; Flower Juice – 10 - 20ml; 20-30 gm for decoction (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *MANTHARAI*
Suvai **(Taste) -** *Thuvarppu* (Astringent).
Veeriyam **(Potency)** - *Seetham* (Cold).
Vibakam **(Transformation)** - *Inippu* (Sweet).
Gunam **(Pharmacological action)** -*Thuvarppi* (Astringent).
Siddha pharmaceutical preparations - *Mantharai kudineer.*
Uses - Used in treatment Vatha disorders &Skin diseases.

PHARMACOGNOSY

Macroscopic

Stem bark – Dark brown, sometimes with silvery patches, rough, compact, exfoliating in woody strips and scales, outer surface with small transverse and longitudinal cracks, inner surface white; taste astringent (Anonymous, 2001).

Gum- Yields the gum known as Sem or Semla gond. It is brown in colour. It swells in water like cherry tree gum, a very small portion only being soluble (Watt, 1972).

Microscopic

Transverse section of mature stem bark shows a wide stratified cork; outer cork composed of thin-walled slightly compressed yellowish brown cells followed by a number of layers of brown coloured cells, inner cork composed of transversely elongated orange brown cells; cork interrupted at places due to formation of rhytidoma; some secondary cortex composed of fifteen or more rows of transversely elongated to circular, thin-walled parenchymatous cells; some secondary cortex cells contain orange brown content, groups of stone cells found scattered in this region, occasionally arranged in 1-7 or more tangential rows; pericyclic fibres, thick-walled with narrow lumen, scattered in secondary cortex in singles or in groups; secondary phloem consists of sieve tubes, companion cells, phloem parenchyma and fibres traversed by funnel shaped medullary rays; phloem fibres are arranged in radial rows throughout phloem region; prismatic and rhomboidal crystals of calcium oxalate abundantly found in phloem and secondary cortex regions, very rarely found in cork cells, cluster crystals also present in secondary cortex and secondary phloem, crystal fibres also found in secondary phloem (Anonymous, 2001; Prasad and Prakash, 1972).

Physical constants

Total ash-Not more than 11%, Acid insoluble ash – Not more than 0.2%; Alcohol soluble extractive-Not less than 2%; Water soluble extractive- Not less than 6% (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Root: Flavanone, dihydrodibenzoxepin, flavanol glycoside-5, 7, 3′, 4′ -tetrahydroxy-3-methoxy-7-O-alpha-L-rhamnopyranosyl (1→3)-O-betagalactopyranoside (Mopuru *et al.,* 2003). (2S)-5,7-dimethoxy-3',4'-methylenedioxyflavanone, dihydrodibenzoxepin, 5,6-dihydro-1,7-dihydroxy-3,4-dimethoxy-2-methyldibenz [b,f]oxepin (Reddy *et al.*, 2003).

Stem: 5, 7-Dihydroxy flavanone – 4′-O-α- L-rhamnopyranosyl β-D-glucopyranoside (Gupta *et al.*, 1979), 5, 7 - dihydroxy and 5,7 dimethoxy flavanone-4-O-α-L-rhamnopyranosyl-β-D-glucopyranosides (Gupta *et al.*, 1979), hentriacontane, octacosanol, sitosterol, stigmasterol (Prakash and Khosa, 1978), neringenin-5, 7-dimethylether-4'-rhamnoglucoside, lupeol (Gupta *et al.,* 1980). 5,7,3',4'-tetrahydroxy-3-methoxy-7-O-alpha-L-rhamnopyranosyl(1-->3)-O-beta-galactopyranoside (Yadava *et al.,* 2003), 2,7-dimethoxy-3-methyl-9,10-dihydrophenanthrene-1,4-dione named as bauhinione (Zhao *et al.*, 2005).

Flowers: Quercitroside, isoquercitroside, rutoside, taxifoline rhamnoside, kaempferol-3-glucoside, myricetol glycoside (Duret and Paris, 1977), apigenin-7-O-glucoside, quercetin, rutin, quercetrin (Abd-El-Wahab *et al.*, 1987), apigenin, ascorbic, aspartic, glutamic, octadecanoic acid, keto acids, amino acid, tannins (Chowdhury *et al.,* 1984), cyaniding-3-glucoside, malvidin-3-glucoside, malvidin-3-diglucoside, peonidin-3-glucoside, peonidin-3-diglucoside, 3-galactoside and 3-rhamnoglucoside of kaempferol (Saleh and Ishak, 1976).

Seed: Carbohydrates, proteins, amino acids, ascorbic acid, flavonoids, alkaloids, leucoanthocyanines. (Niranjan *et al.,* 1985), aspartic acid, glutamic acid, arginine, glycine, alanine, histidine, isoleucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, valine (Wassel *et al.*, 1989). 5-hydroxy7,3',4',5'-tetra-methoxyflavone 5-O-beta-D-xylopyranosyl-(1-->2)-alpha-L-rhamnopyranoside (Yadava and Reddy, 2001)

PHARMACOLOGICAL ACTIVITIES

Plant was found to have antitumour (Rajkapoor *et al.*, 2003a; Rajkapoor *et al.,* 2003b) anti-inflammatory (Yadava and Reddy, 2003), anti-ulcer (Rajkapoor *et al.,* 2003c), antimicrobial (Pokhrel *et al.*, 2002), amphetamine hyperactivity (Bhakuni *et al.,* 1969) and hypothermia (Dhar *et al.,* 1968; Bhakuni *et al.*, 1969) activities.

TOXICOLOGY

The alcoholic extract of stem bark produces hypothermia in mice. It also responded to amphetamine hyperactivity test (Bhakuni *et al.,* 1969).

THERAPEUTIC EVALUATION

Effect of cap. Thyrocap containing solid extract of *B. variegata* (Kanchnar), *Commiphora mukul* (Guggulu); *Glycyrrhiza glabra* (Yastimadhu) and *Convolvulus pluericaulis* – 100 gm each on simple diffuse goiter has been reported with physical and biochemical improvement (Pandit and Prasad, 1992)

PIL.28, a compund preparation, containing *Bauhinia variegata* and other ingredients processed in certain six plant juices was tried at a dose of one tablet, twice daily for six weeks in 50 patients suffering from haemorrhoids revealed very good response in 56.25% and good response in 37.5% patients (Vastrad and Pakkanavar, 2002).

One hundred patients suffering from non-healing diabetic foot ulcers for 20-30 months of duration were studied. Assessment were done on the basis of subjective and objective parameters. Patients were divided into two groups each consisting of 50 cases. Group I was kept on close follow up with antibiotics for systematic use and antiseptics for tropical use along with pentoxylline 400 mg. t.i.d. Group II was treated with plant extract (dipping of ulcers in plant extract of Manjishtha – *Rubia cordifolia*). Manjishtha was also used topically in the form of ointment. Manjishtha along with another drug Kanchanara (*Bauhinia veriegata*) was given orally in a dose of 500 mg t.i.d. for 3-4 months. All the above investigations were repeated every month along with assessment of subjective findings. Patients belonging to group-I-had poor recovery along with 60% cases of amputation where as group II showed 80% improvement with 10% partial amputation (Ojha *et al.*, 1996).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Usirasava, Candanasava, Vidangarista*
Guggulu – *Kanchanara guggulu*
Bhasma – *Kanchanara drava*
Rasayoga – *Gandamala Kandana Rasa* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

Retail market price – Stem bark – Rs. 50 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Bauhinia tomentosa Linn., *B. purpurea* Linn., *B. racemosa* Linn. are used as substitute or adulterants (Garg, 1992; Prasad and Prakash, 1972; Vaidya, 1982; B.N., 1982).

PROPAGATION AND CULTIVATION

The ornamental plant is propagated with seeds, stump planting and branch cuttings. Seeds are sown in March-April. The seedlings are then transplanted in July-August. Their germination require onset of monsoon (Chauhan, 1999; Anonymous. 1988).

In vitro regeneration of *B. variegata* was reported in nodal explants from mature trees. Optimal shooting was obtained on MS media supplemented with 13.3µM BA within 15-20 days. Single shoots with 3-4 nodes initiated rooting when transferred to MS with 4.9 µM IBA within 45 days (Mathur and Kumar, 1992).

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KANKOLA

BOTANICAL NAME: ***Piper cubeba* Linn. f.**
Syn.- *Cubeba officinalis* Miq.

FAMILY: **Piperaceae**

CLASSICAL NAMES
Gandhaushadha, Kankola (C.S.; S.S.; A.H.).

SYNONYMS
Charna, Cinoshna, Dwipamaricha, Gandhamaricha, Kababchini, Kandaphala, Kankolaka, Kankolika, Katukaphala, Kolaka, Koshaphala, Kritaphala, Shital chini, Sungadha-maricha (Sharma, 1978; B.N., 1982; D.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Cubebs, Tailed pepper, Tailed cubebs, Java pepper. **Hindi-** *Seetal chini, Kabab chini, Val-milaku, Chinikabab*. **Beng.-** *Kabab-chini, Sugandhamaricha, Sitalachini.* **Guj.-** *Chanakabab, Chinikabab, Kababchini, Tadamiri, Chinnkabale*. **Kan.-** *Gandhamenasu, Balamenasu*. **Mal.-** *Cheenamulaku, Takkolam, Val-milaku, Valmulaku*. **Mar.-** *Kankola, Himsi mire, Kababa chini, Kankola, Chinnkabale.* **Punj.-** *Kababchini, Sardchini* **Tam.-** *Valli milaku, Valmilagu, Val-milaku.* **Tel.-** *Chalavamiriyalu, Tokamiriyalu, Balamenasu, Sinban-karawa*. **Arab.-** *Kababah, Kabab sini, Habbul urus, Kibabeh*. **Assam**- *Kakkol, Kababcheni*. **Kash.-** *Kushfal, Kababchini, Luit-mars.* **Oriya-** *Kababchini*. **Pers.-** *Kababachini, Kibabeh, Kbab-chini, Hab-el-arus*. **Urdu-** *Kababchini*. **Kon.-** *Kankola, Himsimiri* (Nadkarni, 1976; Anonymous, 1969; Watt, 1972; Anonymous, 2001; Sharma, 1978; Vaidya, 1968; Anonymous, 1998; Anonymous, 1995; B.N., 1982; Chatterjee and Pakrashi, 1994; Anonymous, 2000a).

BOTANICAL DESCRIPTION
Gregarious large perennial, woody or liana like climber with ash grey, smooth, flexuous, jointed stem and branches, rooted at the joints. Leaves simple, alternate, entire, petiolate, glabrous, ovate, oblong with cordate or rounded base, acuminate, coriaceous and very strongly nerved. Flowers dioecious, in spikes. Fruit sub-globose, drupe, 6-8 mm in diam., apiculate and distinctly stalked, green becoming black and wrinkled on

KANKOLA ***Piper cubeba*** Linn. f.

drying. Flowering and Fruiting: September-December (Anonymous, 1969; Anonymous, 1995; Bhattacharjee, 2000; Kurup *et al.*, 1979; Chauhan, 1999; Mukerji, 1953).

DISTRIBUTION

Cultivated in India, mostly in Karnataka, but not on a commercial scale. A native of Indonesia (Anonymous, 1969). It is indigenous to Java, Sumatra, Borneo and Malaya Archipelago(Nadkarni,1976). Also cultivated in Sri Lanka, England, West Indies (Chopra, *et al.*,1958, 1986; Anonymous, 1998; Anonymous, 1995; Anonymous, 2003).

PART(S) USED

Fruit and oil (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The fruit is acrid, bitter, thermogenic, aromatic, stimulant, carminative, diuretic, expectorant (Nadkarni, 1976), analgesic, dentifrice, anti-inflammatory, anthelmintic, deobstruant, vulnerary, appetising, digestive, stomachic, cardiotonic, rejuvenating, emmenagogue, sedative and antiseptic. They are useful in bodyache, odontalgia, cephalalgia, halitosis, inflammation, helminthiasis, worms infestation, wounds and ulcers, catarrh, anorexia, dyspepsia, flatulence, haemorrhoids, cardiac debility, cough, asthma, bronchitis and various respiratory disorders, amenorrhoea, dysmenorrhoea, gravels, renal bladder stones, strangury, genito-urinary diseases (like gonorrhoea), rheumatism and hay fever (Chopra *et al.*, 1958). Fruits contain an essential oil beneficial as a local remedy in the form of lozengel of relief throat troubles when taken internally. It is found to exert a positive antiseptic effect on urine hence used in genitourinary diseases (Chatterjee and Pakrashi, 1994; Anonymous, 1995).

AYURVEDIC PROPERTIES

Rasa – *Katu*, *Tikta* (S.S.Su.46.202).
Guna – *Laghu*, *Ruksha*, *Tikshna* (S.S.Su.46.202).
Vipaka – *Katu* (S.S.Su.46.202).
Veerya – *Ushna* (S.S.Su.46.202).
Doshaghnata – *Kaphavatashamaka* (Sharma, 1978; B.N., 1982).
Karma – *Raktotkleshaka*, *Uttejaka*, *Shothahara*, *Daurgandhyanashana*, *Krimighna*, *Vranaropana*, *Rochana*, *Deepana*, *Pachana*, *Anulomana*, *Hridya*, *Shleshmanissaraka*, *Kaphaghna*, *Vajikarana*, *Artavajanana*,

Mootrala, Ruchiprada, Trishnashamaka, Mukhadaurgandhyahara, Mukhajedyanashaka, Bastishodhana (Sharma, 1978; B.N., 1982).

Rogaghnata – *Kaphavataja vikara, Shotha, Vedana, Vatavyadhi* (C.S.Su.5.77), *Mukharoga* (A.H.U.22.93; C.S.Su.5.77), *Galaroga, Dantaroga* (A.H.U.22.93), *Shirahshoola, Agnimandya, Aruchi, Vishtambhi, Arsha, Hridroga, Kasa, Shwasa* (C.S.Ci.28.153; S.S.Ci.24.21; A.H.Ci.21.78), *Kashtartava, Rajorodha, Dhwajabhanga, Klaibya, Jeernapuyameha, Mootrakrichchhra, Andhya, Bastishotha, Jeernashwasaneekashotha Daurgandhya* (S.S.Su.46.202) (Sharma, 1978; B.N., 1982).

Doses : Powder- 1-3 gm; Oil- 1-3 drops (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *VALMILAGU*

***Suvai* (Taste) -** *Thuvarppu* (Astringent).

***Veeriyam* (Potency) -** *Seetham* (Cold).

***Vibakam* (Transformation) -** *Inippu* (Sweet).

***Gunam* (Pharmacological action) -** *Ushnamundaakki* (Stimulant), *Kozhaiyagattri* (Expectorant).

Siddha pharmaceutical preparations – *Samranipoo pathanmgam, Venpoosani ney, Narathai ilagam, Kungumapoo mathirai, Impooral ilaam.*

Uses: Used in treatment of respiratory diseases and in Leucorrhea.

PHARMACOGNOSY

Macroscopic

Fruit- Wrinkled, rounded, 5-7 mm in diam., light brown to dark brown, about 7 mm long stalk attached; pericarp reticulately wrinkled, red to slightly brown, testa fused with pericarp; texture hard and stony, seed single, albumen white and oily; odour aromatic, spicy and characteristic; taste pungent and slightly bitter.

Microscopic

Transverse section of fruit shows an outer layer of epidermis, externally covered with thick cuticle, hypodermis made up of small group of stone cells, a row of 2-5 small, crushed, brown and thick-walled cells below; mesocarp composed of large, thin-walled parenchymatous cells, oil cells and vascular bundles. Parenchyma of mesocarp containing rounded starch grains and prisms of calcium oxalate; large polyhedral cells of perisperm filled with polyhedral starch grains; endocarp of multi-layered sclereids heavily lignified with narrow lumen; testa and tegmen composed of elongated cells, tegmen cells hyaline, kernel cells greyish in colour, large amount of perisperm having frequently a central cavity. Oil cells are distributed throughout the perisperm and absence of beaker cells (Anonymous, 2001; Mukerji, 1953; Brindha *et al.,* 1981; Anonymous, 1998).

Powder microscopy

Fruit powder brownish-black to dark brown in colour; shows fragments of outer and inner epidermis of pericarp, groups of polygonal parenchyma cotaining few starch grains, fragments of perisperm cells packed with small starch grain, cells of inner sclerenchymatous layer having very thick pitted walls, lignified thick walled rounded sclerenchymatous cells of the pedicel, fragments of vessels bearing annular, pitted thickening, groups of elongated brown coloured wavy walled cells of outer layer of testa, polygonal straight walled cells of centred layer of testa, abundant oil cells and starch grain (Henry and Colline, 1904).

Physical constants

Foreign matter- Not more than 2%; Total ash- Not more than 8%; Acid insoluble ash- Not more than 1%; Alcohol-soluble extractive- Not less than 14%; Water soluble extractive Not less than 11%; Volatile oil 10 to 18%; Crude fibres 23.05% (Anonymous, 2001; Brindha *et al.,* 1981).

Volatile oil colourless or pale yellow or bluish green having:

Specific gravity: 0.910-0.935.

Optical rotation: -20° to -35°.

Refractive index at 20°:-1.480 –1.502.

Solubility : freely soluble in dehydrated alcohol; one in eighteen parts of alcohol (90%). Fraction Distilling between 250° -280° - Not less than 60% (Mukerji, 1953).

Thin Layer Chromatography:

TLC of the methanol extract of fruits on applying on pre-coated silica gel ‘G’ plate (5 x 15 cm) using Toluene: ethyl acetate (70:30) as solvent system and spraying the plate with 20% sulphuric acid in methanol and heating at 100°C for 5 minutes gives five spots at Rf. 0.13 (light blue), 0.24 (dark blue), 0.58 (pinkish red), 0.71 (bluish violet) and 0.77 (brownish red) (Anonymous, 1998).

CHEMICAL CONSTITUENTS

Plant: New lignans (8R, 8'R)-4-hydroxycubebinone and (8R, 8'R, 9'S)-5-methoxyclusin and two new sesquiterpenes, (5 alpha, 8 alpha)-2-oxo-1(10), 3, 7(11)-guaiatrien-12, 8-olide and (1α, 2β, 5α, 8α,10α)-1, 10-

epoxy-2-hydroxy-3, 7(11)-guaiadien-12, 8-olide, (-)-clusin, (-)-yatein, ethoxyclusin, and (-)-dihydroclusin (Usia *et al.*, 2005).

Fruits: (–)Cubebin (Prabhu and Mulchandani, 1985; Batterbee *et al.*, 1969a), (–)clusin, (–)hinokinin, asaronaldehyde, (–)deoxypodorhizon (Koul *et al.*, , 1983), (–) dihydrocubebin (Dwuma-Badu *et al.*, 1975), (2R, 3R) -2-(3″, 4″, 5″-trimethoxy benzyl)-3-(3′, 4′-methylene-dioxybenzyl)-1, 4-butanediol (–)-dihydroclusin, (3R, 4R)-3, 4-bis-(3, 4, 5-trimethoxybenzyl)tetrahydro-2-furanol [(–)-cubebinin], (–)-yatein (Prabhu and Mulchandani, 1985), α-O-ethyl cubebin, β-ethylcubenin, dihydrocubenin monoacetate, 5″-methoxythiokinin (Badheka *et al.*, 1987), cubebin (Chatterjee *et al.*, 1968; Batterbee *et al.*, 1969b), (–)-cubebininolide (cordigerine), (–)-2-(3”, 4”-methylenedioxybenzyl)-3-(3’, 4’-dimethoxybenzyl)butyrolactone, (–)-isoyatein, (–)-cubebinone and (–)-di-O-methyl thujaplicatin methyl ether (Badheka *et al.*, 1986), bisasarin (Yuan *et al.*, 1982), cubebinic ether, cubebinol, isocubebinic ether, hibalactone, dehydrocubebin, isohinokinin, (±) – hinokinin (Batterbee *et al.*, 1969b).

Essential oil: Sesquiterpene hydrocarbons-bicyclosesquiphellandrene, 1-epibicyclosesquiphellandrene, zonarene, calamenene, epizonarene, δ-cadinene, cubenene, α-muurolene (Terhune *et al.*, 1974).

Seed oil: Palmitic, linolic, oleic, linolenic, stearic, arachidic, behenic and hexadecenoic acids (Bedi *et al.*, 1971), cubebol, cubebic acid, piperidine, sesamin (Prabhu and Mulchandani, 1985).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antibacterial (Kar and Jain, 1971; Jain *et al.*, 1974), anti-inflammatory, antinociceptive (Choi and Hwang, 2003), antifungal (Rao and Nigam, 1976), anthelmintic (Sharma *et al.*, 1979), antidysenteric, antiasthmatic, diuretic, carminative, sedative, antiseptic, activity against hepatitis crisus (Hussein *et al.*, 2000) and antioxidants (Karthikeyan and Rani, 2003) activities.

The essential oil of *P. cubeba* showed antibacterial activity against *B. subtilis*, *V. cholerae*, etc. The oil had no appreciable effect on *E. coli*, *S. aureus*, *S. lutea* and *Micrococcus* sp (Kar and Jain 1971; Jain *et al.*, 1974; Rao and Nigam, 1976).

The oil of *P. cubeba* also showed significant antifungal activity against *Aspergillus flavus*, *A. fumigatus*, *Trichoderma virid*, *Curvularia lunata*, *Alternaria tenuis*, *Penicillium* sp, *P. javanicum*, *P. striatum* and *Fusarium solani* (Rao and Nigam, 1976).

The essential oil from fruits has also reported for anthelmintic activity against earth worms and tape worms *in vitro* (Sharma *et al.*,1979).

THERAPEUTIC EVALUATION

Several malignant cases (10 patients) of advanced stages of cancer management has been dealt with Ayurvedic herbal drugs. Malignant cases include, Squamous cell carcinoma, breast cancer, lung cancer, Hodgkins lymphoma, vocal cord cancer, multiple myeoloma, adenocarcinoma. Patients were administered with Ayurvedic preparations made of plant materials such as *Mesua ferrea, Asparagus racemosus, Adhatoda vasica, Tinospora cordifolia. Hemidesmus indicus, Withania somnifera, Smilax glabra, Piper cubeba, Piper longum, Glycyrrhiza glabra, Tribulus terrestris, Pterocarpus santalinus* and *Terminalia belerica.* It was found that, herbal mixture was an effective treatment in advanced malignacies though not a total cure (Kulkarni, 1998).

Herbal cough syrup containing eleven herbal ingredients including *Piper cubeba, Ocimum sanctum, Curcuma longa, Adhatoda vasica, Aloe barbadensis, Solanum indicum* etc. showed efficacy in thinning of bronchial secretion in case of acute bronchial trachiobronchitis (Jayaram *et al.,* 1994).

Piperine, the active principle of *Piper* species was explored as a single dose in patients with uncontrolled epilepsy on the steady-state pharmacokinetics of phenytoin. In patients piperine increased significantly the mean plasma concentration of phenytoin, possibly by increasing the absorption (Pattanaik *et al*., 2006).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Kumaryasava, Khadirarista, Dasmoolarista, Vasakasava, Jirakarista, Drakshasava, Babbularista.*

Avaleha and Paka – *Guduchyadi modaka, Puga khanda, Jirakadi modaka.*

Taila – *Chandanadi taila, Bala taila, Vayucchaya Surendra taila.*

Vati and gutika – *Khadiradi gutika (mukharoga).*

Vartti (Netrabindu and anjana) – *Muktadi mahaanjana.*

Rasayoga – *Navaratnarajanrganka rasa* (Anonymous, 1978, 2000).

TRADE AND COMMERCE

Fruits are largely imported from Singapore, Malaysia and Indonesia (Nadkarni, 1976; Anonymous, 1969).

Source of Supply – Wild/Forests

Demand 1999-2000	185.9 tonnes
Demand 2004-2005	434.7tonnes

Average growth rate of demands – 24.0 % per annum
Market rate – Cubeb oil – Rs. 8000 – 8500 per kg (Anonymous, 2005).
Retail Market Price – Fruits – Rs. 265 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Some allied species *viz.*, *Piper ribesiodes* Wall., *P. sumatrana*, *P. crassipes* Korth., *P. cannum* Blume; *P. baccatum* Blume, *Litsea cubeba* Pers. and African *Piper* species *P. clusii* DC. and *P. guineense* DC. are used as substitute or adulterants (Anonymous, 1998; Anonymous, 1969; Garg, 1992).

In Indonesia fruits of *Litsea cubeba* Pers. are employed as a substitute (Anonymous, 2000a). Bitter fruits of *Pericampylus glaucus* (Lam) Meerill and fruits of *Schinus molle* Linn. are used as substitute and adulterants (Anonymous, 2000a). Fruits of *Vitex altissima* Linn. are used as substitute in South India (Garg, 1992). Fruits of *Embelia ribes* Burm. f. are also used as substitute or adulterants for the powder of cubeb (Garg, 1992). The true drug when treated with sulphuric acid develop a bright red colour while adulterants give a violet or brownish colour (Anonymous, 1969).

PROPAGATION AND CULTIVATION

The plant is a liana like climber and reported to be cultivated in India, mostly on the lands of Mysore. Climber can be easily grown by planting at the foot of the shade trees in coffee plantations. The plant is propagated by vegetative methods. Fruits are collected when fully grown and green. Dried in sunlight until black and wrinkled (Anonymous, 1969).

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KARCHURA

BOTANICAL NAME: *Curcuma zedoaria*(Christm.) Rosc.

FAMILY: Zingiberaceae

CLASSICAL NAMES
Karchura, Kanchanaka, Nisachhada, Gandhapalasha (In Brihattrayi these names taken as synonyms of both plants Karchura and Sati) (C.S.; S.S.; A.H.)

SYNONYMS
Dravida, Durlabha, Gandhamulaka, Gandhasara, Jatala, Kalpaka, Karsha, Sati, Shathi, Shati or sati, Vedhmukhya, Vedhya (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Zedoary, Round Zedoary. **Hindi-** *Kachura, Kalihaladi, Gandamasti, Kakhnr, Kakhurra, Kuchoora, Narakachur*. **Beng.-** *Ekangi, Kachura, Sati, Shori, Sutha*. **Guj.-** *Kachuri, Kachura, Shatakachura*. **Kan.-** *Kachara*. **Mal.-** *Kachcholam, Kachar, Kacheharikizhana, Pulakizhanna; Pulan-Kizhana, Adavikachhola, Kochuri Kizhanu, Kaccurikizhangu*. **Mar.-** *Kachari, Kachora, Maraka chora, Narakachora, Kachura*. **Tam.-** *Kaccolam, Katsjulam, Kacholakilangn, Kachnla-Kalangn, Kichilikilhangu, Pulan Kilhangu; Kastori-manjal, Nirvisham, Pulan-Kizhanga, Kichilic-Kizhanga*. **Tel.-** *Kachoram, Kichchiligaddalu, Kachoeramu*. **Per.-** *Kazhua, Urukelkasar*. **Arab.-** *Zurambad, Aurakulakappura*. **Urdu-** *Kachura*. **Konkani**.- *Kachora*. **Sinhalese**.- *Harankaha, Hinhurh* (Sharma, 1978; Kirtikar and Basu, 1989; Nadkarni, 1976; Chopra *et al.*, 1958, 2002; B.N., 1982; Anonymous, 2000a; Vaidya, 1985; Nair and Mohanan, 1998; Anonymous, 1950).

BOTANICAL DESCRIPTION
Herbs upto 120 cm high, rhizome pale-yellowish white; tubers sessile, cylindric, many, white. Leaves 4-6, 20-60 x 8-10 cm, oblong or narrowly oblong-lanceolate, apex acuminate; petiole shorter than blade. Inflorescence 10-18 x 6-8 cm long spikes. Flowers yellow. Capsules ovoid, 3-gonous, thin, smooth, dehiscing irregularly. Seeds ellipsoid with a white laceolate, lacerate aril. Flowering and Fruiting: July - September (Cooke, T, 1967; Anonymous,

KARCHURA ***Curcuma zedoaria*** (Christm.) Rosc.

1996; Bhattacharjee, 2000; Kirtikar and Basu, 1989; Haines, 1961; Kurup *et al.*, 1979; Chatterjee and Pakrashi, 2001).

DISTRIBUTION

Found wild in the Eastern Himalaya (Hooker, 1973), moist deciduous forests of the coastal tract of Kanara; native to north East India, also cultivated more or less throughout India, especially in Eastern Bengal, districts of Chittagong and Tipperah (Nadkarni, 1976; Kirtikar and Basu, 1989). Also cultivated in Sri Lanka and China (Anoymous, 1950; Anonymous, 1996).

PART(S) USED

Rhizome, leaf (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Rhizome is aromatic, cooling, carminative, diuretic, stomachic, stimulant. Powdered rhizome as a paste applied to bruises and relieves pain. Decoction mixed with cinnamon, pepper and honey beneficial for cold and fevers, as one of the ingredients of Ayurvedic recipe for antifertility, an ingredient in Chinese medicine for extradurnol haematomas, 'sati food' prepared from powdered rhizome found useful for children and infants (Chopra *et al.*, 1958). The rhizome is also used as appetizer, cardio tonic, anthelmintic, antipyretic, alexiteric, destroys fowlness of the breath, useful in leucoderma, piles, bronchitis, asthma, tumours, tuberculous glands of the neck, enlargement of the spleen and epileptic seizure. Leaves are used in dropsy (Chatterjee and Pakrashi, 2001; Kirtikar and Basu, 1989).

AYURVEDIC PROPERTIES

Rasa – *Katu, Tikta.*
Guna – *Laghu, Tikshna.*
Vipaka – *Katu.*
Veerya – *Ushna.*
Doshaghnata – *Kaphavata shamaka* (C.S.Su.27.155) (Sharma, 1978; B.N., 1982).
Karma – *Vatasamshamana* (S.S.Su.39.7), *Asthapana vasti* (S.S.Ci.38.42) *Shothahara, Vedanastapana, Kushtaghna, Rochana, Deepana, Hridya, Arshaghna* (C.S.Su.27.155), *Anulomana, Yakrtauttejaka, Krimighna, Uttejaka, Raktashodhaka, Kaphaghna, Shwasahara, Artavajanana, Vajeekarana, Mootrajanana, Kushtaghna, Jwarghna* (Sharma, 1978; B.N., 1982).

Rogaghnata – *Kaphavata vikara, Sandhivata, Gridhrari* (S.S.Ci.38.67), *Shotha* (A.H.Ci.17.24), *Aruchi, Agnimandya, Adhman, Anaha, Grahani* (C.S.Si.3.38; A.H.Ci.10.46; S.S.U.51.50), *Arsha* (C.S.Si.3.38; S.S.U.51.50), *Krimi, Hriddaurbalya, Raktavikara, Kasa, Shwasa, Hikka* (C.S.Su.27.155; S.S.U.51.50), *Rajorodha, Kastartava, Dhavajabhanga, Mootrachrichhra* (A.H.Ci.14.14), *Jwara, Shoola, Gulma* (S.S.Ci.38.67; C.S.Si.3.38) (Sharma, 1978; B.N., 1982).
Doses : Juice 10-20 ml, Powder 3-6g. (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES
Siddha Name -*KICHILI KIZHANGU*
***Suvai* (Taste) -** *Kaippu* (Bitter).
***Veeriyam* (Potency) -** *Veppam* (Hot).
***Vibakam* (Transformation) -** *Kaarppu* (Pungent).
***Gunam* (Pharmacological action) -** *Manamootti*(Aromatic), *Ushna-mundaakki* (Stimulant).
Siddha pharmaceutical preparations - *Arakku thylam, Siropara nivarana thylam, Lagu chanthanathi thylam, Karapan thylam, Idivallathy.*
Uses: Used in treatment Vatha disorders, Skin diseases and as a deodar ant

PHARMACOGNOSY
Macroscopic
Rhizome – The primary rhizome or root-stock is conical upto 10 cm long, 5cm in diameter, attached with many sessile finger shaped lateral branches, 3-7 x 1-2.5 cm; both marked with annular scars, demarcating nodes and internodes, lateral branches nearly cylindrical, outer surface of the fresh rhizome light brown or grey or greyish-white while greyish-white to almost white internally often with light bluish tint; many long thin as well as thick adventitious roots arises from the rhizome. Small ovate or oblong tubers, 3-5 cm X 1-3cm at the tips of some of the stouter roots, are mearly the root endings get swollen on account of storage of water; odour a distinct, camphoraceous; taste acrid or pungent.
Microscopic
Transverse section of the young rhizome shows intact epidermis composed of rectangular, tangentially elongated cells, older rhizome shows cork consisting of 7-10 layers of rectangular to tangentially elongated thin walled cells, 50 - 120 X 25-35µ. The ground tissue differentiated into outer cortex and the inner stele with a distinct endodermis. The cortical ground tissue with the cork is composed of rounded cells, 70-145 µ in diam, containing

yellowish content with the adjacent parenchymatous cells mostly arranged in a radiating manner, almost all cells of the ground tissue densely packed with starch grains which are simple, comparatively big flattened, rectangular or ovid, possessing a slight projection at one end and having numerous transverse indistinct striations, hilum at the narrow end but not distinct, grains measuring 20-70 x 7-9µ in size. Many vascular bundles scattered in the ground tissue of which a large number occur within the endodermis, arranged in a ring just inner to the endodermis. Endodermis is usual with their radial walls slightly thickened. The cortical and steler vascular bundles collateral with 2-10 vessels, each bundle having a sheath of small sized parenchymatous cells completely encircling it. 1-3 slightly thick walled cells associated with the bundle sheath cells in some of vascular bundles (Ayer and Kolammal, 1964; Kurup, 1977, 1979; Chopra *et al.*, 1958).

Powder microscopy

Dried rhizome powder greyish or yellowish in colour, less aromatic with pungent taste. It shows groups of parenchymatous cells filled with yellow colouring matter, oily globules, numerous cells with oleoresin; cork cells thin-walled; vessels bearing spiral, annular thickening; sclerenchymatous fibres absent; abundant starch grains simple flattened, ovoid with faint striations and indistinct hilum (Raghunathan and Mitra, 1982; Henry and Collin, 1904).

CHEMICAL CONSTITUENTS

Chemical analysis on *Curcuma zedoaria* rhizome volatile oil, using gas chromatography-mass spectrometer techniques, demonstrated the presence of beta-tumerone (19.88%), 1, 8-cineole (8.93%), and 7-zingiberene (7.84%) as major constituents (Champakaew *et al.*, 2006).

Rhizomes: β-turmerone, ar-tumerone (Hong, *et al.*, 2001; Hong *et al.*, 2002), curcumenol, S-guaiazulene (Hikino *et al.*, 1968g), curdione (Hikino *et al.*, 1966a), zederone (Hikino *et al* 1966b), furanodiene (8, 12-oxido-germacra-1, 4, 7, 11-tetraene) (Hikino *et al.*, 1968b), pyrocurzerenone (Vishwanatha and Krishna Rao, 1974), pyrocurzerenone, dihydropyrocurzerenone (Hikino *et al.*, 1968c; Miyashita *et al.*, 1984), curcumenone, epicurzerenone (Hikino *et al.*, 1968a), curzerene (Hikino *et al.*, 1968a), curcumariolide A and B, zedoarol, 13-hydroxygermacrone, guaiane-zedoarondiol (Chatterjee and Pakrashi, 2001), p-methoxycinnamate, ethyl-para-methoxycinnamate (Joshi *et al.*, 1989), germacrome (Rongbao *et al.*, 1991), dehydrocurdione (Hikino *et al.*, 1972), isofuranodienone, epicurzerenone, furanodienone, pyrocurzerenone, furanogermanone (Hikino *et al.*, 1975), curcolone (Hikino *et al.*, 1968e), procurcumenol (Hikino *et al.,* 1968f). Curzerenone, Curzeone, cur Curcumenone, Zedoaronediol (Makabe *et al.,* 2006).

Essential oil: Curzerenone, curcumol (Hikino *et al.,* 1965), (-) curdione, d-α-pinene, d-camphene, cineol, d-camphor, d-borneol, sesquiterpenes and sesquiterpene alcohols (Seigo *et al.,* 1968; Hikino *et al.,* 1968a).

Plant: Dehydrocurdione (Hikino *et al.,* 1972), epicurzerenone (Hikino *et al.,* 1968a), isofuranodienone, furanodienone (Hikino *et al.,* 1975), zedoarone identical with curzerenone (Seigo *et al.,* 1968), isofuranogermacrene (Hikino *et al.,* 1968a), isolinderalactone (Takeda *et al.,* 1969).

PHARMACOLOGICAL ACTIVITIES

Plant was found to be having insecticidal, antifungal (Hewage *et al*. 1997), antibacterial (Banerjee and Nigam, 1977; Wilson *et al.,* 2005), hepatoprotective (Mastuda *et al.,* 1998), analgesic (Navarro *et al.,* 2002) and antifungal (Joshi *et al.,* 1989) activities.

1, 7-bis(4-hydroxyphenyl)-1, 4, 6-heptatrien-3-one, procurcumenol and epiprocurcumenol from the crude methanolic extract of the rhizomes of *C. zedoaria* exhibited significant TNF-alpha antagonistic activity (Jang *et al.,* 2001). Furanodiene and furanodienone suppressed the TPA-induced inflammation of mouse ears by 75% and 53%, respectively, at a dose of 1.0 micromol which are comparable to that of indomethacin, the normally used anti-inflammatory agent (Makabe *et al.,* 2006). Beta-turmerone and ar-turmerone, sesquiterpenoids *C. zedoaria*, were reported to inhibit lipopolysaccharide (LPS)-induced prostaglandin E 2 production in cultured mouse macrophage cell RAW 264.7 in a dose-dependent manner. Both the compounds exhibited inhibitory effects on LPS-induced nitric oxide production in the cell system (Hong *et al.,* 2002). Zedoary oil exhibited pronounced potential against the fourth instar larvae of *A. aegypti* with an LC(50) and LC(99) of 33.45 and 83.39 ppm, respectively (Champakaew *et al.,* 2006).

The extracts obtained from rhizome of the plant collected in autumn and winter, at doses of 10 mg/kg body weight, i.p., caused considerable antinociceptive activity inhibiting 91.1 and 93.4% of the abdominal constrictions, respectively (Pamplona *et al.,* 2006).

The inhibitory effect of *C. zedoaria* on experimental pulmonary metastasis of B16 melanoma cells were reported by Seo *et al* (2005). The intake of *C. zedoaria* at doses of 250 and 500 mg/kg for 6 weeks from 2 weeks before tumor inoculation significantly reduced the number of metastatic surface nodules in the lung, resulting in an extended life span.

Zedoalactones A, B, and C were reported to have anti-babesial activity was. The IC_{50} value of diminazene aceturate was reported to be 0.6 microg/mL, while those of zedoalactones A, B, and C were 16.5, 1.6 and 4.2 microg/mL, respectively (Kasahara *et al.*, 2005).

Zedoariae rhizome were also reported to inhibits proliferation of hepatic myofibroblast cells hMF growth (IC50 = 8.5 microg/ml)hMF, probably via an intracellular mechanism, through early COX-2-dependent release of prostaglandin E2 and cAMP, and delayed COX-2 induction (Kim *et al.*, 2005).

TOXICOLOGY

A high-protein flour from rhizomes of shati (*C. zedoaria*) proved highly toxic to 5-week-old rats and caused 100% mortality within 6 days when given at 320 g/kg diet. This same shati meal was given to 1-d-old chicks at 100 and 200 g/kg diet. All the chick survived the test period (20 d), but body-weight, food intake and efficiency of food conversion decreased with increase in the level of shati meal in the diet (Latif *et al.*, 1979).

The polysaccharide fractions of *C. zedoaria* at dose of 6.25 mg/kg/d showed 50% inhibition in solid tumor growth. When mice were injected with fractions at the dose of 100.0 mg/kg, 91.6% and 97.1% of tumor growth were inhibited, respectively, indicating that the cytotoxic effect of polysaccharide on sarcoma 180 cells increases upon increasing the amount of polysaccharide administered. In Ames test it did not show any transformation of revertant with or without S-9 metabolic activating system, indicating the lack of mutagenic effect of the compound. Up to 259.0 microg/ml concentration of fraction neither micronucleus formation nor chromosomal aberration was induced regardless of the presence of S-9 metabolic activating system (Kim *et al.*, 2005).

THERAPEUTIC EVALUATION

The inhibitory effect of *C. zedoaria* on experimental pulmonary metastasis of B16 melanoma cells were reported by Seo *et al* (2005). The intake of *C. zedoaria* at doses of 250 and 500 mg/kg for 6 weeks from 2 weeks before tumor inoculation significantly reduced the number of metastatic surface nodules in the lung, resulting in an extended life span.

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FORMULATIONS AND PREPARATIONS

Avaleha and Paka – *Ardraka khanda avaleha.*
Churna – *Ashvagandhadi churna.*
Rasayoga – *Sutasekhar rasa, Balarka rasa* (Anonymous, 1978, 2000).

TRADE AND COMMERCE

Retail market price Rs. 130 per kg. for the year 2006.

SUBSTITUTES AND ADULTERANTS

Hedychium spicatum Ham. ex Smith is used as substitute (Garg, 1992; B.N., 1982; Singh and Chunekar, 1972).

PROPAGATION AND CULTIVATION

An ornamental plant, propagated by tubers and rhizome pieces bearing buds on the onset of monsoon in shady and well-irrigated conditions. Crop is cultivated during October-April and matures within 8-9 months. Crop rotation of two years facilitates the rhizome development (Anonymous, 1950).
Tissue culture of *C. zedoaria* was done using rhizome sprout cultures. Cultures were initiated on MS medium supplemented with 20% (v/v) coconut water and different auxins and cytokinins. MS medium supplemented with 3 mg/L BA was reported to be most effective for shoot induction *i.e.* 3 shoots per culture was obtained on an average of 30 days of culture. Combination of 3 mg/L BA and 0.5 mg/L IBA, developed maximum number of shoots. Also, 3 mg/L BA alone or in combination with 0.5 mg/L IBA produced multiple shoots. NAA (2 mg/L) induced 18.5 ± 4.8 adventitious roots of 5.1 mm in length within 4 weeks of culture. Medium with 1 g/l AC when used lead to adventitious root formation (Loc *et al.*, 2005).

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KASHA

BOTANICAL NAME: ***Saccharum spontaneum*** Linn.

FAMILY: **Poaceae**

CLASSICAL NAMES
Kasha (C.S.; S.S.; A.H.).

SYNONYMS
Ikshugandha, Ikshukanda, Ikshukusuma, Ikshvari, Iskhuraka, Kasa, Kasekshu, Khaggara, Pushpa, Swetacharmar (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Thatch grass, Wild sugar cane. **Hindi-** *Kagara, Kans, Kansi, Kas, Kosa, Kus, Kasa.* **Beng.-** *Kagara, Kas, Kash, Kashiya, Khagra, Chhote-kase, Kash, Keshe.* **Guj.-** *Kans, Kansado, Kansadoghas, Kansa, Ghans.* **Kan.-** *Kirayikagachchha, Kasalua.* **Mal.-** *Nannaua, Kusa, Kuruvikarimpu.* **Mar.-** *Kagara, Kasai.* **Punj.-** *Kahi, Kanh, Kans, Sarakara, Kani, Nanalu, Karumbu, Kasa, Amaver.* **Tam.-** *Achabaram, Anjani, Eruvai, Kosangan, Kucham, Kumil, Kurbagam, Nanal, Nanarbul, Nanmulgappul, Peykkarumbu, Sangabidam, Saravanam, Sarupparasi, Sasabaram, Sugattan, Suvedasaram, Tittru, Tittiruchi, Tuttam, Vedasam, Pekkarimpu.* **Tel.-** *Billugaddi, Kakicheraku, Kakiveduru, Koregadi, Rasalamu, Rellugaddi, Veticheraku, Kakiceruku, Kakigaddi, Relu***.** **Sind.-** *Kahu, Khan, Khau.* **N.W.P.-** *Kans, Kansa, Kansi.* **Oriya-** *Chhatiagaso, Inkora, Kaso, Khnodi, Pothhoro, Khhodi.* **Urdu-** *Kansa, Kasa* (Anonymous, 1996a; Anonymous, 1972; Anonymous, 2001; Chopra *et al.*, 2002; Sharma, 1978; Watt, 1972; Chatterjee and Pakrashi, 2001; Anonymous, 2000a; B.N., 1982; Kirtikar and Basu, 1989; Vaidya, 1995).

BOTANICAL DESCRIPTION
Perennial rhizomatous 1.5-2 m, tall grass with erect culms, stem 1.2 – 6 m, erect from a stout rootstock, solid, smooth, polished, silky beneath the panicle. Culms green, grey, ivory or white, hard but very pithy and often hollow in the centre, often rooting at nodes; internodes usually long. Leaves

KASHA ***Saccharum spontaneum*** Linn.

30-75 X 3-6 cm, linear-acuminate, rigid, coriaceous, glabrous, margins convolute, sheaths smooth with fimbriate mouth. Inflorescence panicle, 20-50 cm long, contracted, pale or greyish-white to purplish, spikelets lanceolate, silky hairy. Flowering and Fruiting: August – January (Cooke, 1967; Anonymous, 1996; Hooker, 1973; Anonymous, 1972; Yoganarsimhan, 1996, 2000).

DISTRIBUTION

Throughout India in the warmer parts ascending to 1800 m in the Himalayas. Also occurs in Sri Lanka, South Europe, East Australia, Pakistan and warmer regions of the old world (Cooke, 1967; Anonymous, 1972; Watt, 1972; Chopra *et al.*, 2002; Hooker, 1973; Kirtikar and Basu, 1989).

PART(S) USED

Whole plant, root, fruit (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The whole plant used as aphrodisiac and laxative. It causes soothing effect on burning sensation, vesicle calculi, dyscrasia, haemorrhagic disorders, strangury and tuberculosis (Chatterjee and Pakrashi, 2001; Chopra *et al.*, 1958). The root is diuretic and galactogogue, astringent, emollient, refrigerant, diuretic, lithotriptic, haemostatic and tonic (Annonymous, 1996). It is useful in, dysentery, galactia, pthisis and general debility (Kirtikar and Basu, 1989).

AYURVEDIC PROPERTIES

Rasa – *Madhura, Tikta Kashaya.*
Guna – *Laghu, Snigdha.*
Vipaka – *Madhura.*
Veerya – *Sheeta* (Sharma, 1978; B.N., 1982).
Doshghnata – *Pittanashaka* (A.H.Su.6.171), *Vata Pittashamaka* (Sharma, 1978; B.N., 1982).
Karma –*Ashmaribhedana* (S.S.Su.38.11; A.H.Su.15.24), *Shukrashodhaka* (S.S.Su.38.75), *Stanyajanana* (C.S.Su.4-9.17), *Vrishya, Vajeekarana* (A.H.U.40.12), *Pittahara, Shramahara, Mootravirechaneeya* (C.S.Su.4-9.35), *Dahaprashamana, Balya, Raktapittashamaka*, (Sharma, 1978; B.N., 1982).
Rogaghnata – *Raktapitta* (C.S.Ci.4.102; S.S.Su.38.75), *Mootrakrichchhra, Ashamari* (C.S.Ci.26.49; S.S.Su.38.11; S.S.Ci.7.9; A.H.Su.15.24; A.H.Ci.11.22), *Daha* (C.S.Su.3.26), *Raktadosha, Shosha* (S.S.Su.38.75),

Kshaya, Paittika Ajeerna, Raktatisara, Raktarsha (C.S.Ci.14.215) *as picchavasti* (C.S.Ci.14.225), *Raktapradara, Shool* (A.H.Ci.13.42), *Jwara* (C.S.Ci.3.257; A.H.Ci.8.125), *Apasmara* (C.S.Ci.10.28; A.H.U.7.25), *Trishna* (C.S.Ci.22.43; A.H.Ci.6.171), *Rasayana* (C.S.Ci.1-1.42), *Shukradosha, Shukradaurbalya* (C.S.Ci.2-4.22) (Sharma, 1978; B.N., 1982).
Doses: Powder 5-6 gm., decoction 50-100 ml.

SIDDHA PROPERTIES
Siddha Name - *NAANAL*
***Suvai* (Taste) -** *Inippu* (Sweet).
***Veeriyam* (Potency)** - *Seetham* (Cold).
***Vibakam* (Tansformation)** - *Inippu* (Sweet).
***Gunam* (Pharmacological action)** - *Malamilakki* (Laxative), *Udal thetrri* (Alterativei).
Uses - Used in treatment of abscess as external medicine.

PHARMACOGNOSY
Macroscopic
Root Stock – Attached with stem portions having numerous dark brown roots; cylindrical, yellowish brown or brown, 2-25cm. or more in length and 0.2-1 cm thick; fracture splintery.
Microscopic
Transverse section shows single layered epidermis consisting of slightly oval, thin-walled cells, a few elongated, pointed, aseptate, long unicellular hairs arising from epidermis; cortex composed of 2-3 layered, elongated, thick-walled, palisade-like cells and 3-4 layers of thin-walled, oval to polygonal parenchymatous cells; endodermis consisting of thin walled, single layered cells, followed by 6-9 layered thick walled, lignified, polygonal, continuous ring of sclerenchymatous cells; pericycle single layered, composed of very small, thin walled cells beneath endodermis; ground tissues wide, composed of thin-walled, oval to polygonal, elongated parenchymatous cells containing numerous, round to oval starch grains measuring 8-24µ in dia., scattered ‘U’ shaped vascular bundle with sheath also present (Anonymous, 2001).
Powder microscopy
Root stock powder dark brown in colour; shows fragments of thin-walled, tabular, somewhat rectangular epidermal cells in surface view, oval to polygonal, thin-walled parenchymatous and thick-walled polygonal sclerenchymatous cells, pointed unicellular hairs, vessels with reticulate thickening, small round to oval starch grains, measuring 8-24µ in diameter (Anonymous, 2001).

Physical constants

Foreign matter – Not more than 2%, Total Ash – Not more than 7%, Acid insoluble ash-Not more than 4%, Alcohol soluble extractive – Not less than 3%, Water soluble extractive – Not less than 4% (Anonymous, 2001).

Thin Layer Chromatography

TLC of the alcoholic extract on silica gel 'G' plate using n-Butanol: Acetic acid: water (4:1:5) shows under U.V. (366 nm) one fluorescent zone at Rf. 0.83 (green). On exposure to Iodine vapour three spots appear at Rf. 0.30, 0.83 and 0.90 (all yellow). on spraying with 5% Methanolic-sulpuric acid reagent and heating the plate for ten minutes at 105°C six spots appear at Rf. 0.13, 0.23, 0.30 (all dull yellow), 0.69, 0.83 and 0.90 (all grey). (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Plant: Protein, calcium, phosphorus, hydrocyanic acid glycosides (Kehar, 1948).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have diuretic, laxative, aphrodisiac activities. It is reported enhance immune system (Gopinathan *et al*., 2004). Alcoholic extract of rhizomes and roots showed diuretic activity at a dose of 500 mg/kg kw. in rats.

FORMULATIONS AND PREPARATIONS

Arka – *Karpuradyarka.*

Kvatha Churna – *Ashmarihara kashaya churna, Trinapanchamoola kvatha churna, Stanyajanana kasaya churna, Mootravirechaniya kasaya churna.*

Ghrita – *Traikantaka ghrita, Sukumara ghrita, Kushadya ghrita, Brihachhagaladya ghrita.*

Vati and Gutika – *Kasturyadi (Vayu) gutika* (Anonymous, 1978; 2000).

Other classical formulations – *Chandanadya taila* (C.S.Ci.3.257), *Sukumara taila* (C.S.Ci.29.102).

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KATPHALA

BOTANICAL NAME: ***Myrica esculenta*** Buch.-Ham.exD. Don
Syn. *M. nagi* Thunb.; *M. cerifera* Linn.

FAMILY: **Myricaceae**

CLASSICAL NAMES

Kayaphal, Somavalka (C.S.; S.S.; A.H.), *Bhadra* (S.S.Ci.), *Kumbhik* (S.S.Su.), Kaitarayam (C.S.Su.;Vi.).

SYNONYMS

Aranya, Bhadranjaka, Bhadravati, Kahakumbhi, Kaidaryama, Kaitarya, Krishnagarbha, Kumbhi, Kumbhika, Kumbhipaki, Kumbli, Kumuda, Kumudika, Laghykashmarya, Mahakumbha, Mahavalkala, Nasany, Prachetasi, Purusha, Ramasenaka, Rohini, Shriparnika, Shriparni, Somavriksha, Somavriksta, Tvakaphala, Ugragandha (Sharma, 1978;D.N., 1982; B.N., 1982;R.N.1982).

VERNACULAR NAMES

Eng.- Box myrtle, Bay-berry. **Hindi-** *Kaiphal, Kaiphar, Kaphala, Kaephala.* **Beng.-** *Kaiphal, Satsarila, Kayachala.* **Guj.-** *Kariphal, Kayaphala.* **Kan.-** *Kirishivani.* **Mal.-** *Maruta, Marutamtoli.* **Mar.-** *Kayaphala, Kaephal, Kaiphala.* **Punj.-** *Kaiphal, Kahela, Kahi, Kaphal.* **Tam.-** *Marudam, Marudampate, Marudam pattai.* **Tel.-** *Kaidaryamu.* **Arab.-** *Ajuree, Azuri, Udulbarka, Quantol, Udulisk, Kandul, Audul.* **Assam-** *Nagatenga.* **N.W.P.-** *Kaiphal, Kaphal, Karphal.* **Pers.-** *Darashish aan, Kandula, Dareshishamkandul.* **Sind.-** *Kaephal, Kaiphal.* **Urdu-** *Kaiphal.* **Kumaun-** *Kaphal.* **Khasi hill-** *Soh-phi, Dingsolira.* **Lushai-** *Keirang.* **Nepal-** *Kobusi.* **Malayese-** *Marutamtoli* (Kirtikar and Basu, 1988; Nadkarni, 1976; Sharma, 1978; Anonymous, 2000a; Chopra *et al.*, 1958; Anonymous, 1962; Watt, 1972; Vaidya, 1985; Singh and Chunekar, 1972; Anonymous, 2001; Anonymous, 1987).

BOTANICAL DESCRIPTION

An evergreen dioecious tree, 3-15 m high, bark rough with deep vertical wrinkles, grey or brownish-grey; young shoots, petiole and inflorescence tomentose. Leaves simple, crowded towards the ends of branches, 7.5-12.5 x

KATPHALA ***Myrica esculenta*** Buch, Ham ex D. Don

2.5 – 5 cm, lanceolate or narrowly oblong – ovate, entire, acute or obtuse, the lower surface pale or rust colour, minutely gland dotted, aromatic. Flowers minute, unisexual, glandular, male flowers in catkins upto 2.5 cm long, solitary in the leaf axils or sessile on a common drooping axillary stalk, female flowers in axillary, erect, 1.3-2.5 cm long. Fruit drupes, sessile, scaly, globose or ovoid, succulent, reddish or cheese colour when ripe, stone wrinkled, and pitted. Flowering : August-December; Fruiting : April-May (Collet, 1971; Hooker, 1973; Chatterjee and Pakrashi, 1994; Chauhan, 1999; Anonymous, 1962).

DISTRIBUTION

Found in sub-tropical or outer Himalaya from Ravi (Punjab) eastwards to Assam, Arunachala Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, in Khasia, Sylnet, Himachal Pradesh, Jaintia, Simla, Bengal, Naga and Lushai hills at an altitudes to 900-2100 m. (Anonymous, 1962; Chauhan, 1999). Native of China and Japan, also occurs in Malaya Islands, West Pakistan and Singapore (Chopra *et al.,* 1958; Hooker, 1973; Chatterjee and Pakrashi, 1994).

PART(S) USED

Stem bark, fruit (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Bark astringent, carminative, antiseptic, useful in fever, asthma, urinary discharges, piles, bronchitis, throat complaints, tumours, anaemia, chronic dysentery, ulcers, a good snuff in headache, collyrium for opthalmia and other eye diseases (Kirtikar and Basu, 1988). Bark is chewed to relieve toothache and a lotion prepared from it finds application for washing putrid sores. Fruits yield a wax which is used externally for healing ulcers (Chatterjee and Pakrashi, 1994).

AYURVEDIC PROPERTIES

Rasa **–** *Kashaya, Tikta, Katu.*
Guna **–** *Laghu, Tikshna.*
Vipaka **–** *Katu.*
Veerya **–** *Ushna.*
Doshghnata **–** *Kaphavatashamaka* (Sharma, 1978; B.N., 1982).
Karma **–** *Kaphaghna, Shirovirechana, Shothahara, Kothagrashamaha, Garbhashaya sankochaka, Vedanasthapana* (C.S.Su.4.47), *Deepana, Grahi, Shadaprashamaha, Sandhaniya, Shothahara, Mootrasangrahaniya,*

Shukrashodhana (C.S.Su.4.20), *Kandughna, Twagdoshhara (Kushthaghna), Sangyasthapaka* (C.S.Su.4.48) (Sharma, 1978; B.N., 1982).

Rogaghnata – *Ardita, Shirahshoola* (S.S.U.26.21), *Agnimandya* (C.S.Ci.4.13), *Atisara* (C.S.Ci.19.54; A.H.Ci.9.59), *Udarshoola, Arsha* (C.S.Ci.14.236; Si.4.13; A.H.Ci.8.151), *Shotha* (S.S.Ci.16.43), *Pratishaya, Kasa, Shwasa* (C.S.Ci.18.113; 28.151; S.S.U.52.14; A.H.Ci.3.162), *Prameha, Shukradosha* (C.S.Ci.6.27; Si.4.13; A.H.Ci.12.7), *Yoniroga* (C.S.Ci.30.90; A.H.U.34.51), *Vatarakta* (S.S.Ci.5.8), *Raktapitta* (C.S.Ci.4.72), *Kushtha, Kandu* (C.S.Ci.7.101; A.H.Ci.8.151), *Nasaroga* (S.S.U.23.4), *Netraroga* (A.H.U.9.34), *Mukharoga* (A.H.U.22.85) (Sharma, 1978; B.N., 1982).

Doses : Stem bark powder 3-5gm, Fruit powder 3-5 gm. (Sharma, 1978; B.N., 1982).

PHARMACOGNOSY

Macroscopic

Stem-bark – Drug occurs in pieces of variable length, 1-2.5 cm thick, slightly quilled, fissured longitudinally and transversely; outer surface rough, grey to brownish-grey, inner surface dark brown and smooth; fracture hard; taste bitter.

Microscopic

Mature stem bark shows multilayered cork, composed of rectangular, tangentially elongated, thin-walled cells, some filled with red content; secondary cortex a wide zone, composed of thin-walled, rectangular to polygonal, parenchymatous cells, a number of cells filled with red colouring matter and simple, round to oval starch grains measuring 6-11 μ in diam.; a number of stone cells, in singles or groups, circular, polygonal or oval, thick-walled, lignified with simple pits and radiating canals, found scattered throughout secondary cortex; secondary phloem consists of sieve elements, phloem fibres, crystal fibres, stone cells and phloem parenchyma traversed by phloem rays; numerous prismatic crystals of calcium oxalate present in secondary phloem; phloem fibres with blunt or pointed end and highly thick-walled, with very narrow lumen present in groups; stone cells similar to those found in secondary cortex, mostly in singles or in groups of 2-3, sometimes associated with fibre groups in phloem parenchyma; in isolated preparation and tangential sections, crystal fibres show more than twenty chambers having single prismatic crystals of calcium oxalate in each chamber; a number of phloem parenchyma cells containing red colouring matter; phloem rays 1-4 seriate containing red colouring matter (Anonymous, 2001).

Macroscopic

Fruit :- A drupe, ellipsoid or ovoid, 0.7-1.0 cm long, 0.5-0.7 wide, dark brown, surface tubercled, very hard; taste sourish sweet. Seed ovoid, 0.6 cm long, 0.3 cm wide; surface very smooth, light brown; taste oily.

Microscopic

Fruit shows isodiametric epicarp cells in surface view, mass of reddish-brown, thin-walled, parenchymatous cells, a few elongated tubercled cells with smooth walls; endocarp hard and stony consisting of sclerenchymatous cells. Seed coat shows single layered, thick-walled, brown coloured cells; cotyledons composed of single layered, thin-walled epidermal cells containing oil globules and aleurone grains; mesophyll cells thin-walled, isodiametric, fully packed with oil globules and aleurone grains (Anonymous, 2001).

Powder microscopy

Stem bark: powder rusty-red in colour; shows a number of stone cells, phloem fibres, crystal fibres and prismatic crystals of calcium oxalate and simple, round to oval, starch grains measuring 6-11-4 in diameter (Anonymous, 2001)

Fruit powder yellowish-brown; shows rectangular to hexagonal, thin-walled seed coat and polygonal epidermal cells in surface view; tubercled parenchymatous cells, oil globules and aleurone grains (Anonymous, 2001).

Physical constants

Value	Stem Bark	Fruit
Ash value	Not more than 4%	Not more than 5%
Acid insoluble ash	Not more than 1%	Not more than 2.5%
Alcohol soluble extractive	Not less than 13%	Not less than 15%
Water soluble extractive	Not less than 12%	Not less than 17%

(Anonymous, 2001).

Thin Layer Chromatography

Stem-bark

TLC of the alcoholic extract on Silica gel 'G' plate using Toluene: Ethylacetate (7:3) in visible light shows four spots at Rf. 0.08 (grey), 0.32 (yellow), 0.51 (grey) and 0.58 (yellow). Under UV (366 nm) three-fluorescent zones appear at Rf. 0.49, 0.67 (both light blue) and 0.86 (blue). On spraying with 5% Methanolic-Sulphuric acid reagent and heating the plate at 110°C for ten minutes six spots appear at Rf. 0.08, 0.21 (both grey), 0.35 (Pink), 0.52, 0.67, and 0.80 (all grey) (Anonymous, 2001).

Fruit: TLC of the alcoholic extract on silica gel 'G' plate using n-Butanol: Acetic acid: Water (4:1:5) shows in visible light five spots at Rf. 0.25, 0.43, 0.57, 0.75 (all grey.) and 0.88 (yellowish – green). Under U.V. (366 nm) seven fluorescent zones are visible at Rf. 0.09, 0.18 and 0.30 (all light blue), 0.43 (green), 0.49 (blue), 0.65 (blue) and 0.71 (pink). On exposure to Iodine vapour eleven spots appear at Rf. 0.07, 0.09, 0.12, 0.25, 0.30, 0.35, 0.43, 0.52, 0.57, 0.75 and 0.88 (all yellow). On spraying with 5% Methanolic-Sulphuric acid reagent and heating the plate for ten minutes at 110°C six spots appear at Rf. 0.09 (black), 0.30 (black), 0.57 (light brown), 0.71 (light pink), 0.82 (light pink) and 0.88 (yellowish-green) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Root bark: 13-Oxomyricanol, (7,O) metacyclophane (Malterud and Anthonsen, 1980), myricetin, myricitrin – glycoside teraxerone, teraxerol, myricadiol (Paul *et al.,* 1974), 28-hydroxy-D-friedoolean-14-en-3-one (Sakurai *et al.,* 1986), betulin (Dischendorfer, 1926), castalagin (Sun *et al.*, 1988), β sitosterol, teraxerol, triterpenediol, myricadiol (Agarwal *et al.*, 1963).

Stem bark: Proanthocyanidin (Krishnamoorthy and Seshadri, 1966), sitosterol, tetraxerone (Sakurai *et al.,* 1986), diarylheptanoid (Inoue *et al.*, 1984), 3-O-gallated prodelphinidin, epigallocatechin-3-O-gallated epigallocatechin (4β→8)- epigallocatechin-3-O-gallate, 3-O-galloylepigallocatechin (4β→8)-epigallocatechin-3-O-gallate (Sun *et al.*, 1988), two diarylheptanoid glucosides, myricanol-5-O-β-D-(6’-O-galloyl) glucopyranoside and myricanol-5-O-β-D-glucopyranosyl (1→6)- β-D-glucopyranoside, alphitolic, arjunolic, maslenic, oleanolic acid, acetyl oleanolic acid, myricolal, gallic acid (Yaguchi *et al.*, 1988), myriconol (Krishnamoorthy *et al.,* 1963; Campbell *et al.,* 1970), steroids, sugars, glycosides, tannins, volatile oils (Nayar *et al.,* 1979), myricanol, myricanone, isomyricanone, asadenin. (Sun *et al.,* 1988; Begley *et al.,* 1971), friedelin glycoside myricitrin, myricetin-3-rhamnoside, aleurilolonic acid, acetoxyaleuritolate (Carpenter *et al.*, 1980).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antiseptic, antipyratic, hypotensive, antiprotozoal activity against *Entamoeba histolytica* (Dhar *et al.,* 1968), antispasmodic (Dhar *et al.,* 1968), piscicidal (Ramanujan and Ratha, 1980) hypotensive, myocardial depressant and vasodilator action (Nayak *et al.,* 1980). Dried water extract of stem bark showed analgesic action (Gupta *et al.,* 1982). Fruit extract showed antifungal activity (Bhatnagar *et al.,* 1961). The Ethanolic extract of stem bark showed marked inhibition of the multiplication of

Ranikhet disease virus (Dhar *et al.*, 1968; Babbar *et al.*, 1970), cutaneous oxidative stress and toxicity (Alam *et al.*, 2000).

TOXICOLOGY

Myricanol from the bark is reported toxic to fish (Krishnamoorthy *et al.*, 1963; Chopra *et al.*, 1958; Chopra *et al.*, 1956).

FORMULATIONS AND PREPARATIONS

Kvatha Churna – *Devadarvadi kvatha churna, Nyagrodhadi Kvath churna.*
Ghrita – *Brihat phala ghrita.*
Churna – *Ashvagandhadi churna, Katphaladi churna, Pushyanuga churna.*
Taila – *Maha vishagarbha taila, Bala taila.*
Vati and Gutika – *Khadiradi gutika (Mukharoga and Kasa).*
Rasayoga – *Maha Vatagajankusha rasa* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

Retail Market Price – Rs. 30 per kg. (Prajapati, 2006).

SUBSTITUTES AND ADULTERANTS

Careya arborea Roxb. has been found to be used in place of Katphala in some parts of India (Singh and Chunekar, 1972).

PROPAGATION AND CULTIVATION

Ornamental tree propagated by seeds, suckers and layering. Ripe fruits are collected in May for edible purpose (Chauhan, 1999).

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KOLA

BOTANICAL NAME: ***Ziziphus mauritiana*** Lamk.
Syn. *Z. jujuba* (Linn.) Gaertn.

FAMILY: **Rhamnaceae**

CLASSICAL NAMES
Kola, Badara (C.S.; S.S.; A.H.).

SYNONYMS
Ajapriya, Badari, Badarika, Balosta, Bary, Boroi, Ghonta, Ghoti, Golika, Karkali, Karkandhu, Kolak, Konkamber, Kool, Kuha, Phalastonstrir, Phenila, Phitni, Sauvir, Shatrukantaka, Turaga, Turangi (D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Common jujube, Jujube fruit, Indian jujube, Chinese date, Indian cherry, Indian plum. **Hindi-** *Pitni ber, Kandika, Kandiari, Singli, Banber, Ber, Bor, Baer, Beri.* **Beng.-** *Ber, Kool, Boroi.* **Guj.-** *Ber, Bor, Bordi, Boyedi.* **Kan.-** *Bore.* **Mal.-** *Badaram, Ilantha, Badari, Kolam, Lanta, Perintutali.* **Mar.-** *Ranbor, Unab, Bor, Bhor, Bhurmi, Bordi, Ber, Baher, Bora.* **Punj.-** *Amlai, Singli, Simli, Barari, Ber, Beri, Unab.* **Tam.-** *Ilandai, Elandai, Elladu, Adidaram, Attiram, Iradi, Iratti, koli, Kondai, Kullari, Kulvali, Padari, Sivagam, Vadari, Vettiram, Veyam* **Tel.-** *Gangareno, Regu, Badaramu, Badari, Gangaregu, Karkhanduru, Renu.* **Oriya-** *Barkoli, Bodokoli, Bodori, Koli* **Pers.-** *Kunar, Kanar, Nabik.* **Santhal-** *Dedhaori, Janum, Jomjanum* **Sind.-** *Ber Jangri, Berjangri.* **Urdu-** *Ber.* ***Canarese*** *:- Bagari, Barihannu, Badari, Bore, Egasi, Jelachi* ***Central Provinces*** *:- Bher, Bori.* ***Konkani*** *- Ber, Bor.* ***Kumaon*** *- Ber, Guter, Khalis.* ***U.P.*** *- Ber, Bera.* ***Porbunder*** *- Boedi, Bordi, Bori.* ***Sinhalese*** *- Ilanda, Mahadebara, Masaka* (Nadkarni, 1976; Kirtikar and Basu, 1933; Chopra *et al.,* 1986; Chatterjee and Pakrashi, 1994; Anonymous, 1976; Anonymous, 2000a; Anonymous, 2001; B.N., 1982; Watt, 1972).

BOTANICAL DESCRIPTION
A large thorny shrub or small tree with rough grey or black bark; prickles on stems, young branches softly pubescent. Leaves simple, alternate, 2-6 cm

KOLA ***Ziziphus mauritiana*** Lamk.

long, variable, oblong- elliptic, ovate or suborbicular, serrate or entire, three nerved, glabrous above covered beneath with a dense whitish or buff tomentum, prickles solitary or in pairs, 2.5 cm long. Flowers bisexual, greenish-yellow in small axillary clusters or short peduncled axillary cymes. Drupes globose or ovoid, succulent, fleshy, smooth, yellow or orange when ripe, stone 1-2 celled. Flowering and Fruiting : September – January (Cooke, 1967; Anonymous, 2000b; Anonymous, 1976; Anonymous, 1993; Brandis, 1972).

DISTRIBUTION

Found wild throughout India in waste places or tropical forests and in the outer Himalaya upto 1500m. (Anonymous, 1976). Also occurs in Sri Lanka, Malacca, Afghanistan, China, Australia, Tropical Africa and Burma (Hooker, 1973).

PART(S) USED

Fruit, stem bark, leaf, root, seed (B.N., 1982).

ACTION AND USES

The ripe fruit is indigestible, aphrodisiac, anodyne, astringent, cooling, stomachic, styptic, tonic, expectorant, mild laxative and removes impurities from the blood. Leaves and twigs paste applied to abscesses, boils and curbuncles to promote suppuration and to strangury. Stem bark astringent, powder or decoction useful in diarrhoea, dysentery and in boils. Root bark juice is purgative, externally applied to gout and rheumatism. Decoction of root is beneficial in fever and powder for old wounds and ulcers (Chatterjee and Pakrashi, 1994). Seeds are acrid and sweetish, tonic, antidiarrhoeal. Kernel used for abdominal pain in pregnancy and an antidote to aconite poisoning. It is used as antiemetic, sedative, sodorific and also cures eye diseases. Leaves astringent and diaphoretic (Kirtikar and Basu, 1933).

AYURVEDIC PROPERTIES

Rasa – *Madhur* (C.S.Su.27.141), *Amla* (S.S.Su.46.140).
Guna – *Guru* (C.S.Su.27.141), *Snighdha* (S.S.Su.46.140).
Vipaka – *Madhur* (C.S.Su.27.141), *Guru Vipaka* (S.S.Su.46.140).
Veerya – *Ushna* (C.S.Su.27.141; S.S.Su.46.140), *Sheeta* (A.H.Su.6.120).
Doshaghnata – *Vata nashakaa* (C.S.Su.27.132), *Pittakarakavatnashaka* (S.S.Su.46.140) (B.N., 1982).

Karma *– Fruit – Vatasamshamaka* (S.S.Su.39.7), *Snehan, Pridana, Raktasthambhaka, Udradaprashamana, Shramahara, Virechaka* (C.S.Su.27.141), *Sangrahi, Dahanashaka* (S.S.Su.36.49), *Hridya* (C.S.Su.4.10), *Vamanapoga* (C.S.Su.4.22), *Virechanopoga* (C.S.Su.4.24; S.S.Su.46.146; A.H.Su.6.139), *Chhardi nigrahana* (C.S.Su.4.28), *Hikka* (C.S.Su.4.30), *Shramhara* (S.S.Su.46.146; A.H.Su.6.139; C.S.Su.4.40), *Udarda prashamana* (C.S.Su.4.43), *Snehana Karma* (C.S.Su.13.94). (B.N., 1982).

Rogagnata *–Jwara* (C.S.Ci.3.187, 258; A.H.Ci.1.33; C.S.Ci.13.124; S.S.Ci.34.13; A.H.U.5.20), *Vishamjwara* (A.H.Ci.1.157), *Udavarta, Asthapana* (C.S.Su.2.11), *Vatavyadhi* (C.S.Ci.28.111; C.S.Su.3.17), *Gulma* (S.S.U.57.10; S.S.Ci.15.29; A.H.Ci.8.149; 14.12; Sa.2.47; C.S.Ci.5.72), *Yakshma* (A.H.Sa.2.47), *Rajyakshma,* (C.S.Ci.8.141), *Kshatakshina* (C.S.Ci.11.34.), *Udararoga* (A.H.Ci.15.8; C.S.Ci.13.84; S.S.U.41.48), *Udarashoola* (A.H.Ci.1.32), *Pandu, Yakrit pleeha vriddhi* (A.H.Ci.15.93; C.S.Ci.13.84; S.S.Ci.12.5), *Arsha* (S.S.Ci.12.5; C.S.Ci.14.200, 204), *Kustha* (C.S.Ci.14.200, 204; S.S.Ci.10.6; A.H.U.5.20), *Grahani* (A.H.Ci.10.15; C.S.Ci.15.82, 89), *Hikka* (S.S.U.50.27), *Shwasa* (C.S.Ci.13.84; 17.108; S.S.Su.46.206; Ci.15.29; 34.13; U.51.38), *Kasa* (C.S.Ci.18.43; S.S.U.52.21; A.H.Ci.3.7), *Yonishool, Yoniroga* (C.S.Ci.29.103; A.H.Sa.2.47; Ci.3.7), *Atisara* (S.S.U.40.96; A.H.Ci.9.29; C.S.Ci.19.35), *Chhardi* (C.S.Ci.20.23, 29, 38; S.S.Su.46.206 ;S.S.U.49.36; A.H.Ci.6.16), *Trishna* (S.S.Su.46.206; U.39.284; A.H.Su.6.139; Ci.6.77; 7.31 ; C.S.Ci.22.36), *Visha* (C.S.Ci.23.94, 96), *Madataya* (C.S.Ci.24.120, 150; A.H.Ci.7.12), *Apasmara, Unmada* (C.S.Ci.29.103; S.S.U.61.28; A.H.Ci.14.15), *Vivandha* (C.S.Su.2.11; S.S.Ci.2.53) *Ashmari* (S.S.Ci.7.7; A.H.Ci.11.19), *Prameha, Sthoulya Shotha (S.S.Ci.10.6; 12.5; U.41.48; A.H.Ci.12.21), Vidradhi* (S.S.Ci.16.36; 12.5; A.H.Ci.13.23), *Mudagabha, Garbhadharana* (S.S.Ci.15.29), *Vranashodhana* (S.S.Ci.19.42), *Vranaropana* (S.S.Ci.20.58), *Vasti* (S.S.Ci.37.21), *Netra roga* (S.S.U.12.21), *Putnagraha* (S.S.U.12.21; 32.7), *Daha* (S.S.U.39.284), *Murcha* (S.S.U. 39.284; 46.18), *Malakshay* (S.S.U.40.136), *Shoola* (S.S.U.42.98), *Panvibhrama* (S.S.U.47.41), *Krimi roga* (C.S.Ci.13.84; S.S.U.54.22), *Aruchi, Kantha, Hridroga* (C.S.Ci.14.200; S.S.U.57.10; A.H.Ci.17.20), *Mutradosha* (S.S.U.58.57), *Apasmara* (S.S.U.61.28), *Shirashoola, Parshashoola, Yonishoola* (A.H.Ci.3.7), *Kshayakshata* (A.H.Ci.3.159), *Swarabheda (leaf of badara)* (A.H.Ci.5.37), *Mutraghata* (A.H.Ci.11.2), *Vatavyadhi* (A.H.Ci.21.28) (B.N., 1982).

Doses : Fruit pulp – 3-6 gm (dried pulp), Stem bark Powder 3-5g, for Decoction 10-20g (B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - ***ILANTHAI***

***Suvai* (Taste) -** *Pulippu* (Sour).

***Veeriyam* (Potency) -** *Seetham* (Cold).

***Vibakam* (Tansformation) -** *Inippu* (Sweet).

***Gunam*(Pharmacological action) -** *Thuvarppi* (Astringent), *Varatchiyagattri* (Emollient).

Siddha pharmaceutical preparations - *Sarapunga vilvathi ilagam, Chitra mutty thylam, Chitra mutty matakku thylam, Lagu chanthanathy thylam, Karisalai ilakam, Thratchathy choornam.*

Uses - Used in treatment Vatha disorders, Skin diseases and in Respiratory disorders.

PHARMACOGNOSY

Macroscopic

Fruit Pulp – Pulp pieces irregular in shape, shrunk with external surface smooth and glossy, 2 mm in thickness, fracture brittle; colour orange red; odour not distinct; taste sour, sweetish.

Microscopic

Fruit pulp shows single layered epicarp consisting of thin – walled, parenchymatous cells covered with thin layer of cuticle; mesocarp differentiated into two zones, outer zone consisting of 5-10 layers of rectangular, thin-walled parenchymatous cells, inner mesocarp consisting of oval to polygonal, thin-walled crushed parenchymatous cells, most of the mesocarp cells filled with reddish-brown substance, which is tannin when tested; a few fibro-vascular bundles found scattered in this region (Anonymous, 2001).

Macroscopic

Stem bark – Bark available in pieces of variable length, usually 0.6-1 cm thick, external surface blackish-grey, hard, rough due to deep furrows and fissures, exfoliating in irregular scales exposing inner brownish-red fibrous zones; odour no any characteristic; taste astringent.

Microscopic

Stem-bark shows a thick portion of rhytidoma, made up of about 25-30 alternate bands of cork, dead cells of secondary cortex and secondary phloem; cork consists of thin-walled, rectangular, about 5-6 layered, crushed, parenchymatous cells, mostly filled with dark brown pigment; secondary cortex consisting of round, oval and crushed rectangular cells; groups of stone cells, fibres and prismatic crystals of calcium oxalate scattered throughout rhytidoma; secondary phloem consists of sieve elements, phloem fibres, crystal fibres, phloem parenchyma, a few stone cells and phloem rays; phloem fibres arranged in alternate bands with phloem parenchyma. Phloem parenchyma consists of rectangular, thin-walled cells, a few contain prismatic crystals of calcium oxalate; crystal fibres present, divided into numerous chambers, each containing single prismatic crystal of calcium oxalate, phloem rays uniseriate to biseriate, upto 10 cells high, consists of round, thin-walled parenchymatous cells. Stone cells, mostly rectangular and occur associated in groups of 2-4 with bands of phloem fibres (Anonymous, 2001).

Powder microscopy

Fruit pulp – Orange in colour; shows round to oval thin-walled, reddish-brown cells of mesocarp, slightly thick-walled polygonal epicarp cells in surface view (Anonymous, 2001).

Stem bark – Reddish-brown in colour; shows fragments of cork cells, phloem fibres with wide lumen and pointed tips, crystal fibres, phloem rays, rectectagular, stone cells and prismatic crystals of calcium oxalate (Anonymous, 2001).

Physical constants

	Fruit Pulp	Stem bark
Total ash	Not more than 4.5%	Not more than 13%
Acid insoluble ash	Not more than 0.2%	Not more than 15%
Alcohol soluble extractive	Not less than 25%	Not less than 6%
Water soluble extractive	Not less than 45%	Not less than 6%

(Anonymous, 2001)

Thin Layer Chromatography

Fruit pulp – TLC of the alcoholic extract on silica gel 'G' plate using n-Butanol: Acetic acid: water (9:1:10) shows under, U.V. (366 nm) a fluores cent zone of Rf. 0.34 (light blue). On exposure to Iodine vapour seven spots appear at Rf. 0.11, 0.17, 0.34, 0.43, 0.54, 0.66 and 0.84 (all yellow). On spraying with 60% Methanolic sulphuric acid reagent and heating the plate for ten minutes at 120°C five spots appear at Rf. 0.17, 0.34 (both black), 0.43, 0.66 and 0.84 (all grey). On spraying with 5% Methanolic – sulphuric acid reagent and heating the plate for ten minutes at 110°C two spots appear at Rf. 0.17 and 0.34 (both black) (Anonymous, 2001).

Stem bark – TLC of the alcoholic extract on silica gel 'G' plate using chloroform: Methanol (95:5) shows under UV (360 nm) a fluorescent zone at Rf. 0.84 (light blue). On exposure to Iodine Vapour two spots appear at Rf. 0.80 and 0.84 (both yellow). On spraying with Dragendorff reagent followed by 5% Methanolic sulphuric acid a spot appears at Rf. 0.84 (orange) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Plant: Jujuboside D, jujuboside A, 5, 7, 4'-trihydroxyflavonol-3-O-beta-D-rhamnopyranosyl-(1-->6)-beta-D-glucopyranoside, 6-coumaroylspinosin, phenylalanine (Liu *et al.,* 2004), jujuboside E, jujuboside B, jujuboside A, betulic acid, sucrose, inosine (Bai *et al.,* 2003).

Leaves: Flavonoids, ziziphin, 13C-frangulamine (Haslinger and Robien, 1982), yuziphine, yuzirin as (R)-1-(4'-hydroxybenzyl)-7-methoxy-8-hydroxy tetrahydroisoguinohine and 1-(4'-hydroxybenzyl)-6-methoxy-7-hydroxyisoghinoline, coklaurine, isoboldine, norisoboldine, asimilobine (Ziyaev *et al.,* 1977), n-octacosanol, alphitolic acid and saponin composed of abetin lactone, glucose, arabinose, 6 deoxy-L-talose (Sharma and Kumar, 1982), ceanothic acid (De Mayo and Starret, 1961), betulinic acid (Singh *et al.,* 1965), rutin (Akhmedov and Khalmatov, 1967).

Fruits: Sapogenin-zizogenin (Shrivastava and Shrivastava, 1979), dammarane saponin I, II and III, jujuboside B (Inove *et al.,* 1978), flavone-C-glucosides-6"-sinapoylspinosin, 6"-feruloylspinosin and 6"-p-coumaroylspinosin (Woo *et al.,* 1980), colubrinic acid, alphitolic acid, 3-O-cis-p-coumaroylalphitolic acid, 3-O-trans-p-coumaroylalphitolic acid, 3-O-cis-p-coumaroyl-maslinic acid, 3-O-trans-p-coumaroylmaslinic acid, betulinic acid, oleanolic acid, betulonic acid, oleanonic acid, zizyberenalic acid (Lee *et al.,* 2003, 2004), fattyacids, carotenes (Guerrero *et al.,* 2004), frangufoline (Tschesche *et al.,* 1967a), a flavonoid-spinosin, carbohydrates, fat, protein, amino acids, anthocyanins, leucoanthocyanins, catechins, cytokinin like zeatin (Ghosh *et al.,* 1981), cyclic guanosine 3′:5′ monophosphate, carotene, citric, folic and malic acids, oleic acid alphitolic acid (Cheung and Williamson, 1969), palmitoleic, vaccinic acid, acidic polysaccharide, zizyphus-pectin A, reducing and non reducing sugars, niacin, riboflavin, thiamine, vitamin C, vitamin B, quercetin (Bhattacharjee and Chatterjee, 1962), jujubosides A and B (Otsuka *et al.*, 1978), cyclic Amp (Cyong and Hanabusa, 1980), jujuboside A, B, berberine, protopine, eriodictyol, myricetin 3-O-glucoside, 3-O-diglucoside and 3-O-rutinoside, rhamnetin, lauric acid, myristic acid, palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid, arachidic acid, docosanoic acid (Zhao *et al.,* 2006).

Stem bark: Leucocyanidin, leucopelargocyanidin (Singh and Seshadri, 1965), amphibine-H (Tschesche *et al.,* 1974e), jubanines A and B, mucronine D and A, hummularines A and B (Tschesche *et al.,* 1976g), sapogenins as hecogenin acid, cocogenin, chlorogenic acid (Marker, 1947), mucronine-D (Tschesche *et al.*, 1972f), maslinic, ursolics, 2α hydroxyursolic acid (Ikram and Tomlinson, 1976), mauritinen A, B (Tschesche *et al.*, 1972b), mauritinen C, D, E, F (Tschesche *et al.*, 1974d), mauritinen-G, jubanine-C, scutianine-C and zizyphine-A (Tripathi *et al.*, 2001).

Seed: Jujuboside A and B (Wang *et al.*, 2005), 1, 3-di-O-[9(Z)-octadecenoyl]-2-O-[9(Z), 12(Z)-octadecadienoyl]glycerol, and a fatty acid mixture of linoleic, oleic and stearic acids, 3-O-[9(Z)-octadecenoyl]betulinic acid, and betulinic acid (Su *et al.*, 2002), jujubosides A1 and C and acetyljujuboside B, protojujubosides A, B, and B1 (Matsuda *et al.*, 1999; Yoshikawa *et al.*, 1997).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have anxiolytic, sedative (Han *et al.*, 1993; Peng *et al.*, 2000), potent inhibitory activity on alpha glucosidase (Nakamura et. al, 1998), antimicrobial, (Valsaraj et. al, 1997), ionophore activity of franqufoline (sedative alkaloid from Z. jujuba) (Park et. al, 1991), antisteroidogenic (Gupta *et al.*, 2004), antioxidative (Wang and Chen, 1991), anticompementary (Lee *et al.*, 2004), cognitive [causative agent cis-9-octadecenoamide (oleamide)] (Heo *et al.*, 2003), inhibitory (Shou *et al.*, 2002; Yamada and Imoto, 1987) and anti-inflammatory activities.

THERAPEUTIC EVALUATION

Jujuboside A is a main component of jujubogenin extracted from the seed of *Z. jujuba* Mill var spinosa (Bunge) Hu ex H F Chou (Ziziphus), showed *in vivo* and *in vitro* inhibitory effects on hippocampal formation (Zhang *et al.*, 2003).

FORMULATIONS AND PREPARATIONS

Ghrita *–Dadhika ghrita, Dhanvantara ghrita.*

Churna *– Yavani sandava, Gojihavadi kvatha churna.*

Taila *– Dhanvantara taila, Brhat Masa taila* (Anonymous, 1978; 2000).

Other classical formulations –

Hapushadya ghrita (C.S.Ci.5.72), *Amritaprasha ghrita* (C.S.Ci.11.37), *Pindarista* (S.S.Ci.10.6), *Mahabnutarava ghrita* (A.H.Ci.11.20), *Rohitaka ghrita* (A.H.Ci.15.93), *Dashamooladya ghrita* (C.S.Ci.15.82), *Rasna ghrita* (C.S.Ci.18.43), *Narayan churna* (C.S.Ci.13.124), *Panchamooladya churna* (C.S.Ci.15.89), *Bhaskar churna* (A.H.U.13.28), *Amritadya taila*

(C.S.Ci.29.103), *Bala taila* (S.S.Ci.15.29), *Ksharaagada* (C.S.Ci.23.96), *Phala asava* (C.S.Su.25.49), *Garbhayoga in 8th month pregnancy,* (C.S.Ka. 10.4; A.H.Sa.1.65), *Chandanadya taila* (C.S.Ci.3.258), *Agurvadaya taila* (C.S.Ci.3.267).

TRADE AND COMMERCE

Retail market price – Fruit (dried) Rs. 40 per kg, Fresh fruit ripe – Rs. 10-20 per kg (2006).

SUBSTITUTES AND ADULTERANTS

There are few varieties of jujuba under cultivation and are used as substitute. Besides these, fruits of *Z. oenoplia* Mill, *Z. xylopyra* Willd., *Z. rugosa* Lam., *Z. sativa* Gae, *Z. nummularia* W.and A. are sometimes used as substitute or adulterants (Anonymous, 2000a).

PROPAGATION AND CULTIVATION

Tree prefers neutral or slightly alkaline, sandy loam, black, light or medium soils having good drainage capacity. Although hot and dry climate is ideal for its cultivation, the plant can tolerate frost, wind and drought conditions as well.

Seedlings can be raised from seeds cuttings, budding, grafting, and root suckers. Plantation is done by direct sowing of seeds or by transplanting seedlings, 11-12 cm apart. It is reported that pruning at an early stage of development helps establishment of the tree for producing maximum yield (Anonymous, 1976).

In vitro multiplication of *Zizyphus jujuba* from stem explants was reported by Mathur *et al.,* 1995. Shoot induction was observed within 4 weeks on modified MS supplemented with 11 μM BA and 0.5 μM IAA. Rooting was initiated on auxin free White's basal medium producing more number of long roots, within 10 days. Studies on various factors related to regeneration in Zizyphus were also reported by Goyal and Arya, 1985; Mathur *et al.,* 1993 and Rathore *et al.,* 1992.

The direct induction of adventitious shoots from leaf explants of adult plants of *Z. jujuba* was reported by Gu and Zhang, (2005). Highest efficiency of shoot formation was observed within 20-day culture in dark on Woody Plant Medium containing 4.54 μM TDZ and 2.85 μM IAA. Regenerated shoots were transferred to MS medium supplemented with 0.89 μM BA and 5.77 μM GA_3 for growth. Shoots of 2 cm height were transferred to Nitsch medium supplemented with 1.14 μM IAA and 2.46 μM IBA to induce rooting. Similarly, Mathur *et al.,* 1995; Chen *et al.,* 2002; Hossain *et al.,* 2003; Wang, 1996; Xu *et al.*, 2003, have also reported *in vitro* propagation of *Zizyphus jujuba.*

In vitro tetraploidy in *Z. jujuba* was induced with colchicine treatment. Cultures were raised using liquid MS medium containing 5.77 μM GA_3 and colchicine in different concentrations. *In vitro* grown shoot tips were transferred to liquid MS medium containing colchicine and shaken (100 rpm) at 25ºC in darkness for 24, 48, 72 or 96 hrs respectively. Shoots were subcultured on MS medium with 5.77 μM GA_3 and 0.89 μM BA at an interval of 30 days. Elongated shoots were rooted on Nitsch basal medium fortified with 1.14 μM IAA and 2.46 μM IBA, Gu *et al.*, (2005).

Purification and characterization of a lectin from *Z. mauritiana* was reported (Gupta and Srivastava, 1998) from various explants *viz.*, cotyledonary leaf, leaf, stem, nodal region and roots from 3 week old seedlings grown *in vitro*. Callusing was obtained on MS medium combined with 1.0 mg/L IAA and 1.0 mg/L BAP. Highest lectin activity was observed in callus cultures of cotyledonary leaf.

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6. 25; **A. H. U. 2.** 34, 48, 72; **5.** 20, 19; **11.** 44; **13.** 28; **25.** 35; **26.** 39; **32.** 20, 23; **34.** 3; **35.** 57.

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MASHA

BOTANICAL NAME : *Vigna mungo* (Linn.) Hepper **Syn.** *Phaseolus radiatus* Roxb., non Linn., *Phaseolus mungo* Linn., non Roxb. & auct.

FAMILY: **Fabaceae**

CLASSICAL NAMES

Masha (C.S.; S.S.; A.H.).

Synonyms

Baladhay, Bhuktiprada, Hayananda, Kuruvinda, Mamshala, Pitrijoultam, Pittiya, Rasottama, Supashreshtha, Suphala, Vajibhojana, Varnarha, Vrishakar (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES

Eng.- Black gram. **Hindi-** *Urd, Urid, Urud, Thikiri*. **Beng.-** *Mash-kala, Tircorai-kalai, Mashkalai, Mash-kulay*. **Guj.-** *Adad, Arad*. **Kan.-** *Uddu, Hasaru*. **Mal.-** *Uzhunnu, Ulunnu, Cheru-poiaar*. **Mar.-** *Udid, Maga*. **Punj.-** *Mash, Mak, Urad*. **Tam.-** *Ulundu, Ulunthu, Patchay-pyre, Panny-pyre*. **Tel.-** *Minumulu, Karuminimulu, Minumu, Nallaminumala, Uddulu, Patsa-pesalu.* **Arab.-** *Mash*. **Pers.-** *Benu mash*. **Kon.-** *Udid* (Anonymous, 1996; Watt, 1972; Anonymous, 1976; Nadkarni, 1976; Yoganarsimhan, 2000; Kirtikar and Basu, 1933; Sharma, 1978; Chatterjee and Pakrashi, 1992; Chopra *et al.*, 1986; Anonymous, 2000a; B.N., 1982).

BOTANICAL DESCRIPTION

Suberect or erect, diffusely spreading hairy herb, 30 to 90 cm high. Leaves alternate, trifoliolate, leaflets elliptic-ovate or oblong-lanceolate, apex acute to acuminate, 5-10 cm long. Flowers yellow, bisexual, terminal, usually 8-12 on c 10-15 cm long peduncle. Pods 3-5 cm long, cylindrical, hairy, terete with a short hooked beak. Seeds 10-15, oblong with square ends, about 3 mm long, black with a white hilum. Flowering and Fruiting : August – November (Cooke, 1967; Anonymous, 2000b; Kirtikar and Basu, 1933; Yoganarsimhan, 1996, 2000; Anonymous, 1976; Naik *et al.*, 1998).

MASHA ***Vigna mungo*** (Linn.) Hepper

DISTRIBUTION

Masha is a native of India and is cultivated as a major pulse crop almost throughout India (Cooke, 1967). The major producing areas are Madhya Pradesh, Uttar Pradesh, Maharashtra, Himachal Pradesh, Punjab, Haryana, Bihar, West Bengal, Andhra Pradesh, Tamil Nadu, Gujarat, Orissa, Assam, Kerala, Jammu & Kashmir, Karnataka and in some parts of Delhi (Anonymous, 1976). Cultivated to some extent in Nepal (Watt, 1972; Chatterjee and Pakrashi, 1992).

PART(S) USED

Seed, root, whole plant (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The seeds are sweet, emollient, demulcent, thermogenic, diuretic, antitpyretic, aphrodisiac, tonic, nutritious, galactagogue, appetizer, laxative and nervine tonic (Nadkarni, 1976; Kirtikar and Basu, 1933). It is used in dysentery, diarrhoea, cystitis, paralysis, piles, internally and externally in gastric cattarh, rheumatism, affections of liver, in form of decoction and poultice in gastritis (Anonymous, 1996). The roots are narcotic and are used for aching bones, abscesses and inflammations (Chatterjee and Pakrashi, 1992; Chopra *et al.*, 1958).

AYURVEDIC PROPERTIES

Rasa – *Madhura* (S.S.Su.46.34; A.H.Su.6.21).
Guna – *Guru, Snigdha* (S.S.Su.46.34; A.H.Su.6.21).
Vipaka – Madhura (S.S.Su.46.34; A.H.Su.6.21).
Veerya – *Ushna* (S.S.Su.46.34; A.H.Su.6.21).
Doshaghnata – *Vatashamaka* (S.S.Su.46.34), *Kaphapittashamka* (A.H.Su.6.21) (Sharma, 1978; B.N., 1982).
Karma – *Snigdha, Ruchya, Rochana, Vataghna, Sransana, Santarpana, Balya, Shukrala, Brihhana, Malabhedana, Vedanasthapana, Nadibalya, Madaka, Purishajanana, Shoolaprashamana, Yakriduttejaka, Mootrala, Vrishya, Stanyajanana, Artavajanana, Indriyaprasadana, Jeevaneeya, Medovardhana* (S.S.Su.46.34; A.H.Su.6.21) (Sharma, 1978; B.N., 1982).
Rogaghnata – *Stanyalpata, Vatavyadhi* (C.S.Su.3.18; C.S.Ci.28. 111; 29.104,), *Nadidaurbalya* (C.S.Ci.28.97), *Sandhivata, Pakshaghata, Karnanada, Ardita* (C.S.Ci.26.155; C.S.Ci.29.104), *Aruchi, Vibandha, Udarashoola, Yakridvikara* (C.S.Ci.28.173), *Arsha* (C.S.Ci.14.10), *Bastishotha, Mootrakrichchhra* (C.S.Ci.28.173), *Shukradaurbalya, Klaibya* (C.S.Ci.2-4.28), *Jwara* (A.H.Ci.1.140; C.S.Ci.3.267), *Kushtha* (S.S.Ci.9.4;

C.S.Ci.7.7), *Apasmara* (C.S.Ci.10.47), *Yoniroga, Rajorodha* (C.S.Ci.30.72), *Krishata, Daurbalya* (C.S.Ci.28.173), *Vajikarana* (C.S.Ci.2-1.27; 2-2.5; 2-3.16; 2-4.21), *Shiravasti* (A.H.Su.22.28), *Linagarbha chikitra* (A.H.Sa.2.19), *Rajyakshma* (A.H.Ci.5.80), *Pidana, in Dustavrana* (A.H.U.25.40), *Vishuchi* (C.S.Ci.19.38; A.H.Ci.3.19), *Atisara* (A.H.Ci.9.20, 33; C.S.Ci.19.38), *Madataya* (C.S.Ci.24.126; A.H.Ci.7.15), *Vatarakta* (S.S.Ci.5.7), *Bhagandara* (S.S.Ci.8.15), *Kasa* (C.S.Ci.18.76; A.H.Ci.3.19), *Shwasa* (C.S.Ci.28.173), *Avabahuka, Paktishoola* (Sharma, 1978; B.N., 1982).
Doses : Seed / Seed Powder - 5-10 gm (Sharma, 1978; B.N., 1982).
Higher doses and prologe use causes – *Pandu* (C.S.Ci.16.7), *Hikka* (C.S.Ci.17.14), *Vatarakta* (C.S.Ci.29.6), *Kustha* (S.S.Ci.9.4).

SIDDHA PROPERTIES
Siddha Name - *Ulunthu*
***Suvai* (Taste) -** *Inippu* (Sweet).
***Veeriyam* (Potency) -** *Thatpam* (Cold).
***Vibakam* (Tansformation) -** *Inippu* (Sweet).
***Gunam* (Pharmacological action) -** *Narambu uramakki* (Nervine tonic), *Anmai perruki* (Aphrodisiac).
Siddha pharmaceutical preparations - *Pirandai vadakam , Ulunthu thylam.*
Uses - Used in treatment Back pain , Sexual debility.

CHEMICAL CONSTITUENTS
Seed: γ-Glu-met, its sulphoxides and homologous γ-glutamyl peptide pattern is used to identify the plant (Otoul *et al* 1975), vitexin, β-sitosterol, lysine, phenylalanine, cystine, methionine, threonine, seedling protein (Dec *et al.,* 1978), phosphatidylinositol, sulpholipids, phosphatidic acid, mono and digalactosyl diglycerides, phosphatidylethanolamine, phosphatidylcholine, diphosphatidylglycerol identified as polar lipid components of galactolipids (Bhatia *et al.*, 1978), arabinogalactan (Hirozo and Masayoshi, 1979), myristic, palmitic, stearic, oleic, linoleic, arachidic, linolenic acid, stigmasterol, β-sitosterol (Tea-Yung *et al.*, 1979), γ-glutamyl-S-methylecysteine, γ-glutamyl-S-methylcysteine sulphoxide, γ-glutamylglutamic acid, γ-glutamylphenylalanine, γ-glutamyl-γ-glutamyl-S-methylcysteine, γ-glutamylaspartic acid, γ-glutamylcysteinyl-β-alanine, γ-glutamyl-N^{δ}-acetylornithine, γ-glutamyl-S-methylcysteinyl-β-alanine, γ-glutamylleucine + γ-glutamylisoleucine. γ-

glutamyl-S-methylcysteine with homoglutathione and γ-glutamyl derivatives of glutamic acid, aspartic acid, phenylalanine, leucine, isoleucine (Kasai *et al.*, 1986).

Plant: (E) p-Coumaroyl-, (E) caffeoyl-and (E) feruloyl-tartronic acid (Strack *et al.*, 1985), genistein, 2'-hydroxy-genistein, 2'-hydroxydaidzein, kievitone, dalbergioidin, cyclokievitone, 5-deoxykievitone, 2'-hydroxydihydrodaidzein, isoferreirin, eurenol, glycinol, demethylverititol, kievitone hydrate, 4'-O-methylkievitone, cyclokievitone hydrate, 5-deoxy-kievitone hydrate, hemicellulose A, kaempferol 7-O-rhamnoside, quercetin 3-O-robinobioside-7-O-rhamnoside, quercetin 3-O, quercetin 3-O-glucoside (isoquercetin), phaseollin , 3-O-galactosyltransferase, saponin (Toya and Iseda, 1964), the hexasaccharide ajugose (Kotiguda *et al.*, 2006), ajugose, raffinose, stachyose, verbascose, and ajugose (Girigowda *et al.*, 2005), lindane (Parihar and Gupta, 2001), tannin (Zia-Ur-rehman and Shah, 2001).

Blackbean: soyasaponin I soyasaponin II, soyasaponin V, saponin A, B (Lee *et al.*, 1999).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antipyretic (Gupta *et al.*, 1983), spasmolytic, diuretic, antifungal, antibacterial (Wang *et al.*, 2005a; Barthakur, 2000), hemagglutinating (Singh and Rao, 1991) and hypolipidemic (Menon and Kurup, 1976) activities. The plant is reported to have hypoglycemic activity in animals (Boby and Leelamma, 2003).

TOXICOLOGY

The LD50 > 1000 mg /kg bw in mice.

THERAPEUTIC EVALUATION

External application of "*Mahamasa taila*" in which *Phaseolus mungo* is one of the main ingredient alongwith internal administration of the drug Ekangeveera rasa was proven effective in polimyelitis management of post polio residual paralysis with certain other Ayurvedic formulations (Nair *et al.*, 1997).

During clinical trials the effects of "*Masha taila*" in which "*Phaseolus mungo*" the main ingredient was studied on hemiplegic patients by monitoring some important biochemical parameters which have clinical significance to the condition. *Masha taila* significantly decreased gastric acidity, peptic activity, total serum cholesterol and elevated high serum lipoprotein (HDL) fraction (Nair *et al.*, 1987).

FORMULATIONS AND PREPARATIONS

Avaleha And Paka *– Chyavanaprasha, Mashadi modaka.*

Kvatha Churna *– Vidaryadi kvatha churna, Mashabaladi Kvatha, Mashatmaguptakadi kvatha.*

Ghrita *–Amritaprasha ghrita, Ashoka ghrita, Brihat Ashvagandha ghrita, Brihachhagaladya ghrita, Shatavaryadi ghrtia, Dadhika ghrita*

Taila *– Dhanvantara taila, Brihat Masha taila, Maha narayana taila, Mulaka taila, Bala taila, Mashabaladi taila, Mahamasha taila, Masha taila.*

Varti *(Netrabindu And Anjana) – Kayasthadya Varti* (Anonymous, 1978, 2000).

Other classical formulations – *Mashayoga* (S.S.Ci.26.29), *Vajeekarana ghrita* (C.S.Ci.2-1. 34), *Apatyakara ghrita* (C.S.Ci.2-4. 28), *Vrishyamasha yoga* (C.S.Ci.2-1.47), *Mashadi pupalika* (C.S.Ci.2-4.23), *Shastikadi gutika* (C.S.Ci.2-2.5,7), *Agurvadya taila* (C.S.Ci.3.267), *Amritadya taila* (C.S.Ci.29.102).

TRADE AND COMMERCE

Retail market price- Seed- Rs.45/- to 60/- per Kg (2006).

PROPAGATION AND CULTIVATION

The crop is grown principally on clayey and black cotton soils, but red loamy, light-red or brown alluvial soils which are not shallow, are also suitable. It is grown almost entirely as a dry crop in tracts with a rainfall not exceeding 85 cm; where rainfall is heavier, it is raised only after rains. Normally the crop is sown in the beginning of May, but as a mid-season crop, it is sown in June / July or as late crop in October. For land preparation, fields are ploughed once or twice to bring soil to a fine tilth. Seeds are generally broadcast or sown in rows 25 cm apart in ploughed furrows and later smoothed by a harrow. In 7-10 days, the plants are well above the ground. The plants flower in 7 weeks from sowing and in 3 months the pods are ready for harvesting. It is always preferred to harvest pods before they are fully ripe, to avoid shattering of dry grains. The dried pods are threshed and winnowed for seed separation. On average, a pure crop yields about 500-725 kg seeds/ha. (Anonymous, 1976).

Shoot regeneration in *P. mungo / V. mungo* and other related species using cotyledonary node explant has been reported. Explant was obtained from 4-day-old *in vitro* germinated seedlings within 2 weeks. Shoot initiation was achieved on MS media supplemented with 1.0 mg/L BA. Shoots 7mm or longer were placed on MS plain and MS with 1.0 mg/L IAA for root initiation, Avenido *et al.,* (1999). Also, plant regeneration was reported by Das *et al.,* 1998; Gill *et al.,* 1987; Ignamuthu *et al.,* 1997 and Geetha *et al.,* 1997ab. *In vitro* regeneration of *P. mungo* plantlets has been reported from seed-derived cotyledon and embryonal axis explants by Ignacimuthu and Franklin, 1999. Multiple shooting was obtained on modified MS medium containing B5 vitamins supplemented with 13.31 μM BAP, 0.161 μM NAA and 12mM proline within 15 days. MS basal medium was used for shoot elongation and rooting was obtained on MS medium containing IBA.

Many workers like Khatoon and Ara, 1995; Eapen and George, 1990, have reported somatic embryogenesis in *P. mungo*.

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MASHAPARNI

BOTANICAL NAME: ***Teramnus labialis*** Spreng**.**
Syn.–*Teramnus parviflorus* Spr.;
Glycine labialis Linn.;
G. parviflora Lam.

FAMILY: **Fabaceae**

CLASSICAL NAMES
Mashaparni (C.S.; S.S.; A.H.)

SYNONYMS
Ardramasha, Ashvapuchhi, Atmodbhav, Bahuphala, Ghana, Hansamasha, Hayapuchhi, Hayapuchhika, Kalyani, Kamboji, Krishnavanta, Krishnavrinta, Mahasaha, Mangalya, Mansamasha, Mashaparnika, Panduloma, Pandulomasha, Pandulomashaparnini, Pandura, Paranini, Shaliparni, Sinhamukhi, Sinhapuchhi, Sinhapuchhika, Sinhavinna, Sulabha, Suryaparni, Svayambhu, Trashiprokta, Vajramuli, Vishambika (Sharma, 1978; R.N., 1982; B.N., 1982; D.N., 1982).

VERNACULAR NAMES
Eng.- Vogel-Tephrosis. **Hindi-** *Mashparni, Mashavan, Vana Urada, Jangli udad, Banurdi, Banudad, Mashoni, Mashani.* **Beng.-** *Mashance, Bankalai, Mashani*. **Guj.-** *Valiyovelo, Jungaliadada vela, Ban udad, Janglee Adad.* **Kan.-** *Kadu uddu*. **Mal.-** *Katt ulandu, Kattu zhunnu.* **Mar.-** *Ran udid*. **Punj.-** *Jangali urad.* **Tam.-** *Katulandu, Kattu-ulandu.* **Tel.-** *Karuminum*, *Adavi-vuddulu*, *Mashperni* (Kirtikar and Basu, 1933; Chopra *et al.*, 1986; B.N., 1982; Nadkarni, 1976; Vaidya, 1968; Sharma, 1978; Anonymous, 1976; Anonymous, 2000a; Ayer and Kolammal, 1963).

BOTANICAL DESCRIPTION
A widely spreading twining herb, stems slender, more or less appressedly hairy. Leaves 3-foliate, leaf-lets membranous or sub-coriaceous, 3.5 – 6 x 1.5 – 2.5 cm, the terminal slightly the largest, ovate-oblong or oblong – lanceolate, hairy beneath, base rounded or acute, stipels subulate, stipules ovate – lanceolate, deciduous. Flowers reddish, bisexual, in axillary few flowered lax racemes, 5-15 cm long, solitary or fascicled along a slender,

MASHAPARNI ***Teramnus labialis*** Spreng.

more or less hairy rachis. Pods 3-5 cm long, narrowly linear, straight or slight incurved, hairy when young, glabrous on maturity with a short stout beak bent upwards nearly at right angle with the pod. Seeds 8-12, oblong, truncate or slightly rounded at the ends, smooth and dark brown in colour. Flowering and Fruiting: August – December (Cooke, 1967; Anonymous, 2000b; Gamble, 1967; Ayer and Kolammal, 1963; Hooker, 1973; Kirtikar and Basu, 1933).

DISTRIBUTION

Found wild throughout the greater parts of the country, especially in the tropics from Punjab eastwards to West Bengal, Gujarat, Maharashtra, Deccan, N. Circars, Tamil Nadu, grows wild in the plains in southern parts of India (Cooke, 1967; Anonymous, 1976). Also occurs in Sri Lanka, Bangladesh, Burma, Thailand, China, Vietnam, Indonesia, Philippines, Madagascar and New Guinea (Kirtikar and Basu, 1933; Haines, 1961; Gamble, 1967).

PART(S) USED

Whole plant, root, fruit (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The fruit is bitter, cooling and sweet. It is used as aphrodisiac, stomachic, nervine tonic, astringent to the bowels, antipyretic and galactagogue, (Kirtikar and Basu, 1933). It is also used in inflammation, biliousness, blood diseases, gout, fevers, bronchitis, thirst, burning sensation, paralysis, rheumatism, affections of the nervous system, haemoptysis, tuberculosis and catarrh (Chatterjee and Pakrashi, 1992).

AYURVEDIC PROPERTIES

Rasa *– Madhura, Tikta.*

***Guna* –** *Ruksha* (S.S.Su.46.36), *Laghu, Snigdha* (Sharma, 1978; B.N., 1982).

***Vipaka* –** *Madhura.*

***Veerya* –** *Sheeta.*

***Doshaghnata* –** *Pittanashaka* (S.S.Su.46.46), *Kaphavataghna* (A.H.Su.6.169), *Vatapitta shamak, Kaphavardhak* (Sharma, 1978; B.N., 1982).

Karma – *Deepana, Snehana, Anulomana, Grahi, Raktapittashamaka* (C.S.Ci.4.84), *Raktashodhaka, Shothhara, Shukrajanana* (C.S.Su.4-9.19), *Jwarghna, Dahaprashmana, Jeevaniya* (C.S.Su.4-9.1), *Balavardhaka* (S.S.Su.46.46; A.H.Su.15.9.) (Sharma, 1978; B.N., 1982).

Rogaghnata – *Pakshaghat, Sandhivata, Ardita* (A.H.Ci.21.76), *Raktapitta* (C.S.Ci.4.84), *Udarshoola, Grahani, Shukrameha* (A.H.U.40.13), *Sheeta jwara, Daha* (C.S.Ci.3.267; A.H.Ci.1.121), *Kshayroga* (C.S.Ci.11.34; A.H.Su.15.9), *Rajayakshma* (C.S.Ci.8.69; A.H.Ci.5.13), *Madataya* (C.S.Ci.24.149), *Vatavydhi* (C.S.Ci.28.149; S.S.Ci.37.19), *Vatarakta* (C.S.Ci.29.61,73), *Shotha* (S.S.Ci.23.12), *Visha* (S.S.Ka.2.47), *Atisara* (A.H.Ci.9.56) (Sharma, 1978; B.N., 1982).

Doses : Powder 5-10 g, Decoction 50-100 ml. (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *KATTU ULUNTHU*

***Suvai* (Taste) -** *Inippu* (Sweet).

***Veeriyam* (Potency) -** *Seetham* (Cold).

***Vibakam* (Tansformation) -** *Inippu* (Sweet).

***Gunam* (Pharmacological action) -** *Annmai perukki* (Aphrodiasic).

Siddha pharmaceutical preparations - *Kattu ulunthu ilagam ,*
Kattu ulunthu choornam.

Uses - Used in treatment Sexual debility.

PHARMACOGNOSY

Macroscopic

Root – Tap root with lateral roots occurs in cylindrical, branched pieces, 3-5 cm long, upto 1 cm diameter, light brown to dark brown with longitudinal and transverse cracks, lateral roots thin, smooth, moderately woody; fracture short and laminated.

Microscopic

Transverse section of root shows poorly developed 4-10 layered cork comprising of tangentially elongated cells having brown walls, exfoliating strips of crushed cork cells occasionally present. Secondary cortex consisting of 3-8 layers of tangentially elongated thin-walled cells. Secondary phloem appearing dome-shaped, composed of sieve tubes, companion cells, parenchyma, fibres and crystal fibres, the whole being traversed by phloem rays; phloem parenchyma thin-walled, polygonal, phloem fibres numerous, lignified, thick-walled, septate, occur mostly in groups, among phloem parenchyma; crystal fibres containing prismatic crystals of calcium oxalate; cambium not distinct. Secondary xylem consisting of vessels, fibres and crystal fibres all traversed by xylem rays; vessels solitary or in groups of 2-3 with pitted thickenings; tracheids present, fibres septate with thick-walls and pointed ends; xylem parenchyma non-lignified, thick-walled elongated cells; crystal fibres elongated, thick walled divided by transverse partitions into chambers, each containing a prismatic crystal of calcium oxalate; xylem rays 1-6 cells wide, thin-walled radially elongated; prismatic crystals of calcium oxalate and starch grains present in secondary cortex, phloem fibres, phloem parenchyma and medullary rays. Starch grains numerous, mostly simple, rarely compound, oval to rounded with central hilum and measuring 3-14 μ in diameter (Anonymous, 2001)

Macroscopic

Stem – Cut pieces 5-8 cm long, upto 0.8 cm in diameter, somewhat twisted and branched, or cylindrical, slender, rough due to cracks and longitudinal ridges and furrows; brownish-grey in colour; fracture short and fibrous.

Microscopic

Transverse section shows 6-11 layers, thin-walled, rectangular exfoliated cork cells; secondary cortex comprising of thin-walled, oval to rectangular parenchymatous cells having numerous groups of cortical fibres arranged in radial rows, pericycle composed of isolated strands of fibres, occasionally with stone cells between them; secondary phloem composed of usual elements along with secretary cells, secondary xylem composed of usual elements, xylem fibres long, lignified; vessels simple pitted; ray 1 or 2 cells wide. Pith composed of oval to polygonal, thin-walled, parenchymatous cells containing secretary cells (Anonymous, 2001).

Macroscopic

Leaf – Trifoliolate, leaflets ovate – oblong, 6-12 cm long, base round or acute, light brownish-yellow in colour.

Microscopic

Transverse section of midrib shows single layer of epidermis covered by thick cuticle and having few unicellular trichomes on both surfaces followed by 4 or 5 layers of thick-walled polygonal collenchymatous cells on both surfaces; 2-3 layers of oval to polygonal, thin-walled parenchymatous cells on both surfaces and 'v' shaped vascular bundles having usual elements. Lamina shows single layered epidermis covered by thick striated cuticle and having a few unicellular hairs on both surfaces; single layered palisade cells; 1-2 layers of thin-walled polygonal parenchymatous cells containing chlorophyll in lower surface, a few small vascular bundles having usual elements scattered in central region; stomata paracytic on both surfaces; stomatal index 28-34 on lower surface and 18-24 on upper surface; Palisade ratio not more than five; vein-islet number 6-8; vein let termination number not more than four (Anonymous, 2001).

Flowers – in lax axillary racemes, 5-15 cm long, red, pink or purple or white in colour, slender, more or less hairy peduncles.

Macroscopic

Fruit – Pod upto 5cm long, straight or sometimes slightly recurved, brownish-black to dark brown containing 8-12 seeds.

Microscopic

Transverse section of fruit shows single layered, thick-walled, radially, elongated epidermal cells followed by one row of thick-walled, rounded to rectangular stone cells of various sizes having narrow lumen and centric striation, 3-4 layers of thin-walled radially elongated parenchymatous cells and several layers of thick-walled lignified sclerenchymatous cells of mesocarp.

Seed – oblong, cylindrical, slightly rounded at the ends; 2-3 mm long and upto 2 mm in diameter; colour dark brown. Testa containing thick-walled, tangentially elongated lignified, sclerenchymatous cells followed by two layers of thin-walled, palisade like cells, palisade internally supported by a single layered bearer cells; cotyledons consists of oval to polygonal, thin-walled parenchymatous cells (Anonymous, 2001).

Powder microscopy

Whole plant powder light yellowish-cream in colour; shows fragments of cork, parenchyma, tracheids, unicellular hairs, thick-walled, elongated polygonal cells of testa, simple pitted vessels, septate, thick-walled and pointed fibres; prismatic crystals of calcium oxalate and simple oval to rounded starch grains measuring 3-14μ in diameter (Anonymous, 2001).

Physical constants

Total ash – Not more than 7%; Acid insoluble ash – Not more than 0.5%; Alcohol soluble extractive – Not less than 3%; Water soluble extractive – Not less than 7% (Anonymous, 2001).

Thin Layer Chromatography

TLC of the alcoholic extract on silica gel 'G' plate Toluene: Ethylacetate (9:1) shows under UV (360 nm) seven fluorescent zones at Rf. 0.05, 0.10, 0.15 (all blue), 0.26 (light blue), 0.49, 0.74 (both blue) and 0.85 (light blue). On exposure to lodine vapour four spots appear at Rf. 0.05, 0.10, 0.33 and 0.69 (all yellow). On spraying with vanillin-sulphuric acid reagent and heating the plate for ten minutes at 110°C four spots appear at Rf. 0.05, 0.10, 0.33 (all violet) and 0.96 (dark violet) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Seed: Fraxidin (Fort *et al.,* 2000), amino acids, lysine, leucine, isoleucine, arginine, valine, histidine; unsaturated fatty acids, minerals-potassium, magnesium, calcium, phosphorus, free phenols, tannins, L-DOPA, hydrogen cyanide, phytic acid; proteins (Vishwanathan *et al.,* 1999).

Stem and aerial part: Flavonol glycoside ($C_{26}H_{28}O_{17}$) characterized as 3, 5, 7, 3′, 4′, 5′- hexahydroxyflavone-3-0-β-D-glucopyranosyl (1→ 3) –O-α-L-arabinopyranoside (Yadava and Jain, 2004), vitexin, bergenin, daidzin, 3-O-methyl-D- *chiro* –inositol (Sridhar *et al*., 2006).

PHARMACOLOGICAL ACTIVITIES

The chloroform extract of stem showed antibacterial and antifungal activities. (Yadav and Jain, 2004). Aqueous alcoholic extract of aerial parts was reported to have antihyperglycemic bioactive flavonol glycoside (Fort *et al.*, 2000). Vitexin, bergenin, daidzin and 3-O-methyl-D- *chiro* -inositol from the plant were reported for antiinflammatory activity. Vitexin exhibited a dose-dependent inhibitory activity on 5-lipoxygenase enzyme and exhibited moderate antioxidant activity (Sridhar *et al*., 2006).

FORMULATIONS AND PREPARATIONS

Avaleha and Paka – *Chyavanaprasha, Brahma rasayana.*

Ghrita – *Amritaprasha ghrita, Ashoka ghrita, Brihat Ashvagandha ghrita, Brihatchhagaladya ghrita, Vidaryadi ghrita.*

Taila – *Dhanvantara taila, Bala taila, Madhyama narayana taila, Narayan taila* (Anonymous, 1978; 2000).

Other classical formulations: *Jeevaniya ghrita, Mahakalyanaka ghrita, Aguvadya taila* (C.S.Ci.3.267).

TRADE AND COMMERCE

Retail market price – Rs. 40 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Phaseolus calcaratus Roxb, *P. sublobatus* Roxb; *P. dalzelli* (Cooke, 1967). *Atylosia goensis* Dalz., *Teramnus mollis* Bakers are used as substitute (Anonymous, 2000a). *Pueraria phaseoloides* Benth. and *Calapagonium mucunoides* are also being sold, in Kerala side, as Mashaparni (Ayer and Kolammal, 1963).

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MURVA

BOTANICAL NAME: ***Marsdenia tenacissima*** **Wight. & Arn.**
Syn. *Asclepias tenacissima* Roxb.;
A. tomentosa Herb;
Gymnema tenacissima Spreng.

FAMILY: **Asclepiadaceae**

CLASSICAL NAMES
Murva, *Madhusrava*, *Piluparni*, *Madhurasa*, *Morata* (C.S.; S.S.; A.H.)

SYNONYMS
Devashreni, Devi, Prithakparni, Srigdhaparni, Swadurasa, Tiktavalli, Triparni (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Rajmahal hemp. **Hindi-** *Jiti, Chiti, Tongus, Maruvabel, Jartore, Chinaharu*. **Beng.-** *Chiti, Jiti.* **Tam.-** *Panjukkodi.* **Tel.-** *Karudushtupatige.* **Oriya-** *Gha.* **Dehradun**:- *Maruabel.* **Nepal** :- *Bahuni lahara, Sunamarai.* **Lepcha**:- *Kamtiongrik.* **Central India** :-*Babal jak.* **U.P.** – *Maruabel* (Sharma, 1978; Singh and Chunekar, 1972; Anonymous, 2000a; Anonymous, 1962; Watt, 1972; Anonymous, 1999; Yoganarsinhan, 1996, 2000).

BOTANICAL DESCRIPTION
A large stout, woody twining or climbing shrub with grey or pale brown, corky deeply furrowed bark, stem cylindrical, young branches tomentose. Leaves simple, opposite, 5-25 x 6-15 cm, broadly ovate, acuminate, base cordate with deep sinus and rounded lobes, tomentose on both sides. Flowers bisexual, greenish-yellow in dense much branched compound cymes. Follicles paired, valvety, tomentose 7.5 – 15 cm long, ovoid, lanceolate, prominently marginal, glabrous, smooth and wrinkled on drying. Seeds flattened, ovate-oblong, 1-1.3 cm long. Flowering: April-July; Fruiting: January – March (Anonymous, 2001; Cooke, 1967; Yoganarsinhan, 1996, 2000; Duthie, 1960; Anonymous, 1962; Shah, 1978).

DISTRIBUTION
Throughout India extending in the north up to Sikkim and abundantly found in Bengal, Madhya Pradesh, Chittagong, Western ghats, Karnataka, Gujarat,

MURVA ***Marsdenia tenacissima*** Wight. & Arn.

Rajmahal hills, Timor, Eastern and Western Himalaya ascending upto 1500 m. (Anonymous, 1962). Also found in Sri Lanka, Burma and China (Duthie, 1960; Cooke, 1967; Gamble, 1967; Prasad *et al.,* 1961; Watt, 1972).

PART(S) USED

Root (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The root is reported to be a remedy for colic pain. Recently, it has been claimed that the roots of this plant constitute the drug 'white turpeth' of the Indian market. The drug is a well-known purgative in Indian medicine (Chopra *et al.,* 1998).

AYURVEDIC PROPERTIES

Rasa **–** *Tikta, Kashaya.*
Guna **–** *Guru, Ruksha.*
Veerya **–** *Ushna.*
Vipaka **–** *Katu.*
Doshaghnata **–** *Tridoshhara* (Sharma, 1978; B.N., 1982).
Karma –
External **–** *Twagdoshhara.*
Internal **–** *Stanyshodhana* (C.S.Su.4-9.18), *Triptighna* (C.S.Su.4-9.11), *Virechana* (S.S.Su.44.35), *Deepana, Amapachana, Pittasaraka, Anulomana, Shoolprashamana, Krimighna, Raktashodhak, Hridya, Pramehaghna, Swedajanana, Kushthaghna, Jwaraghna, Rasayana* (A.H.U.39.155) (Sharma, 1978; B.N., 1982).
Rogaghnata –
External **–** Paste of root applied as *lepa in Charmaroga.*
Internal **–** *Amadosha, Amlapitta, Kamala, Pandu* (C.S.Ci.16.122; A.H.Ci.16.11), *Vivandha* (S.S.Su.44.35), *Shoola, Krimi, Hridayroga* (S.S.U.39.204; A.H.Ci.1.65), *Raktavikar, Prameha* (C.S.Ci.6.27; S.S.Ci.11.8; A.H.Ci.12.25), *Stanyavikar* (C.S.Su.4-9.18), *Kushtha* (C.S.Ci.7.68; S.S.Ci.9.9; A.H.Ci.19.33), *Vishamjwara* (C.S.Ci.3.205), *Apasmara* (C.S.Ci.10.20; S.S.U.61.34; A.H.U.7.22), *Grahani* (A.H.Ci.10.34; C.S.Ci.15.125), *Shwasa* (C.S.Ci.17.109), *Kasa* (C.S.Ci.18.86; A.H.Ci.3.133), *Vatarakta* (C.S.Ci.27.32; S.S.Ci.5.12), *Urasthabha* (C.S.Ci.27.32), (Sharma, 1978; B.N., 1982).
Doses : Powder 3-6 gm; 10-20 gm for decoction (Sharma, 1978; B.N., 1982).

PHARMACOGNOSY

Macroscopic

Root – Cylindrical, unbranched, available in cut pieces of varying length and 0.5-3 cm thick, externally yellow to buff colour with dark brown patches on the cork; outer surface marked with prominent longitudinal ridges, furrows and transverse cracks; bark easily separable from wood; fracture short and granular in bark region and fibrous in wood; odour distinct but unpleasant; taste slightly bitter (Anonymous, 1999; Prasad *et al.*, 1961).

Microscopic

Transverse section of root shows a cork, composed of 15-25 layers of thin-walled, tangentially elongated, rectangular cells, some filled with reddish-brown content; secondary cortex composed of an outer region of broken ring of stone cells of varying thickness followed by wide zone of oval to polygonal parenchymatous cells; stone cells yellow in colour, of variable shape and size mostly round, oval to polygonal or linear; secondary phloem composed of mostly parenchyma with small patches of sieve elements and small strands of stone cells, similar to those present in secondary cortex; resin cells present irregularly in this region; phloem fibres absent; phloem rays 1-3 cells wide; secondary xylem segmented and shows a wedge-shaped structure; consisting of small tangential concentric bands of unlignified masses of parenchymatous tissue; separated by similar concentric band of lignified tissue, composed of vessels, tracheids, fibres, fibretracheids and xylem parenchyma; in isolated preparation xylem vessels cylindrical to oblique with transverse articulations, vary in shape and size, with bordered pits; fibres much elongated with mostly tapering ends and pitted walls; thick-walled and lignified parenchyma possess simple and bordered pits and scalariform thickening; tracheids are narrower with tapering ends and some of them are elongated and irregular in shape with small projection from their margin, xylem fibres are narrow, wavy and pitted. Xylem rays not distinctly marked where adjoining parenchyma are delignified; rosette and a few prismatic crystals of calcium oxalate and abundant starch grains present in parenchymatous tissue; starch grains simple, elliptical to spherical with central hilum, 5.5-22 μ diam, compound grains having 2-3 or rarely upto 6 components (Anonymous, 1999; Raghunathan and Mitra, 1982; Prasad *et al.*, 1961).

Powder microscopy

Root- powder light brown in colour; shows a number of stone cells, xylem fibres, tracheids, fibre-tracheids, vessels with pitted walls, fragments of cork, rosette and prismatic crystals of calcium oxalate, simple and compound starch grains measuring. 5.5-22μ in diameter (Anonymous, 1999).

Physical constants

Total ash – Not more than 5%; Acid insoluble ash – Not more than 0.5%; Alcohol soluble extractive – Not less than 7%; Water soluble extractive – Not less than 14% (Anonymous, 1999).

CHEMICAL CONSTITUENTS

Plant: Steroidalglycosides (Shen and Chen, 2005), marstenacigenins A and B, dresgenin (Qiu *et al.*, 1996), thirteen pregnane glycosides (Abe *et al.*, 2000).

Roots: 17α-Marsdenin, 17β-marsdenin, D-cymarose, β-D-glucosyl-L-thevetose, cinnamic acid, acetic acid (Rao *et al.*, 1976), 13-(31,32-dimethyl-30-methylene-21α-acetoxytetradecanyl)-29-methyl-perhydrophenanthr-1,3-diene (Goel and Ali, 2004).

Seed: Methyl glucoside as methyl-4-O-(3-O-methyl-6-deoxy-β-D allopyranosyl) -β-D cymaroside (Singhal *et al.*, 1980a, d), genins, sugars , methyl glycoside, sugars -D-cymarose, asclepobiose, D-canarose, 3-O-methyl 6-deoxy-D-allose, isodrevogenin-P- (Singhal *et al.*, 1980a), drevogenin Q as 11-O-isovaleryl-12-O-acetyldrevogenin-P, 14-anhydro-17α-drevogenin-Q (Mittal *et al.*, 1980; Singhal *et al.*, 1980a), tenasogenin-11α-O-β, β-dimethylacryloyl, 3β, 12β, 14β, 20R-tetrahydropregn-5-ene (Singhal *et al.*, 1980a, b), cissogenin as 3β, 11α, 12β, 14β, 20S-pentahydroxypregn-5-ene (Singhal *et al.*, 1980a, c).

Stem: Tenacissosides A, B, C, D, E. Tenacissoside A as tenacigenin B-I 3-O-β–D-glucopyranosyl-(1→4)-3-O-methyl-6-deoxy-β-D-pyranosyl-(1→4)-3-O-methyl-6-deoxy-β-D-pyranosyl-(1→4)-β-D-oleandropyranoside, tenassoside B as tenacigenin B-II 3-O-β-D-glucopyranosyl-(1→4)-3-O-methyl-6-deoxy-β-D-allopyranosyl-(1→4)-β–D-oleandropyranoside, tenassoside C as tenacigenin B III 3-O-β-D-glucopyranosyl-(1→4)-3-O-methyl-6-deoxy-β-D-allopyranosyl-(1→4)-β-D-oleandropyranoside, tenacissoside D as tenacigenin B IV 3-O-β-D-glucopyranosyl-(1→4)-3-O-methyl-6-deoxy-β-D-allopyranosyl-(1→4)-β-D-oleandropyranoside and tenacissoside E as tenacigenin B-V 3-O-β-D-glucopyranosyl-(1→4)-3-O-methyl-6-deoxy-allopyranosyl-(1→4)-β-D-oleandropyranoside (Miyakawa *et al.*, 1986), tenacissosides J and tenacissosides K (Xing *et al.*, 2004), tenacigenin A (Jun *et al.*, 1980), marsdenosides A , B, C and D (Xia *et al.*, 2004), marsdenosides A-H , 12β-O-2-methylbutyryl-tenacigenin A, 11α,12β-di-O-acetyltenacigenin B, 11α-O-tigloyltenacigenin B (Deng *et al.*, 2006), 12 β-cinnamoyl-dihydrosarcostin and 12 β,20-dibenzoyldihydrosarcostin (Qiu *et* *al.*, 1996), 11α-O-benzoyl-12β-O-acetyl tenacigenin B,11α-O-tigloyl-12β-O-acetyl tenacigenin B, 11α-O-2-methylbutyryl-12β-O-acetyl tenacigenin B, 11α-O-2-methyl butyryl-12β-O-tigloyltenacigenin B, 11α-O-2-methyl butyryl-12β-O-benzoyl tenacigenin B and 11α, 12β, O-ditigloyl-17β-tenacigenin B (Luo *et al.*, 1993b), tenacissoside L, tenacissoside M (Wang *et al.*, 2006), tenacissosides G, H, I and marsdenosides C, G (Deng *et al.*, 2006).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have mild CNS-depressant, anthelmintic, antispasmodic (Rao *et al.*, 1976), cytotoxic (Luo *et al.*, 1993b), antimutagenic (Lee and Lin, 1998) and anticancer (Miyakawa *et al.*, 1986; Luo *et al.*, 1993a,b) activities. It had no effect on frog rectus abdominis muscle but enhanced the contraction produced by acetylcholine. The extract was reported to be devoid of antibacterial activity (Rao *et al.*, 1976).

TOXICITY

Polyoxypregnanes from stem showed cytotoxic activity against the KB cell lines (Luo *et al.*, 1993).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Ayaskriti, Kumaryasava.*
Kvatha Churna – *Brihanmanjisthadi Kvatha churna.*
Guggulu – *Maha yogaraja guggulu.*
Churna – *Sudarshan.*
Ghrita – *Maha Panchagavya ghrita.*
Taila – *Chandanabalalakshadi taila, Mahalakshadi taila.*
Vati and Gutika – *Marma gutika* (Anonymous, 1978; 2000).
Other classical formulations – *Madhuparnyadi taila* (C.S.Ci.29.94).*Mahatikta ghrita, Chandanadya ghrita, Kiratadya churna, Pancham Kshara* (C.S.; S.S.; A.H.).

TRADE AND COMMERCE

Retail Market Price – Rs. 40 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Maerua arenaria Hook f and Th., *Marsdenia roylei* Wight, *Clematis gouriana* Roxb, *C. triloba* Linn. *Helicteres isora* Linn., *Sanseviera roxburghiana*, *Bauhinia tomentosa* Linn., *B. vahlii* W & *A.*, *Chonemorpha* *macrophylla* G. Don are used as murva in different parts of the country or as substitute (Anonymous, 2000a, Singh and Chunekar, 1972; Sharma, 1978; Vaidya, 1982).

PROPAGATION AND CULTIVATION

Plant is vegetatively propagated owing to its low seed viability. Propagation through leaf petiole is one of the easiest method as the petioles have a capacity of rooting. Cuttings soaked for 1 minute in various concentrations of IBA also root well. Leafy stem cuttings show maximum rooting at a concentration of 1000 ppm IBA (Pandey and Singh, 2002).

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PADMAKA

BOTANICAL NAME: ***Prunus cerasoides*** **D. Don**
Syn. P. *puddum* Roxb. ex Wall. Brandis

FAMILY: **Rosaceae**

CLASSICAL NAMES
Padmaka (C.S.;S.S.;A.H.)

SYNONYMS
Charu, Hima, Kaidara, Kedaraja, Malaya, Maleyo, Padmagandhi, Padmakashtha, Padmaksha, Padmavhaya, Padmavriksha, Patalapushpavarnaka, Patalaputrasanibha, Pita, Pitaka, Pitarakta, Rakta, Shitala, Shitavirya, Shubha, Sugrabha, Suratbhav, Suprabha (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Himalayan wild cherry, Bird cherry. **Hindi-** *Padmakatha, Paddam, Phaya, Padamakha, Padmakath, Padamak, Phaja, Padmakashtta, Pajia, Paya.* **Beng.-** Padmak, *Padmakashtha.* **Guj.-** Padmakathi, Padmakanu lakadu, Padmakashtha, Padmak. **Kan.-** *Padamaka.* **Mar.-** *Padmakastha, Padmaka, Padmakasta*. **Punj.-** *Paja, Chabheearee, Amalguckr, Chamiari, Paddam, Pajja, Pajia*. **Tam.-** *Patumugam*. **Lepcha** :- *Kongki*. **Assam-** *Dieng sohiongkrem*. **Burm.-** *Panni*. **Kumaon** - *Paddam, Paiya, Puya, Padam*. **Nepal**- *Paiyung* (Kirtikar and Basu, 1989; B.N, 1982; Chopra *et al.,* 1958, 1986; Anonymous, 1969; Anonymous, 2000a; Anonymous, 1995; Sharma, 1978; Chatterjee and Pakrashi, 1992; Watt, 1972; Vaidya, 1968).

BOTANICAL DESCRIPTION
A middle sized or large tree, bark smooth, brown, peeling off in horizontal strips exposing a shining copper coloured surface. Leaves membranous, ovate-lanceolate or elliptic-lanceolate, blade 7.5-12.5 cm, glossy, nearly glabrous, margin sharply serrate, with one or more conspicuous glands on the petiole. Stipules long, 3-5 parted, glandular, fringed. Flowers white, pink or crimson 2.5 cm in diameter in umbellate fascicles, peduncles long. Drupes ovoid, oblong or ellipsoid, 1.25-2 cm long, obtuse at both ends, yellow or reddish; stone ovoid, wrinkled and furrowed, pulp very little. Flowering and

PADMAKA ***Prunus cerasoides*** D.Don

Fruiting: October - May (Hooker, 1973; Anonymous, 1969; Chauhan, 1999; Collett, 1971; Nair and Henry, 1983; Yoganarsimhan, 1996).

DISTRIBUTION

Indigenous and wild in the temperate Himalaya extending from Kashmir to Bhutan, Garhwal, Sikkim in Akai and Khasia hills in Assam, Manipur at altitude of 900-2300m. (Anonymous, 1969). Found in the districts of Chamba, Kangra, Manipur, Bilaspur, Kullu, Sirmour and Simla in Himachal Pradesh upto elevation of 1800m., upper Burma (Kirtikar and Basu, 1989), Kodaikanal, Utakamund. Also cultivated in the temperate Himalaya from Kashmir to the North eastern part of India (Gamble, 1972; Chopra *et al.*, 1986; Chauhan, 1999).

PART(S) USED

Heart wood, stem, seed (Sharma, 1978; B.N., 1982)

ACTIONS AND USES

The heartwood is bitter, acrid, refrigerant, demulcent, antipyretic, vulnerary, and causes flatulence. It is beneficial in leprosy, hallucinations, leucoderma, erysipelas, burnings, vomiting, asthma, hiccough and thirst (Kirtikar and Basu, 1989). Seed kernal is used in the treatment of stone and gravel in the kidney (Chatterjee and Pakrashi, 1992; Chopra *et al.*, 1958).

AYURVEDIC PROPERTIES

Rasa – *Kashaya, Tikta.*
Guna – *Laghu.*
Vipaka – *Katu.*
Veerya – *Sheeta.*
Doshghnata – *Kaphapittashamaka* (Sharma, 1978; B.N., 1982)., *Pittashamaka* (A.H.Su.15.6).
Karma –*Varnya* (S.S.Ci.2.38), *Kandughna, Kushtaghna, Dahaprashamana* (C.S.Su.3.27; A.H.Ci.5.70), *Vedanasthapana, Raktastambhana, Mootrala, Garbhasthapana, Jwarghna* (Sharma, 1978; B.N., 1982).
Rogaghnata – *Shirashool* (C.S.Su.3.24), *Kandu, Kushtha* (C.S.Ci.7.68; S.S.Ci.9.8; A.H.Ci.19.8), *Visarpa* (C.S.Ci.21.77, 87; S.S.Ci.17.8; A.H.Ci.18.14), *Daha* (C.S.Su.3.27), *Nadishool, Vamana, Trishna* (A.H.Su.15.16), *Raktapitta* (C.S.Ci.29.93; A.H.Ci.2.27), *Ashmari* (C.S.Ci.29.112), *Visha* (C.S.Ci.23.200; S.S.Ka.5.68;), *Amashaya-Shaithilya, Dhoompanyoga* (C.S.Su.5.21), *Jwara* (A.H.Ci.1.56;

C.S.Ci.3.258 ; 15.138), *Prameha (Pittaja)* (C.S.Ci.6.30; A.H.Ci.12.18), *Rajyakshma* (C.S.Ci.8.82; A.H.Ci.5.70), *Shotha* (C.S.Ci.12.65; A.H.Ci.17.22) *Grahani* (C.S.Ci.15.126; A.H.Ci.10.35), *Hikka, Shwasa* (C.S.Ci.17.80, 145; A.H.Ci.4.13), *Kasa* (C.S.Ci.18.88, 172; A.H.Ci.3.10, 172), *Urasthambha (C.S.Ci.27.30), Vrana* (S.S.Ci.2.40; A.H.U.25.65), *Bhagandar* (S.S.Ci.8.44), *Vasti* (S.S.Ci.38.52; C.S.Si.3.48; A.H.Ka.4.12), *Agada* (S.S.Ka.8.49), *As Dhupan* (A.H.Ci.21.76), *Netraroga* (S.S.U.17.90, 93), *Raktavikar* (S.S.U.40.121), *Arsha* (A.H.Ci.8.113) (Sharma, 1978; B.N., 1982).
Doses : Powder 1-3 gm.

PHARMACOGNOSY

Macroscopic

Heart wood - Available in variable sized pieces, yellowish – brown to orange, to which some whitish portion of sap wood still attached; heavy, dense,moderately hard and very strong, annual rings distinctly marked by an irregular and not continuous belt of numerous pores; odour very faint; tasteless.

Microscopic

Mature heart wood consisting of vessels, fibres, tracheids and xylem parenchyma traversed by xylem rays; vessels lignified, moderately thin-walled, reticulate thickening, fairly large with bordered pits having an oval-shaped, lateral perforation at each end, measuring upto 220 μ in length and upto 68 μ in width; fibres occur mostly in groups, usually found associated with other xylem elements, moderately thick-walled, lumen narrow, pointed at both ends, 55-137μ long; tracheids usually thick-walled, lignified, elongated cells; xylem parenchyma composed of thick-walled, found associated with vessels and fibres, oval to elongated, polygonal cells, xylem rays uni- to multiseriate, uni- and biseriate more common, multseriate generally 3-5 cells wide, 40-50 cells high; cut material, when treated with ferric chloride solution turn yellowish, pigments blue or black, indicating tannin (Anonymous, 2001; Gamble, 1972)

Powder microscopy

Heart wood powder reddish-brown in colour; shows fragments of abundant groups of or single pointed fibres measuring 55-137 μ in length, moderately thick-walled, fairly large vessels with reticulate thickening and bordered pits, thick-walled, lignified tracheid cells, pieces of ray cells and xylem parenchyma cells (Anonymous, 2001).

Physical constants

Total Ash – Not more than 1%; Acid insoluble ash-Not more than 0.5%; Alcohol soluble extractive – Not less than 3%; water soluble extractive – Not less than 1% (Anonymous, 2001).

Thin Layer Chromatography

TLC of the alcoholic extract on silica Gel 'G' plate using Toluene: Ethylacelate (9:1) shows under UV (360nm) a fluorescent zone at Rf. 0.64 (blue). On exposure to lodine vapour seven spots appear at Rf. 0.15, 0.32, 0.42, 0.53, 0.59, 0.64 and 0.76 (all yellow). On spraying with Vanilline – Sulphuric acid reagent and heating the plate for ten minutes at 105°C four spots appear at Rf. 0.15, 0.32, 0.53 and 0.59 (all violet) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Heartwood: Dihydrotectochrysin, dihydrowogonin, pinocembrin, chrysin, naringenin, kaempferol, aromadendrin, quercetin, taxifolin, 7-hydroxy-5, 2′, 4′-trimethoxy flavanone(Carasinone), 2′-hydroxy 2, 4, 4′, 6'- tetramethoxy chalcone (Carasidin), 2', 4' dihydroxy-2, 4, 6′-trimethoxy-chalcone (carasin) (Nagarajan and Parmar, 1977a, b).

Stem: Narigenin, apigenin, β-sitosterol, sakuranetin, prunetin, genkwanin (Kalidhar and Sharma, 1984).

Sapwood: A flavone glycoside puddumin A [7-O-(β-D-glucopyranosyl)-5-O-methylnaringenin], genistein (Perkin and Newbury, 1899; Bahuguna *et al.*, 1987), prunetin (Finnemore, 1910), n-pentacosane, triacontane, n-octacosanol, β-sitosterol, ursolic acid , oleic, palmitic and stearic acids, afzelin, kaempteritrin, naringenin, β-sitosterol-β-D-glucoside (Bahuguna and Jangwan, 1987).

Stem bark: Padmakastein and its derivatives, β-sitosterol behenate, tectochrysin, genistein, leucocynidin, 4′-glucoside of genkwanin, chrysophenol, emodin, 8β -D glucosides, orientalone, physcion, β-sitosterol glucoside (Garg *et al.*, 1985), amygdalin, prunasetin (isoflavone), sakuranetin, puddumetin, flavanone (Chakravarti and Ghosh, 1942-43; Chakravarti and Bhar, 1942-43), sakuranetin (5, 4′-dihydroxy-7-methoxy flavone) and its 5-glucoside, neosakuranin (2, 4′-dihydroxy-4-methoxy-6-glucosidoxy chalcone), leucocyanidin (Chakravarti and Ghosh, 1942-43), puddumin B (naringenin-4'-methyl ether-7-O-β-D-galactoside) (Jangwan and Bahuguna, 1989).

Root bark: Ursolic acid, stigmasterol, prunetinoside, glucogenkwanin, (Thapliyal and Bahuguna, 1993).

Seed: Naringenin-5-O-α-L-rhamnopyranoside, 4′-O-methyl-liquiritigenin-7-O-α-L rhamnopyranoside, naringenin 4′-methylether 7-xyloside, β-sitosterol-3-O-D-galactopyranoside (Shrivastava, 1982a, b).
Leaves: Quercetin-3-rhamnoglucoside, kaempferol (Cronenberger, 1959).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antispasmodic (Dhar *et al.*, 1968) and antioxidant (Blando *et al.*, 2004) activities.

TOXICOLOGY

Although plant is not reported for any specific toxicity, it belongs to a genus where most of species produce hydrogen cyanide that gives flavour to almonds. Hydrogen cyanide present in very small quantities and therefore. Stimutate respiration and improve digestion. Howerver, in excess, it can cause respiratory facture and even death (www.ibiblio.org, 2007).

THERAPEUTIC EVALUATION

Puddu-min-A a flavonone glucoside from *P. ceresoides* showed the increased diuretic activity. Plant is not much explored but studies on behevioral approaches after ingestion of plant are going on.

FORMULATIONS AND PREPARATIONS

Asava And Arista *–Usirasava, Chandanasava, Dashmoolarista, Mritasanjivani sura, Sarivadyasava.*
Arka *– Karpuradyarka.*
Kvatha Churna *– Draksadi Kvatha churna, Guduchyadi ghana Kvatha churna.*
Ghrita *–Kasisadi ghrita, Maha Kalyanaka ghrita, Satavaryadi ghrita, Brhatcchagaladya ghrita.*
Churna *– Sudarshana churna.*
Taila *– Arimedadi taila, Kumkumadi taila, Chandanadi taila, Jatyadi taila, Triphaladi taila, Bala taila, Bhringaraja taila, Madhuyastyadi taila, Ashvagandha taila, Guduchyadi taila.*
Vati And Gutika *– Khadiradi Gutika (Mukharoga)* (Anonymous, 1978, 2000).
Other classical formulations: *Padmakadileha* (C.S.Ci.18.174), *Mahatiktaka ghrita* (C.S.Ci.7.145), *Chandanadya ghrita* (C.S.Ci.15.126), *Manashiladi ghrita* (C.S.Ci.17.145), *Kirathadya churna* (C.S.Ci.15.138), *Phalatrukadi churna* (S.S.U.52.14), *Madhuparnyadi taila* (C.S.Ci.29.93), *Mahapadma taila* (C.S.Ci.29.112).

TRADE AND COMMERCE

Retail market price for the year 2006 is Rs. 40 per kg.

SUBSTITUTES AND ADULTERANTS

Var. *rubeus* Ingram and var. *majestica* Ingram, grown in some area like Darjeeling hills are used as substitute or an adulterants. (Anonymous, 1969).

PROPAGATION AND CULTIVATION

The tree reproduces freely from root suckers and can be grown from cuttings with a heel in July/August. The seeds germinate readily. Seeds of the plants requires 2-3 months cold stratification and is best sown in cold frame as soon as it ripe. Stored seeds sown as early as in the year, sometime takes more than 8 months to germinate (www.ibblio.org, 2007).

The seedlings are also used as a rootstock for the propagation of sweet cherry by the orchardists (Chauhan, 1999; Anonymous, 1969).

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PUSHKAR

BOTANICAL NAME: *Inula racemosa* Hook. f.

FAMILY: **Asteraceae**

CLASSICAL NAMES

Paushkar, Pushkarmoola (C.S; S.S; A.H.), *Pushkarahva, Pushkarajajata, Pushkarajata, Pushkarakhya, Paushkarmoola* (C.S.Ci; S.S.Ci.).

SYNONYMS

Brahmatirtha, Dheer, Kashmir, Kushthabheda, Moola, Moolapushkara, Padinapatra, Padma, Padmapatra, Paushkarmoola, Pauskaram, Pusharaja, Pushkakhya, Pushkarahvay, Pushkarshipha, Puskar, Puskaram, Shwasari, Veeja (D.N., 1982; B.N., 1982; R.N., 1982; Sharma, 1978).

VERNACULAR NAMES

Hindi- *Pohakarmula, Pushkaramula.* **Guj.-** *Pushkarmula.* **Kan.-** *Rasnabheda, Poshkaramula, Pohakarmool.* **Mal.-** *Puskkaramulani.* **Mar.-** *Pushkaramula.* **Tam.-** *Puskkaramulam.* **Tel.-** *Puskaramu.* **Arab.-** *Rasan, Zaniabileshami.* **Kash.-** *Poshkar.* **Pers.-** *Gharsa, Pilgush, Rasan, Zanjabilishami.* **Urdu-** *Rasan* (Nadkarni, 1976; Anonymous, 1996; Kirtikar and Basu, 1989; Chopra *et al.*, 1986; Anonymous, 1959; Anonymous, 2000a; Anonymous, 1987; Vaidya, 1968; Sharma, 1978; B.N., 1982).

BOTANICAL DESCRIPTION

A tall stout herb, 30-150 cm high, stem rough, grooved. Leaves radical and alternate, leathery, rough above, densely hairy beneath, coriaceous, crenate, basal leaves 20-45 X 12.5 – 20 cm, long stalked, elliptic, lance shaped, cauline leaves oblong, half stem clasping, often deeply lobed at the base. Flowers yellow in many heads, very large, 3.8 – 5 cm in diameter, in racemes. Fruits achene, 4 mm long, slender, glabrous, pappus 8 mm and reddish. Flowering and Fruiting: July – September (Kirtikar and Basu, 1989; Chowdhary and Wadhwa, 1984; Hooker, 1973; Kurup *et al.*, 1979; Chauhan, 1999).

PUSHKAR ***Inula racemosa*** Hook. f.

DISTRIBUTION

Found in temperate and alpine Western Himalayas from 1800m to 4800m, in Jammu and Kashmir, upto 2000-3000 m.(Agarwal, 1997) In Himachal Pradesh it is found in Parwati valley of Kulu and in Lahul division (Kurup *et al.*, 1979). Also occurs in Afghanistan (Hooker, 1973).

PART(S) USED

Root (Sharma, 1978; B.N., 1982)

ACTIONS AND USES

The root is considered as thermogenic, anti-inflammtory, anthelmintic, carminative, diuretic and febrifuge. It is used in anaemia, catarrah, coryze, cough, dysmenorrhea, loss of appetite, weak heart and skin diseases. The extract revealed antipyeretic and antispasmogenic activity (Kurup *et al.*, 1979). The root is also aromatic, stimulant, antiseptic, alexipharmic, deodorant, anodyne, digestive, stomachic, cardiotonic, expectorant, bronchodilator, stimulant, aphrodisiac, sudorific, emmenagogue and resolvent. It is used as tonic and beneficial in foul ulcers and wounds. It is also reported to be beneficial in hemicrania, cardiodynia, hepatalgia, splenalgia, arthralgia, inflammations, anorexia, dyspepsia, flatulence, colic, cardiac debility, hiccough (Anonymous, 1996) chronic bronchitis and rheumatism (Nadkarni, 1976).

AYURVEDIC PROPERTIES

Rasa – *Tikta, Katu.*
Guna – *Laghu, Tikshna* **.**
Vipaka – *Katu.*
Veerya – *Ushna.*
Doshaghnata – *Kaphavata shamaka* (Sharma, 1978; B.N., 1982).
Karma – *Kaphaghna, Deepana, Pachana, Anulomana, Hridya, Kasahara, Shwasahara, Parshashoolhara, Hikkanigrahana* (C.S.Su.25.40), *Vajeekarana, Swedajanana, Katupaushtika, Medohara, Shothahara, Jwaraghna, Kushthaghna* (C.S.Ci.3.210; S.S.U.61.35) (Sharma, 1978; B.N., 1982).
Rogaghnata – *Kaphavatavikara, Shirashoola* (C.S.Ci.26.270), *Agnimandya, Mootrakrichchhara, Krichchhra, Ashmari* (C.S.Si.4.13), *Ajeerna, Amaghna, Hridayashoola, Jeernakasa, Hikka, Swasha, Pashvashoola, Kshya, Rajyakshma,* (C.S.Su.25.40; Ci.8.108; 17.129;18.53; S.S.U.42.120; 52, 41; A.H.Ci.3.128; U.40.56), *Charmaroga and Kushtha, Jwara, Pandu* (C.S.Ci.3.210; S.S.U.61.35; A.H.Ci.1.66), *Prameha*

(C.S.Ci.6.40), *Grahani* (C.S.Ci.15.109), *Pleeha*, *Visuchika* (C.S.Ci.26.21), *Gulma* (C.S.Ci.5.89), *Arsha* (A.H.Ci.14.31), *Apatantraka* (S.S.Ci.5.21), *Udarshoola* (A.H.Ci.14.39), *Udavarta* (S.S.U.55.45), *Apasmara*, *Unmada* (S.S.U.61.35), *Rajoradha*, *Kashtartava* (Sharma, 1978; B.N., 1982).
Doses : 1-3 gm (Sharma, 1978; B.N., 1982).

PHARMACOGNOSY

Macroscopic

Root: Grey coloured, 10-15 cm long and upto 20cm diam; outer surface more or less longitudinally striated or wrinkled; odour aromatic, characteristic; taste bitter and camphorous.

Microscopic

Transverse section of the root shows prominent vertical rhytidomes, a 4-5 layered thin zone of phelloderm cells filled with dark brown amorphous content a crushed zone of cortex merging into a broad parenchyma zone which includes phloem and several secretory canals. The central core is compact consisting of xylem vessels, few fibres in small patches adnate to some vessel groups as well as in central parts of the xylem and sclerenchyma, the xylem parenchyma being absent. 4-6 primary xlem bundles are present at the center. Vessels are mostly in the center, having, horizontal and slit -like pits and few with rounded bordered pits. Inulin granules and oil globules in parenchyma and yellow resinous mass in the secretory canals. The cortex of old roots shows radial cracks (Anonymous, 1987; Kurup *et al.*, 1979).

CHEMICAL CONSTITUENTS

Plant: Innual, isoalloalantolactone, pyrazoline, isotelekin (Kaur and Kalsi, 1985), tetrahydroalantolactone (Cocker and Nisbet, 1963), oxygenated alantolides (Kalsi *et al.*, 1988), beta-sitosterol, daucosterol and isoalantolactone (Tan *et al.*, 1998).
Essential oil: Sesquiterpenes, aplotexene (heptadeca-1, 8, 11, 14-tetraene), phenylacetonitrile, dihydroaplotaxene (Bokadia *et al.*, 1986), p-cymene, 2-furfural, norbornyl acetate, benzaldehyde sesquiterpene hydrocarbon, elemene, α-pinene oxide, α-humulene, α-farnesene, ar-curcumene, α-ionone, 2-phenylethanol, β-ionone, sesquiterpene alcohol, sesquiterpene aldehyde (Jennings and Shibamoto, 1980).
Root and Root oil: Oxygenated alantolides (Kalsi *et al.*, 1988), liqnans, sesquiterpene lactones, isoalantolactone, alantolactone, tetrahydroalantolactone, selinanone, g-ketoeudesman, 8α-hydroxyeudesman (Singh *et al.*, 1959; Mehra *et al.*, 1967; Purushothaman *et*

al., 1972), dihydroisoalantolactone, neoalantolaetone (Singh *et al.,* 1959), germaacranolide-inunolide, dihydroinunolide, neoalantolactone, dihydroisoalantolactone (Raghavan *et al.,* 1969; Ravindranath *et al.,* 1978), β-sitosterol, octadecanoic acid, D-mannitol, inulin, germacronolide, β-D-glycoside, (–) dammara-20, 24-dien-3 β-ylacetate (Paknikar *et al.,* 1982), alloalantolactone, isoalloatantolactone, telekin, isoinunal (Kalsi *et al.*, 1988).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have anti-pyretic, sedative, anti-inflammatory, hepatoprotective (Rao and Mishra, 1997), antiageing, anti-malarial, anti-viral, anti-bacterial, anticancer (Rai and Acharya, 1998; Mishra *et al.*, 1979a), anthelmintic, antihistaminic, antiasthamatic, antifungal, anti-dermatophytic, hypoglycaemic, insect repellent, insectidal, antispasmodic (Singh *et al.,* 1976, 1980; Tripathi *et al.,* 1978; Mishra *et al.,* 1979a), antiallergic (Srivastava *et al.,* 1999), antiangial, hypolipidemic agent (Singh *et al.,* 1991), cardioprotective, antiplatelet, hypotensive, hypoglycaemic (Dwivedi, 1994) activities.

The root extract showed anti-inflammatory activity against carrageenin induced oedema and antipyretic activity in rats. Graded doses of the extract did not produce any anabolic effects in rats but showed potent antispasmodic activity in various experimental preparations (Singh *et al.,* 1976, 1980).

Alantolactone and isoalantone, the major constituents of the roots showed *in vitro* antifungal activity against *Trichophyton mentagrophytes* and *Microsporum canis* (Tripathi *et al.,* 1978).

The essential oil showed anthelmintic activity against earthworms and tapeworms in varying concentrations but was less active than piperaxine citrate (Mishra *et al.,* 1979b). The 50% ethanolic extract of whole plant has been reported to have no significant hypoglycemic effect in normal rabbits (Sharma *et al.*, 1978).

The efficacy of *I. racemosa* (root) and *Gymnema sylvestre* (leaf) extracts in combination was found to be effective in the amelioration of corticosteroid-induced hyperglycaemia in mice. However, in specific observation, no marked changes in thyroid hormone concentrations were observed by the administration of any of the plant extracts in dexamethasone treated animals. Therefore, these plant extracts may not prove to be effective in thyroid hormone mediated type II diabetes (Gholap and Kar, 2003). *I. racemosa* is also reported to potentiate insulin sensitivity in an animal model (Kelly, 2000).

Alcoholic extract of root of *I. racemosa* was reported to possess potent anti-allergic properties (Srivastava *et al*., 1999).

TOXICOLOGY

The approximate LD50 of root extract was 2030 ± 35 mg/kg i.p. in mice. The LD50 of extract (whole plant) was 250 mg/kg i.p. in rats (Sharma *et al.*, 1978).

THERAPEUTIC EVALUATION

In clinical trials on 30 patients of bronchial and 14 patients of chronic spasmodic bronchitis, *I. racemosa* showed improvement in pulmonary functions, haematological picture and general health (Singh *et al.*, 1983). In another clinical study on 9 patients of ischaemic heart disease, prior treatment of the patients with powdered drug (in dosage of 3 gm, orally) could prevent post exercise ST segment depression in all the cases. The observations were comparable with those of nitroglycerine (Tripathi *et al.*, 1984b). A test drug (Lipistat) comprising of equal-proportions of extracts of *Terminalia arjuna*, ***I. racemosa*** Hook. and latex of *Commiphora mukul* is also reported to be useful in the prevention of ischemic heart disease (Seth et al., 1998).

A combination of oleoresin of *Commiphora mukul* and ***I. racemosa*** has been clinically tried in 50 patients of ischaemic heart disease. The combination was administered in a dose of 6g per day, in three divided dose for a period of 4 months. In a trial 5 patients were cured i.e., they did not have pricordial pain and the serum cholesterol and ECG were within normal limits after 4 months treatment. Varying degree of improvement was observed in 40 patients while in 5 there was no improvement (Tripathi *et al.*, 1984b). Kasadamana – a composite drug prepared from 3x tincture of *Adhatoda vasica, Clerodendron serratum,* ***Inula racemosa*** *and Solanum xanthocarpum* was investigated in 62 cases of kasa. The drug has shown encouraging results in new cases of kasa especially kaphaja variety. It has been proved to be an effective expectorant (Abhang and Kulkarni, 1989). 150 patients of coronary heart disease treated with puskara guggulu powder for a period of six months at total dose level of 6-8g per day in divided doses, exhibited most efficacious Lipid lowering activity (Singh *et al.*, 1991). Haritaki vati (HT) is composed of seven herbal drugs such as *Terminalia chebula, Acorus calamus, Pluchea lanceolata, Piper longum, Zingiber officinale, Hedychium spicatum* and ***Inula racemosa***. 20 patients were administered 2 tablets of HT orally, TDS for 2 months and observations were made. The gradation of chest pain was found to be shifted towards less severe grades and anginal frequency was reduced. Reduction in serum cholesterol and serum triglyceride levels were significant (Awasthi *et al.*, 1996).

Triventa, an Ayurvedic drug containing plants, *Solanum xanthocarpum, Piper longum,* ***Inula racemosa****, Adhatoda vasica, Curcuma longa, Terminalia chebula and Datura alba* etc. was given (1-2 tea spoonful three times a day) to 23 patients of bronchospasm, bronchitis for four weeks. Drug proved to be effective (87% total relief), non-toxic and without undesirable side effects (Mehta, 1995).

The effect of a new combination of herbal drugs *Commiphora mukul, Terminatia. arjuna,* ***Inula racemosa*** was studied in 25 age old patients (age group 51-60 yr) having hypertension, diabetes mellitus and coronary artery disease. The drug was effective in lowering the serum triglycerides only in the hypotensive groups of patients. The drug lowers systolic as well as diastolic blood pressure. Nowever, the drug has no antianginal action. The drug exhibited hypoglycaemic action (Arora *et al.*, 1995).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Rodhrasava, Dashmoolarista, Kumaryasava (A), Kumaryasava(B).*

Avaleha and Paka – *Eranda paka, Agastya Haritaki rasayana, Astangavaleha.*

Kvatha Churna – *Shwasahara Kasaya churna, Katphaladi churna, Nimbadi Kvatha churna, Panchatikta Kvatha churna, Rasnadi Kvatha churna.*

Guggulu – *Saptavimsatika guggulu.*

Ghrita – *Maha Pancagavya ghrita, Dadhika ghrita, Dashmoola ghrita.*

Churna – *Hingvadi churna, Narayana churna.*

Taila – *Brihat Saindhavadya taila, Pippalyadi taila.*

Vati and Gutika – *Kankayana gutika, Khadiradi gutika (Kasa), Siva gutika.*

Lauha – *Pippalyadi lauha.*

Lavana Ksara – *Abhaya lavana* (Anonymous, 1978; 2000).

Other important classical formulations – *Chitrakadileha* (C.S.Ci.18.52), *Chavanprash* (C.S.Ci.1.1.63), *Marichadya churna* (C.S.Ci.15.109), *Pushkarmooladi churna* (S.S.U.42.120), *Hingusauvarchaladya grita* (C.S.Ci.5.69), *Arguvadya taila* (C.S.Ci.3.267), *Mahanila taila* (C.S.Ci.26.270), *Shathydi Kashaya* (C.S.Ci.3.211).

TRADE AND COMMERCE

As per the local raw drugs dealers the selling and storing of this drug has been banned by the Govt. of India, hence, the rates per kg could not be obtained or available.

SUBSTITUTES AND ADULTERANTS

Inula royleana DC. is used as substitute. (Singh and Chunekar, 1972; Garg, 1992) *Costus speciosus* Sm. has also been named as Pushkar mula (Agarwal, 1997).

PROPAGATION AND CULTIVATION

Plant can be grow by seeds and by root division in hot locations. Long and thick roots develop in deep and rich porous soils as well as heavy clay soil (Chauhan, 1999). Moist, well drained garden soil in sun or partial shade also enhances the root growth (Chittendon, 1956; Thomas, 1990; Philips and Rix, 1991; Huxley, 1992).

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SARSHAPA

BOTANICAL NAME: ***Brassica campestris*** **Linn.** ***var.*** sarson ***Prain.***
Syn. *B. campestris* Linn. **subsp**. ***napus*** Hook. f. and T. Anders.

FAMILY: **Brassicaceae (Cruciferae)**

CLASSICAL NAMES
Siddhartha, Sarshapa (C.S; S.S; A.H.)

SYNONYMS
Bhutaghana, Bimbata, Duradharsha, Grahagna, Kadamba, Kadambada, Kadambaka, Kalasarshapa, Katukasveha, Katusveha, Rajakshavaka, Rajika, Rakshitaphalo, Raktasarshapa, Sidhaprayojana, Tantubha, Tantuka, Tuverika, Ugragandha (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Coleseed, Colza, Field Cabbage, Navette, Swedish, Turnip, Wild Navew, Field Mustard, Indian Colza, Turnip Rape, Wild Turnip, Rape Seed, Mustard. **Hindi-** *Bangasarson, Baralai, Dain, Dainlai, Jadiya, Jariya, Kalerai, Khetiya, Lahota, Lai, Laita, Pilasarson, Pilirai, Rararada, Rarasarson, Sarsonzard, Shetashirsha, Sursi, Tori, Saraso, Lahi, Lutni, Maghi, Sarson, ,Toriya,* **Beng.-** *Sadarai, Sanshi, Shurshi, Schwebai, Sursha, Sursi, Sarisa, Sada rai.* **Guj.-** *Kalarai***,** *Raiva***,** *Sarashire, Sarsawa, Sarasad, Rai.* **Kan.-** *Tilgugul, Sasuve, Sasive.* **Mal.-** *Karupakatuka, Seemamullangi, Katuka* **Mar.-** *Kalamohare, Sherasa, Dahakobi, Dahakubi, Shirasi. Mohari, Shiras, Shalgham.* **Punj.-** *Gonglu, Shalgam, Thipper, Sareya, Sarayo, Sarson.* **Tam.-** *Karuppukkadugu, Kadugu* **Tel.-** *Nallaavalu***,** *Avalu*. **Assam-** *Salgam*. **N.W.P.-** *Amemniyenzi*. **Oriya-** *Salgum*. **Pers.-** *Sarshapha*. **Urdu-** *Sarson,* **Sinhalese**- *Kaluabbe* (Anonymous, 2001; Anonymous, 1988; Kirtikar and Basu, 1933; Nadkarni, 1976; Chopra *et al.*, 1958, 2002; Sharma, 1978; Chatterjee and Pakrashi, 1994; B.N., 1982; Anonymous, 2000a).

BOTANICAL DESCRIPTION
An annual or biennial erect, stout, simple or branched glabrous herb, 60-100 cm. high. Leaves large petioled, more or less pinnatified, upper cauline

SARSHAPA ***Brassica campestris*** Linn. var. **sarson** Prain.

oblong or lanceolate, smaller, basal lyrately pinnatifid, lowest leaves auricled, glaucose, more or less hairy beneath at first. Radical leaves 20-30 x 3-5 cm, cauline ones 3-6 x 1-2 cm. Flowers bisexual, bright yellow, large, in oblong corymbs elongating 20-45 cm long racemes. Pods 3-4 cm, reticulately veined, cylindrical, linear, glabrous, sub erect, 2-valved, 2-celled or spuriously 3-4 valved, beak conical, stout often 2.5cm long. Seeds small, smooth, subglobose, dirty yellowish-brown or brown, more or less angular. Flowering and Fruiting: January-March (Anonymous, 2000b; Cooke, 1967; Kirtikar and Basu, 1933; Collet, 1971; Anonymous, 1988; Duthie, 1960).

DISTRIBUTION

Throughout India, largely cultivated as a winter crop in Uttar Pradesh, Punjab, Bihar, Madhya Pradesh, Rajasthan and Assam (Kirtikar and Basu, 1933; Anonymous, 1987; Anonymous, 1988; Asolkar, 1992; Chopra *et al.*, 2002).

PART(S) USED

Seed, leaf (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Seeds are anthelmintic, anti-scorbutic, diuretic, laxative and rubifacient (Kirtikar and Basu, 1933). The crushed seeds are beneficial in external application in the form of ‘poultice’ in rheumatic affections. Brushing teeth with the seed oil mixed with common salt is reported to cure hemophilia and gum inflammation; for external application in cutaneous affections. Combined with camphor the seed oil finds local application in muscular rheumatism, stiff neck and is found to be efficacious when rubbed on the chest in bronchial catarrh and influenza (Chatterjee and Pakrashi, 1994), also recommended for the treatment of snakebite (Chopra *et al.*, 1958).

AYURVEDIC PROPERTIES

Rasa – *Katu, Tikta* (S.S.Su.46.49).
Guna – *Tikshna, Ruksha (Shaka), Snigdha (oil & seed)* (S.S.Su.46.49).
Vipaka – *Katu* (S.S.Su.46.49).
Veerya – *Ushna* (S.S.Su.46.49).
Doshaghnata – *Kaphavatashamaka, Pitta vardhaka* (S.S.Su.46.49; S.S.Ci.9.10; A.H.Ci.19.59) (Sharma, 1978; B.N., 1982).
Karma
External –*Seed-lekhana, Kushthaghna, Varnya* (S.Su.19.27), *Oil – Jantughna, Vedanasthapana, Snehana*.

Internal – *Vatahara, Pittakara, Deepana, Vidahi, Krimighna, Kaphaghna, Pleehaghna, Hriday uttejaka, Mootrajanana, Vajeekarana, Garbhashaya uttejak, Kushthaghana, used as vasti* (C.S.Si.3.65;7.24) *and Eye disease* (S.S.U.12.48) (Sharma, 1978; B.N., 1982).

Rogaghnata –

External – *Shirovirechana* (S.S.Su.39.6), *Uttarbasti* (A.H.Su.19.72), paste of seed or oil used in *Kushtha, and vrana; as Abhyanaga for Balabriddhi,* Oil taken as *Gandusha* (keep in month) or apply with *saindhava* for Dental caries.

Internal – Seed powder used in *Agnimandya, Mootraghata, Kandu, Kushtha, Grahani* (C.S.Ci.23.135), *Krimi*, *Pleehavrddhi*, *Kasa*, *Shwas* (C.S.Ci.18.183), *Vidradhi* (S.S.Ci.16.35), *Gulmama, Jwara, Rajarodha, Klaibya* (A.H.Su.15.33; A.H.U.30.16), *Graharoga* (A.H.U.3.47), *Bhutapratirudh* (A.H.U.5.10,15), *Nasaroga* (A.H.U.20.16), *Pratishaya* (A.H.U.22.81), *Rajayakshma* (S.S.Ci.8.177; A.H.Ci.5.81). According to *Kashyapa Samhita* it considered as one of the best drug in *Pleeha vriddhi* (Sharma, 1978; B.N., 1982).

Doses: Paste 0.5-1gm; Seed power 2-4gm (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - *KARUPPU KADUGU*

***Suvai* (Taste) –** *Kaarppu* (Pungent).

***Veeriyam* (Potency) -** *Veppam* (Hot).

***Vibakam* (Tansformation) –** *Kaarppu* (Pungent).

***Gunam* (Pharmacological action) -** *Vanthi undakki* (Emetic), *Thadipundakki* (Rubifacient).

Siddha pharmaceutical preparations - *Kadugu utkalli, Kadugu thylam.*

Uses - Used in treatment Vatha diseases, Bronchitis.

PHARMACOGNOSY

Macroscopic

Seeds - Small, slightly oblong, pale or reddish brown, bright, smooth, 1.2-1.5 mm. in diameter; under magnifying glass it is seen to be minutely reticulated; taste bitter and sharp.

Microscopic

Seed shows single layered colourless testa followed by 3-5 layered non-lignified, hexagonal thick walled cells filled with yellowish-brown content; embryo and endosperm consists of hexagonal, thin-walled parenchymatous cells containing oil globules (Anonymous, 2001).

Powder microscopy

Seed powder yellow in colour with brown particles and oily, slightly bitter and acrid in taste; shows frequently thick-walled, fragments of reddish-brown cells of hypodermis and yellowish hyaline masses (Anonymous, 2001).

Physical constants

Total ash-Not more than 5%, Acid insoluble ash – Not more than 0.5%, Alcohol soluble extractive – Not less than 8%, Water soluble extractive – Not less than 16%, fixed oil – Not less than 35% (Anonymous, 2001).

Thin Layer Chromatography

TLC of the alcoholic extract of seeds on silica gel 'G' plate using Toluene: Ethylacetate (9:1) shows under UV (360 nm) two fluorescent zones at Rf. 0.12 and 0.59 (both blue). On exposure to lodine vapour three spots appear at Rf. 0.12, 0.59 and 0.20 (all yellow). On spraying with Anisaldehyde-Sulphuric acid reagent and heating the plate for ten minutes at 105°C three spots appear at Rf. 0.12, 0.59 and 0.70 (all violet) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Plant: p-Coumaric, ferulic, sinapsic, caffeic acids, three sulphur containing phytoalexins methoxybrassinin, brassinin and cyclobrassinin (Tollsten and Bergstrom, 1988), an acidic arabinogalacton comprised of L-arabinose, D-galactose, D-glucuronic acid (Siddiqui *et al.,* 1973), linalool, citronellol, geraniol, nerol (Buttery *et al.,* 1976), cis-hex-3-en-1-yl acetate, cis-hex-3-en-1-ol, benzaldehyde, phenylacetaldehyde, naphthalene, 2-phenylethanol, sec-butylisothiocyanate, pent-4-enylisothiocyanate, indole, 2-aminobenzaldehyde, dimethyl disulphide, dimethyl trisulphide, hexanal, trans-hex-2-enal, pent-4-en-1-ol, pent-2-en-1-ol, cis-hex-3-en-1-yl acetate, trans-hex-3-en-1-ol, cis-hex-3-en-1-ol, trans, trans-hepta-2,4-dienal, sec-butylisothiocyanate, but-3-enyl-isothiocyanate, pent-4-enyl-isothiocyanate, 2-phenephyl-isothiocyanate, hex-5-enonitrile, 2-phenylpropionitrile, 6-(methylthio) hexanonitrile, dimethyl trisulphide (Tollsten and Bergstrom, 1988).

Flowers: Sesquiterpene α-farnesene, β-pinene, sabinene, myrecene, limonene, β-phellandrene (Tollsten and Bergstrom, 1988), flavonoid glycoside-brassicoside (Bandyukova and Avanesov, 1971).

Seed oil: The glycerides of palmitic, stearic, oleic, linoleic, linolenic, eicosenoic, behenic, crucic acids, sinigrin, alkenyl glucosinolates, indole glucosinolate, gluconapin, glucobrassicanapin, polysterols-triterpenes, gluconapoleiferin, 5-dehydroavenasterol, 3-butenylisothiocyanate, 2-phenylethylisothiocyanate, phenyl acetonitrile, brassicasterol (24βmethylcholesta–5-trans-22-diene-3β-ol), dehydrocompesterol (24α-methyl cholestas-trans-22-diene-3β-o1), campesterol (24α-methyl cholest-5-en-3β-ol), sitosterol and 5-dehydro-avenasterol (Matsumoto *et al.,* 1983).

Seed epidermis: Arabinose, rhamnose, glucose, mannose, galactose, α-D-galactopyranosyl-(1→6)-O-α-D-galactopyranosyl-(1→1)-L-myoinositol arabinan (Siddiqui *et al.,* 1973), S-1-methoxy-1- (3,5-dimethoxy-4-hydroxyphenyl) ethane, indolacetonitrite, 4-hydroxy indoleacetonitrile, 4-hydroxyphenyl acetonitrile (Nagatsu *et al.*, 2004), rutin (Francois, 1960) and epi-progoitrin (Austin *et al*., 1968), brassicasterol, 22-dehydrocampesterol (Matsumoto *et al.,* 1983), (S)-3-Hydroxypent-4-enethionamide and (R)-3-Hydroxypent-4-enethionamide (Austin *et al.,* 1968).

PHARMACOLOGICAL ACTIVITIES

Plant was found to be have rubifacient (Agarwal, 1997), anti-inflamatory, antiscorbutic, antibacterial, antifungal, fungitoxic and antioxidative (Nagastu *et al.,* 2004) activities.

TOXICOLOGY

The glucosinolates and its derivatives are responsible for the toxicity. The glucosinolates split upon enzymatic hydrolysis to produce sulphur containing compounds. After intramolecular rearrangement they give rise to isothiocyanates, thiocyanates, nitriles which are more toxic (Anonymous, 1988).

THERAPEUTIC EVALUATION

50 known patients of bronchial asthma were tested for response to common allergens like, pollen, fungi, dust, mites by skin test. The most common pollen allergens were found to be *Holoptelia integrifolia* (36%), *Carica papaya* (36%), *Brassica campestris* (32%) (Dabaniya *et al.*, 1999).

FORMULATIONS AND PREPARATIONS

Asava and Arista *– Ayaskriti.*
Guggulu *– Maha Yogaraja Guggulu.*
Taila *– Maricadya taila, Kumkumadi taila, Somaraji taila, Dashmoola taila, Hingvadi taila, Karpasathydi taila, Prabhanyana vimardana taila.*
Lepa *– Sarsapadi Pralepa* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

Retail market price: Seed Rs. 40 /kg. Seed oil – Rs. 65 per litre.(2006).

SUBSTITUTES AND ADULTERANTS

Both Black mustard and Indian mustard as wall as mustard oil are often adulterated with the seeds and seed oil of *Argemone mexicana* (Mukerji, 1953). Seeds of *Eruca sativa* Linn. has been used as an adulterant and substitute (Anonymous, 2000a).

PROPAGATION AND CULTIVATION

The crop is cultivated as a mixed crop along with wheat or barley in medium, loamy soil. Sowing is done in October using seed drill and the seed rate of 2-2.5 kg/ha. Harvesting follows in middle of February. For cultivation as a sole crop, land is ploughed 2-3 times and seeds are sown at the rate of 5-7 kg/ha (Anonymous, 1988).

Plant regeneration from mesophyll protoplast using a feeder culture system was reported. Leaf or hypocotyl tissue from *in vitro* grown seedlings were used as explants as a source of protoplast. Protoplasts were placed on solid medium B over a feeder cell suspension of *B. napus*. The developed calli when transferred to regeneration medium E supplemented with 30μM of $AgNO_3$ regenerated shoots (Qiong *et al.,* 1999).

Studies on cotyledonary protoplasts using feeder cell technique has also been reported by Chi *et al.,* 1989; Glimelius 1984; Jourdan and Earle, 1989; Pauk *et al.,* 1991 and Zhao *et al.,* 1994.

Efficient plant regeneration in *B. campestris* from cotyledon explant is reported. Cotyledons were excised from 6 days old seedlings grown *in vitro,* cultured on various combinations of auxins and cytokinins. Callus formation and enhanced growth was observed on MS media with 2.0 mg/L Kn/BAP and 0.2 mg/L NAA. Calli when subcultured, formed multiple shoots within 2-3 weeks. 1mg/L zeatin along with 0.1 mg/L IAA also proved effective in shoot differentiation. Rooting was obtained on the same medium (Jain *et al.,* 1988).

Tissue culture studies in *B. campestris* have also been reported by Dunwell, (1981); Killer *et al.,* (1979) and Singh and Chandra, (1984).

Influence of silver nitrate and silver thiosuphate on plant regeneration in Brassica sp. was studied. Peduncles were used as explants and cultured on MS medium supplemented with 10 μM BA, 0.5 μM silver thiosulphate and silver nitrate. Regeneration was achieved within 10-12 days of culture. In 2-3 weeks, well-developed shoots were observed. Shoots were subcultured on MS medium supplemented with 0.5 μM BA for growth. MS medium with 5μM NAA was used for rooting (Eapen and George, 1997).

Microspore culture for high-frequency embryogenesis in *Brassica campestris* has been carried out successfully. Flower buds from donor plants older than 6 weeks and raised in controlled environmental conditions were selected. Microspores were seperated from buds and cultured on NCN medium with 150 mg/L activated charcoal. After three weeks, the embryos were transferred to solid plain B5 medium. For further development, buds between 2.0 mm and 3.9 mm in length responded well to produce embryos. Addition of activated charcoal in the medium yielded nearly 6000 embryos per 100 buds and thus has proved to be the best record of microspore culture(Guo and Pulli, 1996).

Also regeneration in *B. campestris* has been worked out. (Baillie *et al.*, 1992; Burnett *et al.*, 1992; Ferrie *et al.*, 1995; Sorvari 1985 and Zhao *et al.*,1994).

High efficiency of shoot regeneration in *Brassica campestris* was obtained by using silver nitrate. MS medium containing 1.0 mg/L NAA, 2 mg/L BAP and 30-60 μM $AgNO_3$ was used on which enhanced percentage of shoot regeneration and number of shoots per cotyledon explant was observed. Cotyledons were used as explants and those older than 6 days formed shoots, with $AgNO_3$. 1/4 MS was used for *in vitro* germination of seeds. 4-8 days cotyledons were removed to include 1-2 mm of petiole and hypocotyls, cut 2-3 mm below the cotyledon were used as explants. Regeneration of shoots was observed on MS medium with 0.1 - 1.0 mg/L NAA and 0.5-2.0 mg/L BAP after 25 days. A maximum of 7% of the cotyledon explants regenerated shoots in the presence of 1.0 mg/L NAA and 2.0 mg/L BAP with root initiation (Palmer, 1992).

Comparative analysis of growth in plantlets and seedlings of *B. campestris* L. under different *in vitro* environmental conditions was studied. Node cuttings each with a part of leaf was used as explant from 10 days old seedlings, cultured *in vitro*. Explants and seeds were grown in culture vessel having controlled conditions and CO_2 level maintained at 425-650 ppm in culture rooms. Readings at 7 days interval have shown that little difference was observed in fresh weight between plantlets and seedlings when cultured under the same *in vitro* environmental conditions (Kozai *et al.*, 1991).

A protocol to produce embryos from microspore culture has been developed in *Brassica campestris*. Microspores used were obtained from buds 2.0 - 2.9 mm in length and cultured on Lichter medium. After 48 hrs, the medium was replaced to NLN medium. Microspores were cultured at 24º C in darkness and embryo development was observed after 3 weeks. The resultant plantlets were treated with colchicine for 1.5 hr. to obtain diploid plants. Medium NLN - 10 at pH 6.2 was the best medium, yielding 9.8 embryos / 100 buds

(Baillie *et al.,* 1992). Similar type of study was carried out by Sato *et al.*, 1989.

Cotyledon protoplast were isolated and cultured on series of media for shoot regeneration. Protoplast cultures were placed in dark for 7 days at constant room temperatures to promote formation of microcalli. Callus was grown on K3 or MS for 4 weeks and transferred to modified K8P (1) medium, which lead to shoot formation within 50-90 days after isolation of protoplast. Varieties of *B. campestris* also showed shoot regeneration on B medium and MS medium. Frequency of shoot formation varied from species to species *i.e.* from 1.5 to 20%. Root formation was observed on 1/2 MS supplemented with 0.1 mg/L IBA. Studies related to the cell wall regeneration and cell division were also carried out (Zhao *et al.*, 1995ab).

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SHALI

BOTANICAL NAME: **O*ryza* *sativa*** linn**.**

FAMILY: **Poaceae**

CLASSICAL NAMES
Dhanya, Shali, Shashtika, Tandula, Vrihi (A.H.; C.S.; S.S.)

SYNONYMS
Hasa, Krishnavrihi, Krishnashali, Laja, Nivara, Shabar,Tandula, Dhanya, Tusha, Vrindaka,Vrihi (D.N., 1982; B.N., 1982).

VERNACULAR NAMES
Eng.- Rice, Paddy. **Hindi-** *Chaval, Dhan.* **Beng.-** *Chal, Chanvol, Chaval, Dhana, Calla, Chawl, Sali.* **Guj.-** *Chokha, Dangar, Paral, Corava, Shalichokha.* **Kan.-** *Nellu, Bhatta, Akki, Bhatto, Bhattada-hullu.* **Mal.-** *Ari, Nellu, Nevaranellu.* **Mar.-** *Bhat, Tandula, Dhan, Tandulamul, Dhanarmul, Bhata Chamul, Sali Bhat*. **Punj.-** *Chaval, Shali, Dhan.* **Tam.-** *Nell, Arisi, Nelver, Arshi.* **Tel.-** *Dhanyamu, Vadlu, Varidhanyamu, Biyyamu, Odalu, Biyyam, Pari, Vari.* **Oriya-** *Dhan, Chaul.* **Arab.-** *Arruz.* **Kash.-** Thomul. **Pers.-** *Biranj.* **Raj.-** *Garri, Sal.* **Urdu-** *Chaval, Biranj* (Kirtikar and Basu, 1989; Anonymous,1999, 2001; Watt, 1972; Anonymous, 1966; 2003; Nadkarni, 1976; Anonymous, 2000a; Anonymous, 1995; Chopra *et al.*, 1958, 1986; Chatterjee and Pakrashi, 2001; B.N., 1982; Yoganarsimhan, 1996, 2000).

BOTANICAL DESCRIPTION
An annual or perennial erect herb, 60-100 cm high; culms hollow, fistular; nodes slightly thickened, glabrous. Leaves linear-lanceolate, 10-15 x 0.6-1.2 cm, minutely scaberulous on nerves above and along margins, glabrous below. Panicles 10-20 cm long. Spikelets generally single, laterally compressed, 0.8 x 0.3 cm, cuneately oblong, pale green, awns 3.5-10.0 cm long; lower glumes upto 0.2 cm long, 1-nerved, mucronate, upper glumes upto 0.2 cm long, ovate, 1-nerved, mucronate. Caryopsis oblong, red or dirty-white. Flowering and Fruiting : August-November (Anonymous, 2000b; Hooker, 1973; Anonymous, 1966; 2003; Anonymous, 1995; Cooke, 1967; Bole and Pathak, 1988; Naik, 1998).

SHALI ***Oryza sativa*** Linn**.**

DISTRIBUTION

Cultivated extensively in the river valleys, deltas and low-lying coastal areas throughout India, particularly in Panjab, Bihar, West Bengal, Uttar Pradesh, Himachal Pradesh, Madhya Pradesh, Orissa, Kerala, Andhra Pradesh, Tamil Nadu, Assam, Gujarat, Maharashtra, Karnataka and Rajasthan (Anonymous, 1966; 2003). Indigenous to tropical Asia. Cultivated in China, Pakistan, Indonesia, Thailand, Burma, Japan, Philippines in Asia, Brazil, U.S.A., South America, West Indies, South Europe, Madagascar, Egypt in Africa, Italy and Spain (Nadkarni, 1976; Watt, 1972).

PART(S) USED

Fruit, root (B.N., 1982).

ACTIONS AND USES

The grains are sweet, acrid, oleagenous, demulcent, soothing, aphrodisiac, diuretic, carminative, galactagogue, antidysenteric and tonic. They are useful in lung diseases, especially pulmonary consumption. It is also used in diarrhoea, disorders of colon, piles, anaemia, burns, wound, boils in feed, fractures, menometrorrhagia, dysuria, fever, intrinsic haemorrhage and vomiting. Seeds with milk beneficial in peptic ulcer, powder dusted over surface has a cooling and soothing effect on burns and scald. It is beneficial in erysipelas, measles, pox, prickly heat and other inflammatory affections of the skin. As poultice applied to abscess, boils, buboes, inflammatory affections, piles and ulcers, also to chest in chronic bronchitis and cough. The roots are cooling, diuretic, febrifuge, are useful in burning sensation, dispepsia, bilious fever, strangury and diabetes (Anonymous, 1995; Kirtikar and Basu, 1989). Rice-water used in febrile and intestinal disorders as demulcent, nourishing, refrigerant and soothing. Rice gruel useful in impaired digestion, like diarrhoea and dysentery (Chatterjee and Pakrashi, 2001; Chopra *et al.*, 1958).

AYURVEDIC PROPERTIES

Rasa – *Madhura*, *Kashaya* (C.S.Su.27.8; A.H.Su.6-1; S.S.Su.46.5-7).
Guna – *Laghu, Snigdha* (C.S.Su.27.8; A.H.Su.6-1; S.S.Su.46.5-7).
Vipaka – *Madhura* (C.S.Su.27.8; A.H.Su.6-1; S.S.Su.46.5-7).
Veerya – *Sheeta* (C.S.Su.27.8 A.H.Su.6-1; S.S.Su.46.5-7).
Doshaghnata – *Tridoshaghna* (C.Su.27.11; A.H.Su.6-1; S.S.Su.46.5-7) (B.N., 1982).
Karma –*Balya, Brihamana, Vrishya, Mootrala, Shukrala* (A.H.Su.6.1; C.S.Su.27.8; A.H.U.40.21; S.S.Su.46.5-7), *Ruchya, Swarya,*

Baddhapavarchasa, Chakshushya, Hridya, Stanyajanana (C.S.Su.4-9.17) *Varnya, Rasayana, Medhya, Paushtika* (S.S.Su.46.5-7) (B.N., 1982).

Rogaghnata – *Trishna, Vishavikara, Mootrakrichchhra* (A.H.Ci.11.11,22; S.S.Su.46.5-7; S.S.Ci.7.9; S.S.U.58.41), *Kasa* (C.S.Ci.18.75; A.H.Ci.3.19), *Shwasa, Hikka* (C.S.Ci.17.99; A.H.Ci.4.36), *Kshata, Kshayahara, Jeernajwara, Jwara* (A.H.Ci.1.72; C.S.Ci.3.257), *Raktapitta* (C.S.Ci.4.36; S.S.U.45.17), *Ajeerna, Atisara* (C.S.Ci.19.38; S.S.Su.40.95; A.H.Ci.9.20), *Antravikara, Krimiroga, Prameha* (C.S.Ci.6.20; S.S.Ci.11.6; A.H.Ci.12.11), *Chhardi* (C.S.Ci.20.26; S.S.U.49.37; A.H.Ci.6.12), *Arsha* (C.S.Ci.14.95; S.S.Ci.6.8; A.H.Ci.8.84), *Panduroga* (C.S.Ci.16.40), *Atidagdha, Vrana, Padagatapitika, Asthibhagna* (A.H.U.27.34), *Raktapradara, Parshwashoola* (A.H.Ci.4.25), *Bastiruja, Shiroruja, Daha, Samanyadaurbalya* (A.H.Su.4.29), *Grahi, Visarpa* (C.S.Ci.21.110), *Kushtha* (S.S.Ci.9.5; A.H.Ci.19.25), *Rajyakshma* (A.H.Ci.5.5), *Gulma* (A.H.Ci.14.59), *Stanyakshaya* (C.S.Su.4-9.7) (B.N., 1982).

Dose : Powder- 5-10 gm; Decoction- 50-100 ml. (B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - ***NEL***

Suvai **(Taste) -** *Inippu* (Sweet).

Veeriyam **(Potency) -** *Seetham* (Cold).

Vibakam **(Tansformation) -** *Inippu* (Sweet).

Gunam **(Pharmacological action) -** *Boshanakari* (Nutrient) ,*Ulazhal atrri* (Demulcent).

Uses - Used in treatment of abscess as external medicine.

PHARMACOGNOSY

Macroscopic

Root- Root fibrous, thin cylindrical, 5-15 cm in length and 0.5-1 mm thick with a few rootlets, soft smooth; creamish-brown to greyish brown.

Microscopic

Transverse section of root shows single layered epidermis consisting of thin walled, rectangular cells with a few unicellular root hairs; exodermis 1-2 layered, composed of thick walled, sclerenchymatous cells; cortex differentiated into three zones; outer 5-8 and inner 2-3 layered, both consisting of round to oval, parenchymatous cells with intercellular spaces; middle zone consisting of rapidly elongated, parenchymatous cells having very large air spaces; endodermis and pericycle both single layered; xylem and phloem form equal number of bundles arranged alternately with each other; centre occupied by a small pith composed of polygonal, thick walled, sclerenchymatous cells (Anonymous, 1999).

Macroscopic

Fruit- Fruit small, one seeded, caryopsis, about 0.6-1 cm. long and 0.2-0.3 cm wide, oblong to ovoid, somewhat angular, blunt, sometimes pointed; surface rough due to minutes trichomes, faintly longitudinal ridges and furrows, mostly six rows, somewhat compressed, flattened and tightly enclosed by lemma and palea, yellowish-brown; seed smooth upto 0.6cm. long, oval to oblong, slightly flattened; blunt, oblique, slightly angled in embryo region; light creamy to white; odour not characteristic; taste sweetish.

Microscopic

Transverse section of fruit shows wavy irregular outline; pericarp and testa fused together; pericarp consist of single layered, thick, lignified sclerenchymatous, outer epidermis with clear pits, covered by a few thick, blunt, some times pointed trichomes and 2-3 layered circular to oval fibres, followed by three to five layered, tangentially elongated, thick walled, tabular parenchymatous cells, having a few scattered fibrovascular bundles and single layered, thin, elongated, slightly wavy inner epidermal cells; testa consists of thin walled, elongated to polygonal, parenchymatous cells packed with numerous, minute single polygonal, polyhedral starch grains, having but hilum without concentric striations, measuring 3-12 μ in diameter. Compound starch grains 2-150 components; embryo small, lying in a groove at one end of the endosperm, separated by a layer of epithelium; embryo consists of a shield-shaped cotyledon known as scutellum (Anonymous, 2001).

Powder microscopy

Root powder- Light-greyish in colour; shows groups of sclerenchymatous cells, pitted vessels and prismatic crystals of calcium oxalate. (Anonymous, 1999). Rice powder white in colour; starch consists of minute granules averaging about 6μ in diameter. They are polyhedral, with sharp angles and without evident concentric striae; a hilum is visible in the larger granules. Compound granules are present and consists of 2-150 components, they average about 12 X 20 microns. The average number of granules per mg of the air dry commercial starch is 10,500,000 (Wallis, 1985).

Fruit- powder light cream; shows fragments of elongated thick-walled, lignified sclerenchymatous cells, endosperm cells filled with starch grains, parenchymatous cells of endosperm filled with granules, small pieces of blunt trichomes; minute, single, polyhedral with starch granules having hilum but without concentric striations (Anonymous, 2001).

Physical constants

Root- Foreign matter – Not more than 5 %; Total Ash- Not more than 21 %; Acid insoluble ash – Not more than 16 %; Water soluble extractive – Not less than 3 % (Anonymous, 1999).
Fruit- Foreign matter- Not more than 2%; Total ash- Not more than 6%; Acid-insoluble ash- Not more than 5%; Alcohol insoluble extractive- Not less than 1%; Water soluble extractive- Not less than 1% (Anonymous, 2001).

Thin Layer Chromatography

TLC of alcoholic extract of fruit on silica gel 'G' plate using Toluene: Ethylacetate (9:1) shows under (366nm) eight fluorescent zones at Rf. 0.11, 0.15, 0.17 (all blue), 0.21 (green), 0.27 (blue), 0.30 (blue), 0.35 (green) and 0.94 (blue). On spraying with 5% Methanolic-Phosphomolybdic acid reagent and heating the plate for about ten minutes at 110°C three spots appear at Rf. 0.21, 0.30 and 0.94 (all blue) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Plant: Carlinoside (6-C-β-D-glycopyranosyl-8-C-α-L-arabinopyranosylluteolin), isoorientin-2″-glucoside, isoscoparine-2″-glucoside, chrysoeriol-6-C-β-D (2-O-β-D-glucopyranosyl) glucopyranoside and its 6″-β coumaric isoscoparin-2″-glucoside-6‴-ferulic ester, 6-C-β-D(2-O-β-D-(6-O-feruloyl) glucopyranosyl) glucopyranosylchrysoeriol and ferulic acid esters, isoscoparin-2′, 6-C-β-D-glucopyranosyl-8-L-arabinopyranosylluteolin neocarlinoside, neocarlinoside, isoscoparin-2″-glucoside-6‴-p-coumaric ester, 6-C-β-D-(2-O-β-D-(2-O-β-D-(6-O-p-coumaroyl) glucopyranosyl) glucopyranosyl chrysoeriol (Besson *et al.*, 1985), schaftoside (Chopin *et al.*, 1974), cyanidin-3-glucoside, peonidin-3-glucoside (Hu *et al.*, 2003), neoshaftoside (Besson *et al.*, 1984).
Leaves: Flavonoid pigments, glucotricin (Minamikawa and Akazawa, 1965), phytoa lexin-oryzalexin-D as (+) 3,7, dihydroxy sandaracopimaradiene (Haruchika *et al.*, 1987), phytoalexins- (+)oryzalexin A (Akatsukal *et al.*, 1983), (+) oryzalexin B and (+) oryzalexin-C (Mori and Waku, 1985; Kono *et al.*, 1984), oryzalexin E (isopimara-8(14), 15-diene-3β, 9α-diol), sakuranetin, momilactones A and B (Konno and Tsumuki, 1991; Kodama *et al.*, 1992; Kato *et al.*, 1993; Grayer and Harborne, 1994; Bouillant *et al.*, 1994; Brooks and Watson, 1991).
Rice bran: RBF-P, RBF-PM, RBF-X, hexane soluble RBF-H (Kimitoshi *et al.*, 1979), alanine, arginine, aspartic acid, glutamic acid, glycine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, proline, serine, threonine, tyrosine, valine (Yano-Ohta *et al.*, 1994), triacylglycerols, acylated

steryl glucoside, digalactosyl diacylglycerol, phosphatidylcholine, phosphatidylethanolamine, phosphatidylinositol, phosphatidic acid (Hemavathy and Prabhakar, 1987).

Epicuticular rice wax: C_{27}, C_{29}, C_{31}, C_{33} alkanes, triacontanal, dotriacontanal, octacasanol,free alcohols (Bianchi *et al.*, 1979).

Rice straw: Tricin (Wen-Jie *et al.*, 1980).

Rice seedlings: IAA myoinositol, avenic acid B, active amino acids (Fushiya *et al.*, 1980; Hall, 1980), mugineic acid, 3-hydroxy mugineic acid, 2'-deoxy-mugineic acid (Takemoto *et al.*, 1978; Nomoto *et al.*, 1979), amino acid derivative-nicotianamine (Fushiya *et al.*, 1982), avenic acid A (Fushiya *et al.*,1980), oryxyanin, phytoalexin diterpenes-momilactones A and B (Cartwrite *et al.*, 1981).

Root: Stachydrine, trigonelline, 1, 5-(12-hepta decenyl)-resorcinol along with four other alkyl resorcinols, ± 3-O-(β-D-glucopyranosyl) cyaniding (Bouillant, 1994; Brooks and Watson, 1991).

Rice hull: Stigmastanol, 3-beta-p-glyceroxydihydrocoumaroate, stigmastanol-3-β-p-butanoxydihydroxycoumarate, lanast-7,9(11)-dien-3α 15α-diol-3α-D-glucofuranoside and 1-phenyl-2-hydroxy-3, 7-dimethyl-11-aldehydic-tetradecane-2β-D-glucopyranoside (Chung *et al.*, 2006).

Seed: Starch, glucose, dextrin, fructose, galactose, raffinose, maltose, isomaltose, maltotriose, maltotetrose, hemicelluloses of rice are made up of arabinose and xylose, mannose, uronic acid (Parihar, 1955; Bevenue and Williams, 1956), a glutelin as oryzenin, albumin, α and β globulins and prolamines (gliadins), tryptophan, phenylalanine (Balsubramanian, 1952; Balsubramanian and Ramchandran, 1957; Sure and House, 1948), free amino acids, alanine, proline, cystine, including nitrogenous compounds as guanine, xanthine, adenine, hypoxanthine, ammonia, di and trimethylamines, guanidine, amino acids and uracil, allantoin (Parihar, 1954), vitamines like E and B, thiamine, pantothenic acid, pyridoxine (Green and Marcinkiewicz, 1956), enzymes like α-amylase, β-amylase, amylosynthease, catalase, protease, lipase, phenolase, oxidase, peroxidase, citric, acetic, fumaric, succinic, oxalic, malic and p-coumaric acid, toxic substance lysolecithin on hydrolysis yields choline, palmitic and glycerophosphoric acid (Sharma and Seshadri, 1955; Houston *et al.*, 1963).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to be have, anti-inflammatory (Hu *et al.*, 2003), antidiarrhoeal, antidysentric, refrigerant, antifungal (Suzuki *et al.*, 1996), antioxidant (Chung and Woo, 2001; Moon *et al.*, 2002), platelet aggregation inhibitor (Cicero and Guddi, 2001) and allergenic (Kagami *et al.,* 1996; Alvarez *et al.,* 1995) activities.

TOXICOLOGY

Isovitexin from *Oryza sativa* exhibited the lowest cytotoxicity towards HL-60 cells (LD_{50} more than 400 μm) (Lin *et al.*, 2002).

THERAPEUTIC EVALUATION

63-dehydrated diarrhoeic chidren were randomly assigned to one of three four-hours oral treatment Oral Rehydration Solution (ORS) with 5% rice flour, 10% rice flour incubated with α-anylase. The sodium and potassium concentrations of the solution as well as the osmolality and viscosity were within the desired range. On average, the children consnmed 70 ± 20%, 90 ± 28%, 80 ± 45% of the respective ORS, equivalent to intakes of 8 ± 4, 23 ± 9, and 33 ± 18 kcal/kg/4 hours. The mean increase in weight in four hours were 1%, 2.7%, 1.6% respectively. The concept of enhanced energy content ORS based on amylase treated rice flow appears to be ready for exploration in chinical studies (Vettorazzi *et al.*, 1996).

Successful rehydration was achieved in 92% of patients receiving rice-based gruel and 91% of those receiving ORS. Over 50% of all patients were rehydrated within 4 to 5 hours after treatment was initiated. The faeccal output was statistically significantly lower in patients receiving rice based gruel than in those receiving ORS. More patients were discharged from the study with hypernatraemia in the group receiving ORS than in the group receiving rice-based gruel. Faeccal sodium concentrations were similar on admission in both groups but were statistically significantly lower at discharge in the group receiving rice based gruel. It is concluded that rice-based gruel could be sofly used as an oral rehydration solution at the community level (Martinez *et al.*, 1996).

FORMULATIONS AND PREPARATIONS

Asava And Arista *– Abhayarista, Kumaryasava (A).*

Avaleha And Paka *– Brahma Rasayana.*

Kvatha Churna *– Ashmarihara Kashaya churna, Stanyajanana Kashayachurna, Darunagaradi Kvatha churna, Bharangyadi kvatha churna.*

Churna *– Yavanyadi churna, Drakshadi churna, Narayana churna.*

Gutika *– Shashtikadi brinhani gutika* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

India exported 890 thousand tones of rice, valued at Rs. 1205 croves during 1994-95 of this Basmati variety along fetched Rs. 865 crores from export of 442 thousand tones. Saudi Arabia remains the traditional chief contributing Rs. 425 crores. Other important importing countries are UAE, UK, Kuwait, USA, Malaysia, Sri Lanka, Cameroon, France and Behrain. During 1994-95. India exported 325 thousand tones of de-oiled rice bran worth Rs. 66.4 crores to various countries. Rice bran raw, 450 tonnes valued at Rs. 5-35 laks was exported to Malaysia in 1994-95. During 1994-95 India imported 6756 tonnes of rice valued at Rs 850 lakh from Australia, Italy and Thailand and rice bran oil 3594 tonnes worth Rs. 573.5 lakh from Nepal (Anonymous, 2003).

Retail market price- Vary depending on the type or variety of rice, polished or unpolished, intact or fragmented rice. Rs. 10-80 per kg (2006).

SUBSTITUTES AND ADULTERANTS

In trade admixtures of broken different types of rice, damaged grains, damaged and half hulled kernels and other foreign material are often added to *Oryza sativa*. Grains of *Coix lacryma-jobi* Syn. *C. lachryma* Linn., *Paspalum scrobiculatam* Linn. are used as a substitute (Anonymous, 2000a).

PROPOGATION AND CULTIVATION

Crop can be cultivated in plains or hilly regions in tropical, subtropical zones, prefer alluvial laterite, alkaline, black and red soil with irrigation facilities. High temperature and high humidity are the favourable conditions for growth but the crop grows well in the temperature range of 32-34°C. Sufficient irrigation is required for low land areas. Land is ploughed, harrowed with addition of green manure, organic manure, NPK, lime and micronutrients in sufficient amount depending on selection of rice variety. Seedlings are raised through seeds. Methods of seed germination vary depending upon climatic conditions and the variety of rice. Seedlings can be raised first in wet, semi-wet or dry raised beds in the nursery. Direct sowing or broadcasting of seeds in the prepared fields are other methods of raising seedlings. Seed rate varies from 60-200 kg/ha based on the method of cultivation.

Weeding at regular intervals increases the total yield upto 30%, compared to the unweeded crops. Doses of fertilizers are essential during the tillering phase to increase the weight of panicles and the development of roots. Crop can be harvested when it attains maturity (Anonymous, 1966).

In vitro culture of excised embryo of rice has been tried successfully and is considered to be potential useful in raising interspecific hybrids. Epidemic caused by *Helminthosporium*, Blast disease caused by *Piricularia oryzae*, Narrow brown leaf spot caused by *Cercospora oryzae*, stem rot caused by *Leptospheria salvinii*, Foot rot caused by *Gibberella fujikurvi* are some of the diseases which affect the rice plant. Spraying with Bordeaux mixture or any fungicide, growing resistant types, avoiding excessive nitrogenous manuring, adjusting planting dates are the control measures of these diseases. Harvesting and threshing conditions have a considerable effect on the quality of the harvested grain. Draining the water 15-20 days before harvest, when the grains reach the dough stage, is said to lead to uniform ripening of the grain and facilitate harvesting and threshing. Early maturing varieties can be harvested one month after full flowering, while late maturing varieties cannot be cut before 6 weeks after flowering. Harvesting the crop while the straw is still somewhat green and slow drying of the leaves before threshing lead to better milling quality. The average yield of rice in India is about 900 Kg/ha with intensive cultivation 3000-6000 Kg/ha, have been recorded (Anonymous, 1966).

Somatic Embryogenesis

In vitro propagation of *O. sativa* L. was achieved through somatic embryogenesis, using young and unemerged inflorescences, 1.5 cm in length; cut into pieces of 5 mm or less. Callus was obtained on Linsmaier and Skoog's (LS) medium containing 1.0, 2.0 or 2.5 mg/L, 2, 4-D and 5% coconut milk (v/v). Cultures were kept in dark at 26^{o}C for 4 weeks. Callus developed on this combination was placed on LS medium supplemented with 0.4 or 0.5 mg/L IAA along with either 2 mg/L kinetin, 1 mg/L BAP or 2.5% coconut milk to get complete plantlets (Chen *et al.,* 1985).

Kavi Kishor and Reddy, (1986) reported regeneration of rice plants from callus tissues derived from one week old root and mature embryos obtained from germinated seeds. Explants were inoculated on LS medium fortified with 2, 4-D (0.5, 1.0, 2.0 and 4.0 mg/L). Amongst these combinations, 2, 4-D, 2 mg/L produced optimum callus. Further, the callus was grown on LS medium containing 3% sorbitol and mannitol with 2% sucrose and maintained osmotic pressure up to 300 mos mols. Regeneration capacity of callus had been observed to be increased upto 1400 days without any addition of growth regulators. Shoot primordia were observed after 7-9 days on this medium.

Formation of somatic embryogenesis from immature and mature embryo was reported by Rueb *et al.,* 1994. Also, the effect of two amino acids namely L-proline and L-tryptophan on somatic embryogenesis and regeneration of rice plants was reported by Chowdhry *et al.,* (1993). High frequency embryogenesis has been reported by Ozawa *et al.,* (1996). Zhao *et al.,* (1999) developed two convenient and efficient microculture techniques, namely; liquid, droplet and shallow-layered culture for production of somatic embryos. Tsugawa and Suzaki (2000) reported preservation protocol for the regeneration activity of embryonic callus.

Protoplast Culture

Yamada, *et al.*, (1986) reported regeneration of plants using protoplast-derived callus on LS medium. Protoplasts of 25 other varieties of rice were also prepared from suspension cultures. Seeds were inoculated on LS medium in combination of 2,4-D to derive a callus. Isolated protoplasts were cultured on LS regeneration agar medium containing $4x10^{-6}$M BA. T_3 cell line was selected for regeneration of plants. Protoplasts colonies were also cultured on N_6 liquid medium for 17 days and again placed on regeneration medium. After 50 days complete plantlets were formed. Zimny and Lorz (1986), performed experiment to obtain rice plantlets from root tip derived suspended callus cultures. Induction of callus was achieved on MS medium containing 2 mg/L 2, 4-D and Dicamba (1 to 4 mg/L) or Picloram (1 mg/L) was observed to be effective for organogenesis and regeneration of plants from 7 weeks old callus.

Regeneration of plants from rice calli was noted by Yamada and Loh, 1984.

Formation of callus from protoplasts of rice has been reported by Deka and Sen (1976), Cai *et al.*, (1978) and protoplasts derived from immature embryo is reported by Yin *et al.*, (1993). Chair *et al.*, (1996) worked on production of transgenic plants using suspension culture technique, while Xue and Earle (1995), reported production of tetraploid lines in rice.

Lee and coworkers (1999), conducted experiments using feeder cell technique and four different culture procedures. The protoclones raised showed somaclonal variation with respect to height of plant, seed length and width, etc.

Pollen Culture

In vitro regeneration of rice plants from pollen culture was reported by Kim and Raghavan (1988). In their experiments they used spikelets as explants, after cold shock treatment at 6-8^{o}C for 7 days. Spikelets were inoculated on to J-19 medium of Gamborg liquid medium fortified with NAA (0.5 and 1.0 mg/L), Kn (0.5 and 1.0 mg/L) and sucrose 2% and 6%. Combination of 6% sucrose and 0.5 mg/L each NAA and kinetin was observed to be beneficial for complete plantlet formation.

Induction of callus from pollen grains and regeneration of haploid plants has been reported by Chen, 1977; Sun, 1978; Zapata *et al.*, 1983. Similarly, Zhang and Qifeng, (1993) reported production of haploid plants and Alemanno and Guiderdoni, (1994) increased the production of haploids by colchicine treatment. Salt tolerant and high yielding plants from hybridization of anther cultures were obtained by Faruque *et al.,* (1998).

Salt Tolerant Plants

Salt tolerant plants of rice were obtained from 2-year-old suspension cultured calli. Three months old calli when subjected to a stress of 1.5% NaCl regenerated complete plantlets. *In vitro* grown plantlets survived up to maturity in green house condition (Binh *et al.*, 1992). Plant regeneration from salt adapted callus was reported by Basu *et al;* (1997).

Zygote Culture

Zygote cultures of indica variety IR58 and Japonica variety Taipei 309 were developed from selected spikelets. Spikelets were collected after 4 hours of anthesis and kept in Kao M (Kao and Michayluk,1975) medium to release the zygotes. Isolated zygotes were further cultured on liquid Kao M for development of microcolonies (4-5 weeks). Microcolonies were transferred on MS medium supplemented with 0.2 mg/L NAA, 0.5 mg/L Kn and 1-5 mg/L BAP.

Regeneration of shoots from zygote-derived calli was observed after 3-4 weeks and rooting was achieved on 1/2 strength hormone free MS medium. (Zhang *et al.*, 1999). Zhao and coworkers, (2000), first time reported the division of zygotes up to proembryo like structures in rice under controlled conditions.

Pistil Culture

An *et al.,* (2004), cultured explants like pistils (8 days after anthesis), organs like paleas, pollens, lemmas, young embryos on MS medium with different combination of BA, 2,4-D to induce callusing. The calli were transferred on different combinations of Zeatin and 2,4-D for floral differentiation. About one month later pistil like organs emerged from calli. There structures were proved as pistil by comparing microscopy and pistil specific gene with the natural organ.

Other References

Khanna and Raina (1998), studied the effect of 8 different media, namely., MS, N6, R2, SK-1, SK-1m, M-019, MMS (S) and MMS(N), on regeneration response of three rice varieties *viz*., IR-72, IR-54 and Karnal Local. They observed that combination of SK 1m for callusing and MS medium for regeneration of cv. Karnal local was reported to be the best as it produced 88% regeneration and showed 233% of shoot-bud induction. However, they also noted that there was significant interaction between the media used for culturing and plantlet regeneration.

Komatsu *et al.,* (1999) reported 103 types of proteins by a procedure for separation and characterization of soluble proteins from suspension cultures of rice.

Okamoto *et al.,* (1996), reported the effect of oxygen percentage on regeneration of plantlets from cell culture of rice. They maintained the callus in bioreactors containing different media and a special attachment for supply of oxygen. The observation showed that regeneration efficiency was maximum in cultures provided with 40% dissolved oxygen available in or provided with aeration 12 mg/L D.O. in controlled condition. Observations were recorded that plants grown in bioreactor were 90% healthy.

Similarly, effect of CO_2 on growth and survival of rice regenerants was reported by Seko and Nishimura, (1996). They grew the rice regenerants on sugar free medium under different concentration of CO_2 (0.4, 50 and 100 mmol mol^{-1}). Concentration of CO_2 increased upto 50 mmol mol^{-1} was found to be effective for survival and shoot growth of rice regenerants. CO_2 at a concentration of 100 mmol mol^{l-} and above caused decrease in survival and over all growth of plantlets.

Seraj and coworkers (1997), conducted experiments to observe the response of regeneration of callus derived from mature and immature embryos of 15 Indian rice varieties. They used modified MS and N6 medium for induction of calli and regeneration, respectively. They also noted that some varieties show regeneration response within 5-7 / 15-20 days. They also stated that regeneration response of individual Indica rice varieties were unpredictable because of large difference in regeneration percent, *i.e.* 0 to 97%.

Similarly, wide range of variation in morphological characteristics were recorded by Ogura *et al.,* 1987; Kanda *et al.,* 1988; Lee *et al.,* 1989; Su *et al.,* 1992 and Mezencev *et al.,* 1995. Somaclonal variation was also reported by Kharabian and Darabi, (2005). They observed cytological mutation in various chromosomes in regenerated plants of rice.

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SHATAHVA

BOTANICAL NAME: ***Anethum sowa*** Roxb. ex Flem.
Syn. *A. graveolens* Linn. var. *sowa* Roxb.; *A. graveolens* Dc., *Peucedanum sowa* Roxb.

FAMILY: **Apiaceae**

CLASSICAL NAMES
Shatahva, Shatpushpa, Shatahvaya, Shatahvaa, Shatakushuma (C.S., S.S., A.H.).

SYNONYMS
Ahichhatra, Atichhatra, Avakpushpi, Bahala, Chatra, Ghosha, Karavi, Madhavi, Misi, Misreya, Misroya, Poti, Pushpavha, Sanghatapatrika, Satapushpi, Shaleya, Shalina, Shatakshi, Shatapatrika, Shataprasana, Shatapushpika, Shipha, Shitashiva, Shophaka, Sthatapushpi, Supushpika, Talaparni, Vajana, Vajrapushpi (D.N., 1982; B.N., 1982; R.N., 1982; Sharma, 1978).

VERNACULAR NAMES
Eng.- Indian Dill Fruit, Dill, Dill seed, Garden dill, Sowa, Anet. Dilly. **Hindi-** *Soya, Sova, Sowa, Sutopsha.* **Beng.-** *Suva, Sulpha, Shulupa, Shaluka, Sowa, Soolpha.* **Guj.-** *Suva-nu-bi, Suah, Surva.* **Kan.-** *Sabasiqe, Sabbasiqe* **Mal.-** *Chatukuppa, Chadakuppa, Satakuppa.* **Mar.-** *Baluntshep, Suva, Surva, Badishep, Shepa, Shepu, Balantashopa, Shopha, Shupa.* **Punj.-** *Soya, Sowa, Soya.***Tam.-** *Satakuppa, Shatakupivirai, Satakuppi.* **Tel.-** *Sadapa, Shatakupivittulu, Satakuppivittulu, Sompa.* **Arab.-** *Shavit, Shubit.* **Kash.-** *Soi, Boil.* **N.W.P.-** *Sawa, Sowa, Soya.* **Sing.-** *Sadakuppa* **Urdu-** *Shibt, Soya.* **Burma**.- *Samin. Samyeit.* **Kumaon.-** *Soya.* **Persian.**- *Shol.* **Portuguese.-** *Endro* **Sinhalese**.- *Sathakuppai* (Kirtikar and Basu, 1989; Chopra *et al.*, 1958, 1986; B.N., 1982; Nadkarni, 1976; Anonymous, 2000a; Vaidya, 1968; Chatterjee and Pakrashi, 2003; Anonymous, 1985; Sharma, 1978; Anonymous, 1999).

BOTANICAL DESCRIPTION
An annual glabrous, aromatic herb, upto 1 m in height. Leaves decompound,

SHATAHVA ***Anethum sowa*** Roxb. ex Flem.

ultimate segments filiform, 1.3 – 2.5 cm long. Flowers pale yellow in compound umbels. Fruit sub-elliptical, dorsally compressed, 3.0-5.0 x 1.5-2.5 mm, glabrous, with three longitudinal ridges, narrowly winged, with two mericarps. Flowering: December -February; Fruiting: January – March (Kirtikar and Basu, 1989; Anonymous, 1985; Haines, 1961; Bhattacharjee, 2000; Mukerji, 1953; Anonymous, 2001).

DISTRIBUTION

Found throughout India and often cultivated as a cold weather crop, chiefly in Punjab, U.P., Gujarat, Maharashtra, Assam and West Bengal (Anonymous, 1985). Native to Asia minor, also cultivated in the south of France, Bangaladesh, Pakistan, Russia, America, Mediterranean areas of Europe (Mukerji, 1953; Kirtikar and Basu, 1989; Chopra *et al.*, 1958).

PART(S) USED

Fruit, leaf, flower and seed oil (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Fruit is used as anthelmintic, antipyretic, aromatic, diuretic, emmenagogue, galactogogue, stimulant and specially a stomachic; beneficial in colic and hiccup. Oil from the seeds used in the preparation of gripe water. Leaves soaked in warm oil and applied locally to abscesses and boils to hasten suppuration (Chatterjee and Pakrashi, 2003). It is also used as carminative, anodyne, antipyretic, aphrodisiac, tonic, aromatic, stimulant, resolvent, abdominal pain, consumption, cough, emaciation, eye disorders, mental retardation, thirst and vomiting. Dill water prepared from the fruit is regarded as stimulant, carminative, aromatic and like anise popularly supposed to promote the secretion of milk (Chopra *et al.*, 1958). It is also used to diminish the griping of purgatives and the tormina of dysentery and given as a drink to woman after confinement. Seeds bruised, boiled in water and mixed with the roots are applied externally in rheumatic and other swellings of the joints. Among Indian drugs, dill seed keeps a prominent place as a stomachic medicine, especially in the ailments of children and women (Nadkarni, 1976).

AYURVEDIC PROPERTIES

Rasa – *Katu, Tikta.*
Guna – *Laghu, Ruksha, Tikshna.*
Vipaka – *Katu.*
Veerya – *Ushna.*
Doshaghnata – *Kaphavata shamak* (Sharma, 1978; B.N., 1982).

Karma

External – *Vedanasthapana, Shothhara, Vranaropana.*

Internal – *Kaphashamaka* (S.S.Su.39.9), *Rochana, Deepana, Pachana, Anulomona, Krimighna, Hridya Uttejak and Shothhara, Kaphaghna, Mootrala, Artavajanana Stanyajanana, Swedjanana, Jwaraghna* (C.S.Su.14.35), *Kushthaghna and Shukranashak* (Sharma, 1978; B.N., 1982).

Rogaghnata

Externally oil is applied for the treatment of *Pakshaghat, Sandhivata, Udarshoola* and *Karnashoola*; *as lepa in Shirshoola, Parshashoola* (C.S.Ci.8.77) and *Vatarakta* (C.S.Ci.29.149;S.S.Ci.5.7;A.H.Ci.22.34).

Internal – *Vatavyadhi* (C.S.Su.3.18; Ci.28.168; A.H.Ci.21.71), *Aruchi, Vaman, Krimi, Hrid dourbalya, Kasa, Shwasa, Hikka* (C.S.Ci.13.125; A.H.Ci.15.14; U.2.39), *Jwara* (C.S.Ci.3.246; A.H.Ci.1.122), *Yakshma* (C.S.Ci.8.74; A.H.Ci.5.67; U.2.55), *Mootrakrichchha,* (C.S.Ci.17.8), *Agnimandya, Ajeerna, Adhamana* (C.S.Ci.13.125; A.H.Ci.15.14), *Rajorodha, Yonishoola, Kashtaratava, Scanty of Breast milk seceration,* (C.S.Ci.30.71; Si.4.12; A.H.Ka.4.61), *Kushtha* (C.S.Ci.7.164), *Arsha as Anuvashnuvasti* (C.S.Ci.14.113; 19.62; A.H.Ci.8.89) *and Pichhavasti* (A.H.Ka.4.2,8), *Nasa roga* (C.S.Ci.26.134; S.S.Ci.20.7) *Udavarta* (C.S.Ci.3.246), *Bhagandar* (S.S.Ci.8.29), *Visharpa* (S.S.Ci.17.4; A.H.Ci.18.11), *Netraroga* (A.H.U.13.3). (Sharma, 1978; B.N., 1982).

Doses : Powder of fruit 1-3 gm, Oil 1-3 drops, Arka 20-40 ml (Anonymous, 1999; Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES

Siddha Name - ***SATHA KUPPAI***

Suvai **(Taste) -** *Kaarppu*(Pungent).

Veeriyam **(Potency) -** *Veppam* (Hot).

Vibakam **(Tansformation) -** *Kaarppu*(Pungent).

Gunam **(Pharmacological action) -** *Akattu vayu agatri* (Carminative) , *Vayirtu pini vilakki* (Stomachic), *Ruthu undakki* (Emmenogogue).

Siddha pharmaceutical preparations - *Arakku thylam , Peenisa thylam, Thalisathi choornam.*

Uses - Used in treatment Amenorrhoea, Fever, Gastritis.

PHARMACOGNOSY

Macroscopic

Fruit:- Dark brown, often stalk attached, broadly oval and compressed dorsally; mericarps usually separate and free, 4mm long, 2-3 mm broad and 1 mm thick, glabrous, traversed from the base to apex by five lighter coloured primary ridges of which three dorsal, slightly raised, brown, filiform and incospicuous, two lateral prolonged into thin, yellowish membranous wings; odour faintly aromatic resembling that of caraway, and a warm, slightly sharp taste.

Microscopic

Transverse section shows pericarp composed of epidermis of polygonal tabular cells having thick outer wall and striated cuticle; mesocarp parenchymatous, some cells lignified and show reticulate thickening; endocarp consists of tabular cells sometimes with sinuous anticlinal walls; vittae four on the dorsal surface and two on the commissural surface, extending the length of each mericarp with an endothelium of brown cells and containing volatile oil; dorsal costae three, one larger and the two lateral broadly winged, each costae with vascular strands; endosperm much flattened and consists of thick-walled, cellulosic, parenchyma containing fixed oil and numerous aleurone grains upto 5μ in diameter containing micro-rosette crystals of calcium oxalate; carpophore split, passing at the apex into the raphe of each mericarp containing a vascular strand of sclerenchymatous fibres and spiral vessels (Anonymous, 1999).

Powder microscopy

Fruit powder brown in colour; shows spiral vessels, micro-rosette crystals of calcium oxalate and oil globules, aleurone grains upto 5μ in diameter (Anonymous, 1999).

Physical constants

Foreign matter-Not more than 2%; Total ash- Not more than 14%; Acid insoluble ash-Not more than 1.5%; Alcohol soluble extractive-Not less than 4%; Water soluble extractive - Not less than 15%; Volatile oil- Not less than 2% (Anonymous, 1999; Mukerji, 1953).

Volatile oil almost colourless or pale-yellow having -

Specific gravity at 15°C: 0.9448-0.9896.

Optical Rotation: +41° to +48°

Refractive index at 20° - 1.491-1.499.

Solubility: Soluble in equal volume of alcohol (90%).

Carvone content (Sulphite method) : 19.0-22% (Mukerji, 1953).

Thin Layer Chromatography

TLC of alcoholic extract of the drug on silica gel 'G' plate using Toluene shows on exposure to Iodine vapour two spots at Rf. 0.59 and 0.68 (all yellow). On spraying with Anisaldehyde-Sulphuric acid reagent and heating the plate for about ten minutes at 110°C three spots appear at Rf. 0.37 (pink) 0.59 (blue) and 0.68 (violet) (Anonymous, 1999).

CHEMICAL CONSTITUENTS

Seed: Contains 1.2-7.7% volatile oil with concentrations varying according to geographical origin and seasons. The oil contains mainly carvone (35/60%), δ-limonene and α- phellandrene, which together can account for 90% of the oil. Interestingly, Egyptian *A. sowa* seeds were found to contain limonene (30.3%), dillapiole (26.8%), carvone (22%), piperitone (8.2%), D-dehydro-p-cymene, camphor and linalylacetate (Bandopadhyay *et al.,* 1972). The main constituents of *A sowa* are reported to be limonene, α-terpene, carvone, dillapiole, d-phellandrene, dihydrocarvone and isoeugenol (Tomar and Mukerjee, 1981). The specific gravity of oil of Indian *A. sowa* is 0.946 to 0.970, whereas that of oil of others is 0.900 to 0.915. The other variety of oil contains less carvone than the Indian oil and substitution would be revealed by the lowered specific gravity and by estimation of the carvone.

Plant: Plant contains, less carvone than the seed oil. It mainly consists of δ-α-phellandrene, eugenol, thymol, isoeugenol, linalyl acetate, phellandral. The plant also reported to have carvone, d-α-phellandrene, benzodipyran-graveolone (Shinde and Usgaonkar, 1978), phthalides (Gijbels *et al.,* 1982), β-D-glucopyranosides and 8-hydroxygeraniol (Bonnlander and Winterhalter, 2000), biphenyl derivatives (Tomar and Dureja, 2001), D-6, 7-octadecenoic acid, D-5, 6 isomer and D-8- isomer alkaloid-piperine, β-sitosterol and its glycosides (Jain *et al.,* 1986), dihydrocarvone, flavonols, quercetin, kaempferols (Baslas and Baslas, 1972), dillapiole, isodillapiole, dihydrodillapiole, 1-cyclopropyl-2, 3-dimethoxy-4, 5-methylenedioxy benzene, dillaldehyde, dihydroxyisodillapiole, dillapionic acid, 1-(2, 3-dimethoxy-4, 5-methylenedioxyphenyl)but-1-en-3-one, and 1,4-dic2,3-dimethoxy–4,5-methylenedioxyphenol)pent-1,4-dien-3-one (Walia *et al.,* 1985).

Fruits: Aromatic glycosides as shashenoside (Kuang *et al.,* 1991), vecinin (Khar Kov *et al.,* 1970), syringin, icariside-F2, benzyl β-D-glucopyranosides (Kitajima *et al.,* 1998), 4-hydroxybenzyl β-D-gluopyranoside, ethyl β-D-gluopyranoside (Kitajima *et al.,* 1998), glycerol 2-O-α-L-fucopyranoside, 2-C-methyl-D-erythritol, (3R)-2-hydroxy methlylbutane-1, 2, 3, 4-tetrol (Kitajima *et al.,* 1998), 1-deoxyl-D-xylitol-1,-deoxyl-D-ribitol, 1-deoxyl-D-glucitol, erythritol, D-threitol, 2-deoxy-D-ribono-1, 4-lactone, glycerol, D-glucose, D-fructose, thymidines, uridine (Kitajima *et al.,* 1999), two monoterpenoid ketodiols as (4s,8s)-8,9- dilydroxy-8, 9-dihydrocarvone (Matsumura *et al.,* 2002), (1s,4s,8s)-8,9-dihydroxytetrahydrocarvone (Ishikawa *et al.,* 2002), 6 monoterpenoid glycosides 3,7-dimethyloct-3(10)-

ene-1,2,6,7-tetrol, betulalbuside, 3,7-dimethyloct-3(10)-ene-1,2,6,7-tetrol 7-O-β-D-glucopyranoside, (2R, 6ζ) –3,7–dimethyloct-3(10)-ene-1,2,6,7-tetrol 2-O-β-D-glucopyranoside, 3,7-dimethyloct-1-ene-3, 8-diol 8-O-β-D-glucopyranoside, 10-hydroxy-trans-linalyl oxide 7-O-β-D-glucopyranoside (Ishikawa *et al.,* 1998), (4s,8s)-8,9-dihydroxy-8,9-dihydrocarvone-9-O-β-D-glucopyranoside, (1s,4s,8s)-8,9-dihydroxytetra hydrocarvone–9-O-β-D-gluopyranoside, (1s,2s,4R)-P-menth-8-ene-1,2-diol 2-O-β-D-opiofuranosyl -(1-> 6) β-D-glucopyranoside, (1s, 2s, 4R)-P-month-8-ene-12-diol 1-O-β-D-glucopyranoside, (1s,2R,4R,8R)-P-menthane-2,8,9-triol 2-O-β-D-glucopyranoside and (1s,2s,4R)-P-menthane-1,2,8-triol 2-O-β-D glucopyranoside (Ishikawa *et al.*, 2002) were reported from the fruits of plant.

Leaves: Flavonoides, quercetin 3-O-beta-D-glucuonide, isorhamnetin 3-O-beta-D-glucuronide, 3-glucosides, 3-galactosides, 3-rhamnoglucosides of quercetin and isorhamnetin,galactose, xylose and arabinose (Teuber and Herrmann, 1978).

Seeds: Piperine, β-sitosterol and its glucoside (Jain *et al.,* 1986), propiophenone (2-methoxy-3, 4-methylene dioxyphenyl-propan-1-one), 4,4-dihydroxy-5,5-disoprophl-2,2-dimethyl-1,1-biphenyl xanthone glycoside-dillanoside (9, 11 dihydroxy-2-methoxy benzo (a) xanthone 9-O-β-D-glucoside (Kozawa *et al.,* 1976), $\Delta^{6,7}$ – octadecenoic acid, its isomer $\Delta^{5,6}$ and $\Delta^{7,8}$ (Kartha and Khan, 1969; Kartha and Selvaraj, 1970).

Roots: Glyceryl esters of saturated and unsaturated fatty acids, phytofluene, β-sitosterol, umbelliferone, scopoletin, stigmasterol, osthole (Karting and Moeckel, 1973), Z-ligustilide, neocnidilide, butylphthalide, senkyunolide (Gijbels *et al.*, 1982; Gijbels *et al.*, 1983), α- and β-phellandrenes, limonene, p-cymene, octanal, tridecane, tetradecane, hexadecane, 4α-dimethylstyrene, camphor, dihydrocarvone, carvotanacetone, octadecane, nonadecane, α, α, β-trimethylbenzyl alcohol, eicosane and apiol (Goeckeritz *et al.,* 1979).

Essential oil: Carvacrol, safrole, thymol, sabinene, linalool, benzylether (Suei-Thu and Jun-Ichi, 1978), d-phellandrene, α-terpinene, caryophyllene, anethofuran, scopoletin (Baslas and Baslas, 1972), α-phellandrene (Misra and Nigam, 1969), cargophyllene, coumarin (6,7-dihydro-8, 8-dimethyl-2H, 8H-benzo-[1,2-b: 5,4-b'] dipyran-2, 6-dione, tripetroselinin, petroselinicdiolein, dipetroselinicolein (Eugenio *et al*. 1969), dillapional (Tomar and Mukerji, 1981), anisicaldehyde, traces of anethol, apiole, γ-terpinene, 2-nonanol, nonaldehyde, α-bergamotene, terpen-4-ol, β-terpineol, decylaldehyde, trans-dehydrocarvone, carbohydrates, proteins, fats, amino acids, threonine, alanine, tyrosine, isoleucine, leucine, fatty acids, stearic, myristic acids (Chatterjee and Pakrashi, 2003).

Volatile seed oil: α-Pinene, β-pinene, myrcene, α-terpinene, α-phellandrene, limonene, *p*-menth-2, 4(8)-diene, cis-ocimene, p-cymene, α, *p* dimethylstyrene, terpinen-4-ol, α-terpineol, trans-dihydrocarvone, cis-dihydrocarvone, carvone, β-caryophyllene, β-eudesmol, myristicin, eugenol, dillapiole, dillfuran, dihydrobenzofuran (2,3-dihydro-7-methoxy-2-methyl-5, 6 methylene dioxybenzofuran), 13 monoterpenoids, four phenylderivatives, two methylenedioxyphenyl derivatives, two sesquiterpene hydrocarbon, α-pinene, pinene, myrcene, α-terpinene, α-phellandrene, limonene, P-menth-2, 4(2)-diene, cis-ocimene, p-eymene, α-p-dimethylstyrene, terpinen-4-o1, α-terpineol, cis-dihydrocarvone, trans-dihydrocarvone, carvone, β-caryophyllene, β-eudesmol, myristicin, eugenol, dillapiole. (Ahmad *et al.*, 1990).

PHARMACOLOGICAL ACTIVITIES

It was reported to have antimicrobial (Chaurasia and Jain, 1978; Jiroretz *et al.*, 2003; Delaquis *et al.*, 2002; Singh *et al.*, 2002), antibacterial, anti-inflammatory (Matu and Staden, 2003), antihyperlipidemic and antihypercholesterolaemic (Yazdanparast and Alavi, 2001) activities. The tests by Mahran *et al.* (1992) have shown that the oil can produce diuresis in dogs, while significantly increasing Na+ and Cl- excretion. At ordinary use levels Indian dill oils are considered non-toxic. Oral administration of plant extracts diminished HCl induced gastric lesions in mice and found to be cryoprotective (Hosseinzadeh *et al.*, 2002). Two flavonoids 3-O-β-D-glucuronide and isorhamnetin 3-O-β-D-glucuronide are reported to have antioxdant activity and helps to prevent peptic ulcer (Moehle *et al.*, 1985; Satyanarayana *et al.*, 2004). Fruits of plant are reported to have antispasmodic effect on the smooth muscles of the gastrointestinal tract (Fleming, 2000). The efficacy of high dose of *A. sowa* extracts was reported to be similar to sucralfate. The acidity and total acid content were reported to be reduced by the orally or intraperitoneally administration of the extracts (Hosseinzadeh *et al.*, 2002). Essential oil of dill seeds was reported to reduce the triacylglyceride levels by almost 42% (Yazdanparast and Alavi, 2001). Oils also reported to induced CA and SCE in a clear dose-dependent manner (Lazutka *et al.*, 2001). Anethofuran, carvone, and limonene were reported to induce the detoxifying enzyme glutathione S-transferase in several mouse target tissues (Zheng *et al.*, 1992). A new furanocoumarin, 5-[4"-hydroxy-3"-methyl-2"-butenyloxy]-6,7-furocoumarin exhibited antibacterial activity against a panel of rapidly growing mycobacteria with minimum inhibitory concentration (MIC) values in the range 2-128 microg/mL (Stavri and Gibbons, 2005).

Apiol, myristicin, D-carvone and especially apiol caused significant reduction in the percentage of adults, emergence and females' fecundity in *parasarcophaga dux* (Khalaf, 2004). It was also found to be effective to treat mylasis (Mazyed *et al.,* 1999). Isorhamnetin 3-sulfate (persicarin) and quercetin 3-sulfate were characterized as the mutagenic principles but carcinogenicity was not observed for dill weed and seeds when the diets containing these in 33% were administered for 450 and 410 days respectively to the inbreed strain ACI rats (Fukuoka *et al.,* 1980).

TOXICOLOGY

The LD_{50} of European dill oil and Indian dill oil samples was more than 3 g/kg bw in mice, while that of pure dillapiole was between 1-1.5 g/kg bw (Shah *et al.,* 1972).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Dashmoolarista.*

Avaleha and Paka – *Saubhagyashunthi.*

Guggulu – *Trayodashanga guggulu.*

Ghrita – *Jivantyadi ghrita, Brihat phala ghrita.*

Churna – *Rajanyadi churna, Lavangadi churna, Narayan churna.*

Taila – *Prasarini taila, Chandanbalalakshadi taila, Dhanvantara taila, Balashvagandhalakshadi taila, Shadabindu taila, Guduchyadi taila.*

Lepa – *Grihadhumadi lepa.*

Vati and Gutika – *Kasturayad (vayu) gutika, Gorochanadi vati* (Anonymous, 1978; 2000).

Other classical formulations : *Agurvadi taila* (C.S.Ci.3.268), *Mulakadya taila* (C.S.Ci.28.186), *Amritadya taila* (C.S.Ci.28.164).

TRADE AND COMMERCE

Retail market price – 60-70 Rs/kg (2006).

PROPAGATION AND CULTIVATION

Crop prefers well-drained sandy loam soil and cold weather for its growth. Seeds are sown by drill or broadcast 1.5-2.0 cm deep in well prepared soil in lines 30-40 cm apart. Nitrogen and Phosphate fertilizers were observed to increase the yield of the crop. Maximum yield of the crop depends upon spacing between rows, preferably 30-45 cms. Harvesting of the crop should be carried out when fruits turn yellowish (Anonymous, 1948; Chadha and Gupta, 1995).

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7.83,164; **8.**74,77; **13.**103,125; **14.**42,113; **17.**8; **19.**48,69**,**116; **26.**63,134,222,225; **28.**164,168; **29.**91,139,141,148; **30.**71,105; **Ka.1.**26; **Si.3.**13,38,42,60,65; **4.**7,8,12,20; **9.**13; **11.**22.34; **12.**31,39,47,52.

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SITAPHALA

BOTANICAL NAME : ***Annona Squamosa*** **Linn.**

FAMILY : **Annonaceae**

SYNONYMS

Agrimakhya, Bahubijaka, Ganda, Gandhagataram, Gandhagatra, Gulea, Krishnabeeja, Priya, Atripya, Seetaaphalam, Shubha, Sitaphala, Sitaphalam, Subha, Suda, Vaidehivallabha (Kirtikar and Basu, 1933; Anonymous, 1976; B.N., 1982).

VERNACULAR NAMES

Eng.- Custard apple, Sugar apple, Sweet sop, Sweet sop of America. **Hindi-** *At, Atasitaphal, Sitaphal, Shariphal, Sharifah, Sharifa, Seetaaphal.* **Beng.-** *Ata, Luna, Meba. Seetaphal.* **Guj.-** *Sitaphal, Anan, Anuram, Anusa, Duk, Seetaphal.* **Kan.-** *Sitaphala, Seethaphala* **Mal.-** *Antacheecha, Attachchakka, Sirpa, Sitapalam, Sutakanni, Sirpha, Sitappalam, Attaccakka, Attichakka, Seethaa-pazham, Seemaatha.* **Mar.-** *Sitaphal, At, Seetaaphal.* **Punj.-** *Sharifa, Sarifa, Sitaphal* **Tam.-** *Atta, Sitapalam, Sitaphazam, Sitappalam, Seethappazham, Attamaram, Attapanam.* **Tel.-** *Gandagatramu, Sitapandu, Sitaphalamu, Sitaapandu, Gandhagaalaramu, Seetaaphalamu.* **Arab.-** *Saripha, Sharifa.* **Assam-** *Ata, Katal, Atakatal, Atlas.* **N.W.P.-** *Behli, Sharifa.* **Oriya-** *Ato, Seethaapholo.* **Pers.-** *Kaj, Sharifah.* **Konkani.-** *At, Ath, Ater* (Kirtikar and Basu, 1933; Nadkarni, 1976; Chatterjee and Pakrashi, 1994; Chopra *et al.*, 2002; Agharkar, 1991; Anonymous, 1985; Asolkar *et al.*, 1992; Anonymous, 1995; Anonymous, 2000a; Anonymous, 1976; Dastur, 1962).

BOTANICAL DESCRIPTION

A tree about 6m high. Bark thin and grey. Leaves simple, alternate, 3.5-8 x 1.5-4 cm, oblong – lanceolate or elliptic, obtuse or subacute, pellucid-punctate, glabrous above, glaucous and pubescent beneath when young; lateral nerves 8-11 pairs, petiole upto 2 cm long. Flower bisexual, drooping, green, solitary, leaf opposed or 2-4 on short extra axillary branchlets. Fruit globose, 5-10 cm in diameter, usually with a glaucous bloom on the surface when young, yellowish-green when ripe, easily broken into large pieces; areoles well marked, pulp white, sweet. Seeds many, arilate, brownish-black, smooth or polished and hard. Flowering: March – July; Fruiting : August -

SITAPHALA ***Annona squamosa*** Linn.

January (Cooke, 1967; Anonymous, 2000b; Kirtikar and Basu, 1933; Anonymous, 1995; Anonymous, 1985).

DISTRIBUTION

It is found wild and cultivated throughout India upto an altitude of 900m. It is found growing gregariously and widely in the hilly tracts, waste lands and has become completely naturalized in several districts of Andhra Pradesh, Punjab, Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, West Bengal, Assam, Gujarat, Maharashtra, Karnataka, Kerala and Tamil Nadu (Anonymous, 1976). It is a native of South America and West Indies. Also cultivated in Bangladesh and Pakistan (Kirtikar and Basu, 1933; Guha Bakshi *et al.*, 1999).

PART(S) USED

Root, leaf, fruit, seed, bark.(B.N., 1982).

ACTIONS AND USES

The root is powerful purgative. It is used in mental depression, spinal disorders and blood dysentry. The leaves are suppurative, stimulant, antispasmodic, sudorific, anthelmintic, insecticidal and are useful in destroying lice (Anonymous, 1994). Leaves made into a paste without adding water are applied to unhealthy ulcers (Nadkarni, 1976) while fresh juice to nostrils in hysteria and fainting (Chatterjee and Pakrashi, 1994). Ripe fruit is sweet, maturant, cooling, good tonic and sedative. It enriches the blood, increases muscular strength, lessens burning sensation, tendency to biliousness and vomiting (Kirtikar and Basu, 1933). Unripe fruit is given in diarrnoea, dysentery and atonic dyspepsia (Nadkarni, 1976). Seeds are detergent, insecticidal and abortifacient (Chopra *et al.*, 1958). Bark is also an astringent and tonic (Anonymous, 1976).

AYURVEDIC PROPERTIES

Rasa – *Madhura.*
Guna – *Snigdha, Laghu.*
Vipaka – *Madhura.*
Veerya – *Sheeta.*
Doshaghnata – *Vatapittashamaka* (Anonymous, 1976; B.N., 1982).
Karma – *Hridya, Vrishya, Balaprada, Pushtikrit, Santarpana, Raktakrit, Shukrala, Jantughna, Shothahara, Stambhana, Raktapittashamana, Jwaraghna* (Anonymous, 1976; B.N., 1982).

Rogaghnata – *Daha, Raktapitta, Visphota, Trishna, Chhardi, Jwara* (B.N., 1982).
Doses – Seeds and Leaves – 3-5 gm. (B.N., 1982).

SIDDHA PROPERTIES
Siddha Name - *Seetha pazham*
***Suvai* (Taste) -** *Inippu* (Sweet).
***Veeriyam* (Potency) -** *Seetham* (Cold).
***Vibakam* (Tansformation) -** *Inippu* (Sweet).
***Gunam* (Pharmacological action) -** *Kulurchi undakki* (cooling)
Thuvarppi(Astringent). .
Uses- Used in treatment of pitha diseases.

PHARMACOGNOSY
Macroscopic
Leaf
Fresh leaves simple, 4-15x2-5.5 cm, oblong-lanceolate, entire, acute, glaucous beneath, pellucid-punctate, petiole upto 2cm long, more or less swollen and grooved towards upper surface; venation reticulate, distinctly visible on both surface, main nerves upto 12 pairs, mid-rib thick on the lower surface; colour green; odour slightly unpleasant; taste somewhat mucilagenous followed by slightly bitter. Dried leaves are crumpled and irregularly bent towards upper surface mainly; surface more or less wrinkled; fracture more or less brittle; colour light green; odourless; taste somewhat slimy and then slightly bitter.
Microscopic
Petiole
Transverse section of petiole has circular with somewhat wavy outline. It shows single layer of epidermis composed of squarish to rectangular cells having thick cuticle. Within the epidermis is a 8-12 layered collenchymatous hypodermis. The cells of collenchyma are rounded to oblong and containing few oily globules and granular substance. Hypodermis is followed by cortex composed of more or less loosely arranged rounded to squarish parenchymatous cells, many containing granular substance, sphaeraphides of calcium oxalate and simple starch grains. Groups of rounded to oblong pitted stone cells are found scattered throughout cortex. Pericycle represent in patches of sclerenchymatous fibres in the form of discontinuous ring. Vascular bundles are oval, 5-7 in number, collateral, conjoint and arranged in arch. Each vascular bundle consist of phloem externally and xylem elements towards centre. Phloem parenchyma has thin wall, arranged compactly

containing few oily globules. Phloem ray parenchyma are mostly uniseriate, squarish to rectangular cells and containing many simple starch grains. Xylem is composed of radially arranged vessels, xylem fibres and xylem parenchyma. Vessels are arranged vertically, lignified, having annular, spiral, scalariform thickenings and few shows tyloses. Xylem fibres are 2-3 in groups with wide lumens and tapering ends. Xylem parenchyma almost unlignified, cells are polygonal, containing simple starch grains and prismatic crystals of calcium oxalate. Pith parenchyma cells at the centre are polygonal, compactly arranged, few cells pitted, containing prismatic crystals of calcium oxalate and simple starch grains.

T. S. of midrib

Transverse section of midrib is rounded with wavy outline. It shows upper single layered epidermis consisting of squarish to rectangular cells and bearing thick cuticle. Lower epidermis is made up of rounded cells, dentate, with thick cuticle. Trichomes are absent. Hypodermis is represented by a patch of 2-3 rows of rounded to oblong collenchymatous cells. It is followed by rounded to oval and squarish compactly arranged parenchymatous cells. Few cells of parenchyma are obliterated. Parenchyma represents few pitted cells, containing sphaeraphides of calcium oxalate in upper region and starch grains in lower parenchyma region. Large vacuoles are arranged in a ring in lower parenchyma region. Endodermis is distinct, cells are rounded to oblong. The vascular bundle is oval, flattened, bulging towards lower epidermis and completely surrounded by sclerenchymatous pericycle. Vascular bundle consists of continuous ring of phloem cells containing prismatic crystals of calcium oxalate. Xylem is composed of vessels, xylem fibres and multiseriate medullary rays. Vessels are arranged vertically, rectangular in shape and bearing annular, spiral, scalariform thickenings. Some vessels shows tyloses. Pith parenchyma cells are rounded to oval or oblong, loosely arranged containing few sphaeraphides of calcium oxalate. Few duct are present in the pith.

T. S. of Lamina

Lamina shows dorsiventral structure. Upper epidermis is single layered, with cuticle, cells are squarish to tabular having straight anticlinal walls, cells in surface view are oval to oblong, wavy walled and containing few prismatic crystals of calcium oxalate. Stomata are absent. Mesophyll is differentiated into palisade and spongy tissue. The palisade is single layered, composed of anticlinally elongated palisade parenchyma followed by 4-6 rows of loosely arranged spongy parenchyma containing few prismatic crystals of calcium oxalate. Vascular bundles are small, oval, covered by sclerenchymatous cap towards lower region. Vessels show spiral and scalariform thickenings.

Stomata are anomocytic and present in lower epidermis only. The single layered lower epidermis is made up of oval cells with cuticle (Sathe *et al.*, 2006).

Seed: More or less oblong or oval, smooth, glossy, shining, hard, blackish or brownish-black polished; 1-2 cm X 0.5 cm; endospermic; internally white; odour none; taste bitterish.

Transverse section show peripheral testa composed of outer epidermis followed by zone of lignified, pitted, roundish to oval stone cells; cotyledon consisting of compactly arranged rounded, squarish or polygonal thin-walled cells packed with starch grains like substance, not becoming bluish with Iodine and big oily globules; endosperm is ruminated composed of polygonal compactly arranged cells containing oily globules; few conducting strands are also present (Sathe *et al.*, 2006).

Powder microscopy

Leaf powder green in colour slightly unpleasant having slimy taste; shows groups of upper epidermis in surface view containing prismatic crystals of calcium oxalate; groups of lower epidermis in surface view with anomocytic stomata; fragments of upper epidermis with palisade and spongy tissue in sectional view; isolated as well as groups of round to oblong stone cells with wide lumen and thick-walled; isolated vessels; isolated vessels bearing scalariform, annular and spiral thickenings, isolated liginified fibres with pitted lumens and pointed ends, groups of collenchyma cells; occasional rounded to oblong simple starch grains measuring, 14.4-21.6-28.8 µ in diameter occasional compound starch grains having two components, measuring 10.8-14.4-18 µ in diameter and few prismatic crystals of calcium oxalate, measuring 14.4-25.2-36X10.8-14.4-18 µ (Sathe *et al.,* 2006).

Physical constants

Ash value – 9.5%; Acid insoluble ash – 1.28%; Alcohol soluble extractive – 5.06%; Water soluble extractive – 14.58%; Methyl alcohol extractive – 8.92%; Chloroform extractive – 4.26% (Sathe, *et al.* 2006).

Thin Layer Chromatography

Solvent system: Tolune:Ethyl acetate (9:1)

Spraying reagent: 10% H_2So_4

Petroleum ether extract gave five spots at Rf. 0.14; 0.25; 0.38; 0.50 (all green), 0.87 (yellow); Chloroform extract gave six spots at Rf. 0.12 (Green), 0.30 (yellow), 0.38 (green), 0.47 (yellow), 0.58 (Green) and 0.89 (Yellow); Ethanol extract gave only two spots at Rf. 0.56 (green) and 0.86 (yellow), while Methanol extract gave three spots at Rf. 0.36, 0.56 (both green) and 0.87 (yellow) (Sathe *et al.,* 2006).

CHEMICAL CONSTITUENTS

Plant: Oxoushinunine, nerlaureline, amino acids, (-) epicatechin (+) catechin, camphor, borneol, squamolone, α and β-pinine, limonene, β-farnesene. iriodenine, moupinamide, -(-)-kauran-16α-01-19-oic acid, 16β-17-dihydroxy-(-)-kauran-19-oic acid, anonaine, 16α-17-dihydroxy-(-)-kauran-19-oic acid, (-)-isokaur-15(16)-en-17 19-dioic acid, squamosamide, 16α-methoxy-(-)-kauran-19-oic acid, sachanoic acid, (-)-kauran-19-al-17-oic acid, daucasterol (Yang *et al.*, 1992), norushinsunine, michelalbine, L(+)-reticuline, analobine, diazepine, squamolone, polyphenols, folic acid, kaurane diterpenoids-(-)kaur-11-en-19-oic acid (Yang *et al.*, 1971), kaurene-19-ol, kauren-19-yl-acetate, kauren-19-al, 17-hydroxy-kauran-19-al and 17-acetoxy-kauran-19-al (Yang *et al.*, 2004).

Leaves and Leaves essential oil: Carvone, linalool and diacetyl (Balbaa *et al.*, 1979), friedelin (-) xylopine, (+) O-methyl armepavine and lanuginosine (Bauhimik *et al.*, 1979), 4-(2-nitroethyl)-1-[6-O-β-D-xylopyranosyl-β-D-glucopyranosyloxy] benzene (Bauhimik *et al.*, 1979), higenamine (Leboeuf *et al.*, 1981), anonaine, roemerine, norcorydiene, corydine, norisocorydine, dienone isocorydine, norlaureline, glaucine (Bhakuni *et al.*, 1972), hyperoside, rutin and quercetin, n-hexacosanol, n-octacosanol, n-triacontanol, 16-hentriacontanone, campsterol, stigmasterol and β-sitosterol (Behari and Sharma, 1986), aporphine (Bhakuni *et al.*, 1972).

Seed: Annotemoyin-1, annotemoyin-2, squamocin and cholesteryl glucopyranoside (Rahman *et al.*, 2005), samoquasine A – a benzoquinazoline alkaloid (Morita *et al.*, 2000), annonaceousacetogenins-squamocin, reticulatain-2, squamocin-I, squamocin-B, squamocenin, motrilin, squamostatin-D, squmostatin-E, cherimolin-1 and 2, reticulatain-2, annotemoyin (Yu *et al.*, 2005), squamocins, squamostatin-A. squamocin-O new adjuscent bis-tetrahydrofuranic acetogenins (Araya *et al.*, 2002; Sahai *et al.*, 1994; Fujimoto *et al.*, 1994).

Bark: Kaurenoic acid, phenolic and nonphenolic alkaloids (Rao and Satyanarayana, 1986), two crystalline alkaloids – muricine, muricinine (Meyer, 1941), (2, 4-cis and trans)-squamolinone, (2, 4-cis and trans)-9-oxoasimicinone, bullacin B, 4-deoxyannoreticuin-cis-4-deoxyannoreticuin and (2, 4-cis and trans)-squamoxinone (Hopp *et al.*, 1998), annosquamosin B as (19-nor-ent-kaurane-4α, 16β, -17-triol) (Wu *et al.*, 1996), bullatacin, bullatacinon and squamone, a new bioactive acetogenin (Li *et al.*, 1990), Cycloprop(e)azulene,germacrene D, bisabolene, caryophylleneoxide, bisabolene epoxide, kaur-16-ene (Chavan *et al.*, 2006).

Stem: Annosquammosin A (16 β-hydroxy-19-al-ent-kaurane-17-yl-16β-hydro-19-al-ent-kaurane-17-oate), annosquamosin C (16α-hydro-17-hydroxy-nor-ent-kauran-4α-o1), annosqumosin D (16β-acetoxy-17-hydroxy-19-nor-ent-kauran-4α-o1), annosquamosin E (16β-hydroxy-17-acetoxy-19-nor-ent-kauran-4α-formate), annosquamosin F (16β-hydroxy-17-acetoxy-18-nor-ent-ent-kauran-4β-hydroperoxide), annosquamosin G (16β-17-dihydroxy-18-nov-ent-kauran-4β-hyperoxide) and ent-kaurane diterpenoids (Yang *et al.*, 2002).

PHARMACOLOGICAL ACTIVITIES

Plant was reported for mosquitocidal (Jaswanth *et al.*, 2002a), insecticidal (Patil and Murthy, 1996; Jaswanth *et al.*, 2002), anti-inflammatory (Joy *et al.*, 2004; Yeh *et al.*, 2005), hypoglycaemic (Gupta *et al.*, 2005; Topno, 1997), antioxidant (Shirwaikar *et al.*, 2004; Kaleem *et al.*, 2006), antimicrobial, cytotoxic (Rahman *et al.*, 2005; Chavan *et al.*, 2006), larvicidal, chemosterilant (Saxena *et al.*, 1993), antiplasmodial (Tahir *et al.*, 1999), anticancer (Peters *et al.*, 1946; Bhakuni *et al.*, 1969), insecticidal (Patro and Pat, 1997; Jaswanth *et al.*, 2002), oxytocic, uterotonic, antispermatogenic, antiimplantation, antifertility, antifungal (Sinha *et al.*, 2002), anti-HIV (Wu *et al.*, 1996), antiplatelet aggregation (Chen *et al.*, 1996; Yang *et al.*, 2002). abortifacient, antiovulatory, diuretic, piscicidal, antiseptic (Adoum *et al.*, 1998), anticonceptional, anticonvulsant (Saluja and Santain, 1994), spasmogenic, vermicidal, β-adrenergic stimulating , molluscicidal, antiheadlice , analgesic, (Dash *et al.*, 2001; Intaranongpai *et al.*, 2006), antifeedant (Meshram *et al.*, 1994; Soni *et al.*, 2004; Saxena *et al.*, 1999), growth disrupting (Gupta *et al.*, 1993), repellent (Hussain *et al.*, 1995; Patil and Murthy; 1996), pesticidal (Chomchalow, 1996; Ignacimuthu, 1998; Kotkar *et al.*, 2002) activities. A cyclic octapeptide, cyclosquamosin B from the seeds of plant was reported for vasorelaxant effect on Rod aorta (Morita *et al.*, 2006).

TOXICOLOGY

The seeds and oil are powerful irritant to the conjunctiva and are reported to cause blindness, so care should be exercised during extraction of the oil (Chopra *et al.*, 2000). The potential cytoxicity of annotemoyins isolated from the seeds were evaluated (Rahman *et al.*, 2005). Doses of 300 mg/kg (treated group I, n=17) and 600 mg/kg (treated group II, n+12) body weight were administered by syringe during 1-5 week of pregnancy. Treatment showed no signs of toxicity (Damasceno *et al.*, 2002). Ethanolic extracts from different parts of six species of the Annonaceae family were evaluated against adult worms and egg masser of *Biomphalaria glabrata*, extracts posses properties lethal to *Biomphalaria glabrata* (Dos Santos and Sant Ana, 2001).

Effect of seed extract of *Annona squamosa* on digestive enzymes were examined at sublethal dose. The inhibition of amylolytic, proteolytic and lipolytic enzymes in the gut regions of beetic indicates the utilization of these enzymes for energy production (Kuruppasamy *et al.*, 2001).

Three new tetrahydrofuran ring acetogenins were reported to have selective cytotoxic activity against human pancreatic tumor cell lines PACA-2 (Hopp *et al.*, 1997; Hopp *et al.*, 1998).

TRADE AND COMMERCE

Bulk of the crop is harvested mostly from the wild plants in Andhra Pradesh. The harvested crop is gathered at different centres and finally transported. It is commercially important plant next to mango, banana, jack fruit and citrus fruits. No proper gradation is done but some dealer grade and pack the fruit at the top. Fruits are sold in lots but no systematic market exist. Since the fruits are perishable easily the packing is done in ventilated boxes for trade (Anonymous, 1985).

Retail market price – Fruits – Rs. 40-60/- kg; Seeds- Rs. 60/- kg (2006).

SUBSTITUTES AND ADULTERANTS

Several hybrids or cultivars of this plants; *A. cherimda, A. reticulata, A. glabra* etc. are used as substitute (Anonymous, 1985).

PROPAGATION AND CULTIVATION

The plant can be cultivated on different types of soils *viz*. loamy, light, sandy, rocky, etc. It is mostly propagated by fresh seeds, germinated on raised beds. One-year-old seedlings are transplanted in pits at the distance of 4-6 m. after which, they can survive on natural rainfall. The plants do not require frequent irrigation, whereas the maximum yield can be obtained when there is rainfall of 50-75 cm. The plants can tolerate temperature of 40°C and the drought conditions.

The tree starts flowering from March – July and fruits matures from August-January. It is always better to harvest when fruits show signs of cracking. An individual tree grown on ordinary soil and in natural conditions, bears 50-100 fruits. An average yield per hectare is reported to be 6600 kg. (Anonymous, 1985).

Callus cultures of *A. squamosa* were induced using different explants including petals, seed contents (mega-gametophyte and embryo) and fruits (mesocarp). Growth of calli induced from the explants was found to be influenced by type, concentration and ratio of auxin Vs. cytokinin. The content of squamocin (67.8 mg/g dry weight) in calli cultured on Gamborg B-5 medium containing 5.0 mg/l Naphthalene Acetic Acid and 4.0 mg/l Zeatin was nearly seven times higher than that of intact fruit.

In vitro haploid plant production was reported using anther culture of *A. squamosa* on Nitsch medium. Anthers incubated in dark for 7 days when placed on Nitsch medium supplemented with 5 mg/L IAA showed production of callus within 2 weeks. This callus when placed on Nitsch medium with 1mg/L NAA and 2 mg/L BAP showed regeneration of plantlets, whereas, 2 mg/L BAP and 0.1 mg/L IAA showed multiple shooting (Nair *et al.*, 1983).

Plant regeneration in *A. squamosa* was achieved using hypocotyls as explants of *in vitro* germinated seedlings and nodal cuttings from 3-year-old plants. Woody plant medium (WPM) supplemented with 9 μM BAP produced 20.2 buds after 8 weeks in culture. Rooting was achieved on WPM with activated charcoal and 43 μM NAA or 39 μM IBA in darkness. Rooting was more successful with galactose (Lemos and Blake, 1996).

Studies on endosperm culture of *A. squamosa* using mature seeds as explant was reported by Nair *et al.*, (1986). White's basal medium was used for seed germination, pretreated with 100 mg/L GA_3. White's medium supplemented with 0.1 mg/L Kn, 0.2 mg/L BAP, 1.0 mg/L NAA and 1.0 mg/L GA_3 was used for callus proliferation. Endosperm explant inoculated on White's medium, supplemented with 0.1 mg/L Kn, 0.2 mg/L BAP, 1.0 mg/L NAA and 1.0 mg/L GA_3 induced callusing and proliferation of the explant was observed within 30 days. Nitsch medium fortified with 0.5 mg/L NAA and 2 mg/L BAP promoted shoot regeneration whereas rooting was achieved on Nitsch medium combined with 5 mg/L IAA.

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SURANA

BOTANICAL NAME : ***Amorphophallus paeoniifolius*** (Dennst**.**) Nicols *var*. *Campanulatus* (Decne.) Sivadasana.**Syn.** *A. campanulatus* (Roxb.) Blume. Ex Decne.

FAMILY : **Araceae**

CLASSICAL NAMES
Surana (S.S.; A.H.).

SYNONYMS
Arshaghna, Bahukanda, Durnamari, Kanda, Kandala, Kandarha, Kandasurana, Kandi, Kandula, Kandvardhana, Kanthalla, Olla, Rutchyakanda, Stala, Sthulakandaka, Sukandi, Suvitra, Tivrakantha, Vajorandi, Vajrakanda, Vatari (B.N., 1982; R.N., 1982; Sharma, 1978).

VERNACULAR NAMES
Eng.- Elephant foot yam, Elephant foot. **Hindi-** *Ol, Madana masta, Kanda, Jimikand, Suran, Zamikand, Suranakanda, Zamilkanda.* **Beng.-** *Ol, Ole, Ol kachu.* **Guj.-** *Suran, Sooran* **Kan.-** *Suvarna-gedda, Suvarna (or Churna), Gadda, Suranagadde.* **Mal.-** *Chena, Kachul, Karanai, Kilangu, Shaenai, Kizhangu, Cena, Kattachena, Kattuchenai, Cena-karana, Mulen- shena.* **Mar.-** *Suran, Goda Suran.* **Punj.-** *Gimikanda, Zamin Kanda.* **Tam.-** *Karunakkalang, Karunalkkilhangu, Chena, Kachul karanai, Kilangu, Shaenai-kizangu, Karunai- kizangu, Dardakandagadda, Gemikandi, karakkaranai, Kanda.* **Tel.-** *Ghemikanda, Godda, Manchikanda, Potikanda, Manshi-kanda – guddae, Potigunda, Theeyakanda, Manashi-kanda, Potigunda, Mancai Kandagodela, Kanda, Duradagadda.* **Arab.-** Kandagadda. **Assam-** *Ol.* **Oriya-** *Farasi, Olna, Simba, Olookanda, Ola, Olua, Suran.* **Pers.-** *Olna, Simba, Olooakanda, Suran.* **Urdu-** *Zaminkand, Zamin-qund, Zamikand.* **Konkani.-** *Shotri, Suran, Luttiexhadd, Suma.* **Sinhalese.-** *Kidaran* (Nadkarni, 1976, Kirtikar and Basu, 1989; Anonymous, 2001; Anonymous, 2000a; Anonymous, 1985; Anonymous, 1994; B.N., 1982; Sharma, 1978).

SURANA ***Amorphophallus paeoniifolius*** (Dennst**.**) Nicols var. ***campanulatus*** (Decne.) Sivadasana

BOTANICAL DESCRIPTION

Perennial, terrestrial tuberous herb, tuber depressed-globose, 20-25 cm in diameter, bulbiferous and dark brown, pale dull brown inside or almost white with numerous long terete roots. Leaves solitary, appearing long after the flowers, 30-90 cm broad, segments spreading, simple or forked, petiole 60-90 cm long, stout, warted, dark green with paler blotches, leaf-lets 60-150 cm long, of variable width, obovate or oblong, acute, strongly many veined with green edges. Flowers monoecious, spathe campanulate, strongly closely veined with recurved, undulate, crisped margins, greenish- pink externally with pale ocellated blotches. Spadix as long as the spathe, dark red, purple, spongy within. Berries clustered, red, 2-3 seeded, obovoid, 8-12 mm long. Flowering and Fruiting : April – May (Cooke, 1967; Yoganarsimhan, 1996; Anonymous, 1985; Anonymous, 1996; Mooss, 1978).

DISTRIBUTION

Cultivated largely throughout the plains of India and also found wild from Punjab to West Bengal, Assam, Konkan, Deccan, Rampa hills (Anonymous, 1985; Hooker, 1973). Also cultivated in Sri Lanka (Kirtikar and Basu, 1989).

PART(S) USED

Corm/tuber and root, seed, petiole (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Corm is acrid, pungent, antiasthmatic, antidysenteric, antiemetic, carminative, expectorant, restorative, stomachic and tonic. It is used in piles, dysentery, acute rheumatism (Chopra *et al.*, 1958), dyspepsia, enlargement of spleen, elephantiasis, haemorrhoids, abdominal pain and tumours. Seeds are used locally in rheumatic swellings while fermented juice of petiole in diarrhoea (Chatterjee and Pakrashi, 2001). It is beneficial for bronchitis, vomitting and blood diseases (Kirtikar and Basu, 1989). Root is emmenagogue and beneficial in boils and ophthalmia (Nadkarni, 1976).

AYURVEDIC PROPERTIES

Rasa – *Katu, Kashaya.*

Guna – *Ruksha, Tikshna, Guru* (S.S.Su.46.306), *Vishada, Laghu* (A.H.Su.6.113).

Vipaka – *Katu.*

Veerya – *Ushna.*

Prabhava – *Arshaghana.* (Sharma, 1978; B.N., 1982),

Doshaghnata *–Kapha Vata shamaka* (Sharma, 1978; B.N., 1982), *Kapha Vata kara, Pitta hara.* (S.S.Su.46.306), *Kaphaghna* (A.H.Su.6.113).
Karma – External – *Shothhara, Vedanasthapana.*
Internal- *Arshaghna* (S.S.Su.46.307; A.H.Su.6.113), *Vatahara, Kaphahara, Gudakilahrit, Raktapittakara, Dadrukara, Kushtahara, Ruchivardhaka, Deepana, Pachana* (A.H.Su.6.113), *Yarkrit-Uttejaka, Shool prasamana, Krimighna, Vrishya, Artavarjnana, Balya and Rasayana.* In higher doses produce *Vishtambha* action (Sharma, 1978; B.N., 1982).
Rogaghnata – External- applied as paste with *ghrita and honey in Sandhishotha, Shlipada, Arbuda.*
Internal- *Arsha* (S.S.Su.46.307; A.H.Su.6.113; Ci.8.34.156), *Pleehagulma, Shwasa, Kasa, Ashthilashoth, Sandhishotha, Arbuda, Sleepada, Aruchi, Agnimandya, Vibandha, Udarshoola, Gulma, Krimi, Rajorodha, Shukradourbalya* (Sharma, 1978; B.N., 1982).
Contraindication – *Raktapitta.*
Dose – Powder 3-6 gm. (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES
Siddha Name - ***Karunai kilangu***
Suvai **(Taste) -** *Kaarppu*(Pungent).
Veeriyam **(Potency) -** *Seetham* (Cold).
Vibakam **(Tansformation) -** *Kaarppu*(Pungent).
Gunam **(Pharmacological action) -** *Thuvarppi* (Astringent), *Ul azhal atrri* (Demulcent).
Siddha pharmaceutical preparations - *Karunai kilangu lehyam.*
Uses - Used in treatment of Ano rectal abscess Hemorrhoids.

PHARMACOGNOSY
Macroscopic
Corm - Occurs as cut pieces of different size and shape; external surface of cork blackish-brown, rough due to numerous scars and few adventitious roots, internal portion creamish white; fracture short; taste acrid.
Microscopic
Transverse section of corm shows a wide zone of cork consisting of 5-25 tangentially elongated, rectangular, thin-walled cells, a few inner layers containing rosette crystals of calcium oxalate and plenty of simple and compound starch grains; ground tissue very wide consisting of thin-walled, parenchymatous cells; a few cells containing both rosette and acicular crystals of calcium oxalate; starch grains both simple and compound, spherical in shape, compound grains consisting of 2-4 components,

measuring 3-31 μ in diameter; vascular bundles are poorly developed, scattered in ground tissue; vessels are arranged in groups of 2-3, having spiral thickenings; a few parenchyma cells of ground tissue are containing yellowish cell contents (Anonymous, 2001).

Powder microscopy

Corm powder creamish-grey in colour; shows abundant simple and compound starch grains measuring 3-31μ in diameter, fragments of cork cells, a few rosette and acicular crystals of calcium oxalate and groups of thin-walled parenchymatous cells, bits of vessels bearing spiral thickening (Anonymous, 2001).

Physical constants

Total Ash – Not more than 8%; Acid insoluble ash - Not more than 2%; Alcohol soluble extractive -Not less than 3%; Water soluble extractive – Not less than 9% (Anonymous, 2001).

Thin Layer Chromatography

TLC of the alcoholic extract on silica gel 'G' plate using Benzene: Ethylacetate (9:1). On exposure to Iodine vapour shows four spots at Rf. 0.09, 0.66, 0.74 and 0.85 (all yellow). On spraying with 5% Methanolic – phosphomolybdic acid and heating the plate at 105°C for ten minutes four spots appear at Rf. 0.09, 0.66, 0.74 and 0.85 (all grey) (Anonymous, 2001).

CHEMICAL CONSTITUENTS

Plant: β-Sitosterol, palmitate of β-sitosterol, stigmasterol, betulinic acid, lupeol, triacontane, glucose, galactose, rhamnose, xylose (Chawla and Chibber, 1976), tyrosinase enzyme (Tembe *et al.*, 2006).

Corms: Protein, fat, carbohydrates, starch, oxalic acid, riboflavin, niacin, phytin, minerals, calcium, phosphorus, iron, thiamine, carotene, vitamin A, lupeole, palmitate (Gopalan *et al.*, 1971; Singh, 1972-73), isoleucine, lysine, phenylalanine, valine, amino acids, arginine, histidine, leucine, methionine, threonine, tryptophan (Ramachandran and Phansalkar, 1956).

Stem and Leaves: Calcium oxalate (Singh, 1972-73).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have analgesic (Shilpi *et al.*, 2005), uterotonic (Bhatnagar *et al.*, 1961) and lypolytic (Prema *et al.*, 1978) activities.

TOXICOLOGY

Methanolic extract 250 mg/kg bw bw was tolerated in mice. The LD_{50} of the ethanolic extract was reported to be > 1000 mg/kg bw i.p. in mice (Aswal *et al.*, 1984).

FORMULATIONS AND PREPARATIONS

Avaleha and Paka – *Sri Bahusala guda.*
Churna – *Samudradya churna.*
Vatika – *Suranvatika.*
Bhasma – *Tamra Bhasma.*
Loha – *Suranava loha*, *Suran modaka* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

Retail market price Rs. 16-20 per kg (2006).

SUBSTITUTES AND ADULTERANTS

Amorphophallus campanulatus var. Blumei Prain, *A. commutatus* Linn. are used as substitute (Anonymous, 2000a).

PROPAGATION AND CULTIVATION

A. paenifolius grows well in loam, alluvial and black soil. Plants can be vegetatively propagated through corms which can be planted in the prepared pits during the month of April – May upto July. It requires frequent, uniform irrigation, warm and humid weather during initial stages of growth. For plantation pits of 30, 45, 60 or 120 cm deep and 30, 60 or 120 cm apart should be prepared and filled with 5 cm thick layer of FYM at the bottom of the pits. Crop can be harvested at different stages of development starting from 6-7 months of plantation upto 4 years as per requirement. The crop is cultivated as a mixed crop in the fields of banana, ginger, groundnuts (Anonymous, 1985; Guha Bakshi et al., 1999).

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SWETA MUSLI

BOTANICAL NAME : *Chlorophytum tuberosum ** (Roxb.) Baker.

FAMILY : Liliaceae

SYNONYMS

Sveta musli, Durnamaari, Maharrusha, Vrushya Kanda (B.N., 1982).

VERNACULAR NAMES

Hindi- *Safed musli, Sufed or Safeta musli, Satavet, Satavar, Hazarmuli, Satmuli*. **Guj.-** *Ujlimusli, Sufed or Safeta musli, Sataver, Dholi musali*. **Mal.-** *Shedeveli*. **Mar.-** *Safed musli, Sufed or Safeta Musli, Sataver, Satavar, Kuli*. **Tam.-** *Tannirvittang, Tannirvittan-Kizhangu, Vipurutti*. **Tel.-** *Tsallogadda*. **Arab**.- *Shaqaqule-hindi,* **Sinhalese.-** *Hirtha-wariya, Mushali*. **Garhwal** – *Jhirna*. **Bom**.- *Sapheta musali, Sufed musli, Sataver*. **U.P.-** *Khairuwa* (Chopra *et al.*, 2002; Nadkarni, 1976; Anonymous, 1976; Anonymous, 1992; Kirtikar and Basu, 1989; Naik, 1998; Sharma, 1978).

BOTANICAL DESCRIPTION

Perennial herbs, upto 30 cm in height, roots fibrous, cylindric with a cluster of ellipsoid whitish fleshy tubers hanging from them. Leaves simple, 6-12, membranous, sessile, 15-30 X 1.2-2.5 cm, acuminate, margin undulate. Scape terete, 8-10 cm long, and naked. Flowers regular, bisexual, white in 5-10 cm long, simple or shortly branched racemes. Capsules obovoid, shining transversely veined, emarginate, cells 4-6 seeded. Seeds irregularly orbicular, about 0.3 cm in diam. and black. Flowering and Fruiting : June – September (Cooke, 1967; Anonymous, 1996; Bole and Pathak, 1988; Gamble, 1967; Hooker, 1973).

•***Chlorophytum tuberosum*** is the official source plant as per the Ayurvedic Formulary of India. In the Ayurvedic literature cited, *Asparagus adscendens* has been mentioned as the source plant of ***safed musli.*** **S**ynonyms, many of the vernacular names, Ayurvedic properties, actions, uses, formulation and preparations belongs to the plant *Asparagus adscendens* only. *C. borivillianum* is being cultivated on large scale in many parts of the county and used as safed musli.

SWETA MUSLI ***Chlorophytum tuberosum*** (Roxb.) Baker.

DISTRIBUTION
Found wild in E. Himalaya, Bihar, W. Bengal, and Western Peninsula in all districts upto 1500 m. Also occurs in Burma and Abyssinia (Cooke, 1967; Gamble, 1967).

PART(S) USED
Tuberous root (Sharma, 1978; B.N., 1982).

ACTIONS AND USES
The tuberous roots are beneficial as demulcent and tonic, and they are reported to be useful in diarrhoea, dysentery and general debility (Nadkarni, 1976).

AYURVEDIC PROPERTIES
***Rasa* –** *Madhura.*
***Guna* –** *Guru, Snigdha.*
***Vipaka* –** *Madhura.*
***Veerya* –** *Sheeta.*
Doshaghnata – *Vatapitta shamaka, Kaphavardhaka* (Sharma, 1978; B.N., 1982).
Karma – *Shukrala, Mootrala, Balya, Brinhana, Rasayana* (Sharma, 1978; B.N., 1982).
***Rogaghnata* –** It is consider as most beneficial in *Shukrakshaya* and *Klaibya.* Also used in *Mootrakrichchhra, Prameha, Daurbalya, Krishata* (Sharma, 1978; B.N., 1982).
Doses : 3-6 gm. powder (Sharma, 1978; B.N., 1982).

SIDDHA PROPERTIES
Siddha Name - *Thanneervittaan kizhangu*
***Suvai* (Taste)** - *Inippu* (Sweet).
***Veeriyam* (Potency) -** *Seetham* (Cold).
***Vibakam* (Tansformation) -** *Inippu* (Sweet).
***Gunam* (Pharmacological action) -** *Kulirchi undaakki* (Refrigerant), *Siruneer perukki* (Diuretic), *Boshanakari* (Nutritive), *Udal uramaakki* (Tonic), *Ul azhal atrri* (Demulcent), *Paal perukki* (Galactagogue) , *Aanmai perukki* (Aphrodisiac), *Isivakatri* (Antispasmodic).
Siddha pharmaceutical preparations - *Thanneer vittaan nei, Chukku thylam, Gandhaga rasayanam, Naasiroga naasi thylam.*
Uses: Used in treatment Diabetes, Leucorrhoea, Boils.

PHARMACOGNOSY

Macroscopic

Tuberous root - Dried unpeeled roots ellipsoidal with attached slender fibrous stalk; 0.5-1.5 X 0.2 – 0.3 cm in size; outer surface more or less rough; texture slightly hard to spongy and light in weight; fracture quite brittle, fractured surface powdery with radial cavities; colour pale brown externally, whitish internally; odourless; taste somewhat sweetish.

Microscopic

Transverse section of root shows outermost 2-3 layers of more or less collapsed cells bearing abundant elongated unicellular hairs followed by single layer of tangentially elongated rectangular thick-walled cells. Cortex parenchymatous, outermost 2-4 layers of tangentially flattened cells followed by 3-4 roundish cells followed by wide multilayers of radially compactly arranged polygonal cells containing granular material, scattered raphides; inner most 2-3 layers composed of roundish parenchymatous cells; endodermis single layered; pericycle 1-2 layered; vascular elements radially arranged, phloem composed of usual cells, vessels bearing reticulate, annular and few scalariform thickening. Pith reduced at the centre and composed of mostly isodiametric larger and smaller diametered cells containing granular material, raphides of calcium oxalate abundant, as seen mostly in longitudinal sections in peripheral cortex and pith parenchyma (Gurav *et al.*, 2005).

Physical constants

Ash value 13.22%, Acid insoluble ash – 7.32%, Alcohol soluble extractive 4.2%, Water soluble extractive – 4.6% (Gurav *et al.*, 2005).

CHEMICAL CONSTITUENTS

Plant: Sugar, starch, proteins, vitamin-C, saponins, phenolic compounds, amino acids, viz: alanine, proline, leucine, valine and glutamic acid (Narsimhan *et al.*, 2006). A glucoside – arjunetin, arjunone, cerasidin, b-sitosterol, friedlin, methyl oleanolate, gallic, ellagic and arjunic acids (http://www.bssmworld.com/herbal_health/chlorophytum_borivillanum.htm). In another aspect *C. borivillianum* is considered to have same or similar bioactives as found in *C. arundinaceum* reported as: spirosta-steroidal saponins comprising diosgenin, tigogenin, neotigogenin and sarsasapogenin as the major genin components and mono-, di- and oligosaccharides, comprising glucose, rhamnose, arabinose, galactose and xylose as glycosidic components, phenolic dibenzyls, spirosta-steroidal glycoalkaloids comprising mainly solasodine and tomatidine as the alkaloidal aglycones (Shibnath Ghosal, 2006).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have antioxidant activity in various models. IC_{50} values of plant extact was reported to be 225.31, 888.44, 809.22 and 422.97 mg/ml for scavenging of DPPH, nitric oxide, lipid peroxidation and ferry bi-pyridyl complex, respectively (Narasimhan *et al.*, 2006).

THERAPEUTIC EVALUATION

Anti-obesity, anti-haemolytic activity and inhibition of lipid peroxidation by saponin rich fraction was reported by Shibnath Ghosal (2006).

FORMULATIONS AND PREPARATIONS

Asava and Arista – *Ashvagandhadyrista*
Avaleha and Paka – *Satavari guda*
Vati and Gutika – *Surana vataka*
Churna – *Musali churna* (Anonymous. 1978, 2000).

TRADE AND COMMERCE

Finding its use in many Ayurvedic, Allopathic and Unani medicine, this wonder herb has a total estimated market demand of approximate 35,000 tonnes. Presently production is not even 5% of the estimated demand. Safed musli is an important ingredient of more than a hundred Ayurvedic, Allopathic, Homoeopathic and Unani medicinal preparations. As a protein rich food supplement, there is a tremendously growing international demand for processed safed musli. There is a huge demand for this drug in the middle East, Europe, Japan and USA (Tripathi, 2003).
Retail market price – Rs. 200-800 per kg (Prajapati, 2006).

SUBSTITUTES AND ADULTERANTS

Chlorophytum arundinaceum Baker, *C. laxum* R. Br., *C. borivillianum* Sant. and Fernand., *Asparagus adscendens* Linn., *Pachystoma senile* Reichb. F., *Cynotis tuberosa* roots are used as substitute. Roots of *Asparagus racemosus* Willd are often used as an adulterant (Anonymous, 2000a; Sharma, 1978; Kirtikar and Basu, 1989; Chadha and Gupta, 1995; Anonymous, 1992; Agarwal, 1997; Aundhe and Deokule, 2001).

PROPAGATION AND CULTIVATION

Plants is cultivated for their roots, prefer irrigated, well drained, loamy to sandy loam soils rich in organic manure, and warm to humid conditions for growth. Propagation is by direct sowing of seeds in seed beds supplemented with FYM or leaf litter. Plants are harvested with fleshy roots in middle of

May. Land supplemented with 10-15 tones of FYM /ha along with 1-2 weeding cum hoeing gives a good yield. Crop matures within 90 days (Chadha and Gupta, 1995). An average yield of roots per hectare is estimated to be 1000 kg fresh and 200 kg dried (Anonymous, 2002).

Seed germination studies were reported by Dalal *et al.,* 1987 and the method of propagation by seeds as well as by roots (tubers) was standardized by Shrivastava *et al.,* 2000.

In vitro micropropagation of safed musli was done by using stem discs. The sprouts can be obtained from stem discs under *in vitro* conditions. In a short period of time a large number of propagules can be produced through this method. *In vitro* propagation of *C. borivillianum* a source plant of Sweta musli, was achieved on MS medium supplemented with 22.2 µM BA. Cultures were initiated from stem discs possessing shoot buds and young shoot bases obtained from field grown plants. Maximum shoot formation was observed on MS supplemented with 22.2 µM BA and subculturing was carried out after every 21 days to acheive 4-fold rate of multiplication. Maximum number of root formation was observed on 3/4 strength MS medium containing 9.8 µM IBA (Purohit *et al.,* 1994).

In vitro propagation of *Chlorophytum borivillianum* was also achieved through zygotic embryo culture by Purohit *et al.,* 1994.

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SHVETAJEERAKA

BOTANICAL NAME : *Cuminum cyminum* Linn.

FAMILY : **Apiaceae (Umbelliferae)**

CLASSICAL NAMES
Ajaji, Jeeraka, Prthyika (C.S.; S.S.; A.H.).

SYNONYMS
Ajajika, Dipya, Dipyaka, Dirghajiraka, Dirghaka, Dirghakana, Gaurajaji, Gaurajiraka, Hrasvanga, Hridya, Jarana, Jira, Jirana, Kana, Kanajira, Kanavha, Kunchika, Magadha, Manjna, Mitadipya, Mitajaji, Pitava, Pujyamanaka, Ruchya, Shuklajaji, Vahmisakha, Varuna (Sharma, 1978; D.N., 1982; B.N., 1982; R.N., 1982).

VERNACULAR NAMES
Eng.- Cumin seed, Cumin. **Hindi-** *Zira, Safed jira, Jeera*. **Beng.-** *Jira, Sadajira.* **Guj.-** *Jirautmi, Jiru, Jiraugi, Jeeru, Jirun*. **Kan.-** *Jirage, Bilejirege, Jirige, Jiringe.* **Mal.-** *Jeerakam, Jorekam*. **Mar.-** *Pandhere jire, Jiregire, Jire*. **Punj.-** *Safed jira, Chitta jira*. **Tam.-** *Sheeragam, Chirakam, Jeerakam, Seerugam, Jeeragam*. **Tel.-** *Jilakarra, Tella Jilakarra, Jilakaru, Jiraka*. **Arab.-** *Kamuna, Ravamuna.* **Assam-** *Jira.* **Kash.-** *Safed zoor*. **Oriya-** *Dhalajeera, Dalajira, Jira*. **Pers.-** *Zira.* **Urdu-** *Zirah, Zirasafed* (Kirtikar and Basu, 1989; Nadkarni, 1976; Chopra *et al.*, 2002; Sharma, 1978; Anonymous, 2001a; Anonymous, 2000a; Anonymous, 1950; Chatterjee and Pakrashi, 1995; Guha Bakshi *et al.,* 1999; B.N., 1982; Watt, 1972; Vaidya, 1968).

BOTANICAL DESCRIPTION
Small slender annual herb upto 35 cm high with much branched angular or striated, glabrous, weak stem. Leaves 5-10 cm long, alternate, 2-3 partite, ultimate segments filiform, bluish-green, sheathing at base. Flowers small, white or pink-rose, in peduncled, 2-6 rayed, upto 8-flowered compound umbels. Fruit 5-7 mm long, cylindric, greyish, brownish, tapering towards both ends and compressed laterally with ridges covered by papillose hairs. Flowering and Fruiting : February-March (Chatterjee and Pakrashi, 1995; Mukerji, 1953; Anonymous, 1950; Kirtikar and Basu, 1989; Anonymous, 1995; Hooker, 1973; Anonymous, 2001a; Kurup *et al.,* 1979).

SHVETAJEERAKA ***Cuminum cyminum*** Linn.

DISTRIBUTION

Extensively cultivated as a cold season crop on the plains and as summer crop on the hills in Northern India (Nadkarni, 1976), Himalayas, Punjab, Kashmir, Kumaon, Garhwal, Chamba, Uttar Pradesh, including Rajasthan, Maharashtra, Gujarat and in some areas of South India including Coimbatore, Cuddapah and Kurnool districts of Tamil Nadu (Anonymous, 1950). A native of Western Asia, and distributed in Mediterranean regions, South-Eastern Europe, North Africa and some countries of America, Baluchistan, China, Turkestan, Persia, Pakistan, Iran, Iraq and Indonesia (Kirtikar and Basu, 1989). It is also cultivated in Egypt, Palestine, Europe, Malta, Persia, Syria, Sicily, Turkey and Morocco (Mukerji, 1953; Wallis, 1967; Watt, 1972; Kurup *et al.*, 1979; Bhattacharjee, 2000).

PART(S) USED

Fruit (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

The fruit is aromatic, acrid, sweet, astringent, carminative, anthelmintic, anti-diarrhoeal, anti-dysenteric, anti-inflammatory, constipating, stomachic, stimulant, depurative, revulsive, diuretic, galactagogue, febrifuge, ophthalmic, tonic, uterine and nervine stimulant. It is also pungent, hot, cooling, aphrodisiac, alexipharmic, antipyretic, cures, tumours, eye diseases, increases appetite and improves taste, beneficial in consumption, leucoderma, leprosy, biliousness and scorpion sting (Kirtikar and Basu, 1989). It is useful in dyspepsia, colic, helminthiasis, inflammations, flatulence, hoarseness of voice. Paste externally applied to allay pain and irritation due to worms in the abdomen. The oil is useful in eczema, anorexia, bilious nausea, gastritis, vomiting, haemorrhoids, strangury, renal and vesical calculi, leucorrhoea, skin diseases, leprosy, leucoderma, cough, malarial fever, fever, ophthalmic disorders, gonorrhoea, hiccough, asthma, bronchitis, ulcers and general debility (Chatterjee and Pakrashi, 1995; Chopra *et al.*, 1958).

AYURVEDIC PROPERTIES

***Rasa* –** *Katu.*
***Guna* –** *Laghu, Ruksha.*
***Vipaka* –** *Katu.*
***Veerya* –** *Ushna* (Sharma, 1978; B.N., 1982).
***Doshaghnata* –** *Kaphavatashamaka* (A.H.Su.15.34), *Vatakaphashamaka* (C.S.Su.27.307) (Sharma, 1978; B.N., 1982).

Karma – *Deepana, Grahi, Medhya, Garbhashaya shuddhikara, Vatanulomana, Pachana, Vrishya,* (C.S.Ci.2-1.42) *Balya, Ruchya, Chakshushya, Shoolaprashamana, Krimighna, Uttejaka, Raktashodhaka, Mootrala, Garbhashayashothahara, Stanyajanana, Twagdoshahara, Katupaushtika, Arshaghna, Shirovirechana* (C.S.Vi.8.151) (Sharma, 1978; B.N., 1982).

Rogaghnata – *Kaphavatajavikara, Shotha* (C.S.Ci.12.44), *Varnavikara* (Vyanga-A.H.U.32.18), *Kandu, Pama, Arsha* (C.S.Ci.14.103; A.H.Ci.8.83), *Netraroga, Vrishchikavisha, Aruchi, Amlapitta, Chhardi, Agnimandya, Ajeerna, Gulma, Adhmana, Udarashoola,* (C.S.Ci.13.126; S.S.U.42.28; A.H.Ci.14.35). *Atisara* (C.S.Ci.19.23), *Grahani, Krimiroga, Hridroga, Raktavikara, Mootraghata* (S.S.U.58.32). *Pooyameha, Ashmari, Shwetapradara, Madatyaya, Twagvikara, Vishamajwara, Jwara* (A.H.Ci.1.77), *Hikka, Kasa and Nasaroga* (A.H.Ci.3.115; U.20.14), (Sharma, 1978; B.N., 1982).

Doses : Powder – 1-3 gm; Decoction- 10-25 ml (Anonymous, 2001).

SIDDHA PROPERTIES

Siddha Name - *Seeragam*

***Suvai* (Taste)-** *Inippu* (Sweet).

***Veeriyam* (Potency)-** *Seetham* (Cold).

***Vibakam* (Tansformation)-** *Inippu* (Sweet).

***Gunam* (Pharmacological action) -** *Akattu vayu agatri*(Carminative), *Kulurchi undakki* (cooling).

Siddha pharmaceutical preparations - *seeraka chooranam, seeraka thylam,pancha deepakni chooranam.*

Uses- Used in treatment Pitha diseases.

PHARMACOGNOSY

Macroscopic:

Fruit- A cremocarp, often separated into mericarps, greyish-brown with light coloured ridges, ellipsoidal, elongated, about 4-6 mm long, 2 mm wide, tapering at both ends and slightly compressed laterally; mericarps with five longitudinal hairy primary ridges from base to apex, alternating with four secondary ridges which are flatter and bear conspicuous emergences; seeds orthospermous; odour umbelliferous characteristic; taste richly spicy.

Microscopic

Transverse section of fruit shows outer epidermis consisting of short polygonal, tabular cells densely covered with short, bristle hairs on ridges, hairs conical, pleuricellular, pleuriserial; seed-coat consisting of brown polygonal cells; the bundles are accompanied by sclerenchymatous fibres with lignified walls. The inner epidermis composed of tolerably regular polygonal cells all elongated in the same direction. Mesocarp with few layers of parenchyma and five vascular bundles under five primary ridges; six vittae under secondary ridges, four on dorsal and two on commissural surface; endocarp consists of polygonal cells containing fixed oil, aleurone grains and small rosette crystals of calcium oxalate, carpophore consists of slender fibres (Anonymous, 2001; Mukerji, 1953; Wallis, 1967; Henry and Collin, 1904).

Powder microscopy

Fruit powder brown in colour; aromatic; shows abundant groups of endosperm cells containing aleurone grains, fixed oil, small rosette crystals of calcium oxalate, fragments of testa of brown polygonal cells, many broken pluricellular, pluriserial hairs, groups of cells of mesocarp traversed by fibro-vascular elements, vessels bearing annular, spiral thickening, groups of thick-walled sclerenchymatous cells of mesocarp having pitted walls, fragments of the fibro-vascular bundles, large oily ducts, abundant free aleurone grains and oily globules (Henry and Collin, 1904).

Physical constants

Foreign matter- Not more than 2% (Mukerji, 1953); Total ash- Not more than 8%; Acid insoluble ash- Not more than 1%; Alcohol soluble extractive- Not less than 7%; Water soluble extractive- Not less than 15% (Anonymous, 2001); Volatile oil – Not less than 2.5%. (Mukerji, 1953).

Volatile oil colourless or pale yellow having:

Specific gravity: 0.8945-0.9300

Optical rotation: +3°: 6 to +8°

Refractive index at 20°C: 1.491-1.507

Aldehydes: Not less than 16%

Solubility: Soluble at 20°C, in eleven volumes of alcohol (80%) (Mukerji, 1953).

CHEMICAL CONSTITUENTS

Plant: Apigenin-7-O-glucopyranoside, luteolin-7-O-glucopyranoside (Ishikawa *et al.*, 2002; Helim and Ross, 1979), apigenin-5-O-glucopyranoside (Chakraborti, 1956-58), cuminal, safranal, monoterpenes, sesquiterpenes, aromatic aldehydes, aromatic oxides, terpenes, terpenols, terpenals, terpenones, terpene esters, aromatic compounds (Yan *et al.*, 2002), acetyl choline, choline, anthraguinones (Agarwal *et al.*, 1979).

Seed oil: Cuminaldehyde, α thujene, sabinene, limonene, 1, 8-cineole, p-cymen-8-ol, cis-p-menth-4-ene-1, 2-diol, p-isopropylphenol (Lee, 2005; Atta-ur-Rahman, 1999).

Cumin oil: γ-Terpene, 1, 3-p-menthadien-7-al and 1,4-p-menthadien-7-al (Iacobellis *et al.*, 2005; Baser *et al.*, 1992), 3-p-menthen-7-al (Tassan and Russell, 1975).

Fruits and Seed: 1, 8-Cineole, α and γ – terpinene, a-terpineol, terpinen-4-o1, cuminyl alcohol, transdihydrocarvone, myrcene, linalool, β-caryophyllene, β-farnesene, β-elemene (EL-Himidi and Ahmed, 1966; Baser *et al.*, 1992), (8 R)-9-hydroxycuminyl β-D-glucopyranoside, (8S)-8, 9-dihydroxycuminyl β-D-glucopyranoside, 8-hydroxycuminyl β-D-glucopyranoside, (3S, 4S, 6R)-P-menth-1-ene-3, 6-diol 6-O-β-D-glucopyranoside, (3R, 4S, 6R)-p-menth-1-ene-3, 6-diol 6-O-β-D-glucopyranoside, (4S)-P-menth-1-ene-4, 7-diol 4-O-β-D-glucopyranoside, (4R, 6S)-P-menth-1-ene 4, 6-diol 4-O-β-D-gluopyranoside, (4S, 6S)-P-menth-1-ene-4, 6-diol 4-O-β-D-glucopyranoside, (4R)-P-menth-1-ene-7, 8-diol 8-O-β-D-glucopyranoside, (4R)-P-menth-1-ene-7, 8-diol 7-O-β-D-glucopyranoside, (3R, 4R)-P-menth-1-ene-3, 4-diol 3-O-β-D-glucopyranoside, (3R, 4R, 6R)-P-menth-1-ene-3, 4, 6-triol 3-O-β-D-glucopyranoside, (1S, 2R, 4R)-P-menth-5-diol 2-O-β-D-glucopyranoside, (1S, 2R, 4R)-P-menth-5-ene-1, 2 diol 1-O-β-D-glucopyranoside, (1S, 2R, 4S)-P-menth-5-ene-1, 2, 4 triol 2-O-β-D-glucopyranoside (Ishikawa *et al.*, 2002), cuminoside A,B, (1S, 5S, 6S, 10S)-10-hydroxyguaia-3, 7(11)-dien-12-olide beta-D-glucopyranoside, (1R, 5R, 6S, 7S, 9S, 10R, 11R)-1, 9-dihydroxyeudesm-3-en-12, 6-olide 9-O-beta-D-glucopyranoside, methyl beta-D-apiofuranosyl-(1→6)-beta-D-glucopyranoside, ethane 1, 2-diol 1-O-beta-D-apiofuranosyl-(1→6)-beta-D-glucopyranoside (Takayanagi *et al.*, 2003), phenols, glycoflavones, flavonols (El-Negoumy and Mansour, 1989), triacylglycerols, diacylglycerols, free fatty acids, sterols, sterolesters, hydrocarbons, glycolipids, acylated monogalactosyldiacylglycerol and acylated sterolglycosides, monogalactosylmonoacy-glycerol and digalactosyldiacylglycerol, phospholipids, phosphatidylethanolamine and phosphatidylcholine, phosphatidylinositol, lysophosphatidylethanolamine and phosphatidyglycerol (Hemavathy and Prabhakar, 1988), fatty acids ,amino acids, crude protein, true protein, non protein (Farid and Georgiev, 1990).

Essential oil: Cuminyl alcohol, dipentene, perialdehyde, α-pinene, α-phellandrene, α-terpinene, limonene, p-cymene (Hans, 1969; Borges and Pino, 1993), α-terpeniol, α-terpinene, β-pinene, 1, 3-menthadien-7-al

(Christopher, 1991), cuminin (Saleh and Gabr, 1963), chysoeriol glycosides (El-Negoumy and Mansour, 1989), α-mannitol, glutamate (Ulrich and Waltraud, 1985), oxalic acid (Singh, 1973), cuminal, cuminic alcohol, γ-terpinene, satranal, cymene, pinene (Rong Li and Zi-Tao Jiang, 2004).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have antimicrobial (Balchin *et al.*, 1998; Baratta *et al.*, 1998; Chao *et al.*, 1998), antifertility, antispasmodic, stomachic, astringent, lactagogue, antibacterial (Nostro *et al.*, 2005), anti-diabetic (Willatgamuwa *et al.*, 1998), anticonvulsant (Sayyah *et al.*, 2002b), platelet aggregation inhibitor (Srivastava, 1989), analgesic, anti-nociceptive, anti-inflammatory (Sayyah *et al.*, 2002a) carminative, antiseptic, antifungal, oil showed the most significant 88% fungicidal activity against *P. boydii* (Atta-ur-Rahman *et al.*, 1999; Boyraz and Ozcan, 2005) insect repellant, anti-implantation, chemopreventive, hypolipidaemic (Dhandapani *et al.*, 2002), anticarcinogenic, (Aruna and Sivaramkrishanan, 1992), antihyperglycaemic, tyrosinase inhibitory and estrogenic (Malini and Vanithakumari, 1987) activities. Its hypolipidemic effects on alloxan induced diabetic rats were reported by Dhadapani *et al.*, (2002).

Recently, an aqueous extract derived from cumin seeds produced a significant enhancement of rifamycin levels in rat plasma. Enhancement of bioavailability of rifamycin was evident due to a flavonoid glycoside, 3',5-dihydroxyflavone 7-O-beta-d-galacturonide4'-O-beta-d-glucopyranoside (Sachin, *et al*., 2006).

TOXICOLOGY

Cumin essence must not be given to children, since it can produce convulsions. The LD_{50} value of 0.59 ml/kg was obtained for the essential oil (Sayyah *et al.*, 2002a).

THERAPEUTIC EVALUATION

Among the spices, fenugreek seeds (*Trigonella foenumgraecum*), garlic (*Allium sativum*), onion (*Allium cepa*), and turmeric (*Curcuma longa*) have been experimentally documented to possess antidiabetic potential. In a limited number of studies, cumin seeds (*Cuminum cyminum*), ginger (*Zingiber officinale*), mustard (*Brassica nigra*), curry leaves (*Murraya koenigii*) and coriander (*Coriandrum sativum*) have been reported to be hypoglycaemic effects (Srinivasan, 2005).

Fifty cases of non-specific leucorrhoea in reproductive phase and beyond were treated with Femiforte which contain plants like Asoka (*Saraca indica*), Triphala, Vasa (*Adhatoda vasica*), Jeeraka (*Cuminum cyminum*), Chandan (*Santalum album*), Hirabol (*Balsamodendron myrrha*), Kababchini (*Cubeba officinalis*), Nagkeshara (*Mesua ferrea*) etc. All patients were given two tablets twice daily. Twenty patients got relief during first two weeks therapy, fifteen after four weeks and ten after six weeks. Five patients failed to respond. Only one patients showed side effects (Shete, 1993).

The clinical study was taken up to establish the therapeutic effect of the combination of Kutaja, Bilva, Babula and Sveta jiraka in the management of Grahani Roga. The effect of drug in the treatment of this disease was very encouraging as this combination showed significant effect in the improvement of Agnibala and regulation of disturbed vata (Naresh Kumar and Anil Kumar, 1997).

The application of the essential oil of *C. cyminum* Linn. (Apiaceae) on the epilepsy was reported to decrease the frequency of spontaneous activity in a time and concentration dependent manner (Janahmadi *et al*., 2006).

FORMULATIONS AND PREPARATIONS

Asava and Arista *– Mritasanjivani sura, Ayaskriti, Amritarista, Ashokarishta.*

Avaleh and Paka *– Narikela khanda, Puga khanda, Madhusnuhi rasayana, Laghu chincadika lehya, Saubhagyasunthi, Eranda paka, Jeerakadi modaka, Panchajeeraka guda.*

Guggulu *– Maha yogaraja guggulu, Yogaraja guggulu.*

Ghrita *– Brhachhagaladya ghrita.*

Churna *–Hingwashtaka churna, Bhaskaralavana churna, Ashvagandhadi churna, Astangalavana churna, Dadimastaka churna, Laghulai churna.*

Taila *– Dashmoola taila.*

Lepa *– Lavangadi churna, Sarasvata churna.*

Vati and Gutika *–Kasturyadi (Vayu) gutica, Cukkumtippalyadi gutika, Mukkamukkaturadi gutika, Agnitundi vati, Lashunadi vati,*

Rasayoga – *Nripativallabha rasa, Piyusavalli rasa, Brihat purnachandra rasa, Manmathabhra rasa, Manikya rasa* (Anonymous, 1978; 2000).

Other classical formulations: *Jeerakadyarishta, Dashmoolarista,Jeeraka ghrita, Yavanikhanda churna, Narayana churna, Jeerakadya churna, Hinguwachadi churna, Agnimukha churna, Kshudhakari vati, Yamanipanchaka, Trividadi modak* (C.S.; S.S.;A.H.).

TRADE AND COMMERCE

The chief trade centres for cumin seeds in India are Jabalpur, Ratlam in Madhya Pradesh, Jaipur and Gangapur in Rajasthan. Cumin seeds are exported from India to Sri Lanka, Malaya, East Africa and straits settlements. Considerable amount of cumin is also imported across land frontiers of Afganisthan.

The projected demand of the drug increases from 1376.7 tonnes (1999-2000) to 2108.5 tonnes (2004-2005) with about 8.9% average growth rate of the demand.

22.309 tonnes of Cumin oleo resin is exported in the year April 2001 to March 2002 for Rs.345.683 Lakhs. 774.324 tonnes of Cumin powder is exported in the year April 2001 to March 2002 for Rs.630.517 Lakhs. 6.603 tonnes of Cumin oil is exported in the year April 2001 to March 2002 for Rs.34.941 Lakhs. 0.027 tonnes of Cumin oil is imported in the year April 2001 to March 2002 for Rs.0.174 Lakhs. 299.372 tonnes of Cumin is imported in the year April 2001 to March 2002 for Rs.308.728 Lakhs (Anonymous, 2001-2002; Anonymous, 2003).

Retail market price- Cumin seed oil- Rs.3500 - 3750/- per Kg. Oleo resin- Rs.25/- per Kg (Anonymous, 2005); Seed- Rs.100-160/- per Kg (2006);

SUBSTITUTES AND ADULTERANTS

Carum carvi Linn. has been frequently used as substitute (Garg, 1992). Seeds of *Plantago exigua* Murr. syn. *P. pumila* Linn. *Plantago indica* Linn. and Percian Cumin a species of carum are used as an adulterant (Anonymous, 2000a; Wallis, 1967).

PROPAGATION AND CULTIVATION

Plant is cultivated on manured, well-drained, rich and loamy soils in mild climatic conditions. Crop grows in 2 seasons and requires less hot and dry conditions for growth. Land is enriched with 20-40 tons of organic manure either in April or at the end of October for cultivation of the crop. Broadcasting requires 25-30 kg seeds per hectare (Anonymous, 1950).

Fruit ripening occurs 2-3 months after sowing and is facilitated by weeding and moderate irrigation. Mature, dried and threshed crop generally yields 250-400 kg/ha seeds while the yield increases significantly on addition of 30 kg N/ha along with 2 hand weeding at 25-30 days interval (Yadav and Jangir, 2005).

In vitro regeneration in *Cuminum cyminum* was reported from various explants *viz.*, roots, hypocotyls and cotyledons from seeds germinated *in vitro* on MS medium. Hypocotyl explant was able to produce somatic embryos on MS supplemented with 8.0 mg/L BAP and 1 mg/L Kn (Dave and Batra, 1995). Similarly, Tawfik and Noga (2001) developed protocol for *in vitro* propagation of *Cuminum cyminum* from explants of hypocotyl and stem internodal segments. Best response of shoot regeneration was observed on MS media with 2.5 μM BA within 5-6 weeks. The regenerated shoots cultured on hormone-free medium rooted within 2 weeks.

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TAGARA

BOTANICAL NAME : ***Valeriana jatamansi*** Jones. **Syn.** *V. wallichi* DC.

FAMILY : **Valerianaceae**

CLASSICAL NAMES
Tagar, Nata (A.H.Su.; C.S.Su.; Ci.; S.S.Su.), *Kalanusarya* (S.S.Su), *Kutila, Vakra* (S.S.Ka; S.S.U), *Balaka* (C.S.Ci; A.H.Ci), *Chakra* (S.S.Ka).

SYNONYMS
Anriju, Barhana, Danda, Dandahasta, Dina, Dipana, Hasti, Jihva, Jimba, Kalanusaraka, Kalanusari, Kalanusarika, Kalanusariva, Kshatra, Kunchina, Loghusha, Mahoraga, Nahush, Nahushakhya, Nandyvartha, Nripa, Padika, Parthiva, Pindatagara, Rajaharshana, Shatha, Vinamra (D.N., 1982; B.N., 1982; R.N., 1982; Sharma, 1978).

VERNACULAR NAMES
Eng.- Indian valerian. **Hindi-** *Mushkbala, Tagar.* **Beng.-** *Mushkbala, Tagar, Nahani, Shumeo, Asarun.* **Guj.-** *Tagarganttoda.* **Kan.-** *Mushkabala.* **Mar.-** *Tagarganthoda, Tagarmul.* **Punj.-** *Balamushkbala, Mushkwali, Chargodar, Sungadhabala, Bala, Balamushk, Char, Dala, Uala.* **Arab.-** *Asarum* **Kash.-** *Mushkbala, Chhalgudi.* **Pers.-** *Asaruna, Rishaiwala.* **Urdu-** *Rishawala.* **Garhwal**- *Sumaiya.* **Canarese**- *Mandibattal.* **Afghanistan**- *Gurbalchorak, Malkak* (Chopra *et al.*, 1958; Sharma, 1978; Nadkarni, 1976; Kirtikar and Basu, 1989; Anonymous, 2001; Anonymous, 2000a; Chatterjee and Pakrashi, 1997; B.N., 1982; Vaidya, 1968).

BOTANICAL DESCRIPTION
A slightly hairy, tufted perennial herb upto 45 cm high, rootstock horizontal, thick with-descending fibres. Leaves mostly radical, often crowded 2.5-7.5 cm diam, long stalked, deeply cordate-ovate, usually toothed or sinuate, cauline leaves few, much smaller, entire or pinnate. Flowers white or tinged with pink, in terminal corymbs, dioecious. Fruit oblong, compressed, hairy or glabrous. Flowering and Fruiting: March-June (Kirtikar and Basu, 1989; Anonymous, 1976; Hooker, 1973; Agarwal, 1997; Chauhan, 1999; Kurup *et al.*, 1979; Collet, 1971).

TAGARA ***Valeriana jatamansi*** Jones.

DISTRIBUTION

Found in the temperate Himalaya from Kashmir to Bhutan between 1300-3600 m, Khasia hills about 1300-2000 m, Jaintia hills between 1500-1800 m. (Anonymous, 1976). Abundant in Western Himalaya. Also occurs in Afghanistan at a height of about 300-3300m. (Hooker, 1973; Kurup *et al.*, 1979). In Himachal Pradesh it is found in upper reaches of Simla, Kangra, Kullu, Kinnour, Sirmour. In Chamba district found abundantly in Bhandal-Kihar area of Salooni block, Kunar area of Bharmour subdivision, upper reaches of Tissa Block and Mehla block (Sharma, 2006).

PART(S) USED

Root and rhizome with stolons (Sharma, 1978; B.N., 1982).

ACTION AND USES

Valerian is one of the most effective remedies in the treatment of neurosis. It is used as anodyne, bactericide, carminative, CNS depressant, hypnotic, sedative, stomachic, nervine tonic, sudorific, laxative, tranquillizer, also in convulsions, hypochondriasis, hysteria, insomnia and neuralgia, to strengthen eyesight, in cardiac palpitation, catarrh, cold, flu, neurasthenia, numbness, polyps, sores, trauma, worms and in wounds (Anonymous, 1996; Nadkarni, 1976; Kirtikar and Basu, 1989). Rootstock is stimulant, antispasmodic. It is beneficial in advanced stages of fever and inflammations, hysteria, epilepsy, cholera, dyspepsia, toothache, skin diseases, falling of hairs, splenopathy, pharyngitis, leprosy and general debility (Chopra *et al.*, 1958; Thakur *et al.*, 1989).

AYURVEDIC PROPERTIES

Rasa – *Tikta, Katu, Kashaya.*
Guna – *Laghu, Snigdha.*
Vipaka – *Katu.*
Veerya – *Ushna* (Sharma, 1978; B.N., 1982).
Doshagnata – *Kaphavatashamaka* (S.S.Ci.4.24; 5.7) (Sharma, 1978; B.N., 1982).
Karma – *Sheetaprashamana* (C.S.Su.4-9.42; 3.28), *Shira, Shoolaprashamana* (C.S.Ci.3.24), *Vedanastapana* (C.S.Ci.9.64; A.H.Ci.21.68), *Vranaropana* (S.S.Su.14.35; 36.27; S.S.Ci.2.68), *Akshepahara, Medhya, Deepana, Saraka, Yakrituttejaka, Hridayauttejaka, Kaphaghna, Shwasahara* (A.H.Ci.4.44,46), *Mootrajanana, Vajeekarana, Artavajanana, Vishaghna, Balya, Kushthaghna, Varnya* (C.S.Ci.7.87;

S.S.Ka.8.47), *Jwaraghna* (C.S.Ci.6.26; A.H.Ci.1.46), *Kandughna* (Sharma, 1978; B.N., 1982).

Rogagnata – *Ardita, Pakshaghata, Unmada* (C.S.Ci.9.64), *Apasmara* (C.S.Ci.9.64), *Sandhivata, Amavata* (A.H.Ci.21.68), *Vaatarakta* (C.S.Su.3.23; Ci.29.93; A.H.Ci.22.44), *Agnimandya, Udarshoola, Anaha, Kamala, Jalodara, Pleehavriddhi, Hriddaurbalya, Shwasa, Kasa, Hikka* (A.H.Ci.4.44,46), *Mootraghata, Kastartava* (S.S.Ci.15.32), *Kushtha* (C.S.Ci.7.87; S.S.Ka.8.47), *Visarpa* (S.S.Ci.17.15), *Raktavikara, Shrotoshodhaka* (A.H.U.2.48), *Vishamjwara, Jwara* (C.S.Ci.6.26; A.H.Ci.1.46; 16.2,12,53), *Prameha* (C.S.Ci.6.42; A.H.Ci.12.25), *Arsha* (C.S.Ci.6.42), *Rajyakshma* (C.S.Ci.8.77; A.H.Ci.5.67), *Urusthambha* (C.S.Ci.27.29), *Vatavyadhi* (S.S.Ci.4.24; 5.7; C.S.Ci.28.154,160), *Yonishool* (C.S.Ci.30.58; A.H.U.34.34), *Vrana ropana* (S.S.Su.14.35; 36.27; S.S.Ci.2.68), *Bhaghna chikitsa* (S.S.Ci.3.60; A.H.U.27.38), *Valmika chikitsa* (S.S.Ci.20.54), *Mukharoga* (S.S.Ci.22.69; A.H.U.22.84), *Netraroga (Abhishandya*) (S.S.U.9.13; A.H.U.5.16,33), *Anjana* (S.S.U.18.94) *Sarpavisha* (A.H.U.36.73,82,84), *Visha* (C.S.Ci.23.54; S.S.Ka.2.47), *Danshtra chikitsa* (S.S.Ka.8.104), *Atisara* (S.S.U.40.91; A.H.Ci.9.6), *Palitya* (A.H.Su.22.21), *Shiravyadh chikitsa* (A.H.Su.27.36), *Rasayana and Vajeekarana* (A.H.U.39.155) (Sharma, 1978; B.N., 1982).

Doses: Powder 1-3gm; Decoction 15-25 ml. (Sharma, 1978; B.N., 1982)

PHARMACOGNOSY

Macroscopic

Rhizome – About 4-8 cm long and 4-10 mm thick pieces, dull yellowish-brown, sub cylindrical and dorsiventrally somewhat flattened, rough, slightly curved and unbranched; upper surface marked with raised encircling leaf scars; under surface bearing numerous, small, circular prominent, root scars and a few stout rootlets, crown bearing remains of aerial stems with scale leaves; fracture short and horny; stolon connecting rhizome about 1-5 mm long and 2-4 mm thick; yellowish - grey in colour, longitudinally wrinkled, usually with nodes and internodes, bearing adventitious roots, occasionally thin stolons 1-2 mm thick; roots yellowish-brown, 3-5 cm long and 1mm thick; odour strong of reminiscent and iso- valeric acid; taste bitter and somewhat camphoraceous.

Microscopic

Transverse section of rhizome shows cork consisting of 4-14 layers of lignified cells occasionally containing oil globules; cortex parenchymatous containing numerous starch grains, oil globules and yellowish-brown substance; outer 2- or 3 layers of cortex, collenchymatous, occasional root traces appear as paler strands. Endodermis single layered. Pericycle parenchymatous and within it 12-18 collateral bundles, separated by dark medullary rays present. Pith large, parenchymatous, lacunar containing starch grains; starch occurs as single or occasional compound grains of 2-components, individual grains being 7-30μ, mostly 10-25μ dia, calcium oxalate crystals absent. Transverse section of stolon shows cork consisting of 2-5 layers; cortex upto 25 layers, parenchymatous followed by 20 collateral vascular bundles, which in young separated by cellulosic parenchymatous medullary rays and in older stolons become lignified. Pith wide and lacunar devoid of root traces. Transverse section of root show small, central parenchymatous pith surrounded by tetrarch to polyarch xylem and a wide parenchymatous bark (Anonymous, 2001; Mukerji, 1953; Datta and Mukerji, 1950; Wallis, 1967, 1985).

Powder microscopy

Brown in colour; odour aromatic; taste comphoraceous and slightly bitter; presence of simple starch grains, root hairs slightly lignified, cells of the cortical parenchyma much elongated or rounded, yellowish containing starch grains, starch granules rounded, mostly simple, compound one with 2-4 component, hilum indistinct or as a cleft; vessels with bordered pits, scalariform and spiral thickening; cork cells lignified, large and polygonal (Iyengar, 2001; Datta and Mukerji, 1950).

Physical constants

Foreign organic matter – Not more than 2%; Total ash – Not more than 12%; Acid insoluble Ash – Not more than 10%; Alcohol (60%) soluble extractive – Not more than 30%; Water soluble extractive – Not less than 19% (Anonymous, 2001; Mukerji, 1953).

CHEMICAL CONSTITUENTS

Root: Actinidine, carotene, calarenol, elemol, jatamols A and B, jatamansic acid, jatamansone, nardol, nardostachonol, norseychelanone, seychellane, seychellene, spirojatomol, valeranal, virolin, angelicin, jatamansin, jatamansinol, oroselol (www.naturalcosmeticsupplies.com), IVHD-valtrate, valerosidate valeriotetrate A (Yu *et al.,* 2006), 1-homoacevaltrate, 1-homoisoacevaltrate, 11-homohydroxyldihydrovaltrate, 10-acetoxy-1-homovaltrate hydrin, 10-acetoxy-1-acevaltrate hydrin, along with 10 known analogues (Tang *et al.,* 2002), 11-methoxyviburtinal, baldrinal, prinsepiol-4-omicron-β-D-glucoside, coniferin, hexacosanic acid (Chen *et al.,* 2005), two new flavone glycosides, acacetin 7-O-β-sophoroside, acacetin 7-O-(6''-O-α-L-rhamnopyranosyl)-beta-sophoroside (Tang *et al.,* 2003), jatamols (Buchi *et* *al*., 1962), 1-homoacevaltrate, 1-homoisoacevaltrate, 11-homohydroxyl-dihydrovaltrate, 10-acetoxy-1-homovaltrate hydrin, and 10-acetoxy-1-acevaltrate hydrin (Yuping *et al*., 2002).

Plant: Iridoids-valtrate, acevalterate (Renwei *et al.*, 1986), bycyclic sesquiterpene as 9 (γ, γ. dimethylallyl) - α-fenchene (Yronne and Claude, 1975), valerosidatum, didrovaltratum, didrovaltratumhydrin, valeriosidatum, valerosidatumpentaacetate, didrovaltrate, valerosidate valeriotetrate A, valtrate, valerosidate (Yu *et al.*, 2006) 11-Methoxyviburtinal, baldrinal, prinsepiol-4-omicron-beta-D-glucoside, coniferin, hexacosanic acid (Chen *et al.*, 2005).

Rhizomes and Root: Flavonoids: 6-methylapigenin (Wasowaski *et al.*, 2002), hesperidin (Marder *et al.*, 2003), naphthoic acid, acyl-linarin, linarin-O-2-methyl butyrate, acacetin-7-O-β-rutinoside, linarin isovalerate (Chari *et al.*, 1977), valepotriates, dihydrovaltrate, linarin-isovalerianate, valeranone, nor-valeranone (Klyne *et al.*, 1964), nardol (Sastry and Maheshwari, 1966), calarene, β-maaliene, 1, 8-dimethylnaphthalene (Buchi *et al.*, 1962), aristolene (Vrkoc *et al.*, 1964; Buchi *et al.*, 1962), norseychelanone, α and β-patchoulenes, patchoule alcohol (Rucker *et al.*, 1976), acacetin 7-O-beta-sophoroside, acacetin, 7-O-(6''-O-alpha-L-rhamnopyranosyl)-beta-sophoroside (Tang *et al.*, 2003), 1-homoacevaltrate, 1-homoisoacevaltrate, 11-homohydroxyldihydrovaltrate, 10-acetoxy-1-homovaltrate hydrin, 10-acetoxy-1-acevaltrate hydrin. (Tang *et al.*, 2002).

Root oil: α-Pinene, limonene, 1, 8-cineole, p-cymene, borneolacetate, borneol, nerolidol, maaliol (Wang Zong *et al.*, 1980), β-bergamotene, α-bergamotene, β-ylangene (Kulkarni *et al.*, 1966), β-sesquicarene, calarane (Coates and Friedinger, 1970), β-santalene, epi- β-santalene (Corey *et al.*, 1962), sesquifenchene (Paknikar and Kirtany, 1972), jatamanshic acid (Chaudhari *et al.*, 1958), jatamansone (Djerassi *et al.*, 1961), oroselol, jatamansin, dihydrojatamansin, angelic acid, methylethylacetic acid, jatamansinol (Shanbhag *et al.*, 1964), valeranone, valerene, jatamansone, jatamansic acid (Govindachari *et al.*, 1961; Krepinsky *et al.*, 1962), hydroxyvaleranone and its acetyl derivative (Kulkarni *et al.*, 1964), α-longipinene (Erdtman and Westfelt, 1963), capaene (Büchi *et al.*, 1963), mustakone (Kapadia *et al.*, 1963), α-ylangene (Hunter and Brodgen, 1964).

PHARMACOLOGICAL ACTIVITIES

The plant is reported for antibiotic, antiamoebic, analgesic, antipyretic, antibacterial and mild CNS depressant activities. The root is reported as antispasmodic, diuretic, carminative (Wagner and Jurcie, 1979; Vohora *et al.*, 1979; Yamaguchi *et al.*, 1964) and stimulant. It has many of the properties of *V. officinalis* and could therefore be employed as a nervine and sedative. It is used as a tranquilliser and nervine, particularly for those people suffering from nervous overstrain (Foster and Duke, 1990). Valerian has been shown to encourage sleep, improve sleep quality and reduce blood pressure (Gilani *et al.*, 2005; Fernandez *et al.*, 2004; Chevallier, 1996).

TOXICOLOGY

Doses higher than 100-mg/kg body weights were found to be toxic in mice.

THERAPEUTIC EVALUATION

A clinical trail conducted with 20 patients affected by Essential Hypertension were treated with Tagara mula churna (*Valeriana wallichii*) 5 gm BD with lukewarm water for 30-40 days. The results were encouraging in the cases of mild essential hypertension and were found to be statistically significant (Shukla and Sharma, 1999).

P'Tabs, a composite herbal drug containing *Acorus calamus, Piper longum, Valeriana wallichii, Rauwolfia serpentina, Hyoscyamus reticulatus, Nardostachys jatamansi, Vitis vinifera and Herpestis monnieri* was given orally (2 tds) to 115 patients of insomnia and irritability. Good relief was observed in 61 patients. Excellent and moderate relief was observed in 17 and 37 patients respectively (Date and Kulkarni, 1995).

Brahmyadi Ghana Vati consisting of plants, namely *Valeriana wallichii, Bacopa monnieri, Acorus calamus, Saussurea lappa, Rauwolfia serpentina* and *Nardostachys jatamansi* was administrated to 40 patients of hypertension. Patients were divided into trial and control groups of 20 each. Trial group was treated with Brahmyadi Ghana vati which was observed 30% good improvement, 30% moderate improvement, 25% slight improvement and 15% no improvement. Analysis shows that the trial drug is significantly effective (Rath *et al.*, 1999).

It is also used internally in the treatment of painful menstruation, cramps, urinary disorders, hypertension, irritable bowel syndrome etc (Nair *et al.*, 1985; Bown, 1995, Chevallier, 1996). Externally, it is used to treat eczema, ulcers and minor injuries (Bown, 1995). The active ingredients valepotriates, have a calming effect on agitated people, but are also a stimulant in cases of fatigue (Foster and Duke, 1990). The fresh root is about three times more effective if dried at 40° C than above 82° C which destroy the active principle in the root (Chopra *et al.*, 1986).

Biological activity: Iridoid glucoside (I) showed (NS depressant activity at 31.6 –100 mg/kg doses in mice.

FORMULATIONS AND PREPARATIONS

Asava And Arista – *Pippalyadyasava, Devadarvarista.*
Arka – *Karpuradyarka.*
Ghrita – *Phala ghrita.*
Churna – *Jatiphaladya churna.*
Taila – *Dhanvantara taila, Bala taila, Manjisthadi taila, Nilikadya taila.*
Lepa – *Vriddhihara lepa* (Anonymous, 1978; 2000).
Other classical formulations – *Madyasava* (C.S.Ci.6.42), *Kalyanak sarpi* (S.S.Ka.6.9), *Bhutaravahvaya ghrita* (A.H.U.5.19), *Bhaskar churna* (A.H.U.6.29), *Agurvadya taila* (C.S.Ci.3.268), *Madhuparnyadi taila* (C.S.Ci.29.93), *Amritadya taila* (C.S.Ci.28.164), *Ksharagada* (S.S.Ka.6.3,9), *Kusthadiagada* (S.S.Ka.8.47), *Bhadradoyanjana* (S.S.U.18.94).

TRADE AND COMMERCE

From wild source – Rs 50/- per kg.
From cultivated plants – Rs. 80-90 per kg. (Prajapati, 2006)
Valerian root with rootlets – Rs. 45 per kg, Valerian root oil – Rs. 22,000 – 23,000 per kg (Anonymous, 2005).
Due to great demand of this plant in market the plant is being collected from forest by people.
Retail Market Price – Rs. 180 per kg. (2006).

SUBSTITUTES AND ADULTERANTS

Roots and rhizomes of *Nymphoides macrospermum* Vasudevan, *Nardostachys jatamansi* Dc., *Valeriana hardwickii* Wall, *V. officinalis* Linn., *V. leschenaultii* De var, *brunoniana*; C.B. Clarke, *V. pyrolaefolia* Decnedre are used as substitute. *Veratrum album* Linn. is used as an adulterant (Wallis, 1967; Mukerji, 1953; Anonymous, 2000; Agarwal, 1997; Sharma, 1978; Garg, 1992).

PROPAGATION AND CULTIVATION

Plant flourishes in rich, heavy loam soil and in moist, shady area (Anonymous, 1978). Land preparation is carried out at the end of February by plouging twice and leaving the soil untilled for 15 days. Ridges of 6-8 cm height are prepared after adding to the soil 30-36 tons of well rotten farm yard manure per hectare. Plants seedlings are raised from seeds or old rhizome cuttings in nursery conditions. Seedlings are planted in the field during June-August at a distance of 30 x 30 cm. The plantation may be irrigated in dry seasons, if required. Weeding and hoeing are carried out 4-5 times in a year. It is reported that application of NPK (40:30:20 kg) produced maximum yield. Crop can be harvested by uprooting the whole plant in the month of October-November. An average yield was reported to be 10-12 quintals/ha. (Sharma, 2006 ; Chauhan, 1999).

Tissue culture of *Valeriana jatamansi* was carried out using petiole explant from *in vitro* grown plants, cultured on MS media with 5.0 mg/L Kn and 1.0 mg/L IAA. MS media supplemented with 3.0 mg/L NAA and 0.25 mg/L Kn initiated growth of callus. Shoot regeneration was obtained when callus was transferred to MS media with 1.0 mg/L Kn and 0.25 mg/L NAA within 6 weeks. Complete plantlet formation *i.e.* rooting and shooting was observed on MS media with 5.0 mg/L Kn and 1.0 mg/L IAA. The plantlets were hardened using a mixture of soil: vermiculite: farm yard manure (2:1:1), (Mathur and Ahuja, 1991). Similar type of study was reported by Becker and Schrall (1980); Becker and Chavadej (1988) and Mathur *et al.*, (1988,1989).

Large-scale multiplication of *V. jatamansi* was reported by induction of shoot proliferation from apical and axillary shoot buds. Buds from six-month-old plants were used as explants and cultured on MS medium. Shooting from buds was observed on MS medium supplemented with 1.0 mg/L BA within 4-6 days. Also shooting and rooting was observed on MS medium with 1.0 mg/L BA, 0.1 mg/L IAA and 1.0 mg/L BA and 0.1 mg/L NAA. NAA at the concentration of 0.75 mg/L induced long roots (Kumar *et al.*, 1999).

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VANSHA

BOTANICAL NAME : *Bambusa arundinacea* (Retz.) Willd.
Syn. *B. bambos* (Linn.) Voss.

FAMILY : **Poaceae**

CLASSICAL NAMES

Vansha (C.S.Su.; S.S.Su.), *Twaksara* (C.S.Su.; S.S.Su.), *Venu* (C.S.Su.), *Vanshalekhana* (C.S.Ci.), *Vanshanirlekha* (A.H.U.), *Yavaphala, Yavarenu* (C.S; S.S;A.H.)

SYNONYMS

Bahupallava, Brihattrina, Dhanurdruma, Dhatyshya, Dridhagranthi, Dridhakanda, Dridhapatra, Duraruha, Kamatha, Kantaki, Kantalu, Karir, Karmuka, Karmmara, Kattuuna, Kichaka, Kilati, Kishkuparva, Kushirandhra, Mahabala, Maskara, Mrityubija, Navagragandha, Phalantaka, Purvayoni, Pushpaghataka, Shataparva, Shatpadalaya, Suparva, Suparvan, Tajana, Tejana, Trinaketu, Trinaketuka, Vadaniya, Vansha, Vanya, Venu, Vansa, Vaishnavi, Trinadhwaja, Sinhalese, Una

Synonymous of *Vanshalochana* –*Banshalochana, Kshiri, Tavakshiri, Tuga, Tugakshiri, Twakshiri, Vanshalekhana, Vanshi, Shubha* (D.N., 1982; B.N., 1982; R.N., 1982; Sharma, 1978).

VERNACULAR NAMES

Eng.- Spiny Bamboo, Thorny Bamboo, Bamboo. **Hindi-** *Bans, Kantabans, Kattang, Magarbans, Malbans.* **Beng.-** *Bans, Behurbans, Ketua, Kutuasi, Bansha.* **Guj.-** *Toncor, Wans, Gemeiner Bambos, Bans.* **Kan.-** *Biduru.* **Mal.-** *Illi, Kampu, Kaniyaram, Karmmaram, Mula, Mulmulam, Pattil, Tejanam, Trinadhavajan, Valiyamula, Venu, Mungil, Moongil.* **Mar.-** *Dougi, Kalak, Mandga, Padhai, Conogui, Kananki, Vellu, Bans, Bambu.* **Punj.-** *Magar.* **Tam.-** *Ponteveduru, Ambal, Ambu, Aril, Iraivarai, Kalai, Kambui, Mulai, Bongu, Kuluaimungil, Masukkaram, Miruttusam, Nettil, Tattai, Panai, Valai, Venu, Veyal, Vindil, Mungil, Mangal, Moongilanisi, Moongiluppu.* **Tel.-** *Bongu, Bonguveduru, Kichakamu, Maskaramu, Mudusuveduru, Pentiveduru, Trinadhvajamu, Veduru, Bonga, Vedurubeeam, Vederuppu.* **Arab.-** *Tabashira, Qasab.* **Assam-** *Kotoha, Bnah, Kata, Koto, Kotoha.*

VANSHA ***Bambusa arundinacea*** (Retz.) Willd.

Burm.- *Kyakatwa.* **Oriya-** *Beudobaunso, Kontabanso, Kontabaunso.* **Pers.-** *Nai, Tabasheer.* **Urdu-** *Bansa* **Gond**.- *Katiwadur.* **Central Provinces**.- *Kattang* **Kon.-** *Kalak, Padhai, Conogui, Kananki, Vellu, Vaso*. **Kumaon.-** *Kantabans.* **Santal**.- *Mat* (Kirtikar and Basu, 1989; Chopra *et al.*, 1958, 2002; B.N., 1982; Nadkarni, 1976; Anonymous, 2000a; Vaidya, 1985; Nair and Mohanan, 1998; Sharma, 1978; Anonymous, 1988; Anonymous, 1994; Agarwal, 1997; Asolkar *et al.*, 1992; Watt, 1972).

Vansalochana:

Eng.- Bamboo manna. **Hindi**.- *Bans-lochana*, *Banskapur*. **Ben**.- *Bans-Kapur*. **San**.- *Vanshalochana, Venulavanam*. **Arab**.- *Tabashir*. **Mar**.- *Bansa, Vanshalochana, Bansamitha*. **Guj**.- *Vanskapur, Vas-nu-mitha*. **Tam**.- *Munga-luppa*. **Tel**.- *Veduruppu*. **Mal**.- *Moleuppa*. **Kan**.- *Bidaruppu, Tavakshira*. **Burma**.- *Vd-chha, Vathega-kiyo, Vasan, Vathe gasu* (Watt, 1972).

BOTANICAL DESCRIPTION

Thorny tree, stems many, tufted on a stout root-stock, grows upto 30 meter high; culms 15-18cm across; nodes prominent, the lower emiting horizontal almost naked shoots armed at the nodes with 2-3 stout recurved spines; internodes upto 45 cm. long. Leaves 17.5 – 20.5 X 2-2.5 cm, linear or linear – lanceolate, tip stiff, glabrous or puberulous beneath, margins scabrous, base cilliate, mid-rib narrow, leaf-sheath ending on a thick callus and shortly bristly auricle. Inflorescence, an enormous panicles often occupying the whole stem. Caryopsis (grain) oblong, 5-8 mm long, grooved on one side. Flowering and Fruiting : Once in life time, often during September – May (Cooke, 1967; Anonymous, 1996; Anonymous, 1988; Bole and Pathak, 1988; Brandis, 1972).

DISTRIBUTION

A common bamboo found distributed throughout the moist parts of India, upto an altitude of 1250 m particularly near river banks (Anonymous, 1988), in Central and South India ascending upto 1100 m on the Nilgiri (Nadkarni, 1976), also cultivated in many places in North-West India and Bengal. It also occurs in Sri Lanka, Malaya, Peru and Myanmar (Burma) (Chopra *et al.*, 1958; Gamble, 1967; Kirtikar and Basu, 1989; Brandis, 1972; Agharkar, 1991; Watt, 1972).

PART(S) USED

Leaf, root, shoot, seed, Vanshalochan (silicious crystalline deposition in the nodal part of female plants). (Sharma, 1978; B.N., 1982).

ACTIONS AND USES

Leaves are antileprotic, anthelmintic, astringent, emmengogue, beneficial in dysmenorrhoea and haemoptysis. Infusion of leaves used internally in bronchitis, fever, gonorrhoea and as an eyedrop, externally in leucoderma and ulcers. Root is beneficial in ringworm, bleeding gums and joints pain. Banslochan is antidiarrhoeal, antiparalytic, carminative, expectorant, febrifuge, pectoral, stimulant, tonic and anti-hepatitis B virus (Chatterjee and Pakrashi, 2001). The stem and leaves are useful in diseases of blood and inflammatory conditions. The sprout and seeds are acrid, laxative, said to be beneficial in strangury and urinary discharges (Chopra *et al.,* 1958). Tabashir or bamboo manna is considered to be sweet, aphrodisiac, cooling and used against the diseases of the blood, tuberculosis, asthma, fever, leprosy, anaemia and burning sensations (Kirtikar and Basu, 1989). The juice of the flowers is used as a drop in the earache and deafness. The young shoots have lethal action on mosquito larvae. The plant extract is used as a remedy in snake and scropion bite (Chopra *et al.,* 1958). The buds are tonic, its paste is restorative, cooling and stomachic (Agarwal, 1997).

AYURVEDIC PROPERTIES

Rasa* – *Madhura, Kashaya.
Guna – *Laghu, Ruksha, Tikshna.*
Vipaka – *Madhura.*
Veerya – *Sheeta.*
***Seed* –** *Rukshma, Ushana* (A.H.Su.6.15).
Vanshalochana* –Madhura and sheeta.*
***Doshaghnata* –** *Vanshamoola-kaphapitta shamaka*; *Patrankur and fruit Pittavardhaka*; *Vanshoalochana, Vatapittashamaka*;
Vanshakarir – Vatapitavardhaka (A.H.Su.6.99) (Sharma, 1978; B.N., 1982).
Karma –
External –Root *Varnya and Kushthaghna, Patrankur Shothhara.*
Internal – *Patrankur Deepana, Pachana, Krimighna and Vidhahi*; *Fruit-Krimighna*; *Vanshalochana Shamaka, Trishnanigrahana, Grahi, Hridya, Raktasthambhaka, Raktashodhaka, Shwasahara, Mootrala, Jwarghna, Balya, Brimhan*; *Leaf-Artavajanana*; *Phala – Lekhana and Vishaghna, Roots are also Vishaghna* (Sharma, 1978; B.N., 1982).
Rogaghnata –
External – *Paste of root used in Varnavikar, Bhasma used in Dadru, Kushtha and Khalitya.*
Internal– *Agnimandya, Ajeerna, Krimi, Vamana, Atisara and Trishna roga, Hridroga, Kasa, Shwasa,* (C.S.Ci.18.72; S.S.Su.46.290), *Mootrakrichchhara,*

Jeernajwara, Kshayajajwara, Samanyaa daurbalya (C.S.Su.14.30), *Visharpa* (C.S.Ci.21.125; A.H.Ci.18.11), *used as splint in Bhanga* (A.H.U.27.15). *Moola* (root) *used in Raktavikar, Mootrakrichchara and Eyedisease* (S.S.U.12.49; 26.32); *Patrakwath* (decoction of leaf*) used in Rajarodha, Kashtaartava and prasavauttargarbhashay shodhana*; *Vanshayava* (seed) *used in Prameha Medoroga and Visha* (A.H.U.18.15). Bark used in *Vriddhi roga* (S.S.Ci.18.19), *Karnashoola* (S.S.U.21.15), *Agada in sarpavisha* (S.S.Ka.5.78; A.H.U.36.66); *Vanshalochana (Tabakshiri) used in Hridroga, Mootrakrichchhra, Raktavikara, Yakshma (Tuberculosis), Shwasa, Kasa, Kushtha* (Sharma, 1978; B.N., 1982).

Dose : Decoction 50-100 ml., Vanshalochana powder – 1-3 gm. (Sharma, 1978; B.N., 1982).

PHARMACOGNOSY

The silicious substance found near the joint inside is a white camphor like crystalline in appearance, slightly sticky to the tongue and sweet in taste (Vaidya, 1982; Watt, 1972).

Physical constants

Vanshalochana or Tabakshir – Silica 90.56%, Potash 1.10%; Peroxide of Iron 0.90%; Alumina, 0.40%; Moisture 4.87% (Watt, 1972).

CHEMICAL CONSTITUENTS

Plant: Cholin, betain, cynogenetic glycosides, albuminoids (Leslic, 1978).

Shoot: Oxalic acid, reducing sugar, resins, waxes, HCN, benzoic acid (Ghosh *et al.,* 1938), diferuloyl arabinoxylanhexasaccharide, diferuloyl oligosaccharide (Tadash, 1991), (5, 5'-di-O-(diferul-9, 9'-dioyl)-[α-L-arabinofuranosyl-(1→3)-O-β-D-xylopyranosyl-9 (1→4) –D-xylopyranose] (taxiphyllin) (Leslic, 1978).

Seed: Arginine, cysteine, histidine, isoleucine, leucine, lysine, methionine, phenylamine, threonine, valine, tyrosine, niacin, riboflavin, thiamine (Chatterjee and Pakrashi, 2001).

Leaves: Protein, gluteline, contains lysine, methionine, betain, cholin, proteolytic enzyme, nuclease, urease (Chatterjee and Pakrashi, 2001).

PHARMACOLOGICAL ACTIVITIES

Plant was found to have antipyretic, analgesic, anti-inflammatory, ulcer healing (Muniappan and Sundaraj, 2003), uterine contraction (Tewari *et al.*, 1966) and antifertility (Vanithakumari *et al.,*1989) activities.

Significant increase in thyroid weight as well as higher excretion of thiocyanate and iodine along with marked decrease in thyroid peroxidase activity were reported by Chandra *et al.*, (2004) in the people who take bamboo shoots. This chronic bamboo shoots consumption was reported to gradually develop a state of hypothyroidism (Chandra *et al.*, 2004). *B. arundinacea* is also reported for highest cell growth inhibition 81.9% in Swiss Albino mice inoculated with Ehrlich ascites carcinoma cells (Masud *et al.*, 2004)

TOXICOLOGY

Young shoots are lethal to mosquito larvae (Chopra *et al.*, 1941).

FORMULATIONS AND PREPARATIONS

Avaleha and Paka – *Pugakhanda, Chyavanprasha.*
Churna – *Dadimastaka churna, Sitopaladi churna.*
Vati and Gutika – *Brahmi vati.*
Rasayoga – *Mahatarunarka rasa* (Anonymous, 1978; 2000).

TRADE AND COMMERCE

Vanshalochana - Two highly priced varieties of 'Bansalochana' are available in the market, the blue and the white, both having a sweet taste (Watt, 1972; Chopra *et al.*, 1958). The bazar stuff, mostly is imported from Malaya or Singapore. It is purified and sorted as large, middle and very minute sized crystals and then sold. (Vaidya, 1982).
Retail Market Price for the year 2003 was Rs. 1600/kg. (Bansal, 2003).

SUBSTITUTES AND ADULTERANTS

Tvakshiri or Tugakshiri is white in colour and used as substitute of Vanshalochana. It is prepared from the tubers of *Curcuma angustifolia* Roxb. Synthetic product is white, very shining, sticky to the tongue (Vaidya, 1982; Watt, 1972).

PROPAGATION AND CULTIVATION

Bambusa occurs in moist forests as well as in temperate regions at high altitudes. Seeds are the most convenient mode of propagation followed by other conventional methods like layering, rhizome cuttings, culm cuttings, pre-rooted and pre-rhizomed branch cuttings, branch cuttings nodal bud chips, seedling multiplication, offset and clump division (Guha Bakshi *et al.*,1999; Nadgauda *et al.*, 1995).
In vitro rhizogenesis and precocious flowering in *B. arundinacea* was reported by Ansari *et al.* (1996). Ten subculture-cycle-old clonal explants from the seedling line of *Bambusa arundinacea* which exhibited *in vitro*

precocious flowering during the 6-7 subculture cycle were chosen and cultured on MS medium supplemented with 2 mg/L BA for shoot multiplication and 3 mg/L NAA for rooting. Root and flower primordia were visible within 10 days and after 45 days of inoculation on rooting medium respectively. Multiple shoots exhibited *in vitro* precocious flowering when they were maintained on MS medium supplemented with NAA for a long period of 45 days. Study on *in vitro* and *in vivo* flowering was also carried out by Nadgauda *et al.* (1990; 1997).

Seeds were germinated *in vitro* on White's basal medium in dark within 1 week. When seedlings grew to a height of 4.5 cm, the coleoptile was excised, used as explant and cultured in MS liquid medium. Proliferated shoots were cultured on MS medium with 2.2 μM BAP and 5% coconut water. The flowering cultures were sub-cultured at intervals of 30-45 days. Considerable difference in the morphological characteristics of *in vivo* and *in vitro* flowering was noted. Studies on flowering of Bamboo was also carried out by John *et al.* (1993;1995).

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VATSANABHA

BOTANICAL NAME : ***Aconitum chasmanthum*** Stapf. ex Holmes.

FAMILY : **Ranunculaceae**

CLASSICAL NAMES

Vatsanabha, Visha (C.S.; S.S.; A.H.).

SYNONYMS

Amrita, Garala, Mahoushadha, Marana, Naga, Pranharaka, Stokak, Ugra, Vatsanabhi (Sharma, 1978; B.N., 1982; D.N., 1982; R.N., 1982).

VERNACULAR NAMES

Eng.-Aconite, Monk's hood, Holf's bane, Indian Napellus. **Hindi-** *Balnag***,** *Mohri, Bisa, Bachnag, Mithazahar, Neethabisha, Meethabisha, Bachhnaga, Teliya Bish, Piun.* **Beng.-** *Kathavish, Bish, Katbish.* **Guj.-** *Nagpuri, Bachnaga, Vachanaga, Basanag.* **Kan.-** *Basanalli, Vatsanabha, Vatsanabhi, Vachanaga.* **Mal.-** *Vatsanabhi.* **Mar.-** *Bachnaga, Nagpuri, Bachnaga, Bachnaba.* **Punj.-** *Mitha Visha, Mithatelia, Mohri.* **Tam.-***Vasanaavi, Vashanavi, Vatsanabhi, Nabhi, Vasanabhi.* **Tel.-** *Vatsanaabhi, Nabhi***.** **Assam.-** *Bish, Mithavish.* **Kash.-** *Banbalang, Mohri, Mohand.* **Oriya-** *Tahara, Mahura, Mithvisa.* **Urdu-***Bachnak, Mithatelia, Beesh, Atees.* **Pushtu.-** *Mohri* (Anonymous, 1999; Anonymous, 1985; Kirtikar and Basu, 1933; Nadkarni, 1976; Chopra *et al.*, 1958, 1986; Guha Bakshi *et al.*, 1999).

BOTANICAL DESCRIPTION

An erect perennial herb, root biennial, paired and tuberous, stem erect, simple, 50-100 cm high. Leaves numerous, lower longer petioled and intermediate orbicular-reniform, 3- palmatipartite almost to the very base, segments divided, ultimate laciniae linear, acute to very acute. Inflorescence a long, narrow, stiff raceme, often over 30cm long. Flowers blue or whitish and variegated with blue. Follicles oblong, 10-16 mm long, continuous or with slightly divergent tips, glabrous. Seeds unequally 3- winged. Flowering

VATSANABHA ***Aconitum chasmanthum*** Stapf. ex Holmes.

and Fruiting: July – September (Dutt, 1928; Anonymous, 1985; Kirtikar and Basu, 1933; Guha Bakshi *et al.*, 1999; Mukerji, 1953).

DISTRIBUTION

Found wild in sub alpine and alpine Western Himalayas from Chitral and Hazara (Guha Bakshi *et al.*, 1999) to Kashmir and Lahul between altitudes of 2100-3600m; also found in the mountains of Assam and in sub alpine grasslands of Himachal Pradesh (Anonymous, 1985; Bhattacharya, 1961).

PART(S) USED

Root (Sharma, 1978; B.N., 1982)

ACTIONS AND USES

The root are considered as highly toxic; but suitable processing may reduce the toxicity. In small doses (0.023 – 0.018g) they are beneficial in nasal catarrh, evula hypertrophy, sore throat, gibbous, paralysis and chronic fever. Internally, the tincture of root (1 in 8 of alcohol in doses of 2 to 5 drops) is used in combination with other drugs for the treatment of fever and rheumatism. The root is considered to be cardiac stimulant, hypoglycemic, diaphoretic and antiphlogistic. Powdered roots in the form of liniment or paste are used to spread over the skin in case of arthritis and in scabies (*A. ferox*; Chatterjee and Pakrashi, 1994). Roots are used as diuretic, antiperiodic, anodyne, antidiabetic, and antipyretic in very small doses. Aconitine is a cardiac irritant alkaloid, which in the form of tincture, when applied locally acts as a peripheral stimulant to sensory nerves, producing first a tingling sensation and then depression and numbness (Chopra *et al.*, 1958). Taken internally it stimulates the vagus center and slower the heart rate. It is used as a cardiac depressant in high arterial tension of cardiac origin. It is also used externally in various forms of neuralgia, tetanus, acute and chronic rheumatism, gout, erysipelas and in affections of the heart, characterized by increased action. Internally it is used in cases of fever and for relieving pain, its general effect being to lower the temperature, increase the amount of urine and to lessen sensibility (Anonymous, 1987).

AYURVEDIC PROPERTIES

Rasa – *Madhura* (Sharma, 1978; B.N., 1982), *Avyakta rasa* (C.S.Ci.23.24).

Guna – *Ruksha, Tikshna, Laghu, Vikashi, Vyavayi, Ushna, Sukshma, Ashukari and Avipaki* (C.S.Ci.23.24; S.S.Ka.2.19; A.H.U.35.7-8), *Vishada* (C.S.Ci.23.24).

Vipaka – *Madhura.*

Veerya – *Ushna.*
Doshaghnata – *Tridoshhara, mainly Vata kapha shamaka* (Sharma, 1978; B.N., 1982).
Karma –
External – *Vedanasthapana, Shothhara.*
Internal –*Deepana, Pachana, Shoolaprashamana, Yakrit uttejaka, Hriday uttejaka, Mootrajanana, Shukrasthambhaka, Artavajanana, Kushthaghana* (S.S.Ci.9.55), *Swedajanana, Jwaraghna* (C.S.Ci.3.308), *Kaphaghna. In lower dose act as Balya and Rasayana* (Sharma, 1978; B.N., 1982).
Rogaghnata – External - *as paste applied on Kushtha (Leprosy)* (A.H.Ci.19.83) *Amavata, Sandhivata, Gridhrashi, Shirashoola.*
Internal – *Tridoshavikar specially in Kaphavatavikara, Nadidourbalya, Agnimandya, Hriddourbalya, Hriday and Phuphphus shotha, Kasa, Shwasa* (A.H.Ci.21.60), *Kushtha* (S.S.Ci.9.55; A.H.Ci.19.83; U.39.79), *Jwara* (C.S.Ci.3.308; A.H.U.39.50), *Samanya dourbalya, Shukrameha* (C.S.Ci. 1-3.24), *Udaravikara, Udarashoola, Yakrita-Pliha vikara, Gulma, Apasmara, Unmada,* loss of Intellect & Memory (C.S.Ci.1-3.24; A.H.Ci.21.16; U.39.50) (Sharma, 1978; B.N., 1982).
Dose: Root Powder (after purification) 15.5 - 32 mg (Sharma, 1978; Anonymous, 1999).

PHARMACOGNOSY

Macroscopic

Root- paired, occasionally separated due to breakage, ovoid, conical, small portion of stem sometimes attached, tapering downwards to a point, 2-4.5 cm, rarely 5 cm long, 0.4-1.8 cm thick, gradually decrease in thickness towards tapering end; outer surface wrinkled longitudinally and transversely, rough due to root scars; dark brown to blackish- brown; fracture cartilaginous, hard and white within the cambium ring and brownish outside cambium; odour indistinct; taste slightly bitter followed by a strong tingling sensation.

Microscopic

Transverse section of the root shows epidermis 1-3 layered, suberised, papillose on outside, primary cortex consisting of 8-10 layers of oval to tangentially elongated, thin walled, parenchymatous cells, without or with a few intercellular spaces, a few rectangular or triangular stone cells in singles found scattered in this zone, 92-230 μ long; primary cortex separated by distinct endodermis; inner bark parenchymatous, consisting of round to oval cells, containing a few groups of phloem strands, occupying more than half the radius; cambium continuous having 6-10 angles; xylem vessels arranged almost in a ring, some scattered, often forming 'V' shaped ring, enclosing xylem parenchyma in older portions; bundles compact often wedge-shaped having acute apex; xylem exarch, metaxylem vessels at the centre; starch grains mostly with central hilum, simple measuring 6-18 µ in diameter and compound grains consisting of 2-5 components with hilum, in the center. Starch grains are present in cortical cells, phloem parenchyma and xylem parenchyma (Anonymous, 1999; Datta and Mukerji, 1950; Mukerji, 1953; Bhattacharya, 1961).

Powder microscopy

Root powder light grey in colour; shows vessels, a few aseptate fibres and numerous simple and compound starch grains having hilum at the center, single grain measuring 6-18 µ in diameter (Anonymous, 1999).

The Drug mounted in nitrocellulose and exposed to u.v. light, some particles gave light bluish green fluorescence, the bulk of the powder remaining unaffected (Bhattacharya, 1961).

Physical constants

Total ash – Not more than 5.5%; Acid insoluble ash – Not more than 2%; Alcohol soluble extractive – Not less than 8%; Water soluble extractive – Not less than 24% (Anonymous, 1999).

Thin Layer Chromatography

TLC of alcoholic extract of the drug on silica gel 'G' plate using Chloroform: Methanol (90:10) shows six spots at Rf. 0.10, 0.20, 0.39, 0.59, 0.74 and 0.96 (all yellow) on exposure to Iodine vapour. On spraying with Dragandorff reagent two spots appear at Rf. 0.39 and 0.96 (both orange) (Anonymous, 1999).

CHEMICAL CONSTITUENTS

Plant: 3(-bikhaconine dichloroethane solvate, 3(-bikhaconine acetone solvate, 14-o-benzoyl-8-ethoxy-bikhaconine, 4-O-benzoyl-8-ethoxy-bikhaconine and 14-O-benzoyl-8-methoxy-bikhaconine (Parvez and Gul, 1998).

Root: Indaconitine, chasmaconitine, chasmanthinine, one unidentified alkaloid-base A ($C_{26}H_{43}O_6N$) (Achmatowicz and Marion, 1964), chasmanine, lycoctonine, aconitine (Achmatowicz *et al.*, 1965), bikhaconitine, α-lycoctonine, pyrosedaconitine (Klasek *et al.*, 1972; Tsuda and Marion, 1963a), delphinine, bikhaconitine, pseudaconitine, pyropseudaconine, isopyropseudaconine, pyrobikhaconitine, pyrobikhaconine, isopyrobikhaconine (Tsuda and Marion, 1963b,c).

PHARMACOLOGICAL ACTIVITIES

Plant was reported to have hypotensive, spasmogenic, hypertensive, depressant, antidiarrhoeal, antifertility, febrifuge, psychostimulant, CNS inhibitor and cardiac stimulant activities (Anonymous, 1985; Rastogi and Mahrotra, 1993; Handa *et al.*, 1951; Asolkar *et al.*, 1992; Anonymous, 2004). The dried roots were found to be analgesic, anodyne, diaphoretic, diuretic, irritant and sedative (Chopra *et al.*, 1986).

TOXICOLOGY

This is a very poisonous plant and should only be used with extreme caution and under the supervision of a qualified practitioner (Worthley, 2002). Within a few minutes after the oral administration of aconite, marked symptoms occur. There is a sensation of burning, tingling and numbness in the mouth, and burning sensation in the stomach. After about an hour there is severe vomiting. Much more weakness and cutaneous sensations similar to those above described soon follows. The pulse and respiration steadily fails, death occurring from asphyxia (Lin *et al.*, 2004; Gupta *et al.*, 1999). The treatment is to empty the stomach by tube or by a non-depressant emetic. The physiological antidotes are atropine and digitalin or strophanthin, which should be injected subcutaneously in maximal doses. Alcohol, strychnine, and warmth must also be employed (Fitzpatrick *et al.*, 1994).

Aconitine is easily absorbed through the skin, and poisoning may occur during picking the leaves without the use of gloves; the toxin in the sap is absorbed through the skin. The sap oozing from picked leaves may cause cardiac symptoms for a couple of hours. In this event, there will be no gastrointestinal effects. Tingling will however start at the point of absorption, and extend up the arm to the shoulder, after which the heart will start to be affected. The tingling will be followed by numbness. Atropine can be used as an antidote (Tai *et al.*, 1992; Agarwal *et al.*, 1977).

Aconitine is a potent neurotoxin that blocks tetrodotoxin-sensitive sodium channels. Pretreatment with barakol (10 mg/kg iv) reduces the incidence of aconitine-induced ventricular fibrillation and ventricular tachycardia, as well as mortality. Tetrodotoxin (5.0 μg/kg iv) also had the same effect. Preventive effects of barakol are probably due to the prevention of intracellular sodium ion accumulation (Salgado and Saar, 2004; Chan, 1994).

THERAPEUTIC EVALUATION

A study was conducted on 50 children with post operative pain symptoms. It was carried out double-blind, the children being given either placebo or aconite. Aconite proved to be 95% effective for children’s post-operative agitation. It is usually stated in such studies that the placebo effect is high and may reach rates higher than 30%. Aconite is an amazing cure when well prescribed, as much for the speediness of its action as for its efficiency. The fundamental research could specify how the remedy works and may discover other molecules effective for stress (Alibeu and Jobert, 1990).

FORMULATIONS AND PREPARATIONS

Taila *– Maha vishagarbha taila, Laghu vishagarbha taila, Vranarakshasa taila.*

Vati Gutika*– Agnitundi vati, Kasturyadi gutika, Saubhagya vati, Sanjivani vati.*

Parpati *– Tamra parpati.*

Rasayoga *– Laghvananda rasa, Laxminarayana rasa, Hinguleshvara rasa, Kaphaketu rasa, Tribhuvankirti rasa, Maha Vatagajankush rasa, Ashvakanchuki rasa, Sutashekhara rasa, Prabhakar rasa, Maha vatavidhvamsana rasa, Jvarankusha rasa Arshakuthara rasa, Kanakasundara Rasa, Anandbhairava rasa, Vatavidhwansana rasa, Mritunjaya rasa, Nagavallabha rasa, Shwaskuthara rasa, Suchikabharana rasa, Svarnabhupata rasa, Jwarmurari rasa* (Anonymous, 1978; 2000).

Other classical formulations – *Aindra rasayana* (C.S.Ci.1-3.24), *Bhutaravahvaya ghrita* (A.H.Ci.21.19).

TRADE AND COMMERCE

No reliable figures are existing about trade of roots. The north-west Himalayas from Kashmir to Hazara, exporting *A. chasmanthum* and *A. heterophyllum* mainly to Amritsar (Chopra *et al.,* 1958).

Source of Supply – Wild/Forests

Demand 1999-2000 190.7 tonnes

Demand 2004-2005 490.2 tonnes

Average growth rate of demands – 30.0 % per annum

Manufacturers purchase price – Rs. 130 per Kg (Anonymous, 2001-2002).

Retail Market Price – Rs. 225 per Kg (2006).

SUBSTITUTES AND ADULTERANTS

Aconitum balfourii Stapf., *A. palmatum* D. Don., *A. deinorrhizum* Stapf., *A. ferox* Wall, *A. laciniatum* Stapf., *A. luridum* Hook. f., *A. spicatum* Stapf., are used as substitute (Anonymous, 2000a; Mukerji, 1953; Chopra *et al.,* 1958; Kirtikar and Basu, 1933). *Aconitum balfourii* Stapf., *A. deinorrhizum* Stapf., *A. falconeri* Stapf and *Delphinium denudatum* Wall are used as an adulterants (Sharma, 1978; Mehra and Puri, 1967; Mukerji, 1953).

PROPAGATION AND CULTIVATION

Plants prefer loamy soil, well dug to loosen the soil particles and to maintain adequate moisture, to produce a better yield. Plants are propagated through well-developed tuberous roots, which are planted in the field in the month of December-January, 30 cm apart (Dutt, 1928). Shady conditions are favorable in the early stage of development for the overall growth of the plant. Flowering occurs within a period of 2-3 years in the month of June–July. Tubers are harvested after flowering, especially in the month of September (Anonymous, 1985).

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