



HERBS

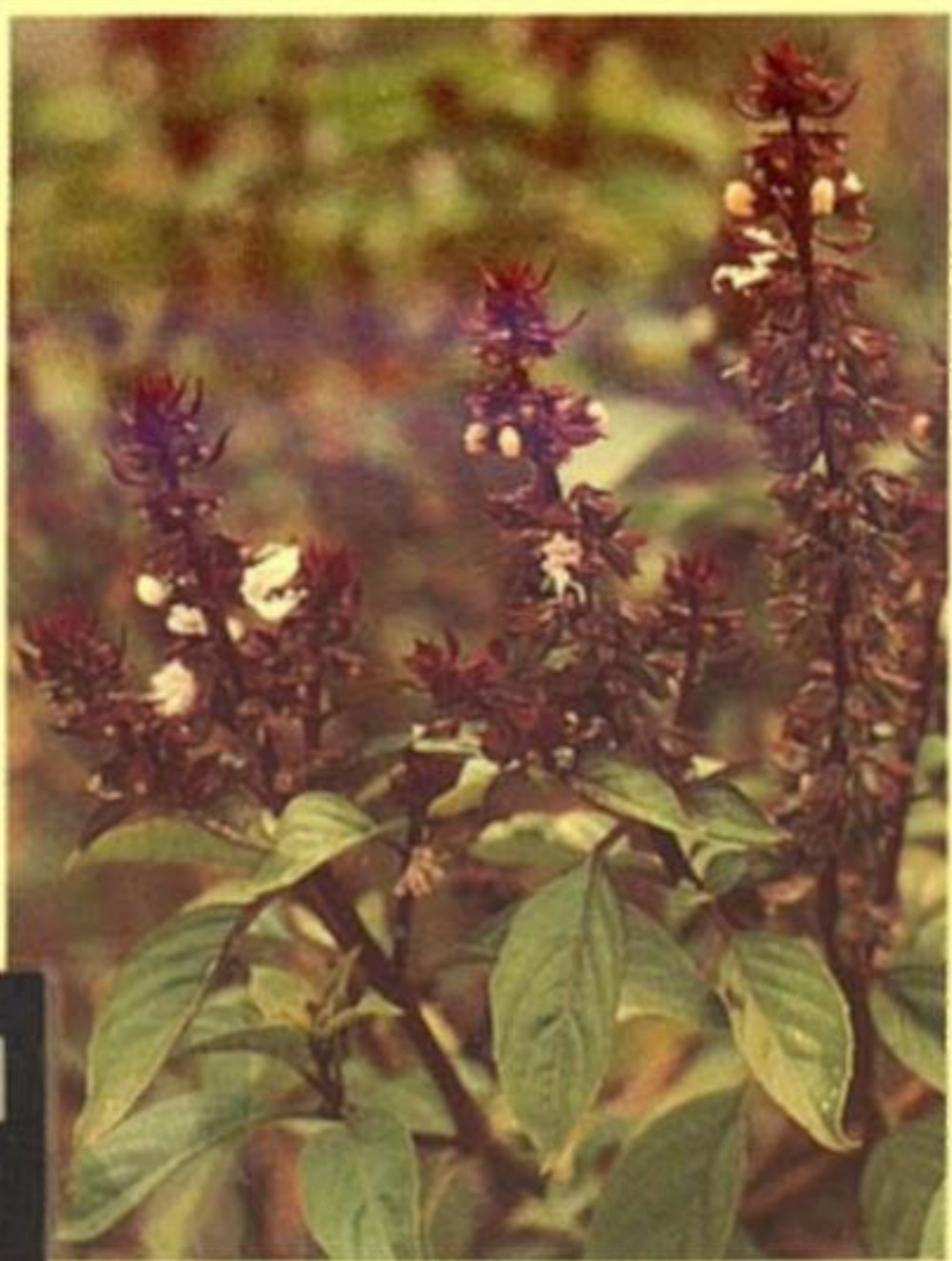
The Green Pharmacy of Malaysia



**Indu Bala Jaganath
Ng Lean Teik**



With technical support from:
Muthuvelu Chinna
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PRIME MINISTER
MALAYSIA

MESSAGE

Malaysia has long ignored the vast biological resources that lie hidden in its magnificent rainforests. Hand in hand with this biological wealth is the vast experience of traditional indigenous healing systems that have been used some thousands of years for therapeutic purposes. This rich knowledge is one of the most important contributing factors in providing modern science new sources of valuable pharmacological compounds of natural origin. Scientific progress and deep insight into the unexploited potentials of our country's flora for pharmaceutical and curative purposes have led to greatly renewed interest in the potentialities of medicinal and aromatic plants.

With the rapid development and modernisation of our country, the quality of life has increased tremendously and Malaysians are now more knowledgeable and health conscious. As such, the science of herbal medicine cannot stand alone by itself. There is a need for integration of various disciplines to make the herbal industry a more scientific one that will eventually lead it to international recognition in terms of safety, quality and efficacy.

The recent establishment of two National Committees on medicinal plants (National Medicinal Plant Committee and the MIGHT Interest Group on Herbs) has brought about smart partnerships between the industries, researchers and universities. To facilitate the herbal industries to penetrate the international market, there is need to identify commercially viable medicinal plant species with efficacies that have been scientifically validated.

This publication is indeed timely as it offers not only valuable information pertaining to some thirty important local medicinal herbs but also a comprehensive taxonomical identification of local species supplemented with scientific findings from pharmacological properties and clinical trials.



DR MAHATHIR BIN MOHAMAD

Putrajaya

23 October 1999

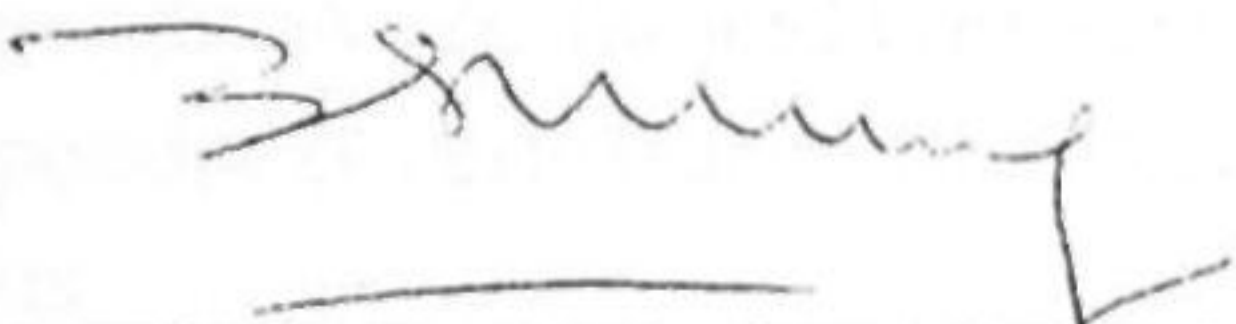
**Message From The
Director General, MARDI.**



Malaysia has a living heritage of a vast diversity of plant species, out of which 1200 has been reported to have therapeutic properties. The therapeutic properties of medicinal plants in many cases are due to the presence of secondary metabolites, which are particularly rich in our tropical rainforest due to the vigorous and competitive conditions they live in. In order to ensure sustainable production of these species and the utilization of their metabolites, there is a need to conserve these plants and at the same time have their potentialities thoroughly investigated for the use in the health care industry.

This living treasure of medicinal plants can only be proven to be beneficial and contribute positively to mankind if they are subjected to proper scientific studies and catalogued in a systematic manner. Such studies have been proven to be more useful if the ethnobotanical approach is taken rather than through random screening. Together with their ethnobotanical information, it is also crucial that these plants be documented with the potential chemical and pharmacological principles they contain. To achieve this objective, a scientific endeavor to integrate a study of botany, chemistry and pharmacology is vital.

This publication documents the results of such a study on 30 important medicinal plants. It also contains information on cultural practices and market demand of these potential herbs; facts which may be useful in the development of the herbal industry. This book in fact covers a wide range of disciplines ranging from pharmaceutical and clinical sciences to botany and agriculture with integration of economics. It is targeted for the scientific, industrial communities and also the public at large with the aim of assisting those interested to discover the wealth of our natural heritage.


(DATO' DR. MD. SHARIF AHMAD)

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Contents

Introduction	1
<i>Acorus calamus</i>	7
<i>Aloe vera</i>	10
<i>Alpinia galanga</i>	14
<i>Andrographis paniculata</i>	17
<i>Centella asiatica</i>	21
<i>Cinnamomum verum</i>	26
<i>Curcuma domestica</i>	30
<i>Cymbopogon citratus</i>	33
<i>Cymbopogon nardus</i>	37
<i>Eclipta alba</i>	39
<i>Elephantopus scaber</i>	42
<i>Eurycoma longifolia</i>	45
<i>Hibiscus rosa-sinensis</i>	48
<i>Kaempferia galanga</i>	51
<i>Labisia pumila</i>	53
<i>Melaleuca alternifolia</i>	55
<i>Melastoma malabathricum</i>	58
<i>Mentha arvensis</i>	60
<i>Morinda citrifolia</i>	63
<i>Moringa oleifera</i>	66
<i>Ocimum basilicum</i>	69
<i>Ocimum sanctum</i>	72
<i>Orthosiphon stamineus</i>	76
<i>Phyllanthus niruri</i>	78
<i>Piper betle</i>	81
<i>Plantago major</i>	84
<i>Pogostemon cablin</i>	87
<i>Polygonum minus</i>	90
<i>Portulaca oleraceae</i>	92
<i>Zingiber officinale</i>	95
Appendix A : Botanical Glossary	101
Appendix B : Glossary of Medical Terms	109
Index	124

Disclaimer

This book is offered for general interest in the area of herb cultivation and utilization. It is not a prescription for any specific condition; neither do the authors endorse any plant, product or method of application as a prescription for the treatment of any particular ailment. Many of the plants, products and compounds described in this text may be poisonous and dangerous if taken internally or when applied externally. Therefore, the authors strongly discourage experimentation by untrained persons or practitioners in the use of these materials for medicinal purposes. The authors and publisher waive any responsibility for injuries to readers of this book resulting from the use of these medicinal herbs.

Note

This book describes the cultivation, uses and commercial potential of selected medicinal herbs of Malaysia. Information in this book represents published and unpublished information from various sources. Despite the lack of proper recorded and documented information on local medicinal herbs, the authors have attempted to bring together relevant scientific literatures and to provide the information as accurately as possible.

Introduction

The Resurgence Of Herbal Medicine - From Plants To Pills And Back To Plants

Herbs were the earliest source of medicine. The use of herbs for healing dates as far back as pre-historic times and has since been woven into the culture and civilization of people. In ancient times, herbs were closely allied to ritual belief, myth and magic. In Egypt, herb gardens were planted about 4,000 years ago and were closely associated with temples. Herbs were used for daily rituals and worships. Beautiful and fragrant plants were regarded as sacred for their importance in mediating between sickness and health and in humanity and divinity. The use of volatile oils was common in baths. Incense has long been important in rituals in ancient Egypt, Rome, Greece, India and China. In terms of ancient herbal record, Chinese herbalism is widely regarded as the oldest in the world with a long unbroken history of record. Ayurvedic (Indian herbalism) medicine is also well recorded and dates back to 2,000 B C.

In the 18th century, with the mushrooming of science and technology, the emphasis in medicine shifted from plants to pills. There was a move to identify individual active ingredients and use them as single drugs. Initially, these drugs were only obtained from plant extracts but later the drugs were synthetically made. One of the first modern drugs to be isolated from a plant source was morphine from the poppy plant (*Papaver somniferum*). Other herbs that revolutionized medicine include periwinkle (*Catharanthus roseus*) for treatment of acute leukaemia and Hodgkin's disease, Meadow sweet (*Filipendula ulnaria*), commonly known as the aspirin plant, Mexican Yam (*Dioscorea species*), a blue print for oral contraceptive, Quinine (*Cinchona species*), an anti-malarial drug and Rauwolfia (*Rauwolfia serpentina*), a tranquilizer.

In the last few decades, an interesting phenomenon occurred, herbal medicine instead of being killed off by medical science and pharmaceutical chemistry, has made a comeback. Herbal medicine has been found to have some impressive credentials, which cannot be substituted by

modern medicine. In the transition from the use of herbs to clinical pills, modern medicine has lost the art of combining herbs which is considered very crucial in herbalism to modify toxicity and reduce side-effects. In this sense, various groups and organizations including the World Health Organization (WHO), have always referred to traditional medicine as being a more "holistic" method of treatment. "Holistic" in the sense that the health of the individual is viewed in totality within a wide ecological spectrum and ill health or disorder is brought about by an imbalance or disequilibrium of man in his ecological system. Perfect ecological balance in a living organism is only witnessed in the wild where Nature has full control and is considered as the self-sustaining miracle of life. With this concept in mind, people are turning back to nature and herbs again for answers about their medical ailments. In fact, this has also become a research avenue that many scientists are now exploring. At Harvard University and the University of Illinois in Chicago, scientists have reopened the field of botanical medicine and folk remedies. They are asking questions about the authenticity and the persistence of herbal medicine and the most fascinating questions of all: Is there sometimes a synergistic effect when the whole plant, as opposed to just the purified chemical derived from it, is used? Could the less pure extractions from the whole herb be more effective because the plant's constituents work synergistically? And lastly: Do some plants contain substances that neutralize the negative effects of the active chemical?

The resurgence of herbal medicine in the health care system is supported by the following statistics. According to World Health Organization (WHO), approximately 80% of the world population currently depend on traditional treatments and this number is in the increase even in young people. In accordance with this, the world market demand for herbs and their products has increased tremendously in recent years. In 1980,

when the synthetics dominated the drug market in the United States, medicines of plant origin was valued at US\$8 billion and this value increased to 9 billion in 1986. In the area of natural products the statistics is even more impressive. In 1981, about 400 species of plants were marketed in "health food" stores throughout the USA, and valued at US\$360 million. This number increased to US\$36.7 billion in 1994 and further to about US\$250 billion in 1996.

In conclusion, it is quite clear that herbs still remains at large the most important and strongest link between man and nature.

Richness of the Malaysian flora

It has been estimated that there are about 500,000 plant species occupying terrestrial habitats in the world. So far, 35,000 of these (some estimate up to 70,000) are used worldwide for medicinal purposes. The biome that is most evolved and supports a large portion of these higher plant species is the tropical rainforest. The Southeast Asia tropical rainforest has been estimated to support 6,500 medicinal plant species.

Malaysia's rainforest, being part of the world's tropical rainforest biome, is also considered one of the most evolved and diverse rainforests in the world as it is believed to be untouched by the Ice Age. The total area under the Malaysian rainforest is estimated to be 19.12 million hectares, which covers 58.1 % of the country's land area. This area supports more than 20,000 plant species, out of which 14,500 are flowering or seed plants. 2,000 plant species have been reported to have medicinal values.

Malaysia is a melting pot of three key ethnic cultures; the Malays, Chinese and Indians. The cultures from these three ethnic groups have been closely intertwined and intermixed for the past five centuries. Plants which were brought in by the Chinese and Indians over the past centuries have adapted, naturalized and hybridized very well in our local conditions. Therefore, the number of medicinal plants used in Malaysia is more than the estimated 2,000 species. There are about 200 species of medicinal plants which are being used by the different ethnic groups in Malaysia. The flora of Malaysia, whether indigenous or naturalized is

not only a huge reservoir of genetic diversity, it is also a storehouse of vast wealth in terms of chemicals that can be harnessed for our health care.

The prospect for herbs and herbal products

Medicinal plants and their parts are a primary source of products for the natural product and pharmaceutical industries. They are used in preparations for a wide spectrum of products ranging from traditional remedies to extracts with standardized contents of active constituents to chemically pure products used in drugs. Medicinal plants are also used in the food, beverage, flavour and fragrance industries.

The growing momentum in the area of traditional medicine worldwide is also reflected in Malaysia where the market demand for medicinal plants has increased steadily over the past years.

Statistics show that the total import value of medicinal and aromatic plants increased from RM141 million in 1986 to RM431 million in 1996. The health food market is also growing steadily by about 15% per year. The market was valued at RM38 million in 1994 and increased to RM45 million by the end of 1995. Currently, the herbal industry is estimated to stand at about RM2 billion.

The purpose of this book

With increasing market demand and the vast inherited genetic resource, Malaysia can be regarded as a 'goldmine' for the upcoming herbal industry. With all the sudden interest in medicinal plants lately, many enthusiastic entrepreneurs are willing to take up the challenge in investing into the herbal industry. Unfortunately, the scientific research and cataloguing of our vast empire of herbs in terms of its chemical constituents, clinical and pharmacological trials in validating the traditional uses of the Malaysian herbs is still in its infancy stage. An incomplete data system will definitely pose a problem to the new enthusiastic local entrepreneurs in identifying potential herbs to be commercialized immediately. Similarly, farmers are unable to identify high demanding herbs to cultivate to cater for the herb industry.

Currently, books or complete catalogue of po-

tential Malaysian herbs relating to their traditional uses with scientific validations and know-how on cultivation practices is very lacking in Malaysia. The purpose of this book is to provide a comprehensive monograph on some of our potential local herbs coupled with global scientific findings on their chemical constituents, pharmacological properties and results of clinical trials. Each herb is also botanically described and details are also mentioned on their cultivation practices and ethnobotanical uses. The database for each herb includes some global and international market values with colored photographs of the plant form, parts used and their ethnobotanical preparations. This book therefore caters to both the scientific and the non-scientific readers. The book is targeted specifically for herb entrepreneurs - both growers and manufacturers, students of botany, medicine and chemistry and, lastly, to the public at large - to accustom themselves with the wealth of our natural heritage.

After detailed exploration of more than 200

species of commonly used herbs, 30 species of herbs were chosen for this book and each of them is equipped with a potential rating for commercialization. The criteria for choosing these herbs and providing them with a potential rating is based on the following :

- Ease of cultivation, including resistance to pest and diseases
- Traditional uses - extent and diversification of uses
- Important phytochemicals
- Industrially important chemical constituent
- Scientific findings to validate the medicinal properties
- Market value - both global and local.

Detailed ranking of herbs is illustrated in Table 1. The number of asterisks (*) in the table denotes the level of each of the criteria for the selected herb. The higher the number of asterisks the greater is the intensity of that particular criteria.

No	Type of herb	Ease of cultivation	Traditional uses	Potentially commercial chemicals	Extent of scientific findings	Market value	Overall potential rating
1	<i>Acorus calamus</i>	****	***	***	***	***	***
2	<i>Aloe vera</i>	****	*****	*****	*****	*****	*****
3	<i>Alpinia galanga</i>	****	***	**	**	**	**
4	<i>Andrographis paniculata</i>	*****	*****	*****	*****	*****	*****
5	<i>Centella asiatica</i>	***	*****	*****	*****	*****	*****
6	<i>Cinnamomum verum</i>	***	***	****	***	****	****
7	<i>Curcuma domestica</i>	***	*****	*****	*****	*****	*****
8	<i>Cymbopogon citratus</i>	*****	***	***	****	***	***
9	<i>Cymbopogon nardus</i>	*****	**	***	**	****	***
10	<i>Eclipta alba</i>	****	***	***	***	***	***
11	<i>Elephantopus scaber</i>	***	****	**	**	*	**
12	<i>Eurycoma longifolia</i>	***	****	**	**	****	****
13	<i>Hibiscus rosa-sinensis</i>	****	****	-	***	***	***
14	<i>Kaempferia galanga</i>	***	****	-	**	**	***
15	<i>Labisia pumila</i>	**	****	-	-	***	**
16	<i>Melaleuca alternifolia</i>	***	*****	****	*****	****	****
17	<i>Melastoma malabathricum</i>	***	****	-	**	**	***
18	<i>Mentha arvensis</i>	***	***	***	***	****	***
19	<i>Morinda citrifolia</i>	****	*****	****	****	*****	*****
20	<i>Moringa oleifera</i>	***	*****	***	***	*	***
21	<i>Ocimum basilicum</i>	***	***	***	****	***	***
22	<i>Ocimum sanctum</i>	***	*****	****	****	****	****
23	<i>Orthosiphon stamineus</i>	****	****	-	**	****	****
24	<i>Phyllanthus niruri</i>	*****	*****	*****	****	****	*****
25	<i>Piper betle</i>	***	****	***	***	***	***
26	<i>Plantago major</i>	****	****	***	***	***	***
27	<i>Pogostemon cablin</i>	**	***	***	**	****	***
28	<i>Polygonum minus</i>	***	**	-	**	-	***
29	<i>Portulaca oleraceae</i>	****	***	***	***	**	***
30	<i>Zingiber officinale</i>	***	*****	*****	*****	*****	*****

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Acorus calamus

Scientific name : *Acorus calamus* L.
Common name : Sweet flag, Calamus root
Local name : Jerangau
Family : Araceae

Potential crop rating : * * *

Introduction

Sweet flag has a very long history of medicinal use and is widely employed in modern herbal medicine as an aromatic stimulant and a mild tonic. It has been used in Asia for at least the last 2 millennia by the Chinese and Indians. The root is well known in Biblical times and is mentioned in Exodus 30 as one of the ingredients of "holy anointing oil". It has also been used by early American settlers and by the ancient Greeks. In Malaysia, it is cultivated in backyard gardens of both the Malays and the Indians, where it is mainly used externally as a poultice or as a lotion. This plant is also known for its biopesticidal properties and has been used in destroying fleas, lice and white ants.

Plant description

Sweet flag is a vigorous perennial herb growing up to a height of 1.0m. It composes of many long, slender, glasslike leaves rising directly from the rhizomes. The leaves are equitantly arranged, simple, glabrous, green with an entire, linear leaf blade. The leaf apice is acuminate with a sheathing leaf base. The leaf venation is parallel and its insertion sheathing. The leaf sheath acts as a pseudostem and is purplish in color. The leaf is aromatic and sessile. The rhizome is very fragrant, containing an aromatic volatile oil. It is creeping, stout, robust and covered with scales. In section the rhizome is white in color and very fibrous. As



the rhizome grows it keeps on producing new suckers. This plant very rarely flowers in Malaysia.

Plant habitat

This plant inhabits wet areas like streams and around pond and lakes, in ditches and seeps.

Plant growth habit/cultivation

Sweet flag is hardy and is an easy to grow crop. It grows in most soil types where there are adequate amounts of water and ample sunshine. New plants are almost always started from root divisions that are about 5cm long and free from any kind of infection. They are normally planted about 3cm deep, 15-20cm apart with leaf shoot upwards. They do well in rich soils with frequent irrigation. The roots/rhizomes are harvested when the plant is about one year old or when the plant reaches a height of 30-40cm. The fresh roots can yield about 1.5-3.5% essential oil while the dried roots yield about 0.8% .

Plant parts used : Rhizomes.

Uses in traditional medicine

Sweet flag is reported to be used for their antiarrhythmic, antibacterial, anticonvulsant, antiperiodic, antiseptic, antispasmodic, contraceptive, diaphoretic, emetic and sedative properties. The rhizome is used as a remedy for flatulence, colic, dyspepsia and intermittent fevers,

internal hemorrhages, intestinal ulcerations, rheumatism, nerve diseases, bowel complaints, dysentery in children, bronchial infections and asthma. Calamus oil is used for preparation of aromatic cordials, liquors, flavoring beer and making perfumes.

In Malaysia, decoction of the plant with *Zingiber officinale* and *Zingiber cassumunar* is used for treating fever and colds. The juice or tincture of the plant is used for treating fluxes. Poultice prepared from the plant and vinegar is used to rub over the body after confinement. A decoction prepared from the plant is taken after confinement as a tonic. A decoction of root is drunk to stop bleeding after childbirth or from excessive menstrual flow. The herb is also used for treating flatulent colic, dyspepsia, rheumatism and malaria. Lotion prepared from the mixture of the plant, *Zingiber officinale* and *Kaempferia pulchra* is used for treating rheumatism and sore eyes.

In India, it is used as a remedy for flatulence, colic and as a mild tonic. It is also used in remittent fevers and as an insectifuge especially for fleas. In Ceylon, an infusion of the rhizome is given for dyspepsia, flatulence, choleraic diarrhea in children, cough, fever, and with other ingredients for abdominal colic, dropsy, piles, asthma and anaemia. In China, the root is used as a restorative tonic for both the body and mind while in the Philippines it is used as a stimulant, carminative and applied as an embrocation for rheumatism. The natives of America used sweet flag as an analgesic for the relief of toothache, headache, for oral hygiene, to fight the effects of exhaustion, and to assist in overcoming a hangover. The roots have also been used to treat diabetes and as a tea for bowel pains. The powdered rhizome is an insecticide and is used in the preparation of toilet powders.

Chemical constituents

i) *Chemicals with commercial potential:* *a*-asarone, azulene, elemicin, isoeugenol, limonene; essential oil.

ii) *Other chemicals:* Aceteugenol, acolamone, acoradin, acoragermacrone, acoramone, acorenol, acorenone, acoric acid, acorin, acorine, acorone,

acoroxide, aneurine, aristolene, asaraldehyde, asaronaldehyde, asarylaldehyde, P-asarone, *y*-asarone, cis-asarone, ascorbic acid, borneol, butyric acid, (-)-cadala-1,4,9-triene, cadalo-1,4,9-triene, 8-cadinene, calacone, calacorene, calamendiol, calamene, calamenene, calamenol, calamenone, calameone, calamol, calamone, (+)-calamusenone, calarene, camphene, camphor, 8-carene, caryophylline, chalcone, choline, 1,8-cineole, cryptoacorone, (-)-p-curcumene, p-cymene, dextrin, 2,5-dimethoxyquinone, 2,6-diepishyobunone, 2,3-dihydro-4,5,7-trimethoxy-1-ethyl-2-methyl-3-(2,4,5-trimethoxyphenyl)indence, P-elemene, enanthylic acid, epishyobunone, epoxyisoacoragermacrone, eugenol, furfural, galangin, guaiene, 8-guazulene, heptylic acid, *a*-humulene, isoacalamone, isocaespitol, isocalamenediol, isocalamusenone, cis-isoelemicin, isoeugenol, isoshyobunone, isotelekin, linalol, menthol, menthone, methylamine, methylchavicol, methyleugenol, methylisoeugenol, mucilage, myrcene, parasarone, phenol, *a*-, *p*- and *y*-pinene, preisocalamenediol, resin, sabinene, sekishone, selina-3, 7(11)-diene, selinene, shyobunone, sitosterol, tannin, telekin, *a*- and *y*-terpinene, *a*-terpineol, terpinen-4-ol, terpinic alcohol, terpinolene, thymol, transasarone, transanethole, transisoelemicine, transisoeugenolmethylether, 2,4,5-trimethoxybenzaldehyde, Z-3-(2,4,5-trimethoxyphenyl)-2-propenal, tropone; mixed fatty acids (arachidonic, linoleic, myristic, oleic, palmitic, palmitoleic, stearic), minerals, sesquiterpenes, saponins, sugars (fructose, glucose, maltose).

Pharmacology

Acorus calamus is reported to have antibacterial, antifungal, CNS depressant, hypotensive, hallucinogenic, smooth muscle relaxing and insecticidal properties. An ethanol extract of rhizome was shown to exhibit a similar effect in central nervous system as that of *oc*-asarone (an active principle of sweet flag), but not in the responses to electroshock, apomorphine- and isolation-induced aggressive behavior, amphetamine toxicity in aggregated mice, and behavioral despair syndrome in forced swimming. *In vivo* study on the water soluble fraction of

ethanol extracts caused negative inotropic and chronotropic effects in frogs (at 1, 10 and 100mg/ml), and antagonize spontaneous motor activity and amphetamine induced hyperactivity in mice at concentrations of 10, 25, 50mg/kg i.p.

In acute and chronic experiments on mice, rats, cats and rabbits, a-asarone is shown to possess tranquilizing, sedative, antiulcer, spasmolytic and antisclerosing properties; LD50 of a-asarone is found to be 417.6mg/kg for mice in enteral administration and 310mg/kg in intra-abdominal. Asarone is also found to inhibit nematode mobility and activity.

Vapours of *Acorus calamus* are found to induce sterility in male houseflies. The dried rhizome of the plant contains carminative, spasmolytic, diaphoretic and vermifuge properties;

it also stimulates salivary and gastric glands.

Clinical trials: No information available.

Towards commercial production

Locally, the use of sweet flag is restricted to only the traditional healers and used chiefly as oilments. But globally, the variable uses of sweet flag have been long acknowledged and currently there are a number of products in the international market. The essential oil from the rhizome is widely used in perfumery, food flavoring and as an insect repellent and insecticide.

Commercially, the oil has been used for aromatic cordials and liqueurs; flavoring beer, gin and also in perfumes. Extract of sweet flag is priced at US\$5.50 per oz(1998).

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Aloe vera

Scientific name : *Aloe vera* (L.) Burm. f.

Synonym : *A. barbadensis* Mill

Common name : Aloe vera

Local name : Lidah buaya

Family : Liliaceae

Potential crop rating : * * * * *



Introduction

Due to its exceptional healing properties, *Aloe vera* is also known as "the lily of the desert", "the plant of immortality", "the first aid plant" and "the miracle plant". It is also one of the most important crude drugs of history and is still extensively used in modern medicine. It contains the same painkilling and antiinflammatory compound as in Aspirin, which helps to relieve pain, heal minor burns, cuts, etc. *Aloe* is also a nutrient-rich-plant, containing more than 200 active-components, vitamins, minerals, essential amino acids, enzymes and other plant chemicals which is said to gently strengthen, sustain and encourage cellular activity in the body.

Plant description

Aloe vera is a succulent perennial herb growing up to a height of 45-50cm. The light green leaves are rosettelly arranged, very fleshy, green in color and covered with rounded specks. The leaves are lanceolate, glabrous with a spinous apice, a sheathing base and a prickly margin. The leaf venation is absent and the leaf sheath is tubular in form, acting as a pseudostem. The flower stalk can grow up to a height of 1m long which then terminates in an elongated cluster of down-pointed yellow to orange-red flowers. The rhizome is stout, white to green color in section and produces tubers. The tuber descends and a few of them will produce suckers, which grow out as new plantlets.

Plant habit

This plant is native to tropical Africa and Mediterranean regions where it can be found growing wildly in dry, sunny and sandy spots. In Malaysia, it is commonly grown in home gardens.

Plant growth habit/cultivation

This plant is very tolerant to drought and therefore does not need much watering especially when grown in the open. *Aloe vera* requires well-drained soils and does very poorly in clayey soils or in waterlogged conditions. It is propagated through separation of the suckers. The suckers are allowed to establish themselves for at least a month in the nursery. They are then transferred to the field and planted 1.0m x 0.5m apart. Although the plant can grow in full sunlight, partial shade is normally preferred for a more vigorous growth. Harvesting is carried out after the 6 month. Harvesting begins from the bottom leaves, which are the broadest, and the largest. The rest of the plant is left until the leaves mature in thickness and size for the subsequent harvest.

Plant parts used : Leaves.

Uses in traditional medicine

Aloe vera is traditionally used for treatment of constipation, edema, eczema, pertussis, burns, pain, swellings, wounds, dyspepsia, coughs, asthma, nervous diseases, leukemia, lung cancer,

glandular enlargements of the spleen and various types of dropsies, piles and colics. It is also used as an antibiotic, antipeptic, cathartic, emmenagogue, purgative and vermifuge.

The fresh juice of the leaves is cathartic and cooling. It is used for various eye diseases. The dried juice is often applied with lime juice for reducing swellings and promoting granulation in ulcers. In Malaysia, it is used for treating wounds, fever, swellings and put on the abdomen of women after confinement. The mixture of sugar with sap obtained from heated leaves is taken for asthma. The mucilaginous flesh and the sap of the leaves are used for poulticing burns. The watery extract is used as a hair tonic. It is also used in cosmetics for decreasing wrinkles and other skin problems. In the Philippines, the juice is applied to prevent the falling of hair and to cure baldness. It is mixed with milk and given for dysentery and pains in the kidney. A vaseline ointment prepared from *Aloe vera* is useful for treating burns and scalds.

Chemical constituents

i) *Chemicals with commercial potential:* Acemannan, aloe-emodin, cinnamic acid, coumarin, emodin, folocin, p-coumaric acid, rhein.

ii) *Other chemicals:* Aleosone, alinase, aloeresin C, aloctin-A, aloe-emodin-anthranol, aloenin, aloesin, aloesol, aloesone, aloetic acid, aloetin, aloetic acid, aloinose, aloinoside-A, aloin, iso-aloesin, aloetic acid, amylase, anthracene, anthranol, anthraquinone-glycoside, anthrol, apoise, arabinan, arabinose, arachidonic acid, ascorbic acid, barbaloin, P-barbaloin, benzylacetone, calcium-oxalate, campesterol, p-carotene, casanthranol-I, casanthranol-II, catalase, choline, choline-salicylate, chrysamminic acid, chrysophanic acid, chrysophanol, chrysophanol-glycoside, .coniferyl alcohol, creatinine, 1,8-dihydroxyanthraquinone, DI-(2-ethylhexyl)-phthalate, formic acid, D-galactan, D-galactouronic acid, globulin, glucomannan, glucosamine, glucogalactomannan, glycerol, glyoxalase I and glyoxalase II, hecogenin, hexauronic acid, homonataloin, hydrocinnamic acid, 7-hydroxyaloin, 5-hydroxyaloin A, 7-hydroxy-chromone, hydroxymethylanthraquinone, isobarbaloin, lignin, lipase, lupeol, 2-methyl-2-

phytyl-6-chromanol, p-methoxybenzylacetone, P-methoxy-hydrocinnamic acid, 8-methyl-tocol, mucilage, nataloin, niacin, niacinamide, pectic acid, polyuronide, proteinase, M-protocatechuic aldehyde, pteroylglutamic acid, purine, quinone, riboflavin, sapogenin, P-sitosterol, thiamin, threitol, trihydroxymethylanthraquinone, uronic acid; amino acids, anthraquinones (rhein, emodin, physcion, chrysophanol), glycosides, minerals, monosaccharides (fructose, galactose, glucose, mannose), mucopolysaccharides, organic acids (citric, maleic, malic, tartaric), phytosterols, polysaccharides, polyphenols, resitannols, saponins.

Pharmacology

Aloe vera has been shown to have antibacterial, antiinflammatory, antidiabetic, antineoplastic, dermatological, antifungal, immunomodulating and insecticidal properties. Both topical and oral treatments with *Aloe vera* extracts and their products were found to improve wound healing in animal studies. *Aloe vera* also improves wound healing and antiinflammatory capabilities in diabetic animals. It also inhibits inflammation and adjuvant-induced arthritis. It was found to contain an active growth chemical known as mannose-6-phosphate, which improves wound healing and inhibits inflammation.

Aloe vera is found to contain several pharmacologically active ingredients, including a carboxypeptidase that inactivates bradykinin *in vitro*, salicylates, and a substance(s) that inhibits thromboxane formation *in vivo*. Acemannan, major carbohydrate fraction obtained from the gel of the *Aloe vera* leaf, is shown to have several important therapeutic properties including acceleration of wound healing, immune stimulation, anticancer and antiviral effects. It also stimulates macrophage cytokine production, nitric oxide release, surface molecule expression and cell morphologic changes. Acemannan is found to be an important immunoenhancer as it increases lymphocyte response to alloantigen. No significant signs of intoxication and no deaths were observed in animals treated with the single injection of acemannan at dosages of 80mg/kg i.v. or 200mg/kg i.p. in mice; 15mg/kg i.v. or 50mg/kg i.p. in rats; and 10mg/kg i.v. or 50mg/kg i.p. in dogs.

Aloe vera does not affect cutaneous erythema and blood flow following ultraviolet B exposure. *Aloe vera* gel was found to contain at least two small molecular weight immunomodulators that may prevent ultraviolet B (UVB)-induced immune suppression in the skin.

Extracts from the parenchymatous leaf gel and the rind of the *Aloe vera* plant were shown to contain seven electrophoretically-identifiable superoxide dismutases (SODs), whose activity are found to be comparable to those of spinach leaves and of rabbit liver. A highly active polysaccharide fraction isolated from the mucilagenous leaf-gel of *Aloe vera* was shown to inhibit the opsonization of zymosan in Human Pooled Serum and display adjunct activity on specific antibody production and the induction of delayed type hypersensitivity in mice.

Clinical trials

The double-blind, placebo-controlled study showed a significant improvement and no sign of toxicity or any other objective side effects on patients with *psoriasis vulgaris* after topically treated with *Aloe vera* extract 0.5% in a hydrophilic cream. In another study, patients with partial thickness burn wound revealed that *Aloe vera* gel treated lesion healed faster than the vaseline gauze area. However, *Aloe vera* gel failed to prevent radiation therapy-induced dermatitis and

protect against radiation therapy-induced dermatitis.

Using a within-subject design, nutritional supplements of freeze-dried *Aloe vera* gel extract in the diet resulted in a remarkable reduction in initial symptom severity in subjects with fibromyalgia and/or chronic fatigue syndrome. A long-term study showed that *Aloe vera* added in the diet of patients with atheromatous heart disease (presented as angina pectoris) reduced significantly the frequency of anginal attacks, total serum cholesterol, serum triglycerides, total lipids, fasting and post prandial blood sugar level in diabetic patients whilst increased the high density lipoprotein (HDL). Patients with diabetes were found to have benefitted the most (without adding any antidiabetic drug). These studies showed no unwanted side effect.

Towards commercial production

Aloe vera and its products have long captured the world market. At present the commercial producers of *aloe* are Texas, Mexico, South America and the Caribbean Islands. There are dozens of *Aloe vera* products in the market, ranging from dietary supplements, aloe extracts, aloe drinks/juice, aloe facial creams, aloe gels, aloe shampoos, aloe antiseptic creams for burns, etc. Examples of some commercial products are Dermaide Aloe, M S M and Pycnogenol.

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Alpinia galanga

Scientific name : *Alpinia galanga* (L.) Willd.
Synonym : *Languas galanga* (L.) Stuntz.
Common name : Greater Galangal
Local name : Lengkuas
Family : Zingiberaceae

Potential crop rating : * *



Introduction

This plant is widely cultivated in tropical Asia where it is commonly used as a spice and in traditional medicine. The medicinal value of this crop was discovered and documented in India as early as 600 AD and therefore lengkuas is believed to have originated from that country. Other than its use in the Ayurvedic medicine, the Malaysian, Yunani and the Chinese have also used this plant for centuries as a medicine. Lengkuas rhizome is also the source of the essential oil, cineol.

Plant description

Lengkuas is a perennial, erect tall herb that grows up to a height of 2-3m. The leaves are simple, glabrous, arranged distichously and green. The leaf blades are linear-elliptical with an entire margin. The leaf has an acuminate apice and sheathing base. The upper leaves are well developed while the lowers ones remain as scales. The leaf sheath acts as a pseudostem. The petiole is pericladial in nature. Flowers are borne on leafy-branched terminal panicles, which are about 12-15cm in length. The peduncle is above the ground and glabrous. The bracts are lanceolate in shape, yellow in color and very conspicuous. They are arranged distichously with two bracts to a flower. There is a single calyx which is tubular 3-dentate in shape, white and with a scaly texture. There are three equal sized corolla lobes and one huge labellum. The corolla is glabrous, pale green with

an orange speck on the posterior lobe. The labellum is ovate with 2 lobes and white in color. There are 2 staminodes and one stamen. The stamen is appendicular and epipetalous in position. There is a single style, terete with 2 coherent stylodes and a funnel-shaped stigma. The rhizomes are creeping, thick, aromatic and robust.

Plant habitat

Lengkuas is naturalized in jungle clearings and can be found up to 1,200m above sea level.

Plant growth habit/cultivation

This plant is easily cultivated and propagated through divisions of rhizome. Rhizomes with at least 1-2 buds are chosen and then planted in the nursery. When the shoots protrude out, they are then transferred to the field. Lengkuas can be grown in the open field under full sunlight but more vigorous growth is exhibited if planted in semi-shaded condition. It thrives on rich, loamy, well-drained, loose soil. It does very poorly under water logged conditions. Lengkuas is planted about 5-7cm deep at a distance of 1m x 1m apart. After about 7 months, the rhizomes can be harvested.

Plant parts used : Rhizome.

Uses in traditional medicine

The rhizome of lengkuas is used for its carminative and stomachic properties. An infusion of the

rhizome is used for treating rheumatism, fever, impotency, bronchitis, dyspepsia and diabetes. The juice of the rhizome is given with human urine for cobra-bite poisoning. An infusion prepared from lengkuas is taken medicinally after childbirth. A paste prepared with a little garlic and vinegar is used as a remedy for herpes. An ointment made from the plant and sulphate of arsenic is used in Kelantan for treating skin eruptions. The leaves are boiled and used as a body lotion.

In India and Indo-China, it is used for treating dyspepsia and bronchitis. In China, the seeds are used for colic, diarrhea and vomiting. In Java, it is used to treat enlarged spleen and to improve digestion. The Arabs used it as an aphrodisiac.

Chemical constituents

i) *Chemicals with commercial potential*: 1'-acetoxychavicol acetate, cadinene, cineol, eugenol, galangin; essential oil.

ii) *Other chemicals*: 1'-acetoxyeugenol, 1'-acetoxyeugenol acetate, ascorbic acid, bassorin, camphor, P-carotene, caryophyllene oxide, caryophyllenol-I, caryophyllenol-II, (E)-8-j3-17-epoxylabd-12-ene-15,16-dial, galangin, galanginmethyl-ether, galangol, isorhamnetin, kaempferide, kaempferol, methylcinnamate, niacin, phlobaphen, D-pinene, quercetin, quercetin-3-methyl ether, riboflavin, terpinen-4-ol, thiamin, trans-3,4-dimethoxycinnamyl alcohol, trans-4-hydroxycinnamaldehyde, trans-4-methoxycinnamyl alcohol; minerals.

Pharmacology

Alcoholic extracts of the rhizomes of lengkuas showed anthelmintic activity against human *ascaris lumbricoides in vitro*. 1'-Acetoxychavicol acetate (ACA) isolated from lengkuas was found to inhibit the development of azoxymethane-

induced colon tumorigenesis. ACA suppressed significantly the phagocytosis of macrophages at an IC50 value of 1.2mM and with negligible effects on pinocytosis and cell viability. (E)-8-p-17-epoxylabd-12-ene-15,16-dial is synergistically shown to enhance the antifungal activity of quercetin and chalcone against *Candida albicans*.

Acute (24 h, at dosage of 0.5, 1.0, and 3g/kg body weight) and chronic (90 days, at dosage of 100mg/kg/day) oral toxicity studies on the ethanolic extracts of the rhizomes of lengkuas showed no significant mortality as compared to the control groups. Hematological studies revealed a significant rise in the red blood cell level of lengkuas-treated animals and a significant fall in the white blood cells as compared to the controls. Lengkuas extract-treated male mice showed no spermatotoxic effects but a gain in the weight of sexual organs, increased sperm motility and sperm counts.

Clinical trials : No information available.

Towards commercial production

In the global market, lengkuas loses out to its closely related species, the lesser known galangal (*Alpinia officinarum*) of the Southeast China in terms of its essential oil quality and content. However, medicinally and as a flavoring agent, lengkuas is more popular. In Malaysia, lengkuas is commonly grown for its flavor and popularly used as a spice.

In the global market, the dried cut form of lengkuas is sold at US\$11.95 per pound (1998). In the local herbal industry, the use of lengkuas is more or less confined to 'jamu preparations' and is commonly used as one of the major ingredients in preparing afterbirth tonics. It is also used in the making of oilments for treating joint and ligament pains.

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Andrographis paniculata

Scientific name : *Andrographis paniculata*
(Burm.f.) wall.ex Nees

Common name : King of Bitter

Local name : Hempedu bumi, pokok cerita

Family : Acanthaceae

Potential crop rating : * * * * *



Introduction

This annual herb is indigenous to Southeast Asia, China and India. Because of its efficient reproductive capacity, it is considered a weed in many regions. This plant has been used for centuries in a number of cures in countries like China, India and Java. However, only recently was its actual potentialities discovered and has since captured the herbal and pharmaceutical market. It is now considered as a new promising herb for many ailments and is being tested for the treatment of many diseases including HIV, AIDs and the myriad symptoms associated with autoimmune disorders.

Plant description

It is an erect, annual herb growing to a height of 60-70cm. The stems are quadrangular and branches profusely. The leaves are green in color, simple, glabrous and decussately arranged with entire margins. The leaves are lanceolate in shape, acuminate at the apice and attenuate at the base. As the plant matures, the leaf size is reduced. The leaves are sessile. Flowers are borne on terminal and axillary panicles of 2-5cm in length. Bracts are about 2.5mm long, green in color and glabrous. The flowers are bisexual in nature, about 1.2cm long, without any distinct odor and very irregular in shape. There are 5 sepals, which are green in color, partially gamosepalous and covered with glandular hairs. The corolla or petals are bilabiate,

white in color with specks of purple, about 1.1cm in length and covered with minute hairs. There are 2 stamens, which are united at the anthers. The filaments are flat, hairy and they arise from midway down the corolla tube. There is a single central style which is filliform in shape and with a terete stigma. This plant bears simple fruits (capsules) which are linear-oblong in shape, about 20mm in length and yellowish brown in color.

Plant habitat

Hempedu bumi is commonly found growing wildly in wastelands and grasslands.

Plant growth habit/cultivation

In Malaysia, hempedu bumi is normally grown in backyard gardens or pots for medicinal purposes. Although this is a very hardy plant and can survive and adapt itself in a variety of soil conditions, it prefers rich loamy soil with some shade. It is propagated from either stem cuttings or seeds. Since the plant flowers profusely all year long, seeds are abundantly produced. Seeds are normally germinated in the nursery and transferred to the field after 30 days. Plant vigor is high both in the nursery and in the field. The planting distance is normally kept at 1m x 1m as the spread of the trees can go up to 85cm. So far, there is no report on any significant pest and disease problems.

Harvesting of the leaves for herbal remedies can be carried out as early as 2 months after

planting, that is, before the plant goes into flowering. Subsequent harvest can be done after an interval of 1.5-2 months.

Plant parts used : Leaves, whole plant.

Uses in traditional medicine

This herb is given as analgesic, laxative, expectorant, digestive, stomachic, antipyretic and is also used for treating diabetes, fever, worm infections, chronic bronchitis, leprosy, pruritis, flatulence, colic, dysentery, diarrhea infestation and skin diseases (eg burns, wounds, ulcers). It is also a good remedy for treating snake-bite and female disorders.

In Malaysia, a decoction of the leaves is often taken orally to cure diabetes and high blood pressure. The roots and leaves are febrifuge, stomachic, tonic, alterative and anthelmintic. A leaf poultice is applied topically to relieve itchy skin and insect bites. It is also used to treat asthma, coronary arteriosclerosis, angina pectoris, malaria and fever. Decoction made from the plant is taken to lower hypertension. Even though it tastes bitter, many people drink it as a tonic, for treating tonsillitis (sore throat), fever, flu and chest pains, and also used as a pain-killer against snake bites. When boiled with misai kucing (*Orthosiphon stamineus*), the water is believed to be effective in treating diabetes. If taken in higher dosages than recommended, it can cause mild side effects such as loss of appetite, nausea, dizziness and insomnia. The juice of hempedu bumi is either taken or applied to area of snake-bites and stings of insects.

In India, it is known as a powerful bitter tonic for dysentery and diarrhea. The dried mixture of hempedu bumi leaves and spices is made into small pellets and prescribed for infants to relieve griping, irregular stools and loss of appetite. An infusion of the plant is given to fever patients and also used as an antidote to cobra venom.

Chemical constituents

i) *Chemicals with commercial potential:* Andrographiside, andrographolide, neoandrographolide.

ii) *Other chemicals:* 6'-acetylneoandrographolide, 2,3-aminomutase, andrograpanin, andrographine,

andrographolide sodium bisulfite, andropanoside, bis-andrograpolides A, B, C and D, γ -bisabolene, caffeic acid, chlorogenic acid, deoxyandrographolide, 14-deoxyandrographolide, 14-deoxy-11-dehydroandrographolide, 14-deoxy-11,12-didehydroandrographiside, 14-deoxy-11-hydroxyandrographolide, 14-deoxy-12-hydroxyandrographolide, 14-deoxy-12-methoxyandrographolide, 14-deoxy-11-oxoandrographolide, 3,4-dideoxyandrographolide-deoxyandrographoliside, 11,12-dihydro-14-deoxyandrographolide, diterpene glycoside, 14-epi-andrographolide, 12-epi-14-deoxy-12-methoxyandrographolide, eugenol, 19-O-p-D-glucopyranosyl deoxyandrographolide, 9-O-p-D-glucopyranosyl hentriacontane, 5-hydroxy-7,8-dimethoxyflavanone, 5-hydroxy-7,8,2',3'-tetramethoxyflavone, 5-hydroxy-7,8,2'-trimethoxyflavone, isoandrographolide, 7-O-methylwogonin, myristic acid, ninandrographolide, panicoline, panicuide A, B, and C, polyphenol, p-sitosterol glucoside, tritriacontane; dicaffeoylquinic acids, diterpenoids, polyphenols.

Pharmacology

Andrographis paniculata is reported to have antibacterial, antidiarrheal (*E. coli* enterotoxin), antimicrobial, febrifuge, hepatoprotective, hypotensive, antiplatelet and antithrombotic activities. A crude extract of hempedu bumi prevents myocardial ischemia and reperfusion injury, and exhibit a dose-dependent hypotensive effect on the systolic blood pressure of spontaneously hypertensive rats.

Herbal medicine derived from hempedu bumi is beneficial in the treatment of post ESWL [renal stones less than 3cm in size and normal renal function underwent extracorporeal shock wave lithotripsy (ESWL)] urinary tract infection and has no allergic reaction. Hempedu bumi improves the activity of sarcolemma ATPase and decreases the harmful effect of oxygen free radicals. Hempedu bumi significantly inhibited cell growth or DNA synthesis in dose-dependent manner. It can also alleviate atherosclerotic artery stenosis induced by both deendothelialization and high cholesterol diet as well as lower restenosis rate after experimental angioplasty. Water decoction of the hempedu bumi

leaves showed mass killing of microfilariae in dogs and showed no toxic effect in rabbits. Prolonged survival was observed after pretreatment with extract of hempedu bumi after black mamba venom treatment.

Antifertility effect of hempedu bumi was observed in mice under different experimental conditions. Dry leaf powder of hempedu bumi when fed orally to male albino rats, at a dose level of 20mg powder per day for 60 days, resulted in cessation of spermatogenesis, degenerative changes in the seminiferous tubules, regression of Leydig cells and regressive and/or degenerative changes in the epididymis, seminal vesicle, ventral prostate and coagulating gland. However, dried extract of hempedu bumi did not produce subchronic testicular toxicity effect in male rats.

Ethanol extract and purified diterpene andrographolides of hempedu bumi induced significant stimulation of antibody and delayed type hypersensitivity response to sheep red blood cells in mice. The plant preparations also stimulated nonspecific immune response of the animals. Alcoholic extracts of hempedu bumi showed good *in vitro* anthelmintic activity against human *Ascaris lumbricoides*. The methanol extract of the aerial part of hempedu bumi showed potent cell differentiation-inducing activity on mouse myeloid leukemia (M1) cells. N-butanol fraction of hempedu bumi was shown to have hypotensive activity.

Flavone extract from the root of hempedu bumi promotes the synthesis of PGI₂, inhibits the production of TXA₂, stimulates the synthesis of cAMP in platelets, impedes aggregation of platelets, and thereby preventing the formation of thrombi as well as the development of myocardial infarction. Dehydroandrographolide succinic acid monoester is found to be active against the human immunodeficiency virus (HIV) *in vitro*.

Both leaf extracts of hempedu bumi and andrographolide accelerate intestinal digestion and absorption of carbohydrate. Andrographolide showed a significant dose dependent (0.75-12mg/kg p.o. x 7) protective activity against paracetamol-induced toxicity on *ex-vivo* preparation of isolated rat hepatocytes. It was found to be more potent than silymarin, a standard hepatoprotective agent. A comparative study revealed that andrographolide

exhibited a lower protective potential than andrographiside and neoandrographolide, which were as effective as hepatoprotective agent, silymarin with respect to their effects on the formation of the degradation products of lipid peroxidation and release of glutamic-pyruvate transaminase and alkaline phosphatase in the serum. Andrographolide isolated from the whole hempedu bumi plant produced a significant dose (1.5-12mg/kg) dependent choleric effect (4.8-73%) in conscious rats and anaesthetized guinea pigs. The LD₅₀ of andrographolide in male mice was 11.46g/kg i.p.

Clinical trials

Randomized double blind study showed that high dose of hempedu bumi (6g/day) significantly relieved fever and sore throat in adult patients with pharyngotonsillitis, with a minimal and self-limiting side effect was found in about 20 per cent of the patients.

Towards commercial production

Currently, this crop is considered as one of the most commercially potential herb in Malaysia. This is mainly because of its easiness to cultivate and its great researched health benefits. So striking are the health benefits of *Andrographis* that it is listed by the World Health Organization as an herb with real medicinal potential. Its potentiality extends to the treatment of diseases such as HIV and other diseases associated with auto-immune disorders, treatment of patients with cardiac risks and cancer. The popularity of this crop is catching up both locally and abroad. There are a few products in the global market, namely: Amni Visnaga Extract - extract of *Andrographis paniculata*; Androtech - *Andrographis paniculata* with *Echinaceae* and vitamin C and zinc - for enhancement of health and immune function; and NBS-AV - 12 herbs inclusive of *Andrographis paniculata*. The extract of *Andrographis paniculata* is currently priced at US\$5.50 (1998) in the global market. With the increasing popularity of this crop, the demand both locally and abroad is expected to increase tremendously. Locally, manufacturers have come out with their hempedu bumi products such as Hempedu Bumi Plus.

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Centella asiatica

Scientific name : *Centella asiatica* (L.) Urban.
Synonym : *Hydrocotyle asiatica* Linn.
Common name : Asiatic Pennywort, Gotu Kola
Local name : Pegaga
Family : Umbelliferae/ Apiaceae

Potential crop rating : * * * * *

Introduction

This plant and its preparation have been in use since ancient times especially in the Ayurvedic medical system of India and in the folk medicine of China and Madagascar. The outstanding importance of the usage of this plant in the tradition medicine of India is implicated by its Indian name "Brahmi" which means 'bringing knowledge to the supreme reality' and it has long been used for its medicinal properties and as an aid to meditation. It is recommended by the World Health Organization (WHO) as one of the most important medicinal plant species to be conserved and cultivated. In Malaysia, although it has been used by our traditional healers in their herbal remedies, but its popularity is confined more as a traditional vegetable or an 'ulam' especially among the Malay communities rather than a medicinal plant.

Plant description

Pegaga is a small, annual, slender, creeping herb. It has long-stalked, green reniform leaves with rounded apices which have smooth texture with palmately netted veins. Pegaga have relatively long pericladial petioles (around 20cm). The flowers are pinkish to red in color, born in small, rounded bunches (umbels) near the surface of the soil. Each flower is partly enclosed in 2 green bracts. The hermaphrodite flowers are minute in size (less than 3mm), with 5-6 corolla lobes per flower. Each flower bears 5 stamens and 2 styles. The fruits



formed are simple, mericarp in nature. Pegaga's rootstock consists of rhizomes, growing vertically down and stolons, which grow horizontally, interconnecting one plant to another.

At the moment there are three distinguishable pegaga subspecies namely;

1. Pegaga salad
2. Pegaga kerinting or nyonya
3. Pegaga biasa or pegaga ubi

The recommended race for commercial production at this stage is pegaga ubi.

Plant habitat

Pegaga grows wildly under a wide range of conditions, some races prefer light shade, while others do well in open sunny areas. Some even grow under more harsh conditions like on stone walls. In the wild, most of these plant are found in wet or moist surroundings like swamps, along the margins of lakes, ponds and have also been seen growing in paddy fields.

Plant growth habit/cultivation

Pegaga is easily propagated asexually by using rhizomes/runners with at least one to 2 nodes. Although the plant can be grown in full sun but most of their races prefer at least light shade and moist soil, ie irrigation is a must if grown in the open. Growth is favored in sandy loam soils with

high organic matter. Organic fertilizers are added at planting and repeated at every 3 months. Planting distance is normally kept at 30cm x 30cm apart. Harvesting can be commenced after 60 days of planting. The whole plant is normally harvested when the leaves reach full size, ie about 4cm wide. The yield of pegaga locally stands at 8,000kg per hectare. The pegaga has few reported pest and disease problems. The major pests are snails, white flies and spider mites. In Sri Lanka, under intensive commercial cultivation, a bacterial wilt caused by *Pseudomonas solanacearum* has been reported. Another drawback in commercial cultivation of pegaga is its constant competition with weeds.

Plant parts used : Whole plant, aerial parts, roots.

Uses in traditional medicine

Pegaga has been used for treating bronchitis, asthma, excessive secretion of gastric juices, dysentery, leucorrhoea, kidney trouble, urethritis and dropsy in many communities. This herb is said to have a direct action on lowering the blood pressure and is often referred to as a rejuvenating medicament. The leaves are eaten raw or finely cut and roasted with scraped coconut. They are believed to purify the blood and cure indigestion, nervousness and dysentery.

In Malaysia, it is commonly consumed as a vegetable (ulam) among Malays, as a cooling drink by the Chinese and as a brain tonic by the Indians. Leaves are consumed either raw, in ulam or cooked. The Malays use the decoction of leaves to treat leprosy and rheumatism. Infusion of the toasted leaves or juice extracted from the leaves, together with food, is used to relieve minor dysentery in children. Some people also use a poultice of leaves to treat sores, or pound leaves into a paste to apply it to the body for fever. Juice from the roots is used to clean ulcerous wounds. The leaves are also believed to be good for mothers who have just given birth and for preserving youthfulness. Because of its bitter taste, the paste and juice are always taken along with equal quantities of honey. When fresh leaves are chewed in excess it is reported to cause dizziness.

In the Chinese Pharmacopoeia, it is used as an antipyretic, diuretic, and as an antidote in the treatment of heatstroke, diarrhea, ulcerations,

eczema, traumatic diseases, urinary tract infection and stones, nosebleeds, common cold, hepatitis, tonsillitis, dysentery, sore throat, bronchitis, pharyngitis, cough, acute enteritis, acute conjunctivitis, mumps, mastitis, glaucoma, measles, hypertension and uremia. It is used externally for bleeding wounds, bruises, boils and sores, snake bites, napkin rash and anus rash in babies, shingles and sty.

In India, the leaves are dried, powdered and taken with milk to improve the memory and as tonics. The plant is useful both internally and externally for skin diseases, chronic and obstinate eczema, secondary and tertiary syphilis with ulceration, enlargement of glands, leprosy, abscesses, chronic rheumatism and urino-genital diseases.

Chemical constituents

i) *Chemicals with commercial potential:* Asiatic acid, asiaticoside, madecassic acid, madecassoside.

ii) *Other chemicals:* Ascorbic acid, betulinic acid, bicycloelemene, brahmic acid, brahminoside, brahmoside, campesterol, camphor, P-carotene, p-caryophyllene, centellic acid, centellinic acid, centellose, centelloside, centoic acid, cineole, N-dodecane, elaidic acid, p-elemene, P-farnesene, germacrene, germacrene-D, 3-glucosylkaempferol, 7-glucosylkaempferol, 3-glucosylquercetin, hydrocotyline, indocentelloside, indocentoic acid, inositol, isobrahmic acid, isothankunic acid, isothankuniside, kaempferol, lignoceric acid, madasiatic acid, madecassol, meso-inosital, myo-inositol, niacin, oxyasiaticoside, p-cymol, phellandrene, raffinose, rhamnase, riboflavin, p-sitosterol, stigmasterol, thankunic acid, thankuniside, trans-p-farnesene, thiamin, vallerine; alkaloids, essential oils, fatty acids (lignoceric, linoleic, linolenic, oleic, palmitic, stearic), flavonols, minerals, polyphenols, saponins, sterols, sugars, tannins, terpenoids, triterpenes.

Pharmacology

Centella asiatica is reported to possess antianxiety, antibacterial, antifertility, antifungal,

antiinflammatory, antimitotic, antipyretic, antispasmodic, CNS depressant, hypotensive, insecticidal, smooth muscle relaxant and increase venous tonus activities. Extracts of the plant are found to be able to induce growth of skin, hair and nails in experimental animals. In rats, the extracts of pegaga showed a healing effect when applied locally to wounds. The pegaga extracts showed marked sedative (CNS depressant) and antidepressant properties in pharmacological tests with mice and rats. Pegaga is also reported to possess potent CNS depressant property.

The aqueous extract of pegaga, at concentration of 25mg/kg i.p. significantly decreased spontaneous motor activity and delayed pentylenetetrazole-induced convulsions in mice. This activity was comparable to that of diazepam. The extract also potentiated pentobarbitone-induced sleep in mice, but did not affect immobility time in swimming tests with rats. The same extract is also found to have anti-HSV-II (antiviral) activity. Oral administration of crude extract and partially purified fractions of pegaga retarded the development of solid and ascite tumors and increased the life span of this tumor bearing mice. The partially fraction of pegaga also significantly suppressed the multiplication of mouse lung fibroblast (L-929) cells at a concentration of 8mg/ml in long term culture. Extract of pegaga inhibited significantly gastric ulceration induced by cold and restraint stress in Charles-Foester rats. The aqueous extract of pegaga fresh leaves causes an overall decrease in the turnover of central monoamines. High concentrations of free tyrosine and phenylalanine, neurotransmitter precursors of catecholamines, were found present in leaves of pegaga.

The ethanol extract of whole pegaga plants (at daily dose of 100mg/kg p.o. for 10 days) exhibited significant antistress activity against stress-induced gastric ulcer formation in rats. The hydroalcoholic extract of pegaga showed anxiolytic/sedative effect in elevated plus maze, potentiation of the hypnotic effect of pentobarbitone and anticonvulsant activity against pentylenetetrazol-induced convulsion in rats. Ethanol extract of pegaga leaves was found to have antifilarial activity.

The hexane and EtOAc extracts of pegaga also

displayed significant inhibitory activity against *B. subtilis*, *E. coli*, *P. aeruginosa* and *P. cichorii* whilst n-BuOH extract was found to be inactive. Similarly, stigmasterol and dotriacont-8-en-1-oic acid inhibited *B. subtilis*, *E. coli* and *P. aeruginosa*. Stigmasterol and stigmasterol-B-D-glucopyranoside displayed significant antifeedant property against lepidopterous insect, *Spilosoma obliqua*.

Asiaticoside, madecassoside, asiatic acid and madecassic acid, triterpenoid fractions of pegaga, reduced granuloma weight in a dose-dependent manner after oral administration. The total triterpenoid fractions of pegaga significantly influence the biosynthesis of collagen and fibronectin in human skin fibroblasts cultures. Asiaticoside is reported to improve healing of surface wounds. The major triterpene saponin is asiaticoside which has shown to be effective in treating leprosy. Intramuscular injection of asiaticoside into mice, rat, guinea pigs, and rabbits provoked a rapid thickening of the skin, local leukocytosis, increased vascularization of the connective tissue, mucous secretion, and hair growth.

The oral LD50 of the pegaga extract in rats was found to be higher than 675mg/kg. In addition, chronic oral administration of pegaga also exhibited a low toxicity for pegaga. The standardized extract and asiaticoside was reported to have a very low level of toxicity via oral application. For example, a dose of asiaticoside as high as 1g per kg body weight of white rats was not toxic.

Clinical trials

Clinical tests and case studies have substantiated many of the positive benefits of pegaga extracts in the healing of skin wounds, burns, and skin diseases; in the treatment of stomach and duodenal ulcers, leprosy, lupus, scleroderma, diseases of the veins and hypertension.

In a controlled, double blind clinical trial, extract of pegaga demonstrated significant improvements in pain on movement and pressure, nocturnal paraesthesia and cramps, sensation of heaviness, trophic disturbances, thigh and ankle circumference and plethysmographic strain gauge determinations. In patients with superficial bladder

ulcers, early bilharzial infections and active bilharzial lesions, the treatment of 2% titrated pegaga extract encouraged healing in about 75% of cases with little scar formation. The treatment also aided healing in patients whose bladder lesions has been treated surgically.

Studies on the effect of total triterpenic fraction of pegaga, at doses of 60mg/day for 3 months in 20 patients showed that pegaga extracts affects serum levels of uronic acids and lysosomal enzymes and is involved in their metabolism in the connective tissue of the vascular wall. The total triterpenoid fraction of pegaga displayed a significant hypotensive activity in patients with venous hypertensive microangiopathy. The study on total triterpene fraction of *Centella asiatica* (TFCA) demonstrated an improvement of histangic homeostasis, the disappearance of diapedetic and hemorrhagic phenomena and active venous hypertonus in patients with post-phlebotic syndrome and venous insufficiency.

In another study, TFCA also demonstrated a significant improvement in the microcirculation and capillary permeability of patients with venous hypertension.

The topical use of cream made of pegaga demonstrated a significant improvement in older women affected with trophic ulcers in their lower limbs. A titrated extract of pegaga significantly improved patients suffering from venous insufficiency of the lower limbs.

Madecassol (product containing asiaticoside) is shown to inhibit the biosynthesis of acid mucopolysaccharides and collagens. The clinical use of this product in systemic scleroderma is also reported to bring significantly symptomatic relief to patients and improvement of keloids and other

skin diseases.

Towards commercial production

In Malaysia, sales of pegaga locally are normally conducted by small holders, who obtain their produce from farmers, backyard gardens or collected from the wild. These are normally sold at farmer's market ('pasar tani') or at night markets at about RM6 per kg fresh weight (1998). With the increasing importance and global demand of pegaga, a few manufacturers have taken up the challenge to produce herbal remedies of pegaga but have difficulty in getting consistent, quality raw materials. Most of the supply currently is imported from Indonesia and India. Because of this, currently there is a big demand of pegaga locally. Some of the pegaga products in Malaysia include pegaga teas, food health products and pegaga health supplements.

Internationally, pegaga or *Centella asiatica*, has long captured the global market and is one of the top 25 best selling herbs in USA and is valued at US\$3.50 per pound (1995). Currently, there are dozens of *Centella* products in the global market ranging from skin care products such as Centasinum, Centelase, Dercut lotion, Ekzepiderm, Ekzevowen, Salve, Elha-Dermazit, Elha-Dermidyn, Emdecassol, Lophakomp-Graphites, Medecassol, Psoriasis-Gastreu R65, herbal drinks and capsules and health health-food (eg Gotu Kola Herbal capsules, Solaray, Ogden, Pennyworth juice drink). Commercial production of pegaga at present is limited to two countries, ie Sri Lanka and Madagascar, the latter being the chief supplier of pharmaceutical pegaga for the world market, with annual exports varying from 26 to 96 tones per year in the period of 1979-1988.

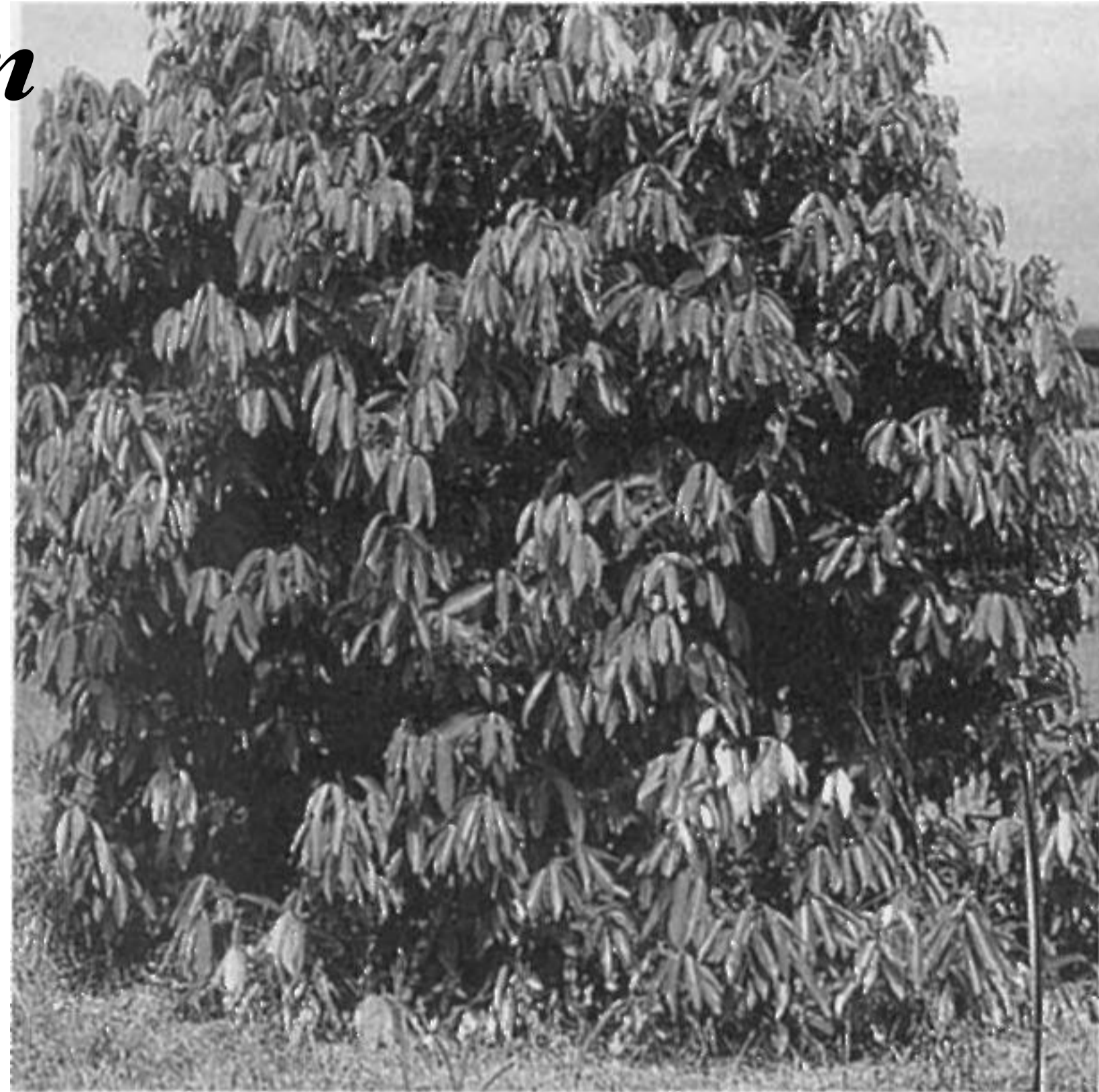
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Cinnamomum verum

Scientific name : *Cinnamomum verum*
Synonym : *Cinnamomum zeylanicum* Blume
Common name : Ceylon cinnamon
Local name : Kayu manis
Family : Lauraceae



Potential crop rating : * * * *

Introduction

Cinnamon, indigenous to Sri Lanka, is one of the most ancient spices and is mentioned in the Bible and in ancient Sanskrit writings. It was the most sought after spice in Europe from the 16th to the 18th century. *Cinnamomum verum* known as 'true cinnamon' is more superior in terms of its chemical constituents than its close relative, Cassia (*Cinnamomum cassia*). The commercial products of cinnamon are derived from its bark and leaves. The bark, both in the whole and ground form, is used in domestic culinary on a worldwide basis especially for its flavoring properties. Other than its culinary purposes, oil obtained from the cinnamon bark is also popularly used in flavoring, perfumery, in dental and pharmaceutical products. The leaf oil, which is different in composition from that of the bark oil, is also used in flavoring and perfumery, and is also a source of the chemical, eugenol.

Plant description

This tree when fully grown can reach up to a height of 6m and occasionally there are trees that even grow to 12m. The trunk is stout, about 30-60cm in diameter and when matured it is covered with a thick grey bark. The branches of this tree are naturally low set and very bushy. The leaves are sub-opposite to opposite with linear-elliptical blade and slightly undulating margins. The leaf apice is acute and its base rounded to acute. The

matured leaves measure about 7-10cm long and 3-5cm wide. The leaves are deep green in color with 3 conspicuous longitudinal veins. The young leaves of the flush are reddish in color which later turns to lighter green and then finally to its deep green in color. The petioles are relatively short, measuring about 0.5-0.7cm in length.

The flowers are borne on axillary and terminal panicles on twigs. The peduncles are creamy white in color, pubescent and about 5-7cm in length. The flowers are small, yellow in color and subtended by a hairy bract. The perianth is campanulate in shape with 6 oblong lanceolate segments. There are 9 stamens and 3 staminodes. Seven of the fertile stamens are arranged in the outer whorl while the other 3 are in the inner whorl. There is a single central style with a superior ovary. The fruit is a fleshy ovoid drupe, black in color and measuring about 1.5-2.0cm in length when ripe.

Plant habitat

This plant is normally cultivated in Malaysia. It can be found growing semi-wildly in Sri Lanka in moist lowlands to an elevation of 2,000 feet.

Plant growth habit/cultivation

Cinnamon is propagated either by seeds or by cuttings. The seeds are collected from ripe fruits by heaping them up in shady places until the outside pulp rots. The seeds are then removed, washed and air dried without exposing them to

the sun. These seeds should be planted as soon as possible as they lose their viability quickly. Seeds can be sown directly in the field or raised in the nursery. If sown directly in the field, irrigation and light shade is a prerequisite. In the nursery, seeds are sown 2cm deep on beds that are well prepared with rich sandy soil equipped with irrigation. After a period of 4 months the seedlings are transferred to polybags which are then kept for another 4-5 months in the nursery before transplanting them to the field.

Cinnamon can also be propagated by cuttings, layering or division of old rootstocks. The latter has been observed to be the most satisfactory method of propagation where the old plants are cut down to within 15cm from the ground and suitable sections of the rootstocks removed. These sections are then planted under light shade and irrigation. The great advantage of this method of using rootstock separation is that the stems are ready for harvest in about 12 to 18 months compared to 3 years for seedlings.

The planting distance is normally kept at 2m between stands. Cinnamon does not require liberal manuring. Cinnamon does well in sandy loam, loose moist soil with a lot of organic material such as cow dung, humus and mulches. The stems are harvested during the rainy season, which facilitates the peeling of the bark. The first harvest is normally of inferior quality compared to the subsequent harvests. The leaves and the twigs are cut off for either mulching or the leaves may be retained for distillation of oil. The best quality of bark is obtained from the middle portion of shoots that arise from the center of the tree. The chief pest recorded attacking cinnamon is the boring caterpillar, which eats the shoots. Some gall (due to mites), leaf fungus has also been recorded to attack cinnamon leaves and twigs.

Plantations in Sri Lanka recorded a yield of 56-67kg of quill (peeled barks) per hectare in the first crop after 3-4 years of growth. This increases to 168-224kg per hectare in subsequent years. The yield decreases after 10 years.

Plant parts used : Bark, leaves.

Uses in traditional medicine

The plant possesses antifungal and antibacterial

actions. The volatile oil has antiviral and hypotensive activity whilst the bark is used for dyspepsia, flatulence, diarrhea, dysentery, vomiting, bronchitis, gangrene of the lungs and phthisis. The bruised bark is steamed and used externally as a fomentation on boils and abscesses. The oil is a rubefacient and is a useful application for acute and chronic rheumatism. Crystalline cinnamic acid is antitubercular and is used as an injection in phthisis. Cinnamon is also given for cramps of the stomach, toothache and paralysis of the tongue and used in massive doses in the treatment of cancer.

In China, the dried bark and twigs are medicinally used, especially combined with other medicinal plants to treat cancer, high blood pressure and stomach troubles. The young twigs are used as a cough remedy (to ease mucous secretion), amenorrhea and for treating pain of the limbs. The cinnamon root skin is used for treating amenorrhea, diarrhea and shock. The bark is a component of tonics and medicines for coughs and chest complaints. In Africa, it is used as a carminative, stimulant, expectorant and for tuberculosis. The bark is widely used as a spice in many Asian countries.

Chemical constituents

i) *Chemicals with commercial potential:* Annin, (+)-catechin, 1,8-cineole, cinnamaldehyde, coumarin, epicatechin, eugenol, hiamin; essential oil.

ii) *Other chemicals:* Acetoeugenol, 4-allylphenol, anhydrocinnzeylanine, anhydrocinnzeylanol, O-anisaldehyde, ascorbic acid, benzaldehyde, benzoic acid, benzylbenzoate, calcium-oxalate, camphene, camphor, f}-carotene, chavicol, cinnamic acid, cincassiol-A and -B, cincassiol-C-1, -C-2, -C-3, -D-1, -D-2, -D-3 and -D-4, cis-cinnamic acid, cinnamylacetate, cinnamylalcohol, cinnzeylanine, cinnzeylanol, cresol, cuminaldehyde, p-cymene, decanoic acid, dihydrocinnamic acid, ethylcinnamate, ethylguaiacol, 4-ethylguaiacol, eucalyptol, farnesol, fenchone, furfural, geranial, guaiacol, heptanoic acid, hex-3-en-1-ol, hexanoic acid, hexanol, humulene, 2-hydroacetophenone, hydrocinnamaldehyde, isoeugenol, linalol, 2-

methylbenzaldehyde, methylbenzoate, 2-methylbutyric acid, 3-methylbutyric acid, methylchavicol, methylcinnamate, cis-2-methoxydihydrocinnamic acid, methyleugenol, methylfurfuryl, methyl-O-cumaraldehyde, methyloctanoate, methylsalicylaldehyde, methylsalicylate, 19-monoacetylcinnassiol-A, mucilage, nonanal, nonanoic acid, octanoic acid, phenol, phenylethylalcohol, phenylethylacetate, 3-phenylpropylacetate, phenylpropylacetate, α -pinene, (3-pinene, riboflavin, rubidium, sabinene, safrole, salicylaldehyde, salicyclic acid, (3-selinene, strontium, styrene, tannic acid, α -terpinene, γ -terpinene, α -terpineol, terpinen-4-ol, terpinolene, trans-cinnamaldehyde, trans-cinnamic acid, trans-2-methoxy-cinnamaldehyde, trans-2-methoxycinnamic acid, 2-vinylphenol; cinnamtannins, minerals, procyanidins.

Pharmacology

The cinnamon extracts are reported to be a good food antioxidant and helps to improve food palatability. Cinnamon is found to possess an antinociceptive effect against both acetic acid-induced writhing and hot-plate-induced thermal stimulation. Cinnamon extract and its bioactive compound(s) potentiate insulin activity, as measured by glucose oxidation in the rat epididymal fat cell assay.

A substance that inhibits the activity of bacterial endotoxin was found in cinnamon bark extract prepared with 67% ethanol/water. Cinnamon exhibited a significant ($p < 0.01$) inhibitory effect on the histamine production and histidine decarboxylase activity of *Morganella morganii* (a potent histamine-producing bacteria in fish). Extract of cinnamon ranged from 0.05-30mg/ml was reported to be active against fluconazole-resistant *Candida species*. Essential oils extracted from cinnamon were found to have antimicrobial activity.

Cinnamon aldehydes found in cinnamon-flavored gums can incite mucosal alterations at points of contact with the oral mucosa. These alterations may include inflammation and epithelial proliferation, but as a rule, the changes are reversible and promptly resolve when gum-

chewing activity is discontinued. Cinnamic aldehyde has been identified as the active fungitoxic constituent of cinnamon bark oil.

Acute (24 hrs; $< 3\text{g/kg}$) and chronic (90 days; 100mg/kg/day) oral toxicity studies on the ethnolic extracts of cinnamon showed no significant acute or chronic mortality, change in the pre- and post treatment body weight of mice, reduction in liver weight whilst a significant fall in hemoglobin level, increase in reproductive organ weights, sperm motility and sperm counts. Raw cinnamon is tumourigenic, inducing squamous papillomas in some and poorly differentiated carcinomas in mice. Exposure to respirable cinnamon and cellulose dusts was found to result in alveobronchiolitis in rats. The bark of cinnamon showed mutagenic activity.

Contact allergy to cinnamic aldehyde in cinnamon was observed in a young Malay female. Cinnamic aldehyde contained in the bark of the cinnamon was reported to irritate and cause contact dermatitis in workers processing cinnamon.

Clinical trials : No information available.

Towards commercial production

Other than its worldwide use as a spice and in perfumery, there are also a number of products that emphasize the medicinal properties of cinnamon. In the global market, cinnamon is used in products like Arthritin, which is recommended for patients with arthritis and rheumatism. The leaf oil is also used in tonics, antiseptics and in remedies for intestinal gas, nausea, colds and hypertension. Locally, the more inferior species of cinnamon is used, that is *cinnamomum iners* and it is used in both small-scale traditional medicine and in commercial products like Radix and Ardisia. Used in combination with other herbs, these products are applied mainly for muscle aches, arthritis and consumed as a tonic. In the global market, cinnamon leaf oil is priced at C\$6.35 per 10ml (1998), while the bark oil is at US\$30 per 10ml (1998). The raw material, normally sold as the dried bark, is priced at US\$12.67 per half pound (1998). Currently, Sri Lanka and Madagascar are the major producers of cinnamon.

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Curcuma domestica

Scientific name : *Curcuma domestica* Loir.

Synonym : *Curcuma longa* L.

Common name : Tumeric

Local name : Kunyit

Family : Zingiberaceae

Potential crop rating : * * * * *

Introduction

Turmeric, the spice that gives the distinctive yellow color to many Malay and Indian curry dishes, has been used as a dye, in folk medicine and flavoring since 600 BC. It has been recorded in the Assyrian herbal Circa about 2500 years ago. This plant is considered as one of the most valuable herbs to mankind. To the traditional folk medicine of India, turmeric is considered as an excellent natural antibiotics while at the same time it is also used to strengthen digestion and help improve intestinal flora. The plant is native to Southeast Asia and is currently cultivated commercially in China, India, Indochina and Indonesia.

Plant description

Tumeric is a perennial herb, growing to a height of about 1m. The leaves are borne in a tuft, alternately arranged, light green in color and rather flaccid. The leaves are glabrous, elliptical-lanceolate in shape with an entire margin. The leaf apice is acuminate and the base sheathing. The petioles are rather long, ending into a broad leaf sheath, which acts as a pseudostem. The tubers and rhizomes arise from the swollen base of the pseudostem. The rhizomes are robust, fleshy and branch at right angle forming a dense clump. The rhizomes are aromatic, orange-brown in color on the outside and bright orange in the inside. The tubers are elliptical in shape, fleshy, white in color and grow vertically downwards.



Plant habitat

In Malaysia, tumeric is normally cultivated in home gardens. They are, however, naturalized in certain areas such as in the teak forest in Eastern Java.

Plant growth habit/cultivation

Kunyit is propagated asexually through rhizome separation. A rhizome with at least one new protruding shoot/bud is normally chosen and then planted. Tumeric will grow well in mild shade but produces larger and better rhizomes when grown in open and exposed to full sunlight. It is also very susceptible to water logged conditions and therefore a good soil drainage is crucial for the well-being of this plant. Growth is favored in loose, friable, sandy loam soils with high organic matter.

Tumeric is normally grown on ridges, usually about 45cm apart and 40cm between plants. Rhizomes are planted about 5-7cm deep and approximately 1,700kg of setts are required to plant one hectare of land. The first leaf appears in about 4 weeks. Harvesting of the rhizomes can be commenced after 9-10 months of planting. Yields are very variable ranging from 13,000kg to 25,000kg per hectare.

The major disease recorded in India is leaf spots caused by *Taphrina maculans* which produces a profuse deep yellow spotting and drying up of the leaves. The most serious recorded pest in tumeric is a shoot-boring caterpillar, *Dichocrosis*

punctiferalis, which results in the death of the central shoot.

Plant parts used : Rhizomes.

Uses in traditional medicine

The plant is used as an anticoagulant, antiedemic, antihypertensive (rhizomes), antiinflammatory, antimalarial, antihelmintic, bactericide, carminative, cholagogue, emmenagogue, fungicide, stimulant and for treating sprains, bruises, ringworms, scabies, neuralgia and rheumatism. It is also used as an insect repellent. The dried tumeric rhizome is commonly used as a condiment and to prepare a yellow color dye. The fresh rhizome is crushed and applied externally on bruises, sprains, wounds and leech-bites. Internally, it is given as an anthelmintic, for treating diarrhea, dysentery, flatulence, dyspepsia, colic jaundice and amenorrhoea. Inhalation of the fumes of burning dry tumeric relieves colds in the head and catarrh.

In Malaysia, tumeric is used as a cosmetic during traditional ceremonies. It is an important ingredient in local cooking, eg curry. Tumeric prepared with oil is used to smoothen rough skin, and with lime, it is used to treat bruises, sprains and wounds. A decoction made from tumeric is used as a cooling eye-wash. Tumeric boiled with milk and sugar is a popular remedy for colds. When mixed with sesamum oil and honey, it is used as a tonic. It is often prescribed for complaints of urogenital system and to aid digestion. A poultice of the rhizome is applied to the breast for stimulating milk flow. The plant is prescribed with *Gendarussa* for treatment of gonorrhoea and amenorrhoea. The underground stem is used to treat irregular menstruation. It is also taken to stimulate the production of red blood cells, dissolve blood clots, arrest bleeding, treat jaundice, stomach problems, pains in the abdomen, chest and back, diarrhea and dysentery. The mixture of the plant with garlic or onions is used for treating flatulence in children, diarrhea and dysentery.

In Sri Lanka, a paste prepared from tumeric is used for treating prurigo, urticaria, boils, sprains and bruises. It is given internally for rheumatism, bronchial ailments and snake-bites. The rhizomes

are roasted with *Vernonia zeylanica* and applied on eczema of the legs.

Chemical Constituents:

i) *Chemicals with commercial potential:* Caffeic acid, 1,8-cineole, curcumin, p-coumaric acid, p-cymene, protocatechuic acid, turmerin, ukonan A; curcuminoids, essential oil.

ii) *Other chemicals:* Arabinose, ascorbic acid, α - and γ -atlantone, azulene, bisabol-3,10-dien-2-one, bisabolene, bisacumol, bisacurone, bisdesmethoxycurcumin, bis(4-hydroxycinnamoyl)methane, 1,7-bis-(4-hydroxyphenyl)-1,4,6-heptatrien-3-one, 2-bornanol, borneol, camphene, camphor, caprylic acid, (3-carotene, caryophyllene, cineole, cinnamic acid, o-coumaric acid, cuminyl alcohol, α - and p-curcumene, curcumene, curcumenol, curcumenone, curdione, curlone, curzerenone, curzerenone-C, cyclo-isoprenemyrcene, dehydrocurdione, dehydroturmerone, desmethoxycurcumin, Dl-p-coumaroylmethane, dicinnamoylmethane, didesmethoxycurcumin, diferuloylmethane, dihydrocurcumin, epiprocucumenol, eugenol, feruloyl-p-coumaroylmethane, (4S,5S)-germacrone-4,5-epoxide, 4-hydroxycinnamoyl-(feruloyl)-methane, p-hydroxycinnamoylferuloylmethane, guaiacol, 1-(4-hydroxy-3-methoxyphenyl)-7-(3,4-dihydroxyphenyl)-1,6-heptadiene-3,5-dione, 2-hydroxymethylanthraquinone, isoborneol, isoprocucumenol, limonene, linalol, p-methoxycinnamic acid, monodesmethoxycurcumin, niacin, oleorasin, oc-phellandrene, α - and p-pinene, procucumenol, riboflavin, sabinene, p-sesquiphellandrene, syringic acid, terpinene, terpineol, α -terpineol, p-tolymethylcarbinol, oc-turmerone, ar-turmerone, α - and P-turmerone, turmeronol A and B, vanillic acid, zedoarondiol, zingiberene; minerals, monosaccharides (fructose, glucose), polysaccharides (ukonan A, B, C and D), sesquiterpenes.

Pharmacology

Curcuma domestica is reported to possess anticarcinogenic, anticoagulant, antihepatotoxic,

antimutagenic/DNA-protecting, antioxidative, cytotoxic and fungotoxic activities. The plant has been found to contain volatile oil and curcuminoids, which are believed to be the active ingredients of tumeric.

Clinical trials

A multicenter, randomized, double-blind trial has demonstrated that tumeric is effective for dyspepsia.

Towards commercial production

Tumeric's potentiality especially in the herbal industry is vast. Globally, certain companies have already captured the market based on some of its important medicinal properties and are marketing

their products as dietary supplements and herbal remedies. They are normally sold in capsule form and are priced in about US\$10-15 per 60 capsules (1998), which are all standardized to 95% curcumin.

Locally, tumeric is either sold as dried rhizome or in the powdered form and are mainly used for flavoring curries or used in ritual ceremonies. The commercial use of tumeric in herbal remedies is slowly becoming popular and one such product is 'tumeric lotion' which is used as a face cream. Most of the tumeric used locally is imported. Currently, the major producers of raw tumeric is China, India and Indonesia and is priced at US\$3.50 per half pound (1998) while tumeric extract is priced at US\$5.50 per oz (1998).

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Cymbopogon citratus

Scientific name : *Cymbopogon citratus*
(DC.) Stapf.

Common name : Lemongrass

Local name : Serai makan

Family : Graminae

Potential crop rating : * * *



Introduction

Lemongrass is a fragrant tropical grass, closely related to Citronella. It is said to be indigenous to India where it has been cultivated for its oil since 1888. The strong lemon odour of the oil contained in the leaves is responsible for its nomenclature. Due to its characteristic smell, the oil is extensively used for scenting soaps, detergents and other products. This crop is one of the chief sources of citral, which is an important raw material for perfumery, confectionery and beverages.

Plant description

Lemongrass is a tall fragrant perennial grass, throwing out dense fascicles of leaves from a stout rhizome. It can grow up to a height of 1m. The leaves are sessile, simple, green, linear, equitantly arranged and can grow to an average size of 40cm long x 1.0cm wide. The leaf is glabrous, venation parallel with acuminate apice and sheathing base. The leaf sheath is tubular in form and acts as a pseudostem. This plant produces flowers at a very matured stage of growth. The rhizome is stout, creeping, robust and creamish yellow in section. The vertical rhizome produces branches, which then produces new suckers, which in turn will form new plantlets.

Plant habitat

Lemongrass grows wildy in many tropical

countries of Asia, America and Africa. In Malaysia, it is normally cultivated in home gardens.

Plant growth habit/cultivation

The plant is propagated vegetatively through rooted slips. Lemongrass is a very hardy crop and can adapt itself to a variety of soil and climatic conditions. However, for high oil content, it was reported that the most suitable conditions for growth are well-aerated soils with good fertility. The rooted slips are normally planted on raised beds of 1-1.5m. At early stages of growth, competition with weeds is quite an annoying problem. This problem can be avoided by keeping the spacing of rooted slips cuttings at a distance of 50cm x 50cm. This crop cannot withstand water-logged and shady areas; therefore open areas are best suited for its cultivation.

The first harvest is normally carried out after 60 days of planting. After that a cutting interval of 40-50 days is normally maintained. The crop is harvested about 20cm above ground. Oil yield has been reported to increase in the second year and reaches its maximum in the third and fourth year after which it declines progressively. Well-maintained plantations of lemongrass are normally replanted after every six to eight years to continue receiving high yield. There is no serious pest and disease problems faced by this crop. Only under

very damp conditions lemongrass becomes more susceptible to insect pest.

Plant part used : Leaves, stem, roots.

Uses in traditional medicine

Lemongrass oil is a valuable remedy for flatulence, irregular bowel movements, gastric irritability and used to arrest vomiting. It is an excellent embrocation for chronic rheumatism, sprains and other ailments. Citral present in the oil is a valuable flavoring agent in perfumes, bath salts and cosmetics. In Malaysia, it is used as a mild diuretic, an emmenagogue, tonic, to promote perspiration, for treating kidney trouble and for preparing lemongrass tea. The stem is used to add fragrance to food. Paste prepared from leaves is used for treating headaches and rheumatism. Extract of lemongrass is believed to be a good mosquito repellent. A decoction of the leaves and roots is consumed to ease urinary problems and stomachaches. The extract from roots is used as a fragrance in shampoo and perfume.

In the Philippines, the leaves are used to flavor wines, sauces and as a spice. A decoction of the root is taken internally as a diuretic. In Brazil, lemongrass is used to prepare tea and used as an anxiolytic, hypnotic and analgesic in folk medicine. In Cuba, lemongrass leaves are used for its antihypertensive and antiinflammatory properties. In Ghana, the leaves are boiled in water and drunk for fever. The oil is used in soaps and medicines.

Chemical constituents

i) *Chemicals with commercial potential:* 1,8-cineole, citronellol, essential oil (citral, cymbopogone, cymbopogonol, geranylacetate, linalol, limonene, methylheptenone, p-myrcene, neral).

ii) *Other chemicals:* oc-camphorene, caprylic acid, caryophyllene, cerylalcohol, citronellal, citronellic acid, a- and p-dihydropseudoionone, decanal, N-decylaldehyde, diacetyl, dipentene, farnesal, farnesol, furfural, geranic acid, geraniol, hexacosanol, isopulegol, isovaleraldehyde, isovaleric acid, linalylacetate, luteolin, luteolin-C-glycoside, methylheptenol, nerol, a-pinene,

quercetin, rutin, P-sitosterol, a-terpineol, triacontanol; minerals, saponins.

Pharmacology

Cymbopogon citratus extract is reported to have fecal p-glucuronidase inhibitory and antioxidant activities. The 80% ethanol extract was found to possess antimutagenic properties towards chemical-induced mutation in *Salmonella typhimurium* strains TA98 and TA100. The aqueous leaf extract of lemongrass showed mitodepressive effect. Oral administration of an infusion of lemongrass fresh leaves to rats produced a dose-dependent analgesia for the hyperalgesia induced by subplantar injections of either carrageenin or prostaglandin E₂, but did not affect that induced by dibutyryl cyclic AMP. The decoction of lemongrass leaves showed some dose-related hypotensive effects when administered intravenously and some weak diuretic and antiinflammatory effect when given orally.

The essential oil of lemongrass was found to exhibit fungitoxicity at minimal inhibitory concentration (MIC) of 1,000ppm, at which it showed wide fungitoxic spectrum and superiority over synthetic fungicides, ie Agrosan GN, Thiride, Ceresan, Dithane M-45, Agrozim, Bavistin, Emison, Thiovit, wettable sulfur, and copper oxychloride. The fungitoxic potency of the oil remained unaltered for 7 months of storage and is thermostable in nature when treated at 5 to 100°C. Lemongrass oil was found to elicit morphological changes like filamentation, inhibition of septum formation, spheroplast formation, production of 'blisters', 'bulges' or mesosomes, as well as lysis and development of abnormally shaped cells in *E. coli*.

P-myrcene is a peripheral analgesic substance and is one of the major constituents of lemongrass oil. It did not show any sign of genotoxic activity in the *in vivo* cytogenetic bone marrow assay. It is also demonstrated to be an inducer of isoenzymes belonging to CYP2B subfamily. The same group of researchers also demonstrated that p-myrcene and lemongrass oil blocked the metabolic activation of some promutagens (eg cyclophosphamide and aflatoxin B₁) in *in vitro* genotoxicity assays, p-myrcene and other monoterpenes of lemongrass, interfere with the

metabolism of xenobiotics which are substrates for isoenzyme, CYP4502B1. The α -citral (geranial) and (3-citral (neral) components individually elicit antibacterial action on gram-negative and gram-positive organisms whilst myrcene did not show observable antibacterial activity on its own. However, myrcene provided enhanced activities when mixed with either of the other two main components identified. Terpenes such as myrcene is capable of inducing antinociception in mice.

Lemongrass is found to be non toxic to mammals. Myrcene is not mutagenic in mammalian cells, but has antimutagenic properties.

Clinical trials

Human clinical studies on a lemongrass herbal tea (one of the most popular Brazilian herbal medicines used for its alleged CNS-depressant effects) showed no sign of toxicity but lacks hypnotic or anxiolytic properties after oral administration.

Towards commercial production

Currently, the value of lemongrass oil in the world market is US\$5-6 per oz (1998) and the major supplier is China.

Dried lemongrass leaves is priced at US\$6 per pound (1998). Introduction of *Lisea cubeba* oil as a substitute source of citral are one of the main contributing factors to the steady decline of the demand of lemongrass oil.

However, in the recent years, due to the expansion of perfumery and related industries, and the rise of price in derived aroma chemicals, the demand of this oil has increased considerably. In addition to the market demand, the scope of this crop is vast in terms of its uses.

Citral extracted from the oil forms an important raw material for a number of products in perfumery, confectionary and beverage industries.

It is also the starting material for the manufacture of ionones. The oil is also used for the production of vitamin A and synthetic violets.

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Cymbopogon nardus

Scientific name : *Cymbopogon nardus* (L.) Rendle

Synonym : *Andropogon nardus* L.

Common name : Citronella

Local name : Serai wangi

Family : Graminae

Potential crop rating : * * *



Introduction

Citronella is a tall fragrant tropical grass, closely related to the lemongrass (*Citronella citratus*). Citronella, the more aromatic of the two, is normally applied externally while lemongrass is confined to internal use. The oil is often used in lotions, soaps and as an insect repellent. It is said to be native to India and Ceylon and was introduced only quite recently to Malaysia.

Plant description

Citronella is a tall fragrant perennial grass, throwing out dense fascicles of leaves from a stout rhizome. It can grow up to a height of 1 -1.5m. The leaves are sessile, simple, green, linear, equitantly arranged and can grow to an average size of 60cm long x 2.5cm wide. The leaf is glabrous, venation parallel with an acuminate apice and sheathing base. The leaf sheath is tubular and acts as a pseudostem. The rhizome is stout, creeping, robust and creamish yellow in section. Raton or suckers keep on arising from the horizontal rhizome as the plant grows.

Plant habitat

Citronella grows wild in many tropical countries of Asia, America and Africa. In Malaysia, it is normally cultivated in home gardens.

Plant growth habit/cultivation

The plant is propagated vegetatively through

rooted slips. Citronella is a very hardy crop and can be adapted to a variety of soil and climatic conditions. However, it thrives on well-aerated soils with good fertility. This crop cannot withstand water-logged conditions and shade; therefore open areas are best suited for its cultivation.

At early stages of growth, the major setback is the competition with weeds. By reducing the planting distance to about 50cm x 50cm this problem is minimized. The first harvest is normally done after 70-80 days of planting and subsequent harvest can be kept at an interval of 45-55 days. The crop is normally cut about 5cm above the leaf sheath (pseudostem). With good cultural practice, the production of citronella can reach to 30-40 ton/ha/year. The leaves are left to wilt in the sun until the moisture is reduced by 30-50% before it is sent for oil extraction.

Plant parts used : Leaves.

Uses in traditional medicine

Citronella oil is used as a rubefacient. It is also a stimulant, carminative, antispasmodic and diaphoretic. The roots are diuretic, sudorific and antiperiodic. It is a mosquito repellent and is used in perfumery and soap-making. In Malaysia, the volatile oil of *Cymbopogon nardus* is given in small doses to comfort the stomach and to aid digestion. It is also used as an emmenagogue. A

decoction of the citronella leaves with *Gendarussa* and betel-pepper is being used as an after childbirth wash.

In South Africa, this grass is used as a vermifuge, febrifuge and a remedy for colds.

Chemical constituents

i) *Chemicals with commercial potential:* Caryophyllene, citronellol; essential oil.

ii) *Other chemicals:* Borneol, bournonene, camphene, camphor, 1-carvotanacetone, 8-3-carene, citronellybutyrate, D-citronellal, D-citronellolacetate, D-citronellol-N-butyrate, p-cymene, elemol, ethanol, farnesol, furfurol, geraniol, geranylacetate, geranylbutyrate, geranylformate, hexanol, limonene, linalol, linalylacetate, methyleugenol, methylisoeugenol, methylheptenone, menthol, myrcene, nerol, nerolidol, cis-ocimene, perillaldehyde,

phellandral, a-phellandrene, a- and (3-pinene, sabinene, a-terpineol, terpinen-4-ol, terpinolene, thujylalcohol, trans-ocimene, tricyclene.

Pharmacology : No information available.

Clinical trial: No information available.

Towards commercial production

The popularity of this crop is catching up very rapidly in the local market, as more entrepreneurs are becoming aware of their many uses. This is especially true in the toiletries and biopesticidal industries.

In the toiletry industry, citronella's aromatic and antibiotic properties are being tapped for making household detergents, soaps, etc. In the biopesticide industry, this crop is used to manufacture products for the control of household pest such as mosquitoes and cockroaches.

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Eclipta alba

Scientific name : *Eclipta alba* hassk.
Synonym : *Eclipta erecta* L.
Common name : False daisy
Local name : Keremak
Family : Compositae

Potential crop rating: * * *



Introduction

Locally, keremak is normally eaten raw as a salad or 'ulam'. According to the Ayurvedic system of medicine, this plant possesses numerous 'hidden' medicinal properties and is especially potent in assisting the wellbeing of the heart and the circulatory system. It is also an important herb used for nourishing the kidneys and the liver.

Plant description

Keremak is a creeping, stoloniferous, and branching annual herb that can grow to a height of about 15-20cm. Its leaves are simple, green, glabrous and arranged in opposite decussate pairs. The leaf-blades are oblong-lanceolate in shape with a sub-entire margin (very shallowly serrated) that is reddish in color. The leaf is sub-sessile with an acute apice and a cuneate base. The plantlets are interconnected with each other through horizontal stems or stolon. The stolon roots at the nodes and throws more or less erect branches that are cylindrical in shape, reddish in color and covered with minute white hairs.

The flowers are borne on axillary heads, which are about 6-8mm in length. There are 8 involucral bracts, which are covered with minute hairs. The flowers are minute and consist of ray and disk florets. The ray florets are ligulate with small ligules. The disk florets are hermaphrodites and are about 1-2mm in length. The calyx is very minute. The corolla lobes are 4-toothed, scaly,

tubular and white in color. The stamens, which are coalescent at the base surrounds the single central stigma. The style is relatively short and cylindrical in shape. The fruit is an achene.

Plant habitat

Keremak can be seen growing wild on damp soil, besides streams, in rice fields, on sugarcane plantations and roadsides.

Plant growth habit/cultivation

This plant is propagated through seeds and stem cuttings. A better growth performance is seen when the plants are propagated through seeds. This plant prefers partial shade and loose sandy-loam soil with good drainage. With irrigation, the seeds or the stem cutting can be grown directly in the field. The seeds are very minute and should be mixed with sand during sowing to prevent seeds from clumping. For the seed sowing methodology, plant thinning has to be carried out after 2-3 weeks. The seeds can also be sown in the nursery to prevent seed wastage. The planting distance should be kept about 25cm x 40cm apart to minimize competition with weeds. This plant is a heavy feeder and needs plenty of N P K green and organic fertilizers such as chicken dung. The first harvest can be carried out when the plant is 3 months old. Harvesting is done by snipping off the plant 10cm above the ground. The plant is then left to re-grow and subsequent harvest can be done

at intervals of 2 months. To produce a good economical harvest the plants should be replanted **yearly**.

Plant parts used : Whole herb, leaves.

Uses in traditional medicine

The plant is used for treating hepatitis, jaundice, arthritis, dropsy, skin diseases and stimulating hair growth. In Malaysia, a decoction of roots is used, either alone or mixed with cummin-seeds and is often taken by the Malay women after childbirth. It is also used as a hair tonic, purgative, emetic, for treating constipation and gastric vertigo. Pounded leaves are used for treating skin diseases, leprosy and elephantiasis. The boiled leaves are rubbed on the gums for toothache.

In India, it is used externally on chronic skin diseases, ulcers, elephantiasis, conjunctivitis and to stimulate the growth of hair; internally it is used for treating arthritis, dropsy and used as a deobstruent for hepatic and splenic enlargements. The root has emetic property and is used as a purgative. In China and Indo-China, the plant is used for checking haemorrhages in women after childbirth, for treating asthma, bronchitis, a counter-irritant in toothache and for strengthening of gums. In the Philippines, a decoction of the leaves and flowers is given for hepatitis, whilst in Java the leaves are eaten and also used externally for ringworm.

Chemical constituents

i) *Chemicals with commercial potential*.

Ecliptalbine, verazine.

ii) *Other chemicals*: Daucosterol, ecliptasaponin, ecliptine, 20-epi-3-dehydroxy-3-oxo-5,6-dihydro-

4,5-dehydroverazine, (20R)-4-p-hydroxyverazine, 4-p-hydroxyverazine, (20R)-25-(3-hydroxyverazine, 25-P-hydroxyverazine, nicotine, stigmasterol-3-O-glucoside.

Pharmacology

The ethanol/water (1:1) extract of keremak showed hepatoprotective activity. Ecliptalbine and verazine isolated from *Eclipta alba* showed good activity against *Candida albicans*. Alkaloids of keremak such as verazine, 20-epi-3-dehydroxy-3-oxo-5,6-dihydro-4,5-dehydroverazine, (20R)-4-P-hydroxyverazine, 4-P-hydroxyverazine, (20R)-25-P-hydroxyverazine and 25-p-hydroxyverazine showed weak cytotoxicity against the M-109 cell line.

Transina, an Ayurvedic herbal formulation comprising of *Eclipta alba*, *Withania somnifera*, *Tinospora cordifolia*, and *Ocimum sanctum*, *Picrorrhiza kurroa* and shilajit, induced a dose-related decrease in streptozotocin (STZ) hyperglycaemia and attenuation of STZ induced decrease in islet superoxide dismutase in male rats.

Clinical trials : No information available.

Towards commercial production

With the very many traditional uses and properties of keremak, the Indian entrepreneurs have come out with a number of products in the international market. These are either in capsule form or as tonic, herbal remedies or health foods. As herbal remedies it is targeted to the liver, circulatory and urinary system. One such product is Bhrigaraj. It is also widely used in the cosmetic industry especially as a hair tonic. The extract of keremak is currently priced at US\$5.50 per oz (1998) in the global market.

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Elephantopus scaber

Scientific name : *Elephantopus scaber* L.
Common name : Elephant's foot / Solomon's seal
Local name : Tutup bumi / Tapak sulaiman
Family : Compositae



Potential crop rating : * *

Introduction

Because of its leaf form which lies flat on the ground and covers more than its share of space, the Malays equate it with the pentacle seal of Solomon by which it confines the jins underground. As Solomon's seal, it is traditionally reputed to be potent for all diseases. So far, this crop has not been domesticated in Malaysia, but collected from the wild by traditional healers for preparing herbal remedies.

Plant description

These are erect, stiff, perennial herbs growing up to a height of 50cm. The leaves are mostly concentrated on the lower portion of the stem and arranged in a rosette manner. The leaves are slightly serrated, covered with white hairs, variable in shape and size, oblonged or rounded near the tip and narrower to the base. The petioles are very short and hairy. The flower heads are borne at the end of dichotomously branched pedicels, which are covered with white hairs. The flowers are numerous, sessile, closely packed forming a large flat-topped terminal inflorescence. Three green broad leaf-like bracts surround each flower cluster. The corolla lobes are violet in color while the tube is white. The corolla margin is deeply cleft on one of its side. The stamen is appendicular in nature and is arranged round the single central style. The fruits or achnes are truncate with fine ridges and surrounded with pappus of stiff bristles.

Plant habitat

These plants can be found growing wildly on roadsides, grassy fields and forest borders.

Plant growth habit/cultivation

This herb can be propagated easily through seeds. The seeds are collected by enclosing the flowers with a piece of paper. The seeds are minute and very light and therefore during sowing they are normally mixed with loose dampen soil and then sprinkled on the nursery beds. Germination success is about 70-80%.

Within two weeks of sowing, the first leaf can be seen emerging out. The plant is then transferred to the field after a period of one month or when the seedling reaches the 4-5 leaf stage. Tutup bumi is a very hardy crop and needs minimal care and fertilizing. It can also adapt itself to a wide range of conditions. It is a relatively a slow growing herb and is susceptible to only insect attacks.

Plant parts used : Whole herb, roots.

Uses in traditional medicine

The plant is primarily used as a diuretic, febrifuge and to relieve anuria and blennorrhoea. Other applications include employment as an antibiotic, antismelling agent, antipyretic, antiinflammatory, bechic and emollient. It is believed to be a good remedy for leucorrhoea, anemia, and beneficial during parturition. In Malaysia, tutup bumi is taken

internally as a diuretic, febrifuge and anthelmintic and applied externally as a poultice for abdominal pains and other complaints. A decoction made from the leaves or roots is used as a tonic for eliminating roundworms and treating coughs and venereal diseases. The roots and leaves are taken after childbirth as a protective medicine. A decoction made from the fresh roots and sireh is prescribed to arrest vomiting whilst the leaves are recommended for treating dropsy.

The plant is used as a diuretic and febrifuge in Indo-China, Thailand, Indonesia and the Philippines. The roots, either pounded in water or in decoction, are used in Indonesia as a remedy for leucorrhoea, anemia of women and children. In the Philippines, a decoction or infusion of the roots and leaves is used as an emollient, for treating diarrhea, dysentery, pulmonary diseases, scabies, urethral discharges and for relieving anuria and belnorrhoea. In Indo-China, a decoction made from the plant is used as diuretic, tonic, diaphoretic, emmenagogue and is taken internally for dyspepsia, intermittent fevers and menstrual irregularities.

In Chinese traditional medicine, the plant is used to treat conjunctivitis, epidemic encephalitis B, pertussis, acute hepatitis, cirrhosis, ascitis, acute and chronic hepatitis, ferunculosis and eczema. The Taiwanese use the root to relieve chest pains.

In India, a decoction of the root is given for urethral discharges, diarrhea, dysentery, dysuria and as a cardiac-tonic. In Ceylon, paste prepared from the tutup bumi leaves, water and honey is used for treating septic nails and wounds caused by bites of wild animals.

In Madagascar, it is considered a diuretic and febrifuge and in the West Indies as a tonic, diaphoretic and emmenagogue and given for dyspepsia, intermittent fevers and menstrual derangements. The plant is traditionally used in Brazil to eliminate bladder stones.

Chemical constituents

i) *Chemicals with commercial potential:* Deoxyelephantopin, molephantinin, phantomolin.

ii) *Other chemicals:* (3-amyirin acetate, crepaside E, deacylcynaropicrin, 11,13-dihydrodeoxyelephantopin, dihydroelephantopin, elephantin,

elephantopin, epifriedelanol, glucozaluzanin-C, isodeoxyelephantopin, lupeol, lupeol acetate, molephantin, nudaphantin, stigmasterol, stigmasteryl 3-(3-glucoopyranoside).

Pharmacology

This herb is reported to have antibacterial activity. Aqueous extract of *Elephantopus scaber* improves hepatic lesions caused by (3-D-galactosamine (D-GalN)- and acetaminophen (APAP)-induced acute hepatic damage in rats. In another study, it was found that hepatic fatty metamorphosis and necrosis of central lobules were significantly improved after treatment with tutup bumi extracts.

Aqueous and hydroalcoholic extracts of tutup bumi, at 0.3-6g/kg i.p. administration, induced writhing, loss of muscle tone, ataxia, prostration and death in mice. However, no analgesic effects of these extracts were detected using mouse hot-plate and acetic acid-induced writhing tests. Both extracts also failed to modify diuresis or carrageenan-induced rat paw oedema. Brewer's yeast-induced hyperthermia in rats was reduced by extracts given at a dose of 100mg/kg i.p., but there was no effect after oral administration (300 or 600mg/kg). Moreover, the aqueous extract decreased the intestinal transit time in mice while the hydroalcoholic extract increased it. Tutup bumi extracts at 25-100mg/kg (i.v.) reduced blood pressure and heart rates in rats.

Tutup bumi exhibited considerable antibacterial activity (MIC=7.8-23.4mg/ml) against cariogenic bacterium and *Streptococcus mutatis*. An extract of the tutup bumi leaves also showed antibiotic activity (1/5) against *Staphylococcus*.

Clinical trials : No information available.

Towards commercial production

Although the health benefits of tutup bumi are tremendous, there has been very little attempt to commercialize its product. A few herbal products such as Shanggan Tablets, derived from tutup bumi is now available in China and in some Chinese traditional medicine stores in Southeast Asia where it is marketed as a Chinese Patent Medicine. Locally, their use is restricted to the traditional healers in preparing local 'jamus'.

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Eurycoma longifolia

Scientific name : *Eurycoma longifolia* Jack.

Local name : Tongkat ali

Family : Simaroubaceae

Potential crop rating : * * * *



Introduction

Locally, this plant owes its popularity for its aphrodisiac claims. Although traditionally the roots are used for this purpose and because of its great local demand, the stems and even its leaves have become common items in medicine stalls. Tongkat ali is also widely used as a tonic and it is sometimes referred to as the 'Malaysian ginseng'.

Plant description

Tongkat ali is a treelet, growing up to a height of 10m with a branch diameter of about 10cm. They have odd-pinnate compound leaves that grow to a length of 1m. The leaflets are arranged in almost opposite pairs. They are dark green in color, oblong-lanceolate in shape, entire with a mucronate apice and oblique base. The leaflets are sessile. The compound leaf is with a petiole that is dark brown in color and measures about 20-25cm in length. Leaves are usually crowded at the tip of the branch. There is minimal branching in tongkat ali. Most trees have either no branches or it is minimized to one or two branches. The tip of the main stem is often orange in color. Flowers are arranged densely on branched panicles, which arise from leaf axils. The panicles are about 60-70cm in length and hairy. The calyx is green in color and the lobes ovate in shape. There are 5 corolla lobes, which are ovate-lanceolate in shape and red in color. The fruit, a drupe is yellowish brown in color.

Plant habitat

This plant inhabits the understorey of lowland forest and its geographical distribution covers Malaysia, Burma, Indochina, Thailand, Sumatra, Borneo and the Philippines.

Plant growth habit/cultivation

Tongkat ali is propagated through seeds. The seeds are sown in the nursery, under shade and high humidity. Seedlings begin to sprout out after a period of about one-month. The viability of the seeds is normally very low.

The seedlings should be kept in the nursery for at least 6 months before field transfer to enhance establishment of the plant. Intercropping tongkat ali with other grown timber species is recommended especially in the early stages of growth to enhance its establishment rate as the young plants cannot withstand full sunlight. For field planting, holes of 30cm deep x 30cm wide are prepared at a planting distance of 3m x 2m. These holes are then fertilized prior to planting which is normally done during the wetter months of the year.

Tongkat ali plants can be harvested after a period of 4 years. The whole plant is pulled out to obtain its taproot. It has been reported that in the cultivation of tongkat ali, the most susceptible pest is the caterpillar, *Atteva scrodoxa*.

Plant parts used : Roots.

Uses in traditional medicine

The plant is traditionally used as a general tonic, after childbirth tonic, aphrodisiac, antidotal, antihypertensive, antipyretic, antituberculous, antivenous, vermifuge and febrifuge. It is also used to relieve pains in the bone and itches and to treat jaundice, dropsy, cachexia, fever, diarrhoea, indigestion, lumbago and dysentery. The tongkat ali roots are well known among various ethnic groups for treating disease and enhancing health.

Chemical constituents

i) *Chemicals with commercial potential:* Eurycomanol, eurycomanone, eurycomalactone.

ii) *Other chemicals:* Bourjotinolone A, campesterol, 5,6-dehydroeurycomalactone, 11-dehydroklaineaneone, dihydroeurycomalactone, 13P,18-dihydroeurycomanol, 13,21-dihydroeurycomanone, dihydroniloticin, 13p,21-dihydroxyeurycomanone, dihydroxyklaineaneone, 14,15|3-dihydroxyklaineaneone, 3-episapelin A, eurycomanol-2-O-p-D-glycopyranoside, eurylactone, eurylene, hispidone, 6-hydroxy-5,6-dehydroeurycomalactone, 9-hydroxycanthin-6-one, 10-hydroxycanthin-6-one, 9-hydroxycanthin-6-one-N-oxide, 6a-hydroxyeurycomalactone, laurycolactone A and B, longilactone, longilene peroxide, melianone, 9-methoxycanthin-6-one, 9-methoxycanthin-6-one-N-oxide, niloticin, pasakbumins A, B, C and D, piscidinol A,

scopoletin, sitosterol, stigmasterol; alkaloids, benzoquinones, quassinoids, saponins, sterols, terpenoids.

Pharmacology

The plant is reported to have antihistaminic, antimalarial, antitumour (quassinoids), antiulcer (pasakbumin A and B), antiviral and cytotoxic properties. Biological studies have shown that the butanol, chloroform, methanol and water extracts of root have antimalarial and aphrodisiac properties. The roots of *E. longifolia* were shown to have cytotoxic activity. Ethanol extract from leaves of tongkat ali was shown to contain potent plant-growth inhibitory constituents. Chloroform and water extracts of roots showed antipyretic activity.

Clinical trials : No information available.

Towards commercial production

This plant has long captured the local market and currently there are about 200 tongkat ali products; most of them focussing and emphasising on its aphrodisiac properties.

Tongkat ali is also used in other herbal products for treating arthritis, rheumatism, flatulence, and as an herbal tonic. Commercial production of tongkat ali is still in its infancy stage and most of the raw materials used in herbal preparation are collected from the wild.

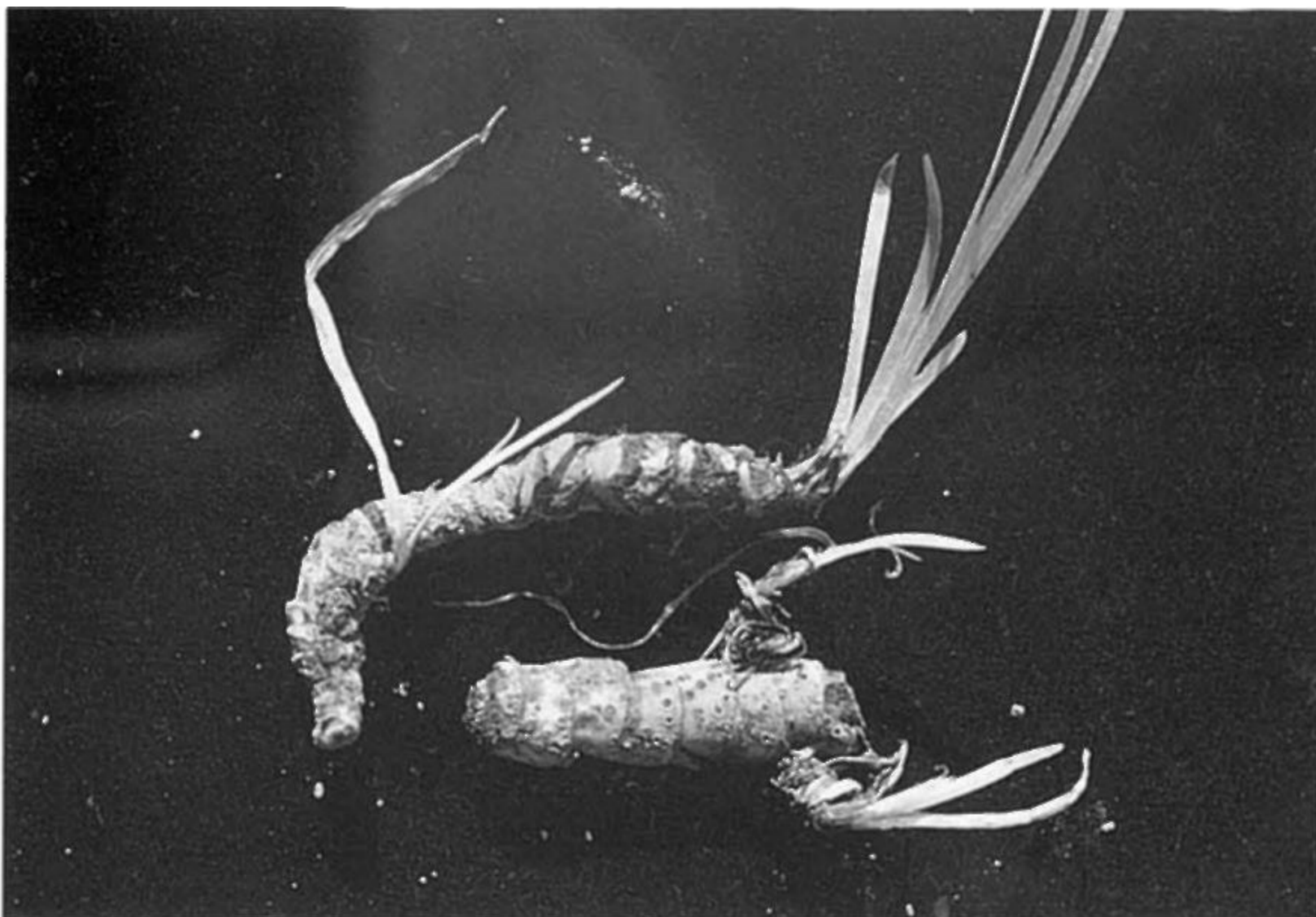
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Acorus calamus



Acorus calamus : plants



Acorus calamus : rhizomes

Aloevera



Aloe vera : plants



Aloe vera : dried leaves, juice & gel

Alpinia galanga



Alpinia galanga : plants



Alpinia galanga : inflorescence



Alpinia galanga : rhizomes

Andrographis paniculata



Andrographis paniculata : plants



Andrographis paniculata : flowers



Andrographis paniculata:
powder & dried leaves

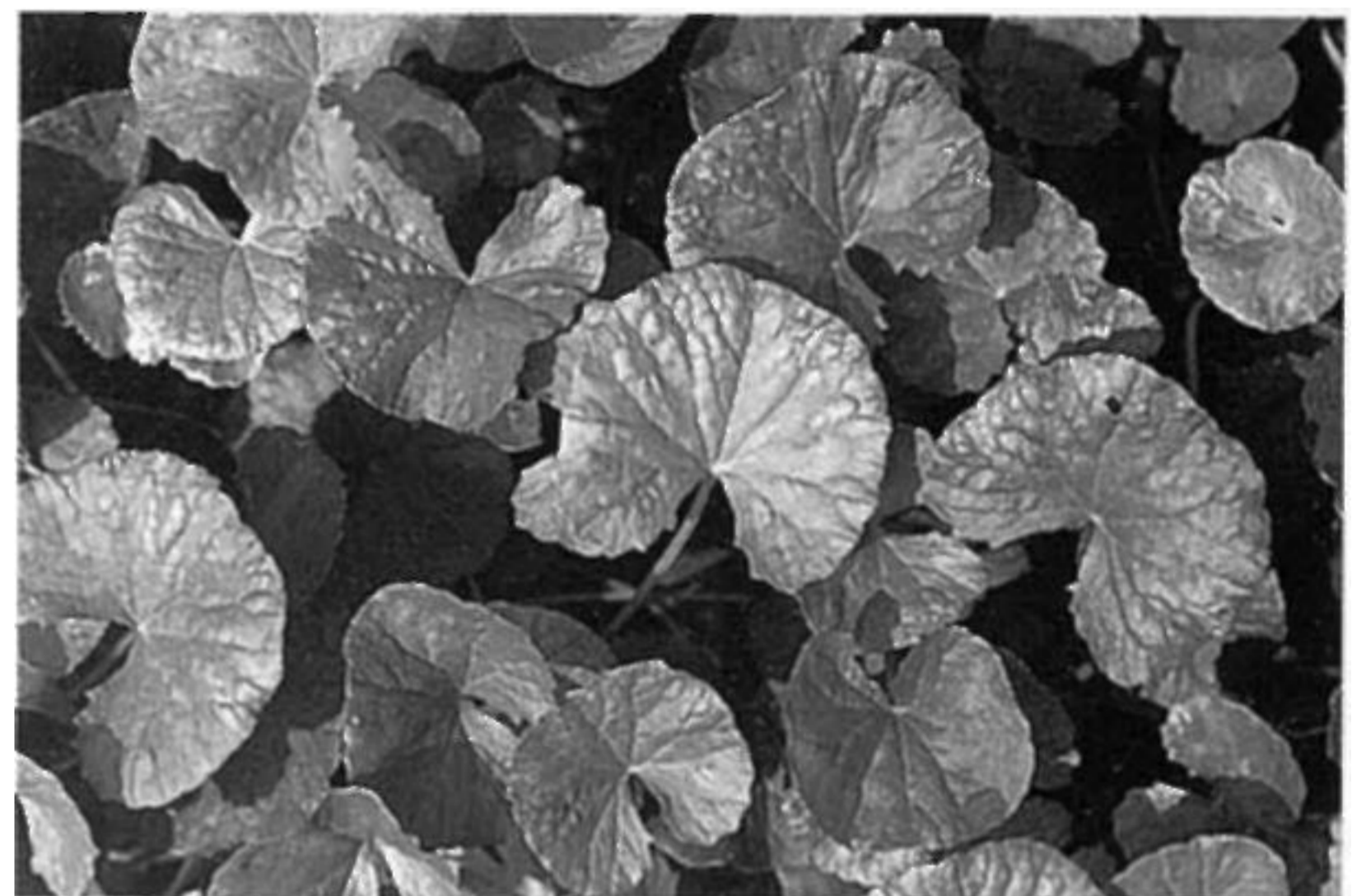
Centella asiatica



Centella asiatica (flowers)



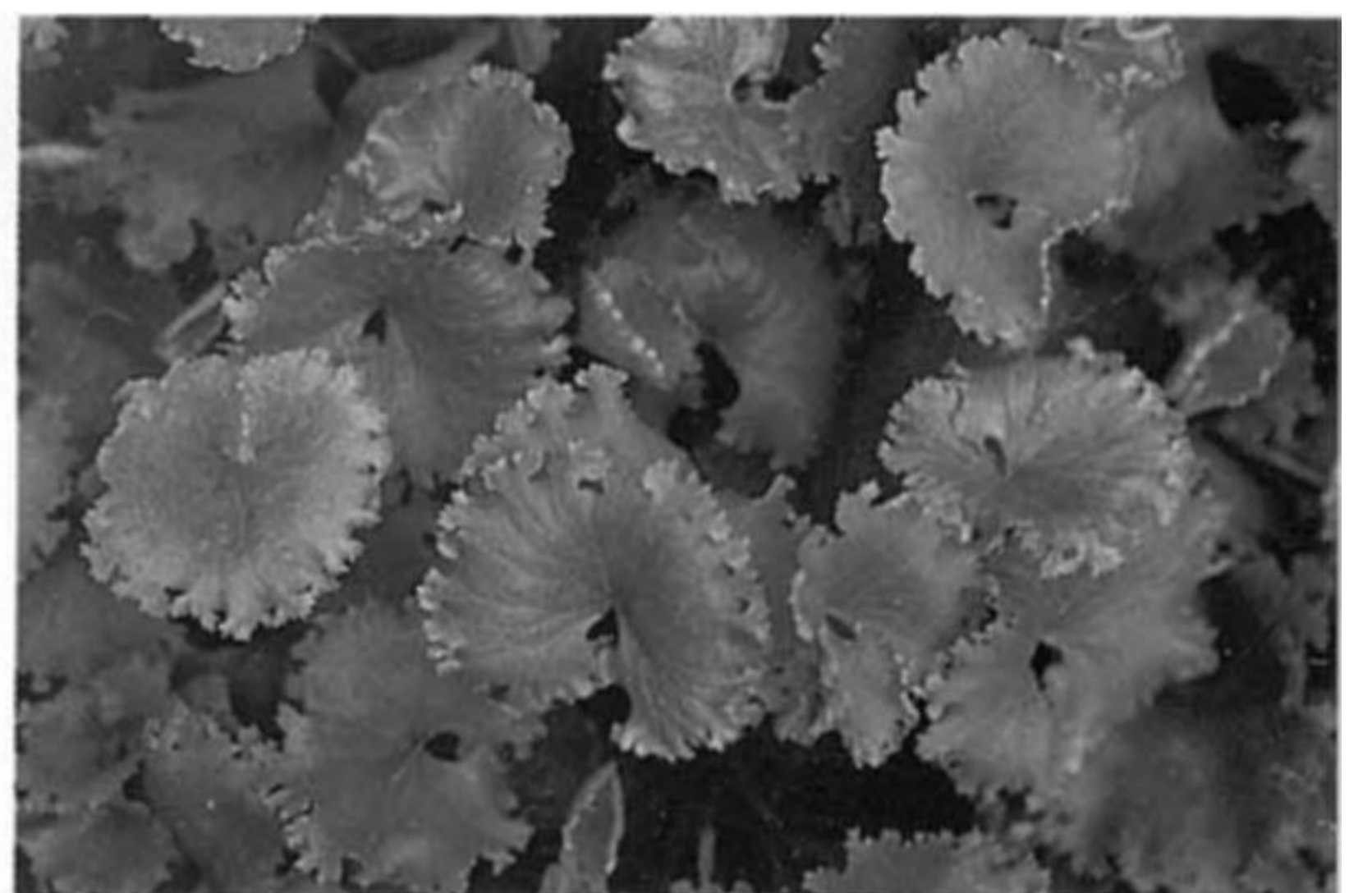
Centella asiatica : dried leaves, juice, tablets & powder



Centella asiatica (Pegaga biasa)



Centella asiatica (Pegaga kerinting)

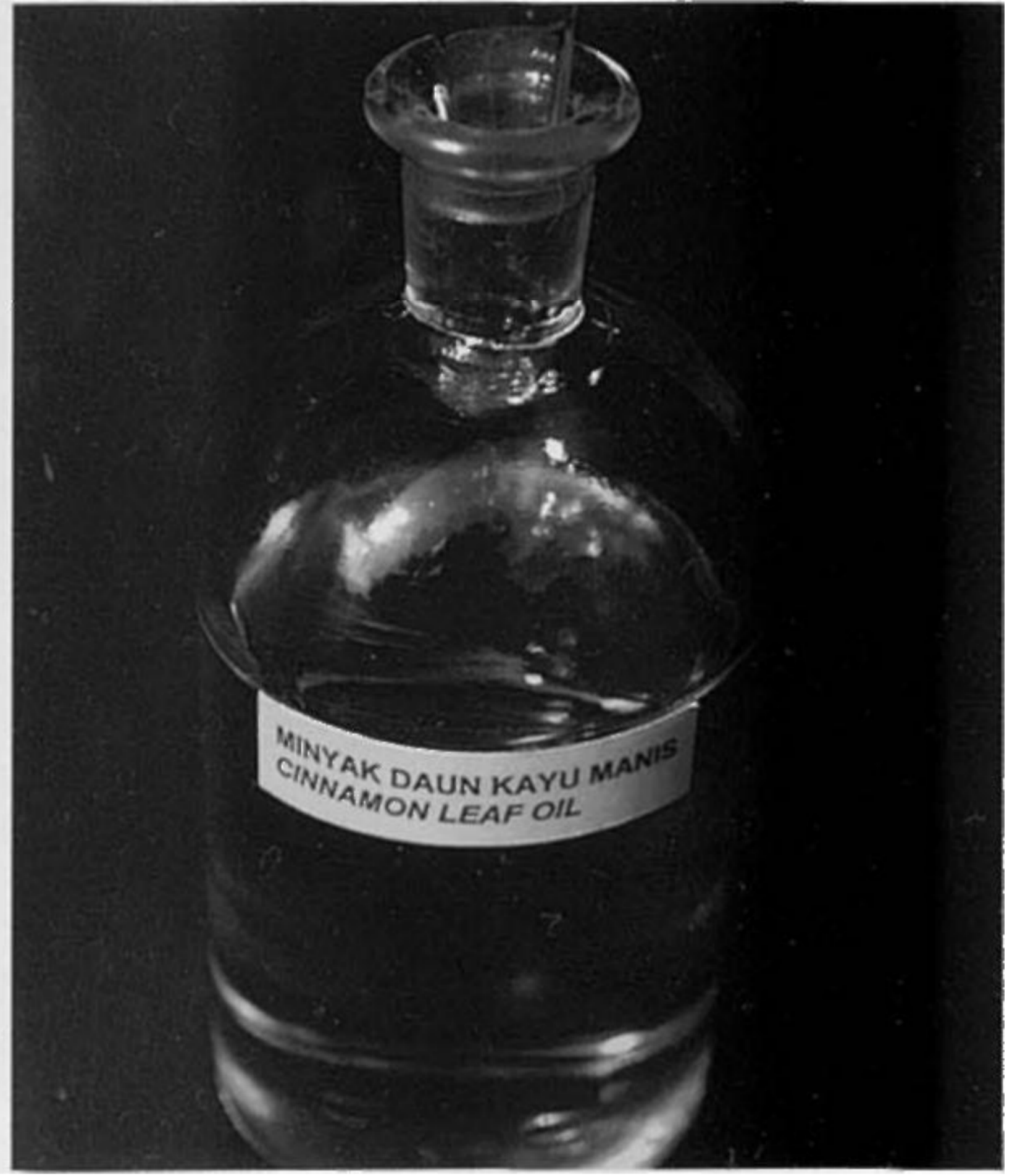


Centella asiatica (Pegaga salad)

Cinnamomum verum



Cinnamomum verum : plant



Cinnamomum verum : essential oil

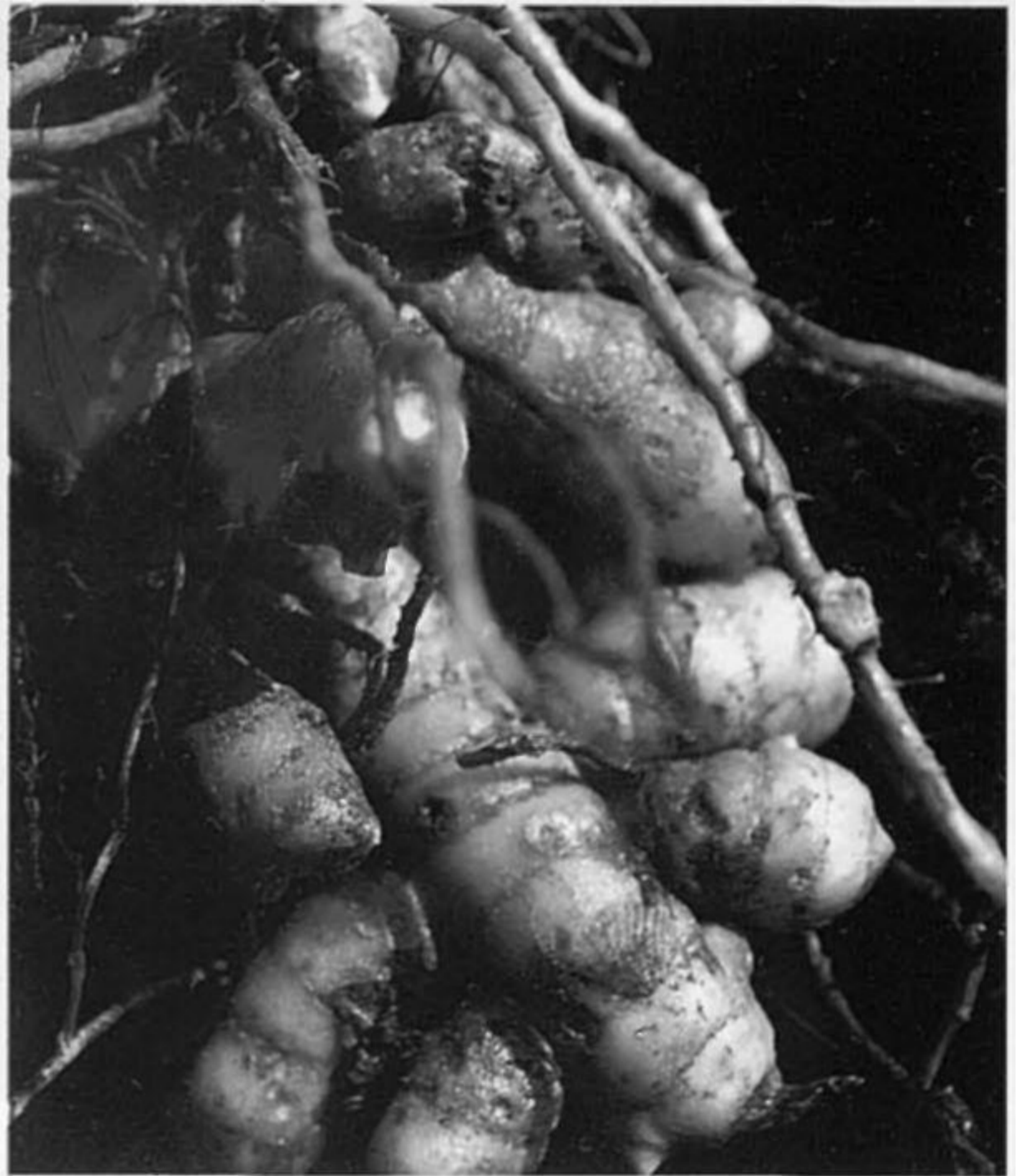


Cinnamomum verum : leaves

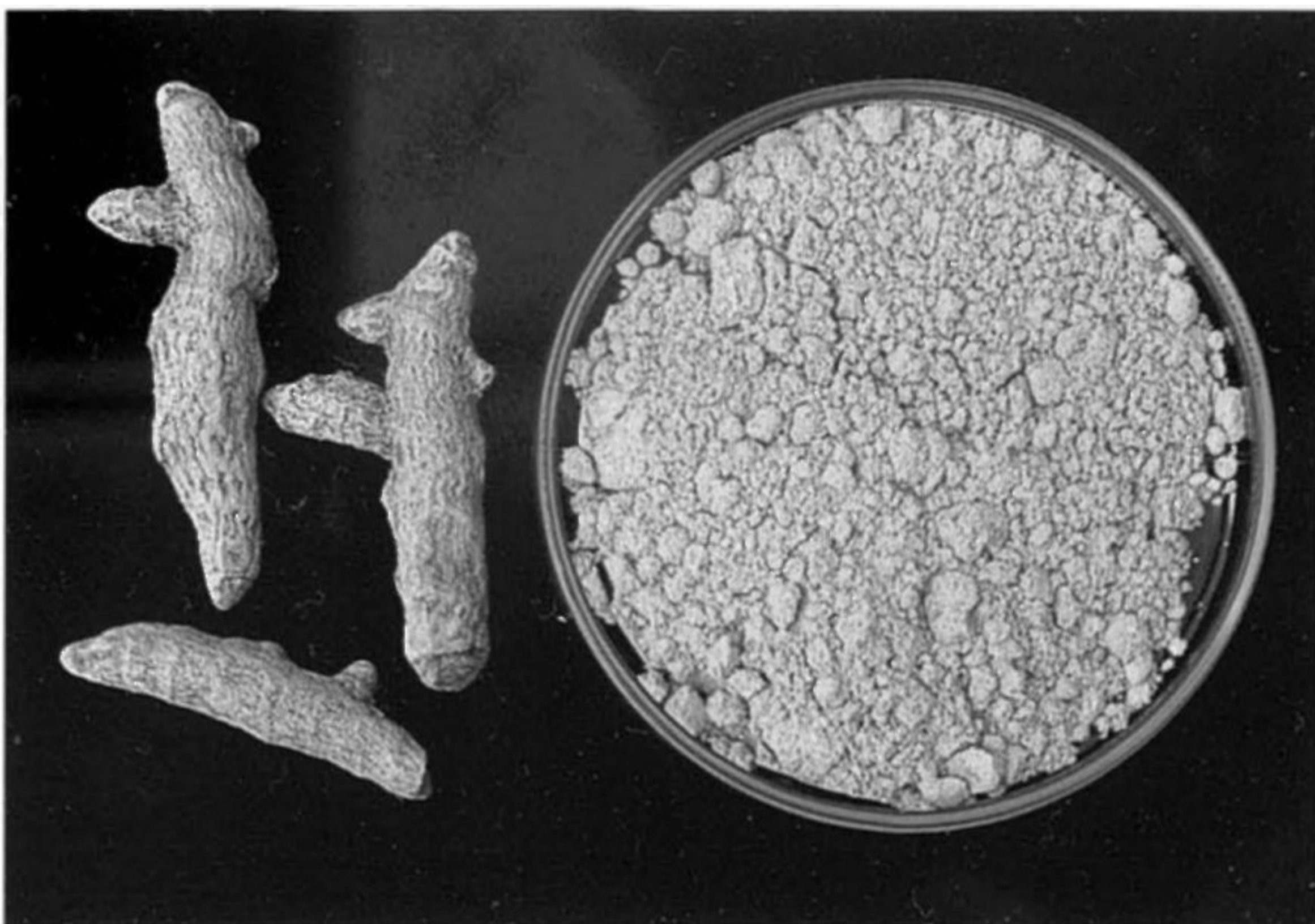
Curcumadomestica



Curcuma domestica : plants



Curcuma domestica : rhizomes



Curcuma domestica: dried & powdered rhizome

Cymbopogon citratus



Cymbopogon citratus : plants

Cymbopogon citratus : essential oil

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Hibiscus rosa-sinensis

Scientific name : *Hibiscus rosa-sinensis* L.

Common name : Chinese hibiscus

Local name : Bunga raya

Family : Malvaceae

Potential crop rating : ☆ ☆ ☆



Introduction

Originating from Asia (China) and the Pacific Islands, *Hibiscus rosa-sinensis*, our national flower, other than its natural beauty has also been credited with wonderful therapeutic properties. It has been widely used in the traditional medicine of both the Chinese and Indians where all parts of the plant are considered to be valuable in treating various kinds of ailments. In the Philippines, the flowers are a household remedy and are used in all kinds of inflammation whilst in the Ayurvedic medicine, hibiscus flowers are also popularly used as a heart tonic and a blood purifier.

Plant description

Hibiscus is a woody shrub with a pale grey bark. Leaves are simple, bright green in color, ovate in shape and serrated towards the upper half. Flowers are showy, solitary and borne on long stalks arising from the axil of the leaves. There are a huge number of different cultivars in this specific species; the flower color itself can range from white to yellow to bright red. Each flower holds 5-7 bracts, which are lanceolate in shape and glabrous in texture. The calyx is pubescent with minute hairs. There are 2 calyx lobes, which are lanceolate in shape. The corolla is campanulate and measures about 7.5cm across. A staminal tube exerted beyond the petals holds the stamens and pistil at its tip.

Plant habitat

Hibiscus is a cultivated plant and is grown in home gardens and as landscape plants.

Plant growth habit/cultivation

The herb is normally propagated by stem cuttings in the nursery where they are induced to root and establish themselves. In about 6 weeks the stem cuttings are ready to be transplanted in the field.

Hibiscus needs a lot of moisture and sunlight and thrive on rich sandy loam soils with good drainage system. As heavy feeders they require liberal fertilization. To encourage production of flowers (as they are known for their therapeutic value), low phosphate and high potassium fertilizers are commonly used.

Insect such as aphids, thrips, scale and whiteflies have been reported to attack this plant. For a safer (organic) pesticide, neem extracts/products can be used to control these insects pest, as there has been good reports on their usage.

Plant parts used : Leaves, roots, flowers.

Uses in traditional medicine

The leaves and young flower buds of hibiscus are traditionally used as a poultice for treating boils and swelling. Red flowers are used to regulate menstruation; together with papaya seeds, they are used to cause abortion. In Malaysia, a decoction

of the roots is used to treat fever and venereal diseases. The flowers are used as an expectorant for bronchitis and are sometimes used for coloring foods. A decoction of the roots is used for treating fevers, coughs, sore eyes and venereal disease. The bark from stems of white flower variety is used to regulate menstrual cycle. The plant is also used for treating birth complications. The leaves and flowers are used to treat skin diseases, mumps and to relieve fever. An infusion of leaves or a poultice of leaves is used for treating headache and boils. The root is used to treat carbuncles.

According to the Indians, the flowers are said to possess a soothing effect on the mucous membrane that line both the respiratory and the digestive tract. They are therefore used for curing gastric ulcers. Other uses of the flower include regulating menstrual cycles in women and in external application to wounds. There are even believed to possess aphrodisiac properties and used as a brain tonic. The Chinese on the other hand use this species of plant to treat minor stomach, intestinal and kidney problems, which is due to hyperactive functions. It is also considered as a blood purifier and used internally to improve complexion and hair growth.

In Indonesia, the flowers are eaten with papaya seeds to cause abortion.

Chemical constituents

i) *Chemical with commercial potential*: No information available.

ii) *Other chemicals*: Ascorbic acid, (3-carotene, cyanidin-3,5-diglucoside, cyanidin-3-sophoroside, cyanidin-3-sophoroside-5-glucoside, hentriacontane, hibiscetin, methyl-10-oxo-11-octadecynoate, methyl-8-oxo-9-octadecynoate, mucilage, niacin, quercetin-3-diglucoside, quercetin, quercetin 3,7-diglucoside, riboflavin, thiamin; minerals, polysaccharides (D-galacturonic acid, D-glucuronic acid), sugars (D-galactose, L-rhamnose).

Pharmacology

Oral administration of aqueous and alcoholic extracts of hibiscus flowers (250mg/kg body weight/day, 30 days) demonstrated no effect on weights of the testis, epididymis, ventral prostate

and seminal vesicle, as well as the histological features of testis and epididymis of the male rats; the extract also showed no apparent toxicity. Ethanolic (50%) and benzene extracts of hibiscus have reduced significantly the glycogen contents in the uterus of adult rats. Aqueous and 90% ethanol extracts of hibiscus flowers did not show teratologic activity orally at doses equivalent to 175mg/kg in rats.

The benzene extract of *Hibiscus rosa-sinensis* flowers was found to cause an irregular estrous cycle at concentrations 125 and 250mg/kg (i.p.) in adult mice. The extract also showed antiovarian effect and estrogenic activity in immature mice. Benzene and 50% ethanol extracts of hibiscus flowers did not affect the concentration of Na⁺ in uterine flushings and of Na⁺ and K⁺ of serum in ovariectomized, pregnant and cyclic rats. In mice, oral administration of the benzene extract of hibiscus flowers at a dose level of 1g/kg body weight from day 5-8 of gestation led to termination of pregnancy in about 92% of the animals. In another study, the benzene extract of hibiscus flowers also showed the effect on implantation and the uterine chemical composition. In unilaterally pregnant mouse having trauma-induced deciduomata in the sterile horn, the extract caused resorption of the fetuses, and regression of the deciduomata accompanied by reduction in weight of the ovaries. Benzene extract of hibiscus flowers, administered during day 1-4 of gestation, exerted antiimplantation effect without affecting the tubal transport of zygote.

Red anthocyanin prepared from petals of hibiscus can function as an antioxidant. The mucilage isolated from their leaves showed considerable anticomplementary activity. Glycoside constituents isolated from hibiscus exhibit hypotensive effects (lowering of blood pressure) in dogs at dosages of 40-80mg/kg; blood pressure remains low for 1-2 hours.

Clinical trials : No information available.

Towards commercial production

There are a number of hibiscus products in the global market ranging from herbal remedies, teas to cosmetics. In the cosmetic industry, hibiscus is popularly used as a contouring lotion for inhibiting

fat production and in the stimulation of fat breakdown. Hibiscus is also included in health food such as Tamra, which is found in the local market. Other herbal products include its extract,

which is used for intestinal, kidney problems and as a blood purifier. In the international market, hibiscus flower extract is sold at US\$5.50 per oz (1998).

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Kaempferia galanga

Scientific name : *Kaempferia galanga* Linn.

Common name : Maraba, Fingerroot,
Chinese ginger

Local name : Cekur

Family : Zingiberaceae

Potential crop rating : ☆ ☆ ☆



Introduction

Kaempferia galanga, thought to be native to China and India is now cultivated quite widely in Malaysia and other Southeast Asian countries. The highly aromatic rhizome of this plant is valued in Malaysia as a spice to flavor rice and also in folk medicine. It is popularly used as an expectorant and a carminative. This spice is rather popular in Thailand where it is used frequently in curries and soups.

Plant description

This is a very short herb with leaves spreading horizontally and lying flat on the ground. The leaves are arranged distichously and packed very closely. The leaves are simple, glabrous, with a sinuate margin, green and elliptical-lanceolate in shape. The leaf apex is acute to acuminate with a ligulate base and measures approximately 16cm in length and 8cm in width. Upper leaves are well developed while the lower ones remain as scales. The leaves are slightly aromatic and subsessile with a channeled and pericladial petiole. Flowers are borne solitary with two scale-like gamopetalous calyx of 60cm in length. The corolla, bilabiate in shape is also partially gamopetalous, glabrous with lobes much shorter than the tube. The labellum is white with a splash of purple. The single stamen is epipetalous, appendicular and inserted above the corolla tube. There is a single, terete style with a funnel shaped stigma. The

rhizomes are strongly branched, aromatic and yellow to orange in section. The root tuber which emerge from the rhizome are long, fleshy, unbranched and aromatic.

Plant habitat

Cekur is found growing wildly in old gardens and as an escape. It is also normally cultivated in **villages**.

Plant growth habit/cultivation

Cekur is propagated through rhizome divisions or cuttings obtained from matured mother plants. The rhizome divisions are preferably first established in the nursery under shade and then transferred to the field after one month. Although cekur can be grown in the open it does better in light shade. It thrives on rich, moist sandy loam soil and does extremely well with organic fertilizers. The spread of a matured cekur can go up to 15cm across and therefore a planting distance of about 30 x 30cm is recommended. Harvesting of the rhizomes are normally done after 6 months of field planting that is when the leaves have reached their maximum size and are beginning to dry out.

Plant parts used : Whole herb.

Uses in traditional medicine

The rhizome of cekur mixed with oil is used externally for healing of wounds and applied warm

on rheumatic regions. The sliced rhizome tied as a poultice hastens suppuration of boils (furuncles). A lotion prepared with the rhizome is used to remove dandruff or scales from the head. It is a stimulant, carminative and a diuretic. The powdered rhizome mixed with bees' honey is given for coughs and pectoral ailments.

In Malaysia, the plant is used for flavoring rice. The roots are used widely in cosmetics. The powdered roots are applied to abdomen after childbirth for eliminating excessive air in the body system. Ashes of the leaves are rubbed on swollen breasts after childbirth. The rhizome is boiled and drunk as a tonic for health. The underground stem is used as a stimulant and for treating toothache, cholera, chest pains, headache and constipation. The juice from the rhizome has expectorant and carminative properties; it is commonly used in children's medicines and as tonics. The leaves and rhizome are chewed for relieving coughs and sore throat.

The leaves are also used for making lotions and poultices for sore throats, fevers, swellings, rheumatism and sore eyes. The rhizome is boiled and consumed as a tonic for after childbirth care. The leaves are crushed and used as hot compress on swellings. Both in Malaysia and Indonesia, cekur is widely used in a lot of 'Jamu' preparations that are moderately warming, especially to treat abdominal pains, swelling and rheumatism.

In the Philippines, a decoction of the rhizome is taken as a tonic and for dyspepsia, headache and malarial chills. It is also used as a gargle. The whole herb is rubbed on the neck as a remedy for cold, headache; the rhizome is mixed with oil to treat boils. In China, this plant is used as a remedy

for toothache, a wash for dandruff or scabs and lice. In India, the leaves are used as a perfume when washing hair. Cekur is also used as an hallucinogen in New Guinea.

Chemical constituents

i) *Chemicals with commercial potential*: Essential oil.

ii) *Other chemicals*: Anisic acid, borneol, camphene, camphor, carene, cineol, cinnamic acid, cinnamic acid ethyl ester, ethyl-cinnamate, ethyl-p-methoxycinnamate, N-pentadecane, p-methoxystyrene, paraeumarin; alkaloids, minerals.

Pharmacology

Kaempferia galanga showed *in vitro* amebicidal activity against *Acanthamoeba culbertsoni*, *Acanthamoeba castellanii* and *Acanthamoeba polyphaga*.

Clinical trials : No information available.

Towards commercial production

The full potentiality of this plant has yet to be tapped both locally and abroad. Currently, there are a few products in the local and global markets. These products range from herbal extracts (product: Shan Nai) sold at US\$7.00 per pound (1998) which is said to effect the lung meridian while the dried rhizomes are sold at US\$10 per 120gm (1998). Cekur is also used in many herbal remedies locally both in traditional and commercial herbal remedies. Some of these products include afterbirth tonics, oilments for rheumatism and arthritis.

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Labisia pumila

Scientific name : *Labisia pumila* Benth.
Synonym : *Labisia pothoina* Lindl.
Local name : Kacip fatimah
Family : Myrsinaceae

Potential crop rating : * * *

Introduction

Kacip fatimah is one of the most popular and potent ingredient used in traditional herbal preparations or 'jamus' for afterbirth care. It is administered by almost all mid-wives and traditional healers in both urban and rural areas including the natives in the jungle. There has so far been no or very little attempt to cultivate this plant - they are normally collected from the wild.

Plant description

Kacip fatimah is a herbaceous shrub with creeping rhizomes. Their leaves are more or less upright and exceptionally dark green with lighter shade of green at its margin. They are elliptic-lanceolate in shape, glabrous with an acuminate apice and an attenuate base. The petioles are relatively short and slightly flattened. The stems are erect, dark brown in color with distinct scars of fallen leaves. The nodes of the stem are capable of rooting and roots can be seen protruding out of the older nodes. Flowers, which are about 2mm in size are borne on racemes that are about 6cm in length. The inflorescences arise from leaf axils. There are 5 calyx and corolla lobes. The outside of the calyx is finely pubescent.

The corolla is pale violet or pink in color and the lobes ovate in shape with a rather acute apice. There are 5 sessile anthers. The fruit is a globose berry, bright red in color and measures about 5mm x 7mm in length.



Plant habitat: Forest understorey in Malaysia.

Plant growth habit/cultivation

Plant thrives in shady places. Open sunlight or even partial shade can be harmful to the establishment and growth of this plant. This is a relatively slow growing herb. It is normally propagated through seeds in the nursery under high humidity and shade. It thrives on rich (with plenty of humus), moist sandy loam soil. It needs liberal fertilizing and does well with NPK blue special and cow dung.

Uses in traditional medicine

Paste prepared from the leaves and coconut oil is rubbed on baby's abdomen to relieve stomach discomfort. The Malays prepare a decoction of the plant to expedite labour and as a protective medicine after childbirth. The preparation is also used for treating dysmenorrhoea, gonorrhoea, flatulence, dysentery and rheumatism.

Chemical constituents

i) *Chemicals with commercial potential:* No information available.

ii) *Others chemicals:* No information available.

Pharmacology : No information available.

Clinical trials : No information available.

Towards commercial production

Because of the wide usage of this plant especially as an afterbirth tonic, the local market demand for kacip fatimah products is very great. Currently,

there are a number of local products of kacip fatimah in the market. They range from afterbirth care products to health tonics used in promoting female health such as 'Pa'ama jamu'.

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Melaleuca alternifolia

Scientific name : *Melaleuca alternifolia* Cheel.

Common name : Tea tree

Local name : Tea tree

Family : Myrtaceae

Potential crop rating : * * * *



Introduction

Tea tree belonging to the same family of plants as the eucalyptus originated from Australia and was discovered by Captain James Cook in the 1770's when he witnessed the natives brewing tea from its leaves. The crop is planted mainly for the extraction of its oil. Although the oil has been used for thousands of years as a traditional antibiotic, its properties were only scientifically proven in the 1990's and since then it has captured the world market. Tea tree oil displays unique characteristic and composition in contrast to the conventional standard antibiotics such as iodine and hydrogen peroxide. Tea tree oil is said to be quite harmless to human tissue and it is said to not only kill microbes upon application but also prevents their growth for days afterwards. Tea tree oil's complex chemical composition also makes it extremely difficult to be synthesized and more importantly for microbes to develop resistance towards it.

Plant description

Although this perennial plant resembles a shrub, it is actually a tree and can grow to a height of 5m in the wild. The leaves are rosettelly arranged, simple, green with a small, linear leafblade. The leaf margin is entire with an acuminate apice and a cuneate base, growing to a size of 1.3cm long x 1.0-2.0mm wide. The leaf is glabrous and aromatic. The petiole is pale yellow in color and is flattened and blade-like in shape. The tree trunk is orange

in color and covered with a papery bark, which can be easily peeled off. The plant branches heavily and each twig which is greyish in color is densely covered with minute leaves.

Plant habitat

It grows wildly in swampy, low lying wetlands of New South Wales in Australia. This tree was only recently introduced in Malaysia (1992) where it is being cultivated for its oil.

Plant growth habit/cultivation

Tea tree is propagated by seeds. Due to its minute size, the seeds are normally mixed with fine sand for even broadcasting. This is carried out in the nursery on propagation beds. Mist spraying is carried out to maintain soil surface moisture to prevent the seeds from drying up and being blown away. The seeds will begin germinating in about 8-10 days. The percentage of germination success from this method is about 30%-40%. After 30 days plants are transplanted to polybags, which are kept in the shade for 'hardening' for a further period of 2 months, or until the plants reach a height of 15cm. These plants are then transferred to the field. For commercial growing, hedge planting of this species is recommended. The spacing between 2 hedges is 1.5m and between rows within hedge is 0.6m and 0.4m between plants. With this planting distance a density of 23,800 plants per hectare can be achieved. Tea tree is a heavy feeder and requires

liberal manuring. Application of NPK blue special fertilizer is rotated with NPK green fertilizer and applied bimonthly at a rate of 900kg/ha/yr. This plant is not susceptible to any significant pest and disease problems.

Harvesting can commence 9 months after field planting or when the plant reaches a height of 2m. The plant is harvested 20-30cm above the ground and left for re-growth. Subsequent harvesting is carried out after 6 to 9 months. To obtain higher oil yield, harvesting should coincide with the drier months of the year. The approximate oil yield under Malaysian conditions is 150kg/ha/year. It has been reported in Australia that one ton of tea tree can produce 7-8kg of pure oil.

Plant parts used : Leaves.

Uses in traditional medicine

Tea tree oil is used as a natural remedy for bacterial and fungal infections of the skin and mucosa. It is used as an antiseptic agent. The aborigine tribes in Australia have used it for thousands of years as a healing plant, crushing the leaves into mudpacks to treat cut and skin infections. As early as 1923, clinical trials in Australia began to provide scientific evidence for tea tree's antiseptic and bactericidal properties. It was used in first aid kits in the Australian army and navy in World War II.

Chemical constituents

i) *Chemicals with commercial potential:* Caryophyllene, cineole, p-cymene, myrcene; essential oil.

ii) *Other chemicals:* Allo-aromadendrene, allyl-hexanoate, aromadendrene, α -bulnesene, α -cadinine, calamenene, camphene, camphor, 1,4-cineole, 1,8-cineole, α -copaene, α -cubebene, α -cymene, p-cymen-8-ol, cymenene, α -p-dimethylstyrene, p-elemene, α -gurjunene, hexanol, humulene, limonene, linalol, α -muurolene, nerol, α -pinene, piperitol, piperitone, α -phellandrene, (3-phellandrene, sabinene, α -terpinene, γ -terpinene, terpinen-1-ol, α -terpineol, terpinen-4-ol, terpinolene, α -terpinolene, α -thujene, α -thujeneviridiflorene, veriflorene; menthatrienes.

Pharmacology

Melaleuca alternifolia oil is reported to possess anticandidal, antifungal and antimicrobial activities. The minimum concentration of oil killing 90% of isolates was 0.25% for *C. albicans* and 0.5% for non-*albicans Candida* species. Tests on three intravaginal tea tree oil products showed that these products possess minimal inhibitory concentration minimum fungicidal concentrations comparable to those of non-formulated tea tree oil. In another study, tea tree oil showed inhibitory activity against *Candida albicans*, *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton tonsurans*, *Aspergillus niger*, *Penicillium* species, *Microsporum gypsum* and *Epidermophyton floccosum*. It was also shown to be effective against *Malassezia furfur* isolates and may be useful in removing transient skin flora while suppressing but maintaining resident flora. Ointment prepared from tea tree oil was found to exhibit a very low minimal inhibitory concentration value for dermatophytes (geometric mean 0.2ug/ml), yeasts (geometric mean 1.0ug/ml), and *Malassezia furfur* (geometric mean 2.34ug/ml). The ointment was found to be a good remedy for fungal infections of the skin and mucous membranes and for treatment of dandruff, a mild form of seborrheic dermatitis. *In vitro* studies showed that tea tree oil may be useful in the treatment of MRSA (methicillin-resistant *Staphylococcus aureus*) carriage.

Terpinen-4-ol isolated from tea tree oil was found to be active against *Candida albicans*, *Escherichia colia*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* while p-cymene demonstrated no antimicrobial activity. Linalol and α -terpineol were active against all organisms with the exception of *Pseudomonas aeruginosa*.

The active ingredients of tea tree are found to be terpinene and cineole. Terpinene is the ingredient responsible for the healing properties. Cineole contributes the disinfectant properties. In large amount, cineole is caustic to human tissue. In order to obtain the best result from using tea tree oil, the percentage of terpinene must be above 35% and the percentage of cineole must be below 10% to ensure skin safety during usage. Some of the biological activities are analgesic, antasthmatic,

anthelmintic, antibacterial, antifungal, antimicrobial, antiseptic, antitussive, antiviral, carminative, counterirritant, diaphoretic, parasiticide, stimulant and expectorant.

Clinical trials

A double-blind, multicenter, randomized controlled trial on 117 patients with distal subungual onychomycosis showed that about half of the patients improved in nail appearance and symptomatology after topical application of 100% tea tree oil twice daily for 6 months. Tea tree oil cream (10% w/w) was found to reduce the symptomatology of tinea pedis as effectively as tolnaftate 1 % but is no more effective than placebo in achieving a mycological cure in a clinical trial on 104 patients. A single blind, randomized clinical trial on 124 patients showed that both 5% tea tree oil and 5% benzoyl peroxide has significantly ameliorated patients' acne by reducing the number of inflamed and non-inflamed lesions (open and closed comedones), although the onset of action in the tea tree oil was slower. Patients treated with tea tree oil experienced fewer side effects.

Clinical studies conducted to determine the allergens of tea tree oil showed that limonene is the most common allergen causing allergic contact

eczema in patients. An ingestion of a modest amount of a concentrated form of tea tree oil is shown to produce signs of toxicity.

Towards commercial production

Due to its potent healing, immune boosting, antifungal and antiseptic properties, tea tree oil has varied uses and is being applied to a huge range of health products like antiseptic creams, ointments, medicated shampoos and soaps, for treatment of bronchitis and colds, as a mouthwash and dog shampoos. The oil stability and spicy character are valued by the flavoring, perfumery, toiletry and soap industries. Because of the huge range of products that can be manufactured from tea tree oil, there is a high demand from the US and, to a lesser extent, from Asia and Europe. Currently, Australia produces about 99% of the world tea tree oil. In 1996, a tea tree oil plantation producing 180-200 tons a year, with an average price of US\$50/kg, took an estimated value of the industry to US\$ 10 million a year. With increasing demand, attractive returns of tea tree industry, together with the fact that harvesting can be carried out twice a year in Malaysia (once a year in Australia and other countries), this industry will become more lucrative.

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Melastoma malabathricum

Scientific name : *Melastoma malabathricum* L
Common name : Singapore rhododendron
Local name : Senduduk
Family : Melastomatacea

Potential crop rating : ☆ ☆ ☆



Introduction

Melastoma malabathricum or senduduk has been classified as a weed and can be seen growing wildly in abandoned or wastelands. This so-called "weed" has been used extensively in traditional medicine both locally and abroad.

It has been found to be especially useful in treating both internal and external wounds. It has also been popularly used by the women folks following childbirth to strengthen the womb and accelerate healing.

Botanical description and natural habitat

Senduduk is an erect much branched shrub growing to a height of 3m. The leaves are simple, entire, lanceolate in shape and can grow up to a length of 7cm. The leaves are green, rough textured, covered with minute hairs with an acute apice and a cuneate base. There are three distinct mid-ribs on each leaf. The stem is reddish, rough with small bristly scales and minute hairs. The flowers are large and showy, measuring 5-7cm across.

They are borne on short axillary inflorescence (cyme). There are 2-6 flowers per cyme. The bracts found at the bottom of the flower stalk is reddish green in color and toothed. There are 5 calyx which coalesce and form a distinct reddish green calyx cup. There are 5 large, purple polypetalous corolla with a fringed margin. There are 10 stamens, 5 of them are longer and have bright yellow and purple

tipped filaments, which curve at the upper part. The other 5 filaments have bright yellow filaments and anthers. The single central style is cylindrical in shape with a green tip. The fruit is a berry.

Plant growth habit/cultivation

This plant is propagated easily through seeds. The seeds are sown in the nursery and after 2 weeks the seedlings can be seen sprouting out. The plants are transferred to the field when they reach about 6 weeks old. It can adapt itself to most soil conditions and thrives in full sunlight. The planting distance can be kept about 2m x 2m apart. Harvesting of the vegetative part is normally done after a period of 6 months.

Plant part used : Leaves, shoots, roots.

Uses in traditional medicine

The leaves and shoots are traditionally eaten to cure diarrhea. In Malaysia, paste made from senduduk leaves and roots are used to prevent scars from scurf or smallpox. A decoction of the roots is used to relieve toothaches, to soften the feet and to eliminate flatulence.

A decoction of the roots and leaves or roots alone is taken by women after childbirth. A decoction prepared from a mixture of senduduk leaves, vinegar, *Zingiber officinale* (ginger) and *Zingiber cassumunar* (bonglai), is used for treating leucorrhea; in another prescription, sugar instead

of vinegar is added to the mixture. A paste made from the senduduk shoots is used for treating puerperal infections. The vegetative parts are astringent.

The leaves and shoot ends, alone or with mangosteen bark or fruit husks, are prepared as decoction for treating diarrhea. The powdered leaves are used for treating dysentery, wounds and as a tonic.

Chemical constituents

i) *Chemicals with commercial potential*: No information available.

ii) *Other chemicals*: No information available.

Pharmacology

Extract of *Melastoma malabathricum* is found to have antiaggregation activities (slows down clotting and the pooling of blood).

Clinical trials : No information available.

Towards commercial production

In Malaysia, the medicinal properties of senduduk and the commercialization of its products has not been fully tapped. Its usage is mainly confined to the traditional healers in preparing their herbal remedies. To date, there are very few commercial products of senduduk; one being 'Senduduk Plus' which is used to promote female health.

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Mentha arvensis

Scientific name : *Mentha arvensis* L.
Common name : Mint
Local name : Pudina
Family : Lamiaceae / Labiatae

Potential crop rating : ☆ ☆ ☆



Introduction

Mint, which originates from the genus *mentha* is distributed mostly in the temperate and sub-temperate regions of the world. *Mentha arvensis* or pudina is an introduced species of *mentha* in Malaysia. This plant is cultivated locally where it is widely used as a culinary herb. It is also used in traditional medicines and in herb teas. Essential oil extracted from this plant is also used as flavoring agents in sweets and beverages.

Plant description

Pudina is a perennial, erect, short stemmed aromatic herb. The leaves are green, simple and arranged in opposite decussate manner. The leaf blade is ovate to lanceolate with an acuminate apice, cuneate base and a serrated leaf margin. The petioles are short, phyllodial and covered with minute hairs. The stems are quadrate, purple and erect. Flowers are borne on axillary verticils which grow to about 10-15mm in length. The bracts are numerous, oblanceolate to linear in shape, minute and green. Bracteoles are also present, numerous and minute. The flowers are hermaophrodite, minute and fragrant. There are 5 calyx lobes, green with an entire margin and with lobes shorter than the corolla tube. There are 4 corolla lobes, which are campanulate in shape, glabrous and pale pink to white in color. There are 4 stamens; epipetalous in position and inserted near the top of the corolla tube. There is a single

style which is cylindrical, terete and with a decurrent stigma. The fruits are dry, smooth nutlets.

Plant habitat

Mint is commonly cultivated in backyards or home gardens in Malaysia. It is also grown commercially in Cameron Highlands. It is not found in the wild as it is an introduced species and cannot compete with our Malaysian weeds.

Plant growth habit/cultivation

Mint is normally propagated through rooted stolons. The stolons should be at least 10-20cm in length and about 3mm thick. Before planting the land should be prepared by ploughing and harrowing and then made into sand beds on which the stolons are planted.

Mint flourishes in full sunlight, in deep soils rich in humus and retentive of moisture, but fairly open in texture and well drained as in sandy loam soils. Mints are considered heavy feeders and liberal manuring is essential. Reports show that the plants do well when organic manure is applied to the land at a rate of 25-30ton/ha at land preparation stage.

The crop is harvested just before it goes into flowering. This normally takes about 60 days. During harvesting, the crop is cut at 10cm above ground level by sickles. They are then spread into the field for 4-5 hours for wilting to commence.

Subsequent harvest is carried out after an interval of 40-50 days. Mint is normally grown as an annual crop and after each harvest new plants are propagated and grown. Crop rotation is advisable when growing mint at a commercial stage. This is to maintain a reasonable control on weeds, the crop's fertility and to obtain higher return from the land.

In India, rotation with crops such as maize, potato, sweet pea is commonly carried out in mint growing areas.

Weeding is an essential operation in mint farming and according to records it accounts for 30% of cost incurred on its cultivation. Mint crops have been reported to be commonly attacked by a relatively large number of pests and disease such as leaf rollers, terminates, stolon rot, wilt, rust and leaf blight.

Plant parts used : Leaves, flowers, stems.

Uses in traditional medicine

The dried mint plant is a stomachic, diuretic and a stimulant. It is used for jaundice and is frequently given to stop vomiting. The leaves are traditionally used in Malaysia for treating headaches and coughs. The essential oil (ie peppermint oil) obtained from the leaves is widely used as an ingredient in medicine and for flavoring food and sweets.

An infusion of the leaves and stems is used in China as a carminative, sudorific and anti-spasmodic. In the Philippines, the flower tops and leaves are used as a carminative whilst the bruised leaves used as an antidote for stings of poisonous insects.

Chemical constituents

i) *Chemicals with commercial potential:* Caryophyllene, eugenol, hesperidin, luteolin, menthol, myrcene, pulegone, rosmarinic acid, thujone; essential oil.

ii) *Other chemicals:* Acacetin-7-O-p-D-glucoside, acetic acid, (+)-8-acetoxy-carvone, acetylmenthol, anisaldehyde, camphene, caproic acid, P-car-3-ene, carvomenthone, (+)-carvone, chlorophyll A and B, 1,8-cineole, p-cymene, p-cymol, 3(5',5'-dimethyltetrahydrofuran-2'-yl)-but-cis-2-en-1-ol,

diosmetin-7-0-|3-D-glucoside, ethylamyl-carbinol, formic acid, furfural, germacrene D, oc,p-hexenic acid, a,y-hexenyl-phenylacetate, (+)-isomenthofuran, isomenthol, (+)-isomenthone, DL-isomenthone, isopulegol, isopulegone, cis- and trans-isopulegone, isovaleraldehyde, isovaleric acid, limonene, linalol, linalol-acetate, p-menthan-trans-2,5-diol, menthone, 1-p-menthen-3-one, menthion, menthonone, menthofuran, menthofurolactone, mentholacetate, menthone, menthylacetate, 3-methylpentanol, neoisomenthol, neoisopulegone, (+)-neomenthol, cis- and trans-ocimene; D-3-octanol, octan-3-ol, (+)-octan-3-ol, octan-3-one, P-phellandrene, a- and p-pinene, piperitenone, piperitenone oxide, pipcritone, (+)-piperitone, piperitone oxide, (+)-pulegone, raffinose, resin, sabinene-hydrate, santene, sitosterol, stachyose, tannin, 3',4',5,7-tetrahydroxyflavone-7-a-L-rhamnosyl-p-D-glucoside, oc-thujene, 4',5,7-trihydroxyflavone-7-a-L-rhamnosyl-P-D-glucoside, 3',5,7-trihydroxy-4'-methoxyflavone-0-p-D-glucoside, 4',5,7-trihydroxyflavone-O-p-D-glucoside; ketones, minerals'.

Pharmacology

The *Mentha arvensis* oil was effective as fumigant against *Sitophilus oryzae* in sorghum (*Sorghum bicolor*). The ointment formulation, which consists of essential oils of *Artemisia nelagrica*, *Caesulia axillaris*, *Chenopodium ambrosioides*, *Cymbopogon citratus* and mint, was found to be able to cure experimental ringworm in guinea pigs within 7 to 12 days. It also showed strong fungitoxicity against dermatophytes, *Aspergillus fumigatus* and *Cladosporium trichoides*. A uterotonic fraction of mint caused a significant interruption in pregnancy (antifertility effect) in rats. Fifty percent ethanolic extract of mint leaves is found to reduce the fructose synthesis in seminal vesicles of rats.

Clinical trials : No information available.

Towards commercial production

The commercialization of mint products is vast in the global market. Mint product ranges from herbal teas, to cigarettes to hygiene products such as toothpaste and mouthwash. The essential oil of

mint is also used in aromatherapy and in lotions. Chai Herbal Tea. One of the major producers of
Some commercial products of mint include *Mentha arvensis* oil is China and it is priced at
HerbaRub, RollaBalm (Vedahealth) and Ban Kah US\$5.60 per 10ml (1998) in the global market.

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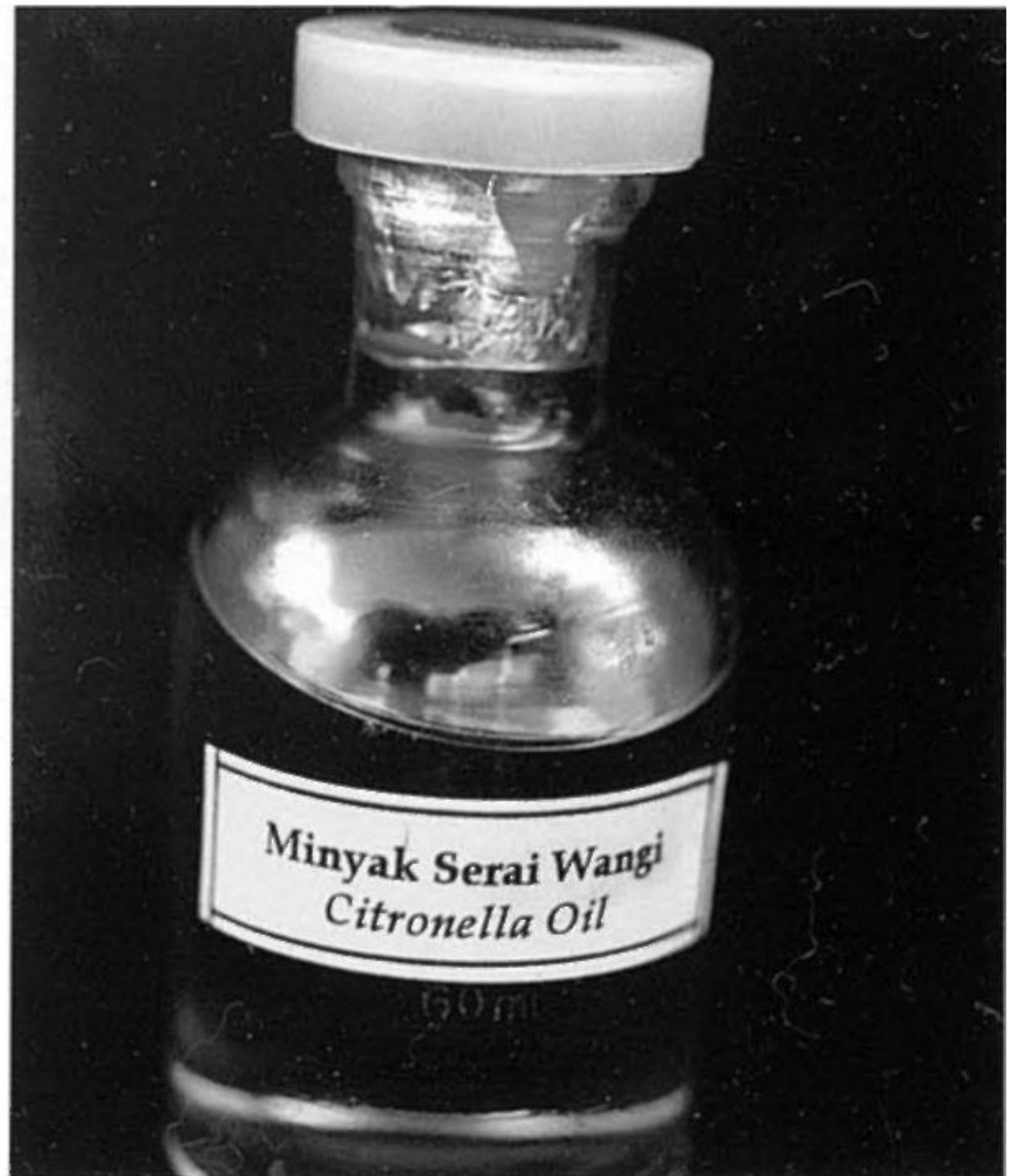
Cymbopogon nardus



Cymbopogon nardus : plants



Cymbopogon nardus : inflorescences



Cymbopogon nardus : essential oil

Eclipta alba



Eclipta alba : plants



Eclipta alba :
plant, decoction & poultrice

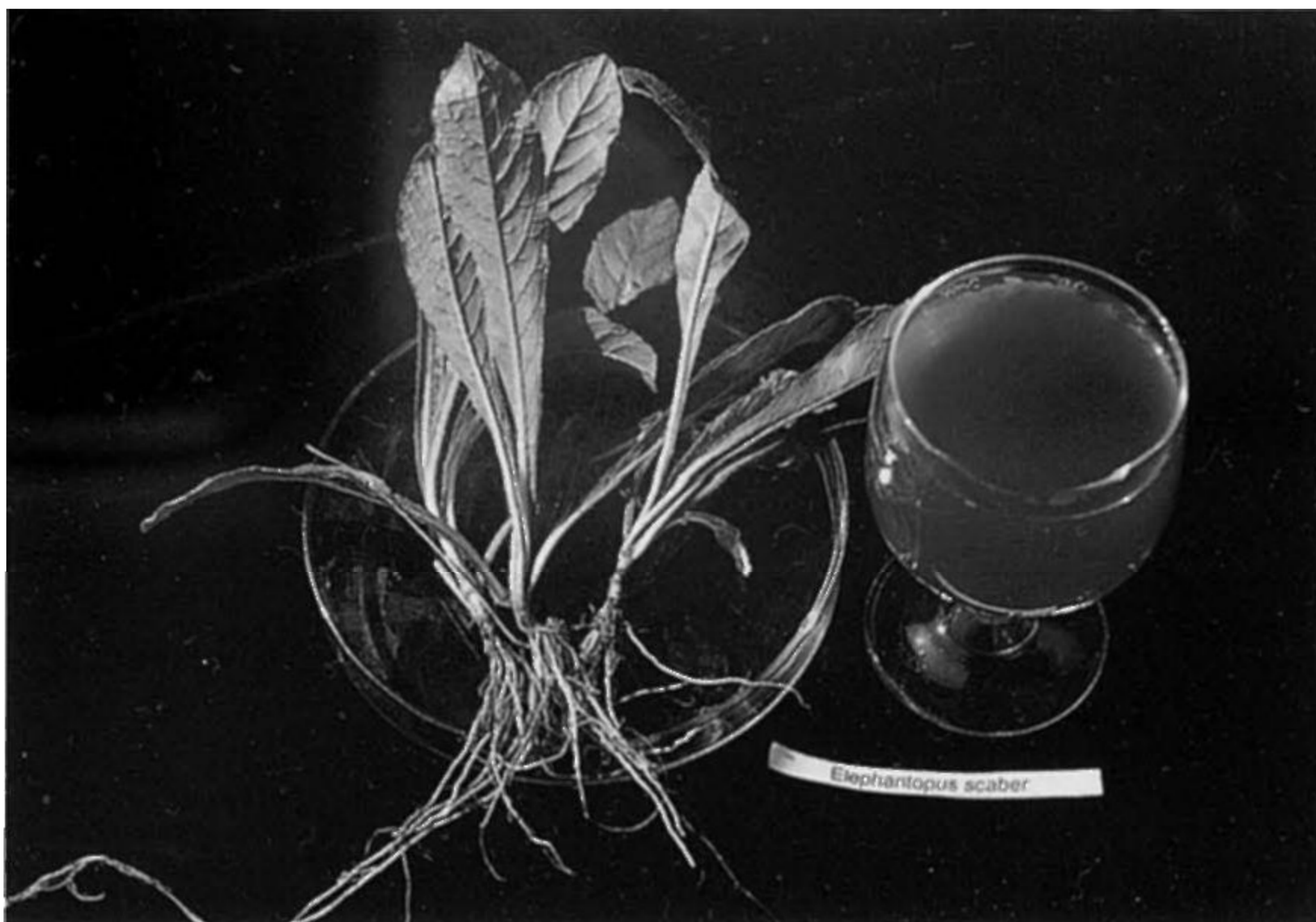


Eclipta alba : flower

Elephantopus scaber



Elephantopus scaber : plants



Elephantopus scaber : plant & decoction

Eurycoma longifolia



Eurycoma longifolia : plant



Eurycoma longifolia : canopy



Eurycoma longifolia : dried root

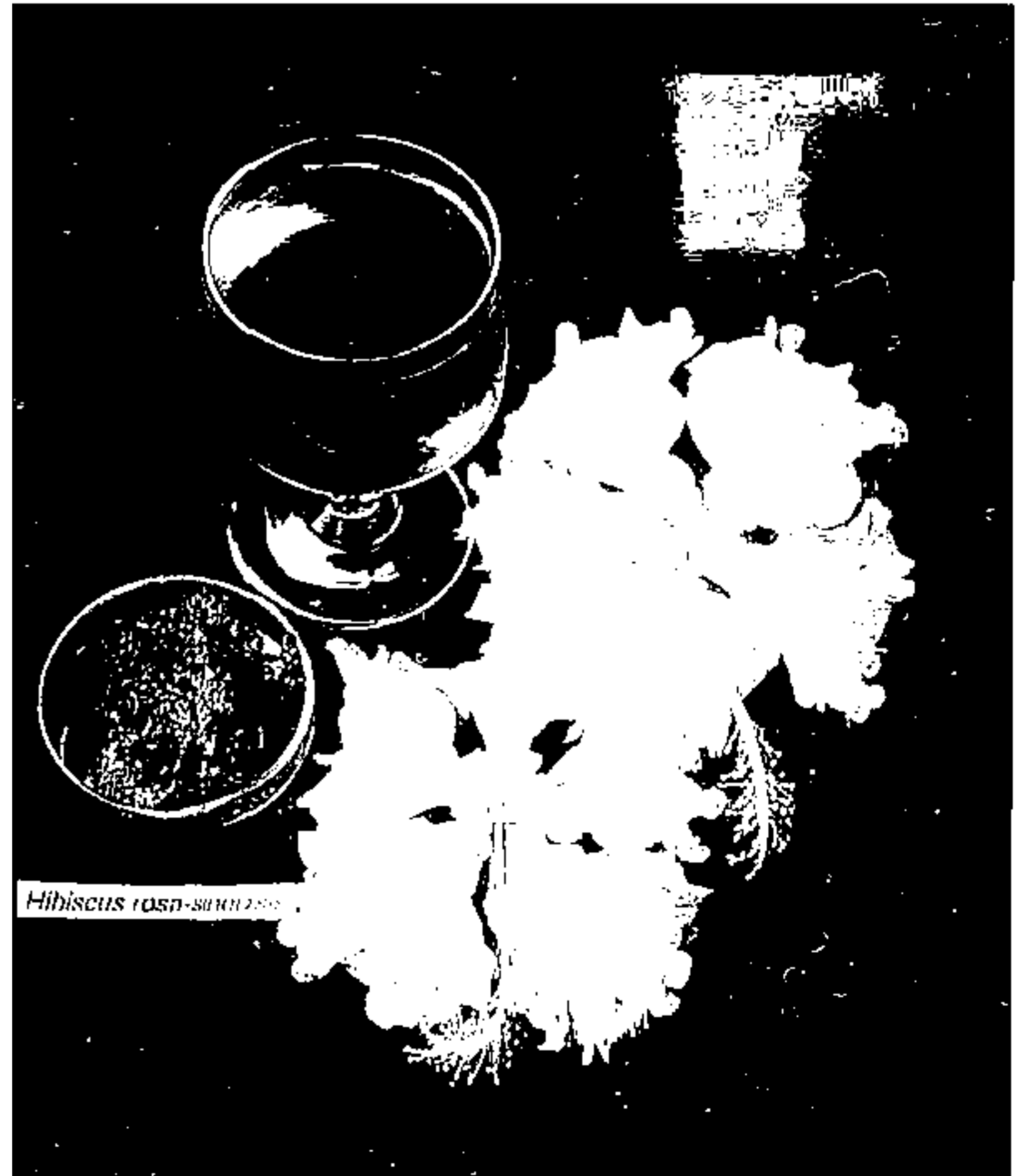
Hibiscus rosa-sinensis



Hibiscus rosa-sinensis : plant



Hibiscus rosa-sinensis : flower



Hibiscus rosa-sinensis :
poultice, decoction & flower

Kaempferia galanga



Kaempferia galanga : plants



Kaempferia galanga : flower

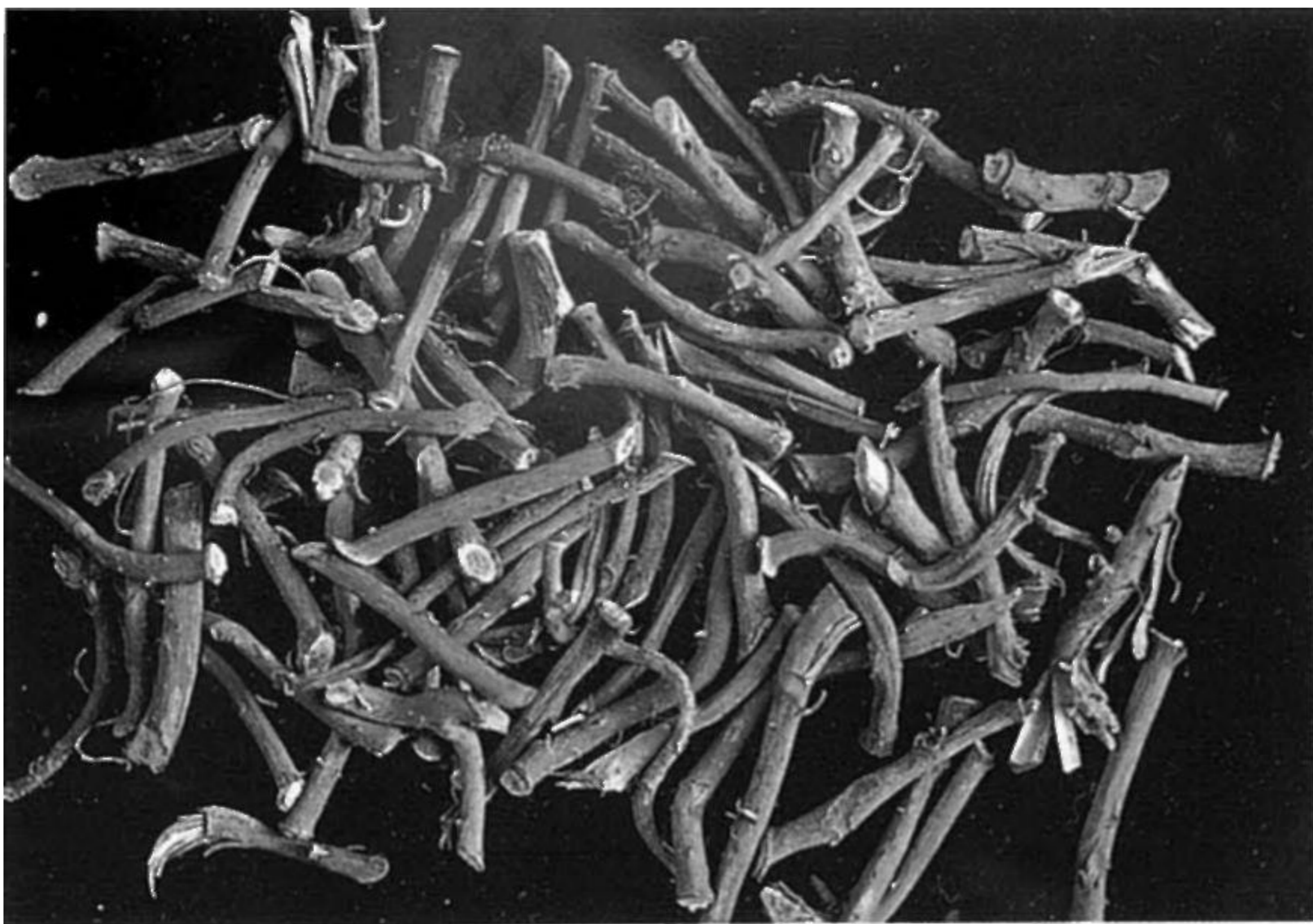


Kaempferia galanga

Labisia pumila



Labisia pumila : plants

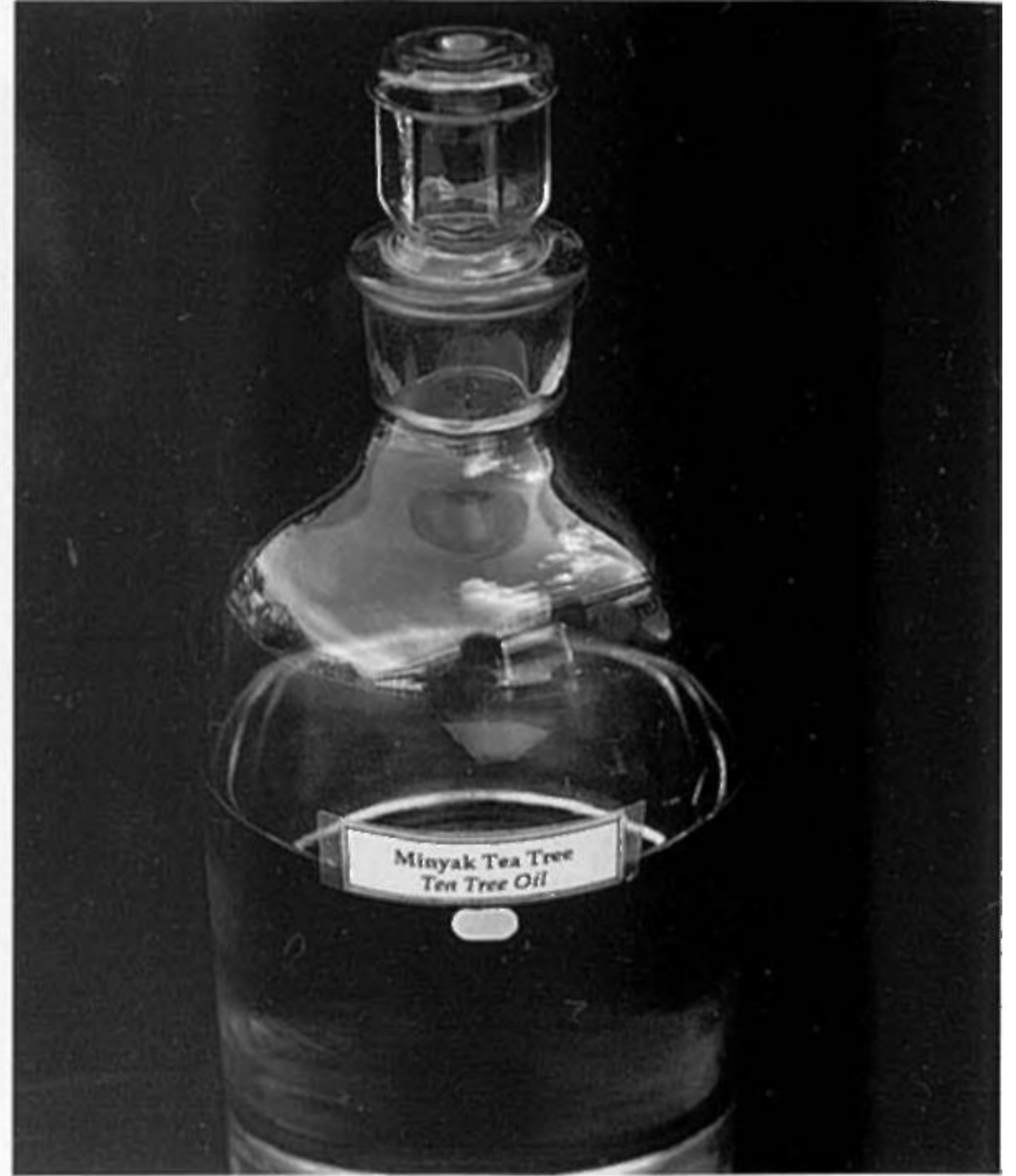


Labisia pumila : dried stem & root

Melaleuca alternifolia



Melaleuca alternifolia : plant



Melaleuca alternifolia : essential oil



Melaleuca alternifolia: leaves

Morinda citrifolia

Scientific name : *Morinda citrifolia* Linn.

Common name : Indian mulberry, Noni

Local name : Mengkudu

Family : Rubiaceae

Potential crop rating : * * * * *

Introduction

Morinda citrifolia, a native of Queensland, Australia is now widespread in many countries around the world including the Southeast Asia, Hawaii, Easter Island and the Caribbean regions. In most of these countries, Morinda's historical use has targeted towards the digestive, respiratory, immune, nervous and the skeletal system. It has been used as a folk medicine by the natives of Hawaii for over 2000 years. It is now popularly known worldwide as 'the Hawaiian magic fruit' or 'the Hawaiian miracle medicine'.

Plant description

Morinda citrifolia is a small evergreen tree with a conical crown, growing up to a height of 7m. The bark of this tree is greyish in color, shallowly fissured and has quadrangular branchlets. The leaves are simple, arranged in opposite pairs, entire and are elliptical-lanceolate in shape. They are dark shiny green in color, glabrous with an acuminate apice and base. An average leaf measures about 30-35cm in length and 13-15cm in width. At each leaf axil there is a green tongue-like shaped stipule measuring about 1.5cm in length. The unique feature of these plants is the flowers, which are borne on inflorescence that look like fleshy heads (resembling the fruits). The flowers are bisexual, fragrant with funnel-shaped corollas. The stamens are inserted at the mouth of the corolla. The fruits



are fleshy, very uneven drupes; more or less oblong in shape and when ripen they change to creamish white in color. The seeds are black in color with a hard albumen.

Plant habitat

They are found growing wildly along the rocky coast of Peninsular Malaysia. They are commonly found in the lowlands to altitudes of 1,500m.

Plant growth habit/cultivation

Morinda citrifolia is propagated by seeds. They are normally sown in the nursery and germinate after a period of 3-9 weeks after sowing. Seeds have been reported to remain viable up to 6 months. After about 2 months, the plant can be transferred to the field. A planting distance of 3m x 3m is recommended. Maintenance of these plants is more crucial in the first year especially in reducing the competition against weeds. After this period very little maintenance is required. This plant is a good inter-crop with cereals and also with perennials. The fruits can be harvested in the second year when the tree goes into flowering and fruiting. Since *Morinda citrifolia* is a non-seasonal plant, production of fruits is possible throughout the year. The plant is said to have a longevity of about 25 years.

Plant parts used : Fruits, leaves, roots.

Uses in traditional medicine

The plant and its parts are used for their antihelmintic, antibilious, antibiotic, antiemetic, antinauseant, antipyretic, antiseptic, antitussive, antihypertensive, astringent, cathartic, decongestant, emetic, emmenagogue, emmolient, expectorant, febrifuge, laxative, tonic and vermifuge properties. It is also used to treat arteriosclerosis, asthma, diabetes, dysentery, lumbago, rheumatism and hepatitis. In external application, it is used for treating cutaneous diseases (boils, eruptions, itches, scabies, sores, psoriasis, ulcers and wounds). In Malaysia, the over-ripe fruit is taken as an emmenagogue. The juice prepared from the fruit is used to treat leucorrhoea and sapsraemia. The roots are commonly taken to increase menstrual flow and to treat female infertility. The juice from fruits, prepared as a drink, is also taken for treating dysuria. Fresh fruits are eaten to cure diabetes, swollen spleen, liver diseases, beri-beri, hemorrhage and coughs. A decoction of the bark is taken as an astringent and used for ague. The leaves are applied to the chests or to the abdomen, for coughs, enlarged spleen, in nausea, colic and fever. The pulp of the fruit is used for cleansing hair, and sometimes used for cleaning iron and steel.

In Java, the fruit pulp is mixed with sugar and taken as a laxative. The very young leaves are eaten as a vegetable. The root is used internally as an astringent and externally to relieve pain in gout and rheumatism. The leaves are given for diarrhea and applied on wounds.

Chemical constituents

i) *Chemicals with commercial potential*: Alizarin, asperuloside, xeronine.

ii) *Other chemicals*: Acacetin-7-0-p-D(+)-glycopyranoside, 5,7-acacetin-7-0-p-D(+)-glycopyranoside, alizarin-a-methylether, anthragallol-2,3-dimethylether, ascorbic acid, asperulosidic acid, caproic acid, caprylic acid, B-

carotene, chrysophanol, damnacanthal, damnacanthol, digoxin, 5,6-dihydroxylucidin, 5,6-dihydroxylucidin-3-p-primeveroside, 6,8-dimethoxy-3-methylanthraquinone-1-O-p-rhamnosyl(4-1)glucopyranoside, 5,7-dimethylapigenin-4'-0-P-D(+)-galactopyranoside, hexoic acid, 5,6-3-hydroxymorindone, 3-hydroxymorindone-6-P-primereroside, indole, lucidin, lucidin-3-P-primeveroside, 3-hydroxymorindone, 3-hydroxymorindone-6-p-primereroside, 2-methyl-3,5,6-trihydroxyanthraquinone, 2-methyl-3,5,6-trihydroxyanthraquinone-6-P-primereroside, a-methoxyalizarin, monoethoxyrubiadin, morindadiol, morindin, morindone, morindone-6-p-primeveroside, niacin, nordamnacanthal, octoic acid, paraffin, purine, quinoline, riboflavin, rubiadin, rubiadin-1-methyl ether, rubichloric acid, p-sitosterol, soranjidiol, thiamin, trihydroxymethylanthraquinone-monomethylether, ursolic acid; ajmalicine isomers, alkaloids, anthraquinones, fatty acids, flavone glycosides, flavonoids, glucose (p-D-glucopyranose).

Pharmacology

Morinda citrifolia is reported to possess analgesic, antimicrobial, hypotensive, uterine muscle relaxant and insecticidal activities.

Clinical trials : No information available.

Towards commercial production

With the recent extensive scientific research on its benefits, mengkudu has instantly become one of the most popular and sought after herb worldwide. There are currently a number of variable products in the global market. Mengkudu is sold as Noni Juice - as a health tonic, Noni Pulp - for skin related problems, as Noni Leaf Extract - for cuts and bruises, as Gingerade - in combination with turmeric, ginger, apple cider as a herbal tonic and as Noni Ginger Throat Spray. In addition to this, mengkudu is also marketed in the capsule form and used for massages and as an antioxidant.

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Moringa oleifera

Scientific name : *Moringa oleifera* Lam

Common name : Horse radish tree/ Drumstick tree

Local name : Kacang kelor

Family : Moringaceae

Potential crop rating : ☆ ☆ ☆



Introduction

Originated from India and Sri Lanka, *Moringa oleifera* is one of the most useful crop to mankind as all parts of the plant is used extensively and is said to be of value. Seed is eaten like peanuts, the foliage and fruits eaten as a vegetable and salad. The seed-oil extracted is used in arts and as lubrication. The seeds are also employed to purify water. The wood is used in the paper industry and to yield a blue dye. *Moringa oleifera* has also been used extensively in folk medicine where again almost all parts of the plant are used in curing various diseases right from tumor to ailments such as cough, headaches and digestive problems. It is also used as a tonic. Due to its nutritive value, *Moringa oleifera* is also categorized as a potential famine food.

Plant description

Moringa oleifera is a slender, relatively small deciduous tree, which can grow to a height of 10m. The compound leaves are tripinnate, growing up to 45cm long. The rachis is slender and thickened at the base. The leaflets are arranged in opposite pairs and measure about 2.5cm in length by 1.5cm in width. The leaflets are elliptical in shape with a rounded apice and an acute base. Petioles are present and are minute, measuring about 2-3mm in length. The branches are light brown in color, scaly and dropping in nature. The bark is corky and the wood soft.

The flowers are creamy-white in color, hermaphrodite and borne on axillary panicles. There are 5 calyx lobes, which are polysepalous and linear-lanceolate in shape. The corolla are polypetalous, 5 in number and cream in color. There are 5 fertile stamens of differing lengths. The base of the stamens is covered with a tuft of hairs. The single central style is cylindrical in shape. The fruits are pendulous legume pods, which can grow to about 45cm in length. The pods are 9-ribbed and hold 3-angled dark brown seeds within.

Plant habitat

It is a cultivated plant and can be seen growing in villages and home gardens.

Plant growth habit/cultivation

Moringa oleifera can either be propagated by cuttings or by seeds. The former methodology is normally practiced, as the seed viability is very poor. Cuttings of 0.5m long from the middle portion of the branch are normally used (diameter of about 5-7cm). They can either be planted in the nursery or directly in the field if irrigation is **available**.

This plant does well in light, well-drained, dry, sandy soil. It prefers areas of low rainfall, as this plant is very drought resistant. It is quite hardy and does not need liberal manuring. The leaves can be harvested after 2-3 months of planting. The

plant starts bearing pods only after 6-8 months but regular bearing only occurs after the 2nd year. Records show that the yields are not large at any harvest but harvesting can be done frequently. The estimated yield is 5 tons per ha.

Plant parts used : All parts of the tree.

Uses in traditional medicine

Moringa oleifera is traditionally used as a thermogenic, digestive, carminative, anthelmintic, constipating, anodyne, antiinflammatory, emmenagogue, sudorific, diuretic, ophthalmic, rubefacient, expectorant, haematinic, antilithic, alexipharmic, stimulant, vesicant, abortifacient, antifungal, purgative and an antipyretic herb. The fresh root, mixed with the root skin of papaya is used externally as a powder to treat edema, muscle weakness and beri-beri. The root decoction is taken as an emmenagogue and is abortive. It is also a remedy for scorbout, rheumatism, hysteria, and epilepsy. The root as well as the leaf is applied as a diuretic in treating gonorrhoea. The leaves together with lime, are externally applied to herpes skin disease for children. The fresh unboiled leaves were found to act as an antibiotic against *Staphylococcus*. The seeds are emetic and purgative.

In Malaysia, the leaves are eaten as a vegetable to stimulate lactation in mothers. The fruit and leaves also act as laxatives. The root is used to stimulate digestion and as a cosmetic when applied to the abdomen of women after childbirth. Poultice of the leaves are applied to the abdomen to expel intestinal worms and rubbed over the breasts to prevent milk flow. The extract of the bark is prescribed for headaches. The leaves and roots are used for treating women diseases. Leaves are taken orally to treat gonorrhoea whilst oil from the seeds is applied to the joints in treating rheumatism.

In Java, gum obtained from the bark is given for intestinal complaints whilst the leaves are used as a poultice to reduce glandular swellings. The fresh root is regarded as a stimulant and as a diuretic. In Indo-China, the roots are regarded as an antiscorbutic, rubefacient and a counter irritant. The juice of the root is useful as a decoction for asthma, gout, rheumatism, enlarged spleen and liver, internal and deeply seated inflammations.

In India, the root, bark, leaf, flower, seed and gum are used in the treatment of enlarged spleen and liver, in acute and chronic rheumatism, fever, epilepsy, sores in the mouth and leprosy. In the Philippines, the oil from the seeds is applied on goitre and acute rheumatism. The immature fruit is often used in Ceylon in making curry and the leaf for shell-fish preparations where it is supposed to counteract any poisonous effects.

In Nicaragua, a decoction of the root is used for dropsy. In Africa and Madagascar, the exudate from the tree is used as a diuretic, antifebrile and remedy for asthma while the resins acts as a rubefacient and an antidiarrhoeic. The oil acts as a remedy for hysteria and scurvy. In Mauritius, the expressed juice or the leaf is used as an irritant purgative and as an anthelmintic. The fruit is taken for diseases of the liver and pancreas while the root bark acts as a stimulant, diuretic, stomachic and an abortifacient.

Chemical constituents

i) *Chemical with commercial potential:*

Moringinine, myristic acid, niaziminin, pterygospermin, spirochin.

ii) *Other chemicals:* 4-[(4'-O-acetyl-ct-L-rhamnosyloxy)benzyl]-isothiocyanate, arachidic acid, ascorbic acid, bassorin, bayrenol, behenic acid, benzylamine, (3-carotene, choline, emulsin, 0-ethyl-4-[9-a-L-rhamnosyl)-benzyl]carbamate, D-glucuronic acid, p-hydroxybenzoate, 0-[2'-hydroxy-3'-(2"-heptenyloxy)]propyl undecanoate, 4-hydroxymellein, 4-hydroxyphenylacetone nitrile, 4-hydroxyphenylacetamide, indoleacetic acid, indoleacetone nitrile, kaempferol, lignoceric acid, moringine, myrosin, niacin, niaziminin A and B, niazirin, niazirin, octacosanoic acid, oxalic acid, quercetin, 4-(a-L-rhamnosyloxy)-benzylisothiocyanate, 4-(cx-L-rhamnosyloxy)phenylacetone nitrile, riboflavin, (3-sitosterol, P-sitosterone, thiamin, tocopherol, vanillin, vitamin-B6; alkaloids, amino acids, fatty acids (oleic acid, palmitic acid, stearic acid), monosaccharides, minerals."

Pharmacology

Extract of *Moringa oleifera* inhibited the growth of *Trichophyton rubrum* and *Trichophyton*

mentagrophytes. The leaf extract was found to have abortive activities while the fresh leafjuice and aqueous extracts from the seeds inhibited the growth of *Pseudomonas aeruginosa* and *Staphylococcus aureus*.

Biochemical and physiological alterations in female reproductive organs were observed in cyclic rats treated with aqueous extract of *Moringa oleifera* roots. The aqueous extract of the roots was also found to have antifertility property. Hot water infusions of flowers, leaves, roots, seeds and stalks or bark of *Moringa oleifera* showed antispasmodic, antiinflammatory and diuretic activities. Ethanol extract of *Moringa oleifera* leaves was found to have hypotensive activity while their roasted seeds possess mutagenic activity.

Niaziminin, a compound isolated from

Moringa oleifera leaves, was found to inhibit tumor-promoter-induced Epstein-Barr virus activation. Thiocarbamates isolated from the leaves of the plant showed hypotensive activity.

Clinical trials : No information available.

Towards commercial production

Moringa oleifera is considered one of the most potentially valuable crops to mankind. The commercialization capacity of this crop lies both in its nutritive value as a food crop and in its medicinal value. Another huge potentiality of this crop lies in its capacity to purify water. All around this tree is a good weapon not only in the underdeveloped nation where famine is prominent and sanitation poor but also in the richer nations where it can be promoted as a health food and crop.

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Ocimum basilicum

Scientific name : *Ocimum basilicum* Linn.

Common name : Sweet basil

Local name : Selasih

Family : Lamiaceae (Labiatae)

Potential crop rating : * * *

Introduction

Basil, native to India, is considered the King of herbs. It can play many roles such as a landscape plant and for culinary purposes especially for flavoring food such as soups and pizza. Basil oil possesses insecticidal and insect repellent properties said to be effective against mosquitoes and houseflies. In the Mediterranean, basil is grown on unscreened windows to repel flies. Laid over tomatoes, basil is said to repel fruit flies. In China, basil is planted to keep down odors of manure. As a traditional medicine, basil is popularly used for treating respiratory ailments and headaches.

Plant description

Basil is a strongly sweet scented herbaceous shrub growing to a height of 75cm to 100cm. It has numerous branches that bear green, slightly serrated and oval shaped-leaves. The leaves are dotted with tiny oil cells that give the herb its strong flavor and scent.

The leaves are simple, glabrous, green and arranged in opposite decussate pairs. The leaf apice is acuminate and the base cuneate with a channeled petiole. The stems are erect and 4-angled. Flowers are borne on terminal verticils, about 10cm in length. The bracts are numerous; oblanceolate in shape, about 10mm in length and each hold 3 purple flowers. The flowers are hermaphrodite in nature, fragrant and with a



zygomorphic symmetry. There are 5 gamosepalous calyx, which are purple in color. The gamopetalous corolla, violet in color and 5 in number, is bilabiate in shape and covered with scattered hairs. The labellum is white, ovate and boat shaped with a fringed margin. There are 4 epipetalous stamens; the upper 2 arising from the base of the corolla tube while the lower 2 arise from the top of the corolla tube. The single style is terete and bilobed. The fruits are nutlets.

Plant habitat

Basil is a cultivated crop in Malaysia and is normally not found in the wild.

Plant growth habit/cultivation

Basil is propagated by seeds, which can be either be sown in the nursery and then transferred to the field or sown directly in the field. The germination rate is high (>80%) and after 6-7 days the leaves can be seen sprouting out.

For nursery sowing, the seedlings are kept in the nursery for at least 30 days before field transfer by which they would have had at least 4-5 leaves. For direct sowing, the seeds are mixed with fine sand and then sown in narrow furrows. A larger quantity of seeds is needed in the later type of propagation and thinning of the seedling is necessary at a later stage. Spacing at 50cm x 100cm is suitable for basil.

This plant can adapt itself to variable

environmental conditions but thrives in full sunlight, high organic fertilizer and well-drained soil. Harvesting of leaves is carried out in the third month that is when the plant has reached a height of 70-80cm or when it starts to bear flowers. Subsequent harvest can be carried out at every 2-3 month interval. During harvest, the crop is cut about 20-25cm above the ground level.

Plant parts used : Leaves, roots, flowers.

Uses in traditional medicine

The roots of basil are used for treating bowel complaints in children. The juice of the leaves is used to cure ringworm infections. The leaves and flowers are considered diuretic and a stimulant for weak digestion. In Malaysia, the juice of the leaves is a common domestic remedy for coughs. It has a slightly narcotic effect, which allays irritation in the throats. The juice is also used as a nasal douche in myosis and for treating irregular menstrual cycles. A decoction of the leaves is taken after childbirth and also used in treating high fever. It is prescribed together with *Centella asiatica* for treating asthma. Flowers are also used to treat coughs in children. The copious jelly obtained by soaking the seeds in water is demulcent, stimulant, diuretic, diaphoretic and used to treat headaches. It is also believed to possess narcotic effects which help to ease itchiness in the throat, to help soothe the stomach and to stimulate bowel movement.

In India, the seeds are mucilaginous and cooling, and are given as an infusion for gonorrhoea, diarrhoea and chronic dysentery. The jelly is used for treating kidney troubles, diarrhoea and intestinal troubles in children while the mucilage is used as a mild tonic. It is also used as an insecticide to keep away bugs and an alternative to adulterate patchouli. The seeds are also given for habitual constipation and internal piles. In Africa, the plant is used for hair care and the juice of the leaves for earache.

Chemical constituents

i) *Chemicals with commercial potential:* Anethole, apigenin, (3-bisabolene, carvone, caryophyllene, esculetin, esculin, myrcene, p-coumaric acid, rutin; essential oil (anethole, cineole, eugenol, linalol,

methyl chavicol, ocimene, pinene, terpene hydrate).

ii) *Other chemicals:* Acetic acid, ascorbic acid, α -amorphene, cis-anethole, trans-anethole, benzylacetate, benzyl alcohol, α -bergamotene, α -bisabolol, borneol, borneol acetate, (3-bourbonene, α -bulnesene, butyric acid, α -, ρ -, 8- and γ -cadinene, 5,10(15)-cadinen-4-ol, P-cadinol, T-cadinol, caffeic acid, caffeic acid-N-butylester, calamene, camphene, camphor, caproic acid, β -carotene, ρ -caryophyllene, caryophyllene oxide, α - and P-cedrene, chavicol, chavicolmethylether, cinnamic acid-methylester, cis-cinnamic acid-methylester, trans-cinnamic acid, trans-cinnamic acid-methylester, 1,8-cineole, citral, citronellol, α -copaene, α - and ρ -cubebene, cyclosativene, β -cymene, ρ -cymene, α -p-dimethylstyrene, P- and γ -elemene, elemol, epibicyclosiquiphellandrene, 1-epi-bicyclosiquiphellandrene, 2-epi- α -cedrene, eriodictyol, eriodictyol-7-O-glucoside, estragole, eugenol, eugenol-methyl ether, farnesol, α -farnesene, (E)-P-farnesene, (Z)- ρ -farnesene, fenchone, α -fenchene, fenchyl acetate, fenchyl alcohol, furfural, D-galacturonic acid, geranial, geraniol, geranyl acetate, germacrene D, α - and 8-guaiene, γ -gurjunene, cis-3-hexenol, humulene, α -humulene, humulene epoxide, hydroxy benzoic acid-4-P-D-glucoside, isocaryophyllene, isoeugenol, isoeugenolmethylether, isoquercitrin, juvocimene-I, juvocimene-II, kaempferol, kaempferol-3-O-P-D-rutinoside, ledene, limonene, cis-limonene, linalyl acetate, luteolin, D-mannuronic acid, menthol, menthone, p-methoxycinnamaldehyde, methylchavicol, methylcinnamate, methylthymol, methyleugenol, mucilage, α - and γ -muurolene, ρ -myrcene, neral, nerol, nerolidiol, nerolidol, niacin, ρ -ocimene, cis-ocimene, trans-ocimene, cis-allo-ocimene, trans-allo-ocimene, octanol, 1-octen-3-ol, 3-octanone, oleanolic acid, orientin, phellandrene, phenylethyl alcohol, α - and ρ -pinene, planteose, propionic acid, quercetin, quercetin-3-O-diglucoside, riboflavin, rosmarinic acid, sabinene, cis-sabinene-hydrate, trans-sabinene-hydrate, safrole, salicylic acid-2-P-D-glucoside, sambulene, α - and (3-santalene, α - and ρ -selinene, sesquithujene, stigmasterol, ρ -sitosterol, succinic acid, syringic

acid-4-P-D-glucoside, syringoyl-glucose, tannin, α - and γ -terpinene, terpinen-4-ol, α -terpineol, terpinolene, α -terpinylacetate, thiamin, α - and p -thujone, thymol, tricyclene, undecylaldehyde, ursolic acid valeric acid, vanillic acid-4-P-D-glucoside, vicenin-2, xanthomicrol, α -bulgarene; amino acids, fatty acids (linoleic acid, linolenic acid, oleic acid, palmitic acid, stearic acid); minerals, phytosterols, sugars (D-arabinose, D-galactose, D-glucose, D-mannose, L-rhamnose, xylose).

Pharmacology

Ocimum basilicum is reported to have carminative, stimulant, diaphoretic and expectorant properties. Its leaves contain compounds that are probably Afunctional inducers which are capable of inducing both phase I enzymes (ie affect the levels of cytochrome P450, aniline hydroxylase and aminopyrine-N-demethylase; and activate the mutagenicities of aflatoxin B1 and benzo[a]pyrene) and phase II enzymes (ie glutathione S-transferase) in rat liver. Essential oils extracted from sweet basil showed antimicrobial activity. The powder of aerial parts and its aqueous and methanolic extracts were shown to have gastric antiulcerogenic effects. Sweet basil is also found to have mosquito larvicidal activity.

Clinical trials : No information available.

Towards commercial production

The uses of basil are vast. In the fresh-market it is cultivated as a culinary herb, as a condiment or spice in the dried form and as a source of aromatic essential oil for the use in foods, flavor and fragrances.

Currently, 2 main types, that is the European and Egyptian basil oil dominate the world market for basil oil. The European sweet basil cultivated in Europe, the Mediterranean region and the United States is considered to be of the highest quality and produces the finest odor. Characteristically, this oil contains a higher concentration of linalol and methyl chavicol at the ratio 2 or 3:1. The pricing of the oil also varies according to the quality of the oil. Basil oil from Hungary is marketed at US\$12.00 per 10ml (1998) while that from India is priced at US\$6.50 per 10ml (1998). The dried powdered leaves of sweet basil cost US\$6.20 per halfpound (1998).

Locally, basil is grown for its flavor and thus used as a spice. As an herbal remedy, its closely related species *Ocimum sanctum* is more popular but there are still a handful of products both in the local and global market that uses basil especially in the cough and cold herbal remedies.

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Ocimum sanctum

Scientific name : *Ocimum sanctum* Linn
Common name : Holy basil / Sacred basil
Local name : Kemangi
Family : Lamiaceae /Labiatae

Potential crop rating : * * * *

Introduction

In India and among the Malaysian Indians this plant is treated with utmost respect as it is considered the most sacred plant of the Hindus. All parts of the plants are used; even the roots have been used to relieve pain from scorpion bites. This plant is traditionally believed to be a powerful aid to the immune system and eating two to a few leaves a day is said to keep the body healthy and fit. It is also rich in essential oils, which have shown to exhibit antibacterial and antifungal activities. Kemangi is also believed to be a good source of dietary fiber.

Plant description

Kemangi is a very aromatic, heavily branched herbaceous shrub with quadrangle hairy erect branches. There are 2 common varieties of kemangi, namely, kemangi hitam and kemangi hijau. The leaf types of both these kemangis are aromatic, simple and arranged in an opposite decussate manner. The leaf color is dark green for kemangi hitam and green for kemangi hijau. For both these varieties, the leafblade is ovate and its margin serrate with an acute apice and acute to cuneate base. The petiole is channeled. Flowers are borne on terminal verticils which grow to an average length of about 7cm. The bracts are caudiform in shape, numerous in number and each bract holds three flowers. In kemangi hitam, the bract color is purplish green while in kemangi hijau



it is green. The flowers are hermaphrodite, 5-7mm in length, fragrant and with a zygomorphic symmetry. There are 5 gamosepalous calyx, green (kemangi hijau) to greenish purple (kemangi hitam) in color. The corolla, 5 in number, is bilabiate in shape, purple (kemangi hitam) to white (kemangi hijau) in color. The corolla, which is gamopetalous, is covered with scattered hairs. The labellum is ovate with a fringed margin. There are 4 stamens, which are epipetalous and are inserted midway down corolla tube. The single style is terete and bilobed. The fruits are nutlets.

Plant habitat

This plant can be seen growing wildly along roadsides and in wastelands. However, it is commonly cultivated in backyard gardens especially in Indian houses.

Plant growth habit/cultivation

Kemangi is normally propagated by seeds. They can be either sown directly in the field or sown in the nursery and when established they are then transferred to the field. The germination rate is high (>80%) and after 6-7 days the leaves can be seen sprouting out.

For nursery sowing, seedling is kept in the nursery for at least 30 days before transferring to the field. To obtain a higher success rate of field establishment, the seedlings should have at least 6-8 leaves when transferred to the field. For direct

sowing, the seeds are mixed with fine sand and then sown in narrow furrows. A larger quantity of seeds is needed in this type of propagation and thinning of the seedling is necessary at a later stage. A planting distance of 50cm x 100cm is considered suitable for kemangi.

This plant can adapt to variable conditions but thrives in partial shade to full light, high organic fertilizer and well-drained soil. Harvesting of leaves is carried out in the third month that is when the plant has reached a height of 70-80cm or when it starts flowering. The subsequent harvest is carried out at every 2-3 month interval. During harvest, the plant is cut about 20-25cm above the ground level.

Plant parts used : Leaves, seeds and roots.

Uses in traditional medicine

A decoction of kemangi leaves and roots is a specific remedy for gonorrhoea and acts as a diaphoretic for malarial fevers. It is a good remedy for coughs, anorexia, chronic dyspepsia, flatulence, colic, acute and chronic bronchitis. It is also a cardiac stimulant and used to treat gangrene of the lungs and phthisis. In Malaysia, the leaves are consumed as a condiment to flavor dishes. An infusion of the leaves is used for gastric disorders while a decoction of the roots is taken orally to treat fevers. The juice of the leaves is given as a laxative and used externally as an embrocation for rheumatism. The flowers are given with honey for bronchitis. Seeds are mucilaginous and demulcent and given for disorders of the urino-genital system. The bruised fresh leaves and roots are applied to stings of bees, wasps and bites of mosquitoes and leeches. Internally, kemangi acts as an aromatic, stomachic and carminative herb. It can also stimulate appetite and improve digestion.

In Java, it is believed to improve the secretion of milk. The seeds are mucilaginous and demulcent, and are used like the seeds of *O. basilicum*. In Ceylon, a decoction of the dried plant is a domestic remedy for croup, catarrh, bronchitis and diarrhea. An infusion of the leaves is given to children for gastric disorders and to adults for hepatic affections. The fresh juice is used as a remedy for earache and used internally to check

vomiting and to destroy intestinal worms.

Chemical constituents

i) *Chemicals with commercial potential:* Carvacrol, ursolic acid; essential oil (cineol, eugenol, linalol, nerol, thymol).

ii) *Other chemicals:* Antistaphylocoagulase, ascorbic acid, camphene, P-carotene, caryophyllene, eugenol-methylether, hexouronic acid, methyl-chavicol, methyl homoanisic acid, mucilage, P-pinene, P-sitosterol, tannin, terpineol, xylose; aldehydes, alkaloids, fatty acids (linoleic, linolenic, oleic, palmitic and stearic acids), glycosides, minerals, pentoses, phenols, saponins.

Pharmacology

Ocimum sanctum leaf extract is found to have antithyroidic, antimycotic, antioxidative and antistressor properties. It is also shown to possess significant free radical scavenging activity *in vitro* and against human pathogenic Gram positive and Gram negative bacteria. Kemangi lowered restraint stress-induced cholesterol levels in rats and its extract was found to have antiulcerogenic property. Extracts of kemangi also inhibit the induction of skin papillomas in mice by 7,12-dimethylbenz[a]anthracene (DMBA).

An aqueous extract of kemangi leaves was found to protect mice against radiation lethality with no toxic effects. The water extract was more effective in radioprotection and less toxic than that of aqueous ethanol extract. Leaf extract of kemangi blocks or suppresses chemical carcinogenesis.

Oral treatment of the leaf extract at 400 and 800mg/kg body weight for 15 days significantly elevated the activities of cytochrome p-450, cytochrome b5, aryl hydrocarbon hydroxylase, and glutathione S-transferase; all of which are important in the detoxification of carcinogens as well as mutagens.

A significant reduction in the values of tumor incidence was observed in mice treated topically with the kemangi leaf extract at either the peri-initiation, post-initiation stages or continuously at peri- and post-initiation stages of papillomagenesis as compared to the corresponding control group.

An ethanol extract of the kemangi leaves was found to prolong the time of lost reflex in mice due to pentobarbital, decreased the recovery time and severity of electroshock- and pentylenetetrazole-induced convulsions, and decreased apomorphine-induced fighting time and ambulation in "open field" studies. Oral administration of alcoholic extract of the leaves led to marked lowering of blood sugar level in normal, glucose fed hyperglycemic and streptozotocin induced diabetic rats.

Oral premedication with the methanol extract and the aqueous suspension of kemangi leaves delayed castor oil-induced diarrhea in rats. Both methanol extract and aqueous suspension of leaves are shown to have immunostimulant activity in albino rats. Ursolic acid isolated from kemangi is active against lipid peroxidation in rat liver and heart microsomes *in vitro*.

Kemangi consumption significantly decreased the incidence of both B[a]P-induced neoplasia and 3'methyl-4-dimethylaminoazobenzene (3'MeDAB)-induced hepatomas. A high dose (eg 200mg/kg and 400mg/kg) of leaf extract was reported to affect the sexual behavioral score of adult male rats.

Kemangi leaf powder fed at the 1 % level in normal and diabetic rats for a period of one month produces a significant reduction in fasting blood sugar, uronic acid, total amino acids, total cholesterol, triglyceride, phospholipids and total lipids. Fresh leaves mixed as 1g and 2g in 100gms of diet given for four weeks resulted in significant lowering in serum total cholesterol, triglyceride,

phospholipid and LDL-cholesterol levels and significant increase in the HDL-cholesterol and total faecal sterol contents in normal albino rabbits.

The fixed oil of kemangi was found to possess significant antiinflammatory activity against carrageenan- and different other mediator-induced paw edema in rats. Linolenic acid present in the fixed oil was shown to have significant antiinflammatory activity against PGE₂, leukotriene and arachidonic acid-induced paw edema.

Clinical trials

A randomized, placebo-controlled, crossover single blind trial in humans showed a significant decrease in fasting and postprandial blood glucose levels during treatment with kemangi leaves as compared to during treatment with placebo leaves. Kemangi leaves is reported to be potentially prescribed as adjunct to dietary therapy and drug treatment in mild to moderate noninsulin-dependent diabetes mellitus.

Towards commercial production

Kemangi is traditionally very rich in medicinal properties and is a very popular herb in India. Due to its vast usage in treating many ailments ranging from diarrhea to skin diseases to bronchitis, a number of variable herbal and health products has been commercialized and produced. Kemangi has been used in shampoos, herbal baths, soaps and as a cough and cold syrup. It is also used in health foods and as a tonic. Kemangi extract is priced at US\$5.50 per oz (1998) in the international market.

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Orthosiphon stamineus

Scientific name : *Orthosiphon stamineus*, Benth
Synonym : *Ocimum aristatum* Bl.,
Orthosiphon aristatus (Blume)
Miq.
Common name : Java tea
Local name : Misai kucing, Kumis kucing
Family : Lamiaceae

Potential crop rating : * * * *



Introduction

This medicinal herb has been used for many centuries in Southeast Asian countries like Indonesia and Malaysia. It is appreciated for treating ailments of the bladder and kidney. Misai kucing began to interest researchers as early as the beginning of the 20th century when this plant was introduced to Europe where it became a popular herbal tea. In Malaysia, it is also appreciated for its elegant unique flowers and is commonly seen growing in many home gardens.

Plant description

Misai Kucing is a herbaceous shrub, which grows to a height of 1.5m. The leaves are arranged in opposite pairs. They are simple, green, and glabrous with a lanceolate leaf blade and a serrate margin. The leaf apice is acuminate with an acute leaf base. The petiole is relatively short, about 0.3cm in length and reddish purple in color. The stem is quadrangle, reddish in color, erect and branches profusely. The flowers are borne on verticils about 16cm in length. The terminal inflorescence is borne on a maroon pubescent peduncle. Bracts are green, minute (1-2mm), caudiform in shape and two bracts normally holds a cluster of 5 flowers. The flowers are campanulate in shape, white to bluish in color with long far-exserted filaments, making the flowers look like cat's whispers. The flowers are hermaphrodite in nature, about 6.2cm in length (including the

stamens) with a very irregular flower symmetry. There are two calyx lobes, which are greenish red in color, measuring about 6mm in length and partially gamosepalous. One of the calyx margin is toothed and the other one entire, both covered with minute white hairs. There are two corolla lobes, which are partially gamopetalous and covered with minute hairs. The corollas are light violet in color with lobes much shorter than the corolla tube. The corollas are bilabiate in shape with fringed margins. The labellum is light violet in color, hairy and pinkish on the under surface. There are 4 stamens, which are inserted near the base of the corolla tube. The stamens are unequal in length, measuring from 4.7cm to 5.2cm. There is a single, central, terete style with a clavate stigma.

Plant habitat

Misai kucing has been cultivated for a long time and is a popular garden plant. In the wild, it can be seen growing along the forest edges, roadsides and wastelands.

Plant growth habit/cultivation

Misai kucing is easily propagated through 3 or 4 noded stem cuttings. These stem cuttings are obtained from a mother plant of more than 5 months of age. Ideally, the middle portion of the stem is chosen to obtain a higher rate of success in propagation. It is best to avoid choosing shoot

tip cuttings. These stem cuttings are propagated in the nursery and then transferred to the field after a period of one month. Misai kucing thrives in well-drained soils in full sunlight. In just about 3-4 months after field transfer the leaves/branches of the plant are ready for harvest. This plant branches more profusely and generally does better with regular applications of organic fertilizers such as chicken dung. Misai kucing is not significantly susceptible to diseases but it is quite prone to insect attacks.

Plant parts used : Leaves.

Uses in traditional medicine

The plant is believed to have antiallergic, antihypertensive, antiinflammatory and diuretic properties. It is used as a remedy for arteriosclerosis (capillary and circulatory disorders), kidney stones and nephritis. It is also used for treating gout, diabetes and rheumatism. In Malaysia, the leaves are used as a diuretic and for treating catarrh of the bladder. A decoction prepared from the plant is used to eliminate stones in the bladder.

Chemical constituents

i) *Chemicals with commercial potential.* No information available.

ii) *Other chemicals:* a- and p-carotene,

cirsimaritin, cryptoxanthin, 5-hydroxy-6,7,3,4-tetramethoxyflavone, inositol, myo-inositol, orthosiphon, pillion, rhamnasin, salvigenin, 4,5,6,7-tetramethoxyflavone, isosinensetin, p-zeacarotene; carotenoids, essential oils, flavonoids, glucosides, glycoproteins, minerals, phenylpropanoids, saponins, terpenoids.

Pharmacology

Orthosiphon stamineus is reported to possess antifungal, antiinflammatory activities. It also exhibits considerable antibacterial activity (minimal inhibitory concentration = 7.8-23.4mg/ml). Alcoholic and water extracts of misai kucing are shown to have a significant diuretic activity in rats.

Clinical trials

Clinical studies show that the diuretic effect of misai kucing has no influence on 12 and 24 hours urine output or on the sodium excretion.

Towards commercial production

Currently, misai kucing is categorized as one of the most potential herbs to be commercialized in Malaysia. This is mainly due to its easiness to cultivate and its validated health benefits especially in treating ailments associated with kidney and the urinary system. A few products of misai kucing has entered the local market, the more popular one being Misai Kucing Plus.

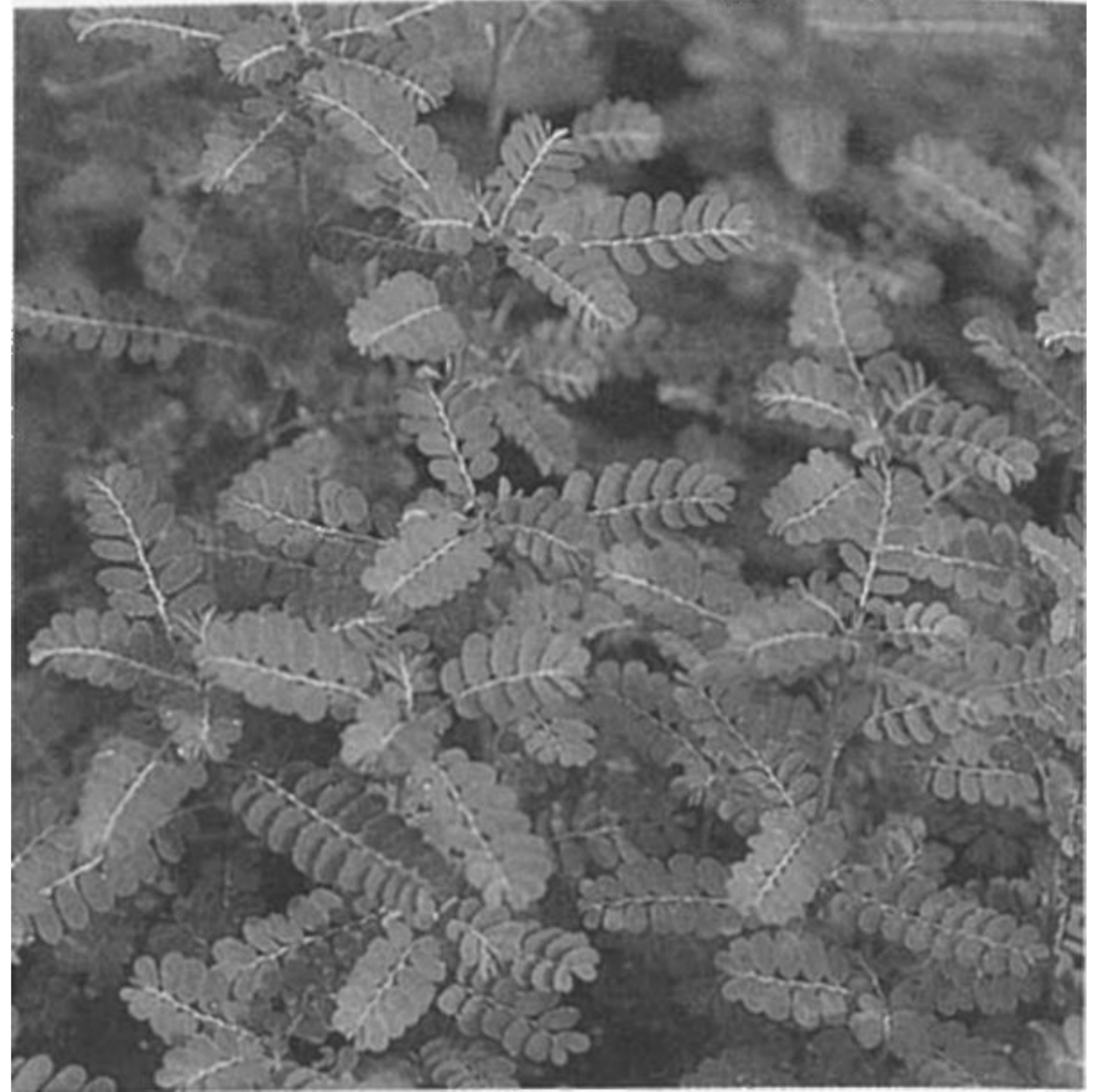
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Phyllanthus niruri

Scientific name : *Phyllanthus niruri* Linn.
Common name : Seed on the leaf/pick-a-back
Local name : Dukung anak
Family : Euphorbiaceae

Potential crop rating : ☆ ☆ ☆ ☆ ☆



Introduction

This plant is indigenous to tropical regions of the world, including the Amazon. It is named the "stone breaker" by the Amazon people and has been used for generations by the indigenous people as an effective remedy to eliminate gallstone and kidney stones.

Dukung anak has gained world attention in the late 1980's due to the plants antiviral activity against Hepatitis B and was found to contain the same beneficial phytochemical as in green tea, which helps to protect cells from stress and pollutants in the environment.

Plant description

Dukung anak is a small erect annual herb growing up to a height of 50-70cm. Their branches spreading and close set with bipinnate compound leaves. The leaflets are green, entire and alternately arranged with an elliptical blade, measuring about 6-10mm. The leaflet stalk is absent while the compound leaf petiole is present and is green in color. The stem is glabrous, green and erect.

The flowers are borne solitary on the underside of the leaves. The bracts are triangular in shape, scaly with each bract holding one flower. There are 2 types of flowers; the male and the female, both of which are very minute, measuring only 1mm in length. There are 5 corolla lobes, which are polypetalous, glabrous and cream-green in color. There is a single style and a laminar shaped

stamen, which is inserted near the base of the corolla tube. The fruit is small, rounded, glabrous and green in color.

Plant habitat

This plant grows and reproduces very easily and is therefore considered as a ferocious weed. They are found growing wildly in gardens, on disturbed soils such as by the roadsides, in fields and in wastelands.

Plant growth habit/cultivation

Dukung anak plants are propagated by seeds. The seeds can be collected from matured plants that are about 2-3 months of age. Normally, a lot of seedlings can be seen growing around mother plants which can act as a good source of planting material.

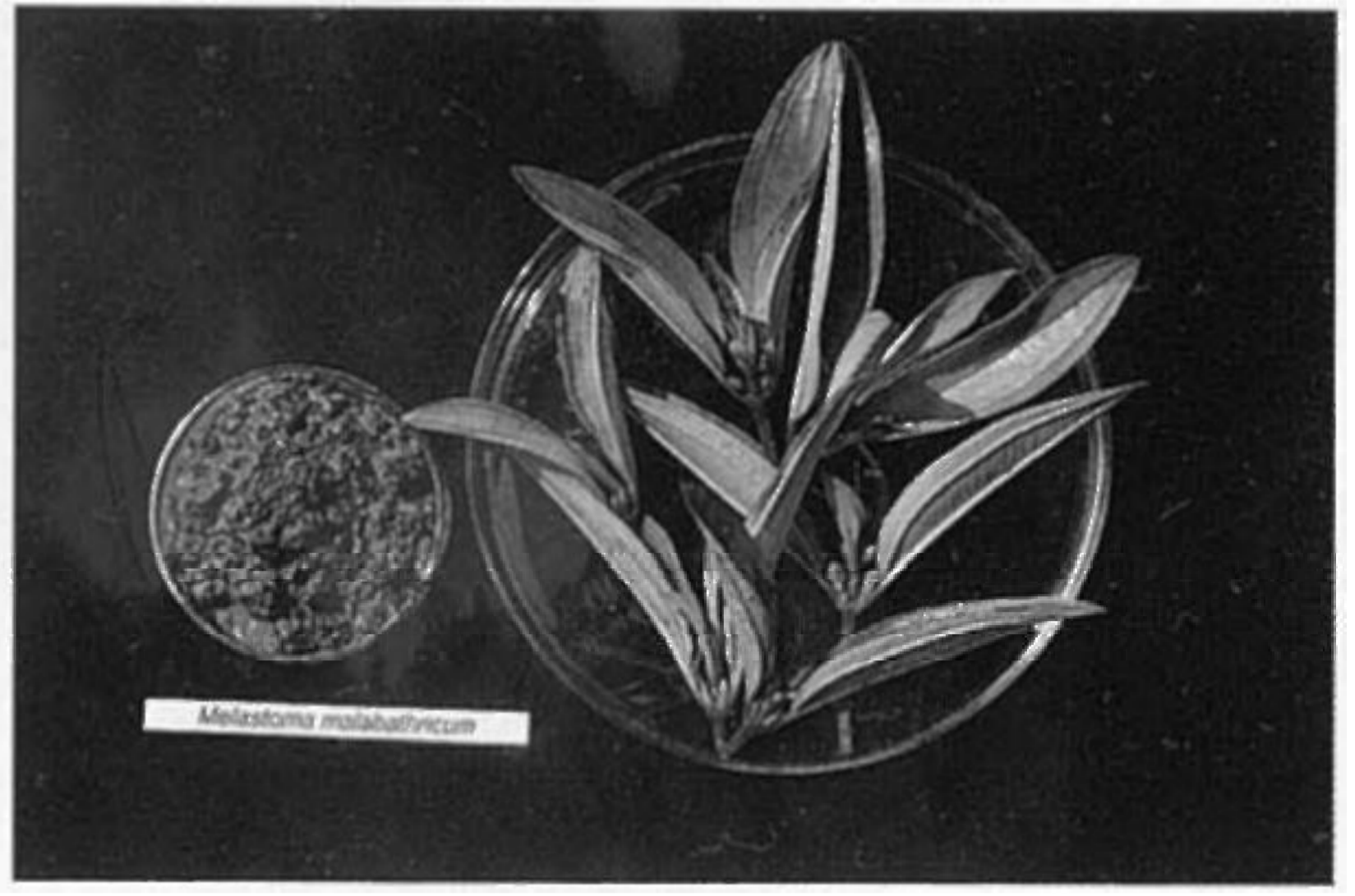
Although this plant can adapt itself to variable environmental conditions, they do extremely well in light shade with sandy loam soils that have high soil moisture content and a good drainage system. This plant needs minimal care, as it is considered as a ferocious weed. The plants can be harvested after 2-3 months that is when the plant reaches a height of about 50cm. So far, there is no documented pest and disease problem as this plant is normally collected from the wild and has never been cultivated in Malaysia.

Plant part used : Aerial part, whole herb.

Melastoma malabathricum



Melastoma malabathricum : plants



Melastoma malabathricum :
poultice & leaves



Melastoma malabathricum : flowers

Mentha arvensis



Mentha arvensis : plants



Mentha arvensis : inflorescences



Mentha arvensis : poultrice & leaves

Morinda citrifolia



Morinda citrifolia : tree



Morinda citrifolia : flowers & fruit

Moringaoleifera



Moringa oleifera : tree



Moringa oleifera : flowers



Moringa oleifera : fruits

Ocimum basilicum



Ocimum basilicum : (Selasih/Ruku)

Ocimum basilicum : (Selasih hitam)



Ocimum basilicum : powdered leaves

Ocimum sanctum



Ocimum sanctum : plants



Ocimum sanctum : dried leaves



Ocimum sanctum : (Kemangi hitam)



Ocimum sanctum : (Kemangi hijau)

Orthosiphon stamineus



Orthosiphon stamineus : plants

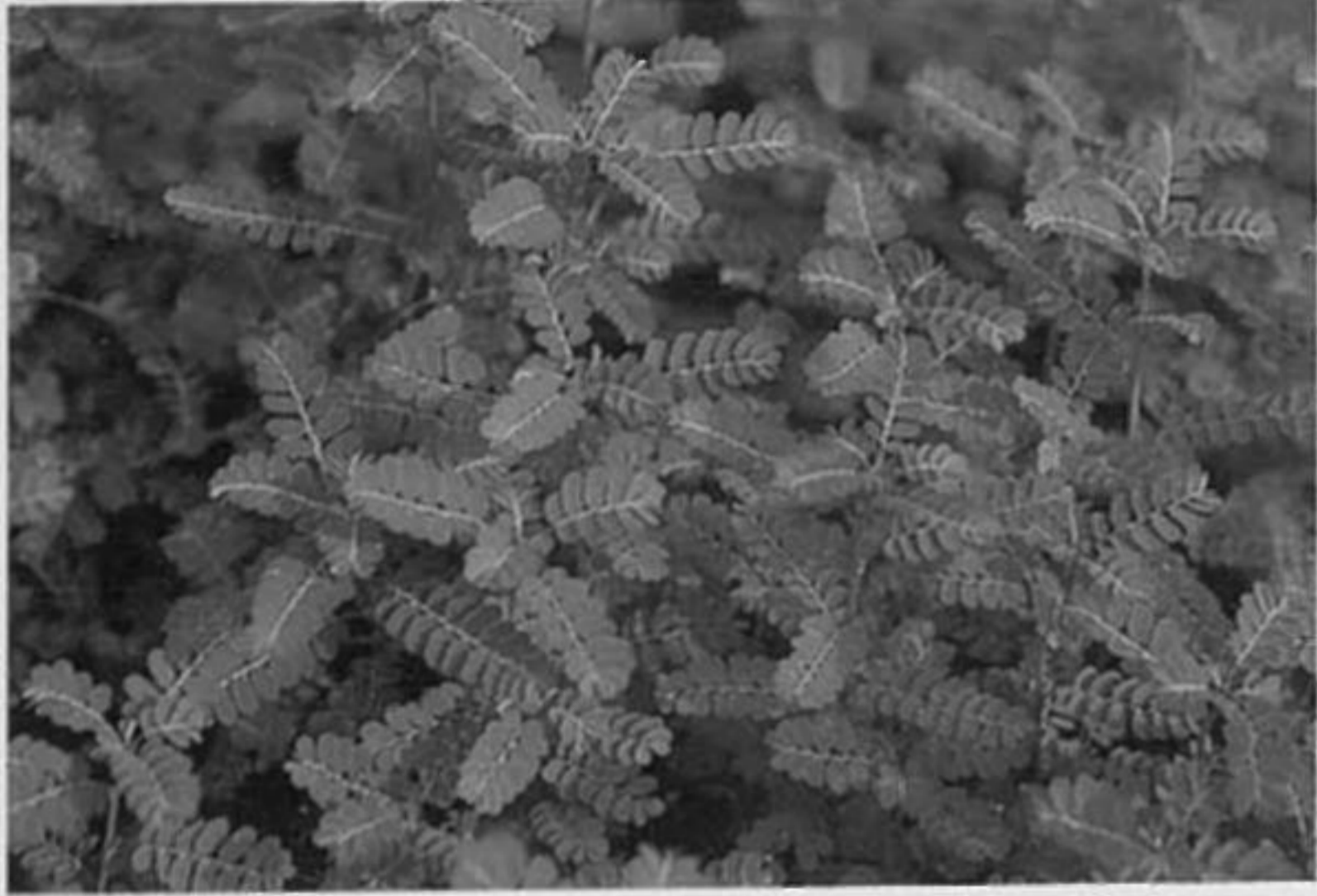


Orthosiphon stamineus :
fresh & dried leaves, decoction

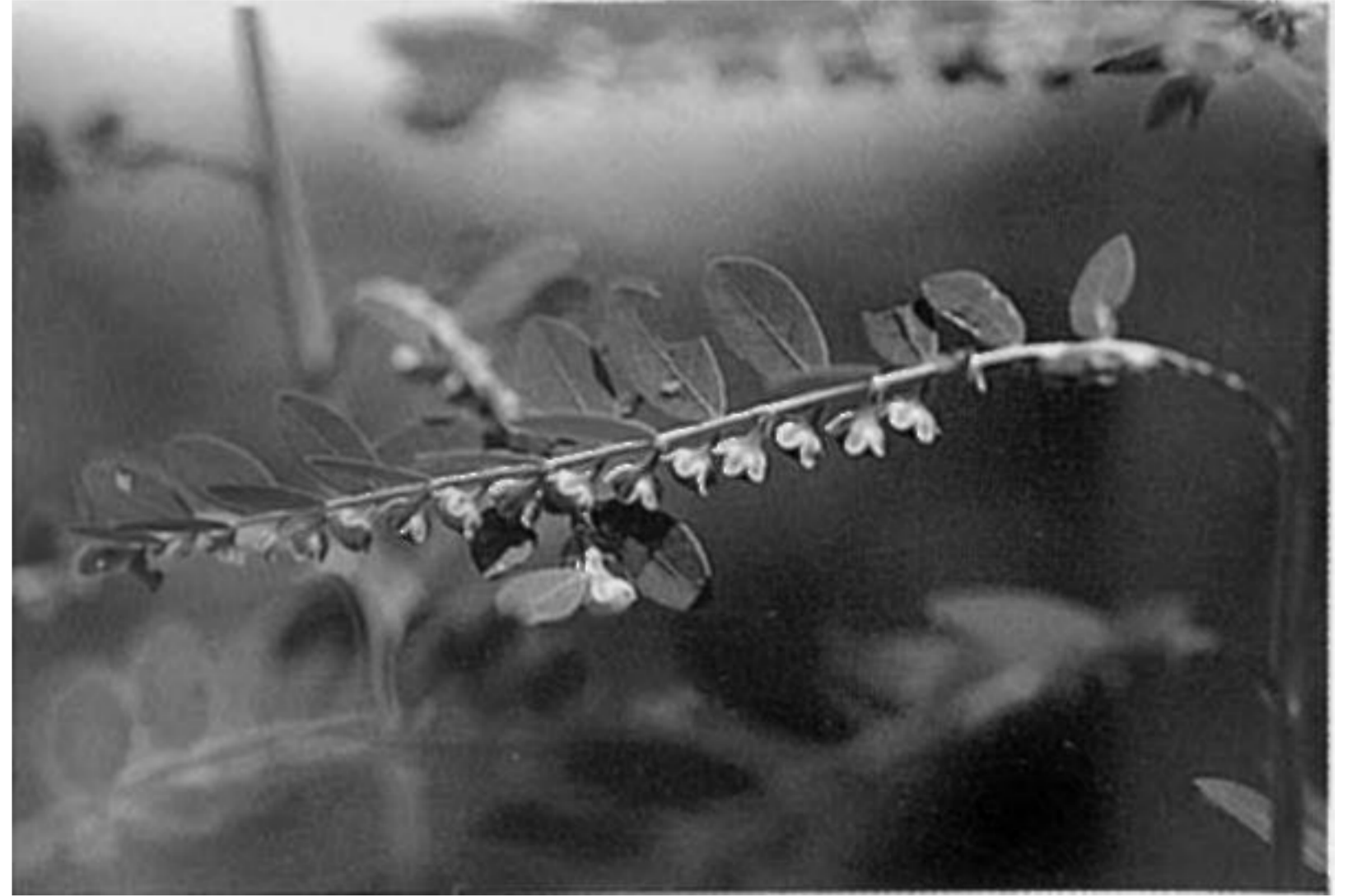


Orthosiphon stamineus : inflorescence

Phyllanthus niruri



Phyllanthus niruri: plants



Phyllanthus niruri: inflorescence



Phyllanthus niruri: plant, decoction & pultice

Uses in traditional medicine

The plant is traditionally believed to have antidiarrhetic, purgative, antihepatotoxic, antihypertensive and diuretic properties. It is used for treating jaundice, dropsy and genito-urinary infectious, emmenagogue, febrifuge, stomachic and swelling. Poultice of leaves is used for treating cuts, bruises, ulcers and sores. In Malaysia, it is used as an emmenagogue, diuretic, as a tonic and used after a miscarriage or childbirth. It is also used for treating diarrhea, kidney trouble, gonorrhoea, syphilis. Juice or extract prepared from the roots and young leaves is taken for strengthening the kidneys. Young leaves are used for treating coughs, especially in children. The pounded leaves and stems are used as poultices for skin complaints including caterpillar itch.

In India, it is used for treating jaundice, dysentery, dropsy, gonorrhoea, menorrhagia, sores and mild fever. In Ceylon, the expressed juice of the plant is given as a diuretic and for treating gonorrhoea whilst the whole plant ground to a paste is given with cow's milk for jaundice. It is also used to lower hypertension and to purify the blood. The extract is effective in healing wounds and scurf. In Indonesia, it is used for treating stomachache, gonorrhoea and children's coughs. The leaves are used as a diuretic in the Philippines islands.

Chemical constituents

i) *Chemicals with commercial potential*: Geraniin, niruriside, phyllanthin, repandusinic, rutin.

ii) *Other chemicals*: Allosecurinine, α -amyrin, astragalin, brevifolin carboxylic acid, calcium oxalate, cymene, dibenzylbutyrolactone, dihydrosecurinine, ellagic acid, ent-norsecurinine, ethyl brevifolin, (2Z,6Z,10Z,14E,18E)-farnesylfarnesol, hydroxysecurinine, hypophyllanthine, isolintetralin, 24-isopropylcholesterol, isoquercitrin, limonene, lintetralin, LUPA-20(29)-ene-3-(3-ol), LUPA-20(29)-ene-3-p-ol acetate, lupeol, 4-methoxydihydronorsecurinine, 4-methoxynorsecurinine, 4-methoxysecurinine, 4-methoxytetrahydrosecurinine, methylsalicylate, niranthin, nirphyllin, nirtetralin, nirurin, nirurinetin, phyllanthusiin D, phyllester,

phyllnirurin, phyllochrysin, phyltetralin, quercetin, quercetin 3-O-p-D-glucopyranosyl- α -L-rhamnopyranoside, quercetin heteroside, quercetol, quercetrin, seco-lignan, securinine, securinol A and B, p-sitosterol, tetrahydrosecurinine, 3,5,7,4'-tetrahydroxyflavone, 3,5,7-trihydroxyflavonal-4'-O- α -L-(-)-rhamnopyranoside, triacontanal, tricontanol, 5,3',4'-trihydroxyflavone-7-O- α -L-(-)-rhamnopyranoside, trans-phytol, vitamin C; alkaloids, fatty acids (linoleic acid, linolenic acid), lignans, phenolics, ricinoleic acids, saponins.

Pharmacology

Phyllanthus niruri is reported to possess antitumor, antiviral and HIV-1-RT inhibiting properties. An aqueous extract of it inhibited human immunodeficiency virus type-1 reverse transcriptase (HIV-1-RT). The active compound was identified to be repandusinic acid A monosodium salt which inhibited up to 90% of HIV-1 specific p24 antigen production in a Clone H9 cell system at concentration 2.5mM. The extract also inhibits woodchuck hepatitis virus DNA polymerase and binds to the surface antigen of WHV (woodchuck hepatitis virus) *in vitro*. In animals recently infected with woodchuck hepatitis virus, the extract was effective when administered i.p. in reducing and eliminating both the surface antigen titer and DNA polymerase activity in serum within 3-6 weeks. Aqueous extract of dukung anak is reported to be nontoxic to mice.

The methanol extract of dukung anak is found to contain a new HIV REV/RRE binding inhibitor known as niruriside. The methanolic extract of callus culture of dukung anak caused graded inhibition of abdominal constrictions induced by acetic acid (0.6%), with ID₅₀ (ie dose that reduced response of control by 50%) value of about 19 mg/kg in mice. Ellagic acid, isolated from the ethanol extract was shown to be an active inhibitor of aldose reductase.

Dukung anak is reported to contain an angiotensin-converting enzyme inhibitor known as geraniin. Phyllanthin and hypophyllanthin, isolated from a hexane extract of dukung anak showed protection against carbon tetrachloride- and galactosamine-induced cytotoxicity in primary

cultured rat hepatocytes, while triacontanal was protective only against galactosamine-induced toxicity.

Clinical trials

Clinical observations revealed that dukung anak is a potential diuretic, hypotensive and hypoglycaemic drug for humans and with no harmful side effects.

Towards commercial production

In Malaysia, the use of dukung anak is only

confined to the traditional healers and the midwives. There is no commercial product of this plant in the local market. However, in countries such as South America and India, the potentials of this plant was long recognized and tapped. Some of the commercial products in the market include extracts of the plant. One such product is Chanca piedra, which is used as a tonic, to ease digestion and cause rapid assimilation. Chanca piedra extract is priced at about US\$30.00 per 100 grams (1998). Another product is Ayulite, which is used for toning up and improving liver functions.

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Piper betle

Scientific name : *Piper betle* Linn.
Common name : Betelvine, piper betel
Local name : Sireh
Family : Piperaceae

Potential crop rating : ☆ ☆ ☆



Introduction

Sireh or betelvine is an important commercial crop grown in countries such as India, Bangladesh and Sri Lanka where it is popularly used in the 'betel chew'. All parts of the plants are used in traditional Auryedic and Yunani medicine. Their medicinal use range from treatments of ulcers, respiratory ailment to afterbirth tonics. In Malaysia, they are popularly used fresh by the Indian communities in 'betel chew' and grown in home gardens.

Plant description

Sireh is a climbing herb with semi-woody twirling stems that has short stout adventitious rootlets arising from its nodes. The leaves are relatively large, growing to a size of 18cm length x 12cm wide. The leaves are aromatic, arranged alternately and green in color. Their margins are entire and slightly undulating. The blades are glabrous, cordiform in shape and with an acuminate apice and cordate base. The petioles are slightly swollen at the base, measuring about 2-2.5cm in length.

Flowers are borne on cylindrical spikes. The female and male flowers are borne on separate spikes. The female spikes are pendulous, cylindrical and measures about 2.5-5cm in length. The fruit is immersed in the fleshy spike which is about 5cm in length and pendulous in shape.

Plant habitat

Sireh is a cultivated plant and usually planted in

villages. It is also seen growing wildly in abandoned clearings and as forest undergrowths.

Plant growth habit/cultivation

Sireh is normally grown from cuttings. Cuttings should be made from the tops of matured vines. The cuttings should measure about 30-50cm in length and have at least 2-3 nodes. Cuttings can either be planted directly in the field or preferably first established in the nursery. The cuttings are planted on nursery beds that are shaded and irrigated regularly. Temporary stakes can be placed near the cuttings to which it is tied.

When the cuttings are about 2 months old they can be transferred to the field and the temporary stakes removed and replaced with either stout hardwood poles or small supporting trees. The planting distance is normally kept at 0.5m x 1m apart. After the second month, the apical part of the cutting is removed to enhance side-branching. Sireh does extremely well in rich organic and moist soils.

Sireh leaves are harvested when the plant is about 3-4 months old. Subsequent harvesting of leaves can be carried out every 10 days. Liberal manuring is carried out during the period of harvest; NPK green fertilizer with chicken or cow dung is applied at monthly intervals. The longevity of the plant can extend to above 10 years.

Plant parts used : Mainly leaves, some roots.

Uses in traditional medicine

The leaves of sireh are described as having carminative, stimulant, corrective, prophylactic (eg treatment of dysentery, fever and certain gastric disorders), stomachic, expectorant, tonic, astringent properties. The leaf extract are gargled to treat mouth odor caused by dental caries, to clean ulcers, against itching, to treat boils, menstrual disorders, hemorrhoids, odorous transpiration, hoarseness and dry cough.

In Malaysia, the leaves are eaten as a stimulant. Juice prepared from the leaves is used externally and used for treating gonorrhoea. Lotions and pastes prepared from young leaves are used to treat ulcers and wounds. Heated leaves are placed on the chest to relieve cough and asthma and to the breast to arrest the secretion of milk. The leaves are also used to relieve constipation in children. Leaves are used for poulticing ulcerated noses and applied to the body after childbirth. The juice of leaves is dropped into ears for wounds; an infusion into the eyes, and a decoction used as a lotion after childbirth.

In India, the sireh juice is used for treating diseases of the mucous membrane of the mouth, nose and lining of the stomach. The mixture made from the stalks of leaves is used to treat edema. In Indonesia, the leaves are included in numerous native medicine. The fresh betel leaves are used extensively as a masticatory. They are stimulant, antiseptic, sialogue, carminative, astringent and aphrodisiac. The bruised leaves are applied as an antiseptic on cuts and wounds, and as poultice on boils. The juice of the leaves is a stomachic and a febrifuge. It is given to children for cough and administered into the eye for night blindness in adults.

It is applied on the breast for checking secretion of milk. Its roots with black pepper are given to women to bring about sterility. In Cambodia, the pounded leaves are used for preparation of lotions and baths for patients suffering from protracted fever, small pox, enlarged glands and lymphangitis.

In the Philippines, the leaves are given for gastric and lung disorders for children. In East Africa, the leaves are applied to purulent ulcers whilst the juice of the leaves is given for catarrh and diphtheria.

Chemical constituent

i) *Chemical with commercial potential*: Arecoline, carvacrol, caryophyllene, piperol, piperbetol; essential oil.

ii) *Other chemicals*: Ascorbic acid, 4-allyl-pyrocatechol, allyl-catechol, arecaidine, p-carotene, cadinene, chavicol, cineole, p-cymene, diastase, estragole, eugenol, eugenol-methylether, ginkgolide B, havibetol, hydroxychavicol, methylpiperbetol, niacin, oxalic acid, piperol A and B, pyrocatechin, riboflavin, safrole, B-sitosterol, tannin, terpenene, thiamin; amino acids, minerals, sugars.

Pharmacology

Piperbetol, methylpiperbetol, piperol A and piperol B, isolated from *Piper betel*, are effective platelet activating factor (PAF) *in vitro*. Sireh leaves do not influence bile secretion and composition but they have a significant stimulatory influence on pancreatic lipase activity. Intravenous injections of water extracts of their inflorescence with eugenol and safrole resulted in hypotensive and bradycardiac effects, whereas intraarterial and intrathecal injections of similar compounds resulted in hypotensive and tachycardiac effects. Acute administration of sireh extracts by different routes may activate C-fiber-evoked parasympathetic and sympathetic cardiovascular reflexes in rats.

Chronic administration of the extract of the stalk of sireh produced a significant decrease in oestrogen and androgen along with increase in cholesterol in adrenal, ovary and testis. This treatment resulted in antifertility in both sexes of albino rats. Aqueous extract of the leaves inhibited the emergence of tumors but not the body weight gain in rats. Chloroform, ethanol and water extracts of the sireh leaves and fruits exhibited antimycotic activity.

Clinical trials : No information available.

Towards commercial production

The main commercial producers of sireh are India and Ceylon where other than sold in fresh form or processed, it is grown mainly for the extraction of its essential oil. The essential oil of this crop is

marketed for its antiseptic property and in aiding respiratory and digestive problems. In Malaysia, the production of sireh is still confined to smallholders and sold in Indian retail stalls and

wet markets for fresh consumption. Among the traditional healers, sireh is used to produce products like lotions for wounds and also in manufacturing deodorants.

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Plantago major

Scientific name : *Plantago major* Linn.
Common name : Great plantain/Common plantain
Local name : Ekor anjing
Family : Plantaginaceae

Potential crop rating : ☆ ☆ ☆



Introduction

Ekor anjing is one of the most widely touted medicinal plants in the world. Every part of this plant has been used since remote time by the Greeks, Romans, Arabs and the Chinese. Its usage as a traditional herbal remedy is widespread covering semi-temperate and tropical countries like the Philippines, Malaysia, South Africa and Indochina. The indigenous use of this plant mainly targets the respiratory and the cleansing system of the body. The organs targeted are the kidney, bladder, liver and the lungs.

Plant description

Ekor anjing is an annual herb with an erect, stout rootstock. The leaves are rosettelly arranged and clustered at the base, measuring about 11cm in length. The leaves are simple, green, the blades elliptical in shape and the margins are shallowly crenate and undulating. The leaf apice is acute while the base is cuneate and sheathing. The petioles are long, about 7-8cm in length, channeled, pericladial and glabrous. The petioles arise directly from the rootstock, that is the plant is without a stem. Tiny flowers are borne on long slender, cylindrical green-brown spikes which can grow up to 9cm in height. The flowers are hermaphrodites, measuring about 1.1cm in length. The calyx is polysepalous, 4 in number and is cream-white (with green stipes). The corolla is white with its lobe much shorter than the tube and

actinomorphic in symmetry. The stamens are antisealous, 4 in number and inserted near the base of the corolla tube. The single style is cylindrical, terete and covered with minute hairs.

Plant habitat

Ekor anjing is normally cultivated in home gardens of the Malaysian Chinese. They can also be seen growing wildly in the highlands of Malaysia.

Plant growth habit/cultivation

Ekor anjing is propagated through seeds. The rate of seed germination is high and after 10 days the first leaf can be seen sprouting out. The seedlings have high vigor and are transplanted to the field after a period of 30-40 days. This plants favors well-drained and moderately fertile soil and thrives in full sunlight. It grows well in the highlands of Malaysia. In the lowlands, the growth is relatively slower. Harvesting of the leaves can be done after 6-8 months or when the leaves reach a size of 10-15cm in length and 5-7cm in width.

Ekor anjing attracts caterpillars and butterflies as it is an important source of food supply.

Plant parts used : Leaves, seeds.

Uses in traditional medicine

The plant is used as a diuretic, astringent, antihepatotoxic, antihypertensive, emmenagogue, febrifuge, stomachic, antidysenteric, purgative, for

treating jaundice, dropsy, genito-urinary infections, cuts, bruises, ulcers, sores and swellings.

In Malaysia, a decoction of the boiled leaves is used for dysentery and gonorrhoea while that of roots is used as a cough mixture. Juice from heated leaves mixed with onion juice and with *Alyxia* is used to cleanse an infant's mouth infected with thrush. A decoction of the plant with seeds is taken for fever, cold, cough, hypertension, nephritis dropsy, bronchitis, diarrhea and to regulate urination. For wound caused by rusty iron nail, a paste made from the fresh plant is used to apply on wound with salt and then bandaged. A decoction made from the entire plant is taken to ensure normal urination and is reputed to be most beneficial in elimination stones from the bladder. It is also used for treating diabetes. The seeds contain ingredients, which help to treat constipation.

In the Philippines, ekor anjing is used as an expectorant, antiphlogistic and to relieve pain; the leaves are used on abscesses. In Java, it is given for stones in the bladder, diabetes, worms, febrifuge and hemorrhoids. The fresh juice of the leaves is known to be a remedy for malaria. The seed is used for dysentery, diarrhea, whooping cough and promotes fertility by increasing the secretion of semen in men. Poultice of leaves is used for sores, particularly inflamed fingernails. In Japan, a watery extract of the seed is given for whooping cough.

Chemical constituents

i) *Chemicals with commercial potential*: Allantoin, apigenin, baicalein, baicalin, chlorogenic acid, p-coumaric acid, ferulic acid, luteolin, plantastine, ursolic acid.

ii) *Other chemicals*: Acetoside, adenine, apigenin-7-glucoside, ascorbic acid, asperuloside, aucubin, benzoic acid, caffeic acid, catalpol, choline, cinnamic acid, citric acid, 3,4-dihydroaucubin, DI-O-methylgalactose, emulsin, fumaric acid, galacturonic acid, geniposidic acid, gentisic acid, 7-(3-D-glucopyranosyloxy-3',4',5',6-tetrahydroxyflavone, glucoraphenine, 6'-O-(3-glucosylaucubin, hispidulin, homoplantagin, p-hydroxybenzoic acid, hydroxycinnamic acid, 9-

hydroxy-cis-11-octadecanoic acid, indicaine, invertin, lignoceric acid, loliolid, luteolin-7-O-p-D-glucoside, luteolin-7-O-P-D-glucuronide, mucilage, neo-chlorogenic acid, nepetin, nepitrin, oleanolic acid, plantagic acid, plantagonine, plantagoside, plantease, planteolic acid, resin, 7-O-a-L-rhamnopyranosyl-4',5,6-trihydroxyflavone, salicylic acid, scutellarin, sitosterol, sorbitol, succinic acid, sulforaphene, syringic acid, syringin, tannin, tyrosol, vanillic acid; alkaloids, amino acids, fatty acids (linoleic acid, linolenic acid, oleic acid), flavonoids, monosaccharides (galactose, glucose, mannose, xylose, arabinose, fructose), minerals, phenolcarbonic acids, polyphenolics, saponins.

Pharmacology

The intracellular fluid of *Plantago major* was shown to have antitumor property and is a potent prophylactic for mammary cancer in mice. Extract of this plant was found to have antioxidant property and anti-giardiasis activity *in vitro*. Aqueous extract of ekor anjing was demonstrated to have uterotonic action, activity which enhances the uterine tonus. Leaf and seed extracts were found to produce significant gastroprotective and laxative actions. No genotoxic activity was observed in aqueous and alcoholic extracts of ekor anjing.

A polyphenolic complex, plantastine, of ekor anjing was found to be an active inhibitor of tumors and prevent toxic damage of the liver in rats.

Clinical trials

A clinical trial on the effect of ekor anjing preparation on patients with chronic bronchitis has confirmed a spastic effect of this plant upon the smooth musculature of bronchi. It is found to have a good tolerance and with no toxic effect on gastrointestinal tract, liver, kidneys, hemopoiesis. Clinical studies on the diuretic property of ekor anjing demonstrated no influence on the 12 and 24 hours urine output or on the sodium excretion.

Towards commercial production

Commercially a number of products can be derived from ekor anjing as it has been gifted with medicinal properties for strengthening the respiratory and the cleansing system of the body. One such product in the international market is

"Plantago smoking aversion" used for treating smokers. Other products include linaments for treatment of gout. The major producers of ekor

anjing are East European countries where ekor anjing is priced at US\$8.00 to \$9.00 per half pound (1998).

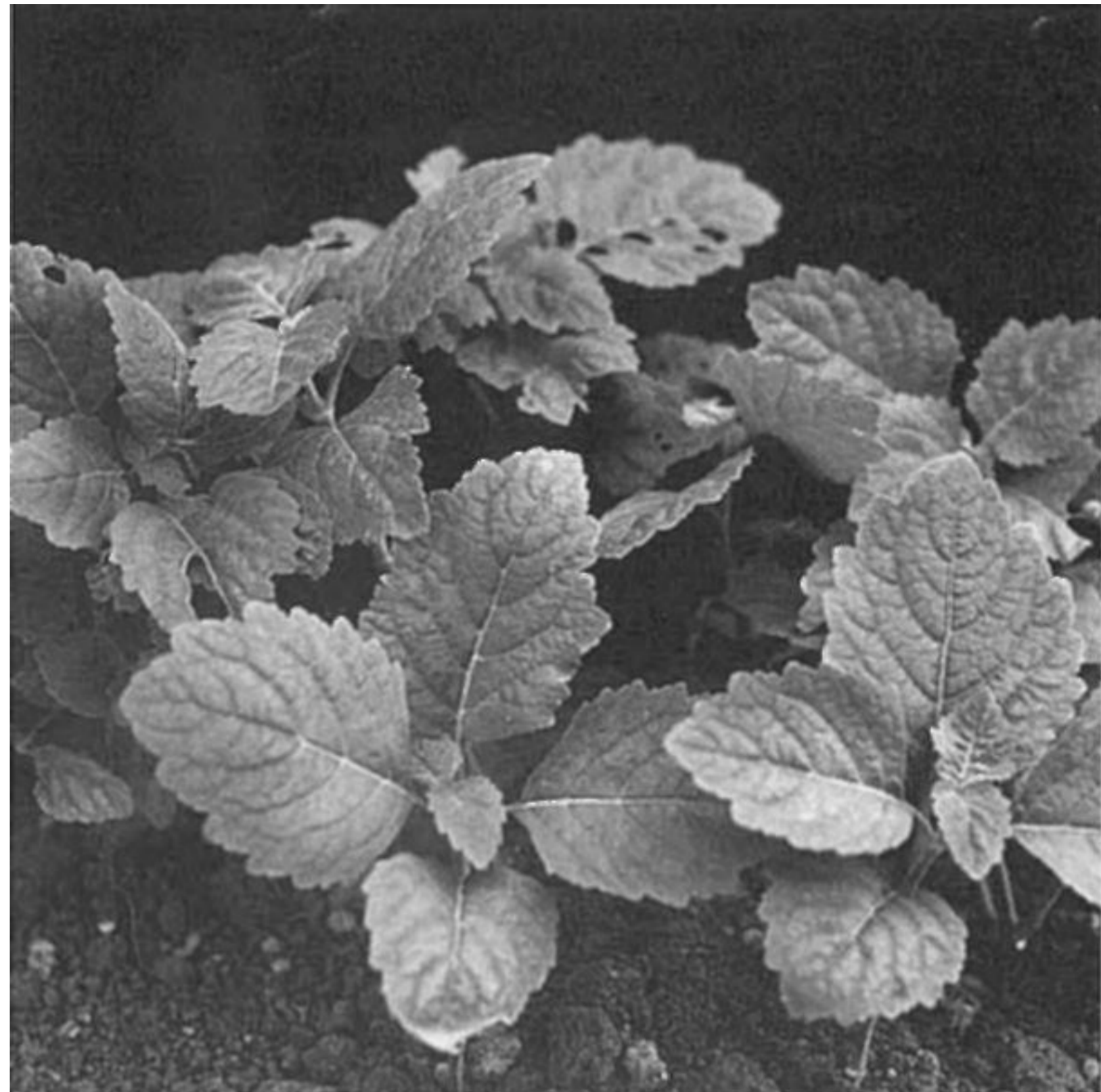
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Pogostemon cablin

Scientific name : *Pogostemon cablin* (Blanco)
Benth.
Common name : Patchouli
Local name : Nilam
Family : Lamiaceae

Potential crop rating : ☆ ☆ ☆



Introduction

This plant is indigenous to Philippines. It was introduced and cultivated for its essential oil in Malay Peninsula in 1980's. In the early 1990's, due to over production and a new interest in commercial cultivation of rubber, there was almost a total abandonment of patchouli cultivation in Malaysia. It is now cultivated on a commercial scale in Indonesia, China and Brazil. Its potentiality lies in its strong fixative properties of the essential oil, which helps to prevent rapid evaporation of a perfume and thereby promotes tenacity. It is therefore a very useful oil and is widely used to give a solid foundation and lasting character to a fragrance.

Plant description

It is an erect annual, branched herb growing up to a height of 1 m. The leaves are arranged in opposite pairs, simple, green with an ovate shaped leaf blade measuring about 10cm in length and 8cm in width. The leaf apice is acute, with a double crenate margin, pinnately netted venation and an attenuate base. The petiole is reddish green in color, channeled measuring about 4cm in length and covered with minute white hairs. The stem, purplish in color is ascending, 4-angled, branching heavily and covered with minute hairs. The leaves when crushed give a peculiar characteristic odor. Patchouli almost never flowers in Malaysia.

Plant habitat

Patchouli is a cultivated species and is grown on plantations in Malaysia. It is rarely found in the wild.

Plant growth habit/cultivation

Since the plant does not flower, propagation is carried out through either normal stem cutting or preferably with shoot tip cuttings with at least 3-4 nodes which is equipped with a terminal bud and a crown of leaves. After one month, the rooted cuttings are ready for transplantation in the field. The rooted cuttings are planted 1m x 1m apart.

Patchouli is quite a hardy plant and can adapt well to a wide range of soil and climatic conditions. It is a shade loving plant and can also be grown as an intercrop in irrigated coffee, coconut and banana plantations. In commercial scale planting, patchouli is considered as an exhaustive crop as liberal manuring is required. It does especially well with organic fertilizer. This plant takes 5-6 months to attain full growth. The quality of oil in the leaves is said to decrease after 2-3 years of age and this is when there is a necessity of replanting it. This plant is reported to be susceptible to two insect pests that is, the leaf feeding caterpillar and leaf roller. It is also susceptible to nematode attacks.

The first harvesting of leaves and tender shoots is done after 6 months of planting that is when the leaves begin to turn color from green to brownish

green. The plant is harvested about 20cm above the ground level. Harvesting is preferably done during drier months when the oil content is higher. Subsequent harvest can be made at every 3-4 month intervals. About 1,400kg air dried herbage/hectare/year is normally considered a fair yield.

Plant parts used : Leaves, root.

Uses in traditional medicine

The plant is used as a gargle for weak and spongy gums, pyrrhoea and halitosis. Internally, it acts as an aromatic stomachic and carminative with astringent properties and is useful in treating anorexia, chronic dyspepsia, flatulence, gonorrhoea, chronic bronchitis, cardiac dropsy, gangrene of the lungs and phthisis. It is also used as an expectorant, diuretic and disinfectant for the genito-urinary mucous membrane. In Malaysia, a decoction prepared from roots is used for treating dropsy whilst that of the leaves is taken for coughs and asthma. The leaves are made into poultices for boils, headache, jaundice and bilious fevers. A lotion from the roots is used for rheumatism.

Chemical constituents

i) *Chemicals with commercial potential:* Apigenin, azulene, cinnamaldehyde, essential oil (benzaldehyde, cadinene, cinnamic aldehyde, eugenol, patchouli alcohol, patchouli camphor).

ii) *Other chemicals:* Apigenin-7-O-p-D-(-6"-p-coumaroyl)-glucoside, apigenin-7-O-p-glucoside, cc-bulnesene, oc-bulnesene oxide, bulnesol, a-bulnesone, camphene, caryophyllene, caryophyllene-oxide, O-cresol, cycloseychellene, daucosterol, dehydracetic acid, dhelwagin, dimethylphenol, P-elemene, epifriedelinol, epiguaipyridine, 1 p,5 P-epoxy-a-guaiene, 1,10-epoxy-a-bulnesene, epoxyaryophyllene, 1a,5oc-epoxy-a-guaiene, friedelin, a-guaiene, a-guaiene oxide, guaiacol, guaipyridine, heptanoic acid, humulene, limonene, 2-methyl-butyric acid, 2-methylhexanoic acid, 4-methylpentanoic acid, nonanoic acid, nordehydropatchoulol,

norpatchoulol, octanoic acid, oleanolic acid, ombuine, pachypodol, a-, P- and y-patchoulene, patchouli acid, patchoulipyridine, patchoulol, patchoulol synthase, pentanoic acid, cis-2-pentylcyclopropylcarboxylic acid, phenol, a- and P-pinene, pogostol, pogostone, retusine, rhamnetin, seychellene, P-sitosterol, tannin, trans-2-pentylcyclopropylcarboxylic acid, p-vinylphenol.

Pharmacology

Hot aqueous extracts of *Pogostemon cablin* showed inhibitory activity on K⁺ contracture of guinea pig taenia coli.

Clinical trials : No information available.

Towards commercial production

The total world production of patchouli is estimated to be about 500-550 tones (1994) per annum, Indonesia being the chief supplier, supplying up to 80% of the annual world production. There is currently a big demand for this oil especially from Europe as it is used in very wide range of products. The cost of this oil in the world market ranges from US\$5.00-7.00 per 1/2 ounce (1998) while the cost of the raw materials (dried leaves) are being sold at US\$13 per half pound (1998).

This oil is generally blended with other essential oils, for example, with those of geranium or clove before use. It is used in a wide range of toiletry products such as toilet soaps, scents, body lotions, pre-shave, after-shave lotions and detergents. Its strong tenacity renders it particularly suitable for heavy perfumes and for imparting a lasting character and strength to lighter perfumes. In very low concentrations (0.0002% or 2.2 lppm), the oil is extensively used as a flavor ingredient in major food products including alcoholic and non-alcoholic beverages, frozen dairy desserts, candy, baked goods, gelatin, and meat and meat products. Blended with sandalwood oil, it gives one of the finest attars, widely used in soaps, cosmetics, tobacco and incense sticks.

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Polygonum minus

Scientific name : *Polygonum minus* Huds

Local name : Kesum

Family : Polygonaceae

Potential crop rating : ☆ ☆ ☆



Introduction

Kesum is an herb commonly grown in home gardens for its rich aroma used in flavoring local culinary dishes such as 'asam laksa and asam pedas'. Although it has been used traditionally to cure certain ailments such as indigestion and after childbirth but its main usage is still as a spice. Its rich aroma is actually derived from the plant's essential oils.

The uniqueness of the kesum oil is in its essential oil constituents which comprises largely of aldehydes which is believed to have tremendous potential in the perfumery industry.

Plant description

Kesum is a relatively bushy herb with slender creeping stems that grows up to a height of 1.5m in the highlands and about 1m in the lowlands. The leaves are alternately arranged, simple, green, glabrous and very aromatic. The leaf blades are lanceolate, entire with an acuminate apice and acute base.

The leaves are sub-sessile with very short petioles that are pericladial and reddish in color. The stems are cylindrical, green with a reddish tinge. The nodes are relatively short, capable of rooting, spaced about 9mm apart and enclosed in a tubular stipule. The stipules are more or less square in shape, membranous in texture with reddish tip that is ciliated at its mouth.

The mature nodes are normally swollen with

leaf and ligule scars. Flowers are hermaphrodite in nature and borne on racemes of about 12-15cm in length. The calyx is pale violet in color, minute, measuring 0.5cm across, and campanulate in shape. There are 5 polysepalous calyx. The corolla is absent. There are 8 stamens and three clavate stigmas. The fruit is a small hard nut.

Plant habitat

This plant grows wildly in cooler climates (15-25°C) such as in the highlands of the Peninsula. It prefers wet areas and can be found growing wildly in wet ditches or near streams.

Plant growth habit/cultivation

The best way of propagating kesum is through the use of stem cuttings of about 10cm long. Prior to field planting, they are induced to root in water under 75% shade and 85% relative humidity. The planting distance for kesum is normally kept at 30cm x 30cm. The number of plants needed per hectare is about 50,000, which can produce a biomass of about 40 tonnes.

This herb is fast growing and prefers high soil moisture levels. Therefore, irrigation is highly recommended. Weed poses a threat at the early establishment and is minimized once ground cover is established.

This plant is prone to incidents of attacks by thrips, aphids and red spider mites. Fertilizer requirement is about 450kg/hectare/year.

Plant parts used : Leaves.

Uses in traditional medicine

In Malaysia, a decoction of leaves is taken for indigestion, after childbirth and eliminating dandruff. The leaves are eaten as a vegetable and sometimes cooked in curries.

Chemical constituents

i) *Chemicals with commercial potential*: Essential oil.

ii) *Other chemicals*: (3-caryophyllene, oc-copaene, cryophyllene oxide, cyclododecane, decanal, decanol, dodecanal, oc-humulene, nonanal, a-pinene, (3-selinene, tetradecanal, undecanal.

Pharmacology : No information available.

Clinical trials : No information available.

Towards commercial production

This crop has tremendous potential especially in the perfumery industry as research has shown that kesum oil is very rich in C₁₀ and C₁₂ aldehydes. The cost estimated by international essential oil dealers for kesum oil is about US\$300/kg. By processing the oil a step further, value-added products such as aldehyde isolates and acetals can also be produced. These products are a bonus to potential kesum growers as they fetch a better price in the international market compared with the essential oil itself.

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Portulaca oleraceae

Scientific name : *Portulaca oleraceae* Linn.
Common name : Green purslane
Local name : Gelang pasir
Family : Portulacaceae

Potential crop rating : * * *

Introduction

Locally, this plant is popularly eaten as an 'ulam' or a traditional vegetable. In countries such as China, The Philippines, Java, Malaysia and Africa, this plant is normally not cultivated but just collected from the wild and eaten. In the Journal of New York Botanical Garden for 1942 it was quoted that "these young stems and leaves when cooked about 15 minutes in boiled salted water are far better than spinach or Swiss chard". Other than its excellent flavor this plant is also well known for its medicinal properties especially for ailments related with the urinogenital system.

Plant description

Gelang pasir is an annual creeping herb growing up to a height of 20-25cm. The stems are succulent, smooth, reddish brown in color, branched and prostrate in mats. Leaves are smooth juicy and thick, simple and arranged alternately. The leaves are green with a tinge of purple at their margins. The leaf blade is entire, cuneate in shape with emarginate apice and rounded base. The petioles are very short; 1-2mm in length and purple in color. Flowers are borne on glomerules arising from leaf axil. The bracteoles are scale-like and very minute. Flowers are hermaphrodite, about 5mm in length. There are 2 calyx lobes, which are green and glabrous. The corolla is bright yellow, 5 in number, campanulate in shape and with lobes much longer than the tube. The stamens, 10 in number, are



inserted near the base of the corolla tube and is about 2mm in length. The single central cylindrical style branches into 4 stigmas and is about 2mm in length. The fruit is a capsule.

Plant habitat

This herb is considered a weed and can be found growing wildly in fields and waste places. It is commonly found on sandy soils.

Plant growth habit/cultivation

This plant does well in moist, well-drained soil and in semi-shaded positions. It can be propagated through stem cuttings or seeds. A better establishment rate is obtained through propagation by seeds. This plant requires a lot of organic fertilizer such as chicken dung. Dung from cows and buffaloes should be avoided as they contain seeds of weeds that can pose serious problems during early establishment of this plant. To avoid competition from weeds it is advisable to plant the shoot cutting or seedlings at a distance of 10cm x 10cm apart. Gelang pasir is normally harvested after 2-3 months of growth.

Plant parts used : Whole herb.

Uses in traditional medicine

This plant is used in all countries as a vulnerary, antiscorbutic, refrigerant and a mild diuretic. It is useful in catarrh and urino-genital ailments. It is

mixed in diet for treating scurvy and liver diseases. The leaves are used for poulticing boils, ulcers and wounds and to heal burns and cure skin diseases. In the form of an infusion or decoction, they are used as a gastric sedative, stomachic, emollient and diuretic, and for treating dysentery and internal ulcerations of the stomach.

In Malaysia, the juice is used for treating eye diseases. In the Philippines, it is used for poulticing burns and skin diseases. In Java, the seeds are considered to be a vermifuge. In Sumatra, it is used for treating chest complaints. In Africa, the plant is used as a sudorific, antiscorbutic and for treatment of haemoptysis, pulmonary, skin diseases and snakebites. It is usually eaten in Europe as a salad, sometimes cooked or made into a sauce.

Chemical constituents

i) *Chemicals with commercial potential*: Catechol, eicosapentaenoic acid, ferulic acid, pantothenic acid, sinapic acid.

ii) *Other chemicals*: Ascorbic acid, asparagic acid, behenic acid, caffeic acid, calcium oxalate, (3-carotene, citric acid, P-cyanin, digalactosyl-diacylglycerol, 3-(3,4-dihydroxyphenyl)alanine, docosahexaenoic acid, folacin, glutathione, malic acid, monogalactosyldiacylglycerol, mucilage, myristic acid, niacin, L-noradrenalin, norepinephrine, oleracin-I and -II, oxalic acid, phosphatidyl-choline, phosphatidylethanolamine, phosphatidyl-glycerol, phosphatidylinositol, phosphatidyl-serine, phytin-P, riboflavin, P-sitosterol, tannin, thiamin, tocopherol, vitamin-B6; amino acids, alkaloids, fatty acids (linoleic acid, linolenic acid, oleic acid, palmitic acid, palmitoleic acid, stearic acid), minerals, monosaccharides (fructose, galactose, glucose), oxalates, pigments (betacyanin, betanidin, betanidin-5-O-p-cellobioside, isobetanidin 5-O-P-cellobioside, isobetanidin), saponins, sulfolipids.

Pharmacology

Portulaca oleracea is reported to be a nutritious food rich in omega-3 fatty acids and antioxidants.

For example, one hundred grams of fresh leaves (one serving) contain about 300-400mg of 18:3w3; 12.2mg of alpha-tocopherol; 26.6mg of ascorbic acid; 1.9mg of p-carotene; and 14.8mg of glutathione.

Extracts of gelang pasir inhibited twitch tension due to direct and indirect electrical stimulation via the phrenic nerve of the rat hemidiaphragm muscle. Gelang pasir extracts (aqueous, dialysable and methanol) stems and leaves were shown to mimic, in part, the effect of D-600 and dantrolene on the rat hemidiaphragm and frog rectus abdominis muscles.

Aqueous extract of the stems and leaves abolished the twitch contraction of the directly stimulated rat hemidiaphragm preparation. It also produced a dose-dependent relaxation of guinea pig fundus, taenia coli and rabbit jejunum and a dose-dependent contraction of the rabbit aorta. On spontaneously-beating rabbit right atria and electrically-paced left atria, the same extract produced a dose-dependent negative inotropic and chronotropic effects. The aqueous extract of gelang pasir produced skeletal muscle relaxation in rats following i.p. or oral administration, with the LD50 in an acute toxicity test in mice was 1,040mg/kgi.p.

Aqueous, alcoholic and ketonic extracts of gelang pasir were found to have high antimicrobial activity. Ethanolic extracts caused an initial augmentation of twitch height in chick biventer cervicis preparations and then blockage.

Clinical trials : No information available.

Towards commercial production

Gelang pasir is considered a good futuristic crop, especially as a health food plant. This is due to its leaves, which are rich in omega 3 fatty acids that is thought to be important in preventing heart attacks and strengthening the immune system. Other potential products that can be derived from gelang pasir is herbal teas used for stomachaches, headaches and for strengthening the urino-genital system.

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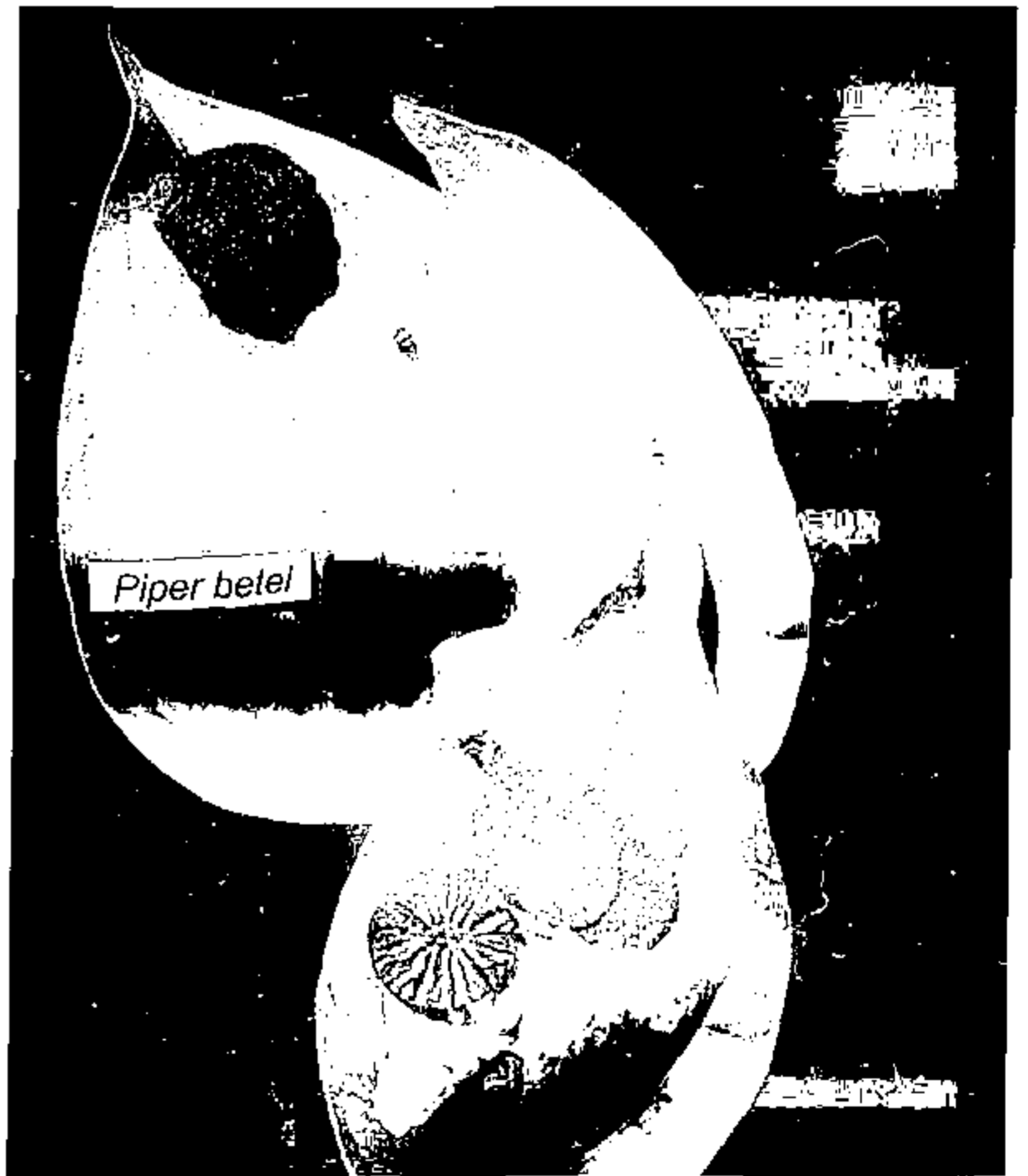
Piper betle



Piper betle : plants



Piper betle : leaves

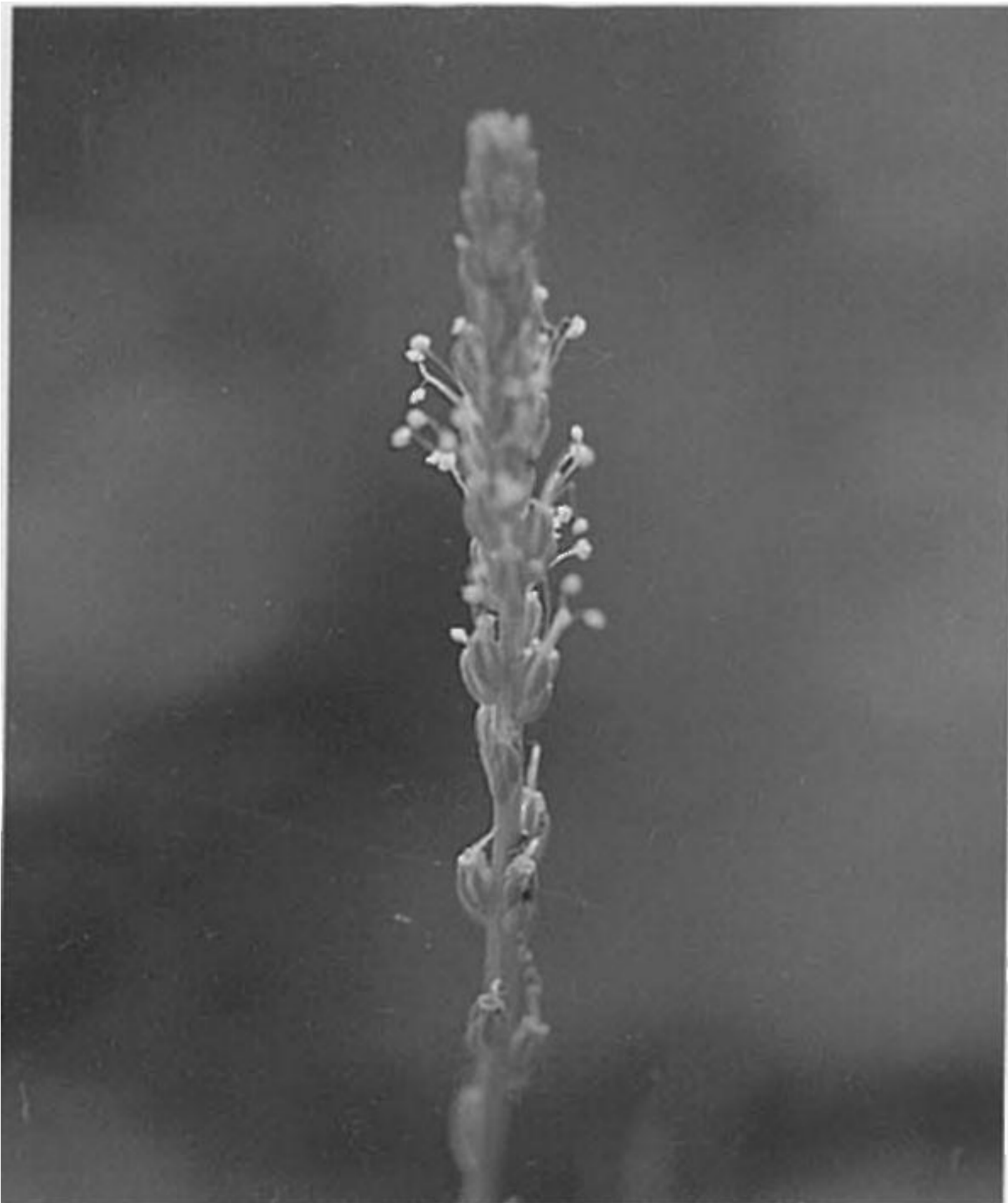


Piper betle :
poulitice, leaves, lime & areca nuts

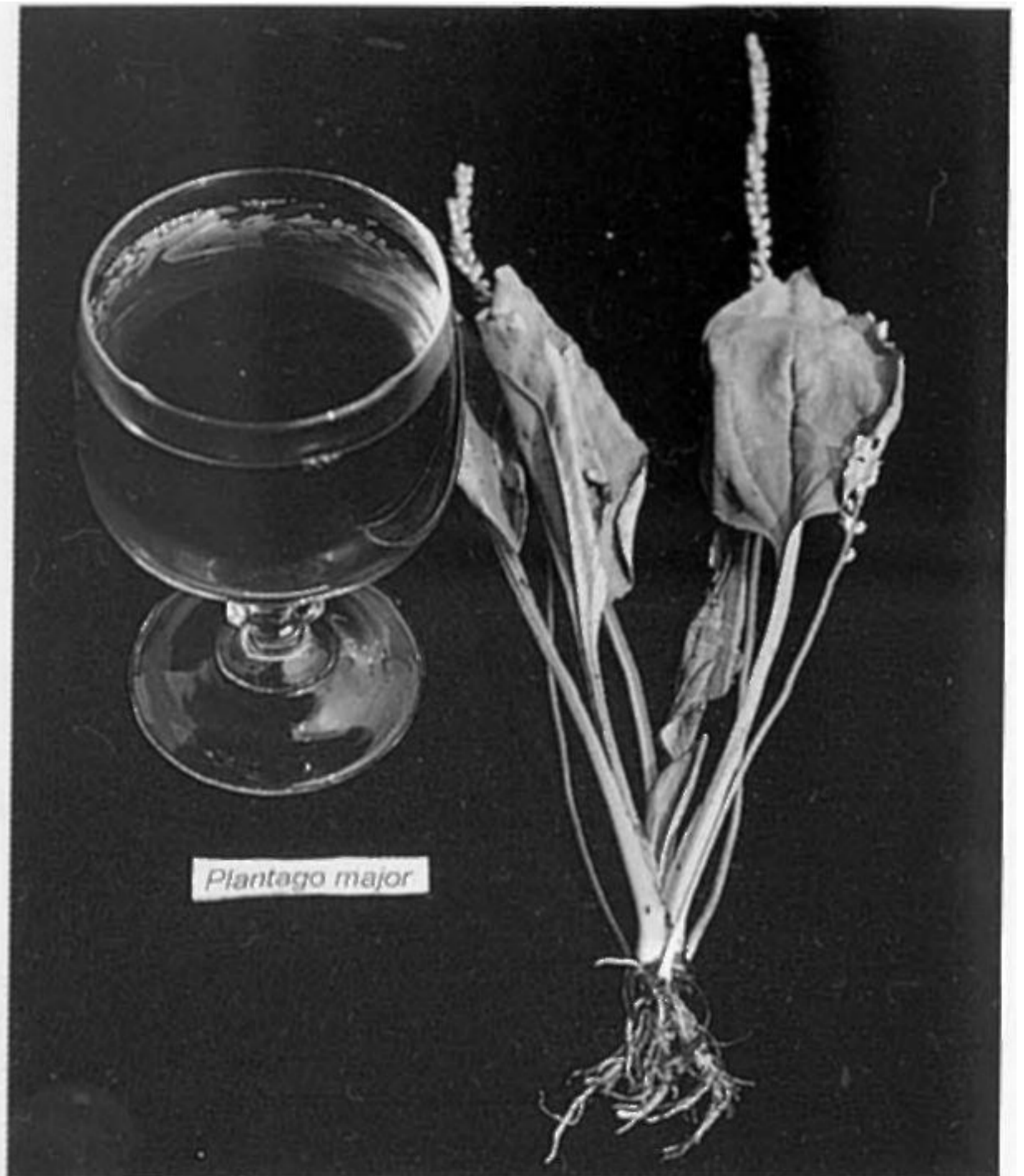
Plantago major



Plantago major : plants



Plantago major : inflorescence

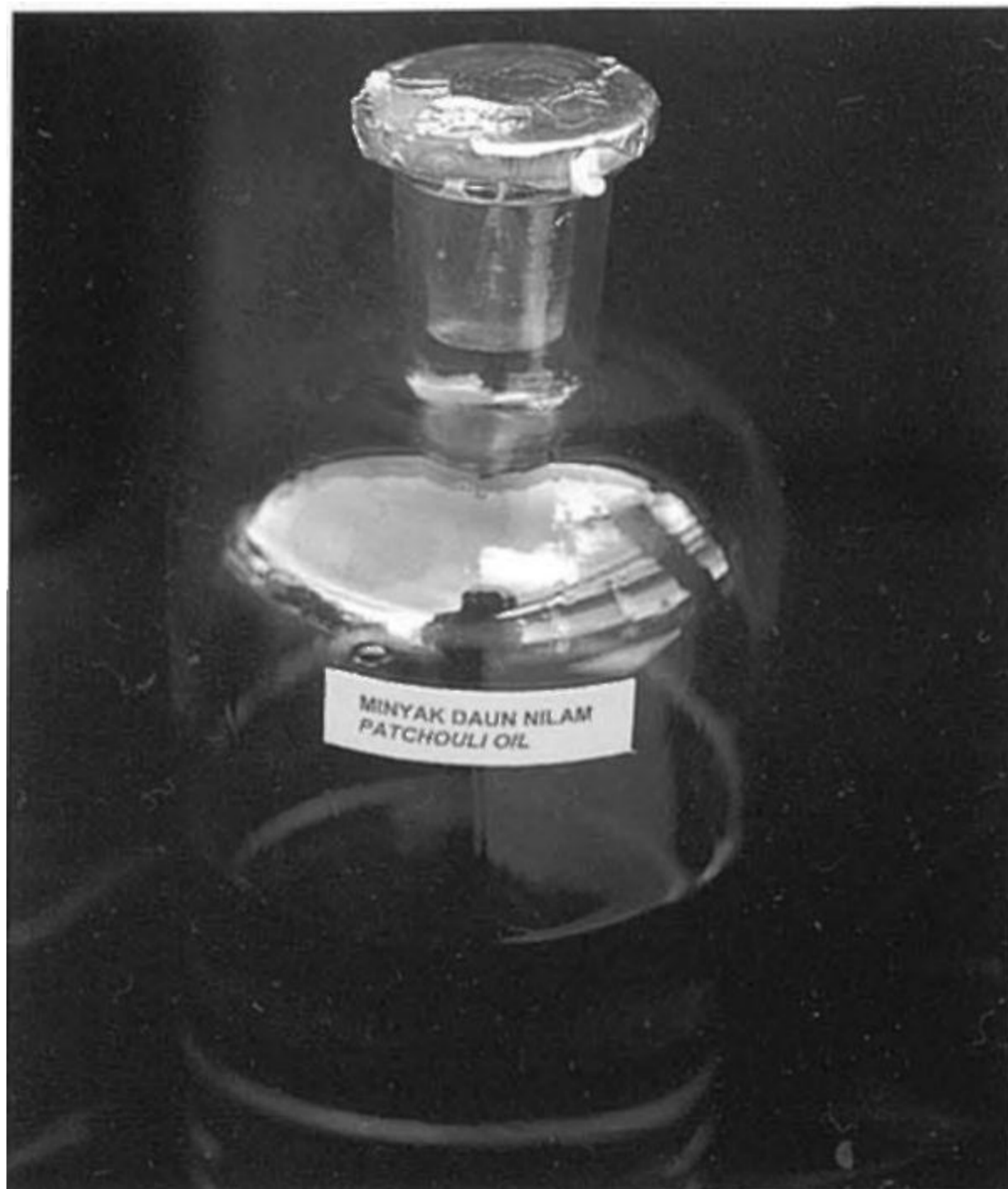


Plantago major : plant & decoction

Pogostemon cablin



Pogostemon cablin : plants



Pogostemon cablin : essential oil

Polygonum minus



Polygonum minus : plants



Polygonum minus : inflorescence

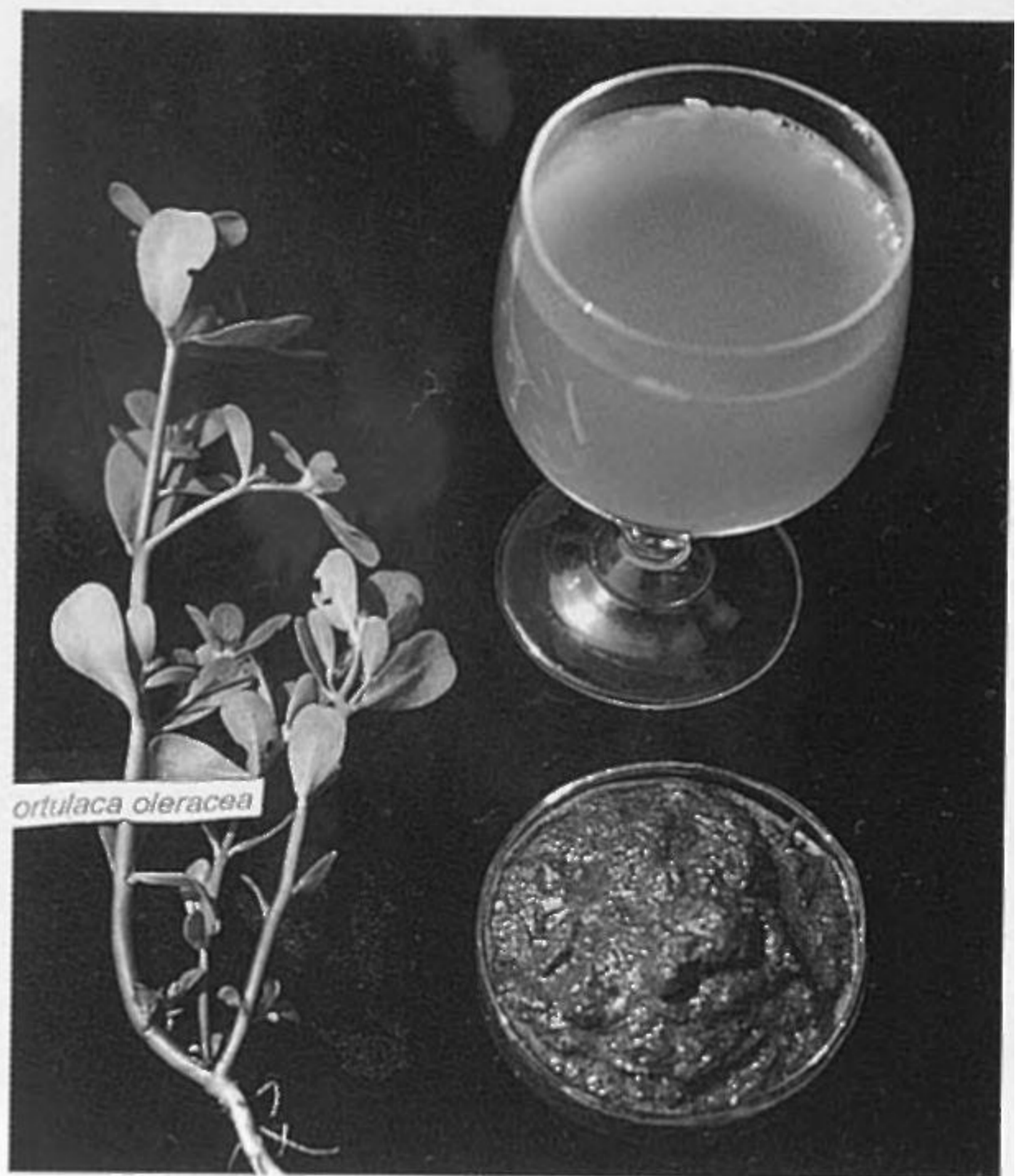


Polygonum minus : essential oil

Portulaca oleracea



Portulaca oleracea : plants



Portulaca oleracea :
plant, pultice & decoction



Portulaca oleracea : flowers

Zingiberofficinale



Zingiber officinale : plants



Zingiber officinale : rhizomes

MARDI's Herb Garden





Zingiber officinale

Scientific name : *Zingiber officinale* Roscoe.

Common name : Ginger

Local name : Halia

Family : Zingiberaceae

Potential crop rating : * * * * *

Introduction

Zingiber officinale is one of the most ancient Asian herbs used in herbal remedies; dating to almost 2,500 years ago. It has been traditionally used to promote cleansing of the body, to calm nausea and to stimulate appetite. It is also one of the earliest oriental spices known to Europe and is still currently in large demand. The plant product, ginger, is actually derived from the tuberous rhizome of the ginger plant. Currently, ginger is more popularly used as a spice and for its oil. It is commercially cultivated in countries like Africa, China, Jamaica and West Indies.

Plant description

Ginger is a slender, erect, perennial herb, growing up to a height of 100-150cm. The leaves are linear-lanceolate with an acuminate apice and sheathing base. The tubular leaf sheath acts as a pseudostem. At the base of the leaf sheath there is a membranous, small ligule. The upper leaves are well developed while the lower ones remain as scales. This plant species seldom flowers in Malaysia. The inflorescence or spike is said to grow to a length of 15-20cm and arises directly from the rhizome. The bracts are light green in color with mucronate tips. The corolla tube is yellowish green with lanceolate lobes. The labellum is shorter than the other corolla lobes and is covered with purplish stripes and light yellow spots. The single central style is enclosed by the



connective appendages of the anther. The rhizomes are fleshy, aromatic, profusely branched, light brown externally and yellow in section.

Plant habitat

Ginger is a cultivated species and can be found growing in the tropics from sea level up to 1,500m altitude.

Plant growth habit/cultivation

Ginger is propagated by planting pieces of rhizomes (2.5-5cm long) on which at least one good bud is present. The pieces are planted about 5-10cm deep and 25cm x 25cm apart on ridges. About 840-1700kg of ginger setts are required for one hectare of land. The plant can withstand some amount of shade and therefore can be intercropped with light shady crops such as yams. A well drained, loose soil is also essential for successful cultivation of ginger. Ginger is an exhaustive crop and requires up to 25-30 tons of cow manure at planting, and about 36kg of N and P₂O₅, and 80kg of K₂O during growth. The first shoot can be observed protruding out of the ground in about 14-20 days. Water supply is crucial and irrigation should be used if rainfall is too low.

A crop of rhizome can be harvested approximately 7 months after planting for production of young rhizomes. For production of matured rhizomes (or dried ginger), harvesting commences in 9-10 months, that is when the leaves

begin to turn yellow and the stem lodges. Under good cultural practices the yield of ginger can reach up to 20-30 tons per hectare.

Ginger plant is susceptible to insect pests such as mealybug, scale, moths and beetles and to diseases such as pseudomonas bacterial wilt.

Plant parts used : Rhizome.

Uses in traditional medicine

Rhizomes of ginger are traditionally used as a stomachic, carminative, stimulant, diaphoretic, sialagogue and digestive herb. In Malaysia, fresh and dry ginger rhizomes are used to flavor food. The fresh or dried rhizomes are believed to be stimulative, carminative, aromatic and with antiemetic properties. It is very valuable in treating flatulence, colic, dyspepsia and atonic dyspepsia. They are effective for colds, coughs and fevers. The rhizomes are also taken to relieve menstrual cramps and as an emmenagogue. A lotion prepared from rhizomes with vinegar is used to rub on the body after childbirth as a protective medicament. A mixture of the rhizomes with pepper is pounded with water and drunk as an abortifacient. A decoction of the rhizomes is also used to treat stomach ache, nausea, vomiting, nose bleeds, rheumatism, coughs and blood in stools. It also improves digestion, expels intestinal gas and stimulates appetite and is used in the treatment of diseases related with the female reproductive system. The rhizomes are often boiled and consumed as an adjunct to other remedies for general tonic or stimulant purposes. Dry ginger and coriander boiled in water is a universal remedy for colds and fevers. With black and long pepper, it is specific for diarrhea given with bees' honey. The expressed juice of the fresh rhizomes is given gradually in increasing doses and it is regarded as a diuretic for general dropsy. The juice with garlic and bees' honey is a favorite remedy for coughs and asthma. It is also often used in the fresh form for flavoring curries, in sauces and cool drinks. Preserved ginger is also an ingredient used in making cakes and other confectioneries.

In India, ginger is described in Ayurvedic medical system as a remedy for asthma, stomach tumor, inflammation, rheumatism and neurological disorders. Administration of ginger is believed to

exert abortive and prophylactic effects in migraine headache without any side-effects. In China, ginger is used for treating stomachache, diarrhea, colic, flatulence, rheumatism and stomach cancer.

Chemical constituents

i) *Chemicals with commercial potential:* Capsaicin, chlorogenic acid, p-coumaric acid, curcumin, ferulic acid, geraniol, 6-gingsulfonic acid, β -ionone, myrcene, myricetin, pantothenic acid, 6-shogaol, zingiberone; essential oil (cineole, citral, farnesene, gingerol, linalol, methylheptenone, shogaol, zingerone).

ii) *Other chemicals:* Acetaldehyde, acetic acid, acetone, γ -aminobutyric acid, (+)-angelicoidenol-2-O-P-D-glucopyranoside, aromadendrine, alloaromadendrine, ascorbic acid, p-bisabolene, β -bisabolol, D-borneol, bornylacetate, sec-butanol, tert-butanol, N-butyraldehyde, α - and δ -cadinene, α -cadinol, caffeic acid, calamenen, camphene, camphene hydrate, camphor, capric acid, caprylic acid, car-3-ene, 8-car-3-ene, p-carotene, caryophyllene, p-caryophyllene, cedrol, chavicol, 1,8-cineole, citronellal, citronellol, citronellyl acetate, α -copaene, cumene, α -curcumene, AR-curcumene, p-cymene, p-cymen-8-ol, N-decanal, decylaldehyde, 6-dehydrogingerdione, 10-dehydrogingerdione, 6,10-dehydrogingerdione, delphinidin, demethylhexahydrocurcumin, diethylsulfide, 6-dihydrogingerdione, dihydrogingerol, dodecanoic acid, P-elemene, elemol, 10-epizonarene, (E)-8-p-17-epoxylabd-12-ene-15,16-dial, 8-p-17-epoxylabd-12-ene-15,16-dial, ethylacetate, ethylisopropyl sulfide, ethylmyristate, p- and γ -eudesmol, farnesal, α -farnesene, trans-P-farnesene, farnesol, furanogermenone, furfural, gadoleic acid, geranial, geraniol, geranyl acetate, 6-gingediol, gingediacetate, 6-gingediolacetate, 6-gingediolacetate-methylether, 6-gingediol-methylether, 8-gingediol, 10-gingediol, 6-gingerdione, 10-gingerdione, gingerenone-A, -B and -C, ginglycolipid A, B, and C, gingerin, 2-gingerol, 4-gingerol, 6-gingerol, 7-gingerol, 8-gingerol, 9-gingerol, 10-gingerol, 12-gingerol, 14-gingerol, 16-gingerol, gingerolmethylether, gingerone, glanolactone, globulin, glutelin, glyoxal, guail, N-heptane, heptan-2-ol, heptan-2-

one, hexa-1-al, hexanol, cis-hexan-3-ol, hexahydrocurcumin, p-himachalene, hydrocurcumine, p-hydroxybenzoic acid, 1-(4-hydroxy-3-methoxyphenyl)-3,5-diacetoxyoctane, 1-(4-hydroxy-3-methoxyphenyl)-3,5-octanediol, humulene, isoeugenol-methylether, isogingerenone-B, isovaleraldehyde, kaempferol, lauric acid, lecithin, limonene, trans-linalol-oxide, malate, mentholacetate, methylacetate, methylallylsulfide, methylcaprylate, methylglyoxal, 6-methylgingediacetate, 6-methylgingediol, methyl-6-gingerol, methyl-8-gingerol, methyl-12-gingerol, 6-methyl-hept-5-en-2-one, methylheptenone, methylisobutylketone, methylnonylke'tone, methyl-6-shogaol, anti-methyl-6-shogaol, anti-methyl-8-shogaol, methyl-8-shogaol, methyl-10-shogaol, anti-methyl-10-shogaol, α - and γ -muurolene, p-myrcene, myristic acid, myrtenal, neoisopulegol, neral, nerol, trans-nerolidol, niacin, nonanal, N-nonane, N-nonanol, nonan-2-ol, N-nonanone, nonan-2-one, nonylaldehyde, nerolidol, octan-1-al, N-octane, trans-octen-2-al, oleoresin, oxalic acid, 9-oxo-nerolidol, paradol, 6-paradol, patchouli alcohol, pelargon-aldehyde, perillene, α - and P-phellandrene, 3-phenylbenzaldehyde, 4-phenylbenzaldehyde, phosphatidic acid, α - and P-pinene, pipercolic acid, prolamine, N-propanol, propionaldehyde, quercetin, raffinose, riboflavin, rosefuran, sabinene, selina-3,7(11)-diene, α -, P- and γ -selinene, cis-sesquiabinene hydrate, P-sesquiphellandrene, cis-P-sesquiphellandrol, trans-P-sesquiphellandrol, cis-sesquisabinene hydrate, sesquithujuene, shikimic acid, singerone, cis-6-shogaol, trans-6-shogaol, 8-shogaol, cis-8-shogaol, trans-8-shogaol, 10-shogaol, cis-10-shogaol, trans-10-shogaol, cis-12-shogaol, trans-12-shogaol, p-sitosterol, α - and γ -terpinene, α -terpineol, terpinen-4-ol, terpinolene, thiamin, 2,2,4-trimethylheptane, p-thujone, tricyclene, undecan-2-ol, undecan-2-one, N-undecanone, vanillic acid, vanillin, vanillyl alcohol, vitamin-B6, xanthorrhizol, zerumbone, zingibain, zingiberene, α - and p-zingiberene, zingiberenol, zingiberol, α - and P- zingiberol, zonarene; amino acids, fatty acids (α -linolenic acid, linoleic acid, oleic acid, palmitic acid, palmitoleic acid, stearic acid), fluorine, germanium, ginger oil (citral, borneol, camphene, phellandrene, zingiberene), gingerols,

monosaccharides (fructose, glucose), pentosans, phytosterols, shogaols, volatile oil (camphene, phellandrene, zingiberene, cineol, borneol).

Pharmacology

Zingiber officinale is reported to have antiemetic, antioxidative and anti-skin tumor-promoting properties. Ginger produced cytoprotective and antiulcerogenic effect in albino rats. Ginger extracts significantly increased the sperm motility and sperm contents in the epididymides without producing any spermatotoxic effect. They also inhibited cyclooxygenase activity of platelets *in vitro*.

The acetone and ethanolic extracts of ginger improve the gastrointestinal side effects of cancer chemotherapy. The ethanolic extract of ginger (200mg/kg p.o.) was shown to be an effective antihyperlipidaemic agent in cholesterol fed rabbits. The same extract showed antiinflammatory, analgesic, antipyretic, antimicrobial and hypoglycaemic activities in rats. It was also shown to have antifilarial activity in dog infected with *Dirofilaria immitis*. Furthermore, it was found to show biphasic effects on secretion of cytokines by human peripheral blood mononuclear cells *in vitro*. The water or organic solvent extract of ginger possesses antioxidative and antiinflammatory properties.

The antiplatelet action of gingerol was shown to be resulted from the inhibition of thromboxane formation. 6-Gingesulfonic acid showed a weaker pungency and more potent antiulcer activity than 6-gingerol and 6-shogaol. [6]-, [8]-, and [10]-shogaols and [6]-, [8]-, and [10]-gingerols isolated from the methanolic extract of ginger rhizome were found to possess antiemetic principles. The gingerol homologues were found to possess greater molar potency than their shogaol in thermogenic activity.

Gingerol and shogaol were found to exhibit potent molluscicidal and antischistosomal activities. 6-shogaol and 6-gingerol effectively destroyed *Anisakis* larvae *in vitro*. Although 6-gingerol is a potent mutagen, the ginger juice also contains antimutagenic component(s) against 6-gingerol and tryptophan pyrolysates. Intravenous (i.v.) administration of 6-gingerol (at 1.75-3.5mg/kg) or 6-shogaol (at 1.75-3.5mg/kg) and oral

administration of them (at 70-140mg/kg) produced an inhibition of spontaneous motor activity, an antipyretic and analgesic effects, and prolonged hexobarbital-induced sleeping time.

Zingicomb (registered trademark of Mattern et Partner), a combination preparation of standardized extracts of *Ginkgo biloba* and *Zingiber officinale* was found to have anxiolytic and anxiogenic properties. Phytopharmakon zingicomb is also reported to have antiemetic properties that are comparable to those of metoclopramide.

Clinical trials

Clinical studies showed that the antiemetic effect of ginger is not associated with an effect on gastric emptying and no adverse effects were noted. Studies conducted on 56 patients (28 with rheumatoid arthritis, 18 with osteoarthritis and 10 with muscular discomfort) showed that more than three-quarters of the arthritis patients experienced, to varying degrees, relief in pain and swelling after taking powdered ginger. All the patients with muscular discomfort experienced relief in pain whilst none of the patients were reported to have any adverse effects during the period of ginger consumption ranging from 3 months to 2.5 years. In another study, patients suffering from rheumatic disorders were found to have pain relief after ginger administration.

A double-blind randomized cross-over trial in patients with *hyperemesis gravidarum* demonstrated that a significantly greater relief of the symptoms was found after ginger treatment (daily doses of 1g during 4 days) compared to placebo and no side effects were observed. A combination of garlic and ginger is much more effective in reducing blood glucose and serum lipids.

Ginger juice produces antimotion sickness activity. In a double-blind randomized placebo trial

on antiseasickness showed that ginger root significantly reduced the tendency to vomiting and cold sweating as compared to placebo treatment ($p < 0.05$). However, in another study, powder ginger (whole root, 500 or 1,000mg) or fresh ginger roots (1,000mg) failed to protect against motion sickness. Powdered ginger (500mg) had no effect on gastric emptying in normal or motion-sick subjects.

A double-blind, randomised study on 60 women who had major gynaecological surgery showed that a statistically significant fewer recorded incidences of nausea in the group that received ginger root compared with placebo ($p < 0.05$). Ginger root was also reported to reduce the induced vertigo significantly.

Towards commercial production

For centuries, ginger has captured the world market for its varied properties. Its spicy flavor is being used in confectionery, in beverages such as gingerbeers, champagnes, in curries and preserved as pickles.

Currently, it is also one of the top 10 herbal remedies sold in the US as it is being valued for its stomachic, immune boosting and hypertensive properties. Some of the herbal ginger products marketed globally include standardized ginger extract, Digestive and Joint/Ligament Tendon Balance (Veda Health) which is in the tablet form and Super Herbal Energy Tonic (New Attitude) and Zingicomb (ZC) (registered trademark of Mattern et Partner). Other more common products include Ginger teas and Ginger oil. At the global market, dried ginger roots are priced at US\$3-5 per half pound while ginger extract are at US\$5.50 per ounce (1998).

In Malaysia, ginger is grown mainly for its consumption as a spice especially for flavoring curries etc. There has been little use of ginger commercially as an herbal remedy.

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Herbs : The Green Pharmacy of Malaysia

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Appendix A : Botanical Glossary

A. PLANT HABIT

Herbs	the stem soft, containing very little woody tissue
Shrubs	the stem woody; commonly with several stems and without a main trunk
Trees	the stem woody and tall and usually with a single main trunk
Climbers	the stem either herbaceous or woody, but thin and slender, often clinging to adjacent objects for support
Annual	plants that live for only one year
Perennial	plant that continues to live for many years.

B. STEMS

Node	that place on a stem, which bears leaves
Internode	the part of the stem between two successive nodes
Stoloniferous	with runners or propagative shoots rooting at the tip producing new plants; bearing stolons

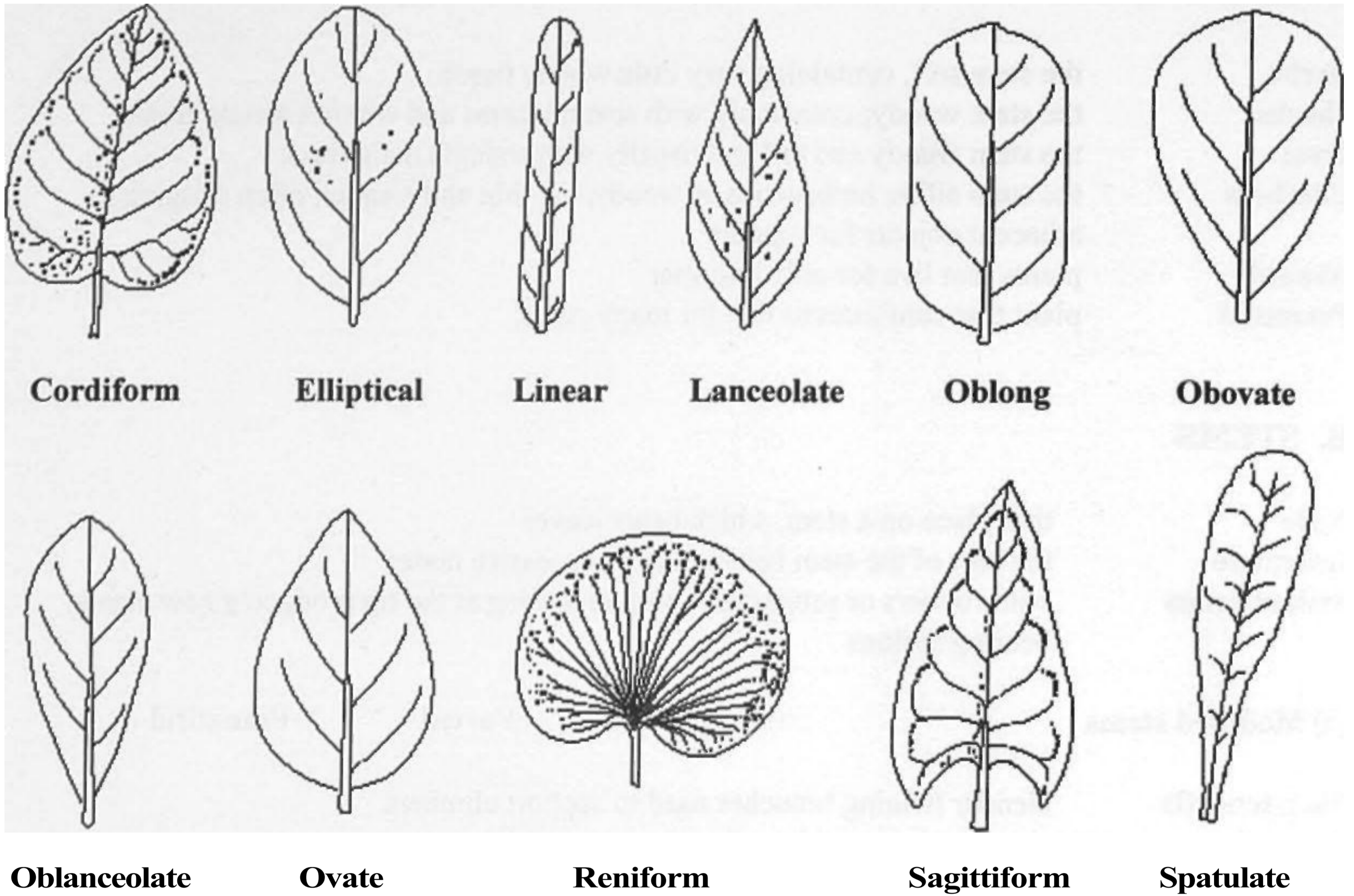
(a) Modified stems

Stem tendrils	slender twining branches used to support climbers
Thorns/spines	sharp and stunted branches
Stolons/runners	stems that trail above the ground, often rooting at the nodes
Rhizome/rootstock	thickened stem creeping horizontally underground and producing new shoots at their tips
Tuber	an underground swollen branch that normally serves for food storage and vegetative growth

C. LEAVES

Petiole	leaf stalk
	(i) channeled petiole petiole with a long longitudinal groove
	(ii) pericladial petiole petiole with a sheathing base
	(iii) phyllodial petiole a flattened petiole
Sessile	lacking a petiole
Stipule	a pair of appendage at the base of a petiole
Simple leaf	a leaf with a single blade
Compound leaf	a leaf with more than one leaf blade
Leaflets	the leaf blades of a compound leaf
Glabrous	smooth texture, devoid of hairs
Pubescent	covered with soft short hairs
Leaf sheath	more or less tubular portion of the leaf surrounding the stem
Ligule	an outgrowth or projection from the top of a leaf sheath

(a) Leaf shapes



Cordiform

heart-shaped

Elliptical

shape of a flattened circle, usually twice as long as broad

Linear

long and narrow with nearly parallel sides

Lanceolate

lance-shaped, tapering from a broad base; much longer than wide

Oblong

twice as long as broad and with sides parallel most of their length

Obovate

ovate, but with the broadest part near the apex

Oblanceolate

lanceolate, but the broadest part near the apex

Ovate

egg-shaped with the broadest part towards the base

Reniform

kidney-shaped

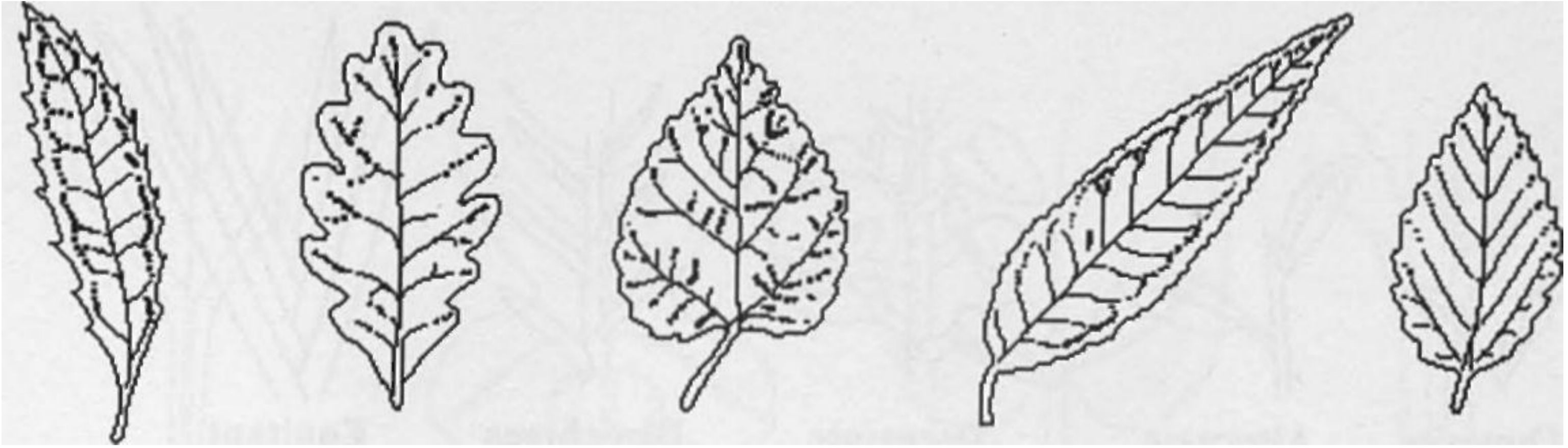
Sagittiform

triangular-ovate with straight or slightly curved basal lobes

Spatulate

oblong or obovate apically

(b) Leaf margin



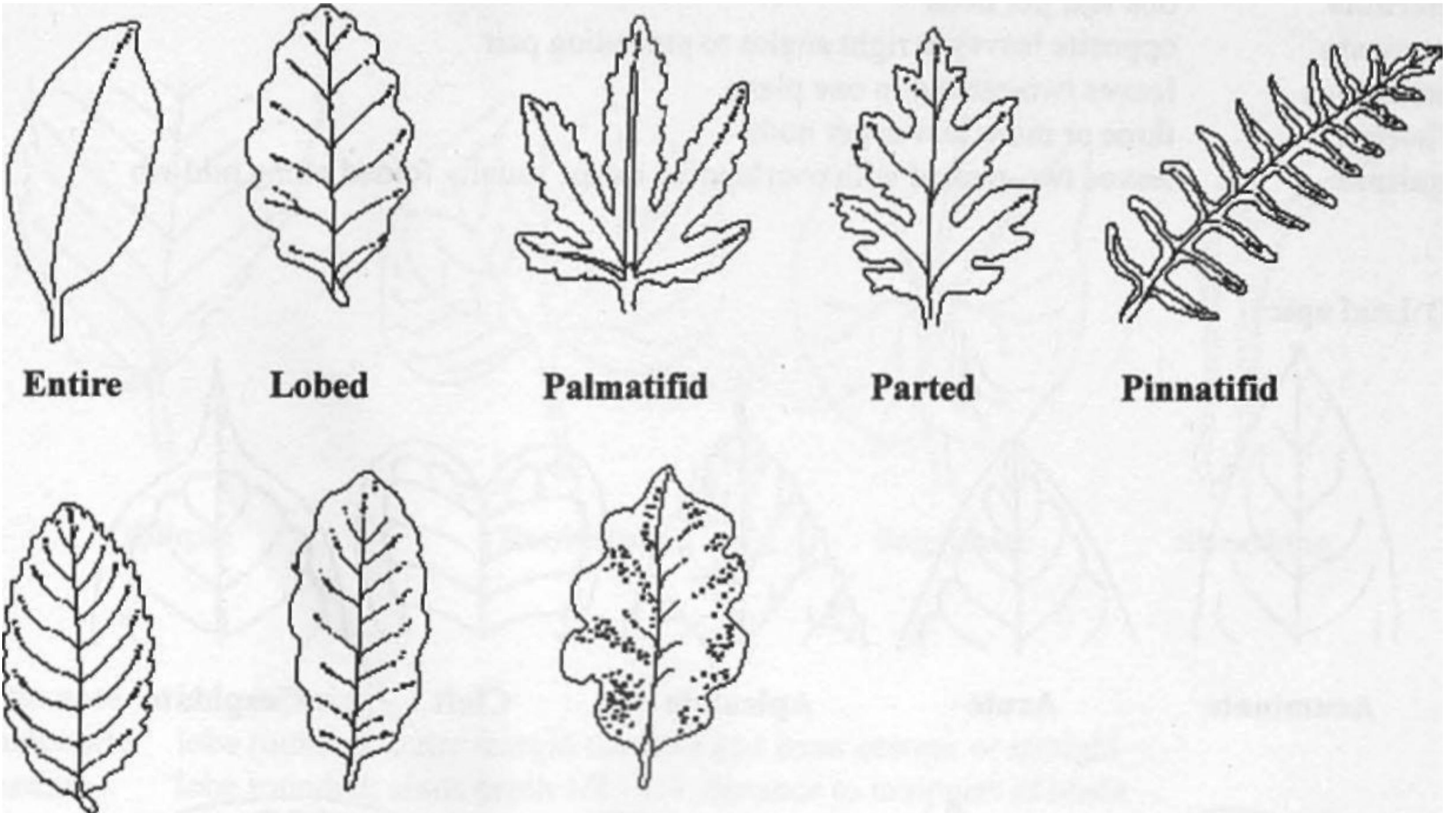
Aculeate

Cleft

Crenate

Crenulate

Dentate



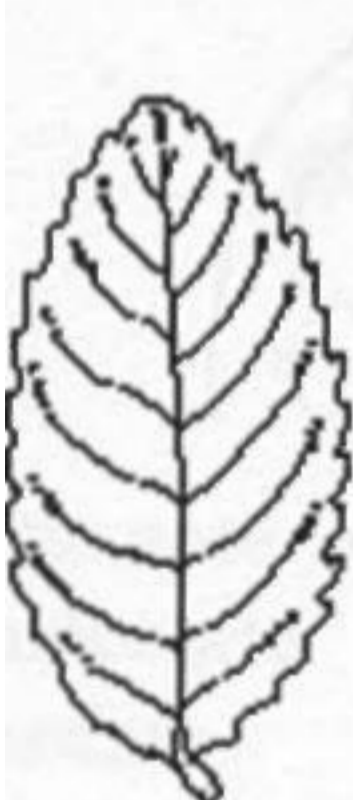
Entire

Lobed

Palmatifid

Parted

Pinnatifid



Serrate



Sinuate



Undulate

Aculeate

prickly

Cleft

indentations cut 1/4-1/2 distance to the mid-rib

Crenate

shallowly ascending round-toothed, cut less than 1/8 to mid-rib

Crenulate

diminutive of crenulate.

Dentate

margins with sharp or rounded teeth that points outwards at right-angles to mid-rib, cut 1/16-1/8 to midrib

Entire

without indentations or incisions on margin

Lobed

large, round-toothed, cut 1/8-1/4 distance to mid-rib

Palmatifid

cut palmately

Parted

indentations cut 1/2 - 3/4 distance to mid-rib

Pinnatifid

cut pinnately

Serrate

saw-toothed, cut 1/16 -1/8 distance to mid-rib

Sinuate

margins shallowly and smoothly indented, wavy in a horizontal plane, lobes indented 1/16 - 1/8 distance to mid-rib

Undulate

margins shallowly and smoothly indented, wavy in vertical plane.

(c) Leaf arrangement



Opposite

Alternate

Decussate

Distichious

Equitant

Basal

leaves form a cluster at the ground level

Opposite

leaves arranged opposite sides of the stem

Alternate

one leaf per node

Decussate

opposite leaves at right angles to preceding pair

Distichious

leaves two-ranked in one plane

Whorled

three or more leaves per node

Equitant

leaves two-ranked with overlapping bases, usually folded along mid-rib

(d) Leaf apice



Acuminate



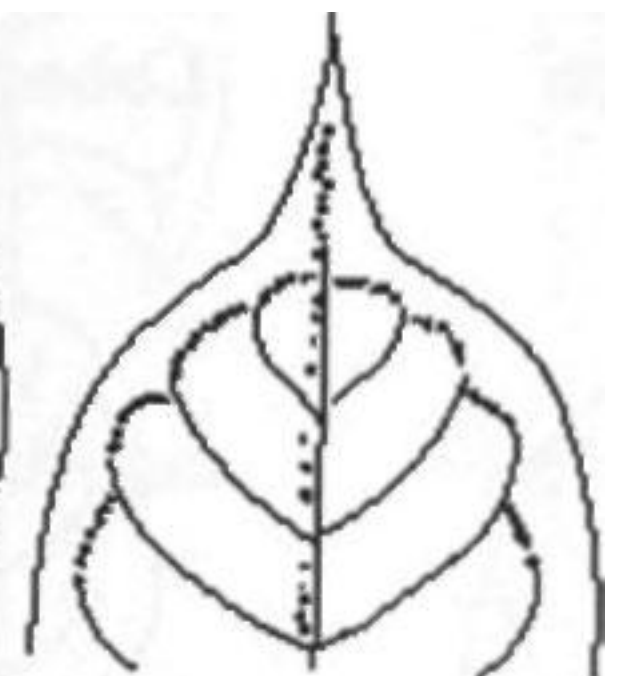
Acute



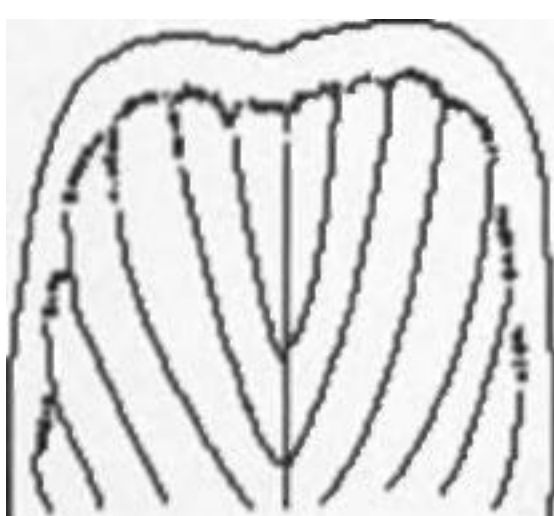
Apiculate



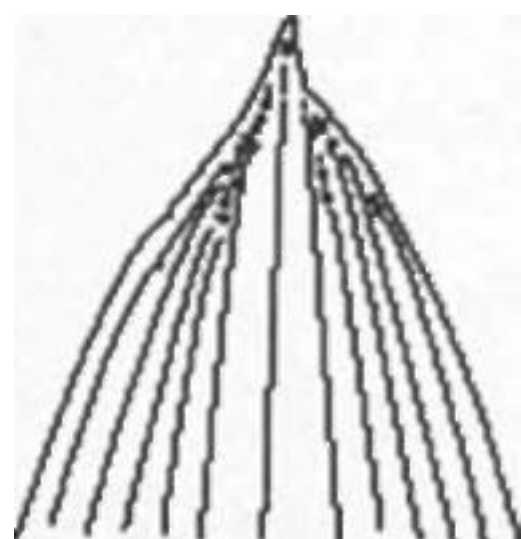
Cleft



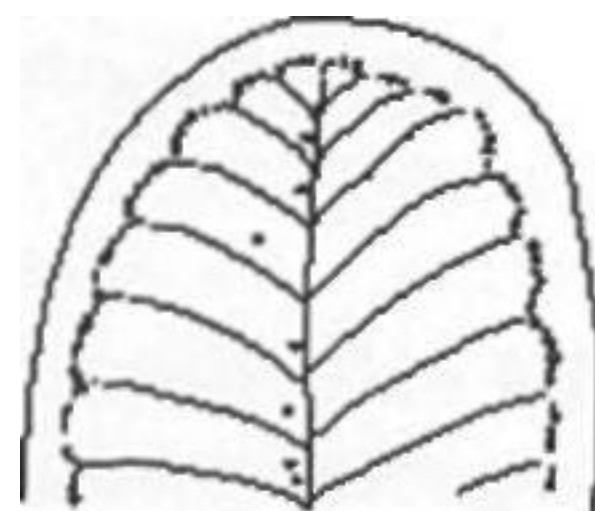
Cuspidate



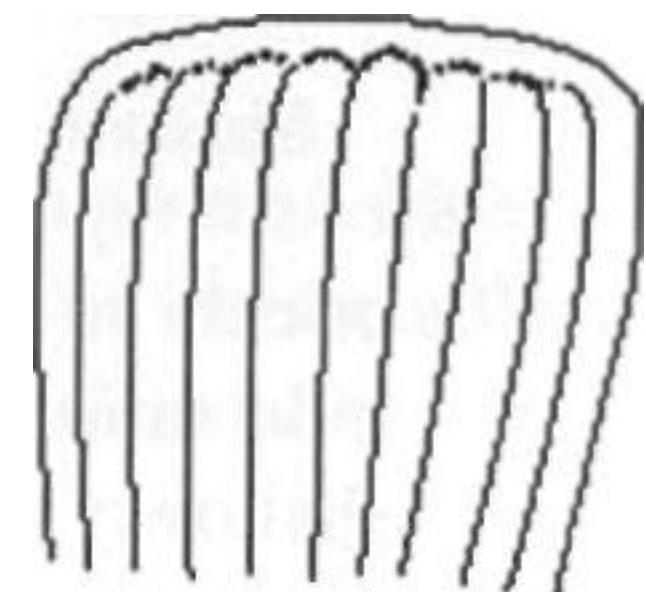
Emarginate



Mucronate



Rounded



Truncate

Acuminate

narrowly tapering to a sharp point forming a terminal angle of less than 45°

Acute

tapering more broadly to a sharp point forming a terminal angle of 45° to 90°

Apiculate

with a mid-rib extension; more than 3:1 (length:width)

Cleft

lobe rounded; sinus depth 1/4-1/2 distance to midpoint of blade

Cuspidate

acute but coriaceous and stiff at the tip

Emarginate

lobe rounded; sinus depth 1/16-1/8 distance to midpoint of blade

Mucronate

ending abruptly in a short stiff point

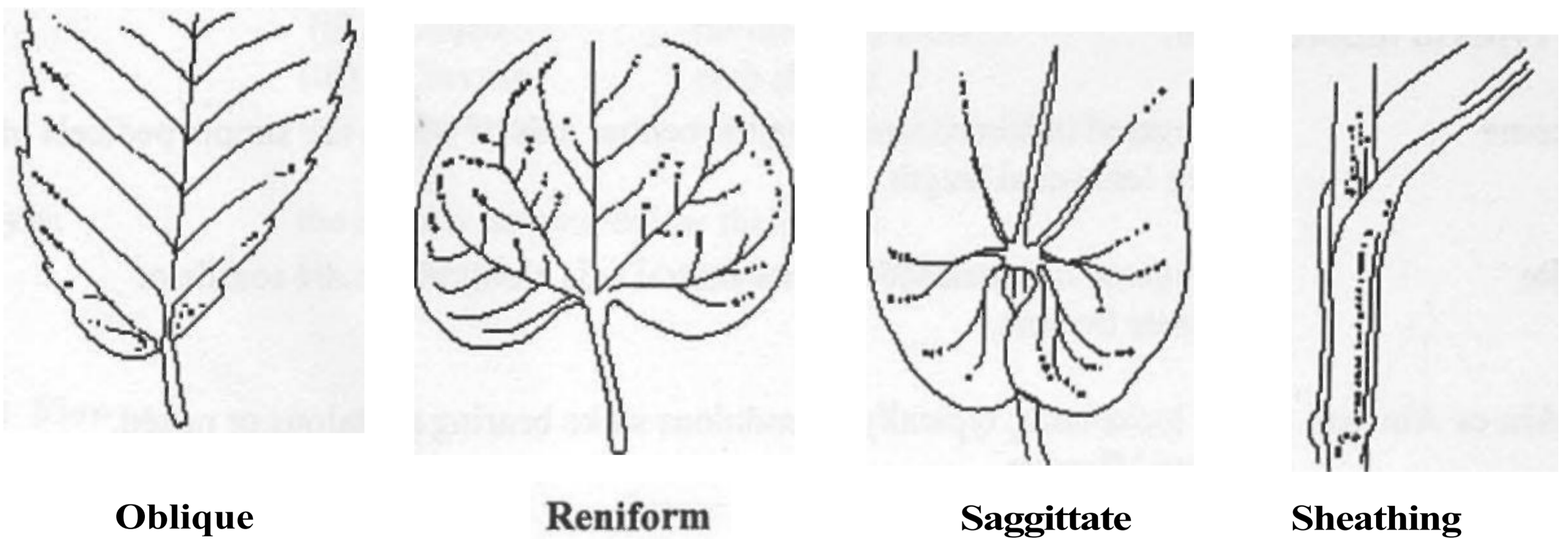
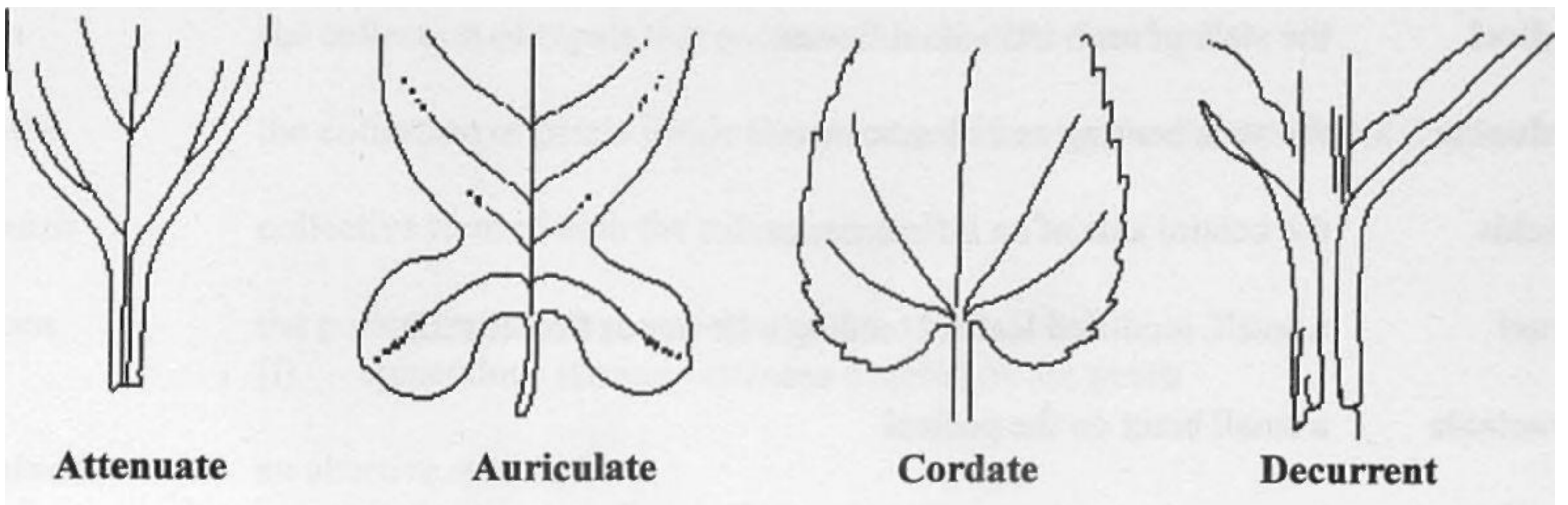
Rounded

margins and apex forming a smooth arc

Truncate

cut straight across, ending abruptly almost at right angles to midrib

(e) Leaf base



Attenuate	long-tapering
Auriculate	lobe rounded; outer margin concave and inner convex or straight
Cordate	lobe rounded; sinus depth $1/8$ - $1/4$ distance to midpoint of blade
Decurrent	extending along downward from leaf base
Oblique	having an asymmetrical base
Reniform	lobe rounded; outer margin convex or straight, inner concave
Saggittate	basal lobes drawn into points on either side of the petiole like the base of an arrowhead
Sheathing	having tubular structure enclosing the stem below apparent insertion of blade or petiole

D. INFLORESCENCES

Pedicel	the stalk of each individual flower
Peduncle	the stalk bearing an inflorescence
Rachis	the central axis of an inflorescence
Bract	a small, modified leaf subtending a flower or flower stalk
Bracteole	a small bract on the pedicel
Spathe	a conspicuous bract surrounding a flower cluster or a spadix

(a) Types of inflorescence

Raceme	an elongated inflorescence along the central axis of which are simple pedicels of more or less equal length.
Spike	an elongated inflorescence with a central axis along which are sessile or subsessile flowers.
Catkin or Ament	rather loose term, typically a pendulous spike bearing apetalous or naked, unisexual flowers.
Spadix	a densely flowering spike with a fleshy and thickened axis and a large subtending or enclosing spathe.
Corymb	a more or less flat-topped raceme in which the pedicels of the lower (or older) flowers are longer than those of the upper (or younger) flowers.
Cyme	a broad, more or less flat-topped inflorescence with central flowers blooming first.
Umbel	several branches arising from a common point at the summit of the peduncle, are terminated either by a single flower or by secondary umbels.
Panicle	a compound inflorescence in which the main axis is branched one or more times.
Glomerule	cluster of sessile or subsessile flower with the lower flowers maturing first.
Verticil	a whorled cyme at the nodes of an elongated rachis.

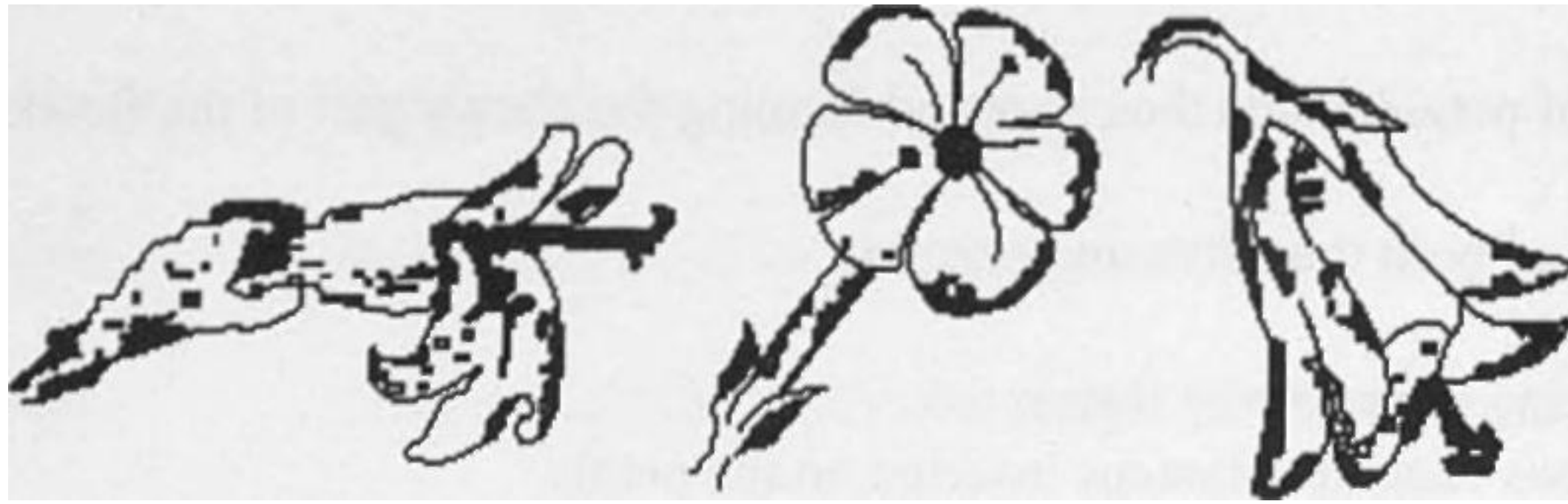
(b) Flower Parts

Calyx	the collection of sepals that encloses the other flower organs
Corolla	the collection of petals inside the calyx and forming the showy part of the flower
Perianth	collective term of both the calyx and corolla
Stamen	the pollen-bearing organ of the flower (i) epipetalous stamen - stamens inserted on the petals
Staminode	an abortive stamen
Stigma	the pollen receptive part of the flower (i) Terete cylindrical and elongate (ii) Lobed divided into lobes (iii) Clavate club shaped (iv) Decurrent elongate and extending downwards
Style:	the narrow column below the stigma (i) Terete cylindrical and elongate

(c) Flower

Actinomorphic or Regular	the flower is radially symmetrical.
Zygomorphic or Irregular	the perianth parts are dissimilar in size and shape
Hermaphrodite or Bisexual	flowers having both male and female organs.
Unisexual	flowers having either the male or female organs
Polysepalous	sepals free, not fused.
Polypetalous	petals free, not fused.
Gamosepalous	sepals fused to one another.
Gamopetalous	petals fused to one another.
Epipetalous	stamen inserted on the petals.

(d) Flower shape



Bilabiate

Salverform

Campanulate

Subglobose

Tubular

Bilabiate	two-lipped, with two unequal divisions. Lip here is also referred to as the labellum.
Salverform	trumpet-shaped with a slender tube
Campanulate	bell-shaped with a flaring tube
Subglobose	almost round or spherical
Tubular	cylindrical in shape
Ray or ligulate	strap-shaped

D. FRUIT

Achene	a one-seeded, dry, indehiscent fruit with seed attached to the fruit wall at one point only
Capsule	dry fruit derived from two or more loculed ovary or a compound ovary with two or more carpels.
Nut	a one-seeded, dry, indehiscent fruit with a hard pericarp, usually derived from a one loculed ovary
Nutlet	a small nut
Berry	fleshy fruit with a succulent pericarp
Drupe	a fleshy fruit with a stony endocarp

Appendix B : Glossary of Medical Terms

Abortifacient	an agent that induces abortion
Abscess	a localised collection of pus caused by suppuration in a tissue
Absorbent	any agent which attracts and sucks up gases or secretions from a wound
Acne	a term denoting an inflammatory disease occurring in or around the subaceous glands
Acrid	biting, pungent
Acute	a short period of time
Agalactia	absence or failure of secretion of milk
Agonist	affinity for receptor to initiate drug action
Ague	malaria
Albuminuria	the presence of serum albimun and serum globulin in the urine
Aldosteronism	disorder due to excessive secretion of aldosterone
Aleciapharmic	antidote to poison
Alexiteric	protective to infectious diseases
Alopecia	baldness, loss of hair - a malady in which the hair falls from one or more circumscribed round or oval areas, leaving the skin smooth and white
Alterative	causing a favourable change in the disordered functions of the body or metabolism
Amenorrhoea	failure of menstruation or abnormal menstrual periods
Amentia	an arrest of the development of the mind from birth to early age
Anaemia	lack of enough blood causing paleness
Anaesthetic	capable of abolishing feeling or sensation to pain or touch
Analeptic	ability to stimulate both the respiratory and vasometer centres in the medula of the brain and so increase the depth of breathing and blood pressure
Analgesic	pain reliever or pain killer
Analgetic	analgesic
Anaphrodisiac	having the power to lessen or inhibit sexual feeling
Anasarca	severe dropsy (obselete term) or generalized oedema
Aneurysm	dilation (ballooning) of artery
Angina pectoris	chest pains radiating to left shoulder down to the arm caused by coronary disease
Anodyne	a soothing medicine that relieves pain
Anorexia	a condition of having lost appetite for food
Antagonist	acting against drug action; act to compete with the drug for receptor
Antalgesic	analgesic
Antalgic	analgesic
Antarthritic	antiarthritic
Anthelmintic	antihelmintic destroying or expelling intestinal worms
Antiamebic	destroying or suppressing the growth of amoema
Antianginal	alleviating angina pectoris or chest pains due to myocardial ischemia
Antiarrhythmic	able to restore a disordered cardiac rhythm (cardiac arrhythmia) to normal sinus rhythm. Also called antidysrhythmic
Antiarthritic	alleviating arthritis, alleviating inflammation of the joints
Antiasthmatic	able to relief difficulty in breathing due to airway narrowing
Antibilious	against affliction with biliousness
Antibiotic	natural substances produced by living micro-organisms that are capable of destroying other micro-organisms or inhibiting their growth; term also applied to certain synthetic compounds having similar properties. It is sometimes used loosely to associate with the term antimicrobial

Antiblenorrhagic	preventing or relieving gonorrhoea
Antibradykinin	opposing the effects of bradykinin; a vasodilator and relaxant of smooth muscle
Antibronchitic	preventing or alleviating inflammation of the mucous membrane of the bronchial tubes
Anticholecystitic	preventing or alleviating inflammation of the gall bladder
Anticholinergic	inhibiting the impulse transmission through the parasympathetic nerves and which is thus opposed to the action of acetylcholine. Also called parasympatholytic
Anticoagulant	any substance that <i>in vivo</i> or <i>in vitro</i> , suppresses, delays or nullifies the coagulation of blood
Anticolic	relieving abdominal pain by expelling gas from the stomach and intestines
Anticonvulsant	relieving or preventing epileptic fits and related types of convulsions
Antidiabetic	relieving or preventing diabetes mellitus
Antidotal	acting as an antidote; also called antidotic, alexeteric (seldom used)
Antidote	an agent which neutralises or opposes that action of a poison
Antidotic	antidotal
Antidyspeptic	acts against nausea due to indigestion
Antiedemic	preventing or alleviating edema
Antiemetic	an agent that relieves vomiting
Antienteritic	preventing or alleviating inflammation of the mucosa of the small intestine
Antiepileptic	suppressing or controlling epileptic seizures or fits
Antifebrile	antipyretic
Antifertility	possessing the property of reducing fertility
Antigastralgie	used against stomach pain from any cause
Antiglaucomic	acting to alleviate or prevent an increase in intraocular pressure of the eye; against glaucoma
Antihepatotoxic	prevents toxicity to the liver
Antiherpetic	drug for skin inflammations
Antihistaminic	inhibiting the production of or neutralizing the effects of histamine
Antihidrotic	inhibiting or preventing perspiration or sweating
Antihyper- cholesterolemic	effective in decreasing or preventing an excessively high level of cholesterol in the blood
Antiinflammatory	able to suppress signs and symptoms of inflammation
Antileprous	antileprotic; general name for drug used in the therapy of leprosy (causative organism <i>Mycobacterium leprae</i>). Active against leprosy
Antileukemic	inhibiting or preventing unrestrained growth of leukocytes and their precursors in the tissues; against leukemia
Antilipemic	antilipidemic
Antilipidemic	antilipemic; counteracting high levels of fat in the blood
Antilithic	an agent which prevents the formation of or causes the removal of stones/calculi in the urinary or biliary tracts
Antimalarial	prevents the occurrence of, or to treat, malaria
Antimicrobial	killing microorganisms or suppressing their multiplication or growth
Antineoplastic	ability to control the growth and spread of neoplasms (cancer)
Antinociceptive	prevents perception of painful stimuli by the brain
Antiophthalmic	counteracting severe inflammation of the eye or the conjunctiva or deeper structures of the eye
Antiparkinsonian	controlling the signs and symptoms of a group of neurological disorders characterized by hypokinesia, tremor and muscular rigidity; against Parkinson disease
Antipeptic	inhibiting the action of gastric juices

Antiperiodic	preventing the regular recurrence of a disease
Antiphlogistic	acting against or relieving inflammation and fever
Antiprotozoic	destructive to protozoa
Antipruritic	preventing or relieving itching (pruritus)
Antipsoric	prevent or arrest itching
Antipsychotic	ability to reduce psychosis, a mental disorder characterised by the derangement of personality and distortion of reality, often accompanied by hallucinations or delusions
Antipyretic	Relieves or reduces fever. Also called antifebrile, antithermic and febrifuge
Antirheumatic	medicine for rheumatism
Antiscorbutic	effective in relieving or preventing scurvy
Antiseborrheic	effective against excessive secretion of sebum (a fatty secretion of skin sebaceous glands)
Antiseptic	an agent that counters sepsis by killing or inhibiting multiplication of microorganisms on living tissues, having the effect of limiting or preventing the harmful results of infection
Antisialagogue	lessens or prevents the flow of saliva
Antispasmodic	relieving or preventing spasm or cramps, usually of smooth muscle, as in arteries, bronchi, intestine, bile duct, ureters or sphincters, but also of voluntary muscle
Anthelmintic	anthelmintic; destroying or eliminating parasitic intestinal worms (helminths)
Antithermic	antipyretic
Antithrombogenic	an agent that prevents the production of clot
Antitubercular	an agent that prevents nodules formation of abnormal mass which performs no physiologic function
Antitumor	inhibits or prevents a spontaneous new tumor growth
Antitussive	cough suppressant; relieving or preventing cough
Antiulcer	preventing peptic ulcer
Antiviral	ability to kill infecting viruses
Anuria	complete cessation of the secretion and excretion of urine
Anxiolytic	antineurotic
Aperient	purgative; a laxative or mild cathartic
Aperitive	stimulates bowel movement; laxative
Aphrodisiac	a drug which stimulates sexual desire
Aphthae	small ulcers, especially the small whitish vesicular lesions on the mouth and tongue that are characteristic of thrush
Apoplexy	a sudden loss of consciousness
Appetite	the natural desire for food
Apthous	thrush
Arthralgia	pain in a joint
Arthritis	inflammation of a joint
Ascites	abnormal accumulation of fluid in the peritoneal cavity
Asphyxia	inability to breathe
Asthma	disease characterized by an increased responsiveness of the trachea and bronchi to various stimuli, manifested by recurrent attacks of widespread narrowing of the airways, difficult breathing, wheezing and cough
Astringent	ability to cause constriction of the tissues and arrest secretion or bleeding. Shrinks tissues and prevents secretion of fluids from wounds
Ataractic	tranquillizer
Ataxia	lack of muscular coordination
Atherosclerosis	disease due to arteries blocked by cholesterol deposits

Atrophy	wasting of a tissue or organ
Bactericide	capable of killing bacteria but not necessarily bacterial spores
Balanitis	a condition of inflammation of the glans penis or of the glans of clitoris
Balsamic	healing or soothing agent
Bechic	anything which relieves or cures cough
Beriberi	a deficiency disease caused by imbalance of carbohydrate and vitamin B
Billious fever	fever with vomiting of bile
Billiousness	a symptom of a disordered condition of the liver causing constipation, headache, loss of appetite and vomiting of bile
Bitter tonic	stimulates salivary flow; used to increase appetite and aid digestion
Blennorrhagia	free discharge of mucus
Bradycardia	disturbance of heart rhythm
Bradycardia	slowness of heart beat
Bronchodilator	produces dilatation of the bronchi
Bronchopathy	any disease of the bronchi
Bubo	an inflammatory swelling of a lymph gland
Cachexia	depressed habit of mind; a condition of general ill health
Calculus	a concretion formed in any part of the body usually compounds of salts of organic or inorganic acids
Calefacient	a remedy which gives rise to a sensation of warmth
Calmative	sedative
Carbuncle	an infection of the skin and subcutaneous tissue by <i>Satphylococcus aureus</i> ; inflamed ulcer, boil or tumor
Carcinogenic	producing carcinoma; the term is used to indicate cancer causing
Carcinoma	a malignant epithelial tumour eventually becoming fatal
Carcinostatic	inhibiting the growth of carcinoma
Cardiac	of or pertaining to the heart
Cardiodepressant	ability to lessen heart action so that it beats slower and weaker
Cardiodynia	pain in the region of the heart
Cardiopalmus	palpitation of the heart
Cardiopathy	a morbid condition of the heart
Cardiotonic	increasing tonicity of the heart
Cardiovascular	relating to the heart and blood vessels
Carminative	drug curing flatulence; expel gas from the alimentary canal
Cataplexy	a condition marked by abrupt attacks of muscular weakness
Cataract	opacity in the crystalline lens of the eye which may be partial or complete
Catarrh	inflammation of a mucous membrane, usually associated with an increase in the amount of normal secretion of mucus
Cathartic	having the power of cleansing the bowels. Alternative names are aperient, lenitive, laxative, evacuative and purgative
Cephalalgia	headache
Cephalic	a remedy for disorders of the head
Cephalopathy	any disease of the head
Cerebroopathy	any disorder of the brain
Cholagogue	a drug which causes increased flow of bile into the intestine
Choleretic	stimulates bile formation
Cholera	a severe infectious epidemic disease due to <i>Vibrio cholerae</i>

Chronic	of long duration
Cicatrizant	causes formation of scar tissue, healing of wounds
Cirrhosis	a general term meaning progressive fibrous tissue overgrowth in an organ
Clavate	club-shaped, slender below and thickened upward
CNS depressant	depressant that lessens brain activity, making the patient dull and less active
CNS sedative	ability to sedate, that is, to calm anxious and restless patients without causing sleep
CNS stimulant	an agent temporarily increasing brain functional activity
Colic	a severe spasmodic griping pain
Colitis	inflammation of the colon
Collyrium	a solution intended for application to the conjunctiva; eye lotions or eye-wash
Colonalgia	pain in the colon
Coloitis	inflammation of the colon
Colonorrhagia	haemorrhage from the colon
Colonorrhea	a mucous discharge from the colon
Colpitis	inflammation of the vagina
Colpoptosis	prolapse of the vagina
Colporrhagia	haemorrhage from the vagina
Coma	the state of complete loss of consciousness
Concoction	a preparation from crude materials, made by combining different ingredients
Condiment	a sauce or relish for food
Conjunctivitis	inflammation of the inner surface of the eyelid
Contraceptive	any agent or device used to prevent conception
Contusion	injury to tissues caused by blunt force which did not disrupt or lacerate their surface or bruise
Convulsant	produces convulsions or severe, involuntary, spasmodic contractions of the muscles
Convulsion	a violent involuntary contraction of the skeletal musculature
Cordial	stimulating medicine or drink
Corn	a small circumscribed painful horn growth
Counterirritant	ability to relieve a troublesome and more deep-seated irritation, inflammation, or pain by producing irritation or inflammation of the skin of less unpleasant sensation
Coxalgia	pain in the hip
Coxitis	inflammation of the hip joint
Croup	any condition caused by respiratory obstruction
Crude drug	any drug, whether of vegetable or animal origin which has not undergone any chemical change but rather only some physical change such as drying and comminution
Cyanosis	narrowing (eg of cardiac valves) ,
Cystitis	infection or inflammation of the urinary bladder and/or urinary tract
Cystalgia	pain in the urinary bladder
Cystodynia	cystalgia
Cystorrhoea	mucous discharge from the bladder
Dandruff	dead scarf-skin separating in small scales and entangled in the hair
Debility	weakness
Decoction	solutions representing the water-soluble constituents of plant drugs prepared by boiling the drug in water
Decongestant	tending to reduce congestion or swelling
Demulcent	an agent that soothe and allays irritation, especially of mucous surfaces; provides a protective coating on membranes
Dental caries	decay of teeth

Dentalgia	toothache
Dentifrice	any liquid, paste or powder used for cleansing the teeth
Deobstruent	relieving or removing obstructions of natural ducts of the body
Deodorant	removing the odour
Depilatory	an agent used for the removal of hair
Depression	emotional dejection; morbid sadness accompanied by loss of interest in surroundings and lack of energy
Depurative	an agent that purifies blood
Dermatitis	inflammation of the skin
Dermatopathy	any skin disorder
Dermatophytosis	a superficial infection of the skin caused by a fungus
Desiccating	depriving of moisture
Detergent	cleansing agent
Diabetes	a disorder characterized by excretion of urine
Diaphoresis	sweating
Diaphoretic	a drug which induces perspiration; sudorific is an alternative name
Diastolic	resting or minimum blood pressure reading when the heart relaxes or not pumping
Digestive	aids digestion
Diphtheria	a specific infectious disease caused by virulent strains of a bacillus
Disinfectant	having a lethal effect upon germs
Diuretic	promoting the flow of urine
Dizziness	any sensation of imbalance of a stable relationship with the immediate environment
Dosage form	a preparation devised to make possible the administration of medication in measured or prescribed amounts
Dropsy	an excessive accumulation of clear or watery fluid in any of the tissues or cavities of the body; edema
Dysentery	inflammation of large intestines with evacuation of liquid, and bloody stool and tenesmus
Dysfunction	abnormal or impaired functioning of an organ or bodily system
Dysmenorrhoea	difficult or painful menstruation
Dysopia	defective vision
Dyspnoea	difficulty in breathing
Dyspepsia	indigestion characterised by nausea
Dysphonia	difficulty or pain in speaking
Dystocia	difficult parturition
Dystrophy	disorder caused by faulty nutrition or by lesions of the pituitary gland and/or brain
Dysuria	difficulty or pain while discharging urine
Ecboic	hastening labour by causing contractions of uterine muscles; causing abortion; any agent producing or hastening labour or abortion. Alleviates menstrual aches and pains
Eclampsia	an attack of convulsion associated with hypertension in pregnancy
Eczema	a noncontagious inflammatory disease of the skin with much itching and burning, and formation of scales and crusts
Edema	abnormal accumulation of fluids in the tissues
Elephantiasis	Disease caused by infection with a parasitic worm; characterised by the skins becoming hard and fissured like that of an elephant's and enlargement of the affected part of the body; gross lymphatic oedema of the limbs leading to hypertrophy
Elixir	a drug capable of prolonging life indefinitely

Embrocate	to moisten and rub
Embrocation	liniment of medicine for external application
Emetic	causing vomiting
Emeto-cathartic	causes vomiting and bowel movement
Emmenagogue	an agent that promotes menstruation; medicine intended to restore the menses
Emollient	softening, soothing application to the skin
Emphysema	inflation, swelling
Empyema	accumulation of pus in the body cavity
Encephalitis	inflammation of the brain and spinal cord due to infection
Encephalopathy	any degenerative brain disease
Enema	any liquid preparation introduced into the rectum
Enuresis	involuntary voiding of urine
Epilepsy	an affection of the nervous system resulting from excessive or disordered discharge of cerebral neurons
Epistaxis	bleeding from the nose
Errhine	an agent causing increased nasal discharge
Erysipelas	an inflammatory disease generally affecting the face marked by a bright redness of the skin
Estrogenic	causing estrus; acting to produce the effects of an estrogen
Eupeptic	promotes good digestion
Euphoric	producing a sense of well-being especially an exaggerated or over-confident sense of well-being
Exanthematous	eruptions as in measles
Expectorant	promoting the ejection of phlegm or other fluid from the respiratory tract by coughing
Febrifuge	antipyretic; anything which reduces fever
Filariasis	infection with filarial nematode worms
Fistula in ano	an open channel from the anus or rectum to the skin near the anus
Flatulence	presence of excessive gas in the stomach or intestine
Flux	fluid discharge from bowels
Fomentation	application of warm, moist substance such as wet cloth to ease pain and inflammation
Frenzy	violent temporary mental derangement
Fungicide	capable of killing fungi, including their spores
Fungistat	induces fungistasis or inhibits the growth of fungi
Furuncle	local pus-forming inflammation of the skin and subcutaneous tissues; a boil
Galactagogue	medicine that promotes secretion of milk
Galactorrhea	excessive or spontaneous flow of milk
Galucoma	a term signifying increased intraocular pressure and its consequences
Gangrene	necrosis and putrefaction of tissue due to lack of blood supply
Gastralgia	pain in the stomach
Gastrodynia	gastralgia
Gastroenteritis	inflammation of the stomach and intestine characterized by pain; nausea and disease germs
Gastrohelcosis	ulceration of the stomach
Gastromegaly	enlargement of the stomach
Gastropathy	any disease of the stomach
Germicidal	causing destruction of microorganisms
Germicide	kills pathogenic microorganisms; it covers terms such as bactericide and fungicide

Gingivitis	inflammation of the gingival margins around the teeth accompanied by swelling and bleeding
Glaucoma	a term signifying increased intraocular pressure and its consequences
Gleet	chronic discharge of thin mucus from the vagina
Glomerulonephritis	renal disease of inflammation of capillaries in the kidney
Glycosuria	excretion of sugar in the urine
Goitre	enlargement of the thyroid gland
Gonorrhoea	an inflammatory disease of the genitourinary passages characterised by pain and discharge
Gout	a disease marked by painful inflammation of the joints
Granulocytopenia	abnormal reduction of granulocytes in the blood; called also agranulocytosis
Gripe	a sharp pain in the stomach
Gum	viscous fluid exuded by some plants which discolours and hardens on exposure to air and light
Haematuria	the presence of blood in the urine
Haematemesis	vomiting of blood
Haemoptysis	spitting of blood
Haemorrhoid	a bleeding pile
Haemostatic	styptic
Halitosis	offensive odour of the breath
Helminthiasis	morbid state due to infestation with worms
Hematorrhea	copious haemorrhage
Hemicrania	headache confined to one side
Hemiplegia	paralysis of one side of the body
Hemorrhage	bleeding, especially profuse
Hemorrhagic	relating to or characterized by bleeding or hemorrhage
Hemorrhoid	painful swelling formed by dilatation of a vein in the anus; usually accompanied by bleeding and constipation; piles
Hemostatic	having the property of stopping bleeding
Hepatitis (viral)	inflammation of the liver; jaundice
Hepatodynia	pain in the liver
Hepatoma	malignant tumor of the liver originating in the parenchymal cells; also called hepatocarcinoma
Hepatomegaly	enlargement of the liver
Hepatopathy	any disease of the liver
Hepatotropic	having a special affinity for or exerting a specific effect on the liver
Hepatosi	downward displacement of the liver
Hepatalgia	pain in the liver
Hernia	the protrusion of an internal organ through a defect in the wall of the anatomical cavity in which it lies
Herpes	inflammation of the skin or mucous membrane with clusters of deep seated vesicles
Hiccough, hiccup	spasm of the breathing organs with an abrupt cough-like sound
Hydrocele	collection of fluid in scrotum; dropsy of the testicle
Hydragogue	promoting expulsion of water or serum
Hydrocele	a circumscribed collection of fluid in the tunica vaginalis testis
Hydrophobia	exaggerated fear of water as in rabies

Hyperadenosis	proliferation of glandular tissue
Hypercholesterolemic	high blood cholesterol
Hyperdipsia	intense thirst of relatively brief duration
Hyperdiuresis	excessive secretion of urine
Hyperemesis	excessive vomiting
Hyperhidrosis	excessive perspiration
Hyperlipidemia	high blood lipids (triglycerides and cholesterol)
Hyperorexia	excessive appetite
Hyperpraxia	abnormal activity; restlessness
Hypertension	high blood pressure
Hyperthermia	a very high body temperature
Hypertropy	increase in mass (eg expansion of the left lower heart chamber as a consequence of extra work-load by the heart)
Hypnotic	induces sleep
Hypocholesterolemic	acts to cause an abnormal deficiency of cholesterol in the blood; also called hypocholesteremic
Hypochondriasis	Hypochondria; an exaggerated concern over physical health in spite of lack of health problems or diseases
Hypoglycemic	pertaining to, characterized by, or producing an abnormally diminished content of glucose in the blood, which may lead to tremulousness, cold sweat, poloerection, hypothermia and headache, accompanied by confusion, hallucinations, bizzarre behaviour, and ultimately convulsions and coma; an agent that acts to lower the level of glucose in the blood
Hypochondriasis	a state of mind in which the surface is much preoccupied with his health
Hypotension	a fall in blood pressure below the normal level
Hypotensive	causing abnormally low blood pressure
Hypothermia	greatly decreased temperature
Hysteria	a neurotic disorder with varying symptoms
Immunostimulant	substances that increase the intensity of the immune response and cause antibody formation
Impetigo	an inflammation of the skin associated with discrete vesicles due to streptococcal infection
Impotence	inability to perform the sexual act due to fialure of the reflex mechanism
<i>In vitro</i>	in an environment outside the body, normally in a test tube or other similar artificial environment
<i>In vivo</i>	within the living body
Inotropic	ability to control the force of heart contraction
Insanity	mental disease of a grave kind
Insecticidal	selectively toxic against the insects
Insecticide	any agent which kills or destroys insects
Insectifuge	any substance which drives away insects
Insomnia	the condition of being unable to sleep
Intoxication	general condition which results following the absorption and difusion in the body of a soluble poison
Intramusculan (i.m)	within the substance of a muscle
Intraperitoneal (i.p.)	within the peritoneal cavity

Intravenous (i.v.)	with a vein
Invigorant	strengthening, energy-giving agent
Irritant	giving rise to irritation
Ischemia	lack of blood in an area of the body due to mechanical obstruction or functional constriction of a blood vessel
Ischemic	relating to local deficiency of blood
Lactagogue	an agent which induces secretion of milk; galactagogue
Lactifuge	retarding or causing cessation of the secretion of milk
Laryngitis	inflammation of the larynx
Larvicide	an agent which destroys insect larvae
Laxative	having the action of loosening the bowel; purgative
Lentigo	a brownish or yellowish spot found on the skin, most often on the hands, arms or face often caused by exposure to sunlight
Leprosy	a chronic disease due to infection with <i>Mycobacterium leprae</i> , forming silvery scales on the skin and eating away the parts affected
Leucoderma	any white area on the skin
Leucorrhoea	an abnormal mucous discharge from the vagina
Leukemia	blood cancer
Leukocytotoxic	causing increase number of leukocytes in the blood
Liniment	a solution of an irritant drug intended to be rubbed on the skin as a counter-irritant
Lipemia	lipidemia; the presence of an abnormally large amount of fat in the blood
Lipidosis	general term applied to a disorder marked by an abnormal concentration of lipid in the tissues
Lithiasis	formation of stones in bladder and urinary tracts
Linthotriptic	an agent that dissolves calculi (an abnormal hard concretion, composed chiefly of mineral substances and salts, forms in various parts of the body especially in ducts, passages and hollow organs)
Lumbago	rheumatic pain in the lumbar region (region pertaining to the loins, part between thorax and pelvis)
Malignant	threatening life or tending to cause death
Malnutrition	faulty nutrition due to inadequate diet or to a metabolic abnormality; wrong intake of nutrients ie inadequate amounts or the wrong proportions of nutrients
Mammillitis	inflammation of the nipple
Masticatory	a substance to be chewed, but not swallowed
Maturate	to bring to maturity
Maturing	bring boils to a head
Melalgia	pain in the limbs
Melancholia	a mental illness in which the predominant symptom is melancholy, depression of spirits, unhappiness and misery
Menolipsis	temporary cessation of menstruation
Menorrhagia	excessive or prolonged menstruation
Menostasis	amenorrhoea
Metropathy	any uterine disease
Metroptosis	prolapse of the uterus
Metrorrhagia	uterine bleeding, usually of normal amount occurring at completely irregular intervals, the period of flow sometimes being prolonged
Metrorrhea	abnormal uterine discharge

Micturition	the act of passing urine
Migraine	a periodic condition with localised headaches, frequently associated with vomiting and sensory disturbances
Molluscicidal	destroying snails and other molluscs, especially the fresh-water snails that are the intermediate hosts of certain human and animal parasites
Morbid	belonging or relating to disease
Mucilage	gum-like material produced by some plants; has a soothing effect on inflamed parts
Mydratic	causes the pupil to dilate
Mumps	inflammation of the parotid glands, an acute infectious disease caused by a virus
Myalgia	muscular pain
Mydriasis	dilatation of the pupil
Mydriatic	a drug that dilates the pupil
Myorelaxant	relieves muscular tension
Myotic	causes the pupil to contract
Myringitis	inflammation of the tympanic membrane
Narcotic	a drug, which in moderate doses allays pain, reduces sensibility and induces sleep; in large amount, induces stupor, coma or convulsions
Nasitis	inflammation of the nose
Nauseant	an agent that causes nausea
Neoplasia	the formation and growth of tumor or new tissue
Neoplasm	the abnormal multiplication of cells with the formation of a mass or new growth of tissue; it may be localized (benign) or spreading and invasive (malignant); also called tumor
Nephralgia	pain in the kidney
Nephritis	inflammation of the kidneys
Nephrosclerosis	hardening of the kidney from arteriosclerosis
Nephrolithiasis	presence of renal calculi
Nephropathy	disease of the kidneys
Nervine	soothing to the nerves; provides nervous relaxation
Neuralgia	a painful affection of the nerves due to functional disturbances or neuritis; nerves causing intermittent but frequently intense pain
Neurasthenia	nervous debility
Neurohypophysis	pituitary gland
Notalgia	pain in the back
Nyctalopia	night blindness
Obesity	an excessive accumulation of fat in the body
Odontalgia	toothache
Odontopathy	any disease of the teeth
Oestrogenic	estrogenic
Oleaginous	oily, greasy
Opacity	an opaque or non-transparent area
Ophthalmia	a term usually applied to conjunctivitis
Ophthalmitis	inflammation of the eye ball
Ophthalmodynia	pain in the eye
Ophthalmopathy	any disease of the eye
Orchialgia	pain in the testis

Orchiopathy	any disorder of the testis
Orchitis	inflammation of the testis characterised by hypertrophy and pain
Ostalgia	pain in the bones
Osteomalacia	softening of the bones, resulting from vitamin D deficiency
Otalgia	pain in the ear
Otitis media	inflammation of the middle ear
Otopathy	any disease of the ear
Otopyorrhea	purulent discharge from the ear
Palliative	alleviates or eases a condition without curing it
Pancreatitis	inflammation of the pancreas
Paraplegia	stroke affecting one side
Parkinsonism	Parkinson's disease - a disease characterised by rigidity of muscles and tremor of the hands
Parturition	childbirth
Pectoral	pertaining to the chest
Pectoralgia	pain in the chest
Pediculicide	an insecticide used for destroying lice and nits
Per os (p.o.)	given by mouth
Pertussis	whooping cough
Pharyngitis	inflammation of the mucous membrane and underlying part of the pharynx; throat inflammation
Pharyngodynia	pain in the pharynx
Pharyngopathy	any disease of the pharynx
Phthisis	any wasting disease in which the whole body or part of the body is involved
Piscicide	any substance poisonous to fish
Pleural effusion	fluid accumulation in the lungs causing shortness of breath
Pneumonia	a general disease in which the essential lesion is an inflammation of the spongy tissue of the lung with consolidation of the alveolar exudate
Pneumonitis	inflammation of lung tissue
Pneumonopathy	any disease of the lungs
Pneumonosis	any lung disorder
Pneumorrhagia	a severe haemoptysis
Poliomyelitis	an acute inflammation of the anterior horn cells of the spinal cord due to an enterovirus infection
Post-partum	after childbirth
Poultice	a soft mush prepared by various substances with oily or watery fluids
Procreant	the drug which begets
Proctalgia	pain in the rectum
Proctitis	inflammation of the rectum
Proctoptosis	prolapse of the rectum
Prophylactic	pertaining to the prevention of the development of a disease
Proteolytic	hastening the hydrolysis of proteins
Prurigo	an eruption of the skin causing severe itching
Pruritus	itching
Psoriasis	a condition characterised by the eruption of circumscribed discrete and confluent reddish, silvery scaled lesions
Psoriasis plantaris	psoriasis of the sole

Psychoactive	producing acute reactions resembling those occurring in mental diseases
Psychopathy	any disease of the mind
Ptyalism	excessive secretion of saliva
Pulmonary	pertaining to the lungs
Purgative	causing vigorous emptying of the bowels, and which may be used to remove poisons from the alimentary canal; causing evacuation from the intestines
Pyorrhoea	a discharge of pus from the gums
Pyrexia	a condition characterised by the presence of pus
Pyrrhea	discharge of pus from the gums
Pyrosis	a stomach disorder characterised by burning sensation with eructations of acidic fluids
Rachialgia	pain in the vertebral column
Radiculalgia	neuralgia of the nerve roots
Radiculitis	inflammation of spinal nerve roots
Ramitis	inflammation of a nerve root
Reactivator	restores to a state of activity
Rectalgia	proctalgia
Rectitis	proctitis
Refrigerant	cooling or relieving fever and thirst
Rejuvenator	causes renewed vitality
Relaxant	lessening or reducing tension; an agent that lessens tension
Renal calculi	calculi relating to kidney
Renopathy	any disease of the kidney
Repand	wavy-margined
Resolvent	causing resolution of a tumour or swelling
Restorative	having the power to restore or renew health
Resuscitative	the act of restoring to life
Retinitis	inflammation of the retina
Retuse	an obtuse-apex somewhat indented
Revulsive	causing revulsion in drawing away of blood from a pathological area to another area; diverts disease from one part to another
Rheumarthritis	rheumatoid arthritis
Rheumatalgia	rheumatic pain
Rheumatism	painful inflammation and swelling of joints, muscles and fibrous tissues
Rhinalgia	pain in the nose
Rhinitis	inflammation of the nasal mucous membrane
Rhinodynia	pain in the nose
Rhinopathy	any disease of the nose
Rhinorrhagia	copious haemorrhage from the nose
Rickets	a disturbance of the calcium/phosphorous metabolism which occurs in the growing child as a result of vitamin D deficiency
Roborant	a strengthening agent
Rubefacient	an external skin application causing redness of the skin
Sarcocele	fleshy swelling or tumour of the testis
Scabicide	an agent which kills mites, especially the causative agent of scabies
Scabies	sarcoptic infestation of the human skin particularly a contagious skin disease caused by invasion of the epidermis

Scald	the lesion caused by contact with a hot liquid or vapour
Scalding of urine	severe burning sensation during micturition
Scleritis	inflammation of the sclera
Scrofula	tuberculous cervical adenitis with or without ulceration; constitutional disease with glandular swellings
Scurvy	a deficiency disease due to lack of vitamin C
Sedative	soothing or allaying excitement or nervousness
Sialogogue	an agent that stimulates the secretion of saliva
Sinovitis	inflammation of the synovial membrane of a joint
Sinusitis	inflammation affecting the mural epithelium of a sinus
Somatalgia	body pain
Somnifacient	causing sleep
Somnolence	sleepiness
Soporific	causing or inducing profound sleep
Spanomenorrhea	scanty menstruation
Splenalgia	pain in the spleen
Splenitis	inflammation of the spleen
Splenohepato- megaly	enlargement of spleen and liver
Splenomegaly	enlargement of the spleen
Splenopathy	any disease of the spleen
Stenosis	narrowing (eg of cardiac valves)
Sternutatory	provoking sneezing
Stimulant	increases or hastens body activity
Stomachalgia	pain in the stomach
Stomachic	stimulates activity of the stomach
Stomatalgia	pain in the mouth
Stomatitis	generalised inflammation of the oral mucosa
Stomatopathy	any disorder of the mouth
Stomatorrhagia	haemorrhage from the mouth
Styptic	having the power to arrest bleeding
Sudorific	inducing sweat; also called diaphoretic
Suppurative	producing or associated with the generating of pus
Syphilis	a contagious venereal disease
Tachycardia	rapid beating of the heart
Taeniafuge	expels tapeworm
Taenicide	an agent which kills tapeworms
Tenesmus	the sensation of a need to evacuate the bladder or bowels without result
Tetanus	an infective disease due to the toxins of <i>Clostridium tetani</i>
Thermoplegia	sun stroke
Thrush	candidiasis of the mouth due to infection with <i>Candida albicans</i> , characterized by the formation of small whitish vascular spots on the mouth and tongue often accompanied by gastro-intestinal irritation and fever
Tincture	alcoholic extract of a plant drug
Tonic	produces healthy muscular condition and reaction
Tonsilitis	inflammation of the tonsil
Toxaemia	the condition of general poisoning caused by the entrance of soluble bacterial toxins into the blood

Tranquilizer	an agent that soothes or allays excitement or nervousness or relieves anxiety or emotional tension, promoting a state of tranquillity without affecting clarity of consciousness
Trauma	a pathological alteration of the supporting tissues of a tooth due to abnormal occlusion
Trichogenous	stimulating the growth of hair
Trypanocide	an agent which kills trypanosomes, the causative organisms of trypanosomiasis; also called trypanosomicide
Tympanites	flatulence of the belly
Tympanitis	inflammation of the middle ear
Ulcer	a superficial inflammation or sore of the skin or mucous membrane discharging pus
Ulemorrhagia	bleeding from the gums
Ulitis	inflammation of the gums
Ulocace	ulceration of the gums
Ulorrhagia	free hemorrhage from the gums
Ulorrhea	bleeding from the gums
Urelcosis	ulceration of the urinary tract
Ureteralgia	pain in the ureter
Ureteritis	inflammation of the ureter
Urethritis	inflammation of the urethra
Urethrorrhagia	flow of blood from the urethra
Urethrorrhea	abnormal discharge from the urethra
Urocyst	the urinary bladder
Urocystitis	inflammation of the urinary bladder
Urodynia	pain on urination
Uro-oedema	oedema due to infiltration of urine
Urolithiasis	urinary calculi
Uropathy	any disease of the urinary tract
Urorrhagia	excessive secretion of urine
Urorrhea	involuntary flow of urine
Uroschesis	retention of urine
Urticaria	nettle rash
Uteritis	inflammation of the uterus
Uterotonic	giving muscular tone to the uterus
Vaginitis	inflammation of the vagina
Vaginodynia	pain in the vagina
Vaginopathy	any disease of the vagina
Vermicide	kills worms
Vermifuge	a drug that expels worms
Verminosis	helminthiasis
Vertigo	dizziness
Vesical	referring to the urinary bladder
Vesicant	an agent used to produce blisters
Visceromegaly	abnormal enlargement of the viscera
Vulnerary	an agent used to assist in wound healing
Wart	a circumscribed cutaneous excrescence

Index

A

Abortifacient	67, 96
Acanthaceae	17
<i>Acorus calamus</i>	4, 7, 8, 9
Ague	64
<i>Aloe vera</i>	4, 10, 11, 12
<i>Alpinia galanga</i>	4, 14
Alterative	18
Anaemia	42, 43
Analgesic	8, 18, 34, 43, 56, 64, 97, 98
<i>Andrographis paniculata</i>	4, 17, 18, 19
Angina pectoris	12, 18
Anodyne	67
Anorexia	73, 88
Anthelmintic	15, 18, 19, 31, 43, 57, 64, 67, 96
Antiarrhythmic	7
Antibilious	64
Antibiotic	11, 30, 38, 42, 43, 55, 64, 67
Anticoagulant	31
Anticonvulsant	7, 23
Antidiabetic	11, 12
Antidotal	46
Antidote	18
Antiemetic	64, 96, 97, 98
Antifebrile	67
Antifertility	19, 22, 61, 68, 82
Antihepatotoxic	31, 79, 84
Antihistaminic	46
Antiinflammatory	10, 11, 23, 31, 34, 42, 67, 68, 74, 77, 97
Antilithic	67
Antimalarial	31, 46
Antimicrobial	18, 28, 56, 57, 64, 71, 97
Antineoplastic	11
Antipeptic	10, 11, 28
Antiperiodic	7, 37
Antipyretic	18, 22, 23, 42, 46, 64, 67, 97, 98
Antiseptic	7, 28, 56, 57, 64, 82, 83
Antispasmodic	7, 23, 37, 61, 68
Antitussive	57, 64
Antiulcer	9, 46
Antiviral	11, 46, 57, 78, 79
Anuria	42, 43
Anxiolytic	23, 34, 35
Aphrodisiac	15, 45, 46, 48, 82
Apiaceae	21
Araceae	7
Arthritis	11, 28, 40, 46, 52, 64, 98
Astringent	59, 64, 82, 84, 88

B

Bactericide	31
Basil	69, 70, 71, 72
Betelvine	81

Bunga raya	48
------------	----

C

Carbuncle	49
Cardiac	43
Carminative	8, 9, 14, 27, 31, 37, 51, 52, 57, 61, 64, 67, 71, 73, 82, 88, 96
Catarrh	31, 73, 77, 82, 92
Cathartic	11, 64
Cekur	51, 52
<i>Centella asiatica</i>	4, 21, 22, 24, 70
Cholera	52
<i>Cinnamomum verum</i>	4, 26
Cinnamon	26, 27, 28
Cirrhosis	43
Citronella	33, 37, 38
CNS depressant	8, 23, 35
Colic	7, 8, 11, 15, 31, 18, 64, 73, 96
Compositae	39, 42
Condiment	31
Conjunctivitis	22, 40, 43
Contraceptive	1, 7
Convulsion	74
Croup	73
<i>Curcuma domestica</i>	4, 30, 31
<i>Cymbopogon citratus</i>	4, 33, 34, 61
<i>Cymbopogon nardus</i>	4, 37

D

Decongestant	64
Demulcent	70, 73
Dermatitis	12, 28, 56
Diabetes	8, 12, 15, 18, 64, 74, 77, 85
Diaphoretic	7, 9, 37, 43, 57, 70, 71, 73, 96
Digestive	18, 67, 83, 96
Disinfectant	56, 88
Diuretic	22, 34, 37, 42, 43, 52, 61, 67, 68, 70, 77, 79, 80, 84, 85, 88, 92, 93, 96
Dizziness	18, 22
Dropsy	8, 11, 22, 40, 43, 46, 67, 79, 85, 88, 96
Drumstick tree	66
Dukung anak	78, 79, 82
Dysentery	8, 11, 18, 22, 27, 31, 43, 46, 53, 59, 64, 70, 79, 82, 85, 93
Dysmenorrhoea	53
Dyspepsia	7, 8, 10, 15, 27, 31, 32, 43, 52, 73, 88, 96
Dysuria	43, 64

E

<i>Eclipta alba</i>	4, 39, 40
---------------------	-----------

Eczema	10, 22,31,43,57		
Edema	10, 43, 67, 74, 82		
Ekor anjing	84, 85, 86		
Elephantiasis	40		
<i>Elephantopus scaber</i>	4, 42, 43		
Elephant's foot	42		
Emetic	7, 40, 64, 67		
Emmenagogue	11,31,34,37, 43, 64, 67, 79, 84, 96		
Emollient	42, 43, 64, 93		
Encephalitis	43		
Epilepsy	67		
Euphorbiaceae	78		
<i>Eurycoma longifolia</i>	4, 45, 46		
Expectorant	18, 27, 49,51,52, 57, 64, 67, 71, 82, 85		
False daisy	39		
Febrifuge	18, 38, 42, 43,46, 79, 82, 84, 85		
Finger root	51		
Flatulence	7,8,18,27,31,34,46,53,58, 73, 88, 96, 98		
G			
Gelang pasir	92, 93		
Ginger	64, 95, 97		
Goitre	.67		
Gonorrhoea	31,53,67, 70, 73,79, 82, 85, 88		
Gotu kola	21		
Gout	67, 77, 86		
Graminae	33, 37		
Great plantain	84		
Greater galangal	14		
Green purslane	92		
H			
Haemoptysis	93		
Halia	95		
Hempedu bumi	17, 18, 19		
Hepatitis (viral)	22, 40, 43, 64, 79		
Herpes	15, 67		
Hibiscus	48, 49, 50		
<i>Hibiscus rosa-sinensis</i>	4, 48, 49		
Horse radish tree	66		
Hypertension	18, 22, 23, 24, 28, 79, 85		
Hysteria	67		
I			
Immunostimulant	74		
Indian mulberry	63		
Insecticidal	8,11,23,64,69		
Insecticide	8,9		
Insomnia	18, 22	Noni	63, 64
Irritant	67		
J			
Java tea		76	
Jerangau		7	
K			
Kacang kelur		66	
Kacip fatimah		53, 54	
<i>Kaempferia galanga</i>		4,51,52	
Kayu manis		26	
Kemangi		72, 73, 74	
Keremak		39, 40	
Kesum		90,91	
Kunyit		30	
L			
<i>Labisia pumila</i>		4,43	
Lamiaceae		60, 69, 72, 76, 87	
Lauraceae		26	
Laxative		64, 67, 73, 85	
Lemongrass		33, 34, 35, 37	
Lengkuas		14, 15	
Leprosy		18, 22, 23,40, 67	
Leucorrhoea		22, 42, 43, 58, 64	
Leukemia		1, 10, 19	
Lidah buaya		10	
Liliaceae		10	
Lumbago		46, 64	
M			
Malvaceae		48	
Maraba		51	
Masticatory		82	
<i>Melaleuca alternifolia</i>		4, 55, 56	
<i>Melasioma malabathricum</i>		4, 58, 59	
Melastomataceae		58	
Mengkudu		63,64	
Menorrhagia		79	
<i>Mentha arvensis</i>		4, 60,61,62	
Mint		60, 61	
Misai kucing		18, 76, 77	
<i>Morinda citrifolia</i>		4, 63, 64	
<i>Moringa oleifera</i>		4, 66, 67, 68	
Moringaceae		66	
Mumps		22	
Myrsinaceae		53	
Myrtaceae		55	
N			
Nephritis		77, 85	
Neuralgia		31	
Nilam		87	

O

Ocimum basilicum 4, 69,71,73
Ocimum sanctum 4, 40,71,72, 73
Orthosiphon stamineus 4, 18,76,77

p

Parturition 42
 Patchouli 70, 87, 88
 Pegaga 21, 22, 23, 24
 Pertussis 10, 43
 Pharyngitis 22
 Phthisis 27, 28 73, 88
Phyllanthus niruri 4, 78, 79
 Pick-a-back 78
Piper betle 4,81
 Piperaceae 81
 Plantaginaceae 84
Plantago major 4, 84, 85
Pogostemon cablin 4, 87, 88
 Polygonaceae 90
Polygonum minus 4, 90
Portulaca oleraceae 4, 92, 93
 Portulacaceae 92
 Prophylactic 82, 85, 96
 Prurigo 31
 Psoriasis 12, 64
 Pudina 60
 Pulmonary 43,93
 Purgative 11,40, 67, 79, 84

R

Refrigerant 92
 Relaxant 64
 Rheumatism 8, 14, 15, 22,27, 28,31,34, 46, 52, 53, 64, 67, 73, 77, 88, 96
 Rubefacient 27, 37, 64, 67
 Rubiaceae 63



S

Scurvy 67, 93
 Sedative 7,9,93
 Selasih 69
 Senduduk 58, 59
 Serai 33
 Serai Wangi 37
 Simaroubaceae 45
 Singapore rhodendron 58
 Sireh 43, 81, 82, 83
 Stimulant 7,8,27,31,37, 53,57,61,67, 70,71, 73, 82, 96
 Stolon 21, 39, 60
 Stomachic 4, 18,61,67,73,79,82,84, 88, 93, 96, 98
 Sudorific 37, 61, 67, 73
 Sweet basil 69, 71
 Sweet flag 7, 8,9
 Syphilis 22, 79

T

Tea tree 55, 56, 57
 Thrush 85
 Tongkat ali 45,46
 Tonsilitis 18, 22
 Tumeric 30,31,32, 64
 Tutup bumi 42, 43

U

Ulcer 18, 23, 24, 40, 49, 64, 79, 93

V

Vermifuge 9, 11,38,46, 64, 93
 Vertigo 40, 98
 Vesicant 67

Z

Zingiber officinale 4, 8, 58, 95, 98
 Zingiberaceae 14,30, 51, 95



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