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TIPPILI
(*Piper longum*)

Information Services Centre
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Medicinal and Aromatic Plant Series, No. 5



Piper longum
- a literature survey -

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Piper longum

1.0 Introduction

For several centuries spices, along with gold, silk and precious stones, were the principal articles of trade from Far Eastern countries. In India and the Far East, where many of the spices originated, their use for food and medicinal purposes was known from the earliest times. References to spices such as ginger, turmeric, long pepper and pepper are found in ancient Sanskrit texts. Ayurvedic texts of Susruta and Caraca, which covered both food and medications, discuss in great detail the use of spices for flavouring foods and for medicinal purposes.

The Egyptians employed many aromatic spices for medicinal, cosmetic, fumigatory and embalming purposes. Hippocrates, the father of medicine and Theophrastus, the Greek philosopher and botanist, wrote treatises on medicinal plants which included many spices.

Long pepper belongs to the family Piperaceae, and to the genus *Piper* which is distributed throughout the tropical and subtropical forest regions of the world. Long pepper is the dried female inflorescence of the aromatic creeper *Piper longum*. Various types of long pepper are known and are recognizable by their distinctive shape and the size of their berries. *Piper longum*, the actual Indian long pepper berries are 1 – 3 cm long and 4 – 6 mm in diameter. *Piper retrofractum* and *Piper officinarum* yield fruits which are very robust, 2.5 – 4.0 cm long and 4 – 8 mm in diameter, and have comparatively smooth surfaces. These species are generally grown in Malaysia and known in the trade as Javanese long pepper, and prices are relatively lower than *Piper longum*.

2.0 BOTANY ^{28,43,85}

2.1 TAXONOMY

Family	:	Piperaceae
Genus	:	<i>Piper</i>
Species	:	<i>longum</i>

Botanical names

Piper longum Linn.; *Piper sarmentosum* Wall.; *Piper latifolium* Hunter; *Chavica roxburghii* Miq.; *Chavica sarmentosa* Miq.

Other names

Sinhala	:	Tippili, Wagapul
English	:	Long pepper
Tamil	:	Argadi, Atti, Pippili
Hindi	:	Pipal, Piplamul
Sanskrit	:	Chanchala, Chapala

2.2 PLANT DESCRIPTION

Piper longum is a slender aromatic climber with perennial woody roots. Stems are numerous 60 – 90 cm long, creeping, much branched, stout, cylindrical, thickened above nodes. Leaves are simple, alternate, numerous, 4 – 9 cm long and 3 – 5 cm wide. The lower ones broadly ovate, cordate with broad rounded lobes at base, upper ones oblong-oval, cordate at base, all subacute, entire, glabrous, thin, bullate with reticulate venation sunk above and raised beneath, dark green and shining above, pale and dull beneath. Petioles of lower leaves 0.1 – 1.2 cm long, stout of upper ones very short or none.

Flowers are unisexual, sessile in axial of fleshy bracts supported by two lateral bracts arranged in solitary, pedunculate spikes. Male spikes slender, bracts narrow; female spikes 1.2 – 2.5 cm long, bracts circular flat, peltate. Fruits are very small ovoid, completely sunk in solid fleshy spike which is 2.5 – 3.7 cm long, ovoid-oblong, erect blunt, blackish green and shining.

3.0 HABITAT ⁴³

Probably a native of Northeast India. Occurs in the warmer parts of India, Sri Lanka, Malay Peninsula, Timor and Philippine Islands.

4.0 AGRONOMY ^{33,37,40,85,87}

4.1 SOIL AND CLIMATE

Pepper vine thrives in a moist, hot climate at altitude from 450 – 600 m. It tolerates temperatures ranging from 24 – 30 °C. An annual rainfall of over 250 cm is ideal, but it also grows well in areas of lower rainfall provided the rain is evenly distributed throughout the year. It grows well in sandy loam soil rich in humus and well drained.

4.2 PROPAGATION

Naturally it is propagated through secondary branches arising at nodes of the main stem. In common practice stem cuttings with 2 – 4 nodes are used for vegetative propagation. Recent research carried out at CISIR has shown that single nodal cuttings can be used instead of the traditional method of propagation using stem cuttings with 3 – 4 nodes. Auxins [10mg/l IBA (Indole-3-butyric acid) or NAA (Naphthalene acetic acid)] can be used effectively to increase the root initiation and growth of shoots as well.

4.2.1 NURSERY TECHNIQUES FOR PLANTING

A mixture of top soil, compost, coir dust and coarse sand in 4:1:1:1 ratio is prepared in a shape of an asbestos sheet. Cuttings with 2 nodes are planted in high places with 15 cm spacing and covered with coconut leaves to retain dampness. Watering the plants at least once a day is necessary. Care should be taken to prevent fungal attack on stems. If any attack is observed, the coverings should be removed, and remedial action taken.

4.2.2 FIELD PLANTING

On a well drained loam land, 30 cm deep planting holes with 120 cm x 120 cm spacing are prepared. Two coconut shells full of compost are added to each hole and, well grown plantlets are inserted in the holes.

Weeding and watering is necessary in the initial stages. Two coconut shells full of compost mixed with urea is applied every 3 – 4 months.

4.3 HARVESTING

The spikes can be harvested 6 months after planting while still green and unripe, as they are most pungent at this stage. They are dried in the sun when they turn grey. The yield increases from 560 kg/hectare in the first year to 1,680 kg/hectare in the third year. Subsequently it becomes less productive and should be replaced. Harvesting can be done weekly and yields of about 50g can be obtained monthly from one plant.

5.0 CHEMISTRY OF PLANT ^{32,34,35,37,39,50,51,80,85}

5.1 CHEMICAL COMPOSITION OF PLANT

Long pepper is similar in proximate composition to black pepper (*Piper nigrum*). But it is less expensive and used as an adulterant of ground black pepper. However it can be detected by the increase in acid-soluble ash and by microscopic examination of starch granules as starch granules of *Piper longum* are longer in size than those of pepper and have a characteristic angular shape.

Proximate Composition

Moisture	9.5%
Protein	12.2%
Starch	39.5%
Fibre	5.8%
Total ash	5.9%
Insoluble acid	4.2%
Volatile oil	1.5%
Fixed oil	6.6%
Piperine	4.5%

(All values except for moisture are measured on dry basis)

The active constituents of *Piper longum* are the alkaloids. They exhibit characteristic mouthfeel, a pepper-like pungency, and pronounced salivation and numbness.

The highest content of piperine was found in the underground part of the stem and roots. Piperine content of fruits increases with maturity from 14 – 16 days (0.53%) to 40 – 45 days (0.9%).

5.2 CHEMICAL COMPOSITION OF *Piper longum* OIL

Long pepper on steam distillation yields 0.7 – 1.5% of light green, viscous oil with a spicy odour resembling that of pepper and ginger, and has the following characteristics.

D₂₀ 0.8484
N₂₀ 1.4769
[α]_D 40.1
m.p. -6 °C
acid value 7.2
saponification value 8.9
sap. value after acetylation 12.8

n-hexadecane	0.7%
n-heptadecane	6.0%
n-octadecane	5.8%
n-eisocane	4.7%
n-heneicosane	2.5%
α - thujene	1.7%
terpinolene	1.3%
zingiberene	7.0%
ρ -methoxy acetophenone	trace
dihydrocarveol	4.3%
phenethyl alcohol	2.1%

5.3 CHEMICAL CONSTITUENTS OF FRUITS

Sylvatin
Sesamin
Diaeuolemin
Piperine
Piplartine
Asarinin
Pluviatilol
Fragenin (E) & (Z)
Pipercide
Guineenside
Longamide
Piplasterol
Dihydropiperonaline

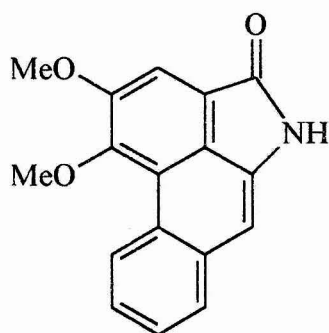
5.4 CHEMICAL CONSTITUENTS OF ROOTS

Piperine
Piperlongunine
Piperlonguminine
Piplasterol
Triacontane

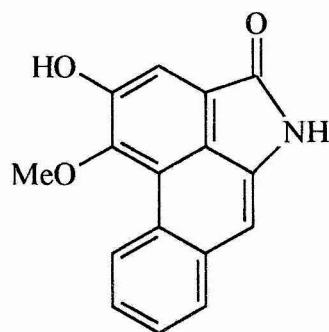
Cepharanone B
Aristolactam AII
Piperolactam A
Piperolactam B
Cepharadione A
Cepharadione B
Norcepharadione B
Sesamin
22,23 – dihydrostigmasterol
methyl – 3,4,5 – trimethoxy cinnamate
piperadione

5.5 CHEMICAL CONSTITUENTS OF LEAVES

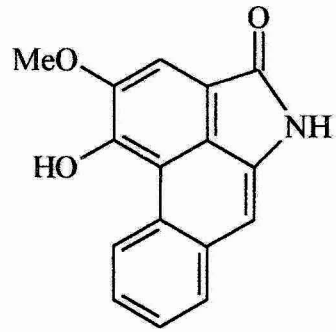
Hentriacontane
 β -sitosterol
hentriacontane – 16 – one
triacontanol



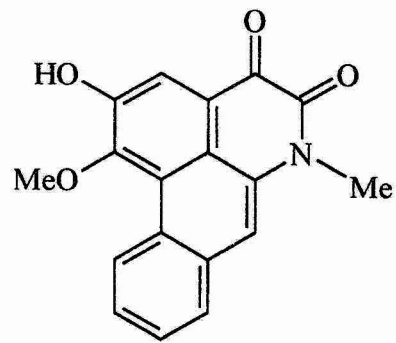
Cepharanone B



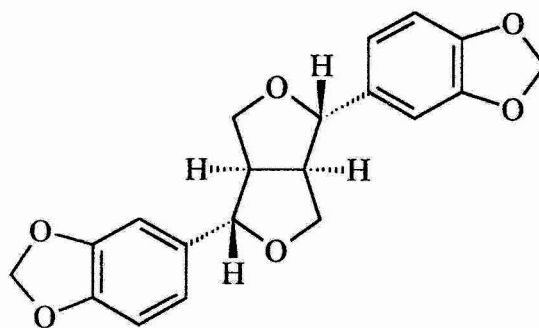
Aristolactam A II



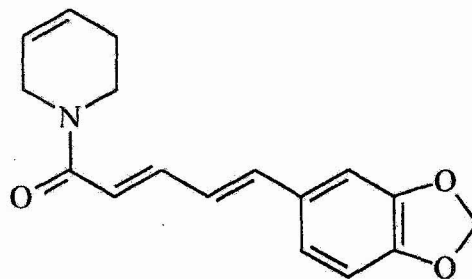
Piperolactam A



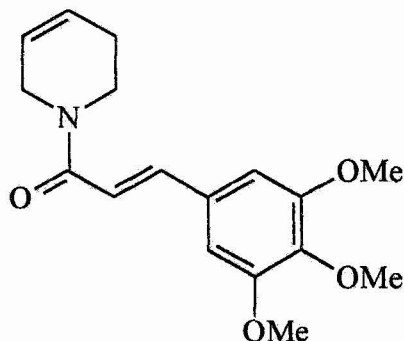
Piperadione



Sesamin



Piperine



Piplartine (Piperlongumine)

Figure 1. Chemical Constituents of *Piper longum*

6.0 BIOLOGY AND HEALTH ASPECTS ^{9,38,45,49,50,85}

6.1 BIOLOGICAL ACTIVITY

Piper longum has been used in medicine for a very long time. The alkaloid, piperine is the most active component in *Piper longum*. It was evaluated for its anti hepatotoxic formulations. It has a significant protection against tert-butyl hydroperoxide and CCl₄ hepatotoxicity by reducing both *in vitro* and *in vivo* lipid peroxidation, enzymatic linkage of glutamali pyruvate transaminase (GPT) and alkaline phosphatase (AP), and by preventing the depletion of glutathione (GSH) and total thiols of intoxicated mice.

The fruits as well as the roots are attributed with numerous medicinal uses, and are used for diseases of the respiratory tract, viz., cough, bronchitis, asthma, etc., as counter-irritant and analgesic when applied locally for muscular pains and inflammation; as snuff in insomnia and epilepsy, as general tonic and haematinic, as cholagogue in obstruction

of bile duct and gall bladder, as an emmenagogue and abortifacient, and for miscellaneous purposes as anthelmintic and in dysentery and leprosy.

An alkaloid isolated from *Piper longum* has shown a significant *in vitro* anti tubercular activity against *Mycobacterium tuberculosis* H-37 Rv strain, which can inhibit the growth of the bacillus in 20 µg/ml concentration.

Alcoholic extracts of the dry fruits and aqueous extracts of the leaves had shown activity against *Micrococcus pyogenes* var. *aureus* and *Escherichia coli*. Ether extracts of the fruits had shown larvicidal properties

Piper species have been used internally in the treatment of various fevers, gastric and abdominal disorders and urinary difficulties. Both *Piper longum* and *Piper nigrum* increase pentobarbitone sleeping time, which was suggested to be, due to the enhancement of barbiturate uptake which was noted in the rat brain in the presence of piperine or altered rate of pentobarbitone degradation observed in rat liver slices up to 1hour.

Both *Piper longum* and *Piper nigrum* have the ability to increase the elevated blood pressure and produced conditional avoidance response in dogs. *Piper longum* can also exert stimulatory effect on the central nervous system in rats.

Under the influence of *Piper longum*, immunological response has been observed in rats and guinea pigs against antigen – induced bronchospasm.

Anti-fertility activity in female albino rats were shown when seeds of *Embelia ribes* and the roots *Piper longum* were administered at a dose of 100 mg/kg body weight on days 4 to 7 and 6 to 9 of pregnancy respectively.

Methanol extract of long pepper shows nematocidal activity on the second stage larva of *Toxocara* even at a concentration as low as 0.1 – 0.2 mg/ml.

Dehydropiperonaline, isolated from dried fruits had significantly inhibited the KCl – induced contraction of the rabbit isolated coronary artery.

6.2 ETHNOMEDICINE

6.2.1 AYURVEDIC USES

Long pepper is one of the widely used medicines in Ayurveda. Fruits, roots and leaves of pepper are used as medicine. According to the Ayurveda Pharmacopoeia, there are four varieties of Tippili namely, Tippili, Gaja Tippili, Saihali and Wana Tippili. Murugu Tippili is another variety found in native Sri Lankan medicine. Among these, Gaja tippili and Murugu tippili are not actual tippili.

In native ayurvedic system, the powdered fruit administered with honey is said to cure cough, asthma, hoarseness, hic-cough and enlarged spleen.

Equal proportions of black pepper, long pepper and ginger, collectively named 'Trikatu', a sanskrit word meaning 'Three Acrids' is documented in Indian Ayurvedic Materia Medica as an essential ingredient of numerous prescriptions and formulations used for a wide range of disorders. Several studies have shown that Trikatu, its constituents and piperine, a major alkaloid from pepper possessed a bioavailability enhancing activity. This has the ability to enhance the bioavailability of number of drugs like vasicine, spartein, sulphadiazine and tetracycline in experimental animals. Trikatu has been described as a major decoction useful in restoring the imbalance of Kapha, Veta and Pitta which according to Ayurvedic Concept represents the three humors of the body and the imbalance of which causes all types of diseases.

'Shadooshnam' an ayurvedic drug consisting of long pepper berries and root, pepper roots, *Plumbago* spp., dried ginger and pepper berries is used as a carminative, digestant and stimulant of taste. It relieves the defects in hearing.

In catarrhal fever with difficulty of breathing, a powder made of equal parts of Karkatashringi, bark of *Myrica sapida* and long pepper is given in one drachm doses with honey.

In rheumatism, roasted aments are beaten up with honey; It is also given powdered with black pepper and rock salt in half tola doses for colic.

Pipalli arista, which composed of long pepper, lodhra, black pepper, grapes and Cissampelos pareira is used in asthma, cough, anonexia, piles, etc.

Equal parts of black pepper, long pepper, seeds of *Moringa pterygosperma* and ginger, powdered and rubbed together with the juice of the root of *Agati grandiflora* is used as a snuff in coma and drowsiness.

A compound powder of five pungents named Panch Kola Churna, consisting of long pepper, long pepper root, dry ginger, stem of pepper plant and chitraka is a good appetizer useful in treating dyspepsia, cough, flatulence and enlarged spleen.

Pippali rasayana, prepared from *Piper longum* and *Butea monosperma*, is used in the treatment of chronic dysentery and worm infections. This has also shown positive results when tested for anti-giardial and immuno-stimulatory activity in mice, infected with *Giardia lamblia* trophozoites.

An ayurvedic preparation consisting of dried ginger, black pepper, long pepper and leadwort root fermented in cow's urine was given internally and a paste made of several medical herbs including *Psoralea corylifolia* for external application, showed positive results in patients with vitillgo.

Ayurvedic preparation consisting of *Thepesia populnea*, *Elletaria cardamomum*, *Zingiber officinalis*, *Gycysrhiza glabra*, *Piper longum* and honey claimed to be useful for jaundice and liver disorders has been evaluated for its anti hepatotoxic activity in male albino rats.

Vyoshadi guggulu, consisting of *Zingiber officinale*, *Piper longum*, *Piper nigrum*, *Plumbago indica*, *Terminalia chebula*, *Terminalia belerica*, *Phyllanthus emblica*, *Embelia ribes* and *Commiphora mukul*, *Vachadi gana* and *Vashpa sweda* have shown good results in cases of rheumatoid arthritis with pain, swelling and functional disability. Chandrodayawati, a compositi herbo-mineral drug containing *Terminalia chebula*, *Terminalia belerica*, *Acorus calamus*, *Saussurea lappa*, *Piper longum*, *Piper nigrum* and knoch ash has been found to be effective in the treatment of nebular corneal opacity and pterigium of recent origin.

Some of the ayurvedic preparations using *Piper longum* and their uses

Ayurvedic Preparation	Uses
1. Pippalyadyasavaya	Tuberculosis, Bronchitis, Cattarrh, Anaemia, Piles, Abdominal diseases
2. Thalisedee Choorana	Cough, Asthma, Cattarrh, Influenza, Diseases of digestive system
3. Thikuluhingu Kwatha	Asthma, Cough, Palpitation, Pain in respiratory system
4. Chavanaprashavaleha	Diseases of respiratory syste and urinary system, Cools the body
5. Kaphahara Kwatha	Cough, Asthma, Whooping cough Bronchitis, Influenza
6. Dashamoolarishtaya	Tonic
7. Seethopaladee Choorana	Bronchial asthma, Asthma, Cattarrh
8. Pippalyadi Kwatha	Diseases in digestive system, gastrities
9. Pippalyadi Louhaya	Diseases of respiratory system
10. Samahan	Cough, Cold, Fever

BIBLIOGRAPHY

1. Abhang, R.A.
Clinical study to evaluate the efficacy of an Ayurvedic Suksma compound preparation in diseases of Pranavahastrotas. *Deerghayu International X-01(37)*p.9-10 (1994)
2. Abraham, C.C.
Occurrence of *Helopeltis theivora* Waterhouse (Miridae:Hemiptera) as a pest of Indian long pepper (*Piper longum* Linn.) *Entomon* **16(3)**p.245-246 (1991)
3. Agarwal, A.K., Singh, M., Gupta, N., Saxena, R., Puri, A., Verma, A.K and Dubey, C.B.
Management of giardiasis by an immuno-modulatory herbal drug pippali rasayana. *J.Ethnopharmacology* **44(3)**p.143-146 (1994)
4. Agarwal, R.G., Tewari, L.C. and Pandey, M.
Periodical analysis of Tribuvan Kirti Rasa. *Aryavaidyan* **4(4)**p.238-244 (1991)
5. Aggarwal, M. and Kaul, B.L.
The radio protective effects of piperine in plants. *Indian Drugs* **29(10)**p.447-449 (1992)
6. Alam, M., Sathiavasan, K., Dasan, K.K.S., Paranthaman, M. and Purushothaman, K.K.
Studies in standardisation of Avalehas.Part III. *J.Res.Ayur.Siddha* **5(1-4)**p.33-37 (1984)
7. Annamalai, A.R. and Mananvalan, R.
Effects of 'Trikatu' and its individual components and piperine on gastrointestinal tracts: Trikatu-a bioavailable enhancer. *Indian Drugs* **27(12)**p.595-604 (1990)
8. Aruna, Krishnakumar, Sivaramakrishnan, V.M. and Sivaswamy, S.N.
Inhibition of nitrosation reaction by some spices/leafy vegetables. *Advances in Plant Sci.* **4(1)**p.189-193 (1991)
9. Aruna, M. and Sivaramakrishnan, V.M.
Plants products as protective agents against cancer. *Indian J. of Exp.Biology* **28(11)**p.1008-1011 (1990)
10. Atal, C.K., Zutshi, U., and Rao, P.G.
Scientific evidence on the role of Ayurvedic herbals on bioavailability of drugs. *J.Ethnopharmacology* **4(2)**p.229-232 (1981)
11. Atal, C.P., Dhar, K.L. and Singh, J.
The Chemistry of Indian Piper species. *Lloydia* **38(3)**p.256-264 (1975)
12. Banerjee, T. and Chaudhuri, S.
The crystal and molecular structure of N-(3,4,5-trimethoxycinnamoyl)-DELTA3-piperidine-2-one, an amide alkaloid (piperlongumine), C₁₇H₁₉NO₅. *Canadian J. of Chemistry* **64(5)**p.876-880 (1986)
13. Bano, G., Amla, V., Raina, R.K., Zutshi, U. and Chopra, C.L.
The effect of piperine on pharmacokinetics of phenytoin in healthy volunteers. *Planta Medica* **53(6)**p.568-569 (1987)
14. Bhat, S.R., Chandel, K.P.S. and Malik, S.K.
Plant regeneration from various explants of cultivated *Piper* species. *Plant Cell Reports-14(6)*p.398-402 (1995)

15. Bhat, S.R., Kackar, A. and Chandel, K.P.S.
Plant regeneration from callus cultures of *Piper longum* L. by organogenesis. *Plant Cell Reports* **11**(10)p.525-528 (1992)
16. Carlo Nisoli, L.G., Maffeo, G., Musso, G., Ramella, F. and Salvo, R.
Estrus induction in cattle and pigs using a herb-based preparation (Prajana). *Indian J.Indigenous Medicines* **8**(2)p.53-58 (1991)
17. Chandhoke, N., Gupta, S. and Dhar, S.
Interceptive activity of various species of *Piper*, their natural amides and semi-synthetic analogs. *Indian J.of Pharmaceutical Sci.* **40**(4)p.113-116 (1978)
18. Chandrasekera, H.I.
Clinical trial on rheumatoid arthritis with vyoshadi guggulu and vachali kwatha. *Rheumatism* **17**(4)p.127-130 (1982)
19. Chhajed, S., Baghel, M.S., Ravishankar, B. and Gurdip Singh
Evaluation of hepatoprotective effect of *Piper longum* and *Withania somnifera* in hepatotoxicity induced by antitubercular drugs in mice. *J.Res.and Edu.in Indian Medicine* **10**(3)p.9-12 (1991)
20. Chopra, R.N., Nayar, S.L. and Chopra, I.C.
Glossary of Indian medicinal plants. Council of Scientific & Industrial Research, New Delhi. 1956
21. Chourasia, H.K. and Roy, A.K.
Effect of relative humidity on fungal association and aflatoxin production in *Piper longum*. *Indian Botanical Reporter* **8**(2)p.138-140 (1989)
22. Chourasia, H.K. and Roy, A.K.
Treat to traditional herbal medicines with moulds. *Int. Sem. on Recent Trends in Pharmaceutical Sci.*, Ootacamund, Abs.No.A25 1995
23. Dadhich, A.P., Vyas, D.S. and Khanna, N.K.
Mrtyunjayarasavati in chronic sinusitis- A preliminary clinical study. *J.Research in Ayurveda and Siddha* **13**(1-2)p.78-81 (1992)
24. Dahanukar, S.A. and Karandikar, S.M.
Evaluation of antiallergic activity of *Piper longum*. *Indian Drugs* **21**(9)p.377-383 (1984)
25. Dananukar, S.A., Karandikar, S.M. and Desai, M.
Efficacy of *Piper longum* in childhood asthma. *Indian Drugs* **21**(9)p.384-388 (1984)
26. Das, P.C., Sarkar, A.K. and Thakur, S.
Studies on animals of a herbo-mineral compound for a long acting contraception. *Fitoterapia* **58**(4)p.257-261 (1987)
27. Dash, Bhagwan Dr.
Ayurvedic cures for common diseases. Hindi Pocket Books (Pvt) Ltd., Delhi 1991
28. Dassanayake, M.D. and Fosberg, F.R.
Flora of Ceylon. Vol.VI. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 1987
29. Dasture, A.V.
Screening of two Ayurvedic preparations for usefulness in treatment of muscular weakness. *Deerghayu International X-1*(37)p.3-8 (1994)

30. De, S. Dave, K.K.
Standardization of Mrtyunjana Rasa. *Indian Drugs* **27**(7)p.375-377 (1990)
31. De, S. Dave, K.K.
Standardization of Tribhuvankirti Rasa. *J. of Res. and Edu. in Indian Medicine* **8**(4)p.43-47 (1989)
32. Desai, S.J., Prabhu, B.R. and Mulchandani, N.B.
Aristolactams and 4,5-dioxoaporphines from *Piper longum*. *Phytochemistry* **27**(5)p.1511-1515 (1988)
33. Dharmadasa, R.M.
Studies on some agromedical and chemical aspects of *Piper longum*. Final year report, University of Ruhuna, 1995
34. Donata, Sr., Kesavan, M., Austin, Sr., Mohan, K.S. and Rajagopalan, K.
Clinical trial of certain Ayurvedic medicines indicated in vitiligo. *Ancient Sci. of Life* **9**(4)p.202-206 (1990)
35. Dutta, C.P., Banerjee, N. and Roy, D.N.
Lignans in the seeds of *Piper longum*. *Phytochemistry* **14**(9)p.2090-2091 (1975)
36. Gakkhar, A.K.
Efficacy of shool Prashaman Mahakshya in stomach pain. *Sachitra Ayurveda* **47**(4)p.265-266 (1994)
37. Govindarajan, V.S.
Piper. *CRC Critical Rev. in Food Sci. and Nutrition* **9**p.115-225 (1977)
38. Grag, S.K.
Antifertility effect of *Embelia ribes* and *Piper longum* in female rats. *Fitoterapia* **52**(4)p.167-169 (1981)
39. Ikram, M. and Hussain S.F.
Compendium of medicinal plants. Pakistan Council of Sci. and Industrial Res., 1978
40. Ilyas, M.
Spices in India. *Econ. Bot.* **30**(3)p.273-280 (1976)
41. Jain, C.M.
Teething troubles in children and their treatment. *Sachitra Ayurved* **47**(2)p.103-107 (1994)
42. Jain, P., Khanna, N.K., Trehan, N., Pendse, V.K. and Godhwani, J.L.
Antiinflammatory effects of an Ayurvedic preparation, Brahmi rasayan, in rodents. *Indian J. Exp. Biology* **32**(9)p.633-636 (1994)
43. Jayaweera, D.M.A.
Medicinal plants. Part IV. The National Science Council of Sri Lanka, Colombo. 1982
44. John, K.
The gallery of spices and herbs-III. *Indian Spices* **27**(4)p.36-46 (1990)
45. Johri, R.K. and Zutshi, U.
An Ayurvedic formulation 'Trikatu' and its constituents. *J. Ethnopharmacology* **37**(2)p.85-91 (1992)
46. Keji, C.
Observation on the analgesic effect of Kuan-xiong aerosol on anginal attacks. *J. Natl. Integ. Med. Assoc.* **24**(4)p.107-110 (1982)

47. Khapkin, I.S.
Prospects of using preparations from plants for regulating platelet aggregation. *Rastitel'nye-Resursy* **30**(1-2)p.86-90 (1994)
48. Kholkute, S.D., Kekare, M.B. and Munshi, S.R.
Antifertility effects of the fruits of *Piper longum* in female rats. *Indian J.Exp.Biol.* **117**(3)p.289-290 (1979)
49. Kiuchi, F, Koshimaru, N., Tsuda, Y., Kondo, K., Tabata, M. and Honda, G.
Screening of crude drugs used in Turkey for nematocidal activity on the larva of *Toxocara canis*. *Shoyakugaku Zasshi* **43**(4)p.288-293 (1989)
50. Koul, I.B. and Kapil, A.
Evaluation of the liver protective potential of piperine, an active principle of black and long Peppers. *Planta Medica* **59**(5)p.413-417 (1993)
51. Koul, S.K., Taneja, S.C., Agarwal, V.K. and Dhar, K.L.
Minor amides of *Piper* species. *Phytochemistry* **27**(11)p.3523-3527 (1988)
52. Kulkarni, P.H.
Clinical Study of Effect of sookshma (subtle) Tripala Guggulu (TG3X) in obesity. *Deerghayu International* **7**(2)p.17-21 (1991)
53. Lee, E.B. and Chan, Y.N.
Pharmacological actions o the combined preparations, 'Sahyangsohap-won' and 'Woohwangporyong-hwan'. *Korean J.Pharmacog.* **17**(4)p.292-301 (1986)
54. Manavalan, R. and Jagdev, Singh
Chemical and some pharmacological studies on leaves of *Piper longum* Linn. *Indian J.of Pharmaceutical Sci.* **41**(5)p.190-91 (1979)
55. Mustaquem, M.
House hold Remedies for Asthma. *Aryavaidyan* **7**(3)p.157-161 (1994)
56. Nadar, T.S. and Pillai, M.M.
Effects Ayurvedic Medicines on beta-glucuronidase activity of Brunner's glands during recovery from cysteamine induced duodenal ulcers in rats. *Indian J.of Exp.Bio.* **27**(11)p.959-962 (1989)
57. Nadkari, A.K.
Indian Materia Medica. Dwotapepeshwar Pratashaw Ltd., India. 1954
58. Nirmala, R., Dahanukar, S.A. and Karandikar, S.M.
Hepatoprotection by indigenous agents. *Indian Pract.* **38**(7)p.551-556 (1985)
59. Niteswar, K. and Rao, T.S.
Role of Deepaniya and Balya drugs in therapeutics. *Nagarjun* **25**(5)p.102-103 (1982)
60. Pande, V.N., Joshi, G.C. and Pandey, G.
Successful cultivation of Pippali (*Piper longum* Linn.) through agrotrials in mountain region, a new achievement towards drug development. *Seminar on Research in Ayurveda and Siddha*, CCRAS, New Delhi, p.92-93, March'95
61. Parimi Suresh, Kumati V.
Critical literary study of Navoyasa Louha. *Sachitra Ayurved* **46**(8)p.78-85 (1994)
62. Philip, J., Nair, G.S. and Premalatha Sudhadevi, P.K.
Standardisation of vegetative propagation techniques in some of the medicinal plants grown in Kerala. *Indian Cocoa, Arecanut Spices J.* **15**(1)p.12-14 (1991)

63. Prakash, A.O.
Potentialities of some indigenous plants for antifertility activity. *Int.J.Crude Drug Research* **24**(1)p.19-24 (1986)
64. Pramod Kumar
Preliminary studies with chandrodayawarti-an ayurvedic formulation for ophthalmic use. *J.Sci.Res.Plants Med.* **2**(1&2)p.35-38 (1981)
65. Rahiman, B.A. and Bhagavan, S.
Analysis of divergence in eight species of *Piper* using D2-statistic. *Botanical Bull. of Academia Sinica, Taiwan* **26**(1)p.39-45 (1985)
66. Ravindran, P.N. and Nirmal, Babu K.
Chemotaxonomy of South Indian Piper. *J.Spices and Aromat.Crops* **3**(1)p.6-13 (1994)
67. Rawal, J.H.
Clinical study of Pippalyadi Yoga as contraceptive method. *Sachitra Ayurved* **44**(5)p.3353-359 (1991)
68. Reedy, M.K., Kokate, C.K. and Chari, N.
Effect of crude drug combinations on fertility in male albino rats. *Ancient Sci.of Life* **8**(3&4)p.223-229 (1989)
69. Roberts, Emmanuel
Vegetable materia medica of India and Ceylon. Plate Limited, Colombo. 1931
70. Samuel, M.R.A.; Bavappa, K.V.A. and Balasubramaniam, S.
Foliar, floral and Abaxial leaf epidermal characteristics of *Piper nigrum* L. and *Piper longum* L. *J. Nat.Agric.Soc. Ceylon* **17-18**p.19-26 (1980-81)
71. Sarasan, V., Nair, G.M., Prakash, J. and Piarik, R.L.M.
Tissue culture of medicinal plants: morphogenesis, direct regeneration and somatic embryogenesis. *Curr.plant Sci. and Biotechnology in Agriculture* **12**p.237-240 (1991)
72. Sarasan, V., Thomas, E., Lawrence, B. and Nair, G.M.
Plant regeneration in *Piper longum* L. (Piperaceae) through direct and indirect adventitious shoot development. *J.Spices and Aromatic Crops* **2**(1&2)p.34-40 (1993)
73. Saraswathy, A., Rajagopal, S., Veerapandian, P. and Purushothaman, K.K.
Standardisation of Siddha compound formulation-Attaticuranam. *J.Research in Ayurveda and Siddha* **13**(1-2)p.71-77 (1992)
74. Sathyaranjan, P.K. and Naseema, A.
Piper longum L.-A new host record for *Colletotrichum gloeosporioides* Penz. *Curr.Sci.(India)* **54**(13)p.637 (1985)
75. Saxena, R.B., Daswani, M.T. and Trivedi, P.D.
Study of Kubja Prasavini taila. *Aryavaidyan* **5**(4)p.232-237 (1992)
76. Sharma, I., Varma, M. and Dixit, V.P.
Hypolipidaemic effect of Panchcole an ayurvedic remedy, in rabbits. *Int.J. Crude Drug Research* **28**(1)p.33-38 (1990)
77. Shastri, M.S. and Dave, K.K. De, S.
Standardization of Swaskuthara rasa. *J. Research Educ. in Indian Medicine* **10**(1)p.31-34 (1991)

78. Shirwaikar, A., Kumar, A.V., Sreenivasan, K.K. and Gundu Rao, P.
Evaluation of a marketed antihepatotoxic Ayurvedic preparation. *Proceedings of 42nd Indian Pharmaceutical Congress*, Manipal, GP05:p.91, Dec'90
79. Shirwaikar, A., Srinivasan, K.K., Vasanth Kumar, A. and Krishnanand, B.R.
Antihepatotoxic activity of 'Kamilari' a marketed Ayurvedic preparation. *Indian Drugs* 29(5)p.219-224 (1992)
80. Shoji, N., Umeyama, A., Saito, N., Takemoto, T., Kajiwarra, A. and Ohizumi, Y.
Dehydropiperonaline, an amide possessing coronary vasodilating activity isolated from *Piper longum* L. *J.Pharm.Sci.* 75(12)p.1188-1189 (1986)
81. Shukla, D.S.
Indian medicinal plants. *Sachitra Ayurved* 45(11)p.803-806 (1993)
82. Shukla, S.C., Chakraborty, E., Tewari, G. and Das, S.R.
Arogya Vardhini Bati and Anand Bhairava Ras. two amoebicidal Ayurvedic drugs *Ancient Science of Life* 10(1)p.56-58 (1990)
83. Suresh Kumar, D. and Prabhakar, Y.S.
A survey of cardioactive drug formulations from Ayurveda, single drug remedies. *Aryavaidyan* 4(2)p.105-108 (1990)
84. Suseeappan, M.S.
Medicinal uses of pepper in Ayurveda. *Indian Spices* 28(3)p.25-26 (1991)
85. The Wealth of India. Raw Materials Vol. VIII, The Publications & Information Directorate, New Delhi. 1969
86. Upadhyay, S.D., Kansal, C.M. and Pandey, N.N.
Clinical evaluation of pippali (*Piper longum*) Kshira Paka on patients of bronchial asthma. A preliminary study. *Nagarjun* 25(11)p.256-258 (1982)
87. Vaidya Bhagwan Dash Acarya Manfred M Junius
A Hand Book of Ayurveda. Concept Publishing Company, New Delhi. 1983.
88. Vara Prasad, P.V. and Joshi, V.K.
Trikatu in Sushruta Samitha. *Sachitra Ayurved* 45(7)p.525-530 (1993)
89. Viswanathan, T.V. and Narayanan, A.K.
Effect of Gamma ray irradiations on sprouting and establishment of Indian long pepper. *South Indian Horticulture* 42(3)p.171-174 (1994)
90. Warriar, P.K.
Spices in Ayurveda. *Indian Drugs* 26(2)p.11-15 (1989)
91. Yasushi, O., Akiko, K., Noboru, S. and Tsunematsu, T.
Isolation of piperidine-type alkaloid from *Piper longum*. *Japan Kokai Tokkyo JP* 62,178,572 (Cl.C07D317/67), 1987, 3PP.
92. Zaman, A. and Maity, L.N.
Role of indigenous drug on Annadrava shoola (gastric outlet obstruction). *Int. Seminar-Traditional Medicine*, Calcutta, 7-9Nov.'92, p.149
93. Zutshi, U. and Kaul, J.L.
The impact of ayurvedic herbals on drug bioavailability. *Indian Drugs* 19(12)p.476-479 (1982)