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An overview on: botany, extraction, phytochemistry and medicinal uses of *Vitex negundo* Linn

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Abstract

Now a day's study on plant research has been increased all over the world and a large body of evidence has collected to show immense potential of medicinal plants used in various traditional systems. *Vitex negundo* Linn Is a large aromatic shrub distributed throughout India. Herbal medication, rather than merely curing a particular disease, aims at returning the body back to its natural state of health. It has been used since very old times as a female remedy and for pains in Ayurvedic system of medicine and also in Roman medicinal system. It is an interesting source of potential bioactive molecules, as iridoids compounds, flavonoids, diterpenoids derivatives, phytosteroids, with antioxidant, anti-inflammatory, antimicrobial, Hepatoprotective activity, analgesic and antihistamine. In this paper morphology, extraction of drugs, general medicinal uses and pharmacological activities of various parts of plants have been reviewed.

Keywords: *Vitex negundo*, medicinal uses, extraction process, medicinal uses

1. Introduction ^[1, 2]

Medicinal plants have been a main source of therapeutic agents since olden times to treat human illness. The recovery of interest in natural drugs started in last decade mainly because of the wide spread belief that natural medicine is healthier than artificial products. Now-a-days, there is manifold increase in medicinal plant based industries due to the increase in the interest of use of medicinal plants throughout the world which are growing at a rate of 7-15% annually. Despite the main advances in the recent medication, the development of novel drugs from natural product is still taken significantly. Conventional therapeutics based lying on herbal medicinal principles is time tested and broadly accepted across different cultural and socioeconomic strata. However, there is lack of precise guidelines to study the herbal compounds and till date a very meagre portion of this tremendous potential drug-repertoire has been scientifically screened. Hence, there is a real need for scientific evidence based validation of these agents. The evaluation of plant products on the basis of medicinal and therapeutic properties forms a platform for the discovery of newer drug molecules from different plant sources. From the numerous plants being researched since ancient time, *Vitex negundo* is vital one. This plant of Verbenaceae family is commonly known as Nirgundi (Hindi) and five leaved chaste tree (English). *Vitex negundo* L. (Sambhalu) is fragrant big bush or little slender tree of about three meter in tallness with quadrangular branches. *Vitex negundo* Linn is a large aromatic shrub (commonly known as Nirgundi, Five leaved chaste tree) belonging to the family *Verbenaceae*. Almost all the parts of this plant possess great medicinal values and it is employed as a remedy in various traditional systems of medicine like ayurveda, chinese, siddha and unani to treat various diseases. In Indian conventional drug system *Vitex negundo* Linn is referred as 'sarvaroganivarani' – the remedy for all diseases. A popular local quote of the Bhangalis in the Western Himalayan region of India which translates as –A man cannot die of disease in an area where *Vitex negundo* Linn is found. Nirgundi meaning in Sanskrit protect the human body from disease.

2. Taxonomic / scientific classification

Kingdom - Plantae - Plants

Sub Kingdom - Tracheobionta - Vascular plants

Super Division - Spermatophyta - Seed plant

Division - Magnoliophyta - Flowering Plant

Class - Magnoliopsida - Dicotyledons

Sub Class - Asteridea

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Order - Lamiales
 Family - Verbenaceae
 Genus - *Vitex* Linn
 Species - *Vitex negundo* Linn. (Chaste tree)

3. Vernacular names

Telugu: Vaavili
 Tamil: Nirkundi, Vellai-nochi
 Hindi: Shivari, Nirgundi
 Malayalam: Vellanocchi, Indranee, Karunacci
 Kannada: Nkkilu, Lakkigida, Nekka, Nakkigida
 Punjab: Shwari
 Assam: Aslok
 Bengal: Nirgundi, Nishinda
 English: Five leaved chaste tree
 Gujarati: Nagod
 Marathi: Nirgundi
 Punjabi: Sambhalu, Banna
 Sanskrit: Nirgundi

4. Geographical source^[3]

The plant is found throughout India, Ceylon- Afghanistan, tropical Africa, Madagascar, China and Philippines. The plant occurs in Bengal, Southern India and Burma also. It is common in waste places around villages, river banks, moist localities and in the deciduous forests. It is common throughout India from coastal belt to subtropical Western Himalayas and Andaman Islands, abundant in drier zones. It is particularly found in Karnataka and Tamilnadu (Wild as well as cultivated).

5. Morphology^[1, 2]

A large plant or tiny slender tree; bark is thin, grey in color; branchless quadrangular, whitish with a fine tomentum. Leaves 3-5 foliate; leaflets lanceolate, acute, the terminal leaflet 5-10 by 1.6-3.2 cm. with a petiole 1-1.3 cm. long, the lateral leaflets smaller with a very short petiole, all nearly glabrous above, covered with a fine white tomentum beneath, base acute; common petioles 2.5-3.8 cm long. 3-5 Flowers in pedunculate branched tomentose cymes, opposite along the quadrangular tomentose rachis of a large terminal often compound pyramidal panicle (axillary peduncles in the upper axils sometimes present); bracts 1.5- 2.5 mm long, lanceolatecaduceous. Calyx 3 mm long, white tomentose; teeth triangular, 0.8- 1mm long. Ovary glabrous; style glabrous; stigma forked. Drupe less than 6 mm diameter, black when ripe. The plant has pungent, bitter, acrid taste; heating, astringent, stomachic, anthelmintic; promotes the growth of hair; useful in disease of the eye, consumption, inflammation, leucoderma, enlargement of the spleen, bronchitis, asthma, biliousness, painful teething of children. The root is an antidote to snake venom. The root is considered tonic, febrifuge and expectorant, otalgia, arthritis, dyspepsia, colic, rheumatism, leprosy, verminosis, flatulence, dysentery, urinary disorders, wounds, ulcers, bronchitis, cough, malarial fever, haemorrhoids, dysmenorrhoea, leprosy, skin diseases and general debility. The plant is reported to have expectorant, carminative, digestive, anodyne, antiseptic, alterant, antipyretic, diuretic, emmenagogue, depurative, rejuvenating, ophthalmic, vulnerary and tonic.⁷ The leaves are aromatic, tonic and vermifuge. A decoction of Nirgundi leaves is given with the addition of long pepper in catarrhal fever with heaviness of head and dullness of hearing. A pillow stuffed with the leaves of Nirgundi is placed under the

head for relief of headache. The juice of the leaves is said to have the property of removing foetid discharges and worms from ulcers. The flowers are useful in diarrhoea, cholera, fever, haemorrhages, hepatopathy and cardiac disorders. Leaves and bark are useful in scorpion stings, seeds are considered useful in eye diseases in form of *anjan*. Tincture of root bark in 1 to 2 dr. doses is recommended in cases of irritable bladder and of rheumatism. Powdered root is prescribed for piles as a demulcent for dysentery. Root is used in dyspepsia, colic, rheumatism, worms, boils and leprosy. The leaves are discutient and are useful in dispersing swelling of joints from acute rheumatism and of the testes from suppressed gonorrhoea. The dried fruit acts as a vermifuge. Six Fruit is nervine, cephalic and emmenagogue; dried fruits act as a vermifuge; flowers are cool and astringent.

6. Special Characters^[2]

Branchlets have prominent auxiliary spines and leaflets possess numerous minute gland dots. The fragrant white flowers contain many stamens. Fruits resemble wood apple. The tender shoots and leaves are quite brittle.

7. Powder Characters^[2]

Grey to grayish-brown; thick-walled, angular cells of cork., numerous prismatic crystal of calcium oxalate, crystal fibres, starch grains simple, 5-19 μ India, mostly round to oval with certric hilum; compound starch grains having 2-3 parts, fragments of xylem vessels with bordered pits and thick-walled xylem fibres.

8. Cultivation and collection^[2, 4]

8.1. Cultivation

It is widely planted as a hedge plant in between the fields and usually not browsed by the cattle. It can be reproduced readily from shoot cuttings. It produces root suckers which may used as planting material. A simply developed plant, it prefers a light well-drained loamy soil in a warm sunny position sheltered from cold drying winds succeeds in poor dry soils. Plants tolerate temperatures down to about -10°C. The leaves and stems are strongly aromatic. The flowers have a most pronounced musk-like perfume.

8.2. Plant collection

The leaves of *Vitex negundo* Linn. Which predominantly is a habitat in arid places were collected from Uthamaseeli, Near Kallanai Dam, Tiruchirappalli district, Tamil Nadu, India during the month of December-January.

8.3. Mode of Propagation: By seeds and grafts.

9. Extraction process^[5]

9.1. Material

Fresh leaves of *Vitex negundo* (L.) different aqueous and non-aqueous solvents and glass wares

9.2. Extraction method

Fresh leaves of the plant (200g) were subjected to hydro-distillation for 8 hrs using closed type Clevenger apparatus. The pale yellow colored oil was collected over water, stored in culture tube and kept in refrigerator.

10. Phytochemical Constituents^[2, 3]

Phytochemical studies on *Vitex negundo* Linn revealed the presence of volatile oil, triterpenes, diterpenes,

sesquiterpenes, lignan, flavonoids, flavones, glycosides, iridoid glycosides and stilbene derivative. The detailed of phytochemical constituents is present in each part of the plant is given below:

10.1. Leaves

The various chemical constituents present in leaves of *Vitex negundo* Linn leaves are Friedelin, vitamin-C, carotene, casticin, artemetin, terpinen-4-ol, α -terpineol, sabinene, globulol, spathulenol, β -farnesene, farnesol, bis(1,1-dimethyl) methylphenol, α -pinene, β -pinene, linalool, terpinyl acetate, caryophyllene epoxide, caryophyllenol, vitexicarpin, viridiflorol, 4,4''-dimethoxy-trans-stilbene, 5,6,7,8,3',4',5'-heptamethoxy, 5-hydroxy-6,7,8,3',4'-pentamethoxy (5-Odesmethylnobiletin), 5-hydroxy-6,7,8,3',4',5'-hexamethoxy (gardeninA), 5-hydroxy-6,7,8,4'-tetramethoxy (gardeninB), 5-hydroxy-7,3',4',5'-tetramethoxyflavone (corymbosin), terpinen-4-ol, α -copaene, β -caryophyllene, β -elemene, camphene, α -thujene, α -pinene, sabinene, linalool, stearic acid and behenic acid [17], α -elemene, δ -elemene, β -elemene, β -eudesmol, camphor, camphene, careen, 1,8-cineol, 1-octen-3-ol, γ -terpinene, α -phellendrene, β -phellendrene, α -guaiene, abietate-7,13-diene, neral, geranial, bornyl acetate, nerolidol, β -bisabolol, cedrol, 2'-p-hydroxybenzoyl mussaenosidic acid, agnuside, lagundinin, aucubin and nishindaside, viridiflorol, squalene, 5-hydroxy-3,6,7,3',4'-pentamethoxy flavone, 5-hydroxy-3,7,3',4'-tetramethoxy flavones, 5,3-dihydroxy-7,8,4-trimethoxy flavanone, p-hydroxybenzoic acid, 3,4-dihydroxybenzoic acid, luteolin-7-glucoside, isoorientin, 3'-benzoyloxy-3,6,7,4-tetramethoxyflavone, 5,3'-dibenzoyloxy-3,6,7,4-tetramethoxyflavone, 5,3'-Dipropoxy-3,6,7,4-tetramethoxyflavone, 5,3'-Dibutanoyloxy-3,6,7,4-tetramethoxyflavone, 5,3'-Dipentyloxy-3,6,7,4-tetramethoxyflavone, 5,3-Dihexanoyl 3,6,7,4-tetramethoxyflavone, betulinic acid, ursolic acid, dimethoxyflavone, 5,3'-dihydroxy-7,8,4'-trimethoxyflavone, 7,8-Dimethylherbacetin-3-rhamnoside, vitegnoside, 1,4a,5,7a tetrahydro 1 β Dglucosyl (3',4'dihydroxybenzoyloxymethyl)-5-ketocyclopenta[c]pyran-4-carboxylic acid, luteolin-7-O- β -D-glucosid[28], 6'-p-hydroxy benzoylmussaenosidic acid.

10.2. Seeds

The seeds of *Vitex negundo* Linn have chemical constituents such as n-Triacontane, n-hentriacontanol, n-hentriacontane, n-pentatriacontane, n-nonacosane, β -sitosterol, p-hydroxybenzoic acid and 5-oxyisophthalic acid, 3,4-dihydroxybenzoic acid, artemetin, 3 β -acetoxyolean-12-en-27-oic acid, 5 β -hydro-8,11,13-abietatrien-6 α -ol, 2 α ,3 α -dihydroxyoleana-5,12-dien-28-oic acid, 2 β ,3 α -diacetoxyoleana-5,12-dien-28-oic acid and 2 α ,3 β -diacetoxy-18-hydroxyoleana-5,12-dien-28-oic acid, vitedoin A, vitedoamine A, vitedoin B, 5,7,3'-trihydroxy 6,8,4'-trimethoxy, 6-hydroxy-4-(4-hydroxy-3-methoxyphenyl)-3-hydroxymethyl-7-methoxy-3,4-dihydro-2-naphthaldehyde.

10.3. Stem and bark

The various chemical constituents present in the stem and bark are 3,6,7,3',4'-Pentamethoxy-5-Oglucopyranosyl rhamnoside, vitexin cafeate, 4'-O-methyl myricetin-3-O-[4'-O- β -D-galactosyl]- β -D-galactopyranoside, β -amyirin, epifriedelinol and oleanolic acid, Hepta methyl-phenyl-cyclotetra siloxane, Cyclo heptasiloxane, tetra decamethyl

Nona methyl, phenyl-cyclopenta siloxane, Cyclo octa siloxane, hexadeca methyl, Borazine, 2,4,6-triphenyl-11,3,5-tryophl, Nonamethyl, phenyl-cyclopenta siloxane, Tetracosamethylcyclododeca siloxane, penta methyl phenyl-Disilane, Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13,-tetradeca methyl,3 α ,3 α' -Dichloro-2 α ,3 α -ethano-3 β -methyl-cholestan-2 α -one, Octadecamethyl, cyclonona siloxanes Cyclo octa siloxane, hexadeca methyl, p-hydroxy benzoic acid, β -sitosterol, 5-hydroxy-3,6,7,3',4'-pentamethoxy flavone, 5-hydroxy-3'-dihydroxy-7,8,4'-trimethoxy flavanone, 3 β -acetoxy-olean-12-en-27-oic acid, 3 β -hydroxy-olean-5,12-dien-28-oic acid.

10.4. Roots

Vitexoside, agnuside, R-dalbergiphenol, negundin A, negundin B, 6-hydroxy-4-(4-hydroxy-3-methoxy)-3-hydroxymethyl-7-methoxy-3,4-dihydro-2-naphthaldehyde, vitrofolal E, (+)-lyoniresinol, (+)-lyoniresinol-3 α -O- β -d-glucoside, (+)-(-)-pinoselinol, and (+) diasringaresinol, 2 β ,3 α -diacetoxyoleana-5,12-dien-28-oic acid; 2 α ,3 α -dihydroxyoleana-5,12-dien-28-oic acid, 2 α ,3 β -diacetoxy-18-hydroxyoleana-5,12-dien-28-oic acid, vitexin and isovitexin, acetyl oleanolic acid, sitosterol, 3-formyl-4,5-dimethyl-8-oxo-5H-6,7-dihydronaphtho (2,3-b) furan (a new furanoeremophilane).

11. Medicinal Uses of parts of plants

Roots, Bark, Leaves and fruits are highly medicinal. Roots are one of the ingredients of the drug *Dasmula arista*; used in colitis, dysentery, diarrhea, flatulence, fever, vomiting and colic.

11.1. Roots and Barks: Used for relieving intermittent fever, thirst and body pain.

11.2. Leaves: Used for treating ophthalmia, deafness, indigestion, piles and Jaundice, leaf juices are used in curing catarrh and fever. Tender fruits are bitter astringent, antilaxatives, digestion, promote digestion and strength, as well as overcome diarrhea and dysentery.

11.3. Ripe Fruits: Nutritious, cooling, used in treating indigestion and to improve vision.

12. Pharmacological Actions [1, 6, 7, 8, 9]

12.1. Analgesic activity

Ravishankar *et al.* (1985, 1986) found that interperitoneal administration of some leaf and root extracts using different solvents showed analgesic activity. M.G. Dharmasiri *et al.* (2003) evaluated analgesic activity from the water extract of new leaves of *Vitex negundo* in feminine Wistar rats by hot plate, tail flick and formalin tests. The standard drug applied in hot plate and tail flick was aspirin (100 mg/kg).

12.2. Anti-inflammatory activity and anti-arthritis activity

The experimental studies on different animal models have found that all parts of plant mainly leaves, fruits, roots and seeds possess anti-inflammatory and anti-arthritis activity (Chaturvedi & Singh, 1965; ravishankar *et al.*, 1985, 1986; Chawla *et al.*, 1991, 1992; Tamhankar & Saraf, 1994; Jana *et al.*, 1999). A.S. Chawla *et al.* (1992) investigated anti-inflammatory activity of chloroform extract of seeds of *Vitex negundo* in Sprague-Dawley male rats in carrageenan induced rat foot edema with the help of Ibuprofen as standard drug.

U.K. Rao *et al.* (1977), M.B. Ahmad *et al.* (1989), A.S. Chawla *et al.* (1991), & E. Nylogira *et al.* (2004) reported anti-inflammatory activity of bark, seeds, seed oil and essential oil of *Vitex negundo*. U. Jana *et al.* (1999) reported preliminary anti-inflammatory activity of *Vitex negundo* in albino rats along with *Zingiber officinale* and *Tinospora cordifolia*. M.G. Dharmasiri *et al.* (2003) investigated anti-inflammatory activity from the aqueous extract of *Vitex negundo* leaves in Wistar rats (male) using carrageenan-induced & formaldehyde-induced rat paw oedema using indomethacin as standard. The early phase of carrageenan induced rat paw oedema was significantly suppressed in an inversely dose-dependent manner. R.K. Gupta *et al.* (2006) found anti-inflammatory activity from the alcoholic extract of *Vitex negundo* leaves in albino rats (of either sex) using carrageenan-induced rat paw oedema and cotton pellet granuloma models using phenylbutazone (10-100 mg) and ibuprofen (10-200 mg) as standards. Pradeep Singh *et al.* (2009) reported anti-inflammatory activity of ethanolic extract of roots.

12.3. Antihyperpigmentation activity

A. Malik *et al.* (2006) investigated tyrosinase inhibition potential of lignans isolated from the methanolic extract of *Vitex negundo* roots with SpectraMax 340 microplate reader.

12.4. Immuno-stimulant activity

D.D. Singh *et al.* (2005) reported immunostimulatory activity from the extracts of *Vitex negundo* in oxyburst phagocytic assay using human polymorph nuclear cells. J.L. Suri *et al.* reported immunostimulatory potential of two iridoid glucosides from *Vitex negundo* leaves.

12.5. Hepatoprotective activity

A. Prabhakar *et al.* investigated hepatoprotective activity of Negundoside & agundoside from *Vitex negundo*. Both compounds were utilized in combination with one or additional pharmaceutical additives that avoid and treat liver diseases.

12.6. CNS activity

M. Gupta *et al.* (1997 & 1999) evaluated CNS activity & anticonvulsant activities of petroleum ether & methanolic extracts of *Vitex negundo* in mice.

12.7. Anti-androgenic activity

S.K. Bhargava (1984, 1986) & R.P. Samy *et al.* (1998) reported antiandrogenic activity of various flavonoids from the seeds of *Vitex negundo*. The flavonoids which shows estrogenic properties as well as anti-implantation activities are 5, 7, 3'-trihydroxy and 6, 8, 4'-trihydroxy flavones.

12.8. Enzyme inhibition activity

A. Haq *et al.* (2004) reported anti-lipoxygenase and anti-butylcholinesterase potential of two lignans Negundin B and Vitrofolal F.

12.9. Mosquito repellent activity

P.K. Amancharla *et al.* (1999) tested parasite i.e. mosquito repellent activity of water extract of *Vitex negundo* leaves. A new chemical 'rotundial' was tested for the said activity.

12.10. Anticonvulsant activity

The crude oil and alcohol leaf extract have shown protection,

whereas, none of root extract has shown protection against high electric shock (MES) seizures. Petroleum root extract could only provide protection against Leptazole induced convulsions (Raviahnkar *et al.*, 1985, 1986) 83-88 whereas methanolic leaf extract showed significant protection against Strychnine and Leptazole induced convulsions (Gupta *et al.*, 1999).

12.11 Antioxidant activity

G. Zheng *et al.* (1999) & G. Zheng and Z. Luo (1999), M. Onu *et al.* (2004) reported antioxidant potential of Vitexin A, Vitexin B and other lignans derivatives from the seeds of *Vitex negundo*. V. Tondon & R.K. Gupta (2005) found anti-oxidant use of Vitexin that may be a new compound. O.P. Tiwari & Y.B. Tripathi (2007) evaluated antioxidant property of different fractions of *Vitex negundo* by employing various *in vitro* systems, such as 2, 2'-azino-bis-3-ethyl benzothiazoline-6-sulfuric acid (ABTS), Lipoid peroxides (LPO), Superoxide, Hydroxyl radical scavenging and iron chelation. Total antioxidant ability was identified by the assay state on the performed radical monocation ABTS. LPO was assessed in terms of thiobarbituric acid reactive substances by using eggs white homogenates as macro molecule loaded media.

12.12 Insecticidal and pesticidal activities

The product of plant of *V. negundo* is reported to possess insecticidal activity against stored product pests, parasite larvae, house flies and tobacco leaf consumption larvae. Leaf oil of the plant is shown to cover repellent action against stored product pests (Deshmukh *et al.*, 1982; Prakash & Mathur, 1985; Hebbalkar *et al.*, 1992).

12.13 Anti-HIV activity

The anti-HIV activity of ethanolic leaf extract of *Vitex negundo* Linn was studied against HIV-1 reverse transcriptase. Using a non-radioactive HIV-RT colorimetric Enzyme Linked Immuno Sorbent Assay kit and with recombinant HIV-1 enzyme were evaluated *in vitro*. The study state that the ethanolic extract exhibits anti-HIV activity and flavonoids as anti-viral agents

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