

A REVIEW ON ETHNOBOTANICAL AND PHARMACOLOGICAL IMPORTANCE OF *VITEX NEGUNDO* L.

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Abstract—People are using various plants for curing various ailments in their routine life. *Vitex negundo* L. is a woody aromatic plant and used in different system of medicine. The family of *Vitex negundo* L. is lamiaceae and is commonly known as cheste tree, nergundi, simli and vanna. It is distributed mainly in tropical to temperate region of the world and is found upto 1500 m amsl in Western Himalaya. This species have ethnobotanical uses, pharmacological activities, strong potential to develop new drug due to presence of chemical constituents and also used in other traditional medicines. The phytochemical analysis of various parts of the species reveals that it has many biomolecules which can be used for curing the diseases. The main constituents of the plants are alkaloids, flavonoids, flavones, lignans, terpenes, vitexoside, nishindine, glycosidiciridoida, phenols and steroids. The plant contributes in various pharmacological properties like anti-inflammatory, anti-oxidant, anti-microbial, immuno-stimulant, anti- cancerous and astringents. The handicrafts can be prepared from the plants which will enhance the livelihood of the people of the fringe villages. The review aims at providing comprehensive information on ethnobotanical uses and phytochemical constituents of the species. The literature was compiled an ethnobotanical and pharmacological significance of *V. negundo*.

INTRODUCTION

Plant used in traditional, ethnobotanical uses for medicines and treating wide variety of diseases is studied all over the world. The people are using the local available plants for curing diseases and ailments. The various plants have been used by people in one form or the other. The traditional systems of medicines are practiced since the period of our ancestors. Various medicinal plants have been identified and modern scientific approach has been used to observe their efficiency in curing ailments (Meena *et al.*, 2011; Singh *et al.*, 2018). *V. negundo* L. is one of the woody species, mainly found on slopes or degraded areas (Li *et al.*, 2007). The word *Vitex* is derived from Latin word *vieo* which means to tie or bind because of its flexible stems and twigs (Ahuja *et al.*, 2015). It is commonly known as five leaved cheste tree (Ambika and Sundrarajan, 2015), Nirgandi in Hindi and Nergundi in Sanskrit and Simali in Nepali and is a deciduous shrub grows

gregariously in wastelands and widely used as a hedge plant (Gautam *et al.*, 2008). The plant can also be used as an ornamental plant and also grown as woody vegetation in agroforestry system. It is also used as fuel wood, medicine and restoration of wasteland. It also reduces the soil erosion on the degraded sites. The stem of the plant is used for the preparation of basket and container for storage of grain. This whole plant has an antiseptic, antipyretic, antihistamine, antioxidant, antibacterial, antifungal, anti-cancerous, inflammation, mosquito repellent, insecticidal, larvicidal, snake venom neutralization, antifertility, antiandrogenic, skin ageing inhibitor and anti-dopaminergic properties (Britto and Sujin, 2012). The leaves also showed an anti-inflammatory, antihistamine and analgesic properties (Dharmasiri *et al.*, 2003). It also contains many compounds like polyphenolic, glycosidiciridoida, terpenoides and alkaloids (Kumar *et al.*, 2010). It is commonly used as a traditional medicinal plant and also has many

pharmacological values (Baral and Kurmi, 2006). Various authors have worked on ethnobotanical and pharmacological importance of *V. negundo* (Chawla *et al.*, 1992; Krishna *et al.*, 2002; Chandramu *et al.*, 2003; Diaz *et al.*, 2003; Khokhra *et al.*, 2008; Singh *et al.*, 2010; Britto and Sujin, 2012; Shamim *et al.*, 2018; Bameta *et al.*, 2019; Maurya *et al.*, 2019; Waghmode, 2020; Das and Muralidharan, 2021). The increasing demand and overexploitation with limited cultivation could lead to its degradation and decline in natural population of this medicinal plant. This review paper deals with the ethnobotanical uses and phytochemical constituents of the species.

PLANT DESCRIPTION

The genus *Vitex* was established by Linnaeus in 1753 with four species of *Vitex* in the family Verbenaceae, but in the 1990s *Vitex* along with several other genera was transferred from Verbenaceae to Lamiaceae on the basis of their DNA sequencing (Shamim *et al.*, 2018). *V. negundo* is an erect, large aromatic shrub or a small size tree with typical five foliate leaf patterns (Fig.1) (Rastogi *et al.*, 2010). It is an erect, 4-6m in height, slender tree with quadrangular branchlets, 3-5 leaflets having



Fig. 1. The inflorescence and population of *Vitex negundo* L.

palmately arrangement, lanceolate opposite, 5-10 cm long, hairy beneath and pointed at both ends (Padalia *et al.*, 2016). The flowers are bluish in colour (Kritikar and Basu, 1987), fruit is succulent, black and round (Gautam *et al.*, 2008).

Distribution

V. negundo is distributed in tropical to temperate regions of the world (Sunayana *et al.*, 2014) and found in India, Afghanistan, Bhutan, China, Sri-Lanka, Burma, Pakistan, Malaysia, Philippines, Thailand, Madagascar, Eastern Africa and South Asia (Vishwanathan and Basavaraju, 2010; Padalia *et al.*, 2016). It is also cultivated in North America, Europe, and West Indies (Chauhan, 1999). It is common in India from coastal regions to subtropical Western Himalayas and Andaman Islands and found abundantly in drier regions (Venkateswarlu, 2012). It is native to India and found in Assam, Bihar, Delhi, Himachal Pradesh, Karnataka, Kerala and Jammu and Kashmir union territories and found throughout the greater part of India at warmer regions up to an altitude of 1500 m amsl in outer, Western Himalayas (Rastogi *et al.*, 2010).

Ethnobotanical Uses

Ethnobotany is the study of the native plants, its uses and the relationship between man and plants. The study of literature reveals that *V. negundo* has been used since ancient times as ethnobotanical plants (Rastogi *et al.*, 2010). The medicinal properties of *V. negundo* is characterized into traditional medicine, and pharmacological medicine (Vishavanathan and Basavaraju, 2010).

Traditional medicine is mainly comprising of Indian Ayurveda, Arabic, Unani and Chinese medicine. In Asia and Latin America, populations continue to use traditional medicine as a result of historical circumstances and cultural beliefs (Dass and Muralidharan, 2021). In Ayurveda, *V. negundo* used in dysmenorrhea, headache and leaves of the species used to dispel catarrh (Jadhav and Bhutani, 2005). In Unani medicine, *V. negundo* commonly known as Nisinda. The seeds are used internally with sugarcane vinegar for relief of swellings and the powder of seeds along with dry *Zingiber officinale* and milk is used in spermatorrhoea (Khare, 2004). In Chinese medicine, the fruits are used in the treatment of headache, redness, puffy and painful eyes and also in arthritis (Liu *et al.*, 2004).

The plants are widely used in the tribal and rural areas as a medicine (Kosalge, 2009). The leaves of *V.*

negundo are used in weakness, vomiting, malaria, black fever and leaves are also filled in pillow for curing headache in India, Bangladesh and Malaysia (Khan and Rashid, 2006). Leaf juice is used in cough, common cold and flu in Guangdong of China (Au *et al.*, 2008). The essential oil extracted from leaves is used in curing of sinusitis and whooping cough in Nepal (Joshi and Joshi, 2000). Root decoction is used for the treatment of asthma and bronchitis in India (Basavaraju *et al.*, 2009).

In India, it is widely used in folk medicine for treatment of wounds and body ache (Sharma *et al.*, 2004), relaxing eye pain (Jain and Puri, 1984), jaundice, (Purkayastha *et al.*, 2005; Pattanaik *et al.*, 2008) and liver disorders (Kotoky and Das, 2008), asthma and cancer (Basavaraju *et al.*, 2009), encephalitis (Jagtap *et al.*, 2006), toothache (Sharma *et al.*, 2004), antidote for snake bite (Samy *et al.*, 2008), respiratory disorders, fever and headache (Rajadurai *et al.*, 2009).

The leaves of the species are used for healing swollen rheumatic joints (Sharma and Sood, 2013), leaves used in gastric and leprosy, paste of leaves along with chili (*Albizia chinensis*) for treating snake and scorpion bites, flowering tips are chewed for curing ulcers, twigs are used as toothbrush (locally called datun), (Verma and Chauhan, 2007). However, fruits and leaves are used for headache and skin diseases body ache, blisters, cough, cold, fever, diarrhea, piles, swelling, ulcers, wounds and skin diseases and twig is also used for cleaning teeth (Sharma and Mishra, 2009). The leaves are boiled and bath of hot water taken for sprain joint fracture and for relaxing pain (Singh *et al.*, 2018a; Sharma *et al.*, 2015), dried smoked for relief from headache, catarrh useful in dispersing swelling of joints from acute rheumatism and swelling of testis from suppressed gonorrhoea and juice of leaves used for removing foetid, discharges and worms from ulcers (Sharma *et al.*, 2013). The fresh leaves are boiled and vapors are inhaled twice a day for curing, headache, cough, cold and fever (Vidyarathi *et al.*, 2013).

PHYTOCHEMICAL ANALYSIS

The phytochemical analysis of *V. negundo* done by various research workers revealed that many types of compounds like lignans, flavonoids, terpenes, volatile oils and steroids are generally found in this species (Chandramu *et al.*, 2003). It contains different secondary metabolites such as poly phenolic terpenoides, glycosidic, iridoids and alkaloids

(Koirala *et al.*, 2020). Chitra *et al.* (2009) also studied the phytochemical analysis on the crude ethanol extract which showed the presence of alkaloids, glycosides, lignin, flavonoids and saponins. The extracts of the plant parts have anti-fungal, antibacterial, anticonvulsant, CNS depressant, antiallergic, immunomodulatory, hepatoprotective, anti-hyperglycemic, antinociceptive, anti-inflammatory, antioxidant, anti-HIV properties and also snake venom neutralization activities (Maurya and Rao, 2019). The phytochemical constituent of the different parts of *V. negundo* has also been described below:

Leaves

The phytochemical analysis indicated many compounds like carbohydrates, alkaloids, flavonoids, glycosides, fixed oils, amino acids, terpenoids and steroids in the species (Sharma *et al.*, 2020). Merlin and Cathrine (2011) also reported antibacterial activity and found various compounds like phenol, flavonoids, steroid, quinines and carbohydrates. Leaves also contain an alkaloid nishidine, flavonoids like flavones, luteolin-7-glucoside, casticin, iridoid glycoside, an essential oil and other constituents like vitamin-C, carotene, benzoic acid, β -sitosterol and C-glycoside (Hussain *et al.*, 1992).

The species also have many phytochemical constituents like viridiflorol, β -caryophyllene, sabinene, 4-terpineol, gamma-terpinene, caryophyllene oxide, 1-oceten-3-ol, globulol (Singh *et al.*, 1999), protocatechuic acid, oleanolic acid, flavonoids (Surveswaran, 2007). It also contains 5,32-dihydroxy-7,8,42-trimethoxyflavanone, 5,32-dihydroxy-6,7,42- trimethoxyflavanone (Achari *et al.*, 1984), protocatechuic acid, oleanolic acid, flavonoids (Surveswaran *et al.*, 2007), angusid, casticin, vitamin-C, nishindine, gluco-nonitol, p-hydroxybenzoic acid, sitosterol (Khare, 2004; Rana and Rana, 2014).

The leaves and twig are stilbene derivative characterized as 4,4'- dimethoxy-trans-stilbene, along with five flavones, 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 (gardenin A), 5- hydroxy-6,7,8,4'- tetramethoxy (gardenin B) and 5- hydroxy-7,3',4',5'- tetramethoxyflavone corymbosin (Chandra and Babber, 1987; Banerji *et al.*, 1988; Kosankar *et al.*, 2000).

The ethanolic extract of the species resulted in the

isolation of new flavones glycoside along with five known compound and characterized as 4',5,7-trihydroxy-3'-O- β -D-glucuronic acid-6''-methyl ester, a new naturally occurring compound named vitexoside (Sathiamoorthy *et al.*, 2007).

Seeds

The seeds of *V. negundo* consists of many compounds like vitedoin-A, vitedoin-B, a phenyl-naphthalene-type lignan alkaloid, vitedoamine-A (Ono *et al.*, 2004), 6-hydroxy-4-(4-hydroxy-3-methoxy-phenyl)-3-hydroxy-methyl-7-methoxy-3, 4-dihydro-2-naphthaldehyde (Zheng *et al.*, 2009), β -sitosterol, p-hydroxybenzoic acid, 5-oxyisophthalic acid, n-pentatriacontane, n-tritriacontane, n-hentriacontane, n-nonacosane (Khare, 2004). It also contains β -sitosterol, hydrocarbons, phthalic acid and benzoic acid (Hussain *et al.*, 1992).

Roots

It consists of negundin-A, negundin-B, vitrofolal-E and vitrofolal-F (Haq *et al.*, 2004); acetyl oleanolic acid, sitosterol, 3-formyl-4,5-dimethyl-8-oxo-5H-6,7-dihydronaphtho (2,3-b) furan (Vishnoi *et al.*, 1983). Vitexoside a new flavonoid glycoside and agnuside, R-dalbergiphenol was recorded (Haq *et al.*, 2004; Dayal, 2004). The isolated compounds from the heartwood of species roots are β -amyrin, oleanolic acid and epifriedelinol (Krishna *et al.*, 2002).

Essential oils

Volatile constituents from leaves of species have 66 compounds in which 35 compounds constitutes 74.96% of oil and the main compounds are viridiflorol (19.55%), J3-caryophyllene (16.59%), sabinene (12.07%), 4-terpineol (9.65%), γ -terpinene (2.21 %), caryophyllene oxide (1.75%), 1-octen-3-ol (1.59%) and globulol (1.05%) (Singh *et al.*, 1999).

Padalia *et al.*, (2016) reported the content of essential oil varied from 0.06 to 0.10% of species and 61 volatile compounds mainly major constituents were sabinene (2.8-40.8%), viridiflorol (10.7%-23.8%), β -caryophyllene (5.3-21.4%), terpinen-4-ol (0.1-7.2%), epi-laurenene (2.2-5.9%), humulene epoxide II (0.5-4.6%) and abietadiene (0.1%-4.3%).

The essential oil yields ranged from 0.06 to 0.10% in the leaves. Flowers of *V. negundo* have formic acid, n-heptane, p-cymene, valencene, β -caryophyllene, trans- α -bergamotene, α -selinene, β -selinene, germacren-4-ol, caryophyllene epoxide, (E) -nerolidol, P-(1,1-dimethylethyle) toluene (Khokra *et*

al., 2008). The antifungal and antibacterial properties of volatile oil against *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Bacillus subtilis*, *Micrococcus luteus* and *Candida albicans* using ciprofloxacin and chloramphenicol were investigated by Singh *et al.*, (2010).

MEDICINAL PROPERTIES

V. negundo is one of the common plants used in traditional medicine in India and also has a large variety of pharmacological properties (Baral and Kurmi, 2006). The uses of different parts of plant are briefly described below:

Leaves

Leaves of the species had been reported for its anti-inflammatory, antihistamic, antioxidant and membrane stabilizing properties (Meena *et al.*, 2011). A decoction with addition of long pepper used to treat catarrhal fever with heaviness of head and weakness of hearing (Venkateshwarlu, 2012). The petroleum ether extract had been reported for larvicidal properties against the *Culex tritaeniorhynchus* and crude aqueous extracts also had laxative properties (Meena *et al.*, 2011). The oil extract had repellent actions against the pests (Hebbalkar *et al.*, 1992). The anti-microbial activity of hexane and methanolic extracts from the leaves are active against the *Mycogone pernicioso*, *Rhizoctonia solani*, *Pseudomonas fluorescens*, *Bacillus megaterium*, *Xanthomonas* species, *Staphylococcus* species (Kaushik *et al.*, 2003).

The phytochemical constituents like reducing sugar, phenol, coumarin, saponins and steroids are source of many useful drugs which is found in the leaves and stems of the species (Bameta *et al.*, 2019). Loganathan *et al.* (2004) reported antibacterial properties against *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus albus*, *Bacillus subtilis*, *Escherichia coli*, *Klebsiella aerogens*, *Proteus vulgaris* and *Pseudomonas aeruginosa* using agar plate method. The chloroform extract from the species had the vitexicarpin, a flavone which had cytotoxic action against human cancer cell (Diaz *et al.*, 2003).

The antihistaminic property of methanolic extract of leaves is found to be active against histamine release from mast cells (Rimando *et al.*, 1987; Stylian, 1996). The antifeedent activity of ursolic acid, betulinic acid, n-hentriacontanol, β -sitosterol and p-hydroxy benzoic acid from the methanolic extract of

leaves are used against the larvae of *Achoea janata* (Manohar *et al.*, 2003). Amancharla *et al.* (1999) tested mosquito repellent activity of aqueous extract in leaves and also found a new chemical 'rotundial'.

Seeds

The seeds, bark oil and essential oils mixed with *Zingiber officinale* and *Tinospora cordifolia* showed anti-inflammatory properties (Jana *et al.*, 1999). Chawla *et al.* (1992) studied the anti-inflammatory activity of chloroform extract of seeds of species in Sprague-Dawley male rats. The anti-oxidant properties were investigated from the *V. negundo* seeds such as vitedoin A, vitedoin B and other legnans derivatives (Zheng *et al.*, 1999; Zheng and Luo, 1999; Ono *et al.*, 2004; Waghmode, 2020).

Flower and fruit

The analysis of the flowers revealed that it has astringent, febrifuge, vermifuge, carminative, hepatoprotective properties and are useful in curing haemorrhages and cardiac disorders (Hussain *et al.*, 1992). Mahmud *et al.* (2009) studied that the fruits have antifungal properties against *Aspergillus flavus*, *Candida albicans*, *Candida glabrata*, *Fusarium solani* and *Microsporium canis*. The fruits have chemical properties like nervine, cephalic, aphrodisiac, emmenagogue and vermifuge (Hussain *et al.*, 1992).

Roots

The root of *V. negundo* is used as a tonic, febrifuge, expectorant, diuretic, increases breast-milk production, regulating hormones and also have progesterogenic properties (Chevallier, 1996). The extracts of the roots of species with *Emblica officinalis* can be used to treat the lethal action caused by *Vipera russelii* and *Naja kaouthia* venom in both in-vitro and in-vivo (Alam *et al.*, 2003). The anti-inflammatory activity of ethanolic extracts of roots is also reported by Singh *et al.* (2009). The tyrosinase inhibitory potential of lignans isolated from the methanolic extract of roots showed immuno-stimulant activity (Malik *et al.*, 2006).

OTHER USES

Besides medicinal uses *V. negundo* has various uses like ornamental, manure and growth promoter in agriculture, reclamation of wasteland, erosion control and handicrafts like basketry and grain storage structure, etc. can be prepared from the specis (Ahuja *et al.*, 2015). The plant has also

insecticidal properties against mosquito larva, houseflies and tobacco leaf eating larva (Tondon, 2005).

CONCLUSION

The review paper summarizes the importance of ethnobotany and pharmacological properties of *V. negundo*. The species can be source of manufacturing of modern drugs. It is suggested that plantation of species can be done for increasing its population. The review of literature revealed the *V. negundo* is treasury for curing many diseases.

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REFERENCES

- Achari, B., Chowdhuri, U.S., Dutta, P.K. and Pakrashi, S.C. 1984. Two isomeric flavones from *Vitex negundo*. *Phytochemistry*. 23(3): 703-704.
- Ahuja, S.C., Ahuja, S. and Ahuja, U. 2015. Nirgundi (*Vitex negundo* L.) – Nature's gift to mankind. *Asian Agri-History*. 19(1) : 5-32.
- Alam, M.I. and Gomes, A. 2003. Snake venom neutralization by Indian medicinal plants (*Vitex negundo* and *Emblica officinalis*) root extracts. *Journal of Ethnopharmacology*. 86(1) : 75-80.
- Amancharla, P.K., Patrick, S.R. and Gottumukkala, V. 1999. Isolation of a potent mosquito repellent from *Vitex negundo* L. *Natural Product Sciences*. 5(2) : 104-106.
- Ambika, S. and Sundrarajan, M. 2015. Antibacterial behaviour of *Vitex negundo* L. extract assisted Zn Onanoparticales against pathogenic bacteria. *Journal of Photochemistry and Photobiology B: Biology*. 146 : 52-57. DOI: <http://dx.doi.org/10.1016/j.jphotobiol.2015.02.020>.
- Au, D.T., Wu, J., Jiang, Z., Chen, H., Lu, G. and Zhao, Z. 2008. Ethnobotanical study of medicinal plants used by Hakka in Guangdong, China. *Journal of Ethnopharmacology*. 117(1): 41-50.
- Bameta, A., Sanwal, S. and Ambwani, S. 2019. Phytochemical screening and antimicrobial activity of *Vitex negundo* leaf and stem extracts against bacterial and fungal pathogens. *International Journal of Current Microbiology and Applied Sciences*. 8(12): 1071-1081.

- Banerji, J., Das, B. and Chakrabarty, R. 1988. Isolation of 4, 4'-Dimethoxy-Trans-stilbene and flavonoids from leaves and twigs of *Vitex negundo* Linn. *Indian Journal of Chemistry*. 27(6): 597-599.
- Baral, S.R. and Kurmi, P.P. 2006. *A Compendium of Medicinal Plants in Nepal*. Pub. Sharma R, 281 Maiju Bahal, Chabhil, Kathmandu, Nepal. 450-457.
- Basavaraju, R., Raj, J.V. and Bhiravamurthy, P.V. 2009. Medicinal plant resources of Puttaparthi Mandal: Taxonomic overview and need for conservation. *Ethnobotanical Leaflets*. 2009(11): 1382-1400.
- Bhardwaj, J. and Seth, M.K. 2007. Medicinal Plant resources of Bilaspur, Hamirpur and Una districts of Himachal Pradesh: An ethnobotanical enumeration. *Journal of Medicinal Plants Studies*. 5(5): 99-110.
- Britto, A.J. and Sujin, R.M. 2012. HPLC analysis of Vitexin and fingerprint of *Vitex negundo* L. *International Journal of Pharmacy and Pharmaceutical Sciences*. 4(2): 138-141.
- Chandra, S. and Babber, S. 1987. Synthesis of 5, 4'-dihydroxy-7, 8, 3', 5'-tetramethoxyflavone and two new isomeric penta-oxygenated flavanones isolated from *Lepidium sativum* and *Vitex negundo*. *Indian Journal of Chemistry*. 26(1): 82-84.
- Chandramu, C., Manohar, R.D., Krupadarum, D.G.C. and Dashavantha, R.V. 2003. Isolation characterization and biological activities of betulinic acid and ursolic acid from *Vitex negundo* L. *Phytotherapy Research*. 17(2): 129-134.
- Chauhan, N.S. 1999. *Medicinal and Aromatic Plants of Himachal Pradesh*. New Delhi: Indus Publishing Co.p. 436-438.
- Chawla, A.S., Sharma, A.K. and Handa, S.S. 1992. Chemical investigation and anti-inflammatory activity of *Vitex negundo* seeds. *Journal of Nature Products*. 55(2): 163-167.
- Chevallier, A. 1996. *The Encyclopedia of Medicinal Plants*. 1st Ed. DK Publishing Inc. New York, USA. 55-281.
- Chitra, V., Sharma, S. and Kayande, N. 2009. Evaluation of anticancer activity of *Vitex negundo* in experimental animals: An in vitro and in vivo study. *International Journal of Pharm Tech Research*. 1(4): 1485-1489.
- Dass, P. and Muralidharan, P. 2021. Review on the neuronal aspect of *Vitex negundo*-beneficial to the brain health. *World Journal of Pharmaceutical and Medical Research*. 7(2): 92-100.
- Dayal, R. 2004. Phytochemistry of some useful forest plants. *Indian Forester*. 130(4): 456-460.
- Dharmasiri, M.G., Jayakody, J.R.A.C., Galhena, G., Liyanage, S.S.P. and Ratnasooriya, W.D. 2003. Anti-inflammatory and analgesic activities of mature fresh leaves of *Vitex negundo*. *Journal of Ethnopharmacology*. 87(2-3): 199-206.
- Diaz, F., Chavez, D. and Lee, D. 2003. Cytotoxic flavone analogues of vitexicarpin, a constituent of the leaves of *Vitex negundo*. *Journal of Natural Product*. 66(6): 865-867.
- Gautam, L.N., Shrestha, S.L., Wagle, P. and Tamrakar, B.M. 2008. Chemical constituents from *Vitex negundo* (Linn.) of Nepalese origin. *Scientific World*. 6(6): 27-32.
- Haq, A.U., Malik, A. and Khan, S.B. 2004. Flavonoid glycoside and a long chain ester from the roots of *Vitex negundo*. *Polish Journal of Chemistry*. 78(10): 1851-1856.
- Haq, A.U., Malik, A., Anis, I., Khan, S.B., Ahmed, E., Ahmed, Z., Nawaz, S.A. and Chaudhary, M.I. 2004. Enzyme inhibiting lignans from *Vitex negundo*. *Chemical and Pharmaceutical Bulletin*. 52(11): 1269-1272.
- Hebbalkar, D.S., Hebbalkar, G.D., Sharma, R.N., Joshi, V.S. and Bhat, V.S. 1992. Mosquito repellent activity of oils from *Vitex negundo* L. leaves. *The Indian Journal of Medical Research*. 95: 200-203.
- Hussain, A., Virmani, O.P., Popli, S.P., Mujra, L.N. and Gupta, M.M. 1992. Dictionary of Indian medicinal plants, Director, Central Institute of Medicinal and Aromatic Plants, Lucknow. 161-162.
- Jadhav, A.N. and Bhutani, K.K. 2005. Ayurveda and gynaecological disorders. *Journal of Ethnopharmacology*. 97(1): 151-159.
- Jagtap, S.D., Deokule, S.S. and Bhosle, S.V. 2006. Some unique ethnomedicinal uses of plants used by the Korku tribe of Amravati district of Maharashtra, India. *Journal of Ethnopharmacology*. 107(3): 463-469.
- Jain, S.P. and Puri, H.S. 1984. Ethnomedicinal plants of Jaunsar-Bawar hills, Uttar Pradesh, India. *Journal of Ethnopharmacology*. 12(2): 213-222.
- Joshi, A. R. and Joshi, K. 2000. Indigenous knowledge and uses of medicinal plants by local communities of the Kali Gandaki Watershed Area, Nepal. *Journal of Ethnopharmacology*. 73(1-2): 175-183.
- Kaushik, R.D., Kumar, A. and Arora, C. 2003. Fractionation, characterization and evaluation of biocidal potential of active principles of leaves of *Vitex negundo* Linn. *Asian Journal of Chemistry*. 15(3-4): 1659-1664.
- Khan, N.A. and Rashid, A.M. 2006. A study on the indigenous medicinal plants and healing practices in Chittagong Hill Tracts (Bangladesh). *African Journal of Traditional, Complementary and Alternative Medicines*. 3(3): 37-47.
- Khare, C.P. 2004. *Encyclopedia of Indian Medicinal Plants. Indian Herbal Remedies. Rational Western Therapy, Ayurvedic and Other Traditional Uses*, Botany. Springer-Verlag Berlin Heidelberg, New York. 232.
- Khokhra, S.L., Prakash, O., Jain, S., Aneja, K.R. and Dhingra, Y. 2008. Essential oil composition and antibacterial studies of *Vitex negundo* Linn. Extracts. *Indian Journal of Pharmacological Sciences*. 70(4): 522-526.
- Koirala, N., Dhakal, C., Munankarmi, N.N., Ali, S.W., Hameed, A., Martins, N., Rad, J.S., Imran, M., Arif, A.M., Hanif, M.S., Basnyat, R.C. and Salehi, B. 2020. *Vitex negundo* L. phytosociological composition,

- nutritional analysis and antioxidant and antimicrobial activity. *Cellular and Molecular Biology*. 66(4): 1-7.
- Kosalge, S.B. and Fursule, R.A. 2009. Investigation of ethnomedicinal claims of some plants used by tribals of Satpuda Hills in India. *Journal of Ethnopharmacology*. 121(3): 456-461.
- Kosankar, P.T., Ingle, V.N. and Pokle, W.K. 2000. Thermogravimetric analysis of lignans from *Vitex negundo*. *Asian Journal of Chemistry*. 12(4): 1173-1180.
- Kotoky, J. and Das, P.N. 2008. Medicinal plants used for liver diseases in some parts of Kamrup district of Assam, a North Eastern State of India. *Fitoterapia*. 79(5): 384-387.
- Krishna, V., Verma, S. and Pareek, R.B. 2002. Terpenoids constituents from some indigenous plants. *Journal of the Indian Chemical Society*. 79(6): 550-552.
- Kritikar, K.R. and Basu, B.D. 1987. *Indian Medicinal Plants*. International Book Distributors. Dehradun. 3: 1937-1940.
- Kumar, P.P., Kumarvel, S. and Lalitha, C. 2010. Screening of antioxidant activity, total phenolic and GC-MS study of *Vitex negundo*. *African Journal of Biochemistry Research*. 4(7): 191-195.
- Li, S.C., Sun, H.L., Yang, Z.R., Xiong, W.L. and Cui, B.S. 2007. Root exchange of *Vitex negundo* L. on rocky slopes under different weathering degrees. *Ecological Engineering*. 30(1): 27-33.
- Liu, C., Tseng, and Yang, S. 2004. *Chinese Herbal Medicine, Modern Applications of Traditional Formulas*. 1stedn. CRC Press, Boca Raton. pp 904.
- Loganathan, V., Sreekanth, N., Kumar, B.S. 2004. Antibacterial Activity of *Vitex negundo* Linn. *Hamdard Medicus*. 67(3): 29-32.
- Mahmud, S., Shareef, H., Farrukh, U., Kamil, A. and Rizwani, G.H. 2009. Antifungal activities of *Vitex negundo* Linn. *Pakistan Journal of Botany*. 41(4): 1941-1943.
- Malik, A., Haq, A., Khan, M.T.H., Haq, A., Khan, S.B., Ahmad, A. and Choudhary, M.I. 2006. Tyrosinase inhibitory lignans from the methanol extract of the roots of *Vitex negundo* Linn. and their structure-activity relationship. *Phytomedicine*. 13(4): 255-260.
- Manohar, R.D., Chandramu, C. and Krupadanam, D.G.L. 2003. Isolation, characterization and biological activity of betulinic acid and ursolic acid from *Vitex negundo* L. *Phytotherapy Research*. 17(2): 129-134.
- Maurya, H. and Rao, V. 2019. The favorable role of alkaloids from *Vitex negundo* in the management of human ailments. *Annals of Clinical Pharmacology and Toxicology*. 1(2): 1007.
- Meena, A.K., Niranjana, U.S., Rao, M.M., Padhi, M.M. and Babu, R. 2011. A review of the important chemical constituents and medicinal uses of *Vitex* genus. *Asian Journal of Traditional Medicines*. 6(2): 54-60.
- Merlin, R.C. and Cathrine, L. 2011. Preliminary phytochemical screening and antibacterial activity on *Vitex negundo*. *International Journal of Current Pharmaceutical Research*. 3(2): 99-101.
- Ono, M., Nishida, Y., Masuoka, C., Li, J., Okawa, M., Ikeda, T. and Nohara, T. 2004. Lignan derivatives and a norditerpene from the seeds of *Vitex negundo* *Journal of Natural Products*. 67(12): 2073-2075.
- Padalia, R.C., Verma, R.S., Chauhan, A., Chanotia, C.S. and Thul, S. 2016. Phytochemical diversity in essential oil of *Vitex negundo* L. population from India. *Records of Natural Products*. 10(4): 452-464.
- Pattanaik, C., Reddy, C.S. and Murthy, M.S.R. 2008. An ethnobotanical survey of medicinal plants used by the Didayi tribe of Malkangiri district of Orissa, India. *Fitoterapia*. 79(1): 67-71.
- Purkayastha, J., Nath, S.C. and Islam, M. 2005. Ethnobotany of medicinal plants from Dibru-Saikhowa Biosphere Reserve of Northeast India. *Fitoterapia*. 76(1): 121-127.
- Rajadurai, M., Vidhya, V.G., Ramya, M. and Bhaskar, A. 2009. Ethno-medicinal plants used by the traditional healers of Pachamalai Hills, Tamilnadu, India. *Studies on Ethno-Medicine*. 3(1): 39-41.
- Rana, S. and Rana, K.K. 2014. Review on medicinal usefulness of *Vitex negundo* Linn. *Open Access Library Journal*. 1(3): 1-13.
- Rana, V.S., Dayal, R. 2003. Seasonal variation of the essential oil of *Vitex negundo* leaves. *Indian Forestry*. 129(5): 607-610.
- Rastogi, T., Kubde, M., Farooqi, I.A. and Khadabadi, S.S. 2010. A review on ethnobotanical uses and phytopharmacology of anti-inflammatory herbs *Vitex negundo* L. *International Journal of Pharmaceutical Sciences and Research*. 1(9): 23-28.
- Rimando, M.A., Inoshiri, O.S. and Kohda, H. 1987. Screening for mast cells histamine release inhibitory activity of Philippine medicinal plants. *Shoyakugaku Zasshi*. 41(3): 242-247.
- Samy, R.P., Thwin, M.M., Gopalakrishnakone, P. and Ignacimuthu, S. 2008. Ethnobotanical survey of folk plants for the treatment of snakebites in Southern part of Tamilnadu, India. *Journal of Ethnopharmacology*. 115(2): 302-312.
- Sathiamoorthy, B., Gupta, P., Kumar, M., Chaturvedi, A.K., Shukla, P.K. and Maurya, R. 2007. New antifungal flavonoids glycoside from *Vitex negundo*. *Bioorganic and Medicinal Chemistry Letters*. 17(1): 239-242.
- Shamim, Ahmed, S. and Fatima, L. 2018. Sanbhaloo (*Vitex negundo*): Pharmacological actions and therapeutic benefits: A review. *The Pharma Innovation Journal*. 7(9): 330-336.
- Sharma, B., Sharma, S., Bhardwaj, S.K., Ndungu, C.K. and Dutt, B. 2015. Ethnobotanical uses of common plant species growing along the national highway 5 from Solan to Shimla in Himachal Pradesh. *World Journal of Pharmacy and Pharmaceutical Sciences*. 4(2): 1210-1218.
- Sharma, K., Yadav, M. and Attri, K. 2020. Pharmacognostic studies on methanolic extract of leaves of *Vitex negundo* L. *Pharmacognosy Journal*. 13(3): 551-556.
- Sharma, M. and Sood, S.K. 2013. Ethnobotanical survey for wild plants of District Solan, Himachal Pradesh,

- India. *International Journal of Environmental Biology*. 3(3): 87-95.
- Sharma, P. and Mishra, N.K. 2009. Diversity, utilization pattern and indigenous uses of plants in and around a cement factory in Bilaspur District of Himachal Pradesh North Western Himalaya. *Biological Forum – An International Journal*. 1(2): 89-91.
- Sharma, P.K., Chauhan, N.S. and Lal, B. 2004. Observations on the traditional phytotherapy among the inhabitants of Parvati valley in Western Himalaya, India. *Journal of Ethnopharmacology*. 92(2-3): 167-176.
- Sharma, P.K., Chauhan, N.S. and Lal, B. 2004. Observations on the traditional phytotherapy among the inhabitants of Parvati valley in Western Himalaya, India. *Journal of Ethnopharmacology*. 92(2-3): 167-176.
- Sharma, P.K., Thakur, R., Gulshan, Deepika. and Kumar D 2013. Studies on some important medicinal and aromatic plants and their traditional usages in District Hamirpur- A sub Himalayan Tropical Region of Himachal Pradesh India. *Weekly Science Research Journal*. 1(7): 2321-7871.
- Singh, J., Singh, J. and Sharma, D. 2018a. Traditional wisdom to treat the most common ailments in Chopal region of Shimla District, Himachal Pradesh, India. *Plant Archives*. 18(2): 2759-2769.
- Singh, J., Singh, J., Kumar, N., Jishtu, V., Sharma, S. and Dhupper, R. 2018. Ethno-medicinal plants used by indigenous people of Kanda Range, Chopal Forest Division, Himachal Pradesh. *World Journal of Pharmacy and Pharmaceutical Sciences*. 7(1): 697-710.
- Singh, P., Mishra, G. and Jha, K.K. 2010. Chemical composition and antimicrobial activity of essential oil of leaves of *Vitex negundo* Linn.(Verbenaceae). *International Journal of Chem Tech Research*. 2(3): 1686-1690.
- Singh, P., Mishra, G., Garg, V.K., Khosa, R.L. and Kumar, A. 2009. Anti-inflammatory activity of *Vitex negundo* root extract. *Pharmacology Online*. 2: 772-781.
- Singh, V., Dayal, R. and Bartley, J.P. 1999. Volatiles constituents of *Vitex negundo* leaves. *Planta Medica*. 65(6): 580-582.
- Stylian, G. 1996. *Vitex negundo*. *Australian Journal of Medical Herbalism*. 8(2): 34-39.
- Sunayana, N., Nalini, M.S., Kumara, S.K.K. and Prakash, H.S. 2014. Diversity studies on the endophytic fungi of *Vitex negundo* L. *Mycosphere*. 5(4): 578-590.
- Surveswaran, S., Cai, Y.Z., Corke, H. and Sun, M. 2007. Systemic evaluation of natural phenolic antioxidant from 133 Indian medicinal plants. *Food Chemistry*. 102(3): 938-953.
- Tondon, V.R. 2005. Medicinal uses and biological activities of *Vitex negundo*. *Natural Product Radiancance*. 4(3): 162-165.
- Utpalendu, J., Chattopadhyay, R.N. and Badri, P.S. 1999. Preliminary studies on anti-inflammatory activity of *Zingiberofficinale* Rosc., *Vitex negundo* Linn and *Tinosporacordifolia* (willid) Miers in albino rats. *Indian Journal of Pharmacology*. 31(3): 232-233.
- Venkateswarlu, K. 2012. *Vitex negundo*: Medicinal value, biological activities, toxicity studies and phytopharmacological actions. *International Journal of Pharmaceutical Phytopharmacological Research*. 2(2): 126-133.
- Verma, S. and Chauhan, N.S. 2007. Indigenous medicinal plants knowledge of Kunihar forest division district Solan. *Indian Journal of Traditional Knowledge*. 6(3): 494-497.
- Vidarthi, S., Samant, S.S. and Sharma, P. 2013. Traditional and indigenous uses of medicinal plants by local residents in Himachal Pradesh, North Western Himalaya, India. *International Journal of Biodiversity Science, Ecosystem Services & Management*. 9(3): 185-200.
- Vishnoi, S.P., Shoeb, A., Kapil, R.S. and Popli, S.P. 1983. A furanoeremophilane from *Vitex negundo*. *Phytochemistry*. 22(2): 597-598.
- Vishwanathan, A.S., Basavaraju, R. 2010. A review on *Vitex negundo* L.-A medicinally important plant. *European Journal of Biological Science*. 3(1): 30-42.
- Waghmode, B.A. 2020. An overview on: Botany, extractuion, phytochemistry and medicinal uses of *Vitex negundo* Linn. *The Pharma Innovation Journal*. 9 (3): 100-104.
- Zheng, C.J., Tang, W.Z., Huang, B.K., Han, T., Zhang, Q.Y., Zhang, H. and Qin, L.P. 2009. Bioactivity-guided fractionation for analgesic properties and constituents of *Vitex negundo* L. seeds. *Phytomedicine*. 16(6-7): 560-567.
- Zheng, G. and Luo, Z. 1999. Determination of antioxidant composition in *Vitex negundo* L. Seeds. *Guangdong Huangong*. 2: 8-9.
- Zheng, G., Lue, Z. and Chen, D. 1999. Studies on the antioxygenic composition of *Vitex* plant leaves. *Guangdong Gongye Daxue Xuebao*. 16(2): 41-47.
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