



***CELASTRUS PANICULATUS*, AN ENDANGERED INDIAN MEDICINAL PLANT
WITH MIRACULOUS COGNITIVE AND OTHER THERAPEUTIC PROPERTIES:
AN OVERVIEW**

NEHA ARORA AND SHASHI PANDEY-RAI*

*Laboratory of Morphogenesis, Centre of Advance Study in Botany, Faculty of Science,
Banaras Hindu University, Varanasi-221005*

ABSTRACT

Celastrus paniculatus is an Indian medicinal plant which has been used for thousands of years in the traditional Ayurvedic system of medicine. It is fast gaining importance in the primary healthcare systems as well as in herbal drug formulations. Oil obtained from the seeds of the plant is reported to be highly beneficial in stimulating intellect and sharpening the memory. It also acts as a potential nervine tonic, rejuvenator and an anti-depressant. Moreover, the plant possesses a strong antioxidant as well as free radical scavenging activity. *C. paniculatus* has also been exploited for its potential role in the management of neurodegenerative diseases and other neuronal disorders such as Alzheimer's disease. Oil being a powerful stimulant for neuromuscular system is also used for the treatment of rheumatism, gout and paralysis. This review aims at exploring the detailed phytochemical composition, pharmacological properties as well as therapeutic applications of different parts of *C. paniculatus*.

KEYWORDS: *Celastrus paniculatus*, nervine tonic, antioxidant, phytochemicals, therapeutic properties



SHASHI PANDEY-RAI

Laboratory of Morphogenesis, Centre of Advance Study in Botany, Faculty of Science,
Banaras Hindu University, Varanasi-221005

*Corresponding author

INTRODUCTION

Celastrus paniculatus is an unarmed woody climbing shrub commonly known as Malkangni, Kangani, Jyotishmati, Sphutabandhani, Svarnalota, Black-Oil tree, Intellect tree, Climbing-staff plant. It grows throughout India up to a height of almost 1,800-2,000 meters. This deciduous vine can grow to a very large size. It belongs to the class Angiospermae and family Celastraceae (Figure 1). The base stem of this shrub grows up to 10 centimeters in diameter and 6 meters in length. Being a rambler by nature, it produces many woody branches that cling to surrounding flora for support (Figure 2). The stem has a rough, pale or reddish brown exfoliating bark covered densely with small elongated white lenticels. The inner bark is light and cork like with yellow sapwood. The leaves are simple, broad, and oval, obovate or elliptic in shape, leathery and smooth, alternately arranged on short petioles

with toothed margins¹. They grow on singular stems ranging from light to dark green color. The flowers are tiny with 3.8 mm diameter, whitish green to yellow green in color and grow on the top of the main stalk in terminal drooping panicles of 5-20 cm length. Capsules of the plant are depressed, globose, tri-lobed, bright yellow colored with 1-1.3 cm diameter, containing 3-6 seeds per capsule/ seed pod which are enclosed by an orange-red aril. The seeds are small and oval shaped growing in round pods that gradually change from a light yellow to a deep red color as they mature (Figure 3). They are known to cause yellow-orange stains on anything their oils come into contact with. Parts of the plant which are generally used for their economic importance include seeds, bark and leaves. Detailed botanical description of the different parts of the plant is discussed in Table 1.

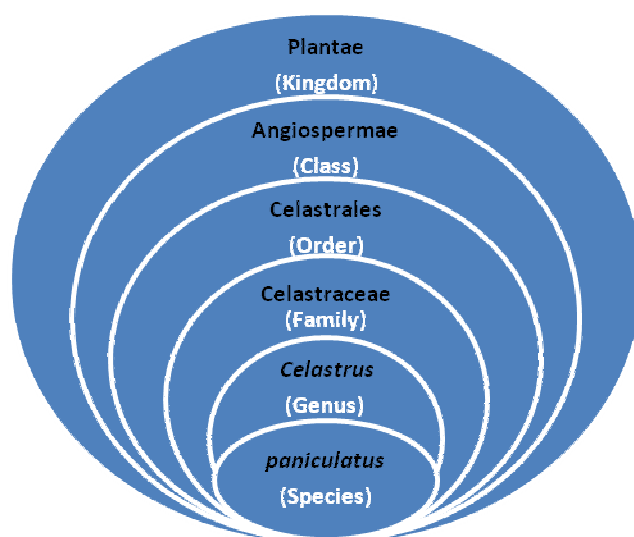


Figure 1
Classification of Celastrus paniculatus Wild.

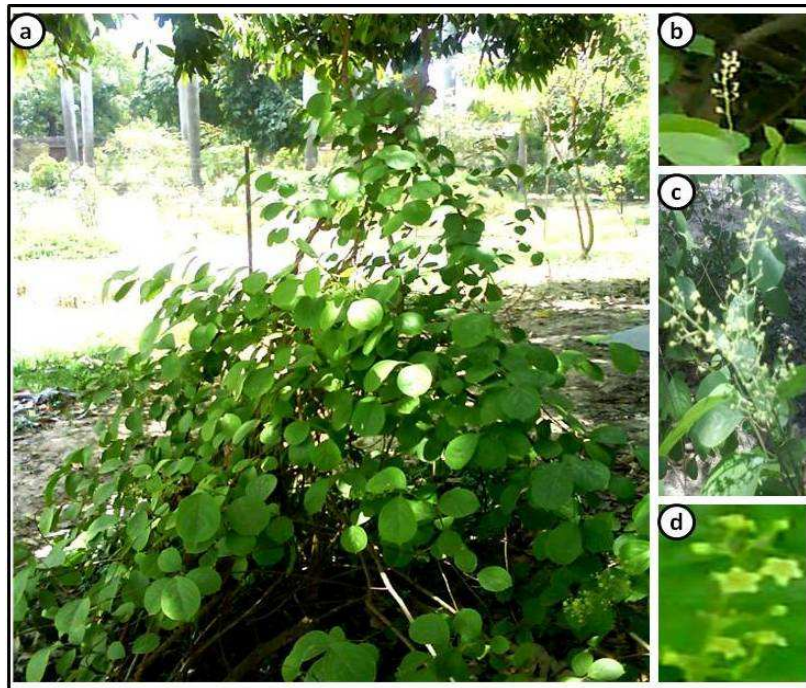


Figure 2

**a) Natural habitat of *Celastrus paniculatus* b) Inflorescence
c) Inflorescence at full bloom stage d) Flowers in yellow green color**

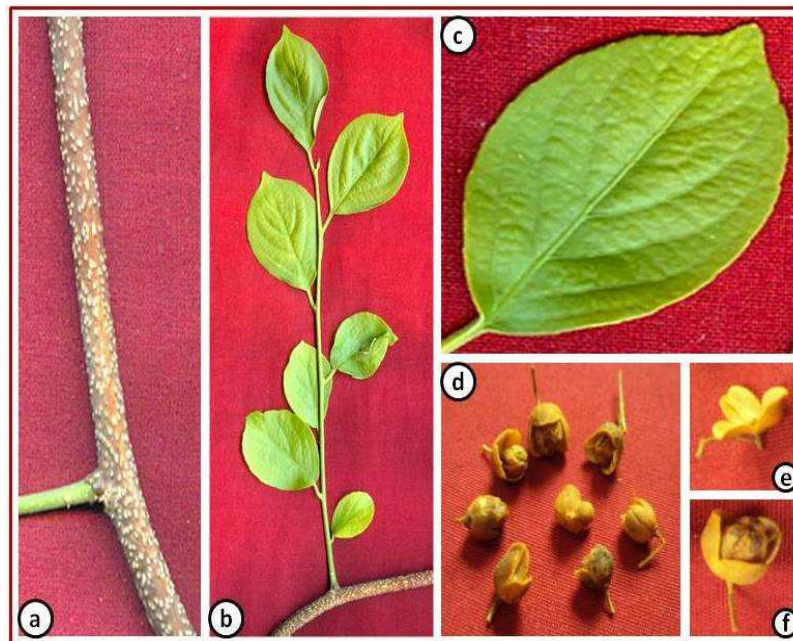


Figure 3

**a) Stem: Reddish brown stem covered with small elongated white lenticels
b) Leaves: Alternately arranged c) Ovate leaf d) Capsules: Orange colored with 3-6 seeds
inside e) Dehiscent capsule without seeds f) Seeds: Single capsule showing seeds
enclosed by an orange-red aril**

Table 1

Botanical description and properties of different plant parts of *Celastrus paniculatus*

Plant part	Botanical Description/ Properties
Bark	Pale yellow corky bark; rough and cracked, exfoliating in small scales
Stem	Woody climber
Leaf	Ovate, Oblong-elliptic, broad, glabrous, simple, alternate, very variable, slightly serrated, sometimes pubescent beneath along the venation, up to 6 × 11 cm; base cuneate, obtuse or rounded; apex acute, acuminate or obtuse
Flower	Unisexual, small, greenish white or yellowish green; panicles large, terminal, pubescent; racemes terminal, compound or supra-decompound, calyx-lobed rounded, ciliated, margin of the disk thin, free. Male flowers are minute, pale green; calyx lobes suborbicular, toothed; petals oblong or obovate-oblong, entire; disk copular. Female flowers have sepals, petals and disk similar to those of male flowers
Capsule	Globose, yellow, transversely wrinkled; trivalved, 3-6 seeded
Seed	Grow inside capsules; ellipsoid or ovoid, yellowish or reddish-brown in color, enclosed in orange red fleshy aril

Region of occurrence in the world

It is a hardy plant that grows in a wide variety of climates and environments. It is native to the Indian continent, but is known to grow widely in Australia, China, Taiwan, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri-Lanka, Thailand, Vietnam as well as many of the Pacific islands. It has also been transplanted and grown in every continent except Antarctica. More recently, it has been cultivated in Africa.

Region of occurrence in India

This hardy bush has been seen growing above an elevation of 5900 feet (1800 meters), along the Himalayan mountainside, Western Ghats, Eastern Ghats and in other high altitude environments. It is a rare plant of Odisha (earlier Odissa), particularly found in all of its forest blocks but is abundantly found in Simlipal Biosphere Reserve forest, Karlapat sanctuary and Niyamgiri hills^{2,3,4}.

Endangered species

C. paniculatus is a rare and endangered medicinal plant distributed throughout India mostly in tropical forests and subtropical

Himalayas. Recent studies show that the wild populations of the plant in India are at high risk². The species is vulnerable in Western Ghats of south India⁵. It is reported to be critically endangered (CR) in Uttar Pradesh and Uttrakhand⁶.

Seed and Oil Studies of *C. paniculatus*

C. paniculatus seeds and oil extracted from them have long been regarded to be highly beneficial and medicinally effective. The seeds yield as much as 52% oil by weight, and it is in this oil that numerous alkaloids are found, compounds such as celastrine and paniculatin. The seeds are highly rich in fatty acids. Percentage composition of four lipid fractions of the seeds viz. normal triglycerides, polar triglycerides, polar nonglyceridic ester, and nonpolar nonglyceridic ester is given in Figure 4. Major component acids in these fractions are palmitic, stearic, oleic, linoleic, and linolenic. The major molecular species constituting the normal triglycerides are: palmito-oleo-palmitin (6.8%), palmito-oleo-stearin (5.6%), palmito-diolein (14.7%), palmito-oleo-linolein (7.0%), stearo-diolein (6.1%), triolein (8.0%) and dio-

leo-linolein (7.6%)⁷. They are generally known to stimulate intellect and sharpen the memory. Seeds are used as expectorant as well as brain and liver tonic. They also cure joint-pains, paralysis and weakness. Oil of *C. paniculatus* is cold-pressed raw herbal oil expressed from the seeds of the plant which follows different procedures of extraction that are mentioned in

Table 2. Oil is stomachic, tonic, good for cough and asthma; used in leprosy, cures headache and leucoderma. Studies reveal that the oil has an efficient therapeutic effect on the central nervous system. Various uses of *Celastrus* seeds and oil are given in Table 3 whereas Table 4 discusses the general properties of the oil derived from the seeds of the plant.

Figure 4
Fatty acid composition (in %) of lipid fractions of *C. paniculatus* seed

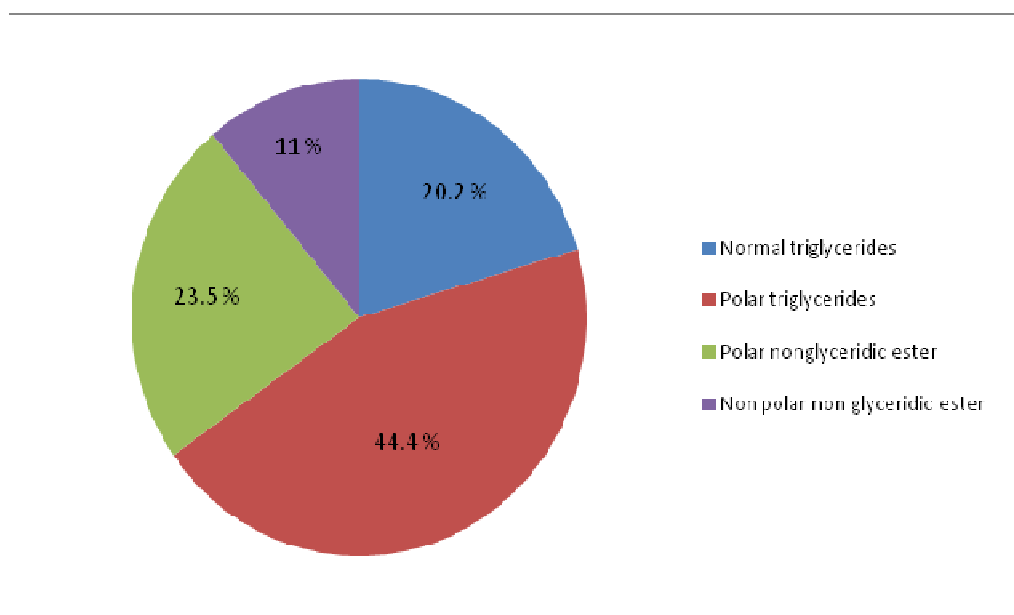


Table 2
Traditional and modern methods of oil extraction

Traditional method of extraction	Modern method of extraction
<ul style="list-style-type: none"> Seeds are first placed in a pot of boiling water or goat's milk for over a period of several hours Essential oils rise to the surface Seeds are strained out, remaining mixture is allowed to settle Finally oil is siphoned out into another container 	<ul style="list-style-type: none"> Large quantity of seeds are placed into a screw press Seed oil squeezes out under the force of the press Oil is then collected

Table 3
Uses of seeds and oil of *C. paniculatus*

Uses	Seed	Oil
Used as/ for	Appetizer, emetic, expectorant, sodorific, aphrodisiac, powerful brain and liver tonic ⁸ , stimulate intellect and sharpen memory, thermogenic, emollient, nervine, stimulant, anti-inflammatory, diuretic, emmenagogue, diaphoretic, febrifuge, digestive, laxative, useful in abdominal disorders	Intellect promoting, shows beneficial effect on the learning and memory process in mentally retarded children ⁹ ; thermogenic and rubefacient, stomachic, tonic, useful in abdominal disorders, enriches blood; powerful stimulant for neuromuscular system
Used against	Seeds used externally on foul, indolent ulcers and scabies; useful both as an external and internal remedy in rheumatism, gout, paralysis, leprosy ¹⁰ and weakness. Used against pruritis, skin diseases, leucoderma, cephalalgia, arthralgia, asthma, cardiac debility, inflammation, stranguary, neuropathy, amenorrhoea, dysmenorrhoea, epilepsy	Used to treat beri-beri (vitamin B1 deficiency disease ^{1,11}); powerful against malaria; useful in treating ADD, anxiety, "brain fog", etc.; works against cough and asthma; cures headaches and leucoderma

Table 4
Oil properties of *C. paniculatus*

Constituents	Uses	Dosage	Toxicity	Shelf life
<ul style="list-style-type: none"> • Protein • Carbohydrates • Fats <ul style="list-style-type: none"> a) Saturated fats: 0.022 of 1% b) Polyunsaturated fats: 0.035 of 1% c) Monounsaturated fats: 0.032 of 1% • Vitamin C • Sodium • Potassium • Ash • Calcium • Iron • Sesquiterpene polyol esters 	<ul style="list-style-type: none"> • Used to stimulate intellect, sharpen memory¹ and facilitate learning, works as a powerful brain tonic • Produces improvements in IQ in mentally retarded children⁹ • Induces a feeling of well-being and has reported aphrodisiac effects • Known to affect the CNS¹² 	<ul style="list-style-type: none"> • 10-15 drops of oil twice daily acts as a powerful stimulant • Higher doses can be used on occasion for a more immediate effect. • Oil is reported to be more effective when used sublingually 	<ul style="list-style-type: none"> • Highest dose of 5 g/kg did not produce any toxic effect nor impair motor coordination • Does not have any lethal or neurotoxic effects • Oil is not harmful even in doses many hundreds of times those normally administered 	<ul style="list-style-type: none"> • Oil in its raw state has a shelf life of 2 years if kept in a cool and dark place

Phytochemistry of *C. paniculatus*

Different parts of the plant when extracted in different solvents give various fractions of active components, which are discussed in Figure 5¹³. The seeds of *C. paniculatus* contain brownish yellow oil, with a higher proportion of acetic and benzoic acids in addition to other fatty acids, as well as a crystalline substance tetracasanol and sterol^{14,15}. A new sesquiterpene ester Malkangunin and three sesquiterpene alkaloids namely celapanin, celapanigin, celapagin have been isolated from the plant¹⁶. The sesquiterpene alkaloids are derived from a new sesquiterpene tetra-ol (celapanol) which is alternately esterified with acetic, benzoic,

nicotinic and β -furoic acids¹⁷. The various mineral elements in the plant have been reported as sodium, magnesium, aluminium, potassium, calcium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, molybdenum, silver while strontium and cerium were found to be absent¹⁸. Besides these, oil of the plant also comprises of proteins, carbohydrates, fats (saturated fats, polyunsaturated fats, monounsaturated fats) and Vitamin C. The 50% ethanolic extract of plant (excluding root) shows 3.52% presence of tannins¹⁹. Table 5 gives the detailed description of the compounds and their active components present in the plant.

Table 5
Types of compounds and the active components present in *C. paniculatus*

Classes/Types of compounds present	Active components
Sesquiterpene esters/ Polyol ester	Malkanguniol, Malkangunin, Celapanine, Celapanigine/ Sesquiterpene polyol ester
Sesquiterpene alkaloids	Celapanin, Celapanigin, Celapagin
Sesquiterpenoids	Dihydroagarofuran sesquiterpenoids
Alkaloids	Celastrine, Paniculatine
Quinone-methide and phenolic triterpenoids	Celastrol, Pristimerin, Zeylasterone, Zeylasteral
Carboxylic acids	Acetic acid, Benzoic acid
Fatty acids	Oleic, Linoleic, Linolenic, Palmitic, Stearic, Crude Lignoceric acid
Crystalline substances	Tetracasanol and Sterol

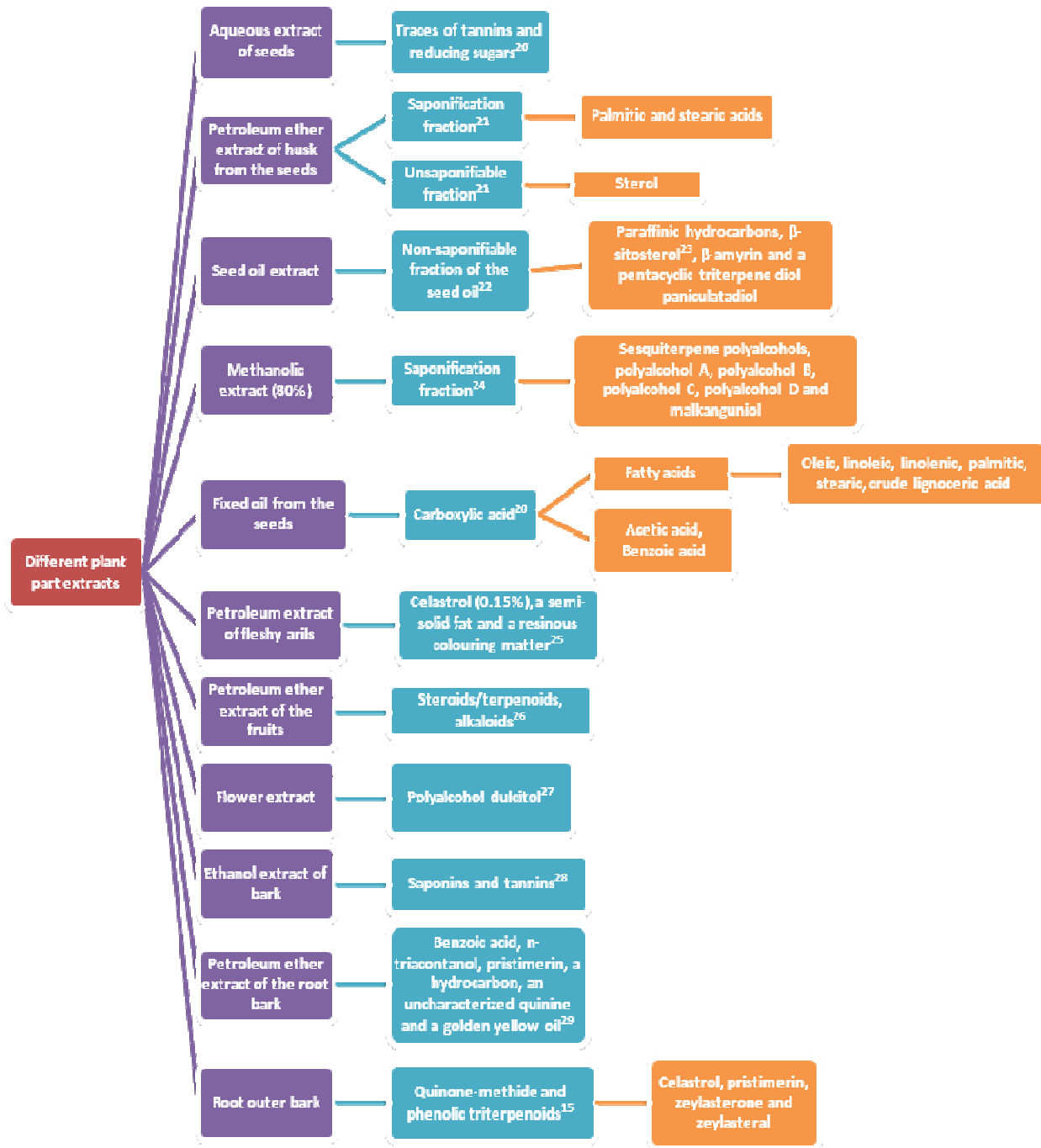


Figure 5

Different phytochemicals or active components derived from different plant part extracts

Traditional use

For thousands of years, Ayurvedic medicine has used the *Celastrus* seeds for their potent medicinal properties. They were used for many different ailments and were administered as

powerful brain tonic, appetite stimulant as well as emetic. They helped in overcoming physical weakness and mental confusion; played an important role in alleviating asthma symptoms, reducing headaches and joint pains due to

arthritis. Men used them as potent balm that worked as sexual stimulant like modern phosphodiesterase inhibitors. In India, ayurvedic doctors of Bastar region in Chhattisgarh, used to prescribe *Celastrus* seeds to the patients suffering from forgetfulness in the dosage of one seed daily in their diet and then gradually increasing it up to 100 seeds per day. Traditional healers have used *Celastrus* oil for centuries to increase mental acuity, improve memory and intellect as well as retention and recalling power; and to alleviate mental fatigue, stress and minor joint pains. People using the oil were able to learn new information more quickly and were able to accurately and efficiently recall that information over longer periods of time. They used to call it 'magzsudhi' or brain clearer. Small quantities of the oil have long been consumed in healthy diet as a supplement to improve dream recall and to help induce lucid dreams. Use of the oil in a pomatum made by mixing one part of the oil in 8 parts of butter for application to the head has also been a common practice³⁰.

Therapeutic uses of *C. paniculatus*

C. paniculatus L. has a remarkable therapeutic value. Popularly being described as Jyotishmati, this plant has an important role in enhancing cognitive function and the natural luminosity

(jyoti) of the mind (mati). It is a warming herb used internally in the treatment of inflammation of muscles and joints, including rheumatism, gout and paralysis³¹. The seeds are used to heal indolent ulcers and sores, as well as infectious skin conditions such as scabies in the form of a poultice³. Medicated oil extracted from the seeds of the plant is used for topical application as a rubifacient and stimulant. Consumption of half a teaspoon of the oil daily or its application on the head acts as a brain stimulant to improve memory³¹. Similarly, a smaller dose of 4-10 drops of the expressed oil can be used in relieving mental exhaustion. Recent medical research on small mammals has proven the efficacy of the oil obtained from the seeds in lowering blood pressure, increasing alertness, and improving problem solving skills, possibly due to its powerful antioxidant action in the blood. *Celastrus* oil (in doses of 10-15 drops) supplemented with benzoin, cloves, nutmeg and mace helps in combating beri-beri, a disease of the peripheral nervous system associated with vitamin B-1 (thiamine) deficiency³. The oil being a powerful stimulant is also used as an ointment for relieving rheumatic pains inflicted by malaria. Figure 6 illustrates the various therapeutic applications of the plant.

Table 6

Active components and therapeutic uses of different parts of *C. paniculatus*

Plant part	Bio-active component	Therapeutic Uses
Leaves	Saponin	Responsible for ant-microbial and anti-fungal activity; used for decoctions and teas; ease cough and fight infections, acts as emmenagogue
Root bark	β -sitosterol, Celastrol, Pristimerin, Zeylasterone, Zeylasteral; Terpenes	Used to treat malaria
Seed/ Seed oil	Acetic and benzoic acids in addition to other fatty acids; crystalline substance tetracasanol and sterol ^{14,15} ; Alkaloids Celastrine and Paniculatin	Used to treat infections; have sedative and antidepressant actions; possess emetic, diaphoretic, febrifugal and nervine properties; sharpens memory; cure sores, ulcers; mosquitoes repellent; alkaloid fractions have tranquilizing properties.; oil enriches blood

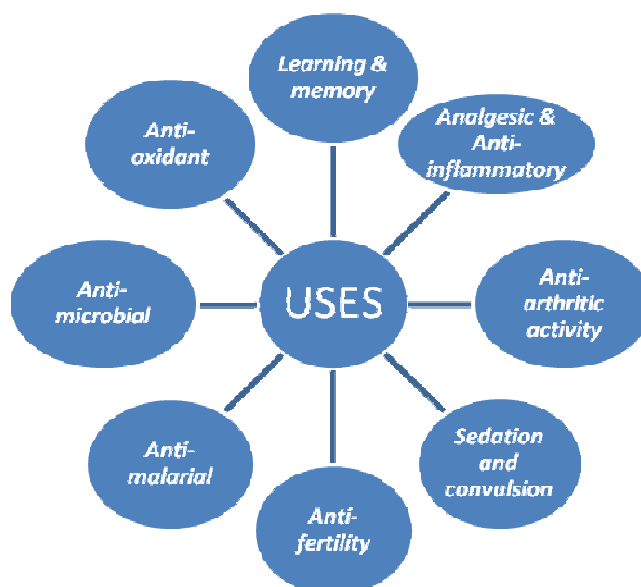


Figure 6
Therapeutic uses of the plant

Learning and memory

Studies conducted on cognitive functions of rats using the aqueous extract of seeds of *C. paniculatus* indicate that the aqueous extract improved learning and memorizing capacity. It selectively reverses the impairment in spatial memory produced by acute central muscarinic receptor blockade, but is not related to an anticholinesterase-like action³². The oil extracted from the seeds was studied for its effect on learning and a significant improvement was observed in the retention ability of the *Celastrus*-treated rats compared with the saline administered controls.

Sedation and convulsion

Studies indicate a sedative property of the oil in cats, monkeys, mice and rats, and an anticonvulsant effect in rats³³.

Antioxidant

Methanolic extract of *C. paniculatus* demonstrates a dose-dependent free radical scavenging capacity and a protective effect on DNA cleavage, confirmed by a significant protective effect on H₂O₂-

induced cytotoxicity and DNA damage in human non-immortalized fibroblasts³⁴.

Analgesic and Anti-inflammatory

A methanolic extract of the flowers of *C. paniculatus* exhibits analgesic and anti-inflammatory activities in the hot water tail immersion test in mice and carrageenan induced pedal edema in rats³⁵.

Hypolipidaemic

50% ethanolic seed extract was demonstrated to reduce serum cholesterol and LDL-cholesterol levels by 60.10% and 71.70%, respectively. Increased faecal excretion of cholesterol suggests modulation of adsorption is affected³⁶.

Anti-arthritis activity

The body weight loss and swelling of the paw in rats during the secondary lesions found during the arthritic condition was corrected on treatment with petroleum ether and alcoholic extracts of the seeds, the study being a supporting evidence for the anti-arthritis activity³⁷.

Anti-fertility

The seed oil in a dose of 0.2 ml/animal/48 h to adult albino rats for 30 days showed anti-spermatogenic effects caused due to vacuolization of seminiferous tubules, germ cell depletion and exfoliation resulting into an arrest in spermatogenesis³⁸.

Wound healing activity

Lupeol, a triterpene compound isolated from petroleum ether extract of leaves exhibited a remarkable wound healing activity with a high rate of wound contraction³⁹.

Anti-malarial activity

Chloroform extract of the root bark containing a quinonoid triterpene, pristimerin was witnessed to have the highest antimalarial activity⁴⁰.

Anti-bacterial activity

The seed oil as well as the aqueous extract has an effective antibacterial activity against numerous microbes viz. *Micrococcus pyogenes*, *Bacillus subtilis*, *B. cereus*, *Corynebacterium diphtheriae*, *Salmonella typhosa*, *S. paratyphi*, *S. dysenterica*, *S. marcescens* *Escherichia coli*, *Proteus vulgaris*, *P. morgani*, *Pseudomonas pyocyana*, *P. aeruginosa* *Staphylococcus aureus*, *S. lutea* and *Klebsiella pneumonia*^{41,42}.

Anti-fungal activity

The plant extracts had a strong inhibitory activity against several fungi like *Trichophyton mentagrophytes*, *T. rubrum*, *T. soudanense*, *Candida albicans*, *Torulopsis glabrata*, and *Candida krusei*, *Aspergillus niger*, *A. flavus*, *Penicillium* sp. and *Trichoderma* sp⁴³.

Pharmacological studies

Celastrus seed oil is used in several diseases like sciatica, lumbago, paralysis, arthritis and facial palsy for massage, which has proved to be very beneficial. Due to its remarkable brain stimulating and antioxidant effects, its effect was tested against immobilization-induced

stress in albino mice. The crude *C. paniculatus* seed oil administered orally, intramuscularly (i.m.) and intraperitoneal (i.p.) in a dose of 1 g/kg produced sedation in rats and showed a significant reduction of movement in mice. The seed oil given as emulsion showed tranquilizing effect on adrenaline and amphetamine-induced excitement in mice³³. Aqueous seed extract at a dose of 200 mg/kg body weight of rat, administered for 14 days has been observed to have an improvement on learning and memory. It has also exhibited antioxidant properties by decreasing lipid peroxidation and augmenting endogenous antioxidant enzymes in brain. Aqueous extract of the plant at 100, 200 and 300mg/kg doses once a day for 21 days, was investigated for its cognitive enhancing and antioxidant property in model of alzheimer's disease in rats. It was found to be effective in preventing the cognitive deficits as well as the oxidative stress caused by ICV streptozotocin in rats⁴⁴. The seed extract has been extensively investigated in several laboratories for their neuropharmacological effects and a number of preclinical reports are available confirming their nootropic action⁴⁵ but the exact mechanism of its action is still uncertain. It has been suggested that the plant exhibits neuroprotective and cognitive enhancing effects due to its antioxidative property and its capacity to modulate the cholinergic system¹³.

Toxicity

The LD₅₀ cut-off dose for petroleum ether extract and alcoholic extract were found to be 5000 mg/kg and 3000 mg/kg body weight respectively during the acute oral toxicity study was carried out as per the guideline set by the Organization for Economic Co-operation and Development (OECD). Since one tenth of the medium lethal dose (LD₅₀) was considered as an effective dose, the therapeutic doses were taken as 500 mg/kg and 300 mg/kg body weight for petroleum ether and ethanolic extracts respectively³⁷.

Dosage

All the products of the plant used clinically are considered safe with low toxicity. Freshly powdered seed at the dose of 1-3 g and freshly crushed seed (tincture) at the dose 1-3 ml, twice or thrice daily is an effective dose. 10-12 seeds of *Celastrus* up to 100 a day, can be chewed at a time without any harmful effect. Oral administration of *Celastrus* oil up to the highest dose of 5 g/kg body weight does not produce mortality or any toxic effect on the normal behavior of the rats. It even did not impair motor coordination at any dose level¹². 2-10 drops of oil consumed twice a day is considered to be the standard dosage⁴⁶, whereas, 10-15 drops twice daily acts as a powerful stimulant unattended by subsequent exhaustion¹.

Recent studies

Celastrus has long been used in Ayurvedic medicine for its potent medicinal properties, modern medicinal studies have only confirmed the miraculous potential of *Celastrus* seeds in supporting mental function. According to the recent study conducted on albino rats, oil

extracted from the seeds of *C. paniculatus* was observed to have remarkable effects on the contents of norepinephrine (NE), dopamine (DA) and serotonin (5-HT) in the brain¹². Significant improvement was observed in the retention ability of the drug treated rats. These data indicate that *Celastrus* oil causes an overall decrease in the turnover of all the three central monoamines and implicate the involvement of these aminergic systems in the learning and memory process³⁴.

Ongoing research

There are researches being conducted to find out the possibility that anticancer drugs like pristimerin, which is derived from the seeds of the *Celastrus* plant, may be an effective means of treating or inhibiting the growth of specific types of cancer cells. H. Yang et.al.⁴⁷, who conducted the research on pristimerin has found it to be quite active against nine cancer cell lines. Many more such researches are still going on and the potential health benefits of *C. paniculatus* looks very promising.

REFERENCES

1. Kirtikar KR and Basu BD. Indian Medicinal Plants. Vol. 1, Lalit Mohan Basu, Allahabad, India, 677-680, (1984).
2. Warriar PK, Nambiar V P K and Ramankutty C. Indian Medicinal Plants. Orient Longman Ltd., Madras, Vol.1-5, (1993-1995).
3. Kirtikar KR and Basu BD. Indian Medicinal Plants, Second edition (Published by Lalit Mohan Basu, Allahabad, India) Vol. II, 1492, (1935).
4. Nayar MP and Sastry ARK. Red Data Book of Indian Plants. Botanical Survey of India, Calcutta, Vol. 1, (1987).
5. Rajasekharan PE and Ganeshan S. Conservation of medicinal plant biodiversity Journal of Medicinal Aromatic Plant Sciences, 24: 132-147, (2002).
6. Prakash Anand and Singh KK. Observation on some threatened plants and their conservation in Rajaji National Park, Uttaranchal, India. J.Econ.Tax, Bot. 25 (2): 363-366, (2001).
7. Sengupta A, Sengupta Chandana, Mazumder UK. Chemical Investigations on *Celastrus paniculatus* Seed Oil. European journal of lipid science and technology, Volume 89, Issue 3, 119-123, (1987).
8. Thakur RS, Puri HS, Akhtar Husain. Major Medicinal Plants of India. Central Institute of Medicinal & Aromatic Plants Lucknow India, 391-394, (1989).
9. Nalina K, Aroor AR, Kumar KB and Rao Anjali. Studies on biogenic amines and their metabolites in mentally retarded children in

- Celastrus* oil therapy. Alternative Medicine, Vol 1 #4, 355-360, (1986).
10. Prajapati HA, Patel DH, Mehta SR, Subramanian RB. Direct in vitro regeneration of *Curculigo orchoides* Gaertn., an endangered anticarcinogenic herb. Curr. Sci., 84: 747-749, (2003).
 11. Varier VS. 19. Indian Medicinal Plants: A Compendium of 500 Species. Madras: Orient Longman, Vol. 2, (1994).
 12. Nalini K, Karanth KS, Rao A, Aroor AR. Effects of *Celastrus paniculatus* on passive avoidance performance and biogenic amine turnover in albino rats. J Ethnopharmacol, 47(2):101-8, (1995).
 13. Bhanumathy M, Chandrasekar SB, Chandur Uma, Somasundaram T. Phytopharmacology of *Celastrus paniculatus*: An Overview. International Journal of Pharmaceutical Sciences and Drug Research, 2(3): 176-181, (2010).
 14. Yoganarasimhan SN. Medicinal plants of India Tamil Nadu. Regional Research Institute Bangalore, India, Vol 2., p 441, (2000).
 15. Gamlath CB, Gunatilaka AAL, Tezuka Y, Kikuchi T and Balasubramaniam S. Quinone-methide, phenolic and related triterpenoids of plants of Celastraceae: further evidence for the structure of celastranhydride. Phytochemistry 29, 3189-3192, (1990).
 16. CSIR. Wealth India-raw material. Council for Scientific and Industrial Research (CSIR), New Delhi, Vol.3., pp 412-413, (1992).
 17. Wagner H, Heckel E. Struktur und stereochemie eines sesquiterpenesters und dreier sesquiterpen-alkaloide von *Celastrus paniculatus* Willd. Tetrahedron, 31(16): 1949-1956, (1975).
 18. Saily A, Sahu R, Gupta B, Sondhi SM. Analysis for mineral elements of medicinal plants used for the treatment of asthma, syphilis, diarrhoea, skin diseases and rheumatism. Hamdard Med, 37(4): 18-22, (1994).
 19. Atal CK, Srivastava JB, Wali BK, Chakravarty RB, Dhawan BN, Rastogi RP. Screening of Indian plants for biological activity: Part VIII. Indian J Exp Biol., 16: 330-349, (1978).
 20. Kumaraswamy ON, Manjunath BL. Chemical examination of the fixed oil from the seeds of *Celastrus paniculatus* Willd. Journal of Indian Chemical Society, 13: 353-357, (1936).
 21. Warsi SA. The chemical examination of *Celastrus paniculatus*. Current Science, 9: 134-135, (1940).
 22. Nanavati DD. Paniculatadiol (a new triterpene diol) from *Celastrus paniculatus* Willd. (Celastraceae). Journal of Oil Technology Association of India, 9: 1-4, (1977).
 23. Dighe Vidya, Adhyapak Shreedha and Tiwari Kanchan. Quantitation of β -sitosterol from *Celastrus paniculatus* willd. Using Validated high performance thin layer chromatography Method. International Journal of Pharma and Bio Sciences VOL2, ISSUE2, (2011).
 24. Hertog Den Jr, Kruk C, Nanavati DD, Dev Sukh. Stereochemistry of malkanguniol and stereostructures of some other related polyalcohols from *Celastrus paniculatus* Willd. Tetrahedron Letter, 26:2219-2222, (1974).
 25. Bhargava PN. Chemical examination of the unsaponifiable matter of the fat from the fleshy arils of *Celastrus paniculatus*. Proceeding. Indian Academy Science, 24(A): 506-509, (1946).
 26. Mukherjee K, Ray LN. Screening of some Indian plant species. Quart Journal of Crude Drug Research, 18:77-82, (1980).
 27. Dutta SK, Sharma BN, Sharma PV. Dulcitol from the flowers of Malkanguni (*Celastrus paniculatus* Willd.). Bull Med Ethnobot Res., 2: 114-115, (1981).
 28. Joshi MC, Sabnis SD. A phytochemical study of South Gujarat forests plants with special reference to the medicinal and of ethnobotanical interest. Bull Med Ethnobot Res., 10: 61-82, (1989).

29. Jain MK. Chemical examination of *Celastrus paniculatus* Willd. Indian J Chem., 1: 500, (1963).
30. Nadkarni KM and Nadkharni AK. The Indian Materia Medica. Popular Prakashay, Bombay, India, pp: 810, (1976).
31. Nadkarni AK. Indian Materia Medica, Bombay, pp. 408, 1476, (1954).
32. Gattu M., Pauly JR, Boss KL, Summers JB, Buccafusco JJ. Cognitive impairment in spontaneously hypertensive rats: Role of central nicotinic receptors. Part I. Brain Res., 771:89–103, (1997a).
33. Gatinode BB, Raiker KP, Shroff FN, Patel JR. Pharmacological studies with malkanguni, an indigenous tranquilizing drug (preliminary report). Current Practice, 1: 619-621, (1957).
34. Russo A, Izzo AA, Cardile V, Borrelli F, Vanella A. Indian medicinal plants as antiradicals and DNA cleavage protectors. Phytomed., 8(2): 125-132, (2001).
35. Ahmad F, Khan RA, Rasheed S. Preliminary screening of methanolic extracts of *Celastrus paniculatus* and *Tecomella undulata* for analgesic and anti-inflammatory activities. J Ethnopharm., 42(3): 193-198, (1994).
36. Mathur NT, Varma M, Dixit VP. Hypolipidaemic and antiatherosclerotic effect of *Celastrus paniculatus* seed extract in cholesterol fed rabbits. Indian Drugs., 30: 76-82, (1993).
37. Patil KS, Suryavanshi J. Effect of *Celastrus paniculatus* Willd: Seed on adjuvant induced arthritis in rats. Phcog Mag., 3(11): 177-181, (2007).
38. Wangoo D, Bidwai PP. Anti-spermatogenic effect of *Celastrus paniculatus* seed extract on the testis of albino rats. Fitoterapia, 59: 377-382, (1988).
39. Harish BG, Krishna V, Santosh Kumar HS, Khadeer Ahamed BM, Sharath R, Kumara Swamy HM. Wound healing activity and docking of glycogen-synthase-kinase-3-beta-protein with isolated triterpenoid lupeol in rats. Phytomed., 15(9): 763-767, (2008).
40. Pavanandt K, Kyle Webster H, Yongvanitchit K, Kun-anake A, Dechatiwongse T, Nutakul W, Bansiddhi J. Schizontocidal activity of *Celastrus paniculatus* Willd. Against Plasmodium falciparum in vitro. Phytother Res., 3(4): 136-139, (1989).
41. Patel RP, Trivedi BM. The in vitro antibacterial activity of some medicinal oils. Indian J Med Res., 50: 218-222, (1962).
42. Pandya KK, Patel RB, Chakravarthy BK. Antibacterial activity of some Indian medicinal plants. Indian Drugs., 27: 415-4117, (1990).
43. Vonshak A, Barazani O, Sathiyamoorthy P, Shalev R, Vardy D, Golan-Goldhirsh A. Screening South Indian medicinal plants for antifungal activity against cutaneous pathogens. Phytother Res., 17(9): 1123-1125, (2003).
44. Kumar MHV, Gupta YK. Antioxidant property of *Celastrus paniculatus* willd: a possible mechanism in enhancing cognition. Phytomed., 9(4): 302-311, (2002).
45. Bhanumathy M, Harish MS, Shivaprasad HN, Sushma G. Nootropic activity of *Celastrus paniculatus* seed. Pharmaceutical Biology, 48(3):324-7, (2010).
46. Selected Medicinal Plants of India [A Monograph of Identity, Safety and Clinical usage]. Published by Basic Chemicals, Pharmaceuticals, and Cosmetics Export Promotion Council, Bombay, India (Set up by the Ministry of Commerce, Government of India) pg. 82.
47. Yang PM, Xiao JY, Ouyang DW, Ni X, Xu HY, Chen J. Method for preparing high-purity pristimerin by high-speed countercurrent chromatography. CN 101519420 (A), (2009).