



A REVIEW ON *FICUS BENGALENSIS* LINN., *CALOTROPIS GIGANTEA* LINN. AND *NYCTANTHES ARBORTRISTIS* LINN.

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ABSTRACT:

An ancient time the plants and herbs were major source of medicine; earliest descriptions of curative and preventive properties of medicinal plants found in Rig-Veda, Charaka Samhita and Sushrasha Samhita give extensive details on various medicinal herbs. *Ficus bengalensis* Linn. belongs to the Family: Moraceae (Synonym: Vatavruksha) is commonly known as a Banyan tree. This tree is considered to be sacred tree in India. *Calotropis gigantea* Linn. belongs to the Family: Asclepiadaceae (Synonym: Mudar, Rui, Arka) is growing in damp shady areas along with roadsides. *Nyctanthes arbortristis* Linn. belongs to the Family: Oleaceae (Synonym: Jasmineae, Nyctantheae, Night Jasmine) is local to India, dispersed generally in sub-Himalayan districts and southward to Godavari. In the indigenous system of medicine, the plants of *Ficus bengalensis* Linn. *Calotropis gigantea* Linn. and *Nyctanthes arbortristis* Linn. are reported to be useful in the treatment of various diseases. The aim of present review is to provide detailed information like distribution, cultivation, botanical description, phytochemistry and pharmacological activities of these three plants.

Keywords: *Ficus bengalensis*, Banyan tree, *Calotropis gigantea*, *Nyctanthes arbortristis*.

INTRODUCTION

Pharmacological evaluation of substances from plants is an established method for the Plants have been playing the role of a major source of drugs in Indian as well as other ancient systems of medicine in the world. Earliest descriptions of curative and preventive properties of medicinal plants found in Rig-Veda, Charaka Samhita and Sushrasha Samhita give extensive details on various medicinal herbs. The importance of medicinal plants and traditional health systems in solving the health care problems of the world is gaining increasing attention. Because of this resurgence of interest, the research on plants of medicinal importance is growing phenomenally at all levels. The identification of lead compounds, which can shows the way for the development of novel and safe medicinal agents. Pharmacological investigation of medicinal plants has provided important advances for the therapeutic approach to several pathologies, as well as extremely

useful tools for the theoretical study of physiology and pharmacology.¹⁻¹⁵

A number of plants used in the traditional medical systems of remedies in India, Europe and China for the treatment of chronic ailments and rejuvenation therapy have been shown to possess various activities by acting their protective effect. Peptic ulcer disease (PUD), diabetes, asthma is a serious diseases that requires a well-targeted therapeutic strategy. A number of synthetic drugs are available for the treatment of various diseases, but clinical evaluation of these drugs has shown incidence of relapse, side effects, and drug interactions. This has been the rational for the development of new drugs and the search for novel molecules has been extended to herbal drugs that offer better protection and decreased relapse. All ancient civilizations have documented medicinal uses of plant in their own ethnobotanical texts. In the indigenous system of medicine, the plant of *Ficus bengalensis* Linn. *Calotropis gigantea* Linn. and *Nyctanthes arbortristis*

Linn. are reported to be useful in the treatment of various diseases.¹⁻¹⁶

1. *Ficus bengalensis* Linn.

Ficus bengalensis (Synonym: Vatavruksha) is commonly known as a Banyan tree. This tree is considered to be sacred tree in India. The plant is a large evergreen tree distributed all over India from sub Himalayan region and in the deciduous forest of Deccan and south India. It is a grown in gardens and road sides for shades. Present in most tropical and subtropical forests throughout the world and distributed all over India from sub Himalayan region and in the deciduous forest of Deccan and south India.¹⁷

1.1 Botanical Description:

Leaves broadly ovate, obtuse, the base cordate; lamina 10-30 cm long, 7-20 cm wide, very coriaceous, puberulous beneath; lateral veins 5-7 pairs, the basal pair prominent, reaching 1/3 of lamina length; petiole 1.5-7 cm long, 5mm wide, puberulous, stipules thick, 1-1.5 cm long and wide, puberulous. Figs paired sessile, puberulous, depressed-globular, 1.5-2 cm diam., maturing orange to red; ostiole broadly unbonate, enclosed by 3 flat apical bracts; basal bracts 3, foliaceous, obtuse, 3-7 mm long, 10-15 mm wide puberulous. Male flowers pedicellate; tepals 2 or 3. Female flowers sessile; tepals 2 or 4. Gall flower pedicellate; tepals 3 or 4 inch.¹⁷



Fig. 1.1: Whole plant of *Ficus bengalensis*.



Fig. 1.2: Fruits & leaves of *Ficus bengalensis*.



Fig. 1.3: Bark of *ficusbengalensislinn.*

1.2 Cultivation:

F. benghalensis is widely cultivated in the tropics. It is cultivated in India and has not had its associated wasp introduced and therefore has not yet spread from initial plantings. *F. Benghalensis* is the world's largest tree in terms of its spread with some old trees covering over an acre of ground. The tree's name "banyan" refers to

the merchants who set up shop under the spreading trees. One of the most popular banyan trees, *F. benghalensis*, on Maui, located on Front St. in Lahaina, is a meeting place for tourists, artists, children, and folks selling their goods. In addition to the large spreading growth form, trees also have attractive red fruits and aerial roots which hang from limbs.¹⁻¹⁷

1.3 Traditional Uses:

Different parts of the tree have been found to possess medicinal properties; leaves are good for ulcers, aerial roots are useful in gonorrhoea, seeds and fruits are cooling and tonic. The roots of *Ficus bengalensis* are given for obstinate vomiting and infusion of its bark is considered as a tonic and astringent and is also used in diarrhoea, dysentery and diabetes. Ayurvedic practitioners in India are using the milky juice (latex) of stem bark of *Ficus bengalensis* for the treatment of rheumatism and other inflammatory diseases. The bark of the plant is used in Ayurvedic medicine for the treatment of diabetes.¹⁻¹⁷

1.4 Phytochemical Properties:

Leaves yield quercetin-3-galactoside, rutin, friedelin, taraxosterol, lupeol, β -amyryn along with psoralen, bergapten and β -sisterol. The bark of *Ficus bengalensis* presence of 5,7 Dimethyl ether of leucopelargonidin-3-O- α -L rhamnoside and 5,3 dimethyl ether of leucocynidin 3-O- α -D galactosylcellobioside, glucoside, 20-tetratriacontene-2-one, 6-heptatriacontene-10-one, pentatriacontan-5-one, beta sitosterol- α -D-glucose, and meso-inositol Earlier, glucoside, 20 tetratriacontene-2-one, 6-heptatriacontene-10-one, pentatriacontan-5-one, β -sitosterol- α -D-glucose, and meso-inositol, Leucodelphinidin derivative, bengalenoside: Aglucoside, Leucopelargonin derivative, leucocynidin derivative, glycoside of leucopelargonidin have been isolated from the bark of the *Ficus bengalensis*^{1,17}

1.5 Pharmacological Activities:

Ficus bengalensis Linn has Pharmacological activities like Anti-inflammatory Activity, Anthelmintic Activity, Antidiarrheal Activity, Immunomodulatory Activity, Antimicrobial Activity, Allopathic Activity, Antidiabetic and ameliorative activity, Antioxidant Activity, Hypolipidaemic activity, Antistress and anti-allergic.⁵⁻¹⁷

2. *Calotropis gigantea* Linn.

Calotropis gigantea linn (Synonym: *Gigantic swallow wort*, *Mudar*, *Rui*, *Arka*, *Alark*) is pantropical, growing in damp shady areas, swamps, pond margins, shallow ditches, roadsides, low-lying waste places, damp pastures, cultivated areas. Occurs in both wetlands and uplands and can grow on a variety of soil types.¹⁸

2.1 Botanical Description:

Family: The Asclepiadaceae is a large family comprising of 175-180 genera and 2200 species distributed mainly in the tropical and subtropical region of the world, represented in India by 23 genera and 41 species. Several genera of this family contain biologically active compounds. Among these are the species of *Asclepius* and *Calotropis* which contain cardenolides toxic to vertebrates. Certain insects notably monarch butterflies and milk weed bugs sequester these cardenolides from *Asclepius* host plants and apparently utilize them for defence against vertebrate predators. *Calotropis* is a small genus of about 6 species of shrubs or small trees, distributed in tropical and subtropical Africa, Asia and Central & South America, represented in India by only two species namely *Calotropis procera* and *Calotropis gigantea*. Both the species closely resemble each other in structure and find similar uses.¹⁹

Genus: The genus has attained a high reputation for its various medicinal properties in the native medical practice. *C. procera* is considered expectorant, anthelmintic, alterative and insecticidal. Bark of the plant is used as Cholagogue, diaphoretic, emetic, alterative and diuretic.

Root: Roots are externally whitish grey in colour. Transverse section of mature root shows the cork zone composed of 30-50 or rows of polyhedral to nearly cubical thin walled cells. Very small sized cubical crystals are found in the inner row. Phellogen is distinct. Cortex is comparatively narrow of few rows of cubical, rectangular or oblong-thin walled cells, most of which are filled with numerous starch grains. Phloem is an abraded zone consisting of number of broad radial bands of thin walled cell traversed by very narrow strips of medullary rays. Lactiferous cells and crystal of calcium oxalate are present, cambium is distinct.

Leaves: Leaves freshly, obovate or obovate-oblong, apex acute, rarely rounded, base cordate, 6-20 cm long and 3-8 cm wide, glaucous green, smooth above, cottony below petioles 0.3-2 cm long.

Stem: The stem is woody with yellowish white bark, young stem and branches covered with soft, loosely appressed, whitish, waxy or sometime powdery pubescence.

Fruit: Single or paired, turgid, recovered, 7-10 cm long.

Seeds: Seeds numerous, broadly ovate, flattened brown in colour 2.5-3.2 cm long, including the white tuft of silky hair and pointed end.

Flowers: Lilac, pale rose or purple, rarely light greenish – yellow or white, inodorous, with spreading reflexed

corolla lobes, born in axillary pediculate corymbs. Flower almost throughout the year but most commonly from November to March in central India.²⁰



Fig. No.1.4: Plant of *Calotropis gigantea* Linn.



Fig 1.5: Fruits and Seeds of *Calotropis gigantea*.

2.2 Distribution:

It is a prostrate weed, widespread throughout the tropics and subtropics, tropical Africa, southern Asia to Japan, Southeast Asia, Australia, and the Pacific Islands. In the western hemisphere, the West Indies, Central America, tropical South America including Argentina, and the United States. In India it is found throughout the hotter parts, ascending to an altitude of 1,200 m in the Himalayas and even cultivated as a potherb.²¹

2.3 Phytochemistry:

Phytochemical studies on *Calotropis gigantea linn* have afforded several type odd compounds such as Cardenolide, triterpinoids, alkaloids, resins, anthocyanins and proteolytic enzymes in latex, flavonoids, tannins, sterolsaponines, and

cardicglycosides. Flowers contains terpenes, multiflorenol and cyclisadol.⁴⁰

Leaves: The leaves contain mainly the alpha-amyrine, alpha-amyrin acetate. Beta-sitosterols, urosolic acid, cardenoloids, calotropin, calotropagenine.⁴¹

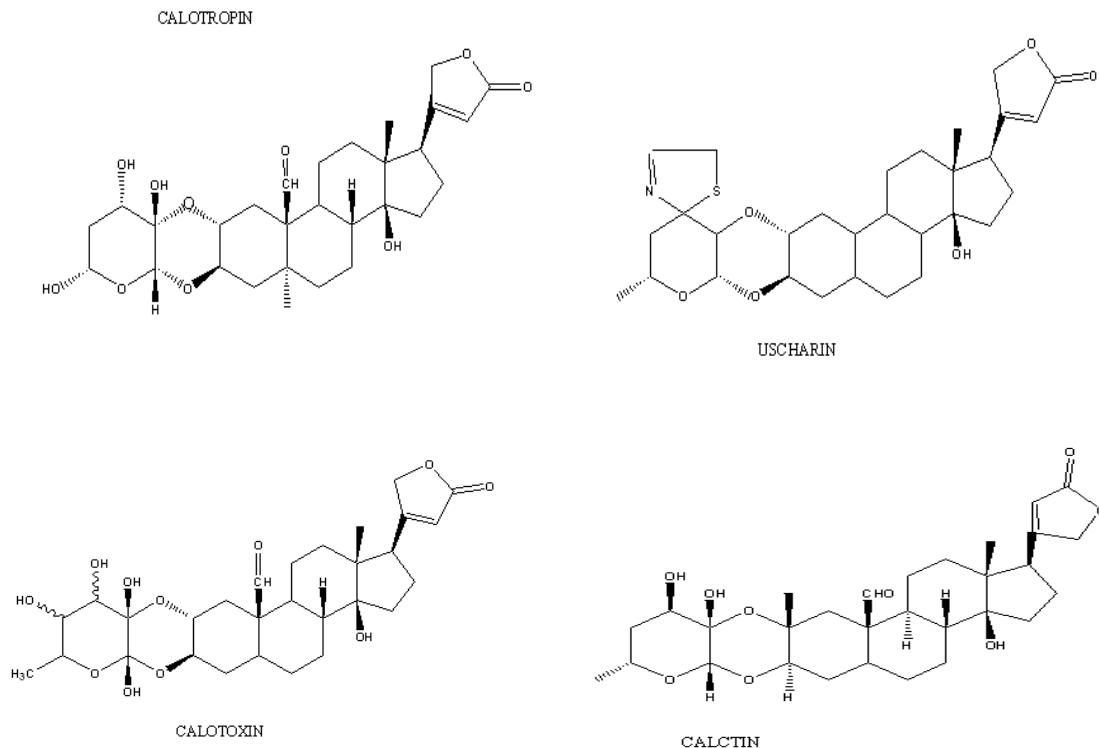
Latex: The latex contains caoutchouc, calotropin, calotoxin, calactin, uscharin, trypsin, voruscharin, uzarigenin, syriogenin and proceroside.⁴²

Flower: The flower contains the flavonoids, quercetin-3-ratioside, strol, calactin, calotoxin, calotropagenin, caloropin, polysaccharide with D-arabinose, glucose, glucosamine and L-rhamnose. Flower also contain enzymes 3-proteinase and calortopain, lupeol, unchain, proceroside, proceragenin, syriogenin, taraxast-20(30)-en-3-(4methyl-3pentenoate), 3thiazolinecarenolide,

gigantin, giganteol, isogiganteol, uscharidin, uzarigenin, voruscharina- calotropeol, 3-epimoretenol, a-lactouceryl acetates and a-lactuceryl isovalerate.⁴³

Bark: Root bark of *calotropis gigantean linn* contains triterpenes, a new norditerpenyl ester, named

Calotropterpenyl ester and two unknown pantacyclic triterpinoids, akundarol isovalerate, mundarol isovaleerates and quercetin-3-rutinoside.⁴³



2.4 Pharmacological Activities:

Calotropis gigantea Linn has Pharmacological Activities like Anti-diarrhoeal activity, CNS activity of *Calotropis gigantea* roots, Anti-cancer activity of the latex *Calotropis procera*, Anti-inflammatory activity of the latex of *Calotropis procera*, Latex extractable of *Calotropis gigantean*, Phenolic hydroxyl ionization in calotropins from *calotropis gigantea* latex, Isolation of Calotropion FI, Flavonol glycoside from *calotropis gigantean*, Isolation, Crystallization of Calotropins DI & DII from *Calotropis gigantean*, Antibacterial Activity, Antiasthmatic Activity, Free Radical Scavenging Activity, Wound Healing Activity, Anti-Fertility Activity, Anti-Inflammatory Activity, Analgesic and Anti-Pyretic Activity.²²⁻⁴³

3. *Nyctanthes arbortristis* Linn.

Nyctanthes arbortristis Linn (Synonym: Forstiereae, Fraxineae, Jasmineae, Nyctantheae, Night Jasmine) is

local to India, dispersed generally in sub-Himalayan districts and southward to Godavari. It is additionally disseminated in Bangladesh, Indo-Pak subcontinent and South-East Asia, tropical and sub-tropical south-east Asia.⁴⁴

3.1 Botanical Discription:

Family: Oleaceae nearly always have opposite, very rarely alternate or whorled leaves that may be undivided or pinnate, and toothless or toothed. The family is rarely unisexual, and more commonly bisexual. The small flowers are in panicles or branched clusters. The flower parts are in two's with the anthers and stamen usually touching. The ovary is superior, with two ovules. Calyxes may not be present on the flowers, if they are usually four-lobed. The corollas are of four or more separate or partly united petals or may be lacking. There are two or very seldom four stamens and one style capped with a two lobed stigma, Berries, drupes,

capsules or samaras are the type of fruit found on the family Oleaceae.⁴⁵

Genus: Family containing 24 extant genera and around 600 species of trees and occasionally vines. As shrubs, members of this family may be twine climbers, or scramblers. Leaf shape and general appearance may be quite variable (although we do not often find a woody and an herbaceous plant in the same genus). The basic pattern of flower structure will stay the same even if there are variations in colour, size and other details. Although intergeneric hybrids occur occasionally, hybrids between species in the same genus are much more common. Some people argue that if two species can be crossed to produce viable seed, then they belong in the same genus.⁴⁵

Leaves: The family is characterized by opposite leaves that may be simple or compound (either pinnate or ternate), without stipule. Alternate or whorled arrangements are rarely observed, with some *Jasminum* species presenting spiral configuration. The laminae are

pinnately-veined and can be serrate, dentate or entire at margin. Domatia are observed in certain taxa. The leaves may be either deciduous or evergreen, with evergreen species predominating in warm temperate and tropical regions, and deciduous species predominating in colder regions.⁴⁵

Flowers: The flowers are most often bisexual and actinomorphic, occurring in racemes or panicles, and often fragrant. The calyx, which may or may not be present and the corolla are gamosepalous and four-lobed. The androecium has 2 stamen inserted in the perigynous zone and alternate with the lobes. The stigmas are two-lobed. The gynoecium consists of a compound pistil with two carpels. The ovary is superior with two locule, each of which bearing two axillary ovules. Sometimes the base of the ovary is circled by a nectary disk. The plants are most often hermaphrodite but sometimes polygamonoecious.⁴⁵

Fruit: Oleaceae fruit can be berries, drupes, capsules or samaras⁴⁴



Fig. No. 1.6: Plant of *Nyctanthes arbor-tristis* Linn.

3.2 Distribution:

It develops in Indo-Malayan area and conveyed crosswise over terai tracts and in addition Burma and Ceylon. It endures moderate shade and is regularly found as undergrowth in dry deciduous backwoods.^{45,46}

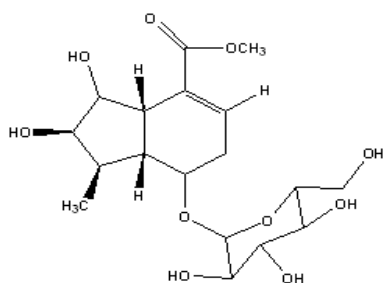
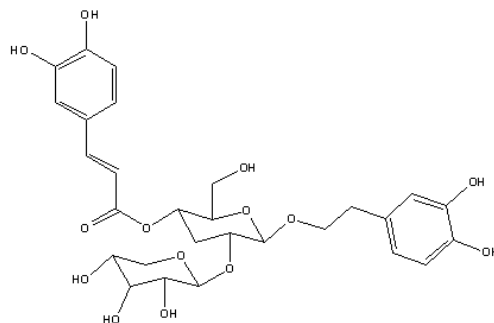
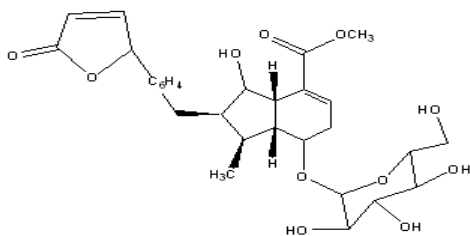
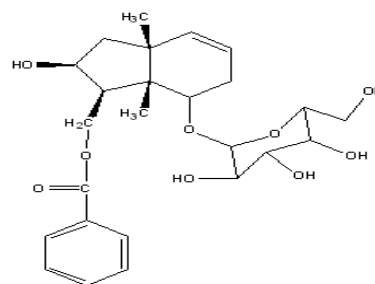
3.3 Phytochemistry:

Ongoing inquiries about revealed the confinement of polysaccharides, iridoid glycosides, henylpropanoid glycoside, β -sitosterol, β -amyrin, hentri-acontane, benzoic corrosive, glycosides, nyctanthoside-an iridoid,

nyctanthic corrosive, Friedelin and lupeol and oleanolic corrosive and 6β -hydroxylogananin and iridoid glucosides-arborsides A, B and C, alkaloids, Phlobatanins, terpenoids and cardiovascular glycosides. Iridoid glucosides (arbortristosides-A, B, C) and 6β hydroxylogananin has additionally been detached from this plant. Segregated 4-hydroxy hexahydrobenzofuran-7-one from the chloroform concentrate of blossoms of *Nyctanthes arbor-tristis*. It was observed to be antibacterial, larvicidal. Phytochemical considers

uncovered the nearness of tertiary alkaloids mostly 7-(α -anilino-*p*-nitrobenzyl)-8-quinolinol and quaternary alkaloids having a place with protoberberines and aporphines. Disengaged carotenoid aglycone Ag-NY1 from the orange hued cylindrical calyx of blossoms of *Nyctanthes arbor-tristis*, which was displayed a decent layer balancing out action when contrasted with the comparing glycoside crocin. Three carotenoid glucosides were likewise confined.⁴⁷⁻⁴⁹

Seed bits yield 12-16% of the light yellow darker settled oil, comprising of settled oil containing glucosides of linoleic, oleic, lignoceric, stearic, palmitic corrosive and *b*-sitosterol. On keeping the oil a little while at tetracyclic triterpenoid corrosive named nyctanthic corrosive is saved. Blossoms contain basic oils, shading matter (nyctanthin), mannitol, tannin and glucose. Its underlying foundations are made out of alkaloids, tannins and glucosides.⁵⁰⁻⁵²

6-HYDOXYLOGANIN⁶NYCTOSIDE-A⁶ARBORSIDE-C⁶ARBORSIDE-D⁶

3.4 Pharmacological Activities:

Nyctanthes arbortristis Linn has Pharmacological Activities like Antispasmodic activity, Antihelmintic activity, Cytotoxic evaluation, Anti-inflammatory activity, Immuno-stimulant, Antidiabetic, Hepatoprotective activity, Treatment of arthritis, Antioxidant activity, Antibacterial, Antimicrobial activity, Antiviral activity, Prevention of lung injury, CNS depressant action, Antihistaminic and antitryptaminergic activity, Anticholinesterase activity, Anti-nociceptive and antipyretic activity.⁵³⁻⁶⁵

Flowers: The blooms are utilized as stomachic, carminative, astringent to entrail, antibilious, expectorant, hair tonic and in the treatment of heaps and different skin infections and in the treatment of ophthalmic purposes. The splendid orange corolla containers of the blossoms contain a shading substance nyctanthin, which is indistinguishable with α -Crocetin (C₂₀H₂₄O₄) from Saffron. The corolla tubes were once in the past utilized for coloring silk, at times together with Safflower or turmeric.

Stem: Traditionally the powdered stem bark is given in rheumatic joint agony, in treatment of jungle fever and furthermore utilized as an expectorant. The bark is

utilized for the treatment of snake nibble and bronchitis. Leaves are utilized in hack. Leaf juice is blended in nectar and given thrice day by day for the treatment of hack. Glue of leaves is given with nectar for the treatment of fever, hypertension and diabetes. Juice of the leaves is utilized as digestives, counteractant to reptile venoms, mellow unpleasant tonic, purgative, diaphoretic and diuretic. Leaves are additionally utilized in the expansion of spleen. The leaf juice is utilized to treat loss of craving, heaps, liver issue, biliary clutters, intestinal worms, unending fever, determined sciatica, ailment and fever with rigors. The removed juice of leaves goes about as a cholagogue, purgative and gentle severe tonic. It is given with little sugar to youngsters as a solution for intestinal illnesses. In a few cases, it has been found to act solidly for intestinal sickness fever. The decoction of leaves is broadly utilized by Ayurvedic doctors for the treatment of joint inflammation, headstrong sciatica, jungle fever, intestinal worms and as a tonic, cholagogue and diuretic. The communicated juice of leaves (10ml BD X 5days) is a local solution for irregular fever.

Seeds: The seeds are utilized as anthelmintic and in alopecia. It is antibilious and an expectorant, and is additionally valuable in bilious fevers. The powdered seeds are utilized to fix scurfy affections of scalp, heaps and skin maladies. The indigenous individuals of Chittoor area Andhra Pradesh (India) broadly utilize the entire plant for treatment of malignancy, pull for fever, sciatica, anorexia, and bark as expectorant.⁵³⁻⁶⁵

Conclusion:

Plants and their active constituents have been providing good source of medicine as they are useful in various diseases. The plant of *Ficus bengalensis* Linn., *Calotropis gigantea* Linn. and *Nyctanthes arbortristis* Linn are the most important plants of traditional medicine and useful to treat various diseases. Because of their importance in traditional medicine, their quality control parameters are established by pharmacognostic and phytochemical studies.

References:

- Mandal S.G., Shete R. V, et al, 2010, review: Indian national tree (ficus bengalensis), Ijpls, 1(5), 268-273.
- E. Edwin jarald et al, 2006, Colour Atlas of medicinal plants, CBS publishers, 1st edition, 134.
- A.K. Nadkarni, 2002, Indian materia medica, Popular prakashan, vol. 1, pp.543-554.
- Patil V.V. et al, 2009, Pharmacognostical studies and evaluation of anti-inflammatory activity of ficus bengalensis linn, Jyp, 1(1), 1-9.
- Vishnu N.T. and Anupama A.S., 2010, Stem bark extraction of *Ficus bengalensis* for anti-inflammatory and analgesic activity in animal models. Indian, J.of experimental biology, 48:39-45.
- Manoj Aswar et al, 2008. Anthelmintic activity of *Ficus bengalensis*. Green Pharmacy, 170-2.
- Mukherjee P.K. and Saha K., 1998, Screening of anti-diarrhoeal profile of some plant extracts of a specific region of West Bengal, Indian, J.of ethnopharmacology,(60):85-89.
- Gabhe S.Y. and Tatke P.A., 2006, Evaluation of the immunomodulatory activity of methanol extract of *Ficus bengalensis* roots in rats, I.J. of Pharmacology, 38(4): 271-75.
- Uma B. and Prabhakar K., 2009, in vitro antimicrobial activity and phytochemical analysis of *Ficus religiosa* and *Ficus bengalensis* against diarrhoeal enterotoxigenic E.Coli, Ethnobotanical leaflets, 13: 472-74.
- Jayakumar M. and Eyini M., 1998, Allelopathic effects of extracts from *Ficus bengalensis*, Korean J. of Ecology, 21(2): 133-37.
- Mahalingam Gayathri and Krishnan Kannabiran, 2008, Antidiabetic and ameliorative potential of ficus bengalensis bark extract in streptozotocin induced diabetic rats, Indian Journal of Clinical Biochemistry, 23(4), 394-400.
- Gupta, V.K. and S.K. Sharma, 2010, In vitro antioxidant activities of aqueous extract of Ficus Bangalensis Linn. Root. Int. J. Biol. Chem., 4: 134-140.
- Shukla, R. et al, 1995, Hypolipidemic effect of water extract of *Ficus bengalensis* in alloxan induced diabetes mellitus in rabbits. Ind. J. Clin. Biochem: 10 (2), 119-121.
- D J Taur et al, 2007, Antis tress and ant allergic effects of *Ficus bengalensis* bark in asthma Nat Prod Res: 21, 14:1266-70.
- Endress, M. E. and P. V. Bruyns, 2000. A revised classification of the Apocynaceae s.l. *Botanical Review* 66: 1-56.
- The Wealth of India, 1950.Council of Scientific and Industrial Research, New Delhi;20-23.

17. Vikas V. Patil et al, 2010, *Ficus bengalensis linn.-an overview*”, International journal of pharma and bio sciences, 1(2), 1-11.
18. Sharma GK, 1934. *Calotropis procera & Calotropis Gigantia*, Indian Journal of Veterinary Sciences;(4):63-74.
19. Mchamara B, D Myeux, R. D., in; Munson, P. L., Eds; 1995. “Principle of Pharmacology Basic Concept and Clinical Application” Chapman and Hall
20. Thomson publishing company, New York;1162-1165.
21. Sheelaa B, Mohamed Hussain S, Sampath Kumar P, Kalaichelvam VK, Venkatachalam Vasodilatation. VK, 2010.
22. Patil, M B., Jalalpure, S. S., Pramod, H. J., 2003. “Anti-Inflammatory Activity of Leaves of *Anacardium Occidentals Linn*”. Indian Journal of Pharmaceutical Sciences; 65(1): 70-72.
23. Saratha V, Subramanian S, Sivakumar S, 2009. Evaluation of wound healing potential of *Calotropis gigantea* latex studied on excision wounds in experimental animals, *Med Chem Res.* 19:936-947.
24. Possible Mechanism of Anti-Inflammatory Activity of Biochanin, 2002.—A Isolated From *Dalbergia Sissoides*, Indian Drugs; 39(3): 161-162.
25. Adhav, V. M, Khan A., Khanum, A., Eds; 2003. “Role Of Biotechnology In Medicinal and Aromatic Plants”, Ukaaz Publication, Hydrabad, Vol-7 :92-106.
26. Tatiya, A. U., Hatapakki, B.C., 2003. “Anti-Inflammatory Activity of Bark of *Michilus Macrantha Nees (Lauraceae)*” Indian Journal of Pharmaceutical Sciences; 65(5):532-533.
27. Hukkeri, V.I., Patil M.B., Jalalpure S.S., and Asharaf Ali., 2001. “Anti-inflammatory Activity of various leaves extracts of *Pergularia Extensa N.E.Br. (Asclepidaceae)* Indian Journal of Pharmaceutical Sciences”; 63 (5):429.
28. “The wealth of India” 2001. “A dictionary of Indian raw materials and industrial products”, New Delhi, CSIR, Raw Material, and Vol 7: N-Pe, 311.
29. Parotta, J.A., Eds., 2001. In *Healing Plants of Peninsular India*, CABI Publishing, Company: 131.
30. Prajapati, D.N, Kumar, T., Purohit, S.S., Sharma A.K., 2003. *A Handbook of Medicinal Plant, A Complete Source of Book. Ist. Edn. Agrobois, Jodhpur, 386-387.*
31. Sen Suchitra, Nirajan Sahu, 1992 .*Phytochemistry*, Vol-31,(8),2919-2921.
32. Pal G, Shinha, N.K., 1980. *Achives of Biochemistry and Biophysics*, Vol-202(2):321-329.
33. Gaurav Kumar, Loganathan Karthik, Kokati Venkata Bhaskara Rao, 2010. Antibacterial activity of aqueous extract of *calotropis gigantea* leaves – an *in vitro* study. *International Journal of Pharmaceutical Sciences Review and Research.* 4 (2):141-144.
34. Rahul Mayee, Ambrish Thosar, Arunkondapure, 2011. Evaluation of antiasthmatic activity of *Calotropis gigantea* roots. *Asian J Pharm Clin Res.* 4 (2):3335.
35. Ahmed M, Rana AC ,Dixit VK, 2003. Free radical scavenging activity of *Calotropis* species. *Indian Drugs.* 40(11): 654-55.
36. Pradeep T. Deshmukha, Jennifer Fernandesb, Akarte Atul ,Emmanuel Toppoa, 2009. Wound healing activity of *Calotropis gigantea* root bark in rats. *Journal of Ethnopharmacology.* 125 : 178–181.
37. Pathak AK, Argal A, 2007. Analgesic activity of *Calotropis gigantea* flower. *Fitoterapia.* 78 ; 40–42.
38. Srivastava SR, Keshri G, Bhargavan B, Singh C, Singh MM., 2007. Pregnancy interceptive activity of the roots of *Calotropis gigantea* Linn. in rats. *Contraception.* 75(4):318-22.
39. Adak M, Gupta JK, 2006. Evaluation of anti-inflammatory activity of *Calotropis gigantea* (AKANDA) in various biological system. *Nepal Med Coll J.* 8(3):156-61.
40. Chitme HR, Chandra R, Kaushik S, 2005. Evaluation of antipyretic activity of *Calotropis gigantea* (Asclepiadaceae) in experimental animals. *Phytother Res.* 19(5): 454-6.
41. Morcelle SR, Caffini No, Priolo N, 2004. Proteolytic properties of *Funastrum clausum* latex, *Fitoterapia:* 75(5), 480-493.
42. Singh B. and Rastogi RP., 1972. *Phytochemistry;* 11:757.
43. Grieve, MM. 1994. *A Mordern Herbel*, Tigers Book International London; 10:154.

47. Atef GH, Elgamal MHA, Morsy NAM, Duddeck H, Kovacs J, and Toth G., 1999. Two cardenolides from *Calotropis Gigantea*. *J. Magn. Reson. Chem*;(17):754-757.
48. Ali A M, Mackeen MM, El-Sharkawy S H., 1996. Antiviral and cytotoxic activities of some Plants used in Malaysian indigenous medicines. *Pert J Trop Agri Sci*, 19:129.
49. Siddique I, Anis M, Jahan AA., 2006. Rapid multiplication of *Nyctanthes arbor-tristis* through in-vitro auxillary shoot proliferation. *World Journal of Agricultural Sciences*; 2: 188-192.
50. Sasmal D, Das S, Basu SP., 2007. Phytoconstituents and therapeutic potential of *Nyctanthes arbor-tristis* Linn. *Pharmacognosy Reviews*; 1: 344-349.
51. Lal JB., 1936. Constitution of the colouring matter of *Nyctanthes arbortristis*. Identity of *Nyctanthin* with α -crocetin; 2: 57-61.
52. Tuntiwachwuttiku P, Rayanil K, Taylor WC. Chemical constituents from the flowers of *Nyctanthes arbortristis*. *Science Asia* 2003; 29: 21-30.
53. Gadgoli C, Shelke S., 2010. Crocetin from the tubular calyx of *Nyctanthes arbortristis*. *Natural Product Research*; 24: 1610-1615.
54. Jensen SR, Franzzyk H, Wallander E., 2002. Chemotaxonomy of the Oleaceae: iridoids as taxonomic markers. *Phytochemistry*; 60: 213-231.
55. Mathuram V, Rao RB, Halder S, Banerji A, Kundu AB., 1994. Occurrence of Desrhamnosylverbascoside in *Nyctanthes arbortristis* and NMR studies of its acetate. *Indian Journal of Chemical Society*; 71: 215-217.
56. Khatune NA, Hoque ME, Mosaddik, MA., 2001. Laboratory evaluation of *Nyctanthes arbortristis* L, flower extract and its isolated compound against common filarial vector, *Culex quinquefasciatus* say (Diptera : culicidae) Larvae. *Pakistan Journal of Biological Sciences*; 4: 585.
57. Kritkar, KR, Basu, BD, 1993. *Indian Medicinal Plant*. LM Basu Allahabad, India, 2: 1526-1528.
58. Das S, Sasmal D, Basu SP., 2010. Antispasmodic and antihelmintic activity of *Nyctanthes arbortristis* Linn. *International Journal of Pharmaceutical Sciences and Research*; 1: 51-55.
59. Das S, Sasmal D, Basu SP., 2008. Anti-inflammatory and antinociceptive activity of arbortristoside-A. *Journal of Ethnopharmacology*; 116: 198-203.
60. Saxena RS, Gupta B, Saxena KK, Prasad DN., 1984. Study on anti-inflammatory activity in leaves of *Nyctanthes arbortristis*. *Journal of Ethnopharmacology*; 11: 319-330.
61. Girach RD, Aminuddin SA, Siddiqui PA, Khan SA., 1994. Ethnomedicinal studies on Harsinghar (*Nyctanthes arbortristis* L)- A less known medicinal plant in Unani medicine. *Hamdard Medicines*; 37: 60-66.
62. Lucas DS, Sekhar RAR., 2000. A review of experimental studies on antihepatoprotective activity of certain medicinal plants used in Ayurveda, *Phytomedicine*; Supplement-II: 23.
63. Mayee R, Thosar A, Kondapur A., 2010. Evaluation of Hepatoprotective activity of leaves of *Nyctanthes arbor-tristis* Linn. *International Journal of Pharmaceutical and Clinical Research*; 2: 109-111.
64. Gupta P, Bajaj SK, Chandra K, Singh KL, Tandon JS., 2005. Antiviral profile of *Nyctanthes arbor-tristis* against encephalitis causing viruses. *Indian Journal of Experimental Biology*; 43: 1156-1160.
65. Rathee JS, Hassarajani SA., 2007. Antioxidant activity of *Nyctanthes arbortristis* leaf extract. *Food Chemistry*; 103: 1350-1357.
66. Girach RD, Aminuddin SA, Siddiqui PA, Khan SA., 1994. Ethnomedicinal studies on Harsinghar (*Nyctanthes arbortristis* L)- A less known medicinal plant in Unani medicine. *Hamdard Medicines*; 37: 60-66.
67. Langhate P, Grampurohit ND, Miranda S., 2003. Antihepatotoxic activity of the leaves of *Nyctanthes arbortristis* L. National Convention on current Herbal Drugs and Annual Conference of Indian Society of Pharmacognosy; Herb: The natural alternative, Gandhinagar.
68. Das S, Sasmal D, Basu SP. Evaluation of CNS depressant activity of different parts of *Nyctanthes Bimlesh Kumar, et al: An update on Nyctanthes arbor-tristis* Linn *Indian Journal of Pharmaceutical Sciences* 2008; 70: 803-806.
69. Saxena RS, Gupta B, Saxena KK, Srivstav VK and Prasad DN., 1987. Analgesic, Antipyretic and Ulcerogenic activity of *Nyctanthes arbortristis* Leaf Extract. *J. Ethnopharmacolgy*; 19:193-200.