

Study of Morphoanatomical Phytochemical and Ethnobotany of *Nyctanthes arbor-tristis*

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Abstract:

According to research done on *Nyctanthus arbour* herbarium specimens this genus shares taxonomic relationship with the Oleaceae. The microscopically anatomy of the vegetative organ of *Nyctanthus arbour tristis* has been studied since it is now customary to include anatomical data when seeking to address difficulties of this nature. This article gathers a thorough examination of the information that is currently known about *Nyctanthes arbor-tristis* morphoanatomical phytochemicals and their ethnobotanical characteristics. There is also discussion of its possible uses in the treatment of various ailments.

Key words: Taxonomy, ethnobotanical,

Introduction

Nyctanthes arbor-tristis Linn. (Oleaceae) is popularly known as 'Night Jasmine' (English) or 'Harsinghar' (Hindi) due to the fact that its flowers emit a very strong and pleasant fragrance during the whole night [R.N Chopra, 1956]. The flowers start falling after midnight and by the day break, the plant appears dull. The generic name '*Nyctanthes*' has been coined from two Greek words 'Nykhta' (Night) and 'anthos' (flower) [K.R Kirtikar, 1935]. The specific name 'arbor-tristis' meaning 'the sad tree' is supposedly derived from dull looks of the tree during daytime [D. Upadhyay 2018]. It is a traditional ethno-medicinal plant found not only in India but also in Asia [R.Kiew, P Baas]. Night Jasmine is the official flower of the state of West Bengal, India, and for Kanchanaburi province, Thailand. The plant lives for 5-20 years. The leaves, flowers, bark, fruits and seeds of the plant all have diverse pharmacological qualities and are employed in alternative systems of medicine like ayurveda, siddha and unani. The entire plant as well as individual sections are utilized as herbal medicine for arthritis, malaria, spleen enlargement, sciatica and blood purification. In China, the leaf parts are used for quadriplegia gall, dysentery, and bellyache. So, most of the drugs used in primitive medicine were obtained from plants and are the earliest and principal *N. arbor-tristis* source of medicines Snigdha [M., Kumar]. The current review study will provide basic information on the chemical ingredients of this plant as well as its pharmacological activity. *N. arbor-tristis* is a sub himalayan plant that grows wild from Nepal to Chenabs, Burma Assam, Central India, Bengal, Rajasthan, Madhya Pradesh, Chhotonagpur and south to Godavari. Since Airy Shaw (1952) removed *Nyctanthes* from the Oleaceae to subfamily Nyctanthoideae in the Verbenaceae, information has accumulated on its anatomy, embryology and phytochemistry which enables it to be compared with the range encountered both in the Oleaceae and the Verbenaceae. While most authors consider the characters of *Nyctanthes* compatible with those of the Oleaceae, Kundu and De (1968) suggest that a new family should be erected for the two species of *Nyctanthes*, *N. arbor-tristis* L. and *N. aculeata* Craib. The following is a summary of the information now available for comparing *Nyctanthes* with other members of the Oleaceae, with new data on the anatomy of *N. arbor-tristis*.

Habit

As mentioned by Airy Shaw (1952), *Nyctanthes* does not "look" oleaceous. It is a coarse shrub with quadrangular stems and scabrid, dentate leaves; characters which are common in Verbenaceae. However, serrate or dentate leaves also found in species of *Olea*, *Osmanthus* and *Myxopyrum*. A quadrangular stem is typical of *Myxopyrum* and is also found in a few Malesian species of *Jasminum*, such as *J. insigne* Bl. The thorns on the stem of *N. aculeata*, however, have no parallel in any genus of the Oleaceae. The roughness of the upper surface of the leaf is so pronounced that leaves of *N. arbor-tristis* used as sandpaper in parts of India where it is indigenous.

Taxonomic details

The genus *Nyctanthes* belongs to the species of *arbor tristis* linn. are a flowering plant lies under the family of Oleaceae, kingdom of Plantae, Division of Magnoliophyta, Class of Magnoliopsida and Order of Lamiales [D Upadhyay, V Sharma ,2018]. Common name Coral Jasmine, Night Jasmine, Harsingar, Tree of Sorrow.

Vernacular name

The plant is named in different languages as below: Like in Sanskrit it's called as Parijatha, in Hindi as Harsingar, in Ayurvedic sastra as Paarijaata, Shephaali, Shephaalikaa, Mandaara, in many English literature it's mentioned as Tree of Sorrow, Night Jasmine, Coral Jasmine, in Bengali called as Harsingar, Sephalika, Seoli, Sheoli, Parjatamu in Telegu, ManjatpuPavelam in Tamil and so on.

Significance of plant in mythology

Historically the flowers area unit gathered for religious offerings and to make garlands. Mythological story reveals that, the drug Parijat might be a heavenly tree delivered to earth by Lord Krishna. A quarrel over it ensued between Satyabhama and Rukmini, Krishna's wives. But Krishna planted the tree in Satyabhama's courtyard in the only way, that when the tree patterned, the flowers fell in Rukmini's grounds. The orange heart is used for coloring silk and cotton, this observation was started with Buddhist monks whose orange robes got their color by this flower.

Floral morphology

The flower of *Nyctanthes* has between 4 and 9 contorted lobes. *Jasminum*, *Menodora* and *Schrebera* all have more than 4 lobes (usually between 4 and 8) but these are apart from the aestivation, the flower is typically oleaceous: it is regular with two stamens which alternate with the two locules of the ovary. This combination of characters is not found in the Verbenaceae. Patel (1960) noted that *Nyctanthesis* heterostylous, as is commonly the case in *Jasminum* *Schrebera* is also heterostylous. Patel also noted that occasional flowers of both *Jasminum* and *Nyctanthes* have three stamens and trilocular ovary.



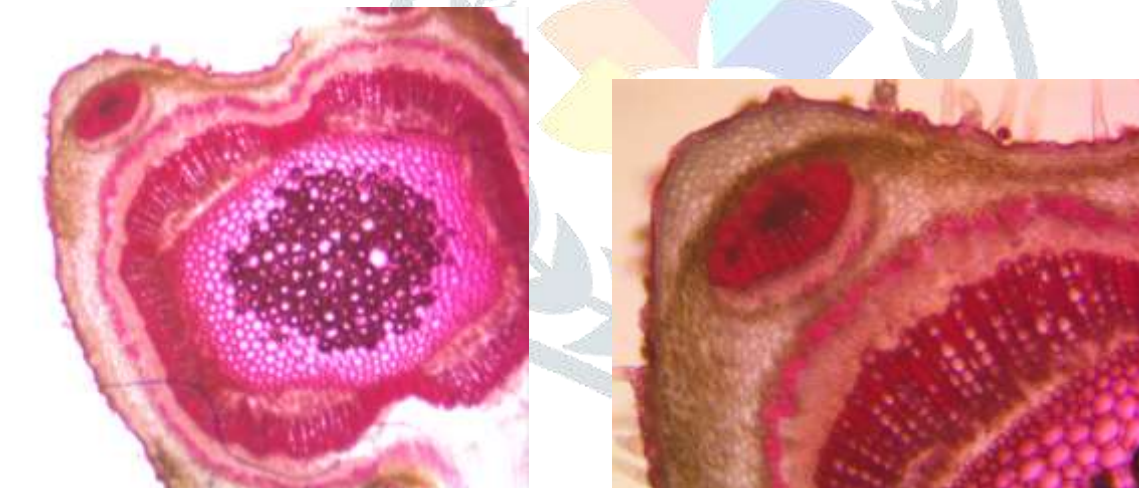
Fruit and seed

fruit of *Nyctanthes* is a dry chartaceous capsule which splits into two one-seeded parts. Capsules are also characteristic of *Menodora*, *Schrebera* and *Syringa*. The seeds are exalbuminous, as in many members of the Verbenaceae and species of *Chionanthus*, *Noronhea* and *Schrebera* of the Oleaceae. The testa of *Nyctanthes* is thick and heavily vascularized, a feature shared by *Jasminum* and *Menodora*. In contrast, the testa of the Verbenaceae is non-vascularized (Kapil and Vani 1966). In addition, the testa of *Nyctanthes* has the outer layer of large transparent cells typical of the Oleaceae (Taylor 1945) and like in *Menodora* the testa is green and the inner layers of cells contain chloroplasts (original observation).



Stem anatomy

Earlier accounts of the stem anatomy of *Nyctanthes* are by Fotidar (1939), Majumdar (1941), both dealing with the vascular organization, and Stant (1952) and Kundu and De (1968), whilst Murthy et al (1978) reported on the xylem vessels. In the latter study features of the metaxylem were highlighted, but probably confusion arose with earlyformed secondary xylem vessels in some cases, and the lateral pitting was erroneously interpreted, rendering this study valueless. In Stant's and Kundu and De's accounts of the xylem the fibres are said to be provided with conspicuously bordered pits and xylem parenchyma is reported to be absent, which is in contrast with our observations, thus rendering the data of questionable value in comparing *Nyctanthes* with Oleaceae and Verbenaceae. It is based on the study of four authenticated samples of *N. arbor-tristis*. The description of the xylem is in line with a forthcoming, comprehensive wood anatomical survey of the Oleaceae.



Leaf anatomy

Leaf architecture: In a recent paper Mohan and Inamdar (1983) demonstrated that *Nyctanthes* showed similarities with Oleaceae in all aspects of leaf architecture and venation. The stomata of *N. arbor-tristis* are anomocytic, and thus typical of the family Oleaceae. The crescent-shaped vascular system of the petiole in *Nyctanthes* which is flanked by two or three pairs of lateral traces (Fotidar 1939; Majumdar 1941; Stant 1952; Kundu and De 1968; and our own study) is also common in members of the Oleaceae (Metcalf and Chalk 1950; Kiew 1983).

Embryology

Kapil and Vani (1966) reported that *Nyctanthes* differs from the Verbenaceae in two important characters. Firstly, the antipodal cells of *Nyctanthes* are small and ephemeral, whereas in the Verbenaceae they are large and persistent. Secondly, following the system of Sou6ges, the embryogeny of *Nyctanthes* is of the type III of Second Period, whereas that of Verbenaceae is Megarchetype IV of first Period. *Jasminum* is the same as

Nyctanthes for these two characters. Devi (1975) also found that the embryology of *Nyctanthes arbor-tristis* and species of *Jasminum* is basically similar.

Pollen

Saxena (1975) described the pollen of *Nyctanthes* as having a thick, subectatesexine with winding muri and wide lumen (with a maximum diameter of over 8 μ m and provided with luminal bacules. He stated that he had not found this type of pollen in his investigation of 286 species in 77 genera of the Verbenaceae. Kundu and De (1968) noted that *Nyctanthes* pollen resembled the pollen of *Jasminum* to some extent, the latter also having a reticulate surface pattern.

Chromosome number

The somatic chromosome number of *Nyctanthes* has been recorded as 44 (Bolkhorskih et al 1969) and as 46 (Kundu and De 1968). Both these numbers occur in the Oleaceae: $2n = 44$ is recorded for *Menodora scabra* (Taylor 1945, who also recorded $2n = 22$ for two other species of *Menodora*) and *Ligustrum*, *L. japonicum* and *L. tschonoskii*, *Osmanthes fortunei* and *O. sandwicensis*, as well as *Syringa amurensis*, *S. emodii*, *S. josikaea*, *S. persica* and *S. vulgaris* (Bolkhorskih et al 1969); while $2n = 46$ is reported from eight genera of the Oleaceae, viz. *Chionanthus* (including *Linociera*), *Fraxinus*, *Ligustrum*, *Nestegis*, *Olea*, *Osmanthus*, *Picconia* and *Schrebera* (Bolkhorskih et al 1969). In contrast, of more than 200 species of the Verbenaceae surveyed only three species have $2n = 44$ (*Lantana camara*, *L. horrida* and *L. indica*).

Phytochemistry

Das and Rao (1966) compared the phenolic acids of *Nyctanthes arbor-tristis* with a few species of the Oleaceae and the Verbenaceae. Of the 13 phenolic acids investigated, *Nyctanthes*—a member of Oleaceae—355 eight were common to both families. *Nyctanthes* had caffeic acid present, which occurs in the Verbenaceae but only as a trace in the Oleaceae. In common with other members of the Oleaceae investigated, *O*-pyrocatechol and phloretic acid were absent (they are present in the Verbenaceae) while ferulic acid was present in large amounts in both *Nyctanthes* and other members of the Oleaceae, but was present as only a trace in the *Nyctanthes* studied. Hegnauer (1969) on the basis of mannitols, agreed that *Nyctanthes* is closer to the Oleaceae than the Verbenaceae. Harborne and Green (1980) found that *Nyctanthes* has the two common flavones of the family Oleaceae.

Ethnobotanical uses

Flowers The flowers are used as stomachic, carminative, astringent to bowel, antibilious, expectorant, hair tonic and in the treatment of piles and various skin diseases and in the treatment of ophthalmic purposes. The bright orange corolla tubes of the flowers contain a coloring substance nyctanthin, which is identical with α -Crocetin from Saffron. The corolla tubes were formerly used for dyeing silk, sometimes together with Safflower or turmeric.

Stems Traditionally the powdered stem bark is given in rheumatic joint pain, in treatment of malaria and also used as an expectorant. The bark is used for the treatment of snakebite and bronchitis. The stem bark pounded with *Zingiber officinale* and *Piper longum* is boiled in water and the resultant liquid is taken for two days for the treatment of malaria. The resulting paste on mixing with *Arjuna* bark is rubbed on the body to treat internal injury.

Leaves The leaves of *Nyctanthes arbor-tristis* Linn are used extensively in Ayurvedic medicine for the treatment of various diseases such as sciatica, chronic fever, rheumatism, and internal worm infections, and as a laxative, diaphoretic and diuretic. Leaves are used in cough reduction. Leaf juice is mixed in honey and given thrice daily for the treatment of cough. Paste of leaves is given with honey for the treatment of fever, high blood pressure and diabetes. Juice of the leaves is used as digestives, antidote to reptile venoms, mild bitter tonic, laxative, diaphoretic and diuretic. Leaves are also used in the enlargement of spleen. The leaf juice is used to treat loss of appetite, piles, liver disorders, biliary disorders, intestinal worms, chronic fever, obstinate sciatica, rheumatism and fever with rigors. The extracted juice of leaves acts as a cholagogue, laxative and mild bitter tonic. It is given with little sugar to children as a remedy for intestinal ailments.

Chemical constituents

Leaves- Leaves contain D-mannitol, β -sitosterol, Flavanol glycosides, Astragaline, Nicotiflorin, Oleanolic acid, Nyctanthic acid, Tannic acid, Ascorbic acid, Methyl salicylate, Amorphous glycoside, Amorphous resin, Trace of volatile oil, Carotene, Friedeline, Lupeol, Mannitol, Glucose, Fructose, Iridoid glycosides, Benzoic acid.

Flowers Flowers contain Essential oil, Nyctanthin, d-mannitol, Tannin, Glucose, Carotenoid, Glycosides, β -monogentiobioside ester of α -crocetin (or crocin-3), β -monogentiobioside, β -D monoglucoside ester of α -crocetin, β -digentiobioside ester of α -crocetin (or crocin-1). • Seeds Seeds contain arbortristosome A & B, glycerides of linoleic acid, oleic acid, lignoceric acid, stearic, palmitic & myristic, nyctanthic acid, 3-4 secotriterpene acid a water soluble polysaccharide made up of D Glucose & D Mannose.

Bark- contains Glycosides and alkaloids. • Stem- Stem contains Glycoside-naringenin-4-O- β -glucopyranosyl- α -xylopyranoside and β -sitosterol. • Flower oil Flower oil contains α -pinene, p-cymene, 1-hexanol methyl heptanone, phenyl acetaldehyde, 1-deconol and anisaldehyde

Modern pharmacological properties

Due to presence of several chemicals and phytochemicals, it's a several pharmacologic actions like opposing allergic, medication, opposing Anxiety, Sedative, Anti-filarial, bactericide. Antioxidant, opposing cancer, opposing diabetic, opposing Anemic, Hepatoprotective and Anti-malarial etc.

Anti-Allergy activity- The pretreatment of guinea pigs exposed to aminoalkane aerosol with a water-soluble portion of the alcoholic extract of *N. arbor-tristis* leaves offered important protection against the event of physiological condition. Arbortristosome A and arbortristosome C square measure gift in *N. arbor-tristis* were reported to be anti-allergic [J.S.Rathee, ., Hassarajani, 2007].

Anti-anxiety- Hydroalcoholic extracts of *N. arbor-tristis* (NAT) have anxiolytic potential. Victimization hydro-alcoholic mixture, dried plant elements of *N. arbor-tristis* was extracted, targeted by distilling off the solvent and so gaseous to condition on the water bathtub and so hold on in an exceedingly air tight instrumentality in refrigerator until used [Abraham, 2006]

Anti-Inflammatory activity- The extracts of the *Nyctanthes arbor-tristis* contains important quantity of flavonoids that vie an honest judge parameter in the reduction of the inflammation and so reducing leg gait. The water soluble fraction of the grain alcohol extract considerably reduced acute inflammation within the genu of rats evoked by the turpentine oil gift within the flowers [Aomkar, Tjeeja, ., Chhaya, 2006]

Sedative activity- Sedative potential of flowers was examined in rats. Male rats exhibited dose- dependent aware whereas the feminine rats stay unaffected [Omkar, A., Jeeja, T., Chhaya, 2006].

Anti-Filarial activity- The chloroform extract of the flowers and a pure compound isolated from *N. arbor-tristis* plant exhibit larvicidal activity against mosquito, a standard nematode vector [N. A. Khatune 2001]

Anti-Bacterial activity Infectious diseases square measure world's leading explanation for premature death. Resistance to antimicrobial agents is conferring in an exceedingly wide range of pathogens and multiple drug resistance is turning into common in various organisms like *Staphylococcus aureus*, *Staphylococcus epidermis*, *Salmonella typhi*, *Salmonella paratyphi A*. In a study, it had been reported that methanolic extract of leaves of *N. arbor-tristis* exhibited important bactericide activity against *Staphylococcus aureus*, *Staphylococcus epidermis*, *Salmonella typhi*, *Salmonella paratyphia* with MIC worth move between 1-8 mg/ml . The zone of inhibition and Minimum repressive Concentration (MIC) of the extracts were determined and compared with the quality medication antibiotic drug and fluconazole. The chloroform extract was found to own each bactericide and antifungal activity whereas the fossil fuel ether and grain alcohol extracts hold solely bactericide activity. [S.P. Kumari, 2012]

Anti-Cancer activity Fruit, leaf and stem methyl alcohol extracts of *N. arbor-tristis* were tested for in vitro malignant neoplasm activities. Moderate activity was determined at 30mg/ml conc. with seventy-one inhibition of dried *N. arbor-tristis* leaf methyl alcohol extract and least repressive activity was determined at

10mg/ml conc. With eighty-six inhibition of carcinoma cell lines freed from pathogens. A high degree of against human carcinoma cell lines (MDA-MB 231) was determined with *N. arbor-tristis* edible fruit methyl alcohol and therefore the IC₅₀ values were calculated to be 9.72mg and 13.8mg. The phyto-chemicals isolated from *N. arbor-tristis* edible fruit methyl alcohol square measure glycosides, tannins, phenols and steroids and square measure expected to be chargeable for this malignant neoplasm activity [Khatune [2003].

Anti-Diabetic activity- The anti-diabetic activity of methyl alcohol extract of root of *N. arbor-tristis* is admired that of diabetic management animals. The extract poses safe and powerful anti-diabetic activity. The extract was ready by extracting 50g root powders with 400µl of methyl alcohol for eighteen hours by hot continuous extraction methodology. The methanolic extract was filtered and divided by victimization fossil fuel ether to get rid of impurities. The solvent was gaseous besieged and dried in vacuum. The dried extract *N. arbor-tristis* so obtained was used for the assessment of hypoglycemic activity. It reduces glucose level once seven days at the 500mg/kg in rats compare with normal drug. It had been found that methanolic extract of *N. arbor-tristis* roots were more practical in reducing the glucose level compare to the quality drug [Bharti,2008]

Anti-Malarial activity Clinical study on one hundred twenty patients of protozoal infection. Administration of contemporary paste of medium sized five leaves of *N. arbor-tristis* thrice daily for 7-10d has cured the unwellness in 76.7% patients at intervals seven days. Alternative twenty patients were cured by ten days whereas the remaining eight patients failed to reply to the treatment. The paste was well tolerated and no severe aspect effects were reported. Screening of methyl alcohol and chloroform extract of leaves for dipteran larvicidal activity against three major dipteran vectors *Aedes aegypti*, mosquito and genus *Anopheles stephensi* has found the 2 extracts to kill larvae of *A. stephensi* with LC₅₀ values of 244.4 and 747.7ppm, severally. 10. **Anti-Anemic activity** A research was performed as hematological study on the ethanolic extracts of the flowers, barks, seeds and leaves of the plant and detected the dose dependent rise in hemoglobin content and red blood cells count in rats. The extracts conjointly shield the decline of hemogram profile in anemic rats[R.Jain, 2005]

Hepato-protective activity- The liquid extracts of the leaves and seeds of *N. arbor-tristis* were found to own anti-hepatotoxic activity against perchloromethane (CCl₄) evoked hepatotoxicity. Further, it had been established that the alcoholic and liquid extracts showed vital hepatoprotective activity by reducing the degree of SGPT (serum glutamic pyruvic transaminase), SGOT (serum glutamic oxaloacetic transaminase) and blood serum animal pigment (total and direct). The results were supported by histopathological studies of liver samples that showed regeneration of hepatocytes by the extracts [R.Jain,]

Anti-Oxidant activity- The radical scavenging potential of the various extracts of leaves of *N. arbor-tristis* was evaluated in-vitro by using diphenyl-picryl-hydrazyl (DPPH) assay methodology. The plant extracts reacted with DPPH, that could be a stable radical and regenerate it to 1,1-diphenyl-1,2-picryl, reducer that was measured at 517 nm. The scavenging result of plant extracts and normal (ascorbic acid and BHT) on the DPPH radical decreases within the following manner: antioxidant > alcohol > ester > BHT > Pet ether, and it had been found to be 93.88% for antioxidant at concentration of 10 mg, for BHT, Butanol, ester and Pet ether was found to be 97.42 %, 95.22%, 84.63% and 82.04% at concentration of a 100mg severally. During this investigation completely different extract of *N. arbor-tristis* leaves possess

Conclusion

Night Jasmine has been used for various medical additionally as domestic functions since a lot of than hundred years, because of its broad spectrum use in health management. It's delineated altogether most all ancient literatures relating to its identification, morphology, sources, handiness, dose and therapeutic use. For exploring it's therapeutic and bio medical utility the present botanic and different modern literatures reviewed and really helpful materials are found like chemical constituents, scientific classification and morphology, habit and environment, therapeutic and industrial use etc. The plant is well tolerated in giant vary of atmospheric condition thus the plant extends from northern Asian nation and southern Kingdom of Nepal through northern Bharat and south east to Thailand and conjointly in different components of the planet. As per the traditional materia medica, because of tikta rasa, ushnavirya and laghuguna it's employed in kapa vitiated diseases, because of ushnavirya it's employed in vata diseases, conjointly because of tikta

rasa it causes assuasive of the amadosa and excess jathara-pitta (gastric acids), successively vital sign is reduced. Curlicue is generally used for industrial functions compared to different components of the plant. On chemical and phytochemical analysis, it's found that, the plant contains several active principles additionally as completely different bio-markers. BSitosterol, nyctanthic acid, tannin, lenoliec acid, D-mannitol and oleic acids square measure richly found in leaves, is also answerable for its high effectivity.

REFERENCES

1. Blatter E, Cains JF, Mhaskar KS.
2. Chopra, R. N. (1956). Glossary of Indian medicinal plants.
3. Duerr, R. H., Taylor, K. D., Brant, S. R., Rioux, J. D., Silverberg, M. S., Daly, M. J., ... & Cho, J. H. (2006). A genome-wide association study identifies IL23R as an inflammatory bowel disease gene. *science*, 314(5804), 1461-1463.9
4. Ferrari, M. J., Grais, R. F., Bharti, N., Conlan, A. J., Bjørnstad, O. N., Wolfson, L. J., ... & Grenfell, B. T. (2008). The dynamics of measles in sub-Saharan Africa. *Nature*, 451(7179), 679-684.
5. Harborne, J. B., & Green, P. S. (1980). A chemotaxonomic survey of flavonoids in leaves of the Oleaceae. *Botanical Journal of the Linnean Society*, 81(2), 155-167. Rathee, J. S., Hassarajani, S. A., & Chattopadhyay, S. (2007). Antioxidant activity of Nyctanthesarbor-tristis leaf extract. *Food chemistry*, 103(4), 1350-1357.
6. Hegnauer, R., & Hegnauer, R. (1969). Myrtaceae. *Chemotaxonomie der Pflanzen: Eine Übersicht über die Verbreitung und die systematische Bedeutung der Pflanzenstoffe*, 163-195.
7. Jain, R. K. (2005). Normalization of tumor vasculature: an emerging concept in antiangiogenic therapy. *Science*, 307(5706), 58-62.
8. Kiew, R., & Baas, P. (1984). Nyctanthes is a member of the Oleaceae. *Proceedings: Plant Sciences*, 93, 349-358.
9. Kiew, R., & Baas, P. (1984). Nyctanthes is a member of the Oleaceae. *Proceedings: Plant Sciences*, 93, 349-358.
10. Kiew, R., & Baas, P. (1984). Nyctanthes is a member of the Oleaceae. *Proceedings: Plant Sciences*, 93, 349-358.
11. Kirtikar, K. R., & Basu, B. D. (1935). Nyctanthesarbor-tristis in medicinal plants, edited by Kiew, R., & Baas, P. (1984). Nyctanthes is a member of the Oleaceae. *Proceedings: Plant Sciences*, 93, 349-358.
12. Kundu, B. C., & De, A. (1968). Taxonomic position of the genus Nyctanthes. *Nelumbo*, 10(3-4), 397-408.
13. Mallick, S., Kunhiparambath, H., Gupta, S., Benson, R., Sharma, S., Laviraj, M. A., ... & Rath, G. K. (2018). Hypofractionated accelerated radiotherapy (HART) with concurrent and adjuvant temozolomide in newly diagnosed glioblastoma: a phase II randomized trial (HART-GBM trial). *Journal of Neuro-Oncology*, 140, 75-82.
14. Omkar, A., Jeeja, T., & Chhaya, G. (2006). Evaluation of Anti-inflammatory activity of Nyctanthesarbor-tristis and Onosma echioides. *Pharmacognosy magazine*, 2(8), 258.
15. Rathee, J. S., Hassarajani, S. A., & Chattopadhyay, S. (2007). Antioxidant activiFerrari, M. J., Grais, R. F., Bharti, N., Conlan, A. J., Bjørnstad, O. N., Wolfson, L. J., ... & Grenfell, B. T. (2008). The dynamics of measles in sub-Saharan Africa. *Nature*, 451(7179), 679-684. ty of Nyctanthesarbor-tristis leaf extract. *Food chemistry*, 103(4), 1350-1357.
16. Reddy, B. S. K., Kumar, K. R., Balakrishnaiah, G., Gopal, K. R., Reddy, R. R., Sivakumar, V., ... & Lal, S. (2012). Analysis of diurnal and seasonal behavior of surface ozone and its precursors (NOx) at a semi-arid rural site in southern India. *Aerosol and Air Quality Research*, 12(6), 1081-1094
17. Sanders, R. W. (2001). The genera of Verbenaceae in the southeastern United States. *Harvard Papers in Botany*, 5(2), 303-358.
18. Snigdha, M., Kumar, S. S., Sharmistha, M., Lalit, S., & Tanuja, S. (2013). An overview on herbal medicines as diuretics with scientific evidence. *Scholars Journal of Applied Medical Science*, 1(3), 209-214.
19. Stant, M. Y. (1952). The shoot apex of some monocotyledons: I. Structure and development. *Annals of Botany*, 16(1), 115-129.
20. Taylor, V., & Rupp, L. (1987). *Survival in the doldrums: The American women's rights movement, 1945 to the 1960s*. New York, NY: Oxford University Press.
21. Upadhyay, D., & Sharma, V. (2018). Nyctanthesarbor-tristis: An Important Vulnerable Medicinal Plant. *IJASRM*, 1, 180-183.

22. Patel, N. K. (1960). SOME PRELIMINARY OBSERVATIONS ON THE FLORAL STRUCTURES OF OLEACEAE. *Current Science*, 29(2), 59-59.
23. Kapil, R. N., & Vani, R. S. (1966). NYCTANTHES ARBOR-TRISTIS LINN-EMBRYOLOGY AND RELATIONSHIPS. *Phytomorphology*, 16(4), 553.
24. Fotidar, A. N. (1939). The Primary Vascular System of the Stem of Nyctanthes Arbortristis L.
25. Majumdar, G. P. (1941). Anomalous Structure of the Stem of Nyctanthes Arbortristis L.
26. Murthy, G. S. R., Aleykutty Sr Avita, K. M., Rao, V. S., & Inamdar, J. A. (1978). Vessels of Oleaceae and Verbenaceae. *Feddes Repertorium*, 89(5-6), 359-368.
27. Inamdar, J. A. (1967, October). Studies on the trichomes of some Oleaceae, structure and ontogeny. In *Proceedings/Indian Academy of Sciences* (Vol. 66, No. 4, pp. 164-177). New Delhi: Springer India.
28. Metcalfe, C. R., & Chalk, L. (1950). Anatomy of the Dicotyledons: leaves, stem, and wood, in relation to taxonomy, with notes on economic uses. *Anatomy of the Dicotyledons: leaves, stem, and wood, in relation to taxonomy, with notes on economic uses*.
29. Maheswari-Devi, H. (1975). Embryology of jasminums and its bearing on the composition of Oleaceae. *Acta Botanica Indica*.
30. Bolkhorskikh Aet al 1969Chromosome number in flowering plants (USSR)
31. Saxena, M. R. (1975). Pollen morphology of the Nyctanthoideae (Verbenaceae).
32. Das, V. S. R., & Rao, K. N. (1966). Chemotaxonomical investigation of Nyctanthes. *Naturwissenschaften*, 53(17), 439-439.

