

# Analysis of ethanomedicinally potential extract of *Nepeta cataria*

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## ABSTRACT

*Nepeta cataria* has been representative species and the most intensively studied plant. Plant is well known for its traditional uses such as remedy for fever, cold, cough, stomach problems, diarrhea, sore throats, headaches, pneumonia, female problems, blood disorders, convulsions, rheumatism, and toothache etc. This heterogeneity could be the result of containment of rich essential oils, oxygenated terpenoid hydrocarbons and other chemical constituents. Apart from these, pharmacological screening reported its antifungal, antibacterial, antioxidant, insecticidal, anti-inflammatory, anti-nociceptive, and spasmolytic properties. Owing to its diversified pharmacological properties, a substantial number of phytochemicals have been isolated till date, but many more are still to be discovered from the store of nature. This review emphasizes on latest information regarding the distribution, taxonomy, traditional uses and more focused on phytochemistry, pharmacology.

**Key words:** *Nepeta cataria*, Catnip, Nepetalactone, Essential oil, Ethanomedicinal, Phytoconstituents

## Introduction

Traditionally various medicinal plants or herbs are used, in less developed countries approximately more than 3.3 billion people use medicinal plants on regular basis, thus medicinal plants are also called 'backbone' of traditional medicine (Ahvazi *et al.*, 2012). Apart from this, due to safety and potency profile via the herbalism, it's getting wide popularity (Gupta *et al.*, 2006). Potential activity of *Nepeta cataria* extracts as well as essential oils is investigated pharmacologically and indicated as Anti diabetic, Anti-Depressant, Anthelmintic, Nematicidal, Trypanocidal and Insect Repellent, antioxidant, antibacterial, anticancer, antiviral, and insecticide, etc (Setzer *et al.*, 2016; Sharma *et al.*, 2019; Mohan *et al.*, 2019; Giarratana *et al.*, 2017; Ali *et al.*, 2012; Ricci *et al.*, 2010; Lenardão *et al.*, 2016; Ashrafi *et al.*, 2019;

Gokce *et al.*, 2010; Setzer *et al.*, 2016; Naguib *et al.*, 2012; Gilani *et al.*, 2009; Bernardi *et al.*, 2011; Satish S., 2013; Bernardi *et al.*, 2010; Saeidnia *et al.*, 2008; Bandh *et al.*, 2011; Pavaraj *et al.*, 2012; Reichert W *et al.*, 2019). The chemical investigation of the plant extracts have shown that the main constituent is terpenoid nepetalactone and others are such as  $\beta$ -caryophyllene, caryophyllene oxide, nerol, elemol, geraniol, 1, 8-cineol, citronellol, etc (Miceli *et al.*, 2005; Mohan *et al.*, 2019). In the current review, we summarized the plant profile, availability, bioactive chemical constituents, taxonomy, ethnobotanical use, pharmacological exploration of *Nepeta cataria*.

## Plant Profile

*Nepeta cataria*

This plant is a multiregional, from Lamiaceae (mint) family and most cats are having strong attraction

towards the plant, also called as 'catmint'. It is a rich source of essential oil and bioactive secondary metabolites. It is a perennial herb having small purple or red-dotted flowers/ whitish or pinkish (occasionally blue or lilac) and 0.3-1.6m (1-5 feet) height (Ibrahim *et al.*, 2006; Sharma *et al.*, 2019). Plant picture has been shown in Fig. 1.

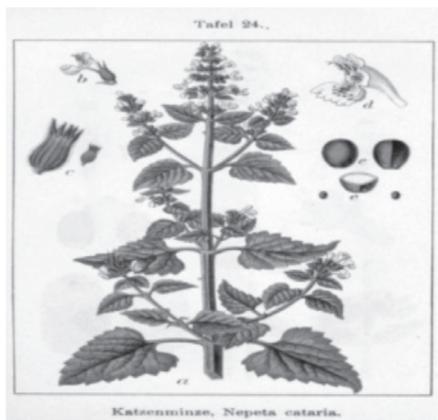


Fig. 1. Picture of *Nepeta cataria*

### Availability

*Nepeta cataria* is native to southern Siberia, Central Asia, China and Eastern Europe. Plant widely grows outside to native area, especially in Eurasia, North America, and Africa. This plant prefers slightly alkaline soil to grow (Small, 2012).

### Chemical Constituents

A bicyclic monoterpenoid, Nepetalactone is a main chemical constituent, isolated and reported in 1941 firstly from this plant *Nepeta cataria*. It contains two fused rings: cyclopentane and lactone (modified  $\delta$ -valerolactone ring). This chemical relates with the iridoids class, also similarity in structure and effects like valepotriates. Apart from this, different type of nepetalactone isomers are also known (Bates *et al.*, 1963). Next, in addition also contains alkaloids along with nepetalactones such as actinidine and iridomyrmecin (Kalpoutzakis *et al.*, 2001). *Nepeta cataria* contains other main chemical constituents as  $\beta$ -caryophyllene,  $4\alpha$ ,  $7\alpha$ ,  $7\alpha\alpha$ -nepetalactone,  $4\alpha$ - $\alpha$ ,  $7$ - $\alpha$ ,  $7\alpha$ - $\beta$ -nepetalactone,  $4\alpha$ - $\alpha$ ,  $7$ - $\beta$ ,  $7\alpha$ - $\alpha$ -nepetalactone, nerol, caryophyllene oxide, elemol, geraniol, geranial, 1, 8-cineol, citronellol, citronellyl acetate. Apart from this,  $\beta$ -sitosterol,  $\alpha$ -amyrin, urosolic acid,  $\beta$ -amyrin, sitosterol  $\beta$ -glucopyranoside and urosolic acid are also present. Few new constituents were identified; Piperitone, Humulene Oxide, Dim-

ethyl-3, 7 Oxa-1 Bicyclo [3, 3, 0] Oct-2-Ene, Hexenyl Benzoate, Thymol Methyl Ether. Some others are sabinene,  $\alpha$ -humulene,  $\alpha$ -Pinene,  $\beta$ -farnesene, etc (Morteza-Semnani *et al.*, 2004; Miceli *et al.*, 2005; Mohan *et al.*, 2019).

### Extraction Methods

There are various methods to obtain essential oils from the *Nepeta cataria* plant parts, mainly via extraction. Various methods for extractions are; Supercritical Fluid Extraction, Soxhlet extraction and Ultrasonic Assisted Solvent Extraction (UAE) (Mukhtar *et al.*, 2019; Salleh *et al.*, 2018).

### Pharmacological Activities

*Nepeta cataria* contains secondary metabolites as well as essential oil and has shown various applications in diverse fields as food industries, agrochemical and pharmaceutical. Essential oil of *Nepeta cataria* also helps in stimulation of excretion, circulation and nervous system. *Nepeta cataria* is having chemical constituents like nepetalactones and iridoids, which are related to biological activities like as insect repellent, insecticidal, cat attractant, etc. Its uses are as follows;

As sedative, an insect repellent (most common pesticides and insect repellents ingredient), carminative, nervine tonic, emmenagogue (regulate menstrual flow), diuretic, diaphoretic.

Medically catnip includes diverse properties as antibiotic, anesthetic, astringent, in muscular aches, in chills, in rheumatism, in hemorrhoids and in toothache, etc. Catnip oil also helps in migraine, ulcers, dyspepsia, menstrual cramps and spasmodic cholera. Other health benefits of this plant are: tightening of muscles, skin, and gums; stimulating appetite and promoting production of hormones (Setzer *et al.*, 2016; Sharma *et al.*, 2019; Mohan *et al.*, 2019; Giarratana *et al.*, 2017).

### *Nepeta cataria* as an Anti-Inflammatory and Antinociceptive Agent

Essential oil of the plant *Nepeta cataria* have different effects on central nervous system and minimizes acute as well as chronic nociception thus acts against inflammation. Ricci *et al.* (2010), discussed and explored about the chemical profile of *Nepeta cataria* by the tail immersion method in mice and acetic acid-induced nociception. *Trans*, *trans*-nepetalactone and *trans*, *cis*-nepetalactone are the main chemicals for this activity (Ali *et al.*, 2012; Ricci

*et al.*, 2010; Lenardão *et al.*, 2016).

#### ***Nepeta cataria* as an Anti-oxidants**

Antioxidant activity has been shown by ethanolic extracts of *Nepeta cataria* and this is in relation with total phenolic compounds content present in the extract; indicates that the plant extract may be as natural source of antioxidants. This activity of essential oil can be due to the presence 'nepetalactones' (62.5%) in oil (Ashrafi *et al.*, 2019; Gokce, *et al.*, 2010).

#### ***Nepeta cataria* as an Antifungal and Antimicrobial Agents**

Essential oil of *Nepeta cataria* composed of following constituents for antimicrobial activity; 4 $\alpha$ , 7 $\beta$ , 7 $\alpha$ -nepetalactone, 4 $\alpha$ , 7 $\alpha$ , 7 $\beta$ -nepetalactone and 4 $\alpha$ , 7 $\alpha$ , 7 $\alpha$ -nepetalactone (Setzer *et al.*, 2016). (Bourrel *et al.*, 1993) examined and reported that the oil that was obtained from the flowering plant of *Nepeta cataria* is rich in lactone than oil that was obtained from the plant before flowering. They find that increased antifungal action against *Candida* was due to lactone, as the sample rich in lactone (70%) than sample lesser in lactone concentration (10%). Further using the microplate technique they found that Catnip oil shown fungistatic activity against *Aspergillus niger*.

#### ***Nepeta Cataria* as an Antidiabetic Agent**

(Naguib *et al.*, (2012) performed research on *Nepeta Cataria* extract on the basis of following mechanism; Inhibition of carbohydrate-hydrolysing enzymes ( $\alpha$ -amylase,  $\alpha$ -glycosidase and  $\beta$ -galactosidase) in the gastrointestinal tract causes retardation of the absorption of glucose by decreasing the postprandial hyperglycemic state. In it, they reported the presence of flavonoid, triterpenes, carbohydrates, glycosides, etc other compounds may be concerned with antioxidants as well as hypoglycaemic effects of *Nepeta cataria* extracts. Also they discussed that extract have shown inhibitory effects on nitric oxide (NO) radical, 2, 2, 1-diphenyl-1-picrylhydrazyl (DPPH),  $\alpha$ -amylase,  $\alpha$ -glycosidase and  $\beta$ -galactosidase enzymes.

#### ***Nepeta Cataria* as Spasmolytics and Bronchodilators**

Gilani *et al.*, (2009) investigated composition of chemical and pharmacological aspect of *Nepeta*

*cataria* in tissues preparations. They identified four constituents in oil; 1, 8-cineole,  $\alpha$ -humulene,  $\alpha$ -pinene, Geranyl acetate. This plant has shown Spasmolytics and myorelaxant action mediated through mainly *via* inhibition of calcium channels and enzyme phosphodiesterase (PDE).

#### ***Nepeta cataria* as a Penile Erecting agent**

The study conducted by Bernardi *et al.*, (2011) reported that enhancement of penile erection and rat sexual behavior via dopaminergic system is shown by catnip plant. Thus may be suggested for future clinical treatments for erectile dysfunction after more valuable research data needed as the long-term effects, mechanism of action and active principles identification on sexual behaviour.

#### ***Nepeta cataria* in the treatment of Alzheimer's disease**

Satish (2013) studied and reported anti-amnesic effects of *Nepeta cataria* as well as influence on central cholinergic action through estimation of whole brain acetyl cholinesterase activity. *Nepeta cataria* essential oil decreased acetyl cholinesterase activity significantly.

Hence, memory improving activity of *Nepeta cataria* essential oil may be due to its neuroprotective, pro-cholinergic, antioxidant, and anti-acetyl cholinesterase properties thus may be use in delaying the onset and decreasing the severity in Alzheimer's disease. Furthermore investigations using more experimental data will be required for further confirmation of essential oil in the treatment of various cognitive disorders.

#### ***Nepeta cataria* as in Anti-Depressant Activity**

Bernardi *et al.*, (2010) studied anti-depressive activity in male mice which were fed very markedly as well as administration of polar and apolar extracts repeated with *Nepeta cataria* leaves. They found immobility reduction in behavior with apolar extracts and no changes in behavior with polar extracts, this indicated that apolar extracts of plant leaves has anti antidepressant action.

#### ***Nepeta cataria* as a Cytotoxic Agent**

Suschke *et al.*, (2007) reported cytotoxic activity of *Nepeta cataria* essential oils by microculture tetrazolium assay method against human keratinocyte and bronchial epithelial cell lines.

### ***Nepeta cataria* as in Trypanocidal, Anthelmintic and Nematicidal Activity**

Saeidnia *et al.*, (2008) studied and reported Trypanocidal activity on epimastigotes of *Trypanosoma cruzi* of diethyl ether extract from *Nepeta cataria*. (Bandh *et al.*, 2011) evaluated and reported Anthelmintic activity *in vitro* and *in vivo* on live *Haemonchus contortus* worms of methanolic extract from *Nepeta cataria*. (Pavaraj *et al.*, 2012) studied and reported Nematicidal activity on *Meloidogyne incognita* egg hatchability of methanol extracts isolated from *Nepeta cataria*. They exposed eggs and nematode to different concentration (10ppm-100ppm) of plant extract for 24, 48, and 72 hrs. After exposing they observed that as plant extract concentration increased, egg-hatching capacity decreased.

### ***Nepeta cataria* as in Insect Repellent activity**

Zhu *et al.*, (2009) studied and have shown that essential oil of *Nepeta cataria* is having repellency activity against *Musca domestica* (L.) and *Stomoxys calcitrans* (L.). Furthermore, toxicity studies of catnip oil reported that it may cause minor irritation in some individuals having sensitive skin Reichert *et al.*, (2019) studied as well as evaluated essential oil from *Nepeta cataria* (catnip) two recently cultivated breed having different chemo type nature and found that chemical constituents (isomers of nepetalactone) have shown repellency against *Aedes aegypti* mosquitoes, causative agent of Dengue and Zika virus. Nepetalactone isomers of *Nepeta cataria*, investigated for repellency activity were E, Z nepetalactone and Z, E-nepetalactone.

### **Traditional Uses**

Traditionally by leaves of *Nepeta cataria*, prepared tea has been used for the cure and treatment of respiratory disturbances like asthma, bronchitis, and cough also for gastrointestinal disturbances like diarrhoea, etc. Some Indian tribes from Chippewa as well as North America used leaves of plant for preparation of herbal tea (excessive intake of tea can cause diarrhoea). Also Indian tribe people prefer the plant to treat coughs, colds as well as stomach upsets. Apart from this, people from Iroquois Indian tribes used this plant for the cure of sore throats, vomiting, diarrhea and headaches. Along with this, to cure pneumonia and as a sweating inducer many Menominee peoples, for pain relief Rappahannock tribe's people and to cure female disorders many

Cherokee peoples used this plant. Shinnecock used for rheumatism and Cherokee Indians used this plant for the convulsion's treatment. Further, as antiseptic, diaphoretic, tonic, carminative, for tooth ache, emmenagogue, and refrigerant all uses were due to aromatic nature of dried leaves and flowering tops of plant (Sharma *et al.*, 2019; Shafaghat *et al.*, 2010; Formisano *et al.*, 2011; Baser, *et al.*, 2000). Other biological and medicinal properties of *Nepeta cataria* are the following: plant extracts having inhibitory activity on production, growth of enzyme as well as bacteria. Leaves or flowering tops have been used for its flavoring property in cheese and soups. Also, in North America, it has been used as medicine, dyes, etc. Further it has been taken as a hot infusion which is useful in insomnia, flu and cold. For preventing miscarriage, premature birth and to cure morning sickness, this plant is also preferred (Nostro *et al.*, 2001; Sharma *et al.*, 2019; Adiguzel *et al.*, 2009; Birkett *et al.*, 2011; Ricci *et al.*, 2010).

### **Recommendation For Farmers**

*Nepeta cataria* is a common wild weed, it can grow widely but this is very sensitive to winter season. *Nepeta cataria* is also used in gardens as an ornamental plant. Essential oil of this plant is very useful, as discussed before. Thus, for farmers it could be a good choice of cultivation during its season (Park *et al.*, 2007). Cultivation of *Nepeta cataria* could be beneficial because worms or bugs don't like the aroma of plant due to the presence of essential oils in it. This feature of insect repellency can work for those crops which are very susceptible by insect attack and disease (Carpenter *et al.*, 2015).

### **Conclusion**

Catnip is a native plant of southern Siberia, Central Asia, China and Eastern Europe with many traditional uses. This review emphasized the plant profile, availability, bioactive chemical constituents, taxonomy, ethnobotanical use and pharmacological exploration of *Nepeta cataria*. As shown in the review, many uses of *Nepeta cataria* are there as for the gastrointestinal (diarrhea) and respiratory (asthma, cough, bronchitis) diseases, Anti diabetic, Anti-Depressant, Anthelmintic, Nematicidal, Trypanocidal and Insect Repellent etc. Many researchers confirm the safety studies of Catnip, though after reviewing traditional aspects given the idea about the plantif uses in safe mode on humans. However, this diver-

sity of results could inspire researchers to do more pharmacological studies which should proceed in other regions also to explore unreported medicinal value of plant.

## References

- Adiguzel, A.H.M.E.T., Ozer, H., Sokmen, M., Gulluce, M.E.D.I.N.E., Sokmen, A., Kilic, H., Sahin, F. and Baris, O. 2009. Antimicrobial and antioxidant activity of the essential oil and methanol extract of *Nepeta cataria*. *Polish Journal of Microbiology*. 58(1) : 69-76.
- Ahvazi, M., Khalighi-Sigaroodi, F., Charkhchiyan, M.M., Mojab, F., Mozaffarian, V.A. and Zakeri, H. 2012. Introduction of medicinal plants species with the most traditional usage in Alamut region. *Iranian Journal of Pharmaceutical Research*. 11(1):185-194.
- Ali, T., Javan, M., Sonboli, A. and Semnani, S. 2012. Evaluation of the antinociceptive and anti-inflammatory effects of essential oil of *Nepeta pogonosperma* Jamzad et Assadi in rats. *DARU Journal of Pharmaceutical Sciences*. 20(1) : 48.
- Ashrafi, B., Ramak, P., Ezatpour, B. and Talei, G.R. 2019. Biological activity and chemical composition of the essential oil of *Nepeta cataria* L. *Marmara Pharmaceutical Journal*, 21(3).
- Bandh, S.A., Kamili, A.N., Ganai, B.A., Lone, B.A. and Saleem, S. 2011. Evaluation of antimicrobial activity of aqueous extracts of *Nepeta cataria*. *Journal of Pharmacy Research*. 4(9) : 3141-3142.
- Baser, K.H.C., Kirimer, N., Kurkcuoglu, M. and Demirci, B. 2000. Essential Oils of *Nepeta* Species Growing in Turkey. *Chemistry of Natural Compounds*. 36(4): 356-359.
- Bates, R.B. and Sigel, C.W. 1963. Terpenoids. Cis-trans and trans-cis-Nepetalactones. *Experientia*. 19(11): 564-565.
- Bernardi, M.M., Kirsten, T.B., Salzgeber, S.A., Ricci, E.L., Romoff, P., Guillard Lago, J.H. and Lourenço, L.M. 2010. Antidepressant-like effects of an apolar extract and chow enriched with *Nepeta cataria* (catnip) in mice. *Psychology & Neuroscience*. 3(2): 251.
- Bernardi, M.M., Kirsten, T.B., Lago, J.H.G., Giovani, T.M. and de Oliveira Massoco, C. 2011. *Nepeta cataria* L. var. *citriodora* (Becker) increases penile erection in rats. *Journal of Ethnopharmacology*. 137(3): 1318-1322.
- Birkett, M.A., Hassanali, A., Høglund, S., Pettersson, J. and Pickett, J.A. 2011. Repellent activity of catmint, *Nepeta cataria* and iridoid nepetalactone isomers against Afro-tropical mosquitoes, ixodid ticks and red poultry mites. *Phytochemistry*. 72(1) : 109-114.
- Bourrel, C., Perineau, F., Michel, G. and Bessiere, J.M., 1993. Catnip (*Nepeta cataria* L.) essential oil: analysis of chemical constituents, bacteriostatic and fungistatic properties. *Journal of Essential Oil Research*. 5(2): 159-167.
- Carpenter, J. and Carpenter, M. 2015. The Organic Medicinal Herb Farmer: The Ultimate Guide to Producing High-quality Herbs on a Market Scale. *Chelsea Green Publishing*. 282-283.
- Formisano, C., Rigano, D. and Senatore, F. 2011. Chemical constituents and biological activities of *Nepeta* species. *Chemistry & Biodiversity*. 8(10) : 1783-1818.
- Giarratana, F., Muscolino, D., Ziino, G., Lo Presti, V., Rao, R., Chiofalo, V., Giuffrida, A. and Panebianco, A. 2017. Activity of Catmint (*Nepeta cataria*) essential oil against *Anisakis* larvae. *Trop. Biomed*. 34(1): 22-31.
- Gilani, A.H., Shah, A.J., Zubair, A., Khalid, S., Kiani, J., Ahmed, A., Rasheed, M. and Ahmad, V.U. 2009. Chemical composition and mechanisms underlying the spasmolytic and bronchodilatory properties of the essential oil of *Nepeta cataria* L. *Journal of Ethnopharmacology*. 121(3) : 405-411.
- Gokce, I. 2010. Antioxidant capacity of catnip (*Nepeta cataria*). *Asian Journal of Chemistry*. 22(4) : 2833-2839.
- Gupta, M., Biswas, T.K., Saha, S. and Debnath, P.K. 2006. Therapeutic utilization of secretory products of some Indian medicinal plants-a review. 5(4) : 569-575.
- Ibrahim, M.E., El-Sawi, S.A. and Ibrahim, F.M. 2017. *Nepeta cataria* L, one of the promising aromatic plants in Egypt: Seed germination, growth and essential oil production. *J. Mater. Environ. Sci*. 8(6): 1990-1995.
- Kalpoutzakis, E., Aligiannis, N., Mentis, A., Mitaku, S. and Charvala, C. 2001. Composition of the essential oil of two *Nepeta* species and *in vitro* evaluation of their activity against *Helicobacter pylori*. *Planta Medica*. 67(09) : 880-883.
- Lenardão, E.J., Savegnago, L., Jacob, R.G., Victoria, F.N. and Martinez, D.M. 2016. Antinociceptive effect of essential oils and their constituents: an update review. *Journal of the Brazilian Chemical Society*. 27(3): 435-474.
- Miceli, N., Taviano, M.F., Giuffrida, D., Trovato, A., Tzakou, O. and Galati, E.M. 2005. Anti-inflammatory activity of extract and fractions from *Nepeta sibthorpii* Benth. *Journal of Ethnopharmacology*. 97(2): 261-266.
- Mohan, M., Satish, S. and Shabaraya, A.R. 2019. A review on pharmacological activities of essential oil in *Nepeta cataria*. *International Journal of Pharma and Chemical Research*. 5(2) : 14-17.
- Morteza-Semnani, K. and Saedi, M. 2004. Essential oils composition of *Nepeta cataria* L. and *Nepeta crassifolia* Boiss. and Buhse from Iran. *Journal of Essential Oil Bearing Plants*. 7(2) : 120-124.
- Mukhtar, H.M. and Singh, G.P. 2019. Pharmacognostic and phytochemical investigations of aerial parts of *Nepeta cataria* Linn. *Asian Journal of Pharmacy and Pharmacology*. 5(4) : 810-815.
- Naguib, A.M.M., Ebrahim, M.E., Aly, H.F., Metawaa, H.M., Mahmoud, A.H., Mahmoud, E.A. and

- Ebrahim, F.M. 2012. Phytochemical screening of *Nepeta cataria* extracts and their *in vitro* inhibitory effects on free radicals and carbohydrate-metabolising enzymes. *Natural Product Research*. 26(23) : 2196-2198.
- Nostro, A., Cannatelli, M.A., Crisafi, G. and Alonzo, V. 2001. The effect of *Nepeta cataria* extract on adherence and enzyme production of *Staphylococcus aureus*. *International Journal of Antimicrobial Agents*, 18(6) : 583-585.
- Park, C.H., Tannous, P., Juliani, H.R., Wu, Q.L., Sciarappa, W.J., VanVranken, R., Nitzsche, P., Dalponte, D. and Simon, J.E. 2007. Catnip as a source of essential oils. *Creating Markets for Economic Development of New Crops and New Uses (ed. Whipkey, A.)*: 311-315.
- Pavaraj, M., Bakavathiappan, G. and Baskaran, S. 2012. Evaluation of some plant extracts for their nematocidal properties against root-knot nematode, *Meloidogyne incognita*. *Journal of Biopesticides*. 5: 106.
- Reichert, W., Ejercito, J. Guda, T., Dong, X., Wu, Q., Ray, A. and Simon, J.E. 2019. Repellency assessment of *Nepeta cataria* essential oils and isolated Nepetalactones on *Aedes aegypti*. *Scientific Reports*. 9(1) : 1-9.
- Ricci, E.L., Toyama, D.O., Lago, J.H.G., Romoff, P., Kirsten, T.B., Reis-Silva, T.M. and Bernardi, M.M. 2010. Antinociceptive and anti-inflammatory actions of *Nepeta cataria* L. var. *citriodora* (Becker) Balb. Essential oil in mice. *J Health Sci Inst*. 28(3) : 289-293.
- Saeidnia, S., Gouhari, A. and Haji, A.A. 2008. Trypanocidal activity of oil of the young leaves of *Nepeta cataria* L. obtained by solvent extraction. *J Med Plants*. 7 : 54-57.
- Salleh, M.M., Ghafar, F. and Hadi, N.N. 2018. October. Optimization of *Nepeta cataria* Essential Oil Extraction Yield by Ultrasonic-Soxhlet Extraction Method Using Response Surface Methodology. In: *IOP Conference Series: Materials Science and Engineering*. 440(1): 012002.
- Satish, S. 2013. Studies on Therapeutic Potential of Essential Oils of *Nepeta cataria* in Treatment of Alzheimer's Disease. *Asian Journal of Biomedical and Pharmaceutical Sciences*. 3(18) : 42.
- Setzer, W.N. 2016. Catnip essential oil: There is more to it than making your cat go crazy. *American Journal of Essential Oils and Natural Products*. 4(4) : 12-15.
- Shafaghath, A. and Oji, K. 2010. Nepetalactone content and antibacterial activity of the essential oils from different parts of *Nepeta persica*. *Natural Product Communications*. 5(4) : 1934578X1000500427.
- Sharma, A., Nayik, G.A. and Cannoo, D.S. 2019. Pharmacology and Toxicology of *Nepeta cataria* (Catmint) Species of Genus *Nepeta*: A Review. *Plant and Human Health*. 3 : 285-299. Springer, Cham.
- Small, E. 2012. Catnip—safer pesticide potential. *Biodiversity*. 13 (2) : 118-126.
- Suschke, U., Sporer, F., Schneelee, J., Geiss, H.K. and Reichling, J. 2007. Antibacterial and cytotoxic activity of *Nepeta cataria* L., *N. cataria* var. *citriodora* (Beck.) Balb. and *Melissa officinalis* L. essential oils. *Natural Product Communications*. 2 (12) : p.1934578X0700201218.
- Zhu, J.J., Zeng, X.P., Berkebile, D., Du, H.J., Tong, Y. and Qian, K. 2009. Efficacy and safety of catnip (*Nepeta cataria*) as a novel filth fly repellent. *Medical and Veterinary Entomology*. 23 (3) : 209-216.
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