

# CNS Acting Potential of Natural Products with Special Reference to Family *Solanaceae*

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## ABSTRACT

*Solanum* species belong to the family *Solanaceae*, with over 1500 species, worldwide. This type of species also contains medicinal plants such as tomato, potato, eggplant, bell, chilli, peppers and many species such as tropical Mapple, aquatic soda apple and sea walnut etc. Plants in this type of species, the family are usually rough hairy and often prickly, with a distinctive part of plants like flower, seed and fruits, and these numerous types of plants occurring from *Solanaceae* made up of rich sources of biotin, minerals, vitamins, iron and potassium salts. Mainly *Solanum* species plants contain steroidal glycoalkaloidal constituents and they are responsible for the various effectiveness in disease and disorders, most of plants contain solasodine and

solamargine and both are possessing anticonvulsants effects. During the study of many review and research, most of *solanum* plants contain steroidal glycosides and they exert the anti-seizure effect because of the solasodine, solmine, solamarginine etc. which inhibit the increment of sodium voltage ions which is responsible for the convulsion.

**Key words:** *Solanum* plants, Anticonvulsants, Solasodine

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## INTRODUCTION

*Solanaceae* is economically and widely distributed family in worldwide. The *Solanaceae* plants having a great asset of glycoalkaloids like solasodine, solanine and solamargine; extensive chemicals are atropine hyoscine, nicotine and other alkaloids used in traditional medicine for the treatment of epilepsy have been scientifically shown to have promising anticonvulsants activities in various animal models (PTZ and MES) for screening for anticonvulsants activity and can be a source of new anti-epileptic drugs (Sandabe UK, *et al.*, 2003; Bilal A, *et al.*, 2005).

## LITERATURE REVIEW

### *Solarium nigrum*

*Solarium nigrum* is abroad and highest quantity plants and distributed in tropical area. The leaves of this plant have anticonvulsants property in chicks, mice and rats (Wannang NN, *et al.*, 2004; Wannang NN and Bichi LA, 2005). The aqueous leaves extract of *S. nigrum* was found to act against MES, pentylenetetrazole and picmtoxin-induced seizures models. The activity may study by the dopaminergic pathway and neuronal activity (Wannang NN, *et al.*, 2008).

The ethanol extract of *S. nigrum* used in three different dose that are (100, 200 and 300 mg/kg body weight) to evaluate anticonvulsants activity by employing carrageenan paw edema and other Supra-maximal electric shock methods. Ethanol's extract of *S. nigrum* produced anticonvulsants ( $P < 0.05$ ) effect in dose dependent. The flavonoid category present in the berries might be a responsible active constituent for anticonvulsants activity (Ravi V, *et al.*, 2009).

### *Solanum sisymbriifolium*

The active constituent solasodine exhibit mechanisms for effects could be the move inside of chloride ions through GABA receptors and inhibition of voltage-dependent  $\text{Na}^+$  channels (responsible for neuron excitation in GABA receptors). In this, the author review that the further future study should focus on identification of exact mechanisms of action of solasodine for the potential CNS and neuronal excitation activity and properties using different an-

imal model (Chauhan K, *et al.*, 2011).

### *Solanum trilobatum L*

This plant is mostly involved for the production of steroidal glycosides. It could be more viable to relax convulsions due to its steroidal-glycoalkaloids, in these plants the rich sources of alkaloid are solasonine (Shilpha J, *et al.*, 2013).

### *Pipernigrum*

The ability of plant extracts and their isolated each compound indicates an important role for medicinal plants in the treatment of neurological disorders. The penetration of plant extracts and their protective effect on the blood-brain-barrier are dressed plant extracts have further relate with subjected to mood and cognition behavioral studies in humans (Lundstrom K, *et al.*, 2017).

### *Solanum melongena Linn*

This plant was mainly evaluated for its anti-epileptic activity against experimental seizures with including various methods. The root's ethanolic extract protected mice against tonic convulsion induced by maximal electroshock model, Pentylene tetrazole and Picrotoxin method. The researcher was found that ethanolic extract upto a dose of 300 mg/kg exhibit the excitation of neuronal activity or may be sodium voltage channel (Kumar S, *et al.*, 2010; Sayyah M, *et al.*, 2002; Vohora SB, *et al.*, 1984).

### *Solanum torvum*

*Solarium torvum* (*Solanaceae*) was identified as having significant anticonvulsant activity in zebrafish larvae with seizures induced by chemical method pentylenetetrazol (the GABA antagonist) and decrease the excitation of neurons with the inhibition of sodium voltage channels. In various ethano-medicines, extraction of this plant in water and other non-polar solvents *Solanum torvum* contains rich number of potentially pharmacologically active constituents including sapogenin steroidal chlorogenin (Challal S, *et al.*, 2014).

### *Solanum tuberosum*

Potato juice has an activity against convulsion induced in mice through the maximum electro shock seizure model *via* binding to GABA receptors. This study suggest that potato juice extract

as food may have the capacity of influencing brain GABA-ergic activity and other activities of CNS. Naturally occurring chemical benzodiazepines that inhibit neuronal excitation have been identified in regular food such as wheat and potato (rich quantity), but there is still no evidence to prove clearly and not further identification of the researches (Muceniec R, *et al.*, 2008).

For curing the epilepsy disorder there are some medicinal plants such as a *figus sycomorus*, *sclercarya*, *Annona diversifolia*, and plants from *Solanaceae* family and solanum species, and many more used in traditional medicine and other crude drugs have found with anticonvulsant properties with effective action in animal models and may be a heat and novel source of newer antiepileptic drugs (Tyagi N, *et al.*, 2019).

#### **Solanum indicum**

The plant bulb extract of *C. jagus* and fruits extract of *S. indicum* protective against electrically induced convulsion with the former exerting greater anticonvulsant effect. Bulb extract of *C. jagus* and fruits extract of *S. indicum* possesses anticonvulsant effect and inhibition of GABA receptor and these findings collaborate with the ethno-medicine uses of this plant (Ohadoma SC, *et al.*, 2017). *S. indicum* also called *Solanum ferox* is an erect armed shrub and he with stiff yellow spines. It is commonly found in wet places in villages and sometimes planted near houses (Irvine FR, 1961).

#### **Lycopersicon esculentum**

*Lycopersicon esculentum* (tomato fruit) can protect from epileptic disorder. The petroleum ether and alcoholic extracts of tomato fruits shows antiepileptic effects. The chronic administration of tomato alcoholic extract significantly increased the GSH level and significantly decrease the MDA as well as protein concentration on MES induced biochemical changes in brain tissue, ether and alcoholic extracts of *Lycopersicon esculentum* fruits may contain the phyto constituents (solasdine) possessing anticonvulsant activity (Azharuddin M, *et al.*, 2013).

#### **Solanum macrocarpon**

The ethanolic root extract of *S. melongena* possess CNS activity and potential binding of GABA receptors. The effect of melongena in mice against tonic convulsion induced by maximum electroshock. The maximum dose of (300 mg/kg) drugs that inhibit voltage-dependent Na<sup>+</sup> channels and voltage dependent chloride channel (Kumar S, *et al.*, 2010).

#### **Solanum triflorum**

Ethanolic extract of *Solanum trillorum* induced in mice to protect from tonic convulsion by experimental method. Convulsions produced by the chemical method by pentylene tetrazole and electrical method by maximal electroshock. The effect of extract was showed significant inhibition of lipid peroxidation in mice brain tissue as compared to control group of standard. Effects on reduced glutathion (GSH) level in mice brain tissue (Gowda G, *et al.*, 2012; Asuntha G, *et al.*, 2010).

#### **Solanum surattense**

Various extracts as alcoholic extracts of *Solanum surattense* used in medicine for treatment of various infections they cause by different organisms. The most effective activity shows the anticonvulsant activity due to its solanine active constituent. The plant shows anticonvulsants efficacy against maximum electro shock. The methanolic extract of this whole plant inhibit the GABA receptors voltage dependent channel (Gurunath HM, *et al.*, 2011; McDonald RL and Kelly KM, 1993).

#### **Datura metal linn**

Plant extracts which are used in prevalent traditional medicines for several years to treat epilepsy and other disease. Whole plant methanolic

extract show anticonvulsants effects on PTZ induced seizure. Due to the binding GABA receptors, decreased the intensity of seizures and reduced seizure duration with its synthesizing agents. Herbal medicines are very cheap in comparison to the conventional form of medication (Manchishi S, 2018).

#### **Solanum lycocarpum**

Ethanol extract and fractions obtained from leaves of *Solanum lycocarpum* were examined in order to determine their phenolic composition used as sedative of nervous system against epilepsy, antioxidant, antibacterial, anti-inflammatory, and cytotoxic potential. Particularly shown potent activity against oxidative stress (Morais MG, *et al.*, 2015; Munari CC, *et al.*, 2012).

#### **Solanum macranthum**

*Solanaceae* were remarkably prized for their alkaloid content which was used for poisoning and psychotropic effects, currently evaluation of the bioactive compounds of the *Solanaceae* family have gain great importance for their therapeutic application (Essien EE, *et al.*, 2012).

*Solanaceae* family is widely known to possess various bioactive phytochemicals such as solasodine, solasonine, solamargine, glycoalkaloids, sesquiterpenoids, cisplatin, doxorubicin, and docetaxel etc (Kalebar VU, *et al.*, 2019; Momin RK, Kadam VB, 2011).

#### **Solanum procumbens**

Ethanol leaves extracts of *Solanum procumbens* has activity against liver diseases, such as hepatitis, cirrhosis, high level of liver enzymes and anticonvulsant effect due to their isolated compounds (Hien TT, *et al.*, 2018). The crude extract remedy or dried materials of *S. procumbens* is considered as a major active ingredient in several tonic products and herbal teas for protection of liver and against conjunctivitis (Chi VV, 2012).

#### **Solanum capsicoides**

Its activities include anti-inflammatory, anticoagulant, antibacterial, antifungal, antiviral, anticancer, anti-hypertensive, antitubercular, anticonvulsant, anti-adipogenic, Cytochrome inhibiting, anti-hyperglycemic and neuroprotective (Dharman AK, Anilkumar M, 2018). Preliminary screening of phytochemical constituents of *S. capsicoides* as pharmacognostic tool for the raw drug industry (Akrouit A, *et al.*, 2010). The important ayurvedic formulations that use kantakari as a constituent (Sivarajan VV, Balachandran I, 1994).

#### **Solanum fastigiatum**

Researcher said that this plant has potential antioxidant and hepatoprotective properties. The extract showed inhibition against TBARS. The plant exhibited strong antioxidant activity in the DPPH (IC<sub>50</sub>, 68.96 ± 1.25 µg/ml) assay (Sabir SM and Rocha JB, 2008).

#### **S. asperum**

*S. asperum* have potent and exist analgesic activity at moderate doses. Solanandaine is most important alkaloid and have neurological effects and inhibition of proliferation, it may also affect as anticonvulsant effects, because it contains glycosidal molecule that is Solanandaine (Pandithurai M and Murugesan S, 2018; Yadav R, *et al.*, 2016).

#### **Solanum aviculare L.**

It inhibited the production of reactive oxygen species as well as elastase release in human neutrophils model and should be considered as responsible for anti-inflammatory activity and aqueous extract of the plant shows antioxidant activity. This herb containing active constituent solamargine and it inhibits the process of increasing sodium voltage channels (Granica S, *et al.*, 2013).

### ***Solanum xanthocarpum* Schrad. and Wendl.**

*Solanum xanthocarpum* Schrad. and Wendl. commonly known as Yellow-Berried Nightshade (pili kateli), Steroidal alkaloid solasodine, present in fruits. Solasodine is very rich with a glycone property, and it exhibit the excitation of neurotransmitter (Kumar N, *et al.*, 2010).

*S. xanthocarpum* able to promote and increase epithelialization either by facilitating the increasing of epithelial cell (Dixit VP and Gupta RS, 1982).

### ***Solanum verbascifolium***

*Solanum verbascifolium* L. is used in prevalent traditional-medicine of East Asia contains highly beneficial active molecules which can be exploited beneficially in healthcare services and nutritional supplement. It is highly rich in protein and high amounts of carbohydrate, potassium, iron, sodium, calcium and phosphorus, vitamin A and vitamin C. *Solanum verbascifolium* L. (*Solanum erianthum*) is used in herbal medicines because their rich content of Solaverbascine (Roy A and Geetha RV, 2013; Sharma A, *et al.*, 2016).

### ***Solanum aculeastrum***

Leaves and berry methanolic extract of *S. aculeastrum*. Dunal (*Solanaceae*) is used in traditional medicine to treat various human diseases (antileishmanial) and LC50 (the concentration at which there was 50% inhibition of the growth of the test fungi) was calculated by extrapolation. This drug also grows up for our society to treat the epilepsy patient because it contain rich source of sugar and non-sugar molecules (Sharma A, *et al.*, 2016; Sharma A, *et al.*, 2017).

### ***Solanum betaceum* Cav**

Tree tomato is a neglected Andean crop considered as one of most important plant to affect neuroactivity. The active constituent of this plant as ethanolic alkaloids binding the site of glutamate (Adam G, *et al.*, 1980).

### ***S. khasianum***

Electrofusion has successfully been used for the production of somatic hybrid plants of *Solanum melongena* (eggplant) and *S. khasianum*. Both plants are rich in solasodine and solasodine are responsible for the inhibit exitment of sodium voltage gated channel (Koduru S, *et al.*, 2006).

### ***Solanum anguivi***

Three new glycosides named anguiviosides A-C were isolated from the fruits of *Solanum anguivi* and characterized as follows: solasodine, l-rhamnose, D-rhamnose, due to all these they are responsible for neurological activity and inhibit the excitation of channels that they are responsible for interference of normal neuronal activity (Cipollini ML and Levey DJ, 1997; Acosta-Quezada PG, *et al.*, 2011).

### ***Solanum aethiopicum***

The plant of *Solanum aethiopicum*, defence mechanism for inflammation, report has shown that *S. aethiopicum* possesses and exhibit ulcer protecting properties against experimentally induced ulcers in rats. The drug also reduces CNS depressants effects (Sihachakr D, *et al.*, 1988; Zhu XH, *et al.*, 2000). These can also be evaluated further for their anti-convulsant activity with the help of MES model (Walling LL, 2000; Anosike CA, *et al.*, 2012; Shrivastava N and Patel T, 2007; Prakash OM, *et al.*, 2013; Rani AS and Kumar A, 2014; Sharma A, *et al.*, 2019; Ajeet K, *et al.*, 2015).

## **CONCLUSION**

During the study of many review and research, most of solanum plants contain steroidal glycosides and they exert the anti-seizure effect because of the solasodine, solmine, solamarginine etc. which inhibit the increment of sodium voltage ions which is responsible for the convulsion.

## **REFERENCES**

1. Sandabe UK, Onyeyili PA, Chibuzo GA. Sedative and anticonvulsant effects of aqueous extract of *Ficus sycomorus* L. (Moraceae) stem bark in rats. *Vet Archi.* 2003; 73(2): 103-110.
2. Bilal A, Khan NA, Ghufuran A, Inamuddin H. Pharmacological investigation of *Cassia sophora* Linn. var. *purpurea*, roxb. *Med J Islam World Acad Sci.* 2005; 15: 105-109.
3. Wannang NN, Anuka JA, Kwanashie HO, Bichi LA. Effects of *Solanum nigrum* Linn aqueous extracts on the behavioural activities in chicks. *Bio Env Sc J for the tropics.* 2004; 1(1): 139-142.
4. Wannang NN, Bichi LA. Determination of LD50 of the aqueous extract of *Solanum nigrum* Linn in rats. *Bio Env Sc J for the tropics.* 2005; 2(1): 117-119.
5. Wannang NN, Anuka JA, Kwanashie HO, Gyang S, Auta A. Anti-seizure activity of the aqueous leaf extract of *Solanum nigrum* linn (*solanaceae*) in experimental animals. *Afr Health Sci.* 2008; 8(2).
6. Ravi V, Saleem TS, Maiti PP, Ramamurthy J. Phytochemical and pharmacological evaluation of *Solanum nigrum* Linn. *Afr J Pharm Pharmacol.* 2009; 3(9): 454-457.
7. Chauhan K, Sheth N, Ranpariya V, Parmar S. Anticonvulsant activity of solasodine isolated from *Solanum sisymbriifolium* fruits in rodents. *Pharm Biol.* 2011; 49(2): 194-199.
8. Shilpha J, Silambarasan T, Pandian SK, Ramesh M. Assessment of genetic diversity in *Solanum trilobatum* L., an important medicinal plant from South India using RAPD and ISSR markers. *Genet Resour Crop Evol.* 2013; 60(3): 807-818.
9. Lundstrom K, Pham HT, Dinh LD. Interaction of plant extracts with central nervous system receptors. *Medicines.* 2017; 4(1): 12.
10. Kumar S, Singh RK, Singh AK, Gupta MK. Anticonvulsant activity of ethanolic extract of *Solanum melongena* Linn. roots. *Int J Pharm Sci Res.* 2010; 1(12): 170-174.
11. Sayyah M, Mandgary A, Kamalinejad M. Evaluation of the anti-convulsant activity of the seed acetone extract of *Ferula gummosa* Boiss. against seizures induced by pentylenetetrazole and electroconvulsive shock in mice. *J Ethnopharmacol.* 2002; 82(2-3): 105-109.
12. Vohora SB, Kumar I, Khan MS. Effect of alkaloids of *Solanum melongena* on the central nervous system. *J Ethnopharmacol.* 1984; 11(3): 331-336.
13. Challal S, Buenafe OE, Queiroz EF, Maljevic S, Marcourt L, Bock M, *et al.* Zebrafish bioassay-guided microfractionation identifies anticonvulsant steroid glycosides from the Philippine medicinal plant *Solanum torvum*. *ACS Chem Neurosci.* 2014; 5(10): 993-1004.
14. Muceniec R, Saleniec K, Krigere L, Rumaks J, Dzirkale Z, Mezhapuke R, *et al.* Potato (*Solanum tuberosum*) juice exerts an anticonvulsant effect in mice through binding to GABA receptors. *Planta Medica.* 2008; 74(05): 491-496.
15. Tyagi N, Verma S, Ajeet K. Pharmacological Aspects of Solasodine Found in *Solanum xanthocarpum* and *khasianum*: A Review. *Am j pharm sci.* 2019; 7(1): 5-9.
16. Ohadoma SC, Osuala FN, Amazu LU, Iwuji SC. Comparative Analysis of the Anticonvulsant activity of *Crinum jagus* and *Solanum indicum* in Mice. *UK J Pharm Biosci.* 2017; 5(3): 31-34.

17. Irvine FR. Woody plants of Ghana. Kew Bulletin. 1961.
18. Azharuddin M, Imran P, Ayaz S. Anticonvulsant activity of *Lycopersicon esculentum* (Tomato) in maximum electroshock induced seizures in mice. *Ethnopharmacol.* 2013; 4: 1-4.
19. Kumar S, Singh RK, Singh AK, Gupta MK. Anticonvulsant activity of ethanolic extract of *Solanum melongena* Linn. roots. *Int J Pharm Sci Res.* 2010; 1(12): 170-174.
20. Gowda G, Das K, Bhosle V, Einstein JW, Mathai KB. Evaluation of anticonvulsant activity of ethanolic leaves extract of *Desmodium triflorum* in mice. *Rev Bras Farmacogn.* 2012; 22(3): 649-656.
21. Asuntha G, Prasannaraju Y, Prasad KV. Effect of ethanol extract of *Indigofera tinctoria* Linn (Fabaceae) on lithium/pilocarpine-induced status epilepticus and oxidative stress in wistar rats. *Trop J Pharm Res.* 2010; 9(2).
22. Gurunath HM, Chature V, Vajjinath D. Anticonvulsant activity of whole plant of *Solanum surattense* Burm against MES and PTZ induced seizures in rats. *Int Res J Pharm.* 2011; 2(1): 275-278.
23. McDonald RL, Kelly KM. Antiepileptic drugs: Mechanisms of action. *Epilepsia.* 1993; 34: S1-S8.
24. Manchishi S. Recent advances in antiepileptic herbal medicine. *Curr Neuropharmacol.* 2018; 16(1): 79-83.
25. Morais MG, Ferreira da Costa GA, Aleixo AA, Teixeira de Oliveira G, Ferreira Alves L, Duarte-Almeida JM, et al. Antioxidant, antibacterial and cytotoxic potential of the ripe fruits of *Solanum lycocarpum* A. St. Hil. (*Solanaceae*). *Nat Prod Res.* 2015; 29(5): 480-483.
26. Munari CC, de Oliveira PF, de Souza Lima IM, Martins SD, da Costa JD, Bastos JK, et al. Evaluation of cytotoxic, genotoxic and antigenotoxic potential of *Solanum lycocarpum* fruits glicoalkaloid extract in V79 cells. *Food Chem Toxicol.* 2012; 50(10): 3696-3701.
27. Essien EE, Ogunwande IA, Setzer WN, Ekundayo O. Chemical composition, antimicrobial, and cytotoxicity studies on *S. erianthum* and *S. macranthum* essential oils. *Pharm Biol.* 2012; 50(4): 474-480.
28. Kalebar VU, Hoskeri JH, Hiremath SV, Kalebar RV, Sonappanavar KL, Agadi BS, et al. Pharmacognostical and phytochemical analysis of *Solanum macranthum* (Dunal) Fruits. *J Pharmacogn Phytochem.* 2019; 8: 284-290.
29. Momin RK, Kadam VB. Determination of ash values of some medicinal plants of genus *Sesbania* of Marathwada region in Maharashtra. *J Phytol.* 2011; 3(12).
30. Hien TT, Tuan HA, Huong DP, Van Luong H, Mai NT, Tai BH, et al. Two new steroidal saponins from *Solanum procumbens*. *Nat Prod Commun.* 2018; 13(10): 193.
31. Chi VV. Dictionary of Vietnamese medicinal plants. Medical Publishing House. 2012; 288.
32. Dharman AK, Anilkumar M. Pharmacognostic studies in *Solanum capsicoides* all. *J Pharmacogn Phytochem.* 2018; 7(4): 397-410.
33. Akrouf A, El Jani H, Zammouri T, Mighri H, Neffati M. Phytochemical screening and mineral contents of annual plants growing wild in the southern of Tunisia. *J Phytol.* 2010; 2(1): 34-40.
34. Sivarajan VV, Balachandran I. Ayurvedic drugs and their plant sources. Oxford and IBH publishing. 1994.
35. Sabir SM, Rocha JB. Antioxidant and hepatoprotective activity of aqueous extract of *Solanum fastigiatum* (false "Jurubeba") against paracetamol-induced liver damage in mice. *J Ethnopharmacol.* 2008; 120(2): 226-232.
36. Pandithurai M, Murugesan S. Investigation on in vivo analgesic activity of methanol extract of marine brown alga *spatoglossum asperum Jagarth.* *Asian J Pharm Clin Res.* 2018; 11(11): 313.
37. Yadav R, Rathi M, Pednekar A, Rewachandani Y. A detailed review on *Solanaceae* family. *Eur J Pharm Med Res.* 2016; 3(1): 369-378.
38. Granica S, Czerwińska ME, Żyżyńska-Granica B, Kiss AK. Antioxidant and anti-inflammatory flavonol glucuronides from *Polygonum aviculare* L. *Fitoterapia.* 2013; 91: 180-188.
39. Kumar N, Prakash D, Kumar P. Wound healing activity of *Solanum xanthocarpum* Schrad. and Wendl. fruits. *Indian J Nat Prod Resour.* 2010; 1(4): 470-475.
40. Dixit VP, Gupta RS. Antispermatic/antiandrogenic properties of solasodine (C<sub>27</sub>H<sub>43</sub>O<sub>2</sub>N) obtained from *Solanum xanthocarpum* berries on the male genital tract of dog (*Canis-familiaris*). A Histophysiological approach. *Int J Andro.* 1982; 5(3): 295-307.
41. Roy A, Geetha RV. Evaluation of the Antibacterial Activity of the Ethanolic Extract of *Solanum verbascifolium*-An *In Vitro* Study. *Res J Pharm Technol.* 2013; 6(12): 1359-1361.
42. Sharma A, Parashar B, Vatsa E, Chandel S, Sharma S. Phytochemical screening and antihelminthic activity of *Cedrus deodara* (Roxb). *World J Pharm Pharm Sci.* 2016; 5: 1618-1628.
43. Sharma A, Parashar B, Vatsa E, Chandel S, Sharma S. A review on *morchella esculanta*: therapeutically potent plant. *World J Pharm Pharm Sci.* 2016; 5(9): 685-699.
44. Sharma A, Sharma S, Parashar B. *Mesua ferra* linn:-a review of the Indian Medical Herb. *Sys Rev Pharm.* 2017; 8(1): 19.
45. Adam G, Huong HT, Khoi NH. Solaverbascine-a new 22, 26-epimincholestane alkaloid from *Solanum verbascifolium*. *Phytochemistry.* 1980; 19(5): 1002-1003.
46. Koduru S, Grierson DS, Afolayan AJ. Antimicrobial Activity of *Solanum aculeastrum*. *Pharm Biol.* 2006; 44(4): 283-286.
47. Cipollini ML, Levey DJ. Antifungal activity of *Solanum* fruit glycoalkaloids: implications for frugivory and seed dispersal. *Ecology.* 1997; 78(3): 799-809.
48. Acosta-Quezada PG, Martínez-Laborde JB, Prohens J. Variation among tree tomato (*Solanum betaceum* Cav.) accessions from different cultivar groups: implications for conservation of genetic resources and breeding. *Genet Resour Crop Evol.* 2011; 58(6): 943-960.
49. Sihachakr D, Haicour R, Serraf I, Barrientos E, Herbretreau C, Ducreux G, et al. Electrofusion for the production of somatic hybrid plants of *Solanum melongena* L. and *Solanum khasianum* CB Clark. *Plant Sci.* 1988;57(3):215-23.
50. Zhu XH, Ikeda T, Nohara T. Studies on the constituents of solanaceous plants.(46). Steroidal glycosides from the fruits of *Solanum anguivi*. *Chem Pharm Bull.* 2000; 48(4): 568-570.
51. Walling LL. The myriad plant responses to herbivores. *J Plant Growth Regul.* 2000; 19(2): 195-216.

52. Anosike CA, Obidoa O, Ezeanyika LU. The anti-inflammatory activity of garden egg (*Solanum aethiopicum*) on egg albumin-induced oedema and granuloma tissue formation in rats. *Asian Pac J Trop Med.* 2012; 5(1): 62-66.
53. Shrivastava N, Patel T. Clerodendrum and healthcare: an overview. *Med Aromat Plant Sci Biotechnol.* 2007; 1(1): 142-150.
54. Prakash OM, Kumar A, Kumar P. Anticancer potential of plants and natural products. *Am J Pharmacol Sci.* 2013; 1(6): 104-115.
55. Rani AS, Kumar A. Designing of sulfanilamide/sulfacetamide derivatives as human topoisomerase II inhibitor: a docking approach. *Am J Pharmacol Sci.* 2014;2(2):42-6.
56. Sharma A, Sharma S, Sagar MK. Pharmacognostical study of *Dioscorea oppositifolia* bark. *Int J Pharm Res Dev.* 2019; 1(2): 25-27.
57. Ajeet K, Mishra A, Kumar A. Recent advances in development of sulfonamide derivatives and their pharmacological effects- A review. *Am J Pharm Sci.* 2015; 3(1): 18-24.