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A review of the phytochemistry and pharmacological activities of solanaceae family

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Abstract
This family is called as nightshades family which is a family of flowering plants. The solanaceae is a large varied family of trees, shrubs and herbs including 98 genera and some 2,700 species. Most members of the Solanaceae are erect or climbing, annual or perennial herbs, but shrubs are not uncommon and there are a few trees eight genera, Solanum, Lycianthes, Cestrum, Nolana, Physalis, Lycium, Nicotiana, Brunfelsia contain more than 60% of the species. Alkaloids are well known phytoconstituents for their diverse pharmacological properties and are found in all plant parts like roots, stems, leaves, flowers, fruits and seeds. Solanaceae family comprises of a number of plants with variety of natural products of medicinal significance mainly steroidal lactones, glycosides, alkaloids and flavonoids also present. Solanaceae have been reviewed by evaluating information on the Internet (using Google Scholar, CAB Abstracts, Elsevier, Cambridge University Press, JSTOR, Nature Publishing and Science online) and in libraries. Traditional medicinal uses of were recorded in the Ayurveda and Chinese pharmacopeia. The present review study covered chemical constituents and pharmacological properties. This has included therapeutic effects of the whole plant and its extracts, fractions and isolated compounds. Antimicrobial, anti-ulcerogenic, antiviral, anti-platelet aggregation, antioxidant, analgesic, anti-inflammatory, systolic blood-pressure modification, and cytotoxic activities have all been described.

Keywords: review, solanaceae, phytochemistry, pharmacological properties

Introduction
The solanaceae is a large varied family of trees, shrubs and herbs 98 genera and some 2,700 species. The name Solanaceae derives from the genus Solanum, "the nightshade plant". The etymology of the Latin word is unclear. The name may come from a perceived resemblance of certain solanaceous flowers to the sun and its rays. At least one species of Solanum is known as the "sunberry". Alternatively, the name could originate from the Latin verb solari, meaning "to soothe" [1] Solanaceae are known for possessing a diverse range of alkaloids. The molecules of these compounds have a characteristic bicyclic structure and include Scopolamine, Atropine and hyoscyamine. Therapeutically, these are the most powerful known anticholinergics in existence, meaning they inhibit the neurological signals transmitted by the endogenous neurotransmitter, acetylcholine. Symptoms of overdose may include mouth dryness, dilated pupils, urinary retention, hallucinations, convulsions, coma, and death [2].
Genus Solanum (Solanaceae) is rich in steroidal glycoalkloids, an important group of plant secondary metabolites. These compounds are used as starting material for the synthesis of steroidal drugs. In majority of solanaceous plants, solasodine occurs as aglycone part of glycoalkloids, which is a nitrogen analogue of sapogenins. Solasodine (C27 cholestane skeleton) can be readily converted to 16-dehydropregnenolone, a key intermediate in the synthesis of steroidal drugs such as progesterone and cortisone [3]. Solasodine is obtained by chemical or microbial hydrolysis of solamargine. It is a potential moiety to be used as a substitute for diosgenin in the semi-synthetic production of steroidal hormones in pharmaceuticals. Therefore, steroidal glycoalkaloid from Solanaceae plants have become increasingly important as the starting material for the production of steroidal hormones [4]. Various species of Solanum like Solanum khasianum (S. khasianum), Solanum lyratum (S. lyratum), Solanum xanthocarpum (S. xanthocarpum), Solanum nigrum (S. nigrum), Solanum gracile (S. gracile), Solanum tuberosum (S. tuberosum), Solanum laciniatum (S. laciniatum) are being extensively used for the treatment of various ailments like asthma, liver diseases and inflammation in the traditional system of medicine. Glycoalkaloids are nitrogen containing secondary metabolites found in plants belonging to Solanaceae family. More then 100 different types of glycoalkaloids have been isolated more than 350 Solanum species [5].
Plants of this family exhibit a wide variety of secondary metabolites with different biological activities, which render them very important from economic, agricultural, and pharmaceutical point of view [6, 7]..Most of these species are known to possess diverse medicinal uses in the Sudanese traditional medicine. Roots of Solanum incanum L. are used as antiasthmatic and for the treatment of dysentery and snake bite [8]. Fruits and leaves of S. nigrum L. are used to treat fever, diarrhoea, and eye diseases (Anonym, 1982). Leaves of S. schimperianum Hoch stare used to treat wounds. Roots and leaves of Withania somnifera and Physalis lagascae Roem. & Schult are used as tonic, diuretic and as poultice for swellings [10]. Plants of Solanaceae family are known to biosynthesize

secondary metabolites with interesting biological activity such as hydroxycinnamic acid amides (HCAAs), steroid alkaloids, polyphenols and glycoalkaloids, presumably to protect themselves from damage by phytopathogens [11, 12]. In contrast, some glycoalkaloids can also have beneficial effects from both ecological and human aspects having multidiscipline pharmacological applications as antibacterial, antioxidant, anti-inflammatory, anticancer, antiproliferative [13].

Phytochemistry

Solanum torvum has been extensively explored for its chemical constituents. Various parts (fruit, leaves and roots) are being in use for the isolation of a wide range of compounds. This plant species is a very good source of alkaloids, flavonoids, saponins, tannins, and glycosides [14]. According to Pérez-Amador *et al*. [15], the percentage composition of various compounds within this species is total alkaloid content (0.12%) total glycoalkaloids (0.038%), and glycosylated compounds derived from solasodine, namely solasonine (0.0043%) and solamargine (0.0028%) [16] Recorded polyphenolic compounds that included phenol, flavonoids and tannin. The concentrations of these compounds were recorded as 160.30, 104.36 and 65.91 mg/g, respectively.

Compounds isolated from aerial parts

Aerial parts of S. torvum are rich sources of steroid and saponins. [17] isolated four steroidal compounds solanolide 6-O-[α-l-rhamnopyranosyl- (1→3) - O-β-d-quinovo pyranoside], solanolide 6-O-[β-d-xylopyranosyl-(1 → 3)-O-β-dquinovopyranoside], yamogenin 3-O-[β-d-glucopyranosyl(1 → 6)-O-β-d-glucopyranoside] and solanolide 6-O- [α-lrhamnopyranosyl-(1 → 3)-O-β-d-quinovopyranoside] reported the isolation of two novel C-22 steroidal lactone saponins, namely solanolactosides A, B (1, 2) and two new spirostanol glycosides, namely torvosides M, N (3,4). Their structures were characterized as solanolide6-O-[α-Lrhamnopyranosyl-(1 -> 3)-O-β-D-quinovopyranoside], solanolide 6-O-[β-D-xylopyranosyl-(1 -> 3)-O-β-D-quinovopyranoside], yamogenin 3-O-[β-D-glucopyranosyl-(1 -> 6)-O-β-Dglucopyranoside] and neochlorogenin 3-O-[β-D-glucopyranosyl-(1 -> 6)-O-β-D-glucopyranoside] on the basis of spectroscopic analyses [18].

Compounds isolated from leaves

isolated torvanol A from the leaves [19] were able to isolate nine new compounds namely neochlorogenin 6-O-β-D-quinovopyranoside, neochlorogenin 6-O-β-D- xylopyranosyl-(1→3) -β- D- quinovopyranoside, neochlorogenin 6-O-α-L-rhamnopyranosyl(1→3)-β-D- quinovopyranoside, solagenin 6-O-β-D-quinovo pyranoside, solagenin 6-O-α-L-rhamnopyranosyl- (1→3) -β-Dquinovopyranoside, isoquercetin, rutin, kaempferol and quercetin. Furostanol glycoside 26-O-beta-glucosidase is an important part of methanolic extracts of the leaves. [19] isolated some non-alkaloidal compounds namely, 3, 4-trimethyl triacontane, octacosanyltriacontanoate and 5-hexatriacontanone by spectral data and chemical studies. Triacontanol, 3tritriacontanone, tetratriacontanoic acid, sitosterol, stigmasterol and campesterol have also been isolated and identified.

Compounds isolated from roots

The root of Solanum torvum is source of steroidal glycosides such astorvosides A-G. They were structurally characterized as (25S)-26-O-fl-~-glucopyranosyl)-5c~-furostan- 3fl, 6a, 22sc, 26-tetraol 6-O-[a-L-rhamnopyranosyl-(1 ---> 3)-fl-Dquinovopyuranoside], (25S)-26-O-(fl-D-glucopyranosyl)-22cemethoxy-Sa-furostan-3fl,6ce,26-triol 6- O- [fl-D-xylopyranosyl- (1---> 3) -/3- D-quinovopyranoside], neosolaspigenin 6-O- [a-Lrhamnopyranosy l-(1--> 3)-fl-D-quinovopyranoside], neosolaspigenin 6-O-[fl-Dxylopyranosyl-(1-->3)-/3-D-quinovopyr anoside], (25S)-26- O-(fl-D-glucopyranosyl)-6a,26-dihydroxy-22amethoxy-Sa-furostan-3-one 6-O-(fl-D-quinovopyra noside), (25S) 26-O-(fl-D-glucopyranosyl)-6a,26-dihydroxy-22a methoxy- Scefurostan-3-one 6-O-[/3-D-xylopyranosyl-(1-->3)-/3-D-quinovo pyranoside], and (25S)-26-hydroxy-22a- methoxy-5a-furostan-3one 26-O-(fl-D-glucopyranoside). The structures of various compounds isolated from S. torvumare.

Table 1: Different genus with representing plant species of Solanaceae family [20-26]

Sr No	Genus	Species	Family	Part used	Chemical constituents	Medicinal Uses
1	Acnistus	Acnistus arborescenes	Solanaceae	Extracts of plant	Withaferin A and withacnistin	Anti–tumor agent, diuretic
2	Atropa	Atropa belladonna	Solanaceae	Roots	Hyoscyamine, atropine, starch, atrosine, scopolamine	Narcotic, diuretic, sedative, antispasmodic, mydriatic.
3	Browallia	Browallia speciosa	Solanaceae	Whole plant	Withanolides	Garden ornamental
4	Brugmansia	Brugmansia arborea	Solanaceae	Flowers	Tropane alkaloids, hyoscyamine, atropine and scopolamine	Spasmolytic, anti-asthmatic, anticholinergic, narcotic and anesthetic
5	Capsicum	Capsicum annum	Solanaceae	Fruits and leaves	Capsaicin, capsanthin, carotene, thiamine and ascorbic acid	Carminative, Appetizer, stomachic, counter irritant the treatment of rheumatism, lumbago and neuralgia
6	Cestrum	Cestrum nocturnum	Solanaceae	Leaves and flowers	sapogenin steroids yuccagenine. nicotine. anthraquinones, cardiac glycosides, carbohydrates, flavonoids, phenol, tannins and terpenoids	Antiepilepsy
7	Cyphomandra	Cyphomandra betacea	Solanaceae	Fruits	Flavonoids, anthocyanins, phenols, carotenoids, withanolides	Anticholinestera se Antioxidative
8	Datura	Datura metel	Solanaceae	Plant	hyoscine(scopolamine)	Parasympatholyt ic Anticholinergic and CNS depressant. In cerebral excitement, asthma

						and cough.
9	Dunalia	Dunalia spinosa	Solanaceae	Fruits, flowers and leaves	(E)-aurone rutinoside (dunaurone), lupeol, betasitosterol,scopoletin, quercetin and withaferin A	Medicine for toothaches, Antimicrobial and antioxidant
10	Fabiana	Fabiana imbricata	Solanaceae	Leaves and flowers	Camphor oil, the coumarin scopoletin and alkaloids	To treat diseases of the kidneys and urinary tract. Also as a potent diuretic and as an antiseptic
11	Hyoscyamus	Hyoscyamus niger	Solanaceae	Plant	Tropane alkaloids hyoscyamine, scopolamine, and atropine. Non-alkaloids constituents such as withanolide steroids, lignanamides, tyramine derivative, steroidal saponins, glycosides, coumarinolignan, and flavonoids	Analgesic, antiinflammatory, antipyretic, anticonvulsant, spasmolytic, antidiarrhoeal, antisecretory, bronchodilatory, urinary bladder relaxant, hypotensive, cardiodepressant, vasodilator, antitumor, and feeding deterrent properties.
12	Iochroma	Iochroma cyaneum	Solanaceae	All parts	Alkaloids and hallucinogens	Toxic if ingested any way. Grown as an ornamental
13	Jaborosa	Jaborosa integrifolia	Solanaceae	Whole plant	Steroid-derived compounds called withanolides.	Antifeedant effects
14	Jaltomata	Jaltomata procumbens	Solanaceae	Fruits and roots	Alkaloids	The fruits are reportedly edible and have been used to make jams. Root used as a medicinal tea (boiled) to treat stomach ailment
15	Lycium	Lycium barbarum	Solanaceae	Whole berry, juice	Beta-sitosterol, betaine, beta carotene, niacin, pyridoxine, acorbic acid	Treatment for sore eyes and inflammation. To treat conditions such as male infertility, promotion of weight loss and general longevity
16	Lycopersicon	Lycopersicon esculentum	Solanaceae	Fruits and pulp	All-trans-lycopene, cislycopene, phytoene, phytofluene, sterols, tocopherols, carotenoids	For liver health, regular use of tomato reduced risk of contracting cancer diseases.
17	Nicandra	Nicandra physalodes	Solanaceae	Whole plant	Withanolides such as Nicandrenone, pyrrolidine alkaloids (the roots contain 0.1% Hygrine) and some calystegines	As an ornamental plant. Have insect repellent properties
18	Nicotiana	Nicotiana tobacum	Solanaceae	Leaves, flow] ers and seeds	Piperidine type of alkaloids, among which the most prominent is nicotine. The other alkaloids are nornicotine anabasine.	Stimulant effects on heart and nervous system, powerful quick acting poison. Rectified tobacco seed oil is used as edible oil.
19	Petunia	Petunia axillaris	Solanaceae	Flowers	Tropane alkaloids	For ornamental purposes. Flowers extract given to the horses for the remedy of skin problem mostly
20	Physalis	Physalis minima	Solanaceae	Leaves, fruits and flowers	Withanolides (Hyoscyamine, scopolamine.	To treat stomachache and constipation, asperient, diuretic
21	Solanum	Solanum khasianum	Solanaceae	Berries and seeds	Solasodine, solakhasianin	As precursor for steroidal synthesis, as sex hormones, oral contraceptives
22	Vestia	Vestia foetida	Solanaceae	Whole plant	Tropane alkaloids	For ornamental purposes.

Pharmacological activities

All over the world scientific research is getting momentum to evaluate the pharmacological activities, side effects and medicinal uses of solanaceae family belong drug against different diseases. On the basis of various experimental and clinical researches, the following pharmacological activities or medicinal properties of have been reported.

Anti-oxidant activity

Phenolic compounds extracted from different parts of S. torvum exhibited anti-oxidant activity [27]. Chloroform, acetone, and methanol extracts of leaves and fruit were explored for their in-vitro antioxidant activity using ferric reducing antioxidant power, 2,2- diphenyl-1-picryl-hydrazyl (DPPH), ABTS•+, iron chelation, and anti-hemolytic activity. Significantly higher concentrations of phenol were recorded for chloroform extracts (Table 3). Of note was the fact that the in-vitro antioxidant activity was shown to be highly dependent on total phenolic content ($p<0.01$). The DPPH and 2, 2' azinobis (3- ethyl benzothiozoline -6- sulfonic acid) diammonium salt (ABTS) cation radical scavenging activities were well proved with the ferric reducing antioxidant capacity of the extracts. However, peroxide clearing studies indicated that aqueous extracts of S. torvum fruit had anti-oxidant activities [28]. This species also exhibited some percentage of antioxidant activity and DNA-repair capability on oxidative DNA damage caused by free radicals [29].

Antiviral activity

Herpes simplex virus (HSV) is responsible for human infections in the orofacial region (HSV-1) and in the genital region (HSV-2) (Travis, 2002). Type 1 (HSV-1) of Herpes simplex virus was tested against methanolic fruit extracts of S. torvum. HSV-1 was maintained in the Vero cell line (kidney fibroblast of an African green monkey), which was cultured in Eagle's minimum essential medium (MEM) with addition of heat-inactivated fetal bovine serum (FBS) (10%) and antibiotics. The test samples were put into wells of a microtiter plate at final concentrations ranging from 20 to 50 mg/ml. The viral HSV-1 (30 PFU) was added into the 96-well

plate, followed by plating of Vero cells (1105 cells/ml); the final volume was 200 ml. After incubation at 37 ºC for 72 h, under 5% CO2 atmosphere, cells were fixed and stained, and optical density measured at 510 nm. Under these screening conditions, the reference compound, Acyclovir, typically exhibited an IC50 of 2-5 mg/ml for HSV-1. Torvanol A, torvoside H, and solasonine also inhibited the expression of herpes simplex virus-1 (HSV-1), and the activity may relate to the entering of glycosides into the viral capsules [30].

Antimicrobial activity

Methanolic extracts of sun-dried fruit of S. torvum were found to have effective antimicrobial activity against human and animal clinical isolates. Biochemical analyses of methanolic extracts indicate the presence of alkaloids, flavonoids, saponins, tannins, and glycosides [31] used methanolic extracts against bacteria (Actinomyce spyogenes, Bacillus subtilis, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa,, Salmonella typhimuriumd, Staphylococcus aureus, Streptococcus pyogenes) fungi (Aspergillus Niger, Candida albicans) isolated from the clinical samples of humans and animals to evaluate antimicrobial activity by the disc diffusion method. The study concluded that methanolic extracts have significant growth-inhibiting activity against bacteria commonly associated with pyogenic infections (Fig 2). The minimum concentration that inhibits bacterial and fungal activity was 0.3125mg/ml and 1.25mg/ml respectively. However, growth of Bacillus cereus, Bacillus subtilis, Candida albicans, Escherichia coli, Pseudomonas aeruginosa and Staphylococcus aureus was monitored in the presence of methanolic leaf extracts of S. torvum by [32]; S. torvum leaf extracts showed the highest activity against B. cereus. Methanolic extracts from fruit and leaves have been described as potentially good sources of antimicrobial agents [33].

Anti-ulcerogenic activity

Ulcers are basically discontinuities of the skin or break in the skin, or can be on inner layers of the skin that stops it from continuing its normal protective functions. This breakdown of the skin can occur at any place in the body leading to various types of ulcer including peptic, corneal, venous and genital ulcers. S. torvum is reported to have anti -ulcerogenic activity. [34] Investigated anti-ulcerogenic properties of aqueous and methanolic extracts from leaves of S. torvum in rats. They induced gastric ulceration by HCl/ethanol, indomethacin, pylorus ligation, and stress. Various doses of aqueous and methanolic extracts at the rate of 250, 500 and 750 mg/kg were tested. Methanolic extracts were fractionated into seven different fractions (A–G) through silica gel column chromatography. These fractions were tested orally at the dose of 100 mg/kg against HCl/ethanolinduced ulceration. Methanolic extracts at the dose of 750 mg/kg produced 98.12, 99.16, 98.70 and 96.03% inhibition when gastric ulcerations were induced by HCl/ethanol, indomethacin, pylorus ligation and stress, respectively (Table 2). Aqueous extracts at the same dose produced 96.55, 96.86, 98.63 and 98.63% inhibition on ulcerations induced respectively by HCl/ethanol, indomethacin, pylorus ligation and stress. All the fractions of the methanolic extracts significantly inhibited ulcer formation. Fractions that contained flavonoids and triterpenes were the most active and exhibited an inhibitory percentage of 84.74 (Table 2). From these results it was obvious that aqueous and methanolic extractions promote production of mucus and reduced gastric-acid secretion. Therefore, although it has effective control of gastric ulceration, S. torvum extracts need to be explored for their effectiveness against peptic, corneal, venous and genital ulcers.

Effect on Systolic Blood Pressure

High blood pressure is generally considered to be induced by a diet rich in fructose. Ethanolic extracts of S. torvum act by preventing and reversing the development of hyperinsulinemia to control the rise in systolic blood pressure [35]. The Mohan group investigated the effect of S. torvum on blood pressure and metabolic alterations in the fructose hypertension condition generated in rats. The hypertensive conditions were induced in male Wistar rats (150–200 g) by a high-fructose diet (fructose 10%, w/v) ad libitum for six weeks. For measurements of systolic blood pressure, non-invasive (indirect) and invasive (direct) methods were used. Ethanolic extractions of S. torvum were demonstrated to be effective in preventing high systolic blood pressure.

Anti-platelet aggregation activity

Haemostatic properties of S. torvum impart to it an antiplatelet aggregation effect [36]. The anti-platelet aggregation activity of aqueous extracts of S. torvum (AES) was evaluated *in vitro* on platelet aggregation initiated by thrombin and ADP. Results showed that anti-platelet aggregation activity is concentration dependent. At 2 mg/ml, AES reduced the amplitude of the aggregation signal induced by thrombin from 9.27 cm to 4.03 cm, representing an inhibition of 55.27%. This effect was significantly higher than that of the lower concentrations 0.5 and 1 mg/ml. Similarly, AES also exerted significant concentration-dependent inhibitory effects on aggregation triggered by ADP. The effect in terms of inhibitory percentage was 31.63%, 47.07%and 56.40% at concentrations of 0.5, 1 and 2 mg/ml respectively.

Analgesic and Anti-inflammatory Effects

S. torvum is amongst the important medicinal species used as analgesic and anti-inflammatory agents in different traditional medicinal systems [37]. The analgesic and anti-inflammatory activity of S. torvum was evaluated for chemical and mechanical stimuli. Abdominal writhing and paw oedema were induced in rats by using 1% acetic acid (1 ml/100 g body weight) and 0.05 ml of a solution of 1% sterile carrageenan in saline, respectively. For the treatment of 1% acetic acid (1 ml/100 g body weight) induced abdominal writhing, aqueous extracts of S. torvum were utilized along with three other painkillers. The aqueous leaf extracts of S. torvum significantly inhibited the pain (Fig.5). Paw oedema induced by the 0.05 ml of a solution of 1% sterile carrageenan was treated by indomethacin (10mg/kg), S. torvum (300mg/kg) and S. torvum (600mg/kg). Extracts of S. torvum (300mg/kg) and S. torvum (600mg/kg) significantly inhibited the paw oedema although the lower dose 300mg/kg worked more effectively in a shorter time period compared with the high

dose of 600mg/kg (Table 4).

Cytotoxic effect

Among the chemical constituents of S. torvum, steroidal lactone saponins and spirostanol glycosides are important for cytotoxicity [38] Isolated new steroidal lactone saponins and spirostanol glycosides from ethanolic extracts of aerial parts. All the four compounds (Solanolactoside A, Solanolactoside B, Trovoside M and Trovoside N) were evaluated for cytotoxic effects *in vitro* against a panel of human cancer cell lines: MGC-803 (Human gastric cancer cell line), HepG2 (Human hepatocellular liver carcinoma cell line), A549 (human lung adenocarcinoma cell line) and MCF-7 (Human breast adenocarcinoma cell line). Cis-diamminedichloroplatinum (CDDP, Sigma) was used as a positive control. The dose concentration was maintained at 5mg/ml. The effects of two compounds (Solanolactosdie A, Solanolactoside B) were not significant; however, the other two compounds Torvoside M and Torvoside N had significant cytotoxicity.

Effects on smooth muscles

Solasonine inhibited cat isolated heart contraction and contraction of the isolated guinea pig ileum and cat trachea induced by acetylcholine. It also had a contracting effect on isolated rabbit aural blood vessels, and could induce contraction and spontaneous activities of isolated rat uterus [39].

Anticancer activities

Natural molecules structurally close to diosgenin including solasodine have been tested for their biological activities on human 1547 osteosarcoma cells [40]. In an Another study, solasodine has been utilized to determine the role of carbohydrate moiety in the mechanism of apoptosis. The C3 side chain of solasodine contains 4'Rha-Glc-Rha2', 4'RhaGlc and H, respectively [41]. In another study, solasodine showed significant cytotoxic effects against human PLC/ PRF/5 cells *in vitro* [42].

Effect of solasodine on CNS

Effect of solasodine to promote neurogenesis *in vitro* and *in vivo* in mouse embryonic terato carcinoma P19 cells was investigated. *In vivo*, a 2-week infusion of solasodine into the left ventricle of the rat brain followed by a 3-week washout resulted in a significant increase in bromodeoxyuridine uptake by cells of the ependymal layer, sub ventricular zone, and cortex that co-localized with double cortin immunostaining, demonstrating the proliferative and differentiating properties of solasodine on neuronal progenitors [43]. An anticonvulsant and CNS depressant effect of solasodine isolated from S. sisymbriifolium using several experimental models was investigated. The results showed that intraperitoneal injection of solasodine significantly delayed latency of hind limb tonic extensor (HLTE) phase in the PCT-induced convulsions. In the MES model, solasodine significantly reduced duration of HLTE in a dose-dependent manner. Prior treatment of solasodine significantly potentiated thiopental-provoked sleep in a dose-dependent manner [44].

Conclusions

Medicinally, as well as in terms of poisoning and psychotropic effects, members of Solanaceae have been prized for their alkaloid content and used throughout history. Important drug plants include deadly nightshade or belladonna (Atropa belladonna), jimson weed (Datura stramonium), henbane (Hyoscyamus Niger), and tobacco (Nicotiana tabacum). Mandrake, the common name for members of the plant genus Mandragora, contains deliriant hallucinogenic tropane alkaloids such as hyoscyamine and the roots sometimes contain bifurcations causing them to resemble human, leading to this plant being used in magic rituals and neopagan religions such as Wicca. Due to presence of diverse phytoconstituents, many medicinal plants have belong to Solanaceae family of drug excellent pharmacological activity such as Anti-oxidant, Antiviral, Antimicrobial, Anti-ulcerogenic, Anti-platelet aggregation, Anticancer, Analgesic and Anti-inflammatory Effects, Effect on Systolic Blood Pressure, Effects on smooth muscles and Effect of solasodine on CNS and also used as dietary supplements. Therefore, there is a need of more well documented clinical trials and more laboratory work to justify their pharmacological actions and toxicity for safe and effective treatment. Pharmacologically, these are the most powerful known anticholinergics acting on parasympathetic nervous system. But, though they are therapeutically parasymapathomimetics; overdose may include various adverse effects like mouth dryness, dilated pupils, ataxia, urinary retention, hallucinations, convulsions, coma and death.

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References

1. Griffin W, Lin G. Chemotaxonomy and geographical distribution of tropane alkaloids. Photochemistry. 2002; 53(6):623-37.
2. Dr Ansari SH. Essentials of Pharmacognosy, 1st edition. 2005; 06:448-456.
3. Pawar Pankaj K, Borse Tushar P, Pinjari Rizwan Z, Maheshwari Vijay L. A simple technique for rapid quantitative determination of solasodine from cultured hairy roots of Solanum surattense. J Herb Med Toxicol. 2008; 2(1):7-10.
4. Solouki M, Hoshyar H, Ramroudi M, Tavassoli A. Comparison and evaluation of steroid alkaloid solasodine on *in vivo* and *in vitro* cultures of Solanum Surat tense Burm L. Afr J Microbiol Res. 2011; 5(23):3981-3985.
5. Sun F, Li S, He D, Cao G, Ni X, Tai G, *et al*. Effects of glycoalkaloids from Solanum plants on cucumber root growth. Photochemistry. 2010; 71(13):1534-1538.
6. Zadra M, Piana M, Brum FT, Boligon AA, Freitas BR Antioxidant activity and phytochemical composition of the leaves of Solanum guaraniticum A. St.-Hil. Molecules. 2012; 17:12560-12574.
7. Oliveira RCM, Monteiro FS, Silva JLV, Ribeiro LAA, Santos RF, Nascimento RJB, *et al*. Methanol andethyl acetate extracts from Solanum megalonyx Sendtn.

(Solanaceae) present spasmolytic activity in guinea-pigileum: A comparative study. Revista Brasileira de Farmacognosia. 2006; 16:146-151.
8. Elghazali GB. Medicinal Plants of the Sudan: Part 1. Medicinal Plants of Erkowit. Medicinal and Aromatic Plants Research Institute. National Center for Research, Khartoum.
9. Anonym, 1982. Medicinal and aromatic plants of the Sudan. Arrow P. press, 1986.
10. Elghazali GB, Bari EA, Bashir AK, Salih AM. Medicinal Plants of the Sudan Part 2. Medicinal Plants of Eastern Nuba Mountains. Medicinal and Aromatic Plants Research Institute. National Center for Research, Khartoum, 1987.
11. Rahman, Au, Choudhary MI. Chemistry and biology of steroidal alkaloids. In: Geoffrey, A.C. (Ed.), The Alkaloids: Chemistry and Biology. Academic Press. 1998; 50; 61-108.
12. Macoy DM, Kim WY, Lee SY, Kim MG. Biosynthesis, physiology, and functions of hydroxyl cinnamic acid amides in plants. Plant Biotechnology Reports. 2015; 9:269-278.
13. Taveira M, Sousa C, Valentão P, Ferreres F, Teixeira JP, Andrade PB, *et al*. Neuroprotective effect of steroidal alkaloids on glutamate induce dtoxicity by preserving mitochondrial membrane potential and reducing oxidative stress. Journal of Steroid Biochemistry and Molecular Biology. 2014; 140:106-115.
14. Chah KF, Muko KN, Oboegbulem SI. Antimicrobial activity of methanolic extract of Solanum torvum fruit. Fitoterapia. 2000; 71:187-189.
15. Pérez-Amador1 MC, Muñoz Ocotero1 V, García JM, Castañeda1 AR, González E. Alkaloids in Solanum torvumSw (Solanaceae). International experimental Botany. 2007; 76:39-45.
16. Kusirisin W, Jaikang C, Chaiyasut C, Narongchai P. Effect of polyphenolic compounds from Solanum torvum on plasma lipid peroxidation, superoxide anion and cytochrome P450 2E1 in human liver microsomes. Medicinal Chemistry. 2009; 5:583-588.
17. Lu Y, Jianguang L, Xuefeng H, Lingyi K. Four new steroidal glycosides from Solanum torvum and their cytotoxic activities. Steroids. 2009; 7(4):95-101.
18. Yuan-Yuan LU, Jian-Guang LUO, Ling-Y. Chemical constituents from Solanum torvum. Chinese Journal of Natural Medicines. 2011; 9(1):30-32.
19. Mahmood U, Shukla YN, Thakur RS. Non-alkaloidal constituents from Solanum torvum leaves. Phytochemistry. 1983; 22 (1):167-170.
20. Kokate CK. Pharmacognosy. Nirali Prakash an fourty seventh edition, 2012.
21. Aldunate Ethanobotany of pre-altiplanic community in the Andes of northen chile. Economic botany. 1983; 37(1):120-135.
22. Smith S, Baum D. Phylogenetics of florally diverse Andean clade iochrominae (solanaceae). American journal of botany. 2006; 93(8):1140-1153.
23. Li J. Chemical & pharmacological researches on hyoscyamus Niger. Chinese herbal medicines. 2011; 3(2):117-126.
24. Smith SD, Baum DA. Phylogenetics of the Florally Diverse Andean Clade Iochrominae (Solanaceae). American Journal of Botany. 8:1140-1153.
25. Watson L, Dallwitz M. The families of flowering plants: descriptions, illusitrations, identification & information Retrieval, 2014.
26. Gupta AK. Ethano- medicinal use of plants belonging to Families Fabaceae & solanaceae.
27. Loganayaki N, Perumal S, Sellamuthu M. Antioxidant activity of two traditional Indian vegetables: SolanumnigrumL and Solanum torvum L. Food Sci. Biotechnol. 2010; 19(1):121-127.
28. Re R, Pellegrini N, Proteggente A, Pannala A, Yang M, Rice-Evans C, *et al*. Antioxidant activity applying an improved ABTS radical cation decolourization assay. Free Radical Bio. Med. 1999; 26:1231-1237.
29. Abas F, Kajis NH, Israf DA, Khozirah S, Umikalson Y. Antioxidant and nitric oxide activities of selected Malay traditional vegetables. Food Chem. 2006; 95:566-573.
30. Arthan D, Svasti J, Kittakoop P, Pittayakhachonwut D, Tanticharoen M, Thebtaranonth Y, *et al*. Antiviral is flavonoid sulphate and steroidal glycosides from the fruits of Solanum torvum. Photochemistry. 2002; 59:459-463.
31. Chah KF, Muko KN, Oboegbulem SI. Antimicrobial activity of methanolic extract of Solanum torvumfruit. Fitoterapia. 2000; 71:187-189.
32. Wiart C, Mogana S, Khalifah S, Mahan M, Ismail S, Buckle M, Narayana AK, *et al*. Antimicrobial screening of plants used for traditional medicine in the state of Perak, Peninsular Malaysia. Fitoterapia. 2004; 75 (1): 68-73.
33. David LL, Alice MC, Charles DH, Barbara M, Claus M, Passreiter JC, *et al*. Antimicrobial properties of Honduran medicinal plants. Journal of Ethnopharmacology 1998; 63(1):253-263.
34. Nguelefacka TB, Catherine BF, Gilber A, Pierre W, Simplice T, Albert DA, *et al*. Anti ulcerogenic properties of the aqueous and methanol extracts from the leaves of Solanum torvum Swartz (Solanaceae) in rats. Journal of Ethno pharmacology. 2008; 119:135-140.
35. Mohan M, Bhagat SJ Sanjay. Effect of Solanum torvum on blood pressure and metabolic alterations in fructose hypertensive rats. Journal of Ethno pharmacology. 2009; 126(1):86-89.
36. Henty EE. Weeds of New Guinea and their control. Department of Forests, Division of Botany. Botany Bulletin. Lae, Papua New Guinea. 1973; 7:149-151.
37. Ndebia EJ, Kinging R, Nkeh-Chungag Anye BN. Analgesic and anti-inflammatory properties of aqueous extract from the leaves of Solanum torvum. (Solanaceae). Afr. J. Trad. Complim. Altern. Med. 2007; 42:240-244.
38. Lu Y, Jianguang L, Xuefeng H, Lingyi K. Four new steroidal glycosides from Solanum torvum and their cytotoxic activities. Steroids. 2009; 7(4):95-101.
39. Basu A, Lahiri SC. Some pharmacological actions of solasonine. Ind J of Exp Bio. 1997; 15(4): 285-289.
40. Trouillas P, Corbière C, Liagre B, Duroux JL, Beneytout JL. Structure-function relationship for saponin effects on

cell cycle arrest and apoptosis in the human 1547 osteosarcoma cells: a molecular modelling approach of natural molecules structurally close to diosgenin. Bioorg Med Chem. 2005; 13(4):1141-1149.
41. Chang LC, Tsai TR, Wang JJ, Lin CN, Kuo KW. The rhamnose moiety of solamargine plays a crucial role in triggering cell death by apoptosis. Biochem Biophys Res Commun. 1998; 242(1):21-25.
42. Lin CN, Lu CM, Cheng MK, Gan KH, Won SJ. The cytotoxic principles of Solanum incanum. J Nat Prod. 1990; 53(2):513516.
43. Lecanu L, Hashim AI, McCourty A, Giscos-Douriez I, Dinca I, Yao W, *et al*. The naturally occurring steroid solasodine induces neurogenesis *in vitro* and *in vivo*. Neuroscience. 2011; 183: 251-264.
44. 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.
45. Degebasa AC. Assessment of plant growth regulators and chemicals for potato (Solanum tuberosum L.) dormancy breaking and subsequent yield in central highlands of Ethiopia. Int. J Hortic. Food. Sci 2020;2(1):10-20. DOI: 10.33545/26631067.2020.v2.i1a.32