www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(10): 692-698
© 2018 TPI
www.thepharmajournal.com
Received: 09-08-2018
Accepted: 13-09-2018

Goutam Mukhopadhyay
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Shramana Sarkar
Department of Pharmacy, Calcutta Institute of Pharmaceutical Technology & AHS, Uluberia, Howrah, West Bengal, India

Snehashis Kundu
Department of Pharmacy, Calcutta Institute of Pharmaceutical Technology & AHS, Uluberia, Howrah, West Bengal, India

Shymodip Kundu
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Pintu Sarkar
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Srotoswini Sarkar
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Riyanka Sengupta
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Chandan Kumar
Department of Pharmacy, Calcutta Institute of Pharmaceutical Technology & AHS, Uluberia, Howrah, West Bengal, India

Sanchita Mitra
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Dixita Jain
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Akshay Sodani
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Debasmita Manna
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Trique Nazar
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Correspondence
Goutam Mukhopadhyay
Department of Pharmacy, BCDA College of Pharmacy and Technology, Kolkata, West Bengal, India

Ethno-pharmacological activity of *Solanum nigrum*

Goutam Mukhopadhyay, Shramana Sarkar, Snehashis Kundu, Shymodip Kundu, Pintu Sarkar, Srotoswini Sarkar, Riyanka Sengupta, Chandan Kumar, Sanchita Mitra, Dixita Jain, Akshay Sodani, Debasmita Manna and Trique Nazar

Abstract
Natural products from plants are rich sources used for treating a number of diseases. In this modern era, the knowledge and experience of the usage of herbs are being blend with advanced technology to develop a safe and elegant herbal product. Hence herbal medicines are the staple of medical treatment in many developing countries. Ethno-medicines deal with the use of several health promoting cultural practices and the use of natural products for the prevention and treatment of diseases, as well as for the maintenance of optimal physical and emotional health. *Solanum nigrum* ("black nightshade") plays an important role in traditional medicines which is a widely used in oriental medicine where it is considered to be an anti-tumorigenic, antioxidant, anti-inflammatory, hepatoprotective, diuretic, and antipyretic agent. The juice of the plant used on ulcers and other skin diseases & the fruits are used as a laxative, appetite stimulant, and for treating asthma and "excessive thirst". It is also confirmed through several experiments that the plant inhibits growth of cervical carcinoma. Upon the administration of crude ethanol extract of *S. nigrum* for longer duration on protein content of liver and kidney at the level of 250mg/kg b. wt. for three, five and seven days respectively revealed a significant increase in protein contents of kidney and liver. Due to having many therapeutically active properties, it creates an interest for its extraction. In this article we will highlight on the ethno pharmacological relevance, extraction procedure, phytochemistry, pharmacological activities, phytochemical screening of *Solanum nigrum*.

Keywords: diuretic, ethno medicine, hepatoprotective activity, phytochemistry, *Solanum nigrum*

1. Introduction
Solanum nigrum is 25-100 cm tall, erect annual herb, pubescent with simple hairs, belonging to family of Solanaceae. Stems are often angular; sparsely-pubescent.it is a species in the genus called "Solanum" is a very large group of about 1400 species found throughout in the temperate and tropical regions of the world like *Solanum aviculare* (Europe, New Zealand), *S. dulcamara* (Europe), *S. incanum* (Africa), *S. khasianum* (Indian subcontinent), *S. laciniatum* (New Zealand, Australia), *S. nigrum* (cosmopolite), *S. pseudocapsicum* (an ornamental, cultivated in greenhouses), *S. tuberosum* (potatoes) and *S. melongena* (eggplant, aubergine). It is also known as "Black nightshade". The fruits are dull black, about 8-10 mm in diameter. The leaves are ovate to heart shaped & 4-10cm long and 3-7 cm wide, pubescent, coarsely dentate, The bases are cuneate and the apex is obtuse with wavy or large-toothed edges& petiole is 1 to 3 cm (0.5 to 1 in) long with a winged upper portion. Inflorescences are extra axillaries umbels, the calyx cup-shaped, the corolla is white, the lobes ovate-oblong, pubescent abaxially, ciliate spreading. Filaments are 1-1.5 mm long; anthers are 2.5- 3.5 mm long. The flowers have petals greenish to whitish, recurved when aged and surround prominent bright yellow anthers. The berry is mostly 6 to 8 mm (0.3 to 0.8 in) diameter, dull black or purple-black.

Table 1: Measurements of different parts of *Solanum nigrum.*

Inflorescences	Peduncle	Pedicels	Calyx	Lobes	Corolla stellate
4-12 flowered	10-20 mm long	10 mm long	1.5-2.2 mm long	1 mm long	8-12 mm diam

The toxicity of S. nigrum varies widely depending on the variety, and poisonous plant experts advise to avoid eating the berries unless they are a known edible strain [1]. Two varieties of Solanum nigrum found one is black colour fruit and second one is reddish brown colour fruit. In both varieties, black colour fruit are toxic [2]. The botanical taxonomy of this plant is given below-

Scientific classification vernacular name

Kingdom:	Plantae
Sanskrit:	Dhvansamaci
Division:	Tracheophyta
English:	Garden night shade
Class:	Magnoliopsida
Hindi:	Makoya
Order:	Solanales
Bengali:	Gudakamai
Family:	Solanaceae
Punjabi:	Mako
Genus:	Solanum
Telugu:	Kamanchi
Species:	*Solanum nigrum* (Linn).
Tamil:	Manarthakkali.

Fig 1: *Solanum nigrum* plant.

Fig 2: *Solanum nigrum* berries

Its leaves, stems and roots are used as a poultice or to treat leucoderma and wounds while extracts of this plant are claimed to possess anti-inflammatory, antispasmodics and vasodilator. The fruits of *S. nigrum* have been reported to play an adjuvant role in the hepatoprotective property. Inhibition of lipid per-oxidation and free radical scavenging activity has been suggested as a possible mechanism of action [3].

It plays a major role in secretion and excretions. The plant is also used in the Oriental systems of medicine for various purposes as an antitumorigenic, antioxidant [4], anti-inflammatory [5], hepatoprotective [6], diuretic [5], and antipyretic agent [5]. *S. nigrum* has been extensively used traditionally to treat various ailments such as hepatitis, pain, inflammation and fever [4-5]. Extracts of *Solanum nigrum* suppressed the oxidant mediated DNA-sugar damage and the plant exerted cytoprotection against gentamicin-induced toxicity on Vero cells and anti-neoplastic activity against Sarcoma 180 in mice. The ethanol extract of the fruit of *Solanum nigrum* was studied for its neuropharmacological properties as well as remarkable hepatoprotective effect against CCl_4 induced oxidative damage on liver cells on experimental animals whereas water extract of *Solanum nigrum* contains several antioxidants, such as gallic acid, PCA, catechin, caffeic acid, epicatechin, rutin and narigenin and possesses strong antioxidative activity in vitro. Decoction of the plant depresses the CNS and reflexes of the spinal cord. Another most important property of *Solanum nigrum* is its anti-cancerous property [7].

2. Ethnopharmacological relevance

All the parts of the plant are very essential, as all the parts as seeds, leaves, flowers, possess medicinal value. The *S. nigrum* has been used as anti-septic, anti-inflammatory, expectorant, cardio-tonic, digestive, diuretic, laxative, diaphoretic, sedative, swelling, cough, asthma, in curing cardiopathy, leprosy, haemorrhoids, nephropathy, ophthalmopathy, dropsy and general debility. The plant has protective effect on the liver and hepato-protective activity in cases of toxicity induced by drugs and chemicals. It is also effective in the treatment of cirrhosis of the liver. Fresh juice of this herb is used for curing fever and alleviating pain [8]. The berries of *Solanum nigrum* used as medicine for alopecia [9] and other medicinal purposes. The leaves are used as poultice for rheumatic and gouty joints (Disease causing the joints to swell and become painful), skin diseases, used in the treatment of anti-tuberculosis and are said to produce diaphoresis. Leaves are also used in dropsy, nausea and nervous disorders. The decoction of the berries and flowers are useful in cough, erysipelas (specific, acute, cutaneous inflammatory disease caused by a haemolytic streptococcus and is characterised by red-hot). These are remedy for pulmonary tuberculosis and Bronchitis, diuretic. The juice of the berries used as an anti-diarrheal, opthalmopathy and hydrophobia. It is also used in anasarca and heart disease. Berries are used to possess tonic, diuretic and cathartic properties & the roots are useful in osteopathy, Ophthalmopathy, rhinopathy and hepatitis.

3. Extraction procedure of Solanum nigrum

Solanum nigrum berries were crushed into coarse powder by machine. 500 g of coarse dry power of *Solanum nigrum* (berries) was taken in 2000 ml conical flask and added 1000 ml of methanol. It was kept for 72 hrs in air tight condition at 25 to 30 °C temperature. After that, it was filtrated by normal filter paper. Filtrate was kept in a 1000 ml beaker. After filtration, the rotary evaporator at 40 to 45 °C temperature and other ambient condition concentrated the filtrate. The percentage yield of extraction was 2.45 % w/w. The extract was stored in glass vials in airtight condition at room temperature with proper label.

4. Phytoconstituents of Solanum nigrum

Although it is considered as a rich source of one of the most popular plant poisons, it has proven also to be a reservoir of phytochemicals with pharmacological prospects [10]. Phytochemical investigation of whole plant reported that Solanum nigrum contains the substances, such as alkaloid, steroid alkaloid, steroidal saponins and glycoprotein, exhibiting anti-tumor activity. Researchers studied the chemical characterization of osmotin - like protein from this plant. New glycoprotein (150 KDa) has been isolated from this plant which consist carbohydrate content (69.74%) and protein content (30.26%) which contain more than 50% hydrophobic amino acids such as glycine and proline. Small unripe fruits of *Solanum nigrum* had a high concentration of solasodine, but both the concentration and the absolute amount per fruit decreases with fruit maturation. It also contains polyphenolic compounds such as gallic acid, catechin, protocatechuic acid (PCA), caffeic acid, epicatechin, rutin, and naringenin [11]. The berries of Solanum nigrum from New Zealand have recently been studied and found to contain 4 steroidal alkaloid glycosides, solamargine, solasonine, α-solanigrine & β- solanigrine. The berries of Solanum nigrum have been found to be contained a saturated steroidal genin, which has been identified as tigogenin by mixed melting point and IR spectroscopy. One spirosestanol glycoside and two furostanol glycosides have been isolated from a methanol extract of the stems and roots of [12]. Some researchers found the presence of ascorbic acid in the fruits of *Solanum nigrum* and the concentration of ascorbic acid is more in fruit than

root. Six new steroidal saponins, solanigrosides -CH and one known saponin, degalactotigonin, were isolated from the whole plant of *Solanum nigrum* [12]. Some researchers isolated two new steroidal saponins, named nigrumnins I and II, together with two known saponins were obtained from the whole plant of *Solanum nigrum.* Recently phytochemical analysis of Solanum nigrum has resulted in the isolation of two novel disaccharides. Their structures were determined as ethyl b-D-thevetopyranosyl-(1-4)-b-D-oleandropyranoside and ethyl b-Dthevetopyranosyl-(1-4)-a-D-oleandropyranoside, respectively, by chemical and spectroscopic methods. *Solanum nigrum* seeds have high lipid content. Their protein content and minerals elements (Mg being prominent) are considerable and Solanum nigrum oil is an important source of linoleic acid [13]. Chemical structures of some phytoconstituents of Solanum nigrum given below-

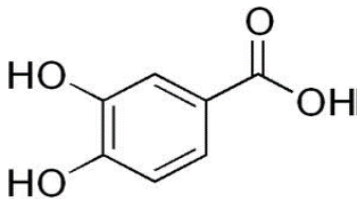

Fig 3: Protocatechuic acid

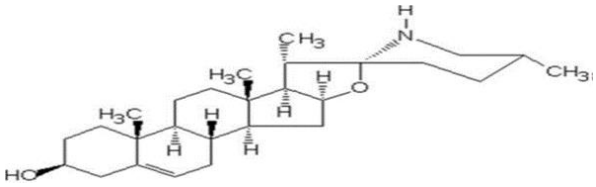

Fig 4: Solasodine

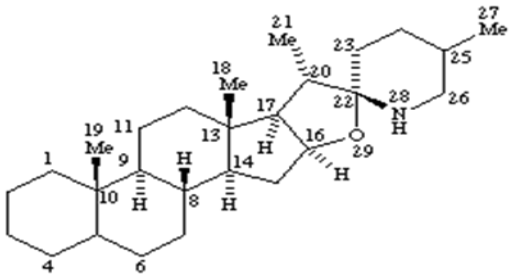

Fig 5: Spirosolane

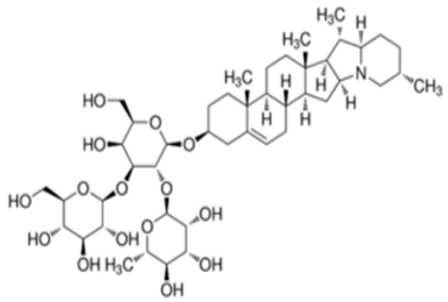

Fig 6: Solanine

5. Pharmacological activities

5.1 Hepatoprotective activity

Solanum nigrum aqueous and methanolic extracts were studied for hepatoprotective activity in rats injected with 0.2 ml/kg carbon tetrachloride (CCl_4) for 10 consecutive days. The water extracts showed a hepatoprotective effect against CCl_4-induced liver damage, which was evident by the decrease in serum aspartate amino transferase (AST), alanine amino transferase (ALT) and alkaline phosphates (ALP) activities bilirubin concentration and by mild histopathological lesions when compared with the group of rats injected with CCl_4 alone. The methanolic extracts of *S. nigrum* (250 to 500 mg/kg) also had hepatoprotective effects with levels of serum AST, ALT, ALP and bilirubin decreasing significantly in animals treated with *S. nigrum* methanolic extract compared to an untreated group [14]. Ethanol extract of *Solanum nigrum* was investigated for its hepatoprotective activity against CCl_4-induced hepatic damage in rats. The ethanol extract showed remarkable hepatoprotective activity. The activity was evaluated using biochemical parameters such as serum aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase (ALP) and total bilirubin. The histopathological changes of liver sample in treated animals were compared with respect to control [15]. In another study, 2-acetylaminoflorene is used as an inducer of hepatocarcino-genesis. *Solanum nigrum* inhibited hepatocarcinogenesis, which is consistent with increased expression of glutathione S-transferase-alpha, and -mu, the level of transcription factor Nrf2, glutathione peroxidase, superoxide dismutase-1, and catalase. In Africa, Aflatoxin B1 (AFB1) induced liver cancer is a common cause of hepatocarcinogenesis. Solanum nigrum increased the activity of uridine diphosphate glucuronyl transferase (UDPGT) and glutathione S-transferase in female rats toxicated with AFB1 (0.2 or 0.4 mg/kg b. wt) and thereby help to cure it.

5.2. Antioxidant properties

Many pathological states encompassing both communicable and non-communicable diseases have been shown to have association with oxidative stress. Consequently, the need for potent antioxidants in our diet and drug supplements becomes very necessary. A study that utilises six pre-treatment methods before cooking on the peroxidase activity, chlorophyll and antioxidant status of *S. nigrum* L., showed that pretreatment methods have significant effects ($p < 0.05$) on the parameters measured. A sharp difference in the carotenoids, phenolics, flavonoids and tannins contents has been reported, indicating the fragility of this antioxidant present in *S. nigrum* [17]. SNL glycoprotein showed a dose-dependent radical scavenging activity on radicals, including one, 1-diphenyl-2-picrylhydrazyl (DPPH) radicals, hydroxyl radical (OH), and superoxide anion (O^{2-}). Although it acts as an anti-tumour, the SNL glycoprotein may induce apoptosis through the inhibition of NFB activation, induced by oxidative stress in HT-29 cells [18]. A 50% ethanol extract of the whole plant of *S. nigrum* also possess hydroxyl radical scavenging potential which is suggested as cytoprotective mechanism. Evaluation of the antioxidant potential of *S. nigrum* (Sn) leaves on the modulation of a 6-hour restraint induced oxidative stress, which suggests that *S. nigrum* was better as an antioxidant with post-restraint treatment than with pre-restraint administration.

5.3 Anticonvulsant activity

Central nervous system-depressant action of Sn was ascertained by measuring the effects of intraperitoneal injection of *Solanum nigrum* on various neuropharmacological parameters. Fruit extracts of Sn significantly prolonged pentobarbital-induced sleeping time,

produced alteration in the general behaviour pattern, reduced exploratory behaviour pattern, suppressed the aggressive behaviour, affected locomotor activity and reduced spontaneous motility. This buttresses its usage as an anti-convulsant and may concur with its acetylcholine-like activity [19]. The potency of *Solanum nigrum* in combating infant convulsion is widely accepted in African paediatric medicine. A 30 min pre-treatment by intraperitoneal injection of *Solanum nigrum* leaf extract protected the animal subjects against different types of pro-convulsants. The aqueous leaf extract produced a significantly ($p < 0.05$) dose dependent protection against electrically induced seizure in chicks and rats, pentylenetetrazole-induced seizure in mice and rats and picrotoxin-induced seizure in mice and rats [20].

5.4 Anti-microbial, nematicidal & molluscicidal properties
Root extracts of *Solanum nigrum* (black nightshade) were analyzed for its activity against isolates ABA-31 and ABA-104 of Alternaria brassicicola, the causal agent of black leaf spot of Chinese cabbage (Brassica pekinensis). Methanolic extracts of dried root tissues of black nightshade contained antifungal properties, which act against *A. brassicicola.* Further fractionation and antimicrobial screening of ethyl acetate, n-butanol and water fractions of root extracts showed that n-butanol extracts was the most potent. Saponins were identified as the active principles conferring antimicrobial effects on *S. nigrum* [21]. An investigation on the effect of sub-lethal (LC25) concentration of leaves of Sn on Saudi Arabian mollusc Biomphalria arabica revealed that AST, ALT and LDH activities were affected in them and may suggest the mechanism for its molluscicidal activities. The effect of a 30 min pre-treatment of mice with varied concentration (2.5 – 10 mg/ml) of crude water extract of Sn on penetration and infectivity of *S. mansoni cercariae* showed a significant reduction in penetration ($p < 0.001$) and infectivity ($p < 0.01$) 22. In a recent study, it is observed that *S. nigrum* extracts act as a larvicidal agent against five laboratory-colonised strains of mosquito species [23].

5.5 Anticancer activity
The fruits of *Solanum nigrum* show anti cancer activity on the HeLa cell line. The methanol extract of the fruits of *Solanum nigrum* methanolic extract were tested for its inhibitory effect on HeLa Cell Line. The percentage viability of the cell line was carried out by using Trypan blue dye exclusion method & the cytotoxicity of *Solanum nigrum* on HeLa cell was evaluated by the SRB assay and MTT assay. From that study, it is observed that *Solanum nigrum* methanolic extract has significant cytotoxicity effect on HeLa Cell Line in concentration range between 10 mg/ml to 0.0196 mg/ml by using SRB assay [24].

5.6 Anti-HCV activity
Methanol and chloroform extracts of Solanum nigrum seeds exhibited 37% and more than 50% inhibition of HCV respectively at nontoxic concentration. Moreover, antiviral effect of Solanum nigrum seeds extract was also analysed against HCV NS3 protease by transecting HCV NS3 protease plasmid into liver cells. The results demonstrated that chloroform extract of Solanum extracts decreased the expression or function of HCV NS3 protease in a dose dependent manner and GAPDH remained constant. This result suggests that SN extract contains potential antiviral agents against HCV and combination of SN extract with interferon will be better option to treat chronic HCV [25].

5.7 Immunostimulant activity
In an investigation it is found that immune-stimulant potential plants being an alternative for preventing fish diseases. Six groups of experimental fishes (*E. suratensis*) were immunized with 0.2ml (4ppm) of five different extracts of *Solanum nigrum* through intra-peritoneal injection and challenged with heat killed Aphanomyces invadans. Blood collected from immunized and normal fish were analysed such as, radial immune-diffusion, antibody titration, nitro blue tetrazolium assay, determination of IgG concentration and host resistance test. In both control and the experimental groups, the peak antibody response was on day 21 after immunization and decreased towards 28th day. The methanol extract treated group, the antibody response was significantly enhanced on the day 14 and day 21 ($p<0.05$). The highest IgG level was on day 21 and decreased towards day 28. In Chloroform extract treated group the neutrophil activity was significantly enhanced on day 6 ($p<0.05$). In toluene extract treated group the neutrophil activity was significantly enhanced on day 6 ($p<0.05$). The ethanol and methanol extract treated group showed less mortality rate when compared to chloroform toluene and water extract treated group. Plants extracts have great potential as immune-stimulant against microorganisms and those can be used in the treatment of infectious diseases caused by microorganisms.

5.8 Anti-Tumor activity
An analysis was done on the polysaccharide fraction from Solanum nigrum (SN) & observed that SN-ppF3 has immune-modulatory activity. These results suggested that tumour suppression mechanisms observed in SN-ppF3-treated mice were most probably due to enhancing the host immune response. SNL-P1a had considerable growth inhibition effect on U14 cervical cancer and protective effect on thymus tissue of tumour-bearing mice.

5.9 Anti-inflammatory activity
The methanolic extract of whole plants of *Solanum nigrum* (Linn.) was investigated for anti-inflammatory activity on the experimental animal models. The methanol extract at a concentration of 100 mg/kg b.w and 200 mg/kg b.w showed the significant dose dependent antiinflammatory activity in carrageenin and egg white induced hind paw edema in rats. The standard drugs were Indomethacin (10 mg/kg) and Cyproheptadine (8 mg/kg) 26.Ethanolic extracts of Solanum nigrum for anti-inflammatory was evaluated by using Carrageenan induced rat paw edema. The study was carried out using doses of 100, 250 & 500 mg/kg orally. Anti-inflammatory activity at the dose of 500 mg/kg ($P<0.01$) as compare to standard drug Diclofenac sodium (50 mg/kg) [26]. The effect of methanolic extracts of berries of *Solanum nigrum* were studied on carrageenan induced paw edema. The methanolic extract decreased the edema induced in hind paw. The methanolic extract of Solanum nigrum (375 mg/kg b.w.) has showed significant anti-inflammatory [27].

5.10 Cytotoxic activity
The ethanolic extract of the dried fruit of Solanum nigrum shows cytotoxic activity. In the brine shrimp lethality test, the extract showed cytotoxicity significantly with LC50= 63.10µg/ml and LC90= 160µg/ml [28].

6. Histopathological effect of *S. nigrum* on Kidneys

Kidney is an important organ actively involved in maintaining homeostasis of the body by reabsorbing important material and excreting waste products. It has been reported that habitual consumption of large amount of alcohol was associated with an increased risk of kidney failure in the general populations [29]. Kidney functional markers such as urea, uric acid, creatinine and CAT are the main indicators of renal dysfunction [30]. According to scientists in normal control group the serum creatinine (0.65 + 0.01mg/dl) and urea (60.63 + 1.27mg/dl) were significantly increased to 1.06 + 0.07mg/dl and 85.67 + 3.73mg/dl respectively while CAT was reduced from 48.14 + 0.84mg/dl to 28.23 + 2.10mg/dl in GM treated renal injury [31]. When the GM treated, renal injury further treated with *S. nigrum* extract resulted in reduction of serum creatinine (0.71 +0.02mg/dl) and urea (67.58 + 1.60mg/dl). However, the level of CAT was elevated to 34.01 + 1.55mg/dl. The normal control levels of urea (25.38 ± 1.69mg/dl), uric acid (1.30 ± 0.06mg/dl) and creatinine (0.86 ± 0.06mg/dl) in ethanol-induced rats were significantly increased to 45.26 ± 2.96mg/dl, 2.63 ± 0.35mg/dl, 1.88 ± 0.07mg/dl respectively whereas treatment with SNFEt (250mg/kgb.wt) significantly decreased 30.51 ± 2.13mg/dl, 2.01 ± 0.16mg/dl, 0.99 ± 0.08mg/dl the levels to near normal values. This indicates the extract of *S. nigrum* and SNFEt improved nephroprotective activity.

7. Phytochemical screening of solanum nigrum berries extract

Phytochemical tests of the methanolic extract of *Solanum nigrum* berries were performed by using following methods:

Detection of Phytosterols

Libermann-Burchard Test: - 10 mg of extract was dissolved in 1mL of chloroform. 1 ml of acetic anhydride was added followed by the addition of 2mL of concentrated sulphuric acid but no reddish violet colour was developed, indicating the absence of steroids.

Detection of Triterpenoids

Nollar's test: - In the test tube 2 ml of 0.01%, anhydrous stannous chloride in thionyl chloride solution and test solution was added. Purple colour formed changed to deep red colour after few minutes indicates the presence of Triterpenoids.

Detection of Flavonoids

Shinoda test: To the extract magnesium turnings and then conc. hydrochloric acid (HCl) was added & red colour was produced.

Detection of Alkaloids

Mayer's test: 1.2 mL of extract was taken in a test tube. 0.2 ml of dilute hydrochloric acid and 0.1 ml of Mayer's reagent were added. Formation of yellowish buff coloured precipitate gives positive test for alkaloid.

Dragendroff's test:-0.1 ml of dilute hydrochloric acid and 0.1 ml of Dragendroff"'s reagent were added in 2 ml solution of extract in a test tube. Development of orange brown coloured precipitate suggested the presence of alkaloid. Wagner's test 2 ml of extract solution was treated with dilute hydrochloric acid and 0.1 ml of Wagner's reagent. Formation of reddish brown precipitate indicated the positive response for alkaloid.

Detection of Alkaloids

Biuret test: 1 ml of 40% NaOH mixed with 2 drops of 1% copper sulphate was added to the extract, a violet colour indicated the presence of proteins.

Detection of Protein and Amino Acids

Ninhydrin test: Extract solution was treated with ninhydrin (Tri-ketohydrindene hydrate) at the pH range of 4-8. Development of purple colour indicated the positive response for amino acids.

Detection of Glycosides

Legal test: Extract was dissolved in pyridine; sodium nitroprusside solution was added to it and made alkaline. Pink red colour was produced.

Borntrager's test: Few ml of dil. sulphuric acid added to the test solution. Boiled, filtered and extracted the filtrate with ether or chloroform. Then organic layer was separated to which ammonia was added, pink red colour was produced in organic layer.

Keller Killiani test: Sample was dissolved in acetic acid containing trace of ferric chloride and transferred to the surface of conc. sulphuric acid. At the junction of liquid reddish brown colour was produced which gradually becomes blue.

Detection of Phenolic compounds and tannins

Ferric chloride test 5 ml of extract solution was allowed to react with 1 ml of 5% ferric chloride solution. Greenish black coloration indicated the presence of tannins.

Potassium dichromate test 5 ml of the extract was treated with 1 ml of 10% aqueous potassium dichromate solution. Formation of yellowish brown precipitate suggested the presence of tannins.

Detection of Saponins

Foam test: 1 ml solution of the extract was diluted with distilled water to 20 ml and shaken in a graduated cylinder for 15 min. Development of stable foam suggested the presence of saponins.

Potassium dichromate test: 1 ml extract was treated with 1% lead acetate solution. Formation of white precipitate indicated the presence of saponins.

8. Result

Phytochemical screening of the methanolic extract of *Solanum nigrum* berries showed in presence of different type of phytoconstituents as depicted in table2.

Table 2: Phytochemical screening of the methanolic extract of *Solanum nigrum* berries

Test	Methanolic extract of *Solanum nigrum* berries extract
Steroids	-
Triterpenoids	+
Flavonoids	+
Alkaloids	+
Protein & Amino Acids	+
Glycosides	+
Phenolic compounds &Tannins	+
Saponins	+

("+" Indicates positive; "-" indicates negative)

9. Toxicity studies

Although *Solanum nigrum* is considered as a rich source of One of the most popular plant poisons but according to Various researches stated that *S. nigrum* total extract was found to be safe >5 g/kg body weight32. This is presumably that glycoalkaloids of *S. nigrum* contain appreciable amount of conjugated metal ions (except Cu2+). The increasing trend in toxicity of the metal ions depleted glycoalkaloids of *S. nigrum* was further manifested in the sub-acute toxicity study. The S. nigrum total extract was found to be safe in hematological and hepatic parameters, upto a dose of 4 gm/kg, p.o. administered for 21 days whereas glycoalkaloids fraction of *S. nigrum* was found to be toxic at a dose of 200 and 400 mg/kg, p.o. treated for 21 days. This states the normal dose of *S. nigrum* (0.43 ml/kg) possesses hepatoprotective effects against CCl_4 induced liver damage in rats [33]. Further, the microscopic examination of hepatic tissue in animals kept on normal and moderate dose (5ml/kg) of herbal drug showed inflammatory changes. Administration of high dose (10ml/kg) of *S. nigrum* extract on animals shows mild patchy necrosis as compared to control animals.

10. Conclusion

From this preliminary investigation and research, it has been concluded that the *S. nigrum* having significant anti-inflammatory and anti-convulsant activity, the flavonoids present in the berries might be a responsible active constituent for this activity. This herb has a vast medical uses so we can articulate that it is antiseptic, anti-inflammatory, expectorant, cardiotonic, digestive, diuretic, laxative, diaphoretic, sedative, swelling, cough, asthma, in curing cardiopathy, leprosy, haemorrhoids, nephropathy, ophthalmopathy, dropsy and general debility and its juices are used for abdominal pain and also for skin diseases. Besides *Solanum nigrum* is a traditional remedy for hepatitis, fever, ulcer, and various immunological applications in cancer and others. The plant is beneficial in preventing hepatotoxicity & cytotoxicity thus improving functions of liver and Kidney. Therefore, further studies required to isolate the active ingredients from the extract of *S. nigrum* for proper drug development to treat the health problems by conducting further clinical trials.

11. Acknowledgements

We are very thankful to BCDA College of pharmacy & technology for their support on study and prepare this review paper in circumstances.

12. References

1. Turner N, Aderka P. The North American guide to common poisonous plants and mushrooms, Timber Press, Toronto, and Canada, 1997, 81-182.
2. Chauhan R, Ruby KM, Shori A, Dwivedi J. Solanum nigrum with dynamic therapeutic role: a review. Int. J. Pharm. Sci. Rev Res. 2012; 15:65-71.
3. Raju K, Anbugarapathi G, Gokula Krishnan V, Raj Kapoors B, Jayakar B, Manian S. Effect of dried fruits of *Solanum nigrum* (Linn.) against CCl_4 Induced hepatic damage in rats. Biol. Pharm. Bull. 2003; 26(2):1618-1619.
4. Lee SJ, Lim KT. Antioxidative effects of glycoprotein isolated from *Solanum nigrum* L on oxygen radicals and its cytotoxic effects on the MCF-7 cell. J. Food Sci. 2013; 68:466-470.
5. Zakaria ZA, Gopalan HK, Zainal H. Anti-nociceptive, anti-inflammatory and antipyretic effects of *Solanum nigrum* chloroform extract in animal models. Yakugaku Zasshi. 2006; 126:1171-1178.
6. Raju K, Anbuganapathi G, Gokulakrishnan V. Effect of dried fruits of *Solanum nigrum* L against CCl_4-induced hepatic damage in rats. Biol. Pharm. Bull. 2003; 26(2):1618-1619.
7. Kumari M. *Solanum nigrum*: A Wild Plant Effective against Breast Cancer and Prostate Cancer. Int. J of Green & Herbal Chemistry. 2004; 3(1):4.
8. Solanum Phylogen, olanaceae Source. Natural History Museum. Agricultural Research Service. http://www.Nhm.Ac.Uk/Researchcuration/Research/Projects/Solanaceaesource/Taxonomy/Phylogeny/Index.Jsp,13 April, 2006.
9. Patel S, Sharma V, Chauhan N, Thakur M, Dixit VK. Hair Growth: Focus on Herbal Therapeutic Agent. Current drug discovery technologies. 2015; 12(1):21-42.
10. Lee SJ, Lim KT. 150 kDa glycoprotein isolated from *Solanum nigrum* Linn stimulates caspase-3 activation and reduces inducible nitric oxide production in HCT-116 cells. Toxicol. In Vitro. 2006; 20(7):1088-1097.
11. Ravi V, Saleem TSM, Maiti PP, Gauthaman K, Ramamurthy J. Phytochemical and pharmacological evaluation of *Solanum nigrum* Linn. African Journal of Pharmacy and Pharmacology. 2006; 3(9):454-457.
12. Ravi V, Saleem, TSM, Patel SS, Ramamurthy J, Gauthaman K. Anti-Inflammatory Effect of Methanolic Extract of *Solanum nigrum* Linn Berries. Int. J Appl. Res. Natur. Prod. 2009; 2(2):33-36.
13. Ravi V, Saleem TSM, Maiti PP, Gauthaman K, Ramamurthy J. of Phyto Chemical and Pharmacological Evaluation of *Solanum nigrum* (Linn). Afr. J Pharm. Pharmaco. 2009; 3(9):454-457.
14. Elhag RAM, Badwi MAE, Bakhiet AO, Galal M. Hepatoprotective activity of *Solanum nigrum* extracts ion chemically induced liver damage in rats. Journal of Veterinary Medicine and Animal Health. 2011; 3(4):45.
15. Kuppuswamy R, Govindaraju A, Velusamy G, Balasubramanian R, Balasundarm J, Sellamuthu M. Effect of dried fruits of *Solanum nigrum* against CCl_4 induced hepatic damage in rats, Biol. Pharm. Bull. 2003; 26(11):1618-1619.
16. Adebooye OC, Ram V, Vasudeva S. Peroxidase activity, chlorophylls and antioxidant profile of two leaf vegetables (*Solanum nigrum* L. and *Amaranthus cruentus* L.) under six pre-treatment methods before cooking. Int. J. Food Sci. Technol. 2008; 43(1):173-178.
17. Mohamed AF, Martina W, Gudrun S, Ulrike L. Antioxidant, antimicrobial and cytotoxic activities of selected medicinal plants from Yemen. J. Of Ethnopharmacol. 2007; 111(3):657-666.
18. Heo KS, Lee SJ, Ko JH, Lim K, Lim KT. Glycoprotein isolated from *Solanum nigrum* L. inhibits the DNA-binding activities of NF-B and AP-1, and increases the production of nitric oxide in TPA stimulated MCF-7 cells. Toxicol. In Vitro. 2004; 18(6):755-763.
19. Perez G, Perez L, Garcia D, Sossa M. Neuropharmacological activity of *Solanum nigrum* fruit. J. Ethnopharmacology. 1998; 62(1):43-48.
20. Wannang NN, Anuka JA, Kwanashie HO, Gyang SS, Auta A. Anti-seizure activity of the aqueous leaf extract of *Solanum nigrum* (linn) (solanaceae) in experimental animals. Afr. Health Science. 2008; 8(2):74-75.

21. Muto M, Mulabagal V, Huang HC, Takahashi H, Tsay HS, Huang JW. Toxicity of black nightshade (*Solanum nigrum*) extracts on (Alternaria brassicicola, causal agent of black leaf spot of Chinese cabbage (Brassica pekinensis). J. Phytopathol. 2006; 154 (1):45-50.
22. Amer HA, Manal MAR. Molluscicidal and cercaricidal efficacy of *Acanthus mollis* and its binary and tertiary combinations with *Solanum nigrum* and *Iris pseudacorus* against *Biomphalaria alexandrina*. J. Egyptian Soc. Parasitol. 2005; 34(3):1041-1050.
23. Raghavendra K, Singh SP, Subbarao SK, Dash AP. Laboratory studies on mosquito larvicidal efficacy of aqueous and hexane extracts of dried fruit of *Solanum nigrum* Linn. Indian J. Med. Res. 2009; 130(1):74-76.
24. Patels S, Gheewala N, Suthar A, Shah A. In-vitro cytotoxicity activity of *Solanum nigrum* extracts againstHela cell lines and Vero cell lines. International journal of pharmacy and pharmaceutical sciences. 2009; 1(1):38-46.
25. Javed T, Usman AA, Sana R, Sidra R, Sheikh R. In vitro antiviral activity of *Solanum nigrum* against Hepatitis C Virus. Virology Journal. 2011; 8:26.
26. Arunachalam G, Subramanian N, Pazhani GP, Karunanithi M, Ravichandran V. Evaluation of anti-inflammatory activity of methanolic extract of *Solanum nigrum (*Solanaceae).Iranian Journal of Pharmaceutical Sciences Summer. 2009; 5(3):151-156.
27. Zakaria ZA, Gopalan HK, Zainal H. Anti-nociceptive, anti-inflammatory and antipyretic effects of *Solanum nigrum* chloroform extract in animal models. Yakugaku Zasshi. 2006; 126:1171-1178.
28. Bhatia N, Maiti PP, Kumar A, Tuli A, Ara T, Khan MU. Evaluation of cardio protective Activity of Methanolic Extract of *Solanum nigrum* L. in Rats, International Journal of Drug Development &Research. 2011; 3(3):139147.
29. Parekh R, Klag M. Alcohol: role in the development of hypertension and end-stage renal disease. Current Opinion on Nephrology and Hypertension. 2001; 10:385-390.
30. Mirunalini S, Arulmozhi V, Krishnaveni M. Protective effect of Solanum nigrum fruit extract on the functional status of liver and kidney against ethanol-induced toxicity. Journal Biochemistry and Biotechnology. 2012; 3(4):339-343.
31. Shaheen U, Zahid M, Tanweer K, Amama K, Faqir M, Ijaz J, *et al*. Evaluation of nephroprotective effects of *Foeniculum vulgare*, *Solanum nigrum* L. and their mixture against gentamicin-induced nephrotoxicity in albino rabbits. International Journal of Pharmaceutical Science Review and Research. 2014; 25(1):1-9.
32. Ganguly P, Amartya K, Upal K, Shibnath G. The chemistry behind the toxicity of black nightshade (*Solanum nigrum*) and the remedy. Journal of Pharmacology. 2009; 1:705-723.
33. Feroz Z, Rafeeq A, Amber L, Mahayrookh R. Hepatoprotective effect of herbal drug on CCl_4 induced liver damage. Pakistan Journal of Pharmacological Science. 2013; 26(1):99-103.