

## PHCOG REV. : Review Article

### *Solanum nigrum* Linn. – A Review

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#### Abstract

*Solanum nigrum* Linn. (Solanaceae) commonly known as 'Black nightshade' that have been extensively used in traditional medicine in India and other parts of world to cure liver disorders, chronic skin ailments (psoriasis and ringworm), inflammatory conditions, painful periods, fevers, diarrhoea, eye diseases, hydrophobia, etc. It has been found that *Solanum nigrum* contains the substances, such as total alkaloid, steroid alkaloid, steroidal saponins and glycoprotein, exhibiting anti-tumor activity. In Indian traditional medicine, the plant is used as a hepatoprotective agent. In this review, we have explored the phyto-pharmacological properties of the *Solanum nigrum* plant and compiled its vast pharmacological applications to comprehend and synthesize the subject of its potential image of multipurpose medicinal agent.

**Keywords :** *Solanum nigrum* Linn. Hepatoprotective agents, Glycoprotein, Black nightshade, Solasonine

#### Introduction

The plant *Solanum nigrum* Linn (Solanaceae) (Fig 1) commonly called as black night shade in English, Makoi in Hindi, Kachchipandu in Telugu, Munatakali in Tamil, Piludi in Gujarati & Kamuni in Marathi. It is an erect, divaricately branched, unarmed, suffrutescent annual herb. Leaves ovate or oblong, sinuate-toothed or lobed, glabrous; flowers 3-8 in extra-axillary drooping subumbellate cymes; fruits purplish black or reddish berries; seeds many, discoid, yellow, minutely.

#### Taxonomical classification

Division – Embryophyta  
Sub-division – Angiospermae  
Class – Dicotyledoneae  
Order – Tubeflorae  
Sub-order – Solanales  
Family – Solanaceae  
Genera – Solanum

#### Habitat and Distribution

These species are only semicultivated in a few countries in Africa and Indonesia, and are largely utilized as a vegetable and fruit source through harvesting from plants growing spontaneously as weeds in cultivated fields, or in weedy plant communities, under trees, along fences and roads, in shaded areas, near buildings and on waste land. They therefore constitute a volunteer crop. Some communities semi cultivate the vegetable in home gardens or on fertile land portions near homesteads. There are a few reports of the cultivation of the garden huckleberry for its fruits in North America.

#### Ethnomedical Properties and Uses

The berries and leaves are mainly used for medicinal purposes, besides the other parts of the whole plant. The leaves are used as poultice for rheumatic and gouty joints (Disease causing the



Fig 1: Whole plant of *Solanum nigrum*

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 are characterized by redhot). These are remedy for pulmonary tuberculosis and Bronchitis, diuretic. The juice of the berries used as an antidiarrhoea, ophthalmopathy and hydrophobia. It is also used in anasarca and heart disease. Berries are used to possess tonic, diuretic and cathartic properties. Seeds are useful in giddiness and dipsia. They are also useful in inflammations and skin diseases. The roots are useful in otopathy, ophthalmopathy, rhinopathy and hepatitis. The whole plant used as antiseptic, anti-inflammatory, expectorant, cardiogenic, digestive, diuretic, laxative,

diaphoretic, sedative, swelling, cough, asthma. The plant is also effective in curing cardiopathy, leprosy, haemorrhoids, nephropathy, ophthalmopathy, dropsy and general debility. Decoction of the plant depresses the CNS and reflexes of the spinal cord (1-5).

#### Phytoconstituents from *Solanum nigrum*

Phytochemical investigation of whole plant reported that which contain alkaloids, flavonoids, tannins, saponins, glycosides, proteins, carbohydrates, coumarins & phytosterols. It has been found that *Solanum nigrum* contains the substances, such as total alkaloid (6), steroid alkaloid (7), steroidal saponins (8) and glycoprotein (9), exhibiting anti-tumor activity (10). Researchers studied the chemical characterization of osmotin – like protein from this plant (11). 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 aminoacids such as glycine and proline (12). 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 (13). The berries of *Solanum nigrum* from New Zealand have recently been studied and found to contain 4 steroidal alkaloid glycosides, Solamargine, Solasonine,  $\alpha$  and  $\beta$ - solanigrine. The berries of *Solanum nigrum* have been found to contain a saturated steroidal genin, which has been identified as tigogenin by mixed melting point and IR spectroscopy (14). One spirosestanol glycoside and two furostanol glycosides have been isolated from a methanol extract of the stems and roots of *Solanum nigrum* (15). 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 (16). Six new steroidal saponins, solanigrins C-H, and one known saponin, degalactotigonin, were isolated from the whole plant of *Solanum nigrum* (17). 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* (18). 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 - D -thevetopyranosyl-(1-4)- a - D-oleandropyranoside, respectively, by chemical and spectroscopic methods (19). *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 (20). Chemical structures of some phytoconstituents from *Solanum nigrum* present in Fig 2.

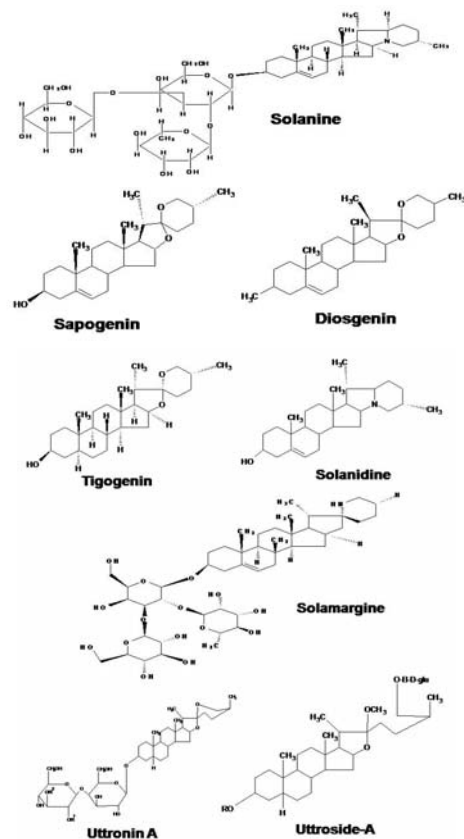


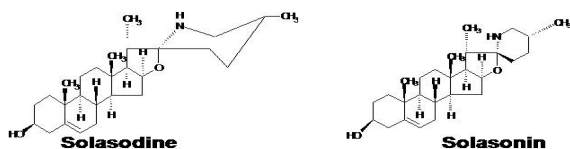
Fig 2 : Phytoconstituents of the plant

#### Pharmacology of *solanum nigrum* linn.

Many investigations showed that 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. More recent studies revealed an inhibitory effect of extracts of *Solanum nigrum* on 12-O - tetradecanoylphorbol 13-acetate (TPA)- induced tumor promotion in HCT-116 cells, and a remarkable hepatoprotective effect of the ethanol extract of dried fruits of *Solanum nigrum* against  $\text{CCl}_4$  - induced liver damage. Recently, Lin et al., demonstrated that the 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 (21, 22).

The ethanol extract of the fruit of *Solanum nigrum* was studied for its neuropharmacological properties on experimental animals. On intraperitoneal injection, the extract significantly prolonged pentobarbital induced sleeping time, produced alteration in the general behavior pattern, reduced exploratory behavior pattern, suppressed the aggressive behavior, affected locomotor activity and reduced spontaneous motility. The observations suggest that the fruit of *Solanum nigrum* possesses potential CNS-depressant action (23).

The protective effects of water extract of *Solanum nigrum* against liver damage were evaluated in carbon tetrachloride ( $\text{CCl}_4$ ) - induced chronic hepatotoxicity in rats. The results of this study suggest that *Solanum nigrum* could protect liver



against the  $\text{CCl}_4$  induced oxidative damage in rats, and this hepatoprotective effect might be contributed to its modulation on detoxification enzymes and its antioxidant and free radical scavenger effects (22). Other research reported that Oral administration of *Solanum nigrum* significantly reduces thioacetamide-induced hepatic fibrosis in mice, probably through the reduction of TGF-1 secretion (10).

Some research reported that a glycoprotein isolated from *Solanum nigrum* has a strong scavenging effect against reactive oxygen radicals, and growth inhibition effects against JA221 and XL1-Blue. Moreover, it has been reported that glycoprotein has a cytotoxic effect against MCF-7 and HT-29 cells, even at low concentrations (9, 24). Glycoprotein has a strong scavenging activity against lipid peroxyl radicals and hypolipidemic activity by increasing the detoxicant enzymes activity through the inhibition of hepatic HMG-CoA reductase in mice (25). It has been reported that glycoprotein has a cytotoxic effect on MCF-7 cells (26) and that the ethanolic extract has anti-proliferative, apoptotic and cytotoxic effects on MCF-7 cells (27). Glycoprotein induces apoptosis through the NF- $\kappa$ B activation and inducible nitric oxide (iNO) production in HCT-116 cells (12). Glycoprotein has the capacity to modulate the TPA-induced DNA-binding activities of transcription factors and NO production, which play a critical role with respect to cytotoxicity in MCF-7 cells. Therefore, glycoprotein from *Solanum nigrum* might be one of the agents that blocks TPA-mediated signal responses in tumor cells (9).

The 50% ethanol extract of the whole plant of *Solanum nigrum* was tested in vitro for its cytoprotection against gentamicin-induced toxicity on Vero cells. Cytotoxicity was significantly inhibited as assessed by the Trypan blue exclusion assay and mitochondrial dehydrogenase activity (MTT) assay. The test extract also exhibited significant hydroxyl radical scavenging potential, thus suggesting its probable mechanism of cytoprotection (28).

Previous reports indicated that *Solanum nigrum* fruits possess beneficial activity as antiulcer, antioxidant and antitumor promoting agent in rats (29). It has been reported earlier that aerial parts of *Solanum nigrum* is believed to offer its antiulcer action through acid and peptic suppression in aspirin induced ulcerogenesis in rats (30). Oral administration of *Solanum nigrum* displayed a significant antiulcer activity without any apparent toxicological effects, which supports the use of *Solanum nigrum* in herbal medicine of India for ulcer therapy. The antisecretory activity of *Solanum nigrum* appears to be mainly related to the inhibition of H+K+ATPase and suppression of gastrin release, while its ulcer protective and ulcer healing activities may be primarily related to an antisecretory effect of *Solanum nigrum* (31).

The antioxidant potential of *Solanum nigrum* leaves extract was evaluated on the modulation of restraint induced oxidative stress. The post treatment of crude extract was found more effective in restoring restraint stress induced oxidative changes in rat plasma than pretreatment. In order to reduce oxidative stress, observed in many pathological conditions, the *Solanum nigrum* leaves extract can be given both as a prophylactic and

therapeutic supplement for scavenging free radicals (32). Antioxidant potential of isolated glycoprotein has been evaluated by several methods like DPPH, superoxide radical & hydroxyl radical assay, from these results it has been suggested that glycoprotein has potent antioxidative potential (33). It has been reported that the extracts of berries of *Solanum nigrum* having significant larvicidal, anti-inflammatory and anti-convulsant activity (34-36). These studies suggest that *Solanum nigrum* possesses a beneficial activity as an antioxidant, and antitumor promoting, and hepatoprotective agent, although the mechanism for the activity remains to be elucidated.

### Conclusion

We conclude from the vast literature study and experimental results analysis that *Solanum nigrum*, is a traditional remedy for ulcer, hepatotoxicity and cancer, employs various immunological applications in cancer and others. The plant is beneficial in preventing liver toxicity & cytotoxicity thus improving functions of liver and Kidney. It also finds immense utility in abdominal problems, body pain, and central nervous system and brain functioning. Taking great concern of the useful benefits of the plant, it can be advocated as a safe, highly important, medicinal plant for general mankind.

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