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## The traditional and pharmacological properties of solanum nigrum: a review

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### Abstract

*Solanum nigrum* has a place in the Solanaceae family with a common name of garden nightshade. It is composed of a variety of glycoalkaloids, glycoproteins, polysaccharides and polyphenolic mixtures such as gallic acid, catechin, protocatechuic acid, and caffeic acid, epicatechin, and rutin. *Solanum nigrum* have hepatoprotective, antitumor, immunomodulatory, anti-ulcer, calming, hostile to convulsant, cardio defensive, antibacterial, antidiabetic and pain-relieving impacts. Traditional medicine in India and other parts of the globe has used *Solanum nigrum* to treat liver disorders, constant skin sickness, fiery circumstances, menstrual cramps, fevers, diarrhoea, eye infections, dizziness and other diseases.

**Keywords:** Solanum nigrum, hepatoprotective, immunomodulatory.

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potential herbal alternative containing anti-cancer properties [5].



*Solanum nigrum*

### Introduction

*Solanum nigrum* belongs to the Solanaceae family with common names of black nightshade or garden nightshade in English, Ganikesopu in Kannada, Makoya in Hindi, Munatakali in Tamil, Kachchipandu in Telugu, and Bengali in Gudakami [1]. The yearly spreading plant *Solanum nigrum* has dull, dim green leaves that are delicious, applauded, or lanceolate and innocuous to marginally toothed on the edges [2]. Extra-axillary drooping sub-umbellate cymes bearing 3–8 flowers [3]. Ripen fruits are petite and black [4]. It has antimicrobial, antioxidant, cytotoxic, anti-ulcerogenic, and chemo preventive properties. In Africa this medicinal herb used to treat a variety of conditions that cause infant death, including feverish convulsions, vision problems, hydrophobia, and chronic autoimmune disorders. It is a

Synonym[6]	Taxonomical classification [7]
Hindi: Makoya	Kingdom: Plantae
English: Black nightshade	Class: Magnoliopsida
Sanskrit: Dhvansamaci	Division : Magnoliophyta
Kannada: Ganikesopu	Family: Solanaceae
Bengali: Gudakamai	Order: Solanales
Malayalam : Manatakkali	Genus: <i>Solanum</i> -nightshade
Marathi: Kamoni	Species: <i>Solanum nigrum</i>

### Morphology

*Solanum nigrum* is an annual plant that grows up to 25-100cm, the entire plant is covered with simple pubescent hairs which are angular and are coarsely pubescent on stems. The fruits are round, dull dark brown, with a diameter of 8 to 10 mm. The leaves are 4-10cm in length and 3-7 cm in width and are covered with trichomes they are ovate with cuneate bases, and coarsely dentate with an obtuse apex. The therapeutic qualities of the *Solanum* species are well-known. Aside from that, the berries and leaves are used to treat various ailments. The leaves are used to treat gouty joints, joint discomfort, skin diseases, and anti-tuberculosis treatments. Anthers are 2.5-3.5 mm long and strands are 1-1.5 mm long [8].

### Phytochemical constituents

*Solanum nigrum* contains a variety of compounds that have pharmacological activities. Glycoalkaloids, polysaccharides and glycoproteins, as well as polyphenolic constituents including catechin, gallic acid, protocatechuic acid, epicatechin, caffeic acid, rutin and naringenin[9], are active components. Solamargine, solasonine, solanine and solamargine, and solasodine solanidine are glycoalkaloids present in plants' unripe fruits and consuming them is toxic to humans and cattle. The first two were also found in all regions of the plants and their quantity grows as the plant grows, though it appears to be influenced by soil type and climate [10].

### Ethno medical properties and uses

The therapeutic qualities of the *Solanum* species are well-known. Aside from that, the berries and leaves are used to treat various ailments. The leaves are used to treat gouty joints, joint discomfort, skin diseases, and anti-tuberculosis treatments. They are likewise answered to cause diaphoresis. Dropsy, nausea and neurodegenerative disorders are also treated with leaves. Cough relief can be provided by drinking a decoction of the berries and flowers. These are diuretic treatments for TB disease and pneumonia in the lungs. The berries' juice is used to treat diarrhoea, ophthalmopathy and hydrophobia. It's also used to treat cardiovascular problems. Berries have traditionally been used for their stimulant, purgative and euphoric effects. They can likewise treat aggravation and skin conditions. Osteopathy, ophthalmopathy and hepatitis can all benefit from the roots. The whole plant is used as a demulcent, diuretic, digestive, diaphoretic, sedative, antispasmodic, antiseptic, laxative, swelling, cough and asthma treatment. Cardiomyopathy, nephropathy, leprosy, ophthalmopathy and general debility can be

treated with this herb. The CNS and spinal reflexes are suppressed when the plant is decocted[11,15].

### Pharmacological Properties

#### Hepatoprotective activity

In rodents (hepatotoxicity actuated with carbon tetrachloride 0.4 ml/kg infusion for 10 days), a near investigation of methanolic and fluid concentrates of *Sn* shows critical hepatoprotective action with methanolic removes [16].

#### Anticancer activity

The anticancer activity of *Sn* products of methanolic separates was tested on the HeLa cell line for their inhibitory effect. The percentage feasibility of the cell line was determined using the Trypan blue colour prohibition technique. The sulforhodamine B and 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide tests were utilized to decide the cytotoxicity of *Solanum nigrum* on HeLa cells. Utilizing the SRB test, *Solanum nigrum* methanolic separate shows a huge cytotoxicity impact on HeLa cell lines in focuses going from 10 mg/ml to 0.0196 mg/ml[17].

#### Immunomodulatory effects

In vivo tests showed that *S.nigrum-P* treatment reestablished the proportion of CD4+/CD8+ peripheral blood T-lymphocyte subpopulations. Moreover, as estimated by ELISA, the *S. nigrum-P* organisation brought about a huge expansion in IFN and a huge abatement in IL. These discoveries uncover that *S nigrum-P* has powerful anticancer action and that *S. nigrum-P* might apply antitumor movement in the host through animating different insusceptible reactions rather than straightforwardly focusing on malignant growth cells in U14 cervical disease-bearing mice. Thus, *S. nigrum-P* can be utilised as an immunomodulator [18].

#### Anti-ulcer activity

Km. Ruby et al. (2012) investigated the anti-ulcerogenic effects of methanolic *Sn* berry concentrate on headache medicine-induced ulceration in rodents, as well as the cell reinforcement status in the gastric mucosa. The findings indicate that *Sn* berries may have a gastroprotective effect by looking for free revolutionaries. *Sn* berries may be useful in the treatment of gastrointestinal disorders[19].

#### Antidiarrhoeal activity

The antidiarrheal activity of a crude extract of *Sn* dried fruit was investigated. At concentrations of 250 and 500 mg/kg body weight, the fruit extract showed significant antidiarrheal activity against castor oil-induced

diarrhoea in rats, reducing the frequency of stools and increasing the mean latent duration [20].

#### **Anti-inflammatory activity**

The anti-inflammatory efficacy of a methanolic extract of whole *S.nigrum* plants was investigated using experimental animal models. At dosages of 100 and 200 mg/kg b/w, the methanolic extract showed significant dose-dependent anti-inflammatory effects in rats with carrageenan and egg white-induced hind paw oedema. The most widely utilised drugs were Indomethacin and Cyproheptadine [21].

#### **Larvicidal activity**

*Culex quinquefasciatus* larvicidal action of unrefined and dissolvable concentrates of *S.nigrum* leaves. The outcomes revealed that the death rates at 0.5% were the most elevated of all the unrefined concentrate focuses. According to the results of log probit analysis, in a bioassay experiment with crude plant extract, the fatal concentration LC50 and LC90 values gradually reduced with exposure periods. As per the consequences of the relapse investigation of rough concentrate of *Sn*, the death rate is decidedly associated with the convergence of the concentrates. The consequences of this study uncovered that the ethyl acetic acid derivation concentrate of *Solanum nigrum* could be utilized as a mosquito larvicidal agent [22].

#### **Anticonvulsant activity**

The CNS depressant activity of *Solanum nigrum* was determined by assessing the effects of i.p injection of *Solanum nigrum* on several neuroprotective parameters by Km. Ruby et al., 2012. The isolated toad rectus abdominis contracts isotonicity. The isolated toad heart has a negative chronotropic and inotropic effect. Isotonic ileal concentration in solitary Guinea pigs. The isolated jejunum of a rat undergoes isotonic concentration. The arterial blood pressure of the cat is decreased. Submaxillary gland secretory effects in rats [23].

#### **Cardioprotective activity**

A worldwide in vitro ischemia-reperfusion injury model with dosages of 2.5 mg/kg and 5.0 mg/kg for 30 days was used to assess the cardiovascular protective role of an ethanolic *Sn* berry. The extract had a substantial cardioprotective effect against global in-vitro ischemia-reperfusion damage, according to the findings. The action was dosage agnostic. The cardioprotective activity was found in a methanolic extract of *Sn* berries [20].

#### **Antidiabetic activity**

The hypoglycemic action of hydroethanolic and aqueous extracts of different sections of the *S. nigrum* plant, namely the fruits leaf, and stem in Sprague Dawley rats. To test oral glucose tolerance with conventional Metformin, several dosages of the extract were used. The findings revealed that aqueous fruit and leaf extracts, followed by hydroethanolic extracts, have a substantial hypoglycemic effect, that is, the amount of the drug. The stem extract of *Sn* has no discernible effects [24]. The effect of ethanol extract of *S.nigrum* on glucose levels in the rat liver after daily oral administration of a dosage of 250 mg/kg b.wt. for 5 and 7 days was also investigated. Once observed, chronic administration over a longer time results in a significant reduction in blood sugar levels. As a result, it's safe to say that *Solanum nigrum* contains anti-diabetic properties [25].

#### **Anti hcv activity**

Chloroform and methanol concentrates of *S.nigrum* seeds restrained HCV by 37% and more than 50%, respectively, at nontoxic focuses. Additionally, by transfecting HCV NS3 protease plasmid into liver cells, the antiviral effect of *S.nigrum* seed extricate was researched against HCV NS3 protease. The outcomes showed that chloroform concentrate of *Sn* decreased HCV NS3 protease articulation and capacity in a portion subordinate way while GAPDH stayed stable. These discoveries suggest that *Sn* remove likewise has antiviral properties against HCV and that joining *Solanum nigrum* separate with interferon might be a prevalent therapy decision for constant HCV [26].

#### **Ethno medical activity**

*Solanum nigrum* leaf extract is beneficial for dental health. Several field trips were conducted to various parts of the research region in the Dharwad district of Karnataka, and 245 herbal healers were contracted in the survey at various times of the year. *Solanum nigrum* was studied for its role in oral health, as well as the manner of medicinal preparation and administration. According to an ethnomedicine survey, *Solanum nigrum* can be used to treat gum disease. The juice was extracted by grinding the leaves and sifting them through the cotton fabric, and it was found that they may be used as an eardrop for toothache relief [27].

#### **Analgesic activity**

The analgesic efficacy of *S.nigrum* ethanolic extracts was tested. The extract's analgesic effect was assessed using Acetic acid-induced writhing and eddy's hot plate for

both peripheral and central pharmacological activities. Oral concentrations of 100, 250 and 500 mg/kg were used in the research. When contrasted with the reference medicine Diclofenac sodium (50 mg/kg), the extract demonstrated considerable analgesic activity at 500 mg/kg [28]. A methanol extract of *Sn* dried fruit was tested for analgesic effectiveness. When mice were administered acetic acid to produce writhing, the ethanolic extract reduced writhing by 52.39 % and 68.75 %, however, compared to Diclofenac. It indicates that analgesic activity is favourable [20].

### Antioxidant properties

Oxidative stress has been linked to a variety of pathological states, including both communicable and non-communicable illnesses. As a result, we have a greater need for powerful antioxidants in our food and pharmacological supplements. Pretreatment methods have a significant variation in the levels of phenolics, carotenoids, tannins and flavonoids demonstrating the fragility of the antioxidant found in *Solanum nigrum* [29]. The radical scavenging action of SNL glycoprotein on radicals such as DPPH radicals, OH radicals and O<sub>2</sub> was dose-dependent. Although *Solanum nigrum* is an antineoplastic drug, the SNL polypeptide may cause death in HT-29 cells by blocking oxidative stress-induced NF-κB activation [30]. A 50% ethanol extract of *S. nigrum*'s entire plant has also been shown to have hydroxyl radical scavenging capacity, which could be a cytoprotective mechanism [31]. The antioxidant capacity of *Solanum nigrum* was more effective as an antioxidant after the restraint than before.

**Anti-seizure activity** By intraperitoneal administration of the extract, Km. Ruby et al. (2012) evaluated the aqueous leaf extract of the leaves of *Sn* for antiepileptic activity in chicks, rats, and mice. Amphetamine potentiates the extracted antiepileptic properties [32].

### Anti-tumor effect

Sepide Miraj et al., 2016 investigated the polysaccharide fraction SN-ppF3 from *S. nigrum* in aspects of the immune-modulatory activity. These results reveal that the tumour-suppression mechanisms seen in SN-ppF3 treated animals are most likely due to an increase in the host immune system. SNL-Pla inhibited the growth of U14 cervical cancer cells and preserved the thymus tissue of tumour-bearing mice [33].

**Anti-microbial, nematocidal and molluscicidal properties** *Solanum nigrum* root extracts were tested for antibacterial activity against *Alternaria brassicicola* isolates ABA-31 and ABA104, the causative agents of Chinese cabbage

black leaf spot. Methanolic preparation of *Solanum nigrum* dried root tissues had antifungal activities that inhibited *Alternaria brassicicola* growth. Further fractionation and antimicrobial screening of root extracts in n-butanol, ethyl acetate and water revealed that n-butanol extracts were the most powerful. Saponins were discovered to be the active components that provide antibacterial activity against *Solanum nigrum* [34]. The effect of sublethal doses of *Solanum nigrum* leaves on the Saudi Arabia mollusc *Biomphalaria Arabica* revealed changes in ALT, LDH, and AST activities, which could indicate the mechanism for its molluscicidal effects. The effect of a thirty-minute pre-treatment of animals with different concentrations (2.5-250mg) of crude water extract of *Solanum nigrum* on *Solanum mansoni* cercariae absorption and infectivity was significant (p 0.001) and (p 0.01), respectively [35]. In a recent study [36], *Solanum nigrum* extracts were reported to be effective larvicidal agents against five laboratory-colonized mosquito strains.

### Protective effect

According to Ruby et al., 2012, an aqueous leaf extract of *Sn* extract protects mice against lead acetate when administered intravenously. The current research shows that *Solanum nigrum* extract protects albino mice brains against lead acetate-induced toxicity [37].

Hypolipidemic, hypotensive potentials and anti-hyperglycemic Hyperlipidemia is a major risk factor for heart disease and stroke. Excessive agitation of the cation pumps on cell membranes aids hypertension and other types of heart disease. As a result, *Solanum nigrum*, a plant that inhibits the H<sup>+</sup>K<sup>+</sup>ATPase, could be used as a cardioprotective treatment. Studying the effects of a 150 kDa glycoprotein produced by *S. nigrum* is crucial. It has been utilized as a hepatoprotective and anticancer agent in folk medicine. Plasma lipoprotein levels were decreased in mice treated with *Solanum nigrum*. Furthermore, at 40 g/g of head bodyweight, Sn glycoprotein inhibits the activity of cholestyramine-induced hepatic HMG-CoA reductase [38]. The oral glucose tolerance test was used to validate the ethnobotanical usage of *S. nigrum* Linn. *Vitex negundo* Linn. and stems of *Nopalea cochinellifera* as anti-diabetic medicines. *S. nigrum* exhibited no significant reduction in BGLs [39]. Antihypertensive effects of Sn, which has been utilised as an antipyretic and anticancer in folk medicine, were studied. In vitro, a 150 kDa glycoprotein isolated from Sn, which contains more than 50 percent lipophilic amino acids such as glycine and proline, blocked nuclear factor NF-κB activation and

reduced inactivating iNO(nitrous oxide) production at a concentration of 40 g/ml [40], inhibited nuclear factor NF-KB activation and reduced inducible iNO(nitrous oxide).

#### Anti-fungal effect

Miraj, Sepide, et al. (2016) investigated the antifungal potential of *Sn* and found that solamargine can be produced at a large yield by an appropriate microbe for microbial epiphytic fungus culture. It may be possible to improve fungal solamargine synthesis with more research, like medium tuning, 1 strain, numerous compounds, and genomic change [41].

#### Anthelmintic study

In comparison with the standard drug, ethanol and water extracts of *S.nigrum* leaves showed significant anthelmintic activity. On the other hand, antimalarial activity was reduced in chloroform and petroleum ether extracts of *Sn* leaves [42].

#### Nutritional study

*Solanum nigrum* Var *virginicum* leaves and seed were estimated to be 24.90% and 17.63%, respectively by Akubugwo et al., 2007. In addition, cyanide levels were found to be significantly higher in the leaves than in the seeds [43].

#### Antimycotic activity

*Candida albicans*, *Trichophyton rubrum*, *Trichophyton tonsurans*, *Microsporum gymseum*, *Trichophyton mentagrophytes* and bacteria including *Pseudomonas aeruginosa*, *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus* were evaluated using petroleum ether and 98% methanolic young leaf extracts of *Solanum Nigrum*. When compared to the low polar petroleum ether extract, the interpoler methanolic extract had the most activity. For each of the test strains, the lowest inhibiting concentration, maximum bactericidal concentration, and minimum fungicidal concentration were determined [44].

#### Conclusion

According to the literature research and experimental data analysis, *Sn* is a traditional treatment for cirrhosis, ulcers, inflammation, and other immunological uses in tumours and other disorders. Hepatotoxicity and cytotoxicity are reduced as a result of the plant, which improves liver and kidney function. Analgesic, antimicrobial, immunostimulant, anti-inflammatory, anti-diabetic, CNS, and brain functions are all affected. It can significantly improve medical and pharmacological practices.

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