

## **Review Article on Pharmaceutical, Pharmacological Activities and Therapeutic Potential of “Solanum Nigrum”**

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**Abstract:-** *Solanum nigrum* linn. (Sn) commonly known as black nightshade is a dicot weed in the Solanaceae family. *Solanum nigrum* is an important ingredient in traditional Indian Medicine, Infusion are used in dysentery, stomach complaints, and Fever. *Solanum nigrum* also has anti-cancer, anti-hepatic, antidiabetic properties; *Solanum nigrum* jamun may have great therapeutic potential in the treatment of gastric diseases.

**Keywords:-** *Solanum nigrum*, antimicrobial activity, anti-oxidant activity, anticancer activity.

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### **I. Introduction:-**

*Solanum nigrum* linn. (Sn) Commonly known as black nightshade is a dicot weed in the Solanaceae family. It is an African paediatric plant utilised for several ailments that are responsible for to infant mortality especially feverish convulsions. Sn is an Annual branched herb of up to 90 cm high, with dull dark green leaves, juicy, ovate or lanceolate, and toothless to slightly tooth on the margins. Flowers are small and white with a short pedicellate and five widely spread petals. Fruits are small, black when ripe. [1] *Solanum Nigrum* is a medicinal plant belongs to the family Solanaceae. Its common names are Makoy and black nightshade. [2, 3] Two varieties of *Solanum nigrum* found one is black colour fruit and second is reddish brown colour fruit. In both varieties black colour fruit are toxic. [4] Leaves, whole plant and roots are used for health point of view. [5]

*Solanum nigrum* is an important ingredient in traditional Indian Medicine, Infusion are used in dysentery, stomach complaints, and Fever. The juice of the plant is used on ulcer and other skin diseases. The fruits are used as a tonic, laxative, appetite stimulant, and for treating asthma and “excessive thirst”. Traditionally the plant was used to treat tuberculosis. It is known as Peddakashapandlakoora in the Telangana region. This plant's leaves are used to treat mouth ulcers that happen during winter periods of Tamil Nadu, India disease Known as Manathakkali keerai in Tamil Nadu and kaagesoppu in Karnataka, and apart from its use as a home remedy for mouth ulcers, is used in cooking like spinach. In North India, the exact of leaves and berries are also used to alleviate liver-related ailments, including jaundice. In Assam, the juice from its roots is used against asthma and whooping cough. [6-9] *Solanum nigrum* is a widely used plant in oriental medicine where it is considered to be antitumorigenic, antioxidant, anti-inflammatory, Hepatoprotective, diuretic, and antipyretic. [10]

### **Plant Profile:-**

Taxonomical Hierarchy- [11]

Kingdom = Plantae – Plants

Subkingdom = Tracheobionta – Vascular Plant

Superdivision = Spermatophyta – Seed Plants

Division = Magnoliophyta – Flowering Plant

Class = Magnoliopsida – Dicotyledons

Subclass = Asteridae

Order = Solanales

Family = Solanaceae – Potato

Genus = *Solanum* – Nightshade

Species = *Solanum Nigrum* L – Black Night Shade

Authority = Linn.

### **Vernacular Name:-**

Australia – Black nightshade, Black berry nightshade;

Cameroon – Kumbo (Banso);

Europe – Black nightshade, annual nightshade, garden nightshade;  
France – Morelle noire;  
Italian – Solano, Solatro;  
Russia – Paslen cernyj;  
Germany – Schwarzer Nightshade;  
South Africa – Nightshade (Cape Prov.);  
New Zealand – Black nightshade;  
Tanzania – Mwaha-ka (Kihehe), Suga (Swahili);

**INDIA NAME -**

Sanskrit – Dhvansamaci,  
Assames – Pitkachi,  
Bengali – Gudakamai,  
English – Garden nightshade,  
Hindi – Makoya, Kakamachi,  
Kannada – Ganikesopu,  
Malayalam – Manatakkali,  
Marathi – Kamoni,  
Orissa – Lunlunia,  
Punjabi – Mako, Peelak, Mamoli,  
Urdu – Mako.

**Botanical Description:-** Plants subglabrous to villous annuals up to 70-75 cm high, covered with simple multicellular hairs with glandular or eglandular heads. It shows tap roots with few branches and numerous small lateral roots, pale brown, easily peeled off exposing pale yellow wood. It has erected glabrous or pubescent green, slightly woody unbranched stem. Leaves are ovate, ovate-lanceolate, ovate-rhombic to lanceolate, 2.5-7.0cm long x 2.0 to 4.5(6.0) cm broad, margins entire to sinuate- dentate.

Inflorescences is simple, lax and often extended cymes, (3)5 to 10-flowered; peduncles (8)14 to 28 mm fruiting when usually erecto-patent; pedicels much shorter, recurved in fruit. Calyces 1.2-2.5 mm long, slightly accrescent, deflexed or adhering to base of mature berry, sepals usually ovate. Corollas stellate, white with translucent basal star, (4)5 to 7(9) mm radius, usually 1.5-3 times as long as calyx. Anthers are yellow, 1.5 to 2.5(2.8) mm long. Pollen is (26.6)29.5 to 33.9(35.7)  $\mu\text{m}$  diameter. Styles are 2.8 to 3.5(4.5) mm long, not exerted beyond anthers. Berries are usually broadly ovoid, dull purple to blackish or yellowish-green, 6-10 mm broad, remaining on plants or falling from calyces when ripe. Seeds are 1.7-2.4 mm long, (15)26 to 60(96) per berry. Sclerotic granules are absent. [12, 13] [Shown in figure- 1]



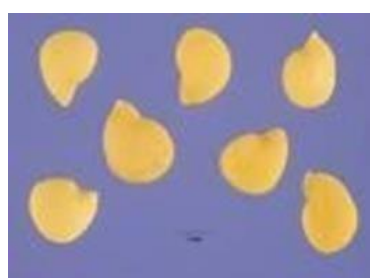
Ripe berry



unripe berry



Stem



Seeds



Figure 1- Plant *Solanum nigrum*

## II. Morphology:-

*Solanum nigrum* is 25-100 cm tall, erect annual herb, pubescent with simple hairs. Stems are often angular, sparsely-pubescent. The fruits are dull black, globose, 8-10 mm in diameter. The leaves are ovate, the bases are cuneate, 4-10 and 3-7 cm wide, pubescent, coarsely dentate, the apex is obtuse. Inflorescences are extra-axillary, umbels, the calyx cup-shaped, the corolla is white, the lobes ovate-oblong, pubescent and axially, ciliate spreading filaments are 1-1.5 mm long, anthers are 2.5-3.5 mm long. [5]

**Habitat and Distribution:-** These species are only semi cultivated 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 weed in cultivated fields, or in Weedy plant communities, under trees, along fences and roads, in Shaded areas, near building and on waste land. They therefore constitute a volunteer crop. Some communities Semi cultivates the vegetable in home gardens or on fertile land portions Near homestead There are a few reports of the cultivation of the garden Hackle berry or its fruits in North America. [14]

**Traditional Uses:-** *S. Nigrum* has been used traditionally to treat various ailments such as pain, information fever and enteric disease. It possesses many activities like antitumorigenic, antioxidant, Antinflammatory. Hepato- protective, diuretic, and anti- antipyretic agent, antibacterial, mycotic infection, cytotoxicity, anti-convulsant, anti-ulcerogenic, It is also used against sexually transmitted diseases. [15-23]

**Chemical Constituents:-** *S. Nigrum* possesses numerous compounds that are responsible for pharmacological activities its active compounds are glycoalkaloid, glycoproteins, and polysaccharide, polyphenolic compounds such as gallic acid, catechin, protocatechuic acid (PCA), caffeic acid, epicatechin, rutin, and naringenin. [24] [Shown in figure- 2]

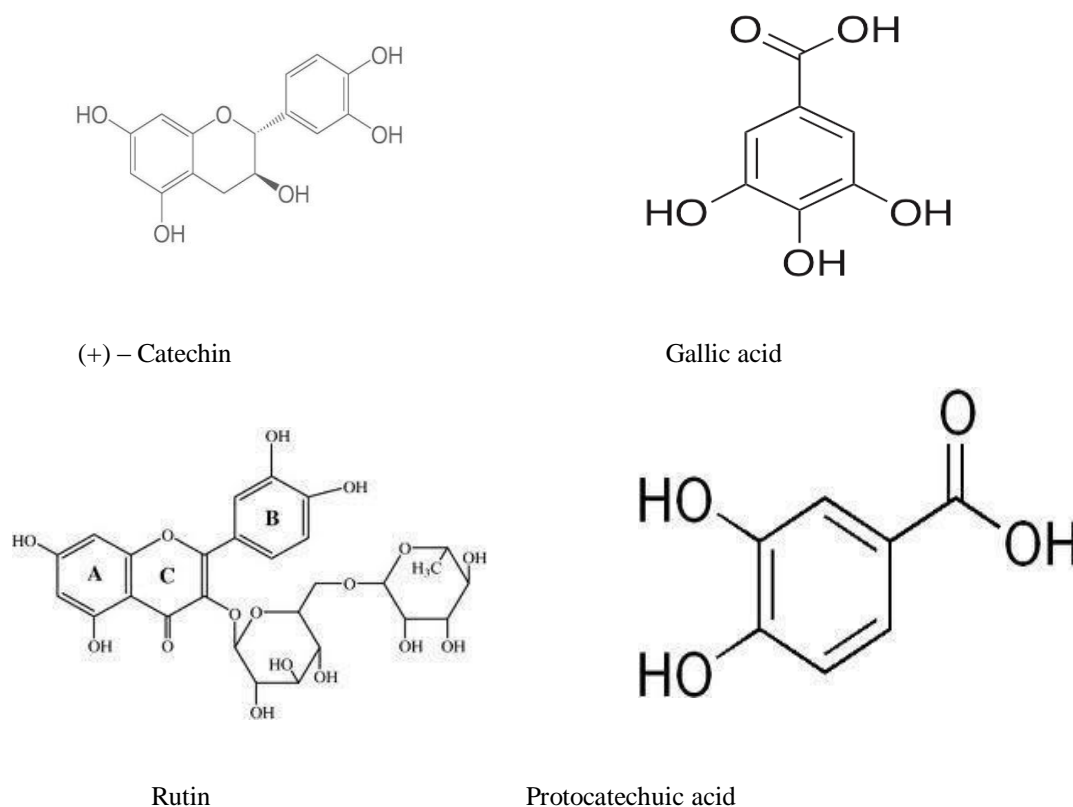


Figure 2- Chemical constituent of *Solanum nigrum*

Several compounds have been isolated from different fraction of Sn which has shown pharmacological relevance to the observed effects of whole plant preparation of Sn. Another study reported the variability of the concentration of organic acids between seedlings of Sn and the mature plant. Acetic acid, tartaric acid, malic acid and citric acid were identified as the major organic acids in Sn.

Tartaric acid and citric acid however, were said to be most important in adaptive response by Sn to environmental stresses. High concentration of solanine, a glycoalkaloid is found in most parts of Sn, but highest levels are found in unripe berries of Sn. However, when ripe, the berries are the least toxic part of the plant and are sometimes eaten without ill effects. Similarly, the solanine may be separated by chromatography into six components: Alpha, beta gamma chaconines, and alpha, beta gamma solanines. The absolute amount of alkaloid per leaf increased during leaf development, Whereas, the concentration declined, Small Unripe fruits of *S. nigrum* had a high concentration of solasodine, but both the concentration and the absolute amount per fruit decreases with fruit maturation. Researches reveal that the alkaloidal content of plant parts change during development of Sn. Nitrates and nitrites also occur in variable amounts in black nightshade and may contribute to its toxic effects. Studies on Sn through spectroscopic analysis, chemical degradation and derivitisation led to the identification of six new steroidal saponins collectively called solanigrasides and a one known saponin degalactotigonin. Similarly, any set of two steroidal saponin known as nigrumins I and II were characterised from Sn. [25]

### **Pharmacological Properties:-**

**Anti-Tumor activity:-** The effect of crude polysaccharide isolated from *Solanum Nigrum* Linn. (SNL-P) was examined on tumor growth. SNL-P had a significant growth inhibitions effect on cervical cancer (U14) of tumour bearing mice. Further the analysis of tumor inhibition mechanism indicated that the number of apoptotic tumor cells increased significantly, the expression of Bax increased and expression of Bcl-2 and mutant P-53 decreased dramatically in cervical cancer section after oral administration of SNL-P for 12 days. Moreover SNL-P treatment decreased the level of blood serum TNF-alpha. These results indicated that the tumor growth inhibition of SNL-P administration might correlated with the reduction of TNF-alpha level of blood serum, which resulted in massive necrosis in tumour tissue and up regulation of Bax and down regulation of Bcl-2 and mutant-53 gene expression which triggered apoptosis in tumor cells. These findings demonstrated that SNL-P is potential antitumor agent. [26] Also in another experiment, the results showed that the total alkaloid isolated from *Solanum nigrum* interfere the structure and function of tumor cell membrane. Disturbed the synthesis of DNA and RNA changed the cell cycle distribution so that total alkaloid could play in inhibition of tumor cells, while the glycoprotein isolated from *Solanum nigrum* Linn. Might have shown anti-cancer abilities by blocking the antiapoptotic pathway of NF-kappaB, activating caspase cascades reaction and increasing the production of nitric oxide. [27]

**Anti-Cancer activity:-** The suppression of EMT in MCF-7 breast cancer cells treated with AESN was evaluated. The results suggested that AESN could inhibit EMT of MCF-7 breast cancer cells mediated by attenuation of mitochondrial function. AESN could be potentially beneficial in treating breast cancer cells, and may be of interest for future studies in developing integrative cancer therapy against proliferation, metastasis, and migration of breast cancer cells. [28] The Anti-tumor effect of AE-SN was evaluated and the synergistic effect of AESN with docetaxel on the human endometrial cancer cell lines was assessed and result showed that AE-SN treatment was effective in suppressing endometrial cancer cells via the autophagic pathway and was also capable of enhancing the cytotoxicity of docetaxel in human endometrial cancer cells our results provide meaningful evidence for integrative cancer therapy in the future. [29]

**Anti-fungal effect:-** The anti-fungal effect of *solanum nigrum* L. was investigated and results showed that the production of solamargine by a cultivable fungal endophyte at a significant yield is a new observation. Further experiments such as media optimization, OSMAC (One Strain Many Compounds) or epigenetic modifiers could be applied to enhance the fungal solamargine production. [30]

**Anti-Stress effect:-** The prophylactic or curative anti-oxidant efficiency of crude extract and the active constituent of *solanum nigrum* Leaves were evaluated results suggested that brain is vulnerable to stress induced prooxidant insult due to high levels of fat content. Thus, as a safe herbal medication the *Solanum nigrum* leaves extract or its isolated constituents can be used as nutritional supplements for scavenging free radicals generated in the brain due to physical or psychological stress or any neuronal diseases perse. [31]

**Anti-oxidative effect:-** The anti-oxidant activity of methanolic extract of berries of the plant *Solanum Nigrum* was evaluated by tissue biochemical anti-oxidant profile. The extract exhibited significant ( $p < 0.001$ ) anti-oxidant potential as evident from the cardiac tissue biochemical anti-oxidant profile. The activity occurred in a dose independent manner. The methanolic extract of berries of the plant *Solanum Nigrum* possessed anti-oxidant activity. [32] The Ethanol extract of the dried fruit of *Solanum Nigrum* Linn. Was assessed for anti-oxidant and cytotoxic activity. In the qualitative anti-oxidant assay using DPPH (1, 1-diphenyl- 2-picrylhydrazyl) the extract showed free radical scavenging properties. [33]

**Hepatoprotective activity:-** The ethanol extract of fruits of *Solanum nigrum* Linn. At a dose of 250mg/kg orally was investigated in male albino rats for its Hepatoprotective activity. It has provided significant protection against most of the



biochemical alteration produced by carbon tetrachloride (CCl<sub>4</sub>). The activities of serum aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphates and total bilirubin were significantly increased with administration of CCl<sub>4</sub>. The degree of protection afforded by ethanol extract, when administered, significantly lowered the elevated serum enzyme and total bilirubin levels. This suggests the maintenance of structural integrity of hepatocytic cell membrane or regeneration of damaged liver cells by the extract. Thus exhibiting potent Hepatoprotective activity. The ethanol extract was also evaluated as Hepatoprotective agent by observing the liver for its Histopathological changes. Histopathological examination of liver section of rat treated with toxicant (CCl<sub>4</sub>) showed intense centrilobular necrosis and fatty changes. The rat treated with extract along with toxicant (CCl<sub>4</sub>) to the considerable extent as evident from the formation of normal hepatic cords and absence of necrosis and vacuoles. [34]

Solanum Nigrum aqueous and methanolic extract were studied for Hepatoprotective activity in rats injected with 0.2 ml/kg carbon tetrachloride (CCl<sub>4</sub>) for 10 consecutive days. S. nigrum aqueous extract (250 to 500 mg/kg) was administered to rats injected with carbon tetrachloride (CCl<sub>4</sub>) for 10 days. The water extract showed a Hepatoprotective effect against CCl<sub>4</sub>-induced liver damage, which was evident by the decrease in serum aspartate amino transferase (AST), alanine amino transferase (ALT) and alkaline phosphatase (ALP) activities, bilirubin concentration and by mild histopathological lesions when compared with the group of rats injected with CCl<sub>4</sub> alone. The methanolic extract of S. nigrum (250 to 500 mg/kg) also showed Hepatoprotective effect with levels of serum AST, ALT, ALP and bilirubin decreasing significantly in animals treated with S. nigrum methanolic extract compared to an untreated group. [35]

**Anti-microbial activity:-** The antibacterial activity of methanol and water extracts of Solanum nigrum leaves was evaluated and phytochemical screening was carried out to know the compounds responsible for these activities. Methanol and water extracts were tested against Escherichia coli, Staphylococcus aureus, Enterobacter aerogenes and Pseudomonas aeruginosa. The susceptibility of the bacteria to the crude extracts on the basis of zones of growth inhibition varied to microorganism and extracting solvent. The methanol extract produced the highest activity when compared to aqueous extract. The organisms used for the purpose of this investigation were associated with opportunistic infections in diabetic patients. [36]

**Anti-ulcer Activity:-** The anti-ulcerogenic effect of the methanolic extract of Solanum nigrum berries on aspirin-induced ulceration in rats with respect to anti-oxidant status in the gastric mucosa have been investigated. Oxygen free radicals are considered to be important factors in the pathogenesis of gastric ulcer. The level of lipid peroxides, which were evaluated highly in rats with acute gastric mucosal injury, was taken as an index of oxidative stress. The activities of anti-oxidant defense enzymes were also decreased considerably by oral gastric administration of aspirin. The decreased level of anti-oxidant enzymes and increased mucosal injury were altered to near normal status upon pretreatment with Solanum nigrum berries when compared to the ulcer-induced rats. The results indicate that Solanum nigrum berries may exert its gastro protective effect by a free radical scavenging action. Solanum nigrum berries may have considerable therapeutic potential in the treatment of gastric diseases. [32]

**Anti-inflammatory Activity:-** The methanolic extract of whole plants of Solanum nigrum L. was investigated for anti-inflammatory activity on the experimental animal models. The methanolic extract at a concentration of 100 ml mg/kg b.wt. and 200 mg/kg b.wt. showed the significant dose dependent anti-inflammatory activity in carrageenan and egg white induced hind paw oedema in rats. The standard drugs were indomethacin (10 mg/kg) and cyproheptadine (8 mg/kg). [37]

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.wt.) has showed significant anti-inflammatory. [38]

**Analgesic Activity:-** Ethanolic extracts of Solanum nigrum for analgesic activity was evaluated. Analgesic activity of the extract was evaluated for its central and peripheral pharmacological actions by using Eddy's hot plate and acetic acid induced writhing respectively. The study was carried out using doses of 100, 250 & 500 mg/kg orally. The extract showed significant analgesic activity at the dose of 500 mg/kg (P<0.01) as compared to standard drug Diclofenac sodium (50 mg/kg). [39]

The Ethanolic extract of the dried fruit of Solanum nigrum Linn. Was assessed for analgesic activity. In acetic acid induced writhing in mice, the Ethanolic extract (250 and 500 mg/kg) exhibited significant (p<0.05 & p<0.01) inhibition of writhing reflex 51.39% and 66.67% respectively compared to standard diclofenac sodium. It shows the positive result for analgesic activity. [40]

**Antidiabetic Activity:-** The aqueous and hydro-alcoholic extracts of different parts of Solanum nigrum plant, viz leaf, fruit and stem for hypoglycemic activity in Sprague Dawley rats. Different doses of the extract 200, 400 mg/kg body weight were employed to evaluate the oral glucose tolerance with standard metformin.

Results indicated that aqueous extracts of leaf and fruit possess significant hypoglycemic effect in dose dependent manner, followed by hydro-alcoholic extracts. The stem extract of S. nigrum has no profound effects. [41] The effect of crude Ethanolic extract of S. nigrum on blood sugar of albino rat after daily oral administration of dose at the level of 250 mg/kg b.wt. For five and seven days respectively. It was noticed that the chronic administration for longer duration leads to significant decrease in blood sugar compared to control. Thus it can be concluded that Solanum nigrum has the anti-diabetic property. [42]

**Anti-Seizure Activity:-** The aqueous extract of the leaves of Solanum nigrum was evaluated for anti-Seizure activity in

chicks, mice and rats by Intraperitoneal administration of the extract. . At a pre- treatment time of 30 minutes and, at graded doses and animals were challenged with different types of proconvulsants. The result was that aqueous leaf extract produced a significantly ( $P < 0.05$ ) dose dependent protection against electrically-induced seizure in chicks and rats, pentylentetrazol-induced seizure in mice and rats and picrotoxin- induced seizure in mice and rats. The anti-seizure property of the extract was potentiated by amphetamine. [43]

### III. Conclusion:-

*Solanum nigrum* is an important medicinal plant in traditional medicine system. *Solanum nigrum* also has anti-cancer, anti- hepatic, anti-diabetic properties; *Solanum nigrum* jamun may have great therapeutic potential in the treatment of gastric diseases. Relieves the tension of the brain due to physical or psychological stress or any neuronal disease. Anti-diabetic properties are also found in *Solanum nigrum*. Carrageenan also has significant dose-dependent anti-inflammatory activity and properties of egg white-induced hind paw edema in rats. It can be advocated as a safe, highly important medicinal plant for general mankind.

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