Solanum Nigrum Linn: A Phytopharmacological Review

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Summary

Plants used in traditional medicine represent a priceless tank of new bioactive molecules. *Solanum Nigrum* L.is one of the important plant from traditional system of medicine found all over the world. *Solanum Nigrum* L., the whole plant shrub, an annual to short lived perennial herb having white or mauve flowers followed by berries, has been reported to possess potent pharmacological properties like hepatoprotective, antiulcerogenic and ulcer healing, neuropharmacological, cytoprotective, antinociceptive, Anti-inflammatory and Antipyretic activities,etc. The various chemical constituents like glycoalkaloids, steroidal oligoglycosides, pregnane saponins, non-saponins, glucose, fructose, β-carotene, ascorbic acid and protein and many others were identified in this plant. This review gives a bird's eye view mainly on the pharmacognostic characteristics, traditional uses, phytochemistry and pharmacological actions.

Key words: *Solanum Nigrum*, phytopharmacology,review.

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Introduction

There exists a plethora of knowledge, information and benefits of herbal drugs in our ancient literature of Ayurvedic (Traditional Indian Medicine), Siddha, Unani and Chinese medicine. One of the earliest treatises of Indian medicine, the Charaka Samhita (1000 B.C.) mentions the use of over 2000 herbs for medicinal purposes while the Chinese Pharmacopoeia lists over 5,700 traditional medicines, most of which are of plant origin.(1,2,3,4,5) Ayurveda-based drug discovery uses reverse pharmacology in which drug candidates are first identified based on large scale use in the population, then validated in clinical trials. Experts say this approach can cut the time for drug discovery from 12 years to 5 years or even less and for a fraction of the used cost.(4)

According to the WHO survey 80% of the populations living in developing as well as developed countries rely almost exclusively on traditional medicines for their primary healthcare needs. (1,2,3) Today, herbal remedies are back into prominence because the efficacy of conventional medicines such as antibiotics, which once had near universal effectiveness against serious infections, is on the wane.(4,6) Since the usage of these herbal medicines has increased the issue regarding their safety, quality and efficacy in industrialized and developing countries are cropped up.(7,8)

Exploration of the chemical constituents of the plants and pharmacological screening may provide us the basis for developing the leads for development of novel agents. In addition, herbs have provided us some of the very important life saving drugs used in the armamentarium of modern medicines. However, among the estimated 250,000-400,000 plant species, only 6% have been studied for biological activity and about 15% have been investigated phytochemically. (1,2,3)

The present attempt is review and compiles updated information on various aspects of *Solanum nigrum,* a plant used all over the world. The plant *Solanum nigrum* Linn. belongs to family Solanaceae which is commonly known as Makoya or kakamachi.(9) Makoya consist of dried whole plant shrub that grows wild and abundantly in open fields. *Solanum nigrum* is

also called as black nightshade which is annual to short lived perennial plant has white or mauve flowers followed by berries that are first green but change to black as they ripen. (10)

Taxonomical Hierarchy (11**):**

Kingdom	:	*Plantae* - Plants
Subkingdom	:	*Tracheobionta* - Vascular plants
Superdivision	:	*Spermatophyta* - Seed plants
Division	:	*Magnoliophyta* - Flowering plants
Class	:	*Magnoliopsida* - Dicotyledons
Subclass	:	*Asteridae*
Order	:	*Solanales*
Family	:	*Solanaceae* - Potato family
Genus	:	*Solanum* - nightshade
Species	:	*Solanum Nigrum* L. - black nightshade
Authority	:	Linn.

Vernacular names (9,12)**:**

Australia : Black nightshade, Black berry nightshade;

Cameroon : Kumbo (Banso);

Europe : Black nightshade, annual nightshade, common nightshade, garden nightshade;

France : Morelle noire;

Italian : Solano nero, solatro;

Russia : Paslen cernyj;

Germany : Schwarzer Nachtschatten,

New Zealand : Black nightshade;

South Africa : Nightshade (Cape Prov.);

Tanzania : Mwha-ka (Kihehe), Suga (Swahili);

India : Sanskrit : Dhvansamaci,

Assamese : Pitkachi,

Bengali : Gudakamai,

English : Garden night shade,

Hindi : Makoya, Kakamachi, Kali makoy

Kannada : Ganikesopu,

Malayalam : Manatakkali,

Marathi : Kamoni,

Orissa : Lunlunia,

Punjabi : Mako, Peelak, Mamoli,

Urdu : Mako

Ecology and Distribution

Natural Habitat: *Solanum nigrum* found in disturbed habitats, such as roadsides, often on arable land especially the edges of cultivated fields and plantations, in hedgerows, on railway cuttings, quaysides and rubbish tips, in areas around buildings and houses, under trees, on forest and grassland margins, as garden weeds, on shingle beaches, riverbanks and in gullies.(13,14)

Biophysical Limit

Altitude : See level to 3048m,

Temperature : Optimal temperatures for the growth of these plants lie between 20 and 30°C, (15,16)

Photoperiod : Approximately 16 hours (daylight is usually supplemented by artificial light) (13)

Moisture : A seed moisture content of 35-40% to be a necessary contributory factor for optimal germination.(17)

Rainfall : Annual rainfall of 500-1200 mm; frequent watering is required during dry periods in temperate areas (18)

Soil type : The plants grow well in light (sandy), medium (loamy) and heavy (clay) fertile soil especially those high in nitrogen or phosphorus and requires well drained acid–neutral or alkaline soil (pH range of 6.0 to 6.5). (10, 19)

Botanical Description (9,12)

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) µm diameter. **Styles** are 2.8 to 3.5(4.5) mm long, not exserted 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.

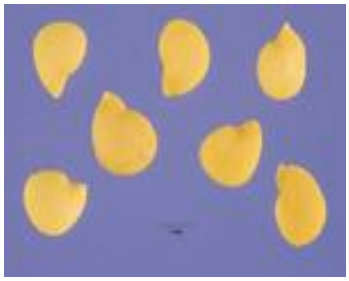
Ripe berry

Unripe berry

Leaves

flower

Stem



Seeds

Microscopy (9)

Petiole and midrib of leaf shows covering, uniseriate trichomes that are 3-5 celled having pointed tips they shows arc shaped bicollateral vascular bundle arrangement. Lamina of leaf shows anisocytic stomata scattered on both upper and lower surfaces but more abundant lower surface.

Palisade ratio : 2-4

Vein islets number : 7-10

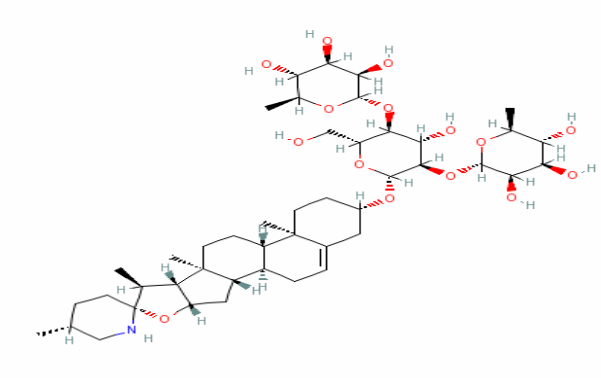
Stomatal index: 15-17(on upper epidermis) and 22-33(on lower epidermis). Fruit shows thin, papery epicarp, pulpy mesocarp and exile placentation; seeds at first remain attached to the placenta but afterwards separate from it and lie free in pulp of fruit.

Phytochemistry

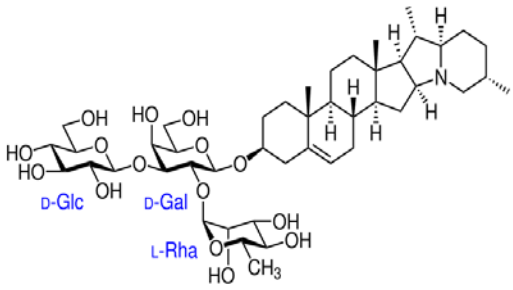
Green unripe fruits contain glycoalkaloids and their eating is a toxic to human being as well as livestock that include solamargine, solasonine, solanine, α and β-solamagrine, solasodine, solanidine(0.09-0.65%). The former two also found in leaves. Solanine is found in all parts of the plants, with the level increasing as the plant matures, though it is apparently modified by soil type and climate (Wetter and Phipps 1978/79). The total alkaloid content of the fruits and leaves are 0.101 and 0.431 respectively. (20, 21, 22) Ripe fruit contains very little alkaloids and can be consumed without ill-effects. The little work done on glycoalkaloids, which are said to be responsible for anticancer activity, indicated that solasonine and solamargine, from leaves and unripe fruits, are the two most important. All authors reported that these compounds are present in the greatest concentrations in green (i.e. unripe) berries, and that the actual concentration can be very variable and can vary according to the stage of plant development, as well as being affected by genetic, seasonal, edaphic and environmental factors.24 Solasonine concentrations are reported highest during fruiting white solamargine is highest during flowering.(24)

Also the phytochemical studies revealed the presence of steroidal oligoglycosides called nigrumnin- I and nigrumnin-II.25 Hu et al. have earlier reported on the identification of three known steroidal glycosides, namely β-2-solamargine, solamagrine, α, β-solansodamine and degalactotigonin. (26) Spirostanol and furostanol glycosides viz. uttroside A, uttroside B ,uttrin A; flavonoids viz. quercetine[3-O-β-glucosyl(1→6)]-O-[β-rhamnosyl(1→2)-O-β-galactoside] and 3-O-α-rhamnos-yl (1→2)-O-β-galactoside and other glycosides of quercetin are also present in *S. nigrum.*(20)

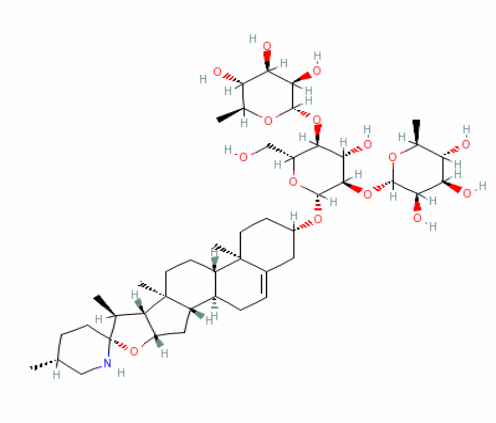
Two new pregnane saponins, solanigroside-A and solanigroside-B were isolated from 60% ethanolic extract of the dried herb of *Solanum nigrum*L.(27) Chemical constituents of the non-saponins from *S. nigrum* were studied on 60% ethanol extract; separation was performed by HPLC and was identified by spectral methods as (I) 6-methoxy-hydroxycoumarine, (II) syringaresinol-4-O-β-D-glucopyranoside, (III) pinoresinol-4-O-β-D-glucopyranoside, (IV) 3,4-dihydroxybenzoic acid, (V) adenosine, (VI) p-hydroxybenzoic acid, (VII) 3-methoxy-4-hydroxybenzoic acid. II, III and V were isolated from this genus for the first time.(28) The steroidal sapogenins, identified as diosgenin and tigogenin, were universally present though not always together, in both the vegetative parts and the unripe berries. The importance of these substances ties in their potential use as raw materials for the industrial production of hormonal steroids. Fruits contain glucose and fructose (15-20%), and β-carotene. Fresh leaves of S. nigrum are said to contain 1 mg/100 g of ascorbic acid. Seeds forming 9.5% of the weight of the weight of the fresh fruit contain 17.5% protein on dry weight basis. (20,23)



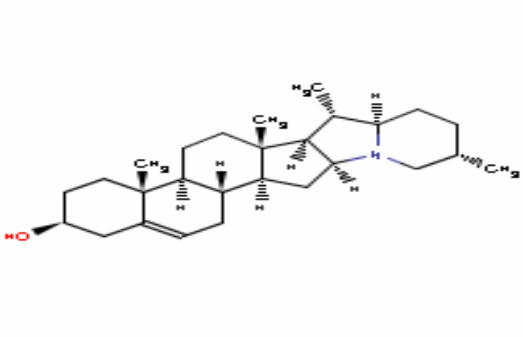
Solamargine



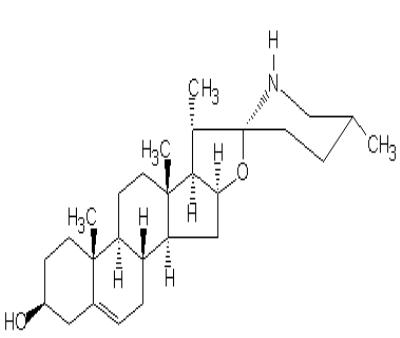
Solanine



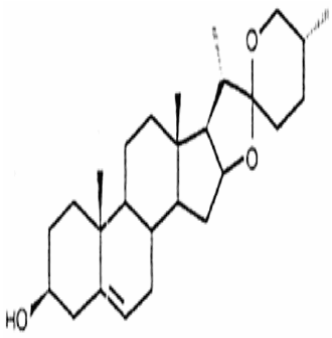
Solasonine



Solanidine



Solasodine



Diosgenin

Nutritive value of vegetable black nightshades

Several studies have been conducted to investigate the nutritive value of the 'vegetable black nightshades; these are summarized in table. From this it is evident that these species constitute nutritious vegetables. The leaves can provide appreciable amounts of protein and amino acids, minerals including calcium, iron and phosphorus, vitamins A and C, fat and fibre, as well as appreciable amounts of methionine, an amino acid scarce in other vegetables. Moreover the berries can apparently yield high mounts of iron, calcium and vitamin B, and appreciable amounts of vitamin C and carotene.(23,29) The seeds too contain vitamin C and carotene (Watt and Breyer-Brandwijk 1962).(29) The nutrient values may, however, vary with soil fertility, plantage and type (i.e. variant or species). It was found that the leaf protein content of *'S. nigrum'* was dependent on the age of the plant. Moreover, the application of nitrogen increases the amount of ascorbic acid and protein while decreasing the calcium content in the leaves.(30) Mathooko and Imungi observed that ascorbic acid content decreased with both an increase in the cooking time and in the volume of water used for cooking. The species accumulate nitrates and contain oxalates and phenolics.(31)

Nutrient per 100-g edible portion	**Range of values**	**Reference Numbers**
Water (%)	83-91	32, 33, 34, 35
Crude protein (g)	2.8-5.8	32, 35, 36,
Crude fibre (g)	0.6-1.4	32, 36, 37,
Fat (g)	0.8	37
Carbohydrate (g)	3.3-5.0	35, 37
Calories (kcal)	38	37
Etheral extract (g)	38-44	32, 35, 36
Total ash (g)	3.3-8.8	35, 36
Iron (mg)	1.0-4.2	32, 36, 37
Calcium (mg)	99-442	32, 36, 37
Phosphorus (mg)	75	37
Beta-carotene (mg)	1.7-11.6	32, 36
Ascorbic acid (mg)	20-158	32, 36, 37, 38
Oxalate (mg)	58.8-98.5	36
Nitrate-N (mg)	29-400	36
Total phenolics (mg)	68.3-73.4	38

Folk Uses:

Place	**Uses**	**Reference No.**
Australia	used as vegetable by old cultures in NW	12
Ethiopia	fruits and leaves edible, fruits edible when black or violet	12
Nigeria	leaves used as spinach	12
Somalia	used as a pot-herb	12
Tanzania (Kigoma Distr.)	leaves boiled and eaten as a vegetable, green fruits edible, roots eaten raw for stomach ache	12
Uganda	leaves eaten	12
Mexico	Fruit is used in traditional medicine, as a remedy for the treatment of nervous condition.	39
Rhodesia	the natives used the plant as one of their remedies for malaria, black water fever, dysenteries, etc.	40
Arab	Used the leaves to treat burns and peptic ulcers.	41
India	The young roots are given in chronic skin diseases and are used with great success in psoriasis.(Konkan) Given internally for cardalgia and gripe and also a household treatment for anthrax pustules when it is applied locally. Berries apparently possess tonic, diuretic and cathartic properties and are also useful in heart diseases and as a domestic treatment for fevers, diarrhoea, ulcers and eye troubles.	12, 40

Zimbabwe	The plant is used as a remedy for malaria, blackwater fever and dysenteries.	12
China	The juices of leaves to alleviate the pain, inflammation of kidney, bladder and in virulent gonorrhea. The leaves are used as a febrifugal or detoxicant drug.	42
Europe (South Africa)	Used for the treatment of convulsions.	43
North America: The Houmas Indians The Rappahannocks	Used an infusion made from boiled roots of this 'species' to administer to babies with worms, and crushed green leaves mixed with a grease to make poultices for sores; Used as weak infusion to cure insomnia	44
Kenya	unripe fruits are applied to aching teeth and squeezed onto babies' gums to ease pain during teething, Roots are boiled in milk and given to children as a tonic.	12

Pharmacology

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 alterations produced by carbon tetrachloride (CCl_4). The activities of serum aspartate amino transferase (AST), alanine amino transferase (ALT), alkaline phosphatase and total bilirubin were significantly increased with administration of CCL_4. The degree of protection afford 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_4) showed intense centrilobular necrosis and fatty changes. The rat treated with extract along with toxicant (CCl_4) to the considerable extent as evident from the formation of normal hepatic cards and absence of necrosis and vacuoles. (45)

Antiulcerogenic and ulcer healing activity:

Gastric ulcers have multiple etiopathogenesis. Ulcers caused by pyloric ligation (PL) are due to increased presence of acid and pepsin in the stomach and damaged by indomethacin are due to decreased prostaglandin (PG) synthesis which is essential for mucosa. Stresses are due to both physiological and psychological factors, which is crucial for gastrointestinal defense and increased accumulation of acid pepsin leading to auto digestion of gastric mucosa. *Solanum nigrum* extract (SNE) showed significant dose dependent ulcer protective effect against cold restraint induced ulcer (CRU), indomethacin (IND) and pyloric ligation (PL) induced gastric ulcer is mainly due to increase omeprazole.In CRU , incidence of ulcer mainly due to increase acid secretion and generation of free radical etc. the protective efficacy against CRU may be due to anti-oxidant activities of SNE and its control on acid secretion thereby strengthening the animal's physiological capability to decrease stress ulcer. in this way , SNE was able to produce significant reduction of gastric mucosal damage induced by IND, indicating probable local increase in PG synthesis.

Moreover, the activation of vagus-vagal reflux by stimulation of pressure receptors in the antral gastric mucosa in the hyper secretion model of pylorus ligature is believed to increase gastric acid secretion. The data clearly demonstrated that, SNE dose dependently decreased the

gastric acid and pepsin secretion which is concordant with earlier reports of antisecretory action of aerial parts of Solanum nigrum. Ethanol treated rats showed significant increase in plasma concentration of gastric hormone gastrin and increase in gastric mucosal H^+K^+ATPase and suppression of gastrin release.(46)

Neuropharmacological activity:
The ethanol extract of fruit of *Solanum nigrum* Linn. was studied for its neuropharmacological properties on Wistar rats. The different neuropharmacological tests were performed on experimental animals with ethanolic extract such as pentobarbital-induced sleeping time, motility test, exploratory behavior pattern (head dip test, Y-maze test, evasive test), test for motor incordination (Rota rod test, Chimney test, traction test, inclined test), anticonvulsant activity, etc. The fruit extract showed the dose dependent activity against various above listed tests. The extract in particular at the dose of 255mg/kg, caused decreased alertness and restlessness. There were neither tremors, twitches, convulsions nor straub tail response. No effects were noticed on alarm, reaction, body posture, limb position, gait, righting reflex, muscle tone, pinna and corneal reflexes. From such observation, it is possible to conclude that the depressant effect of extract on locomotory activity was probably not due to peripheral neuromuscular blockage. The extract was well tolerated by mice and there were no signs of acute (during the 2 hour observation period) or delayed (3 days after extract administration) toxicity. It appears that the ethanolic extract of *Solanum nigrum* Linn. which can cause central nervous system depression which may be correlated with an increased parasympathetic tone.(39)

Cytoprotective role (Vero cells):
The 50% ethanol extract of the whole plant of *Solanum nigrum* was tested in-vitro for its cytoprotection against gentamycin induced toxicity in Vero cells. The cytotoxicity study was assessed by the Trypan Blue exclusion assay, mitochondrial dehydrogenase activity (MIT) assay and hydroxyl radical scavenging method. Incubation of Vero

cells with the different concentration of dried 50% alcoholic extracts of the whole plant of *Solanum nigrum* significantly protected the cells from the effect of gentamycin in dose dependent manner. The observed cytoprotection may be due to increase in activity of free radical scavenging enzyme or counteraction of the free radicals.(47)

Ethno medical activity:
The leaves extract of *Solanum nigrum* was found to be used in oral health care. Several field visits were made in Dharwad district of Karnataka to different parts of study area and in the survey, 245 herbal healers were contacted during different seasons of the year. Information was collected about *Solanum nigrum* used in oral health care, the method of medicinal preparation and its administration.The ethno medicine survey showed that *Solanum nigrum* has its application in tooth ache. Leaves were ground and juice was extracted by filtering through cotton cloth and was found to be used as ear drop for relief from tooth ache. (48)

Antitumor activity:
The effect of crude polysaccharide isolated from *Solanum nigrum* Linn. (SNL-P) was examined on tumor growth. SNL-P had a significant growth inhibition effect on cervical cancer (U14) of tumor 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 if TNF-alpha level of blood serum, which resulted in massive necrosis in tumor 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.(49) 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 anticancer abilities by blocking the antiapoptotic pathway of NF-kappaB, activating caspase cascades reaction and increasing the production of nitric oxide.(50)

Antioxidant effect:

Glycoprotein from *Solanum nigrum* Linn. (SNL-Glycoprotein) was isolated and tested for antioxidative effects on oxygen free radicals using a 1,1-diphenyl-2-picrylhydrazyl (DPPH) assy. The free radical scavenging activities of the SNL-glycoprotein are optimal in acidic pH and up to 60^0C. However, it has minimal activities in the presence of EDTA, although such activities are not dependent on M^{2+} ions (Ca^{2+} and Mg^{2+}) in the presence of EDTA. Interestingly, when SNL-glycoprotein was treated with deactivating agents (Pronase E and $NaIO_4$), the DPPH radical scavenging activity was decreased as compared with SNL-glycoprotein treatment alone. The antioxidative effect of SNL-glycoprotein on super oxide anion and hydroxyl radical under optimal conditions revealed that SNL-glycoprotein has remarkable scavenging effect on both radicals, but exhibited slightly higher scavenging effect on super oxide anion generated by the enzymatic hypoxanthine/ xanthine oxidase system than on hydroxyl radicals generated by the Fenton reaction. However, SNL-glycoprotein was more effect against hydroxyl radical in cell culture (NIH/3T3). Consequently, 20 microgram/mL SNL-glycoprotein has scavenging ability superoxide anion corresponding to that of ascorbic acid. On the other hand, its hydroxyl scavenging activity corresponds to 0.1microgram/mL catalase. From these result, we can say that SNL-glycoprotein has potent anti-oxidative potential. (51)

Molluscicidal and larvicidal activities:

The ethanolic extract preparation of *Solanum nigrum* Linn. leaves were made by soaking powder over night in cold 70% ethanol, was evaluated for molluscicidal and larvicidal effect. The extract shown the highest Molluscicidal activity (LC-50 3.37mg/L within 24 hour) as well as larvicidal activity against larvae of two mosquito species, *Aedes caspius* and *Culex pipiens*, (LC-50 51.29 and 125.89mg/L within 24 hour and 21.38 and 38.11mg/L within 48 hour, respectively). Sunlight, pH and turbidity did not affect the activity of this extract but molluscicidal activity seems to be correlated with the increase of temperature. The concentrated extract (1000mg/L) can be stored at room temperature for six months without any change in its activity, but diluted solution of this extract lost their activity after four week.(52)

Antinociceptive, Anti-inflammatory and Antipyretic Effects:

The chloroform extract was prepared by soaking (1:20; w/v) the air-dried powdered leaves (20 g) in chloroform for 72 hrs followed by evaporation (40°C) under reduced pressure to dryness (1.26 g) and then dissolved (1:50; w/v) in dimethylsulfoxide (DMSO). The supernatant, considered as the stock solution with dose of 200 mg/kg, was diluted using DMSO to 20 and 100 mg/kg, and all doses were administered (sub cutaneous ; 10 ml/kg) in mice/rats 30 min prior to tests. The extract exhibited significant (p<0.05) antinociceptive activity when assessed using the abdominal constriction, hot plate and formalin tests. The extract also produced significant (p<0.05) anti-inflammatory and antipyretic activities when assessed using the carrageenan-induced paw edema and brewer's yeast-induced pyrexia tests. Overall, the activities occurred in a dose-independent manner. The demonstrated that the lipid-soluble extract of *S. nigrum* leaves possessed antinociceptive, anti-inflammatory and anti-pyretic properties and confirmed the traditional claims.(53)

Toxicity:

Most species associated with Solanum section Solanum are reputedly poisonous to both humans and livestock. The widely reported toxicity of S. nigrum has been attributed to the alkaloid solanine causing varying degrees of poisoning in humans, cattle, pigs, goats, ducks and chickens, with death resulting in some cases. The effects of solanine poisoning in humans are reported to be nausea, vomiting, diarrhoea, colic, headache, dizziness, loss of speech, fever, sweating and tachycardia, reduced heartbeat, pupil dilation, blindness, mental confusion, convulsions, coma and death. Such effects normally appear around eight hours after ingestion. (24)

These plants also contain high levels of nitrate nitrogen (NO 3 -N) and are included in the group of plants which can cause $N0_3$-N toxicity in livestock. Acute nitrate toxicity can lead to death, with chronic toxicity resulting in a decrease in milk yield, abortion, impaired vitamin A and iodine nutrition, muscle tremors, staggering gait, rapid pulse, frequent urination, laboured breathing, followed by collapse and coma, with or without convulsions.23 Indeed a chemical survey of various members of the section Solanum reported the presence of potentially toxic alkaloids only in unripe fruits, with ripe berries. Therefore it is concluded that the plant is probably only poisonous to indiscriminate feeders such as livestock who might consume the whole plant.(43)

Discussion

Medicinal plants have provided copious leads to combat diseases, from the dawn of civilization. Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins and lesser costs (54, 55, 56). The extensive survey of literature revealed that *Solanum nigrum* L. is important medicinal plant with diverse pharmacological spectrum. The

plant shows presence of many chemical constituents, which are responsible of the various activities of the plant. *Solanum nigrum* L. embibing a tremendous potential deserves a special attention of the scientific fraternity to emerge as a milestone for medical science of this millennium due to its various medicinal uses. Further evaluation needs to be carried out on *Solanum nigrum* L. in order to explore the concealed areas and their practical clinical applications, which can be used for the welfare of the mankind.

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