**SOLANUM AMERICANUM MILL: A SYSTEMATIC REVIEW STUDY WITH ITS DIFFERENT PHARMACOLOGICAL PROPERTIES**

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**ABSTRACT**

Medicinal plants are extensively used to cure various disease on human beings., which are free from side effects. In Indian traditional medicinal system Ayurveda, Unani and Siddha, there are several single herb formulations and many compound formulation having more than one herbs are mentioned for arthritis disease. The present study was designed to investigate the Anti-arthritic potential of the leaves of plant *Solanum Americanum mill* (Solanaceae) commonly known as “Black nightshade” Arthritic is an autoimmune disease. Characterized by systematic inflammation of joints and damaging of bone around the joints. features including cardiovascular, pulmonary, physiological and skeletal disorders. The body’s natural defenses are part of the problem in rheumatoid arthritis. Due to some unknown reason, the immune system starts attacking certain parts of the body instead of protecting it. Various studied have shown that the *Solanum Americanum mill* have possess various effect/activities like: Anti-tumor effect, Anti-cancer activity, Anti-fungal effect, Anti-stress effect, Anti-oxidant effect, Anti-allergic effect. Although it consists a very vast history of medicinal use with the traditional systems.

**Key words: Solanum Americanum mill, anti-tumor effect, anti-convulsant activity, anti-allergic effect.**

**INTRODUCTION:**

India is one of the largest producers of medicinal herbs in the world. Most of the herbal benefits seem to have been developed through observation of wild animals and by trial-and-error methods. Herbal medicine is an unwritten science well stablished in some cultures and tradition of developing countries. In very last of few decades, there is a tremendous growth in the region of herbal medicine, It is coming popular in both developed and in developing countries due to its natural origin. As the time goes on, People started to find and to utilize more herbs having medicinal power. They systematically brought together information on herbs and developed to well-defined herbal Pharmacopoeias i.e., traditional Medicinal system.

Plant is the source of chemical intermediates which are needed for the production of the drugs as well as plant are also the source of a number of well establish and important drugs, Siddha medicine taken part in the Health service in India with the record of 10000 years existing alongside conventional medicine.

In Siddha Pharmacology The published national Siddha formulary of India lists 500 or above than that well Siddha for the mutations.
Medicine from plant sources have been in use in Homeopathy, Ayurvedic, Allopathy and also in traditional medicines since time immemorial. A medicinal plant plays a significant role among the modern and traditional systems. Their use has been multiplied through various researches and application due to a number of side effects from use of synthetic drugs, antibiotics and high cost. The people of rural area mainly depending on the traditional medicine for curing their ailments cause of the non availability of modern medicines and hospitals. In India, with more than 75% of the population residing in rural areas [1] close to the natural resources, rich traditions of utilizing medicinal plants have existed among indigenous people of ages [2].

In the desire of existence man has always endured for the healthy life. In eagerness to obtain healthy life, to achieve happiness and diminue sorrows man has always turned to nature from the time immemorial. He has made continuous effort to know more about nature and become most adaptogenic to nature by using eternal treasure for his benefits and so the science of health has flourished. This process is always dynamic and is still in progress. In this process man used many substances as provided by nature; various herbs being the commonest among them. In 21st century, developing countries hugely depend on medicinal plants for healthcare. [3] Currently, near about 80 % of the world population use herbal medicine and World Health Organisation (WHO) also encourages, recommends and promotes inclusion of herbal drugs in national health care programs. Because these drugs are easily available at a price within the reach of common man and such are time tested that these are considered to be safer than modern synthetic drugs. But one of stumbling blocks in the wider acceptance of medicinal plant drug is lack of or inadequacy of scientific data at the hand on the ethno-medicinal aspect of these drugs. Nowadays, worldwide interest is increasing in Traditional System of Indian Medicine due to its unique fundamentals and practices. It is being adopted, & studied and explored widely for its potential of treating wide array of diseases. For this, it is the need of the hour to collect and review more and more information from the ancient literature which may provide a link to researchers to unravel this system [4]. India is the largest producer of medicinal herbs and is called as “botanical garden of the world”. Plants have the ability to synthesize a wide array of chemical compounds that protect them against the attack from a wide variety of the predators such as microbes, insects, and herbivorous mammals. Some of these compounds, while being toxic to plant predators, turn out to be have beneficial effects when used to treat human diseases. Such secondary metabolites are highly varied in structure; many are aromatic substances, most of which are phenols or their oxygen-substituted derivatives. Natural products such as plants extract, either as of pure compounds or as standardized extracts, provide unlimited opportunities for new drug discoveries because of the unmatched availability of chemical diversity [5]. The therapeutic effects of herbs/herbal extract cannot be determined as unless its active ingredient or cofactors are identified. One way to indicate strength is standardization to one or several marker compounds that are believed to be mainly responsible for biological effects. Although phytotherapy continues to be used in several countries, most of traditional medicinal plants have not received scientific or the medical scrutiny [6].

USES OF HERBAL DRUGS IN MEDICINES:

In India, Herbal drugs are important part of Indian Medicine system (Ayurveda)which is an ancient and conventional system. Moreover, this our culture is rich in herbal drugs in that way causing a high incidence of their self-medication, as also these drugs are sold openly [7].
PLANT PROFILE:

*Solanum Americanum mill* is a medicinal branched herb belongs to family Solanaceae and it has its beneficial effects on different diseases like arthritis, cancer and microbial infections and many more. The phytochemical investigation of *Solanum Americanum mill* shows the presence of saponins, tannins, and alkaloids. A dietary intake of *Solanum Americanum mill* supplies to our body with a lot of nutrients that offer protection against numerous diseases. All parts of *Solanum Americanum mill* are used in the traditional medicine as a remedy for treating various diseases like cough, cold, asthma, arthritis, skin disease and liver problem.

BIOLOGICAL SOURCE:

It consists of the dried and full-grown berries of *Solanum Americanum mill*.

GEOGRAPHICAL SOURCE:

Medicinal Botany, National Institute of Siddha, Chennai, Tami Nadu, India [8].

COMMON NAME:

Black nightshade, Makoi

- **BOTANICAL NAME**: *Solanum Americanum mill*
- **FAMILY**: Solanaceae
- **KINGDOM**: Plantae
- **UNRANKED**: Angiosperm
- **ORDER**: Solanales
- **GENUS**: Solanum
- **SPECIES**: *Solanum Americanum mill*
- **TAXONOMICAL CLASSIFICATION**
  - **DIVISION**: Embryoophyta
  - **SUB DIVISION**: Angiospermae
  - **CLASS**: Dicotyledonae
  - **ORDER**: Tuber florae
  - **SUBORDER**: Solanales
  - **FAMILY**: Solanales
  - **GENERA**: Solanum

SYNONYMS: [9]

- Australia: Black nightshade, Black berry nightshade,
- Europe: Black nightshade, annual nightshade, common nightshade, garden nightshade,
New Zealand: Black nightshade,
South Africa: Nightshade,
Sanskrit: Dhvansamaci,
Bengali: Gudakamai,
English: Garden night shade,
Hindi: Makoya, Kakamachi, Kali makoy
Kannada: Ganikesopu,
Malayalam: Manatakali,
Marathi: Kamoni,
Punjabi: Mako, Peelak, Mamoli,
Urdu: Mako. (8)

MORPHOLOGY:
The Bark is little thin and get Easily peeled off showing pale yellow wood. The flowers are having the five petals and regular in shape. They are mostly found in the flat and star –shaped. The leaves are variable and may be dissected without stipules and are alternate Usually, the fruits are thin and pulpy. The Seeds are oil free in the pulp of fruit [10].

DESCRIPTION:
The leaves of Solanum Americanum mill is 4.0 to 7.5 cm long and 2 to 5 cm wide, ovate to heart –shaped, and with a wavy toothed edge, both surface hairless and hairy; The flower having petals to whitish, recurved when aged and surround with prominent bright yellow anther. The Berry is mostly 6-8 mm in diameter and having the purple black color [11].

HABITAT AND DISTRIBUTION:
• The species are semi cultivated in few of the countries like Africa & 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 & roads, there are a few reports of the cultivation of the garden huckleberry for its fruits in North America. Solanum Americanum mill growing mostly in South Asia.
• The black nightshade is widely distributed in the various habitats throughout the world, from tropical to temperate regions and from sea level to the altitudes exceeding 3500 m. It is a rather common species in wet woods, near river, wasteland, old field, ditches roadside and in cultivated land [12].

CHEMICAL CONSTITUENTS:
• Phytochemical investigation of whole plant reported that it contains alkaloids, flavonoids, tannins, glycosides, saponins, carbohydrates, proteins, phytosterols & coumarins, it has been found that Solanum Americanum mill contains the substances, such as total alkaloid, steroidal saponins, steroid alkaloid and glycoprotein which exhibiting the anti-tumor activity.
- It is studied that chemical characterization of osmotic–like a protein from this plant. Glycoprotein consist of carbohydrate content (69.74%) and protein content (30.26%) which contain more than 50% glycine and proline.
- Some researchers isolated the two new groups of steroidal saponins, named as Solanum’s 1 and 2, together with 2 known saponins were obtained from the whole plant of solanum Americanum mill. Recently phytochemical analysis on the Solanum Americanum mill has resulted in the isolation of two novel disaccharides [13,14].

PHARMACOLOGICAL PROPERTIES:

ANTICANCER PROPERTIES:
The effect of crude polysaccharide isolated from Solanum Americanum mill. (Solanum Americanum mill -P) was examined both in vivo and in vitro on U14 cervical cancer cells. Though exposure to Solanum Americanum mill -P had no antiproliferative effect in vitro at doses up to 1 mg/ml, it decreased the number of ascites tumour cells and survival time of U14 cervical cancer bearing mice which received between 90 - 360mg/kg bw. P.o. FACScan flow cytometer analysis showed that most of the ascites tumour cells were arrested in G2/M phase of cell cycle. This can be considered as the basis for its use as an anticancer agent [15].

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 which utilises six pre-treatment methods before cooking on the peroxidase activity, chlorophyll and antioxidant status of Solanum Americanum mill., showed that pre-treatment 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 Solanum Americanum mill. Solanum Americanum mill glycoprotein showed a dose-dependent radical scavenging activity on radicals, including 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radicals, hydroxyl radical (OH), and superoxide anion (O2 −). Although Solanum Americanum mill acts as an anti-tumour, the Solanum Americanum mill glycoprotein may induce apoptosis through the inhibition of NF-kB activation, induced by oxidative stress in HT-29 cells. A 50% ethanol extract of the whole plant of Solanum Americanum mill also possess hydroxyl radical scavenging potential which is suggested as cytoprotective mechanism. Evaluation of the antioxidant potential of Solanum Americanum mill leaves on the modulation of a 6 h restraint induced oxidative stress, which suggest that Solanum Americanum mill was better as an antioxidant with post-restraint treatment than with prerestraint administration [17,18].

ANTI-CONVULSANT ACTIVITY:
Central nervous system-depressant action of Solanum Americanum mill was ascertained by measuring the effects of intraperitoneal injection of Solanum Americanum mill on various neuropharmacological parameters. Fruit extracts of Solanum Americanum mill 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. The potency of *Solanum Americanum mill* in combating infant convulsion is widely accepted in African paediatric medicine. Researcher tested the anti-convulsant effects of leaves of *Solanum Americanum mill* in chicks, mice and rats [19]. A 30 min pre-treatment by intraperitoneal injection of *Solanum Americanum mill* leaf extract protected the animal subjects against different types of proconvulsant. 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. Present experimental data supporting the claims of the acetylcholine-like activity of *Solanum Americanum mill* [20]. They based their conclusion on the basis of the observation of the following effects: Isotonic contraction of the isolated toad rectus abdominis;

2) Negative chronotropic and inotropic action on the isolated toad heart;

3) Isotonic contraction of the isolated guinea pig's ileum;

4) Isotonic contraction of the rat's isolated jejunum;

5) Decrease on the cat's arterial blood pressure;

6) Secretory effects on the rat's submaxillary gland. Fruits of *Solanum Americanum mill* were also found to contain acetylcholine-activity compounds up to 250 micrograms/g of fruit [21].

**ANTI-TUMOR EFFECT:**

It has investigated on the polysaccharide fraction from *Solanum Americanum mill*, *Solanum Americanum mill*-ppF3 was examined regarding to immune-modulatory activity. These results suggested that tumour suppression mechanisms observed in *Solanum Americanum mill*-ppF3-treated mice were most probably due through enhancing the host immune response. *Solanum Americanum mill*-P1a had significant growth inhibition effect on U14 cervical cancer and protective effect on thymus tissue of tumour-bearing mice [22].

**ANTI-LARVICIDAL EFFECT:**

It has performed by the biocontrol potentiality of active ingredient isolated from ethyl acetate extract of mature leaves of *Solanum Americanum mill* (Solanaceae) was investigated. The findings indicated that there is a clear dose-dependent mortality, as the rate of mortality (Y) was positively correlated with the concentrations of the compound (X); having regression coefficient value close to 1 [23].

**ANTI-STRESS EFFECT:**

The prophylactic or curative anti-oxidant efficacy of crude extract and the active constituent of *Solanum Americanum mill* leaves were evaluated. result 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 Americanum mill* leaves extract or its isolated constituents can be used as nutritional supplement for scavenging free radicals generated in the brain due to physical or psychological stress or any neuronal diseases [24].

**ANTI-ALLERGIC EFFECT:**
Potential of the plant berries in the treatment of asthma was evaluated. The petroleum ether extract of *Solanum Americanum mill* berries can inhibits parameters linked to the asthma disease [25].

**ANTI-ULCER ACTIVITY:**

It has performed on the anti-ulcerogenic effects of the methanolic extract of *Solanum Americanum mill* berries on aspirin induced ulceration in rats with respect to antioxidant status in the gastric mucosa have been investigated. The results indicate that *Solanum Americanum mill* berries may exert its gastroprotective effect by a free radical scavenging action. *Solanum Americanum mill* berries may have considerable therapeutic potential in the treatment of gastric diseases [26].

**ANALGESIC ACTIVITY:**

It has investigated on the ethanolic extracts of *Solanum Americanum mill* 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 [27].

**ETHANOMEDICINAL USES:**

The Berries and leaves are mostly used for their medicinal properties, Besides the other parts of the plant. The leaves are used for rheumatic & gouty joints, skin diseases, used in the treatment OF Anti-tuberculosis & said to produce Diaphoresis. The leaves are also showing their effect in dropsy, nausea & nervous disorders. In the cough the detection of the berries and flowers are found to be very useful. These are remedy for pulmonary tuberculosis and bronchitis, and also in diuretic [28].

In the Anti-diarrheal, Ophthalmopathy and hydrophobic condition hydrophobic condition the juice of the berries is used it is also used in the diseases related to heart. Berries are possessing tonic property. They are also useful in inflammations and skin diseases. The roots are useful in osteopathy, rhizopathy & hepatitis the whole plant used as antiseptic, anti-inflammatory, expectorant, cardiotonic, diuretic, laxative, sedative and also as a diaphoretic [29].

**CULINARY USES**

- *Solanum Americanum mill* is used as food since early time fruits are used as famine food 15th century in China. The ripe berries and boiled leaves of edible strains are eaten. The boiled leaves although strong and bitter flavoured are used like a spinach as Horta and in fataya pies and quiches. The ripe black berries are sweet and salty, with hints of liquorice and melon.
- In Kenya, the *Solanum Americanum mill* is a vegetable delicacy which when blanched and sauteed or boiled to soften then salted or sauteed and eaten with Ugali (meal product).
- In India, fruits are casually grown and eaten, but not cultivated for commercial use. In South India, the leaves & berries are habitually consumed as food after cooking with tamarind, onion, and cumin seeds. The berries are referred to as "fragrant tomato". Although not popular across much of its growing region, the fruit and dish are common in Tamil Nadu, Kerala, southern Andhra Pradesh, and southern Karnataka.
In South Africa, the very ripe and hand-selected fruits are cooked into a beautiful but quite runny purple jam.

In Indonesia, the young fruits and leaves of cultivated forms are used. The fruit and leaves are eaten raw part of a traditional salad or the fruit is cooked.

It was imported into Australia from Mauritius in the 1850s as a vegetable during the gold rush but it is now prohibited for trade as a food by the Australia New Zealand Food Standards Code [31].

**ADVANTAGES/BENEFITS:**

- *Solanum Americanum mill* is benefited for human from ancient time. It is used in the various forms as a medicinal plant and it is also used as food.
- *Solanum Americanum mill* is best used in treat diuretic in cardiac dropsy.
- It is medicine for infirmities that needed cooling.it is enough good for cooling hot inflammation testicular swelling ringwormed.
- A decoction of the stalk, leaves, and the roots of black nightshade is beneficial for wounds and cancerous sores.
- Freshly prepared extract of the plant is so effective in treating cirrhosis of the liver and also works as an antidote to poisoning by opium.
- Ripe fruits of the black nightshade are eaten by children during normal times, while all the affected people eat fruits of the plant during famines.
- The juice of the herb or an ointment prepared from it is externally applied to cure certain skin problems and tumours [32].

**DISADVANTAGES/SIDE EFFECT:**

*Solanum Americanum mill* is quite poisonous and if it is taken in higher doses, it may be cause:

- Nausea
- Diarrhea
- Headache
- Dizziness

**CONCLUSION**

This article revealed the therapeutic importance of Solanum Americanum mill. Although *Solanum Americanum mill* have a very vast history of medicinal uses within the traditional systems (Siddha, Ayurveda). It has a wide range of potential therapeutic applications in various activities like Anti-tumor effect, Anti-cancer activity, Anti-fungal effect, Anti-stress effect, Anti-oxidant effect, Anti-allergic effect. In present time many pharmacological and phytochemical studies have been performed on this drug. Therefore, more researches can be done to exploit the unexplored therapeutic potentials of *Solanum Americanum mill* which have already been mentioned in the traditional literature.

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