

# Pharmacological Aspects of Solasodine Found in *Solanum xanthocarpum* and *khasianum*: A Review

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**Abstract** Epilepsy is a neurological disorder (related to central nervous system) in which brain activity becomes abnormal, causing seizures or periods of unusual behavior, sensations, and sometimes loss of awareness. Epilepsy is considered to be resolved for everyone who is seizure-free for the last 10 years out of which 5 years should be without medicines. Although lots of antiepileptic drugs are available in the market, almost 33% patients continue to present seizure. For the curing of epilepsy disorder there are some medicinal plants such as a *Ficus sycomorus*, *Sclerocaryabirrea*, *Annona diversifolia*, and plants from Solanaceae family, and many more used in traditional medicine have found with anticonvulsant properties in animal models and may be a great and novel source of newer antiepileptic drugs. Based on various reviews on Solanaceae plants eg. *Solanum nigrum* also consists the active constituent of solasodine and it is the main constituent to inhibit the epilepsy disorder by the exhibition of excitatory sodium voltage channels they are responsible for excitation of neurons. It should be very helpful to continuing research on Solanaceae plants especially those contain solasodine because it helps further curing treatment about epilepsy disorder.

**Keywords:** *solanum khasianum*, *solanum khasianum*, *solasodine*, *epilepsy*

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## 1. Introduction

Epilepsy is a common disorder, found in all countries and at all age groups. [1] Modern drugs have not exhibited sufficient effectiveness in their ability to cure seizures; then there are many side effects such as an impairment of the central nervous system, aplastic anemia, hepatic failure, or even death. [2]

Biological activities of different parts of the plant of solanaceae reported include anti-microbial, antioxidant, anti-inflammatory, analgesic, anti-diabetic, cytotoxicity, hepatoprotective, anti-cancer, larvicidal and piscicidal activity, and all these novel experiments was performed successfully, as per all these the solanaceae plants should have efficacy to cure epilepsy disorder. [3] Berries of *Solanum surattense* contain high concentration of an alkaloid solasodine, which is shown the variation in its content in the range of 1.1%-4.6%. Berries collected during September to October yielded the alkaloids solasonine and solamorgine. However, the fruits collected during May-June yielded another alkaloid solasonine. The solasodine is glycoalkaloid components and the exhibit sodium ions. [4] *Solanum xanthocarpum* Schrad. &Wendl. Is an important source of many pharmacologically and medicinally important chemicals, particularly steroidal hormone solasodine and chemicals like solasonine, campesterol, campeferol, diosgenin and

various useful alkaloids. [5]

MES-, and PTZ-induced seizures and thiopental-provoked sleep models. Solasodine (25, 50, and 100 mg/kg, i.p.) showed dose-dependent significant ( $p < 0.001$ ) anticonvulsant activity in the MES-induced convulsions paradigm. Antiepileptic drugs prevent MES-induced HLTE phase by inhibition of voltage-dependent  $Na^+$  channels. Protection offered by solasodine against HLTE (hind limb tonic extensor) phase in this model predicts inhibition of voltage-dependent  $Na^+$  channels to prevent the seizure discharge in the brain. [6]

As per these studies, Gamma-Aminobutyric acid, the principal inhibitory neurotransmitter in the cerebral cortex, maintains the inhibitory tone that counterbalances neuronal excitation. When this balance is perturbed, seizures may ensue. Voltage-gated, sodium channels are responsible for the generation and propagation of action potentials. Through transiently, increasing membrane permeability to sodium ions. [7] within the central nervous system, Voltage-gated sodium channels are crucial for regulating neuronal excitability and, therefore, network activity. [8]

## 2. Plant Profile

### 2.1. Solanum Xanthocarpum

The plant is common in wasteland and roadside in India. It grows mostly as a weed. In India, it grows mostly in dry

parts of Rajasthan, Gujarat, Uttar Pradesh, Madhya Pradesh and Haryana. [9]

Common Name: Kantakari, yellow fruit nightshade

Family plant: Solanaceae

Related species: *S. nigrum*, *S. khasianum*

Plant parts used: The leaves and fruits are mainly used, sometimes the unripe fruits and whole plant. [10]

### 2.1.1. Phytochemistry

Plant contain saponins, alkaloids, flavonoids, sterols, glycosides, carbohydrates, fatty acids, amino acids etc. Structures of some phytoactive compounds from *Solanum xanthocarpum* Schrad. & Wendl. And Steroidal alkaloids is the principal alkaloid [11].

## 2.2. Solanum Khasianum

It is a hardy shrub belonging to the family Solanaceae. The Solanaceae family consists of 90 genera with 3000-4000 species. The genus *Solanum* alone has 1250-1700 species. This family shows a wide difference in habitat, distribution as well as morphology. [12]

Common Name: Kantakari, *Solanum viarum* Duna, Dutch eggplant

Family plant: Solanaceae

Plant parts used: The leaves and fruits are mainly used, sometimes the unripe fruits and whole plant. [13]

### 2.2.1. Phytochemistry

Solasodine has been isolated in 5.4 per cent yield from mature berries of *Solanum khasianum* berries collected from different localities has shown that those from the Nilgiris contain the most solasodine. The plant belonging to the genus *Solanum* and the glycoalkaloids are variously named solasonine, solamargine etc. with the common spiroaminoketal alkaloid or aglycon namely solasodine. [14]

## 3. Extraction and Isolation

### 3.1. Various Types of Extraction of *S. xanthocarpum* and *S. khasianum*

Plant's extracts or constituents that have been tested for anticonvulsant activity are: alcoholic extract; aromatic essential oil; alkaloidal extract; aqueous extract; aqueous solution of mixed fatty acids; boiled extract; 6-benzoylheteratisine; 1-benzoylnapelline; chloroform extract; ethanolic extract; essential oil; hydro alcoholic extract; imperatarin; lyophilised aqueous extract; methanol extract; neutral essential oil; steam distillate extract; scoparone; water extract; vacuum dried aqueous extract; Xanthoxyletin, these all methods are useful in extract solvents. [16]

### 3.2. Isolation of Solasodine

The steroidal glycoalkaloids which are the active constituents were isolated as pure compounds from the crude methanolic extract of *S. xanthocarpum* by preparative GC-MS and after characterization was used as external standards for the development and validation of

the method. Extracts prepared by conventional Soxhlet extraction, and ultra sonication was used for analysis. [15]

## 4. Pharmacological Activity of Solanaceae Plants

Various studies generated and its potential prospects for the further scientific investigation for the development of effective.

### 4.1. Antioxidant Activity

Extracts of leaves were tested for in vitro free radical scavenging assays, such as hydrogen peroxide and hydroxyl radical, inhibition of superoxide anion radical and 2, 2-diphenyl-1-picryl hydrazyl radical, reducing ability and total antioxidant activity. Further, total phenolic content of *S. surattense* was analyzed. The antioxidant activity of alcoholic leaf-extract of *Solanum surattense* (Solanaceae) (*S. surattense*) study validates the therapeutic benefits of the Indian system of medicine. [17]

### 4.2. Anticonvulsion Activity of *Solanum nigrum*

The potency of *Solanum nigrum* in combating infant convulsion is widely accepted in African pediatrics medicine. Researcher tested the anticonvulsant effects of leaves of *S. Nigrum* in chicks, mice and rats. In this reviews the author was say that the drug constituents are solasodine, and the solasodine also found in *S. xanthocarpum* and *S. khasianum*. [18]

### 4.3. Anticancer Activity

The plant material of *S. Xanthocarpum* was serially extracted with hexane, chloroform, ethyl acetate and methanol. Compounds were isolated from methanolic extracts, steroidal constituents from *Solanum Xanthocarpum* and *Asparagus racemosus* clearly have the job to tumor cell death, and these natural products represent interesting lead compounds for the development of potential cancer therapeutics. [19]

### 4.4. Immunomodulatory Activity

This review will focus on the latest developments to immunomodulatory activities of plants of steroidal saponins of *Solanum Xanthocarpum* and *Solanum nigrum*, Use of phytoconstituents has been a supportive practice for our immune system against infectious disease since centuries as these drug substances enhance the immune response against infections. [20]

### 4.5. Antimicrobialactivity

*Solanum nigrum* possess antimicrobial activity against bacteria of respiratory tract infections. The plant belongs Solanaceae family can be used as a source of oral drugs against respiratory tract infections and however, further studies are required to isolate the active principle from the

crude extract for proper drug development. Because of various researches now confirmed by researchers. [21]

#### 4.6. Hepatoprotective Activity

50%, ethanolic fruit extract of *S. Xanthocarpum* (100, 200 or 400 mg/kg body weight) was administered daily for 14 days in experimental animals. Liver injury was induced chemically, by carbon tetra chloride administration (1 ml/kg). The hepatoprotective activity was assessed using various parameters like biochemical aspartate amino transferase, alanine aminotransferase, Serum alkaline phosphatase and bilirubin. [22]

#### 4.7. Antiurolithiatic Activity

This study was designed to rationalize the use of *Solanum Xanthocarpum* in kidney stone and to investigate its mechanism of action, through the various biochemical parameters were measured in urine, serum, and kidney homogenate. Kidneys were also analyzed by histopathological analysis. A well-known traditional herb *Solanum Xanthocarpum* is widely used saponin rich fraction prepared from the fruits of *Solanum xanthocarpum*. [23]

#### 4.8. Antinociceptive Activity

The methanolic extract of *Solanum xanthocarpum* with its aerial parts, given orally at 125, 250 and 500 mg/kg, showed many antinociceptive activity in animal model with mice, and shows that inhibits nociception because the drug contains glycol-steroidal alkaloids. [24]

#### 4.9. Antimalarial Activity

The fruits and leaves are reported to contain several steroidal alkaloids like solanacarpine and solamargine. Larval and pupal mortality of *C. quinque fasciatus* after the treatment of ethanol *S. xanthocarpum* was found to be very effective. [25]

#### 4.10. Antidiabetic Activity

Solanaceae family comprised of one thousand five hundred species and most of the members of the genus are widely used as food and traditional medicine. Diabetes mellitus is a common and serious metabolic disorder around the world. Traditionally used medicinal plants played an important role as alternative medicine due to less toxic effects and economic cost. [26]

#### 4.11. Hypoglycaemic Activity

Aqueous extract of the fruits of *Solanum Xanthocarpum* Schrad. & Wendl. (Solanaceae) was investigated for hypoglycemic activity in rats and mice. It is enhancing the peripheral use of glucose that decreases the level of glucose and has an extra pancreatic effect. [27]

#### 4.12. Haemolysis Effect

Methanolic extract of the fruits of *S. Xanthocarpum* is partially capable of protecting the erythrocyte membrane

and tissue of both human and sheep blood cells against haemolysis induced by a hypotonic solution. It is also capable of protecting the cells by decreasing the percentage of release against induced lipid peroxidation. [28]

#### 4.13. Antifertility Activity

THE berries are the main source of solasodine and diosgenin. Solasodine is N-analogue of diosgenin and used as a steroidal precursor in the steroid drug industry for the manufacture of corticosteroids, antifertility drugs, anabolic steroids etc. It is present as a glycoside in most of the berries of the plant of the genus *solanum* and the glycoalkaloids are variously known as solasonine, solamargine etc. with the common spiroaminoketal alkaloid or aglycon namely solasodine. [29]

#### 4.14. Antifungal Activity

The author studied *in vitro* activity of the microbial growth and used the powdered plant materials were extracted successively with n-hexane, chloroform, acetone, methanol and water to afford corresponding fractions, minimum inhibitory concentration Water extracts of *Acacia nilotica*, *Justicia S. xanthocarpum*, *Lantana camara* and *Saracaasoca* exhibited good activity against all the tested bacteria and the minimum inhibition concentration was recorded in range of 9.375-37.5 µg/ml and 75.0-300.0 µg/ml against the bacterial and fungal pathogens, respectively. [30]

#### 4.15. Anti-inflammatory Activity

*Solanum xanthocarpum* Schrad and Wendl (Kaṅṭakari) is a diffuse herb with prickly stem, traditionally used for the treatment of inflammation and one in the group of *dasmula* (group of ten herbs) herbs commonly used drug in Ayurveda. [31]

#### 4.16. Antitussive Activity

Moreover its efficacy was nearly the same as codeine phosphate, the antitussive drug used in clinical practice. Antitussive activities have also been observed with polysaccharides such as arabinogalactans, arabinogalactanproteins. [32]

#### 4.17. Antihelmenthic Activity

The drug evaluated that antihelmenthic activity of *S. surattense* whole plant crude aqueous, hydroethanolic, and ethanolic extracts at 25, 50, and 100 mg/ml conc. in distilled water. Piperazine citrate 10 µg/ml used as a reference standard. The study revealed and succeed ethanolic plant extracts (100 µg/ml conc.) showed the remarkable antihelmenthic property than aqueous and hydroethanolic extracts. [33]

#### 4.18. Wound Healing Activity

Wounds (Physical injuries) and wound infections are the most common diseases overcome by wound healing. Wound healing restores the disturbed anatomical continuity and normalizes the epithelial integrity of the

skin. Many plants used as a remedy for wound healing, in traditional system of the medicine. Investigations on the wound healing property of various plants led to the discovery of a large number of wound healing agents from plants. [34]

#### 4.19. Diuretic Activity

Investigations of on diuretic and electrolyte regulation properties of *S. surattense* fruit extracts revealed that fruit extracts significantly increased the urine output in a dose-dependent manner. Fruit extract exhibited the diuretic activity by increasing the osmolality of urine together with excretion of electrolytes, due to the presence of phenolic caffeic acid and methyl caffeates as secondary metabolites regarding the liquid electrolytes, fruit extracts reduced the level of sodium, potassium, and calcium whereas liquid bicarbonates' concentration was increased in a dose-dependent regulation. Treatment with fruit extracts results a big decrease in blood urea nitrogen and Ca<sup>2+</sup> proved its diuretic potential. [35]

#### 4.20. Analgesic Activity

*Solanum surattense* leaves extracts have the potential ability to use as an analgesic. Studies in experimental animals with plant extracts showed an elevated response in the dose-dependent manner. This investigation authenticates the traditional use of *S. surattense* as analgesic and provides the scope to develop natural analgesics from the folklore claims. [36]

#### 4.21. Anti-piles Activity

The Ayurvedic drugs mentioned that *S. surattense* (synonyms of *solanum xanthocarpum*) possess anti piles activity. Indian traditional to cure piles since from the ancient past has used a root of *S. surattense*, as a traditional medicine. Still, it is practiced in many regions of India because of its remarkable curative properties. [37]

#### 4.22. Antiulcer Activity

Investigations on antiulcer potential of *S. surattense* leaf extracts by revealed that alcoholic extracts exhibited significant antiulcer property than other solvent extracts. Plant extract raises the pH (3.10) and gastric contents and lowered the total acidity resulted in decrease of ulcer index. The antiulcer efficiency of *S. surattense* was comparable to show the effect of standard antiulcer drug Omeprazole in lowering the total acidity. [38]

Biological activities of different parts of the plant of solanaceae reported include anti-microbial, antioxidant, anti-inflammatory, analgesic, anti-diabetic, cytotoxicity, hepatoprotective, anti-cancer, larvicidal and piscicidal activity, and all these novel experiments was performed successfully, as per all these the solanaceae plants should have efficacy to cure epilepsy disorder. [39]

### 5. Conclusion

For future, further explorations of bioactive compounds from *S. Xanthocarpum* and *S. khasianum* & its validation

promise the possibility to exploit and develop novel chemotherapeutic drugs from this natural resource. All the purpose of review on both drug that they contain a solasodine with various medicinal studies and the bioactive compounds of these drugs should show prevention of epilepsy because it is contained solasodine.

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